Preface

OVERVIEW

It's been only six years since the publication of the third edition but the market seems much different, and the experiences of the investors and traders who have used the market have been intense. We've seen the end of an incredible bull market in stocks that had everyone believing that 20% returns were to be expected; we've seen the Nasdaq index lose over 80% of its value. We experienced 9/11, a date not to be forgotten, the invasion of both Afghanistan and Iraq, and born-again terrorism. Everyday life has changed, and it is reflected in the markets.

Add to that the increasing advances in technology, communications that continue to make the world smaller, new trading vehicles—such as index futures, exchange traded funds (ETFs), and sector indices—as well as a bombardment of information through financial networks such as CNBC and Bloomberg. We also have seen a structural change in the way prices move. What used to work may not work now. Individual stocks may now be following the index, instead of creating it. Is it a new paradigm? Perhaps it is.

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NOW WITH EQUITIES

Since its first publication, *Trading Systems and Methods* has focused its attention on futures markets. Most of the well-known systems were created for these markets and migrated to equities. Over the years there has been a shift in this trend so that both futures and stocks now share techniques. Credit must be given to the incredible bull market of the 1990s for attracting large numbers of systematic daytraders to the business.

In recognition of this shift, the fourth edition, *New Trading Systems and Methods*, has tried to balance examples of trading methods using all markets, including stocks, ETFs, mutual funds, and futures. Some systems don't work as well for some of these markets, and there are explanations why this might be so. You may find that a method is most robust when it can be equally successful across different types of markets.

Creating a systematic method for trading equities can be very different from futures. The large number of stocks demands that the same trading method be applied in the same way to any stock price series. Attempting to create a special set of rules for each stock seems wrong and impractical. Therefore, a program that has a high chance of succeeding in trading any stock is likely to be more robust than the traditional strategies applied to futures markets, each of which is unique. In that regard, the equity strategist has a big advantage over the futures trader, whose method for trading copper or soybeans is not likely to work on Eurodollars or the S&P 500.

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MARKETS PROVE DIFFICULT, SOMETIMES FATAL

The past seven years have seen unprecedented price moves in equities and equity index markets. Exceptional returns during the late 1990s spawned a new industry of daytraders, many of them ordinary investors who saw larger, faster profits in the volatility and steady upwards movement of Nasdaq and the S&P. The launching of the e-mini contracts for those markets, reducing the size and risk of trading, further encouraged them. But it is one thing to make money in a market that is rising on euphoria, and another to coerce profits out of prices that first move up quickly, pause for an uncomfortably long period of sideways, erratic movement, then burst out to the downside and quickly reverse again. Many of the beginning traders realize that they profited because of luck, not skill, and are now trying to learn more. The stock market run of the 1990s is not going to be repeated soon.

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LOSING THE SKILLS

New, powerful computers and software tools are both a blessing and a curse. Certainly, no one would suggest eliminating electricity because it can be dangerous, and no one would now disparage what the computer has done for our society and productivity. At the same time, computers change our culture as they become increasingly integrated into everything we do.

A growing number of sophisticated software products enable traders to smooth trends, create oscillators, and even extract cycles from price movement. Can traders and analysts use these tools effectively if they don't understand how to do the calculations manually? Here we stumble onto a classic philosophical dilemma. If we needed to know everything that has come before in order to solve a problem, society would eventually grind to a halt. We use pocket calculators even though we could add the numbers manually, but is the trend different? Do we need to know the mathematics of a Fast Fourier Transformation to accept that there is a 65-day cycle in Delta Airlines?

We are all guilty of using a computer without knowing how to build one. By the way, how *does* it manage to run two software programs at the same time? In the early part of my career I was a graduate student in electrical engineering and could design and build a computer (with vacuum tubes). Over the years, I've gone down one path and the computer industry down another. Now, it's only important to me how fast the computer runs a program and how much information can be stored. We can't do everything.

Having said that, we need to make choices because the ability to conceptualize and create new trading systems requires a generalist's attitude. That is, you need to learn how many of the pieces work, and observe the detail, in order to have the best chance of the sudden realization (called an "Aha!") that there is an opportunity that has not been exploited.

As the competition for trading profits gets keener, we may need to look at more innovative, and perhaps more complicated, solutions. Professional money managers need investment programs that are different from those of other managers, yet profitable. This takes creativity, skill, tools, and a broad awareness of the markets. Do managers need to know the inner workings of all of the techniques? It might help, but it seems impractical.

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NEW FEATURES IN THE FOURTH EDITION

To help achieve the goal of developing a successful strategy, this edition includes more systems and more programs. It has a greatly expanded section on charting, recognizing that many of the basic trading methods were built on chart patterns. Some of the charting material was drawn from *A Short Course in Technical Trading*, although this coverage addresses a more experienced trader. The book has also been reorganized to begin at the beginning, with charting.

No trader can be successful without controlling risk; therefore, this book has expanded coverage of portfolio allocation. Balancing your trading exposure is the best way to minimize risk; however, active traders have a unique problem finding the right solution. In the last chapter, the individual trader will find a helpful explanation of how to use Excel's *Solver*, and there is a special genetic algorithm solution that institutions will find attractive.

For those who need a reminder about why they are trading, I quote Friedlander, who wrote "No amount of happiness can buy you money."

PERRY J. KAUFMAN
Redding, Connecticut
December 2004

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Chapter 1: Introduction

OVERVIEW

Let's start by redefining the term "technical analysis." *Technical analysis is the systematic evaluation of price, volume, breadth, and open interest, for the purpose of price forecasting.* A systematic approach may simply use a bar chart and a ruler, or it may use all the computer power available. Technical analysis may include any quantitative analysis as well as all forms of pattern recognition. Its objective is to decide, in advance, where prices will go over some time period, whether 1 hour or 5 years. Technical analysis must have clear rules.

Technical analysis is no longer just the study of chart patterns or the identification of trends. It encompasses intramarket analysis, complex indicators, mean reversion, and the evaluation of test results. It can use a simple moving average or a neural network to forecast price moves. This book serves as a reference guide for all of these techniques, puts them in some order, and explains the functional similarities and differences for the purpose of trading.

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THE EXPANDING ROLE OF TECHNICAL ANALYSIS

Quantitative methods for evaluating price movement and making trading decisions have become a dominant part of market analysis. Those who do not use methods such as over-bought and oversold indicators are most likely to watch them along the bottom of their screen. The major financial networks are always pointing out price trends and double bottoms, and are quick to say that a price move up or down was done on low volume to show that it might be unreliable. These comments show the simplicity and the acceptance of technical analysis.

Events beginning in 2002 cast doubt on the integrity of the research produced by major financial houses that have a conflict between financing/underwriting and retail brokerage. The exposure of Enron also cause us to question the earnings, debt, quality of business, and other company data released to the public by large and small firms. It is not surprising that more quantitative trading methods have been adopted by these firms. When decisions are made with clear rules and calculations that can be audited, those analysts recommending buys and sells are safe from scrutiny.

Extensive quantitative trading exists around the world. *Interest rate arbitrage* is a major source of revenue for banks. *Location arbitrage* is the process that keeps the price of gold and other precious metals the same all over the globe. *Program trading* keeps the price of individual stocks within a narrow band of the S&P futures and Spyder prices.

If you don't think of arbitrage as technical trading then consider market neutral strategies, where long and short positions are taken in related markets (pairs trading) in order to profit from the relative move, one stock rising or falling faster than the other. You might prefer to take advantage of the seasonality in the airline industry or try your hand trading soybeans. Both have clear seasonal patterns as well as years when other factors (such as the Iraqi War) overwhelm the seasonal factors. Trading seasonal patterns falls under technical analysis.

Technology that allows you to scan and sort thousands of stocks, looking for key attributes—such as high momentum, a recent breakout, or other indicator values—is also technical analysis on a broader scale.

Most impressive is the increase in managed funds that use technical and quantitative analysis. Many billions of investment dollars are trading using trend-following systems, short-term timing, mean reversion, and countless other techniques. Technical analysis allows you to backtest and estimate the expected risk, two great advantages to the fund manager. The use of technical analysis has infiltrated even the most guarded fundamental fortresses.

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CONVERGENCE OF TRADING STYLES IN STOCKS AND FUTURES

The development of technical analysis has taken a different path for stocks and futures. This seems natural because the two markets cater to investors with different time frames. At the same time the markets place very different financial demands on the investor.

The original users of the futures markets were grain elevators and grain processors, representing the supply side and the demand side, respectively. The elevators are the grain wholesalers who bought from the farmers and sold to the processors. The futures markets represented the fair price and grain elevators sold their inventory on the Chicago Board of Trade in order to lock in a price (hopefully a profit). The processor, typically a bread manufacturer or feedlot operator, used the futures markets to lock in a low price for their material cost and as a substitution for the storage of inventory. Both producer (the sell side) and processor (the buy side) only planned to hold the position for a few weeks or a few months, until they either delivered their product to market or purchased physical inventory for production. There was no long-term investment. Futures contracts, just like stock options, expire every two or three months and can be traded for about one year; therefore, it is nearly impossible to "invest" in futures.

One other critical difference between futures and stocks is the leverage available in futures. When a processor buys one contract of wheat, that processor puts up a good faith deposit of about 5% of the value of the contract. If wheat is selling for $3.00 a bushel and a standard contract is for 5,000 bushels, the contract value is $15,000. The processor need only deposit $750 with the broker. The processor is essentially buying on leverage of 20:1.

Even in the 1970s, the futures trader paid an outrageous round-turn commission of $50 per contract. This is about .3 of one percent, and was probably one of the highest commission ratios in the futures industry. Now, years after negotiated commissions have become part of the system, the fee is closer to $8, or .05 of one percent. Commission costs are so low that they are not a consideration when trading futures.

How does the short holding period, high leverage, and low commissions affect trading in futures? Futures traders have short holding periods and tight risk controls. They use fast techniques and try to anticipate price moves. They don't invest—they trade. In the derivatives markets, *fast* is one to three days, and *slow* is anything longer than thirty days.

Although speculation has always had a place in the stock market, the investor, rather than the trader, has been the major force. The stock market is an investment in America. The growth of the economy parallels the growth and efficiency of industry. Of course, commissions and tax regulations played a large part in shaping the long-term view of the investor. With commission costs of 1% for each buy and sell order, it is not possible to be a short-term trader. That role was reserved for the market maker on the floor of the stock exchange. It is difficult to be a trader of any sort when you pare 2% from each of your trades. In addition, favorable tax treatment strongly encouraged holding positions for a long-term capital gain, at least six months. The uptick rule for selling discourages speculation on the decline of stock prices. And even now, short sales are not allowed in most retirement funds. Given the difference in the type of investor caused by commissions and regulation, the type of trading in stocks and futures was very different.

The change in stock trading has been in direct response to lower commission and is partly due to electronic trading. Where once you would have paid 25¢ to buy or sell Microsoft at $25 (50¢ total for a trade), anyone can now pay $10 per order—l¢ per share on a 1,000 share order—or slightly higher for smaller lots. That is a commission rate of .04%, four hundredths of one percent—right in line with futures.

Low commissions in stocks open up the possibility of fast trading. Low commissions do not resolve the issue of being able to execute a short sale as quickly as a buy, and they do not provide the leverage of the futures markets, but they do expand the opportunities. In index markets, which have exceptionally high volatility, short-term trading has become popular. Stock traders now look to the methods used by futures traders to identify trends faster and use tighter risk control.

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A LINE IN THE SAND BETWEEN FUNDAMENTALS AND TECHNICALS

The market is driven by fundamentals. It is also driven by consumer confidence, supply and demand, geopolitical factors, and expectations of price movement. It is just too difficult to trade using those facts. There is no timely indication that the value of a company has changed, that supply has increased, that the world has resolved its differences, or that expectations have changed. Recently we have had the disturbing realization that the data we use to make fundamental decisions may not be reliable.

Technical analysis, when used to determine the long-term direction of prices, attempts to objectively evaluate these complex fundamentals. It is no different from the economists who use regression, seasonal, and cyclic analysis to forecast the economy. The technical trader can use those tools as well as chart trendlines, pattern recognition, and probability distributions. Perhaps the economists are doing the same thing.

It is well known that the Federal Reserve monitors trading and prices in order to decide how to time their rate changes and, when necessary, their currency intervention. Even the Fed knows that, when the dollar is falling like a rock, you don't try to catch it. If the public wants to sell the dollar, the Fed doesn't have enough clout to stop it. It must use its resources carefully, and it uses market know-how and price analysis to time its actions.

The primary advantages of a technical approach are that it is objective and completely self-contained. The accuracy of the data is certain. One of the first great advocates of price analysis, Charles Dow, said:

> *The market reflects all the jobber knows about the condition of the textile trade; all the banker knows about the money market; all that the best-informed president knows of his own business, together with his knowledge of all other businesses; it sees the general condition of transportation in a way that the president of no single railroad can ever see; it is better informed on crops than the farmer or even the Department of Agriculture. In fact, the market reduces to a bloodless verdict all knowledge bearing on finance, both domestic and foreign.*

Much of the price movement reflected in any market is anticipatory; it results from the expectations of the effects of macroeconomic developments or the outcome of good corporate management and new products. Markets, however, are subject to change without notice. For example, the government may block the merger of two companies, or approve or reject a new drug. A hurricane bound for the Philippines may send sugar prices higher, but if the storm turns off course, prices may reverse. Anticipation of employment reports, housing starts, or corn production reports causes highly publicized professional estimates, which may correctly or incorrectly move prices before the actual report is released. Markets then react to the accuracy of the estimates rather than to the economic data itself. By the time the public is ready to act, the news is already reflected in the price.

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PROFESSIONAL AND AMATEUR

Beginning technical traders may find a system or technique that seems extremely simple and convenient to follow, one that seems to have been overlooked by the professionals. Most often there is a simple reason why that method isn't used. As you learn more about trading, you'll find that you may not be able to get good execution with a given system, or the risk is much higher than you originally expected, or that the system has too many losses in a row. Trading is a business, not one to be taken casually. As Richard Wyckoff said, "Most men make money in their own business and lose it in some other fellow's." Plan to invest your time before your money, so that when you begin trading, you have more realistic expectations.

To compete with a professional speculator you must be more accurate in anticipating the next move or in predicting prices from current news—not the article printed in today's newspaper ("Government Approves New AIDS Drug"), which was discounted weeks ago, and not the one on the wire service ("15% Fewer Soybeans and 10% More Fish-meal"), which went into the market two days ago. You must act on news that has not yet been printed. In order to anticipate changes, you must draw a single conclusion for the many contingencies possible from fundamental data, or

- Recognize recurring patterns in price movement and determine the most likely results of such patterns.
- Determine the "trend" of the market by isolating the basic direction of prices over a selected time interval.

The bar chart, discussed in Chapter 3, is the simplest representation of the market. These patterns are the same as those recognized by Jesse Livermore on the ticker tape. Because they are interpretive, more precise methods such as point-and-figure charting are also used, which add a level of exactness to charting. Point-and-figure charts are popular because they offer specific trading rules and show formations similar to both bar charting and ticker-tape trading.

Mathematical modeling, using traditional regression or discrete analysis, has become a popular technique for anticipating price direction. Most modeling methods are modifications of developments in econometrics and basic probability and statistical theory. They are precise because they are based entirely on numerical data.

The proper assessment of the price trend is critical to most trading systems. Countertrend trading, which takes a position opposite to the trend direction, is just as dependent on knowing the trend as a trend-following technique. Large sections of this book are devoted to the various ways to isolate the trend, although it would be an injustice to leave the reader with the idea that a "price trend" is a universally accepted concept. There have been many studies published claiming that price trends do not exist. The most authoritative papers on this topic are collected in Cootner, *The Random Character of Stock Market Prices* (MIT Press, 1964); more recent and readable discussions can often be found in the *Financial Analysts Journal*, an excellent resource.

Personal money management has gained an enormous number of tools during this period of computerized expansion. The major spreadsheet providers include linear regression and correlation analysis; there is also inexpensive software to perform spectral analysis and apply advanced statistical techniques. There is an Excel add-in, Solver, that can easily be adapted to portfolio allocation. Development software such as TradeStation and MetaStock have provided trading platforms and greatly reduced the effort needed to program your ideas. Professionals maintain the advantage of having all of their time to concentrate on the investment problems; however, nonprofessionals are no longer at a disadvantage.

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RANDOM WALK

It has been the position of many fundamental and economic analysis advocates that there is no sequential correlation in the direction of price movement from one day to the next. That is, prices have no memory of what has come before—this has been named the "random walk" theory. Prices will seek a level that will balance the supply-demand factors, but that this level will be reached either instantaneously, or in an unpredictable manner as prices move in an irregular response to the latest available information or news release.

If the random walk theory is correct, the many well-defined trading methods based on mathematics and pattern recognition will fail. The problem is not a simple one, but one that should be resolved by each system developer because it will influence the type of systematic approaches studied in this book. There are two arguments against random movement in prices.

The first argument is simply the success of many fully technical trading strategies. There is definitive documentation of performance for systematized arbitrage programs, hedge funds, and derivatives funds, showing success for many years. This is not to say that all technical programs are successful—far from it. But neither are fundamental methods. You still need a sound strategy, whether discretionary or automatic, in order to be profitable. Not everyone can create and implement such a strategy.

The second argument against the random walk is that prices move on anticipation. One can argue academically that all participants (the market) know exactly where prices should move following the release of news. However practical or unlikely this is, it is not as important as market movement based on anticipation of further movement. For example, if the Fed lowered rates twice this year and the economy has not yet responded, would you expect it to lower rates again? Of course you would. Therefore, as soon as the Fed announces a rate cut you can speculate on the next rate cut. When most traders hold the same expectations, prices move quickly to that level. Prices then react to further news relative to expectations. Is this price movement that conforms to the random walk theory? No. But price movement can appear, theoretically, similar to random movement.

Excluding anticipation, the apparent random movement of prices is dependent on both the time interval and the frequency of data observed. When a long time span is used, from 1 to 20 years, and the data averaged to enhance the smoothing process, the trending characteristics appear more clearly, along with seasonal and cyclic variations. Technical methods, such as moving averages, are often used to isolate these price characteristics. Averaging daily or weekly data to create monthly or quarterly prices smoothes out irregular short-term movements, resulting in higher correlations between successive prices. With less frequent data it is easier to see a trend. In general, the use of daily data shows more noise (random movement) than data of less frequency.

In the long run, prices seek a level of equilibrium. For stocks, equilibrium is where the return on investment (appreciation of share value plus dividends), balanced with the risk of the investment, puts it on an equal footing with the returns of a risk-free investment, such as Treasury notes. In futures, equilibrium is the balance between supply and demand.

Prices do not move in a symmetric pattern and they do not have a normal distribution, two additional facts that argue against random walk. The asymmetry of the index markets, in particular those built on traditional stocks, are easy to understand because the public consists overwhelmingly of buyers. But it is also the nature of price movement to show unique patterns when prices move farther from their normal value during periods of exceptional supply and demand imbalance. When looking at price movement in terms of "runs"—hours or days when prices continue in the same direction for an unusually long sequence—we find that price data has a *fat tail*, representing much longer runs than can be explained by a normal distribution. The existence of a fat tail also means that some other part of the distribution must differ from the norm because the extra data in the tail must come from somewhere else. Throughout this book we refer to these differences in price patterns as the reason why certain trading methods work.

Price movement is driven by people, and people can buy and sell for nonrandom reasons, even when viewed in large

numbers. People create price distribution opportunities that allow traders to profit. The long-term trends that reflect economic policy, normally identified by quarterly data, can be of great interest to longer-term *position traders*. It is the short-term price movements caused by anticipation (rather than actual events), extreme volatility, prices that are seen as far from value, countertrend systems that rely on mean reversion, and those that attempt to capture trends of less duration that are the primary focus of this book.

It is always worthwhile to understand the theoretical aspects of price movement, because it paints a picture of the way prices move. Many traders have been challenged by trying to identify the differences between an actual daily price chart and a synthetic one, created using random numbers. There are differences, but they will seem more subtle than you would expect. The ability to identify these differences is the same as finding a way to profit from actual price movements. A trading program seeks to find ways to operate within the theoretical framework, looking for exceptions, selecting a different time frame and capturing profits—and all without ignoring the fact that most of the price movements is very close to random.

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BACKGROUND MATERIAL

The contents of this book assume an understanding of the stock market and related futures market, such as the S&P 500 and Treasury notes. These futures markets have a great impact on stock patterns and trade 24 hours a day. The workings of those markets are not explained although they are simple to understand. Ideally the reader should have read one or more of the available trading guides and should understand the workings of a buy or sell order and the specifications of contracts in futures. Experience in actual trading would be helpful. A professional trader, a broker, or a purchasing agent will already possess all the qualifications necessary, as will any businessperson who understands how prices reflect earnings and the need to accumulate inventory at the lowest price. Individuals who manage their own stock portfolio or watch one of the financial news networks are also qualified. It also helps if you enjoy playing any competitive game including board games and crossword puzzles. You like to win.

There are excellent books available to both the beginning and advanced trader. The ones that stand out as excellent sources of general information are Jack Schwager's two-volume set, *Schwager on Futures* (Wiley, 1995), which includes one volume on fundamental analysis and one on technical analysis. John Murphy's *Technical Analysis of the Futures Markets*, 2nd Edition (New York Institute of Finance, 2001) and *Intermarket Technical Analysis* (Wiley, 1991) are highly recommended. There are excellent books on more specific topics. Of these you should consider reading John Bollinger's *Bollinger on Bollinger Bands* (McGraw-Hill, 2002) and Martin Pring's *Pring on Market Momentum* (International Institute for Economic Research, 1993). Two other more comprehensive books worth considering are Peter Bernstein's *The Portable MBA in Investment* (Wiley, 1995) and *The Encyclopedia of Technical Market Indicators* by Robert W. Colby and Thomas A. Meyers (Dow Jones Irwin, 2002); the latter offers an intelligent description of the calculation and trading performance of many market indicators that could be used by traders. Comparing the results of different indicators side by side can give you valuable insight into the practical differences in these techniques.

The basic reference book for general contract information has always been the *Commodity Trading Manual* (Chicago Board of Trade), but each year *Futures* magazine publishes a *Reference Guide* which gives the trading hours, contract size, and other specifications of the primary futures and options markets traded around the world. All of this information is also available on the Internet. For reviewing the basics there is Little and Rhodes, *Understanding Wall Street*, 3rd Edition (McGraw-Hill, 1991), and Todd Lofton's, *Getting Started in Futures*, 4th Edition (Wiley, 2001). The introductory material is not repeated here.

A good understanding of the most popular charting method requires reading the classic by Edwards and Magee (and now Bassetti), *Technical Analysis of Stock Trends*, 8th Edition (originally published by John Magee), a comprehensive study of bar charting. For a constant flow of both classic and new techniques, the magazines *Technical Analysis of Stocks & Commodities*, *Futures*, and *Active Trader* have numerous articles on trading systems and methods. A basic understanding of market phenomena and relationships, often requiring some math skill, can be found in the *Financial Analysts Journal*.

On general market lore and to provide motivation when trading is not going as well as expected, the one book that stands out is Lefèvre, *Reminiscences of a Stock Operator* (originally published by Doran, reprinted by Wiley in 1994). Wyckoff mixes humor and philosophy in most of his books, but *Wall Street Ventures and Adventures through Forty Years* (Harper & Brothers) may be of general interest. More recently, Jack Schwager's *Market Wizards* (New York Institute of Finance, 1989) has been very popular.

There are a number of associations and user groups that can be very helpful to traders at all levels. The Market Technician's Association (MTA), found at www.MTA.org, offers a Certified Market Technician credential, and the Association for Investment Management Research (AIMR) offers the Charter Financial Analyst (CFA) credential. For those with higher math skills, the International Association of Financial Engineers (IAFE) offers excellent resources, and the TradeStation users groups, found in larger cities and on the Internet, can be a means for solving a difficult problem.

As for this book, a reader with a good background in high school mathematics can follow everything but the more complex parts. An elementary course in statistics is ideal, but a knowledge of the type of probability found in Edward Thorp's *Beat*

the Dealer (Vintage, 1966) is adequate. Fortunately, computer spreadsheet programs, such as Excel and Quattro allow anyone to use statistical techniques immediately, and most of the formulas in this book are presented in such a way that they can be easily adapted to spreadsheets. Even better, if you have a computer with trading software, such as TradeStation Technologies' TradeStation Platform, MetaStock, or any number of other products, you are well equipped to continue. If you have a live data feed, such as CQG, you will also have access to technical studies that you will also find very helpful.

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RESEARCH SKILLS

Before starting, there are nine guidelines that may help make the task of developing a trading system easier.

1. **Know what you want to do before you start.** Base your trading on a sound premise. It could be an observation of how prices move in response to Government policy, a theory about how prices react to economic reports, or simply a pattern that shows up at the same time each day or each month. This is the *underlying premise* of your method. It cannot be discovered by testing everything on a computer. You need to know it in advance.

2. **State your idea or question in its simplest form.** The more complex it is, the more difficult it will be to evaluate the answer. More complex methods do not usually work as well as simple ones.

3. **Do not assume anything.** Many projects fail on basic assumptions that were incorrect. It takes practice to avoid making assumptions and to be critical of certain elements that you believe to be true. Prove everything to your own satisfaction.

4. **Try the simplest and most important parts first.** Some of the rules in your trading program will be more important than others. Try those first. It's best to understand how each rule or technique contributes to the final system. Then build slowly and carefully to prove the value of each element of the system.

5. **Build one step at a time.** Go on to the next step only after the previous ones have been tested successfully. If you start with too many complex steps and fail, you will have to simplify to find out what went wrong. The ability to readily understand the operation of each part of your system is called a *transparent solution*, rather than a *fully integrated* or *complex* one. Transparent solutions are very desirable.

6. **Watch for errors of omission.** It may seem odd to look for items that are not there, but you must continually review your work, asking yourself if you have included all the necessary costs and accounted for all the risk. Simply because all the questions were answered correctly does not mean that all the right questions were asked. Important questions may be missing.

7. **Question the good results.** There is a tendency to look for errors when results are extremely bad, but to accept the results that are very good. Exceptionally good results are just as likely to be caused by errors in rules, formulas, or data. They need to be checked as carefully as extremely bad results.

8. **Do not take shortcuts.** It is sometimes convenient to use the work of others to speed up the research. Check their work carefully; do not use it if it cannot be verified. Check your spreadsheet calculations manually. One error can ruin all of your hard work.

9. **Start at the end.** Define your goal and work backwards to find the required input. In this way, you only work with information relevant to the results; otherwise, you may expend a lot of unnecessary effort.

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OBJECTIVES OF THIS BOOK

This book is intended to give you a complete understanding of the tools and techniques needed to develop or choose a trading program that has a good chance of being successful. Execution skill and market psychology are not considered—only the strategies, the methods for testing those strategies, and the means for controlling the risk. This is a goal of significant magnitude.

Not everything can be covered in a single book; therefore, some guidelines were needed to control the material included here. Every technique in this book qualifies as systematic; that is, each has clear rules. Most of them can be automated. We begin with basic concepts, including definitions, how much data to use, how to create an index, some statistics and probability, and other tools that are used throughout the book. The next several chapters cover the techniques that are most important to trading, such as identifying the trend, followed by momentum. Other chapters are organized by common grouping so that you can compare the different ways that similar problems have been solved. Although charting is an extremely popular technique, it is included only to the degree that it can be compared with other systematic methods, or when various patterns can be used in a computerized program (such as identifying support and resistance) or channels. There has been no attempt to provide a comprehensive text on charting; however, various formations may offer very realistic profit objectives or provide reliable entry filters.

Neither stock options nor options on futures are included in this book. Although there are strategies that combine outright trading of stocks or futures with options, the subject is too large and too specialized to be included here. There are already many good books on options strategies.

This book does not attempt to prove that one system is better than another, because it is not possible to know what will happen in the future or how each reader will cleverly apply these techniques. Instead the book evaluates the conditions under which certain methods are likely to do better and situations which will be harmful to specific approaches. By grouping similar systems and techniques together, you should be able to compare the differences and study the results. Seeing how analysts have modified existing ideas can help you decide how to proceed and give you an understanding of why you might choose one path over another. By seeing a more complete picture, common sense should prevail over computing power.

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PROFILE OF A TRADING SYSTEM

There are quite a few steps to be considered when developing a trading program. Some of these are simply choices in style, while others are essential to the success of the results. They have been listed here and are discussed briefly as items to bear in mind as you continue the process of creating a trading system.

Changing Markets and System Longevity

Markets are not static. They evolve as does everything else. During the past ten years, changes in the markets have continued at an astounding rate. These changes fall into the categories of technology, participation, globalization, and the cost of doing business.

Technology includes communications, trading equipment (primarily computers and handheld devices), and electronic exchanges and order entry. These innovations have accelerated the trading process, provided faster access to quotes, and created instantaneous order entry based on computerized strategies. Electronic markets have changed the nature of the order flow and made information about buyers and sellers more accessible. It has accelerated the process and changed the way prices react to news.

Increased participation is the result of the historic bull market of the 1990s, financial news networks, better communications, computers, and computer software that is user-friendly and readily installed in anyone's home. More participation has changed the level of noise in individual stocks and futures, but it is most obvious in the index markets. Noise results from a large, constant flow of orders placed for unrelated reasons.

Globalization is mostly the result of the reliability of advances in communications. Not only can we see the same news at the same time everywhere in the world, but we can pass information quickly via the Internet or telephone. Equally important, we do not think about the reliability of this communication. We expect our televisions, telephones, and Internet connections to work without question. When we trade, we are willing to bet on it.

The dramatic reduction in commission cost has been a major influence on trading, opening up opportunities for the fast trader. Negotiated commissions have served the God of Competition. For institutions, stock transactions can be done at far less than l¢ per share, and for the general public, anyone can get $10 per order. This not only facilitates fast trading but encourages greater participation. Everyone wins.

The challenge for the trader is to find a system that will adapt to future changes, whatever they are. Most changes are not sudden, but are gradually reflected in price patterns. The steady change in the percentage of institutional volume compared to individual trader orders will slowly alter price patterns. The increase in overall participation affects the level of market noise and may also affect volatility and risk. Index arbitrage and the trading of indices force the component stocks to move in the same direction regardless of their individual fundamentals. The creation of your own successful trading program may require the utmost simplicity or the inclusion of features that adapt to an uncertain future. It is both challenging and rewarding to create a program with longevity.

The Choice of Data

System decisions are limited by the data used in the analysis. Although price and volume for the specific stock or futures market may be the definitive criteria, there is a multitude of other valid statistical information that might also be used. Some of this data is easily included, such as price data from companies in the same sector or industrial group, or the current yield curve relationship. Other statistical data, including the wide range of U.S. economic reports and weekly energy inventories, may add a level of robustness to the results but are less convenient to obtain and less timely.

Diversification

Not all traders are interested in diversification, which tends to reduce returns at the same time it limits risk. Concentrating all of your resources on a single market that you understand may produce a specialized approach and much better results than using a more generalized technique over more markets. Diversification may be gained by trading two or more unique strategies applied to the same market, instead of one strategy used on a broad set of markets.

Time Frame

The time frame of the data impacts both the type of system and the characteristics of the results. Using five-minute bars introduces considerable noise into your program, making it difficult to find the trend, while using only weekly data puts the greatest emphasis on the trend to the exclusion of other techniques. A shorter time may guarantee faster response to price changes, but does not assure better results. Using more frequent data usually results in a shorter holding period for the trade and greater sensitivity to execution. There is no universal trading system that works in all time frames. You will need to learn whether you are best trading fast or slow, then concentrate in that area.

Choosing a Method of Analysis

Some methods of analyzing the market are more complex than others. This has no bearing on the final success. All good trading methods begin with a sound premise. You must first know what you are trying to extract from the market before you select a technique. If you want to capitalize on long interest rate trends or the result of government policy, then a weekly moving average or trend system is the place to start. If you see false breakouts whenever the price penetrates the high of the day in the second half of the trading session, you should look at a momentum indicator based on 5-, 10-, or 15-minute data. First isolate the idea, then choose the tool.

Trade Selection

Although a trading system produces signals regularly, it is not necessary to enter all of them. Selecting one over another can be done by a method of filtering. This can be a confirmation of another technique or system, a limitation on the amount of risk that can be accepted on any one trade, the use of outside information, or the current volume. Many of these additional rules add a touch of reality to an automated process. You may find, however, that too many filters result in no trading.

Testing

There is a lot of emphasis in this book on testing and the way to evaluate test results. A mistake in testing may cause you to trade a losing strategy or discard a profitable one. Back-testing is the only option available to confirm or validate your ideas. Testing is misguided when it is used to "discover" a successful trading method by massive scanning of combinations of techniques. The purpose of testing is to validate an idea and show robustness—that the method works over a wide range of situations in a similar manner. It can also provide a good indication of expectations, both returns and risk. A robust solution, one that works on many stocks or across similar markets, is not as good as the optimized results of a single stock. But using the same system for all stocks in the same sector will give you a more realistic assessment of expectations and a much better chance of success.

Risk Control

Trading survival is based on risk control. Most analysts believe that nearly any system can be profitable with proper risk management. This also means that any system can lead to ruin without risk controls. Risk must be addressed at the individual trade level by using a strategy with entry and exit signals that minimize losses, such as a simple but fast trend method. Trade risk can also be controlled using a stop-loss. Risk must also be managed at the portfolio level by diversification and correct allocation of size to each asset. Futures traders must also pay attention to leverage. Risk management does not need to be complex, but it has many tiers.

Order Entry

A system that performs well on paper may be dismal when actually traded. Part of a trading program is knowing how to enter and exit the market, as well as having realistic expectations about the transaction costs, both commissions and slippage. Short-term, fast trading systems are most sensitive to transaction costs because the expected profit on each trade is small. Directional trading strategies, those that buy as prices are rising and sell when they are falling, have larger slippage than mean reversion techniques.

There is equal damage in overestimating costs as there is in underestimating them. By burdening a system with unrealistic

fees, tests may show a loss instead of a profit, causing you to reject a successful trading method.

Performance Monitoring and Feedback

A system is not done when you begin trading; it is only entering into a new phase. Actual trading results must be carefully monitored and compared with expectations in order to know if it is performing properly. It is very likely that slippage will result in some changes to the system rules or to the size of the position traded. Performance monitoring provides the essential feedback needed to be successful. Even a well-designed and well-tested program may start out badly, but proper monitoring can put it on track.

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A WORD ABOUT THE NOTATION USED IN THIS BOOK

In order to make the contents of this book more useful for trading, many of the traditional mathematical formulas are also shown as a single line in Microsoft's Excel notation, as well as TradeStation's EasyLanguage. EasyLanguage can be understood by anyone who knows the programming language BASIC or FORTRAN.

There are also more complex systems and indicators that appear in both Excel and EasyLanguage, but mostly in the latter. Although these programs have been entered and tested on TradeStation, there are occasional errors introduced during final editing and in transferring the code into this book. Recent market activity may also produce combinations of price movement that did not occur during testing. Readers are advised to check over the code and test it thoroughly before using it.

Computer software used to develop trading strategies may vary in the notation they use to express the simplest statistical functions. For the standard deviation, Excel uses *stdev* while Easy Language uses *stddev.* One program expects the mean to be *avg* while another requires *average*. Please check each formula and solution for notation consistent with your needs.

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Chapter 2: Basic Concepts

> *Economics is not an exact science: it consists merely of Laws of Probability. The most prudent investor, therefore, is one who pursues only a general course of action which is "normally" right and who avoids acts and policies which are "normally" wrong.*
> —L.L.B. Angas

OVERVIEW

After watching *Star Trek* for so many years, many of us wonder why we still do not have voice communication with computers. While we are still waiting for those advancements, we do not notice that we depend on computers, calculators, cell phones with automatic dialing and infrared reception, and countless other devices to perform tasks that once were done manually. There will come a time when we will no longer know how to do the calculation for long division because miniature, voice-activated computers will be everywhere. We might not even need to be able to add; it will all be done for us. We will just assume that the answer is correct, because computers don't make mistakes.

In a small way this is happening now. Not everyone checks their spreadsheet calculations by hand to be certain they are correct before going further. Nor does everyone print the intermediate results of computer calculations to verify their accuracy. Computers don't make mistakes, but people do.

With computer software making technical analysis easier and more sophisticated, we no longer think of the steps involved in a moving average or linear regression. A few years ago, we looked at the correlation between investments only when absolutely necessary because they were too complicated and time-consuming to calculate. It would even be difficult to know if you had made a mistake without having someone else repeat the same calculations. Now we face a different problem: If the computer does it all, we lose our understanding of *why* a moving average trendline differs from a linear regression. Without looking at the data, we don't see an erroneous outlier or that the stock wasn't adjusted for splits. By not reviewing each hypothetical trade, we miss seeing that the slippage can turn a profit into a loss.

To avoid losing the edge needed to create a profitable trading strategy, the basic tools of the trade are explained in this chapter. Those of you already familiar with these methods may skip over it; others need to be confident that they can perform these calculations manually.

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ABOUT DATA AND AVERAGING

The Law of Averages

We begin at the beginning, with the *law of averages*, a greatly misunderstood and misquoted principle. In trading, the law of averages is most often referred to when an abnormally long series of losses is expected to be offset by an equal and opposite run of profits. It is equally wrong to expect a market that is currently overvalued or overbought to next become undervalued or oversold. That is not what is meant by the law of averages. Over a large sample, the bulk of events will be scattered close to the average in such a way that the typical values overwhelm the abnormal events and cause them to be insignificant.

This principle is illustrated in Figure 2.1, where the number of average items is extremely large, and the addition of a small abnormal grouping to one side of an average group of near-normal data does not affect the balance. It's the same as being the only passenger on a Boeing 747. Your weight is insignificant to the operation of the airplane. A long run of profits, losses, or an unusually sustained price movement is simply a rare, abnormal event that will be offset over time by the overwhelming large number of normal events. Further discussion of this and how it affects trading can be found in "Gambling Technique—the Theory of Runs," Chapter 22.

Figure 2.1: The Law of Averages. The normal cases over-whelm the unusual ones. It is not necessary for the extreme cases to alternate—one higher, the next lower—to create a balance.

Bias in Data

When sampling is used to obtain data, it is common to divide entire subsets of data into discrete parts and attempt a representative sampling of each portion. These samples are then weighted to reflect the perceived impact of each part on the whole. Such a weighting will magnify or reduce the errors in each of the discrete sections. The result of such weighting may cause an *error in bias*. Even large numbers within a sample cannot overcome intentional bias introduced by weighting one or more of the parts.

Price analysis and trading techniques often introduce bias in both implicit and explicit ways. A *weighted average* is an overt way of adding a positive bias (positive because it is intentional). The use of two analytic methods acting together may

unknowingly rely doubly on one statistical aspect of the data; at the same time, other data may be used only once or may be negated by offsetting use. The daily high and low used in one part of a program and the daily range (high to low) in another section would introduce bias.

How Much Data Is Enough?

Statisticians will say, "More is better." The more data you test, the more reliable your results. Technical analysis is fortunate to be based on a perfect set of data. Each price that is recorded by the exchange is exact and reflects the netting out of all information at that moment. The price of IBM at the close of trading in New York on May 5, or the price of Eurodollars at 10:05 in Chicago, are the exact prices.

Economic Data

Most other statistical data are not as timely, not as precise, and not as reliable. Economic data, such as the Producer Price Index (PPI) or Housing Starts, are released as monthly averages, sometimes seasonally adjusted. A monthly average represents a broad range of numbers. In the case of the PPI, some producers may have paid less than the prior month and some more, but the average was +.02. The lack of a range of values or a standard deviation of the component values reduces the usefulness of the information. Statistical data is often revised in the following month; sometimes those revisions can be quite large.

Sample Error

When an average is used, it is necessary to have enough data to make that average accurate. Because much statistical data is gathered by sampling, particular care is given to accumulating a sufficient amount of representative data. This holds true with prices as well. Averaging a few prices, or analyzing small market moves, will show more erratic results. It is difficult to draw an accurate picture from a very small sample.

When using small, incomplete, or representative sets of data, the approximate error, or accuracy, of the sample can be found by using the standard deviation as discussed in the previous section. A large standard deviation indicates an extremely scattered set of points, which in turn makes the average less representative of the data. This process is called the *testing of significance.* The most basic of these tests is the error resulting from a small amount of data. Accuracy increases as the number of items becomes larger, and the measurement of error becomes proportionately smaller

$$Error = \frac{1}{\sqrt{Number\ of\ item\ sampled}} = \frac{1}{\sqrt{N}}\ or\ 1/Sqrt(N)$$

Therefore, using only one item has an error factor of 100%; with four items, the error is 50%. The size of the error is important to the reliability of any trading system. If a system has had only 4 trades, whether profits or losses, it is very difficult to draw any reliable conclusions about performance expectations. There must be sufficient trades to assure a comfortably small error factor. To reduce the error to 5%, there must be 400 trades. This presents a dilemma for a very slow trend-following method that may only generate 2 or 3 trades each year. To compensate for this, the identical method can be applied across many markets and the number of trades used collectively.

Quality of Data Used

The amount of data is a good estimate of its usefulness; however, the data should represent at least one bull market, one bear market, and some sideways periods. More than one of each is even better. If you were to use 10 years of daily S&P Index values from 1990 to 2000, or 20 years of 10-year Treasury Notes ending in 2002, you would only see the bull market. A trading strategy would be profitable whenever it was a buyer, if you held the position long enough. Your test results would show that buying was good and selling was bad. Unless you included a variety of other price patterns, you would not be able to create a strategy that would survive a downturn in the market. Your results would be unrealistic.

Data That Is No Longer Useful

There are clear cases when a stock or futures market has undergone a structural change and the current data is different from historic data. The evolution of General Electric from a manufacturer of light bulbs to a massive financial institution represents a structural change. A company that began in the United States, such as McDonald's, but expanded to have large international exposure, also shows a structural change in its price patterns. In foreign exchange we have seen the

individual European currencies first tied together by agreement, then finally merged into a single European unit, the euro.

Is it important to include historic data in your testing when that data represents a different company profile or a different geopolitical situation? Ideally, your strategy is robust if it can adapt to these changing profiles and show consistently profitable returns over a long test period. Longer really is better. These companies and markets will continue to evolve and your program will need to continue to adapt.

As a very fast trader, you may be able to limit your testing to much shorter periods and avoid the most severe changes. If you trade once each day, then in 5 years you would generate 1,250 trades; in 10 years, 2,500 trades. If your trading strategy is profitable over 2,500 trades then you've satisfied the issue of a small sampling error.

Safety First

It is important to remember that the accuracy of your testing depends on the amount of data used and the number of trades generated by the system. If your estimates of loss are not reliable, you put your investment at risk.

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ON AVERAGE

In working with numbers, it is often necessary to use representative values. The *range of values* or the *average* may be substituted to change a single price into a general characteristic in order to solve a problem. The average (*arithmetic mean*) of many values can be a preferable substitute for any one value. For example, the average retail price of one pound of coffee in the Northeast is more meaningful to a cost-of-living calculation than the price at any one store. However, not all data can be combined or averaged and still have meaning. The average of all prices taken on the same day would not say anything about an individual market that was part of the average. Averaging the prices of unrelated items, such as a box of breakfast cereal, the hourly cost of automobile repair, and the price of the German DAX index would produce a number of questionable use. The average of a group of values must have some useful meaning.

The average can be misleading in other ways. Consider coffee, which rose from $.40 to $2.00 per pound in 1 year. The average price of this product may appear to be $1.40; however, this would not account for the time that coffee was sold at various price levels. Table 2.1 divides the coffee price into 4 equal intervals, then shows that the time spent at these levels was uniformly opposite to the price rise. That is, prices remained at lower levels longer and at higher levels for shorter time periods, which is very normal price behavior.

Table 2.1: Weighting an Average

Open table as spreadsheet

Prices Go		Average During Interval	Total Days for Interval	Weighted	1/*a*
From	To				
40	80	a_1 = 60	d_1 = 100	6000	.01666
80	120	a_2 = 100	d_2 = 80	8000	.01000
120	160	a_3 = 140	d_3 = 60	8400	.00714
160	200	a_4 = 180	d_4 = 40	7200	.00555

When the time spent at each price level is included, it can be seen that the average price should be lower than $1.40. One way to calculate this, knowing the specific number of days in each interval, is by using a weighted average of the price

$$W = \frac{a_1 d_1 + a_2 d_2 + a_3 d_3 + a_4 d_4}{d_1 + d_2 + d_3 + d_4}$$

and its respective interval

$$W = \frac{6000 + 8000 + 8400 + 7200}{280}$$

$$W = 105.71$$

Although this is not exact because of the use of average prices for intervals, it does closely represent the *average price relative to time.* There are 2 other averages for which time is an important element—the *geometric mean* and the *harmonic mean.*

Geometric Mean

The geometric mean represents a growth function in which a price change from 50 to 100 is as important as a change from 100 to 200. If there are n prices, a_1, a_2, a_3,..., a_n, then the geometric mean is the nth root of the product of the prices

$G = (a_1 \times a_2 \times a_3 \times \cdots \times a_n)^{(1/n)}$ or `product(a1,a2,a3, ..., an)^(1/n)`

To solve this mathematically, rather than using a spreadsheet, the equation above can be changed to either of two forms:

$$\ln G = \frac{\ln a_1 + \ln a_2 + \cdots + \ln a_n}{n}$$

or

$$\ln G = \frac{\ln(a_1 \times a_2 \times a_3 \times \cdots \times a_n)}{n}$$

The two solutions are equivalent. The term *ln* is the *natural log*, base *e*. When using a spreadsheet, the function *ln* is the equivalent of the natural log, and the function *log10* is the equivalent of *log*, base 10. Using the price levels in Table 2.1,

$$\ln G = \frac{\ln 40 + \ln 80 + \ln 120 + \ln 160 + \ln 200}{5}$$

disregarding the time intervals, and substituting into the first equation:

$$\ln G = \frac{3.689 + 4.382 + 4.787 + 5.075 + 5.298}{5}$$

Had one of the periods been a loss, that value would simply be negative. We now perform the arithmetic to solve the equation:

$$\ln G = 4.6462$$
$$G = 104.19$$

While the arithmetic mean, which ignored time, gave the value of 105.71, the geometric mean shows the time-weighted average as 104.19.

The geometric mean has advantages in application to economics and prices. A classic example compares a tenfold rise in price from 100 to 1000 to a fall to one tenth from 100 to 10. An arithmetic mean of the 2 values 10 and 1000 is 505, while the geometric mean gives

$$G = (10 \times 1000)^{1/2} = 100$$

and shows the relative distribution of prices as a function of comparable growth. Due to this property, the geometric mean is the best choice when averaging ratios that can be either fractions or percentages.

Quadratic Mean

The quadratic mean is most often used for estimation of error, and can be found under the name *Law of Error Combination.* It is calculated as:

$$Q = \sqrt{\frac{\sum a^2}{N}}$$

or, in spreadsheet terms,

```
= sqrt(average(list of N values of a²))
```

The quadratic mean is the square root of the mean of the square of the items (root-mean-square). It is most well known as the basis for the *standard deviation.* This will be discussed later in this chapter in the section "Dispersion, Skewness, and Kurtosis."

Harmonic Mean

The harmonic mean is a time-weighted average, not biased towards higher or lower values as in the geometric mean. A simple example is to consider the average speed of a car that travels 4 miles at 20 mph, then 4 miles at 30 mph. An arithmetic mean would give 25 mph, without considering that 12 minutes were spent at 20 mph and 8 minutes at 30 mph. The weighted average would give

$$W = \frac{(12 \times 20) + (8 \times 30)}{12 + 8} = 24$$

The harmonic mean is

$$\frac{1}{H} = \frac{\frac{1}{a_1} + \frac{1}{a_2} + \cdots + \frac{1}{a_n}}{n}$$

which can also be expressed as

$$H = n / \sum_{1}^{n} \left(\frac{1}{a_i} \right) \quad \text{or} \quad \texttt{Count(list) / sum(list of 1/a)}$$

For two or three values, the simpler form can be used:

$$H_2 = \frac{2ab}{a + b} \qquad H_3 = \frac{3abc}{ab + ac + bc}$$

This allows the solution pattern to be seen. For the 20 and 30 mph rates of speed, the solution is

$$H_2 = \frac{2 \times 20 \times 30}{20 + 30} = 24$$

which is the same answer as the weighted average. Considering the original set of numbers again, the basic form of harmonic mean can be applied:

$$\frac{1}{H} = \frac{\frac{1}{40} + \frac{1}{80} + \frac{1}{120} + \frac{1}{160} + \frac{1}{200}}{5}$$

$$H = 87.59$$

$$= \frac{.05708}{5} = .01142$$

We might apply the harmonic mean to price swings, where the first swing moved 20 points over 12 days and the second swing moved 30 points over 8 days.

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PRICE DISTRIBUTION

The measurement of distribution is very important because it tells you generally what to expect. We cannot know what tomorrow's S&P trading range will be, but we have a high level of confidence that it will fall between 1000 and 2000 basis points—for example, a range of 20 points from 910 to 930. We have a lower confidence that it will vary from 2000 to 3000 basis points. We have virtually no chance of picking the exact range. The following measurements of distribution allow you to put a probability, or confidence level, on the chance of an event occurring.

In all of the statistics that follow, we will use a limited number of prices or—in some cases—individual trading profits and losses that will be called the *sample.* We want to measure the characteristics of our sample, finding the shape of the distribution, deciding how a smaller sample compares to a larger distribution of prices, or how similar two samples are to each other. All of these measures will show that the smaller samples are less reliable, yet they can be still be used if you understand the size of the error or the difference in the shape of the distribution.

Frequency Distributions

The *frequency distribution* can give a good picture of the characteristics of the data. Theoretically, we expect prices to spend more time at low price levels and only brief periods at high prices. That pattern is shown in Figure 2.2. The most frequent occurrences are at the price where the supply and demand balances. When there is a shortage of supply, or an unexpected demand, prices rise for a short time until either the demand is satisfied or supply increases to meet demand. There is a small tail to the left where prices occasionally trade for less than the cost of production, or at a discounted rate.

Figure 2.2: Price-frequency distribution. Prices spend more time at lower levels.

To calculate a frequency distribution, we find the highest and lowest prices to be charted, and divide the difference by 20

to get the size of one *bin.* Beginning with the lowest price, add the bin size to get the second value, add the bin size to the second value to get the third value, and so on. When completed, you will have 21 bins that begin at the lowest price and end at the highest price. You then can count the number of prices that fall into each bin, a nearly impossible task, or you can use a spreadsheet to do it. In Excel, go to Tools/Data Analysis/Histogram and enter the range of data items and the range of values representing the bins. It will all be done instantly. You can then plot the results as you see them in Figures 2.3 and 2.4. In Excel, if you haven't done this before, you will need to use Tools/Add-ins in order to get the features that allow you to create the histogram.

Figure 2.3: Nasdaq 100 frequency distribution, August 1997 through March 2003. Prices spend more time at lower levels, primarily in the range from 1200 to 2500.

Figure 2.4: Frequency of S&P 500 cash index prices (SPX), 1st Quarter, 2003. Although the data sample is very small, there is a tendency for more frequent occurrence at lower price levels.

In reality, the frequency distribution is very descriptive of price patterns, but never as perfect as the theoretical chart in

Figure 2.2. If we look at Nasdaq 100 prices from August 1997 through March 2003 (see Figure 2.3), we see a distribution very similar to the expected one but with a lump in the right tail. Still, it shows that prices spend less time at high levels and that the normal price of the index is somewhere in the range of 1200 to 2000.

The same frequency distributions occur even when we look at shorter time intervals, although the pattern is more erratic as the time interval gets very small. During the first three months of 2003, the S&P 500 shows a pattern similar to the expected frequency distribution (see Figure 2.4), but the offsetting factors of the Iraqi war and a lethargic U.S. economy kept prices off balance. Again, we see that most trading occurred in the range from 833 to 853, but had a larger than normal frequency at the far right in bin 932. This pattern will also appear when prices stay at unusually high levels for short periods before dropping.

It should be expected that the distribution of prices for a physical commodity, interest rates (yield), or index markets, will be *skewed* towards the left (where there are lower prices or yields) and have a *long tail* at higher prices at the right of the chart. This is because prices remain at relatively higher levels for only short periods of time while there is an imbalance in supply and demand. In the stock market, history has shown that stocks will not sustain exceptionally high price/earnings (P/E) ratios indefinitely.

When observing shorter price periods, patterns that do not fit the standard distribution may be considered in transition. Readers who would like to pursue this topic should read Chapter 18, especially the sections "Frequency Distributions" and "Steidlmayer's Market Profile."

The measures of *central tendency* discussed in the previous section are used to describe the shape and extremes of price movement shown in the frequency distribution. The general relationship between the three principal means when the distribution is not perfectly symmetric is

Arithmetic mean > Geometric mean > Harmonic mean

Median and Mode

Two other measurements, the *median* and the *mode*, are often used to define distribution. The median, or "middle item," is helpful for establishing the "center" of the data; it halves the number of data items. The median has the advantage of discounting extreme values, which might distort the arithmetic mean. Its disadvantage is that you must sort all of the data in order to locate the middle point. The median is preferred over the mean except when using a very small number of items.

The mode is the *most commonly occurring value.* In Figure 2.5, the mode is the highest bar in the frequency distribution.

Figure 2.5: Hypothetical price distribution skewed to the right, showing the relationship of the mode, median, and mean.

In a normally distributed price series, the mode, mean, and median all occur at the same value; however, as the data becomes skewed, these values will move farther apart. The general relationship is:

Mean > Median > Mode

If a normal distribution has the same value for the mode, mean, and median, then when these values are not the same we know that prices are skewed. A normal distribution is commonly called a *bell curve*, and values fall equally on both sides of the mean. For much of the work done with price and performance data, the distributions tend to be skewed to the right (higher prices or higher trading profits), and appear to flatten or cut off on the left (lower prices or trading losses). If you were to chart a distribution of trading profits and losses based on a trend system with a fixed stop-loss, you would get profits that could range from zero to very large values, while the losses would be theoretically limited to the size of the stop-loss. Skewed distributions will be important when we measure probabilities later in this chapter. There are no normal distributions in a trading environment.

Characteristics of the Principal Averages

Each averaging method has its unique meaning and usefulness. The following summary points out their principal characteristics:

The *arithmetic mean* is affected by each data element equally, but it has a tendency to emphasize extreme values more than other methods. It is easily calculated and is subject to algebraic manipulation.

The *geometric mean* gives less weight to extreme variations than the arithmetic mean and is most important when using data representing ratios or rates of change. It cannot always be used for a combination of positive and negative numbers and is also subject to algebraic manipulation.

The *harmonic mean* is most applicable to time changes and, along with the geometric mean, has been used in economics for price analysis. It is more difficult to calculate; therefore, it is less popular than either of the other averages, although it is also capable of algebraic manipulation.

The *mode* is the most common value and is only determined by the distribution—and not by the size of the variations from the average. It is the location of greatest concentration and indicates a typical value for a reasonably large sample. With an unsorted set of data, such as prices, the mode is time-consuming to locate and is not capable of algebraic manipulation.

The *median* is the middle value, and is most useful when the center of an incomplete set is needed. It is not affected by extreme variations and is simple to find; however, it requires sorting the data, which causes the calculation to be slow. Although it has some arithmetic properties, it is not readily adaptable to computational methods.

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DISPERSION, SKEWNESS, AND KURTOSIS

The center, or central tendency, of a data series is not a sufficient description for price analysis. The manner in which prices are scattered about a center point, its *dispersion*, *skewness*, and *kurtosis*, are necessary to describe the data.

In the following calculations, we will use the notation *price* to be the average of a list of *n* prices,

$$\overline{price} = \frac{\sum_{i=1}^{n} price_i}{n}$$

The *mean deviation* is a basic method for measuring distribution and may be calculated about any measure of central location, such as the arithmetic mean. It is found by computing

$$MD = \frac{\sum \left| price_i - \overline{price} \right|}{n}$$

where *MD* is the mean deviation, the average of the differences between each price and the arithmetic mean of the prices, or other measure of central location, with *signs ignored*.

Variance, the best estimate of dispersion, will be used as the basis for many other calculations. It is

$$Var = \frac{\sum \left(price_i - \overline{price} \right)^2}{n-1}$$

where *price* is the average of all prices in the sample. Notice that the variance is the square of the next measurement, the standard deviation. It is found as *var*(*list*) in Excel and *variance*(*price*,*n*) in EasyLanguage.

The *standard deviation* is a special form of measuring average deviation from the mean, which uses the root-mean-square

$$Standard\ deviation = \sqrt{\frac{\sum \left(price_i - \overline{price} \right)^2}{n}}$$

where the differences between the individual prices and the mean are squared to emphasize the significance of extreme values; then the total value is scaled back using the square root function. This popular measure, used throughout the book, is available in Excel as *Stdevp* and in TradeStation, for *n* prices, as *StdDev*(*price*,*n*).

The standard deviation is the most popular way of measuring the degree of dispersion of the data. The value of one standard deviation about the mean represents a clustering of about 68% of the data, two standard deviations from the mean include 95.5% of all data, and three standard deviations encompass 99.7%—nearly all the data. While it is not possible to guarantee that all data will be included, you can use 3.5 standard deviations to include 100% of the data in a normal distribution. These values represent the groupings of a perfectly *normal* set of data, shown in Figure 2.6.

Figure 2.6: Normal distribution showing the percentage area included within one standard deviation about the arithmetic mean.

Probability of Achieving a Return

If we see Figure 2.6 as the annual returns for the stock market over the past 50 years, then the mean is about 8% and one standard deviation is 16%. In any one year we can expect the returns to be 8%; however, there is a 32% chance that it will be either greater than 24% (the mean plus one standard deviation) or less than -8% (the mean minus one standard deviation). If you would like to know the probability of a return of 20% or greater, you must first rescale the values,

$$Probability\ of\ reaching\ objective = \frac{Objective - Mean}{Standard\ deviation}$$

If your objective is 20%, we calculate

$$Probability = \frac{20\% - 8\%}{16\%} = .75$$

We look in Table A1.1, Appendix 1 under the probability for normal curves, and find that a standard deviation of. 75 gives 27.34%, a grouping of 54.68% of the data. That leaves one half of the remaining data, or 22.66%, above the target of 20%.

Calculating the Probability Automatically

It is inconvenient to look up the probability values in a table when you are working with a spreadsheet or computer program, yet the probabilities are easier to understand than standard deviation values. You can calculate the area under the curve that corresponds to a particular z value (the standard deviation), using the following approximation.[1] Let $z' = |z|$, the absolute value of z. Then

$$r = 1 + z' \times (c_1 + z' \times [c_2 + z' \times (c_3 + z' \times [c_4 + z' \times (c_5 + z' \times c_6)])])$$

where $c_1 =$ .049867347

$c_2 =$ .0211410061

$c_3 =$ .0032776263

$c_4 =$ .0000380036

$c_5 =$ .0000488906

$c_6 =$ .000005383

Then the probability, P, that the returns will equal or exceed the expected return is

$$P = .5 \times e^{[\ln(r) \times (-16)]}$$

Using the example where the standard deviation, $z = .75$, we perform the calculation

$$r = 1 + .75 \times (.049867347 + .75 \times [.0211410061 + .75 \times (.0032776232 + .75 \times [.0000380036 + .75 \times (.0000488906 + .75 \times [.000005383])])])$$

$$r = 1.0507$$

Substituting the value of r into the equation for P, we get

$$P = .5 \times e^{[\ln(1.0507) \times (-16)]} = .226627$$

Then there is a 22.7% probability that a value will exceed .75 standard deviations (that is, fall on one end of the distribution outside the value of .75). The chance of a value falling inside the band formed by ±.75 standard deviations is 1 − (2 × .2266) = .5468, or 54.68%. That is the same value found in Table A1.1, Appendix 1.

Skewness

Most price data, however, are not normally distributed. For physical commodities, such as gold, grains, and interest rates (expressed as yields), prices tend to spend more time at low levels and much less time at extreme highs. While gold peaked at $800 per ounce for one day in January 1980, it has remained between $250 and $400 per ounce for most of the past 20 years. The possibility of falling below $400 by the same amount as its rise to $800 is impossible, unless you believe that gold can go to zero.

Stocks also favor lower prices, even though, in the long run, they can keep moving steadily higher. A sudden run-up in prices is normally overextended and prices fall back to more realistic levels.

This relationship of price versus time, where markets spend more time at lower levels, can be measured as *skewness*—the amount of distortion from a symmetric distribution which makes the curve appear to be short on one side and extended on the other. The extended side is called the *tail. Negative skewness*, typical of price distributions, can be seen as a longer tail extending towards the right (the higher prices). *Positive skewness* has the tail extending towards the left. This can be seen in Figure 2.7.

Figure 2.7: Skewness. Nearly all price distributions are positively skewed, showing a longer tail to the right, at higher prices.

In a perfectly normal distribution, the median and mode coincide. As prices become extremely high, which often happens over a short period, the *mean* will show the greatest change and the *mode* will show the least. The difference between the mean and the mode, adjusted for dispersion using the standard deviation of the distribution, gives a good measure of skewness

$$(Skewness)\ S_K = \frac{Mean - Mode}{Standard\ deviation}$$

Because the distance between the mean and the mode, in a moderately skewed distribution, is three times the distance between the mean and the median, the relationship can also be written as:

$$(Skewness)\ S_K = \frac{3 \times Mean - Mode}{Standard\ deviation}$$

This last formula may be more practical for computer applications because the mode requires dividing the data into groups and counting the number of occurrences in each bar. When interpreting the value of S_K, the distribution leans to the right when S_K is positive (the mean is greater than the median), and it is skewed left when S_K is negative.

For computational purposes, skewness can be found as

$$S = \frac{n}{(n-1)(n-2)} \sum \left(\frac{x_j - \bar{x}}{s} \right)^3$$

where n = the number of prices in the distribution
s = the standard deviation of the prices

Transformations

The skewness of a data series can sometimes be corrected using a *transformation* on the data. Price data may be skewed in a specific pattern. For example, if there are three of the occurrences at twice the price, and $1/9$ of the occurrences at three times the price, the original data can be transformed into a normal distribution by taking the square root of each data item. The characteristics of price data often show a logarithmic, power, or square-root relationship.

To calculate the probability level of a distribution based on the skewed distribution of price, we can convert the normal probability to the *exponential probability* equivalent, P_E, using

$$P_E = \frac{\bar{x} \log_{10}\left(\frac{1}{1-P}\right)}{\log_{10} e}$$

where x = the average of all prices
P = the normal probability
$\log_{10} e$ =.434294482

While the normal probability, P, understates the probability of occurrence in a price distribution, the exponential distribution will overstate the probability, P_E. Whenever possible, it is better to use the exact calculation; however, when calculating risk, it might be best to err on the side of caution and state slightly higher than the expected risk.

Skewness in Distributions at Different Relative Price Levels

Because the lower price levels of most commodities are determined by production costs, and interest rates are limited by their effectiveness at very low yields, price distributions show a clear tendency to resist moving below these limitations. This is seen as negative skewness in a frequency distribution. At unusually high levels, prices are erratic and unstable, causing a positive skewness that can be interpreted as being "top-heavy" if the frequency distribution is held sideways with the highest prices at the top. Somewhere between the very high and very low price levels, we may find a frequency distribution that looks normal. Figure 2.8 shows the change in the distribution of prices as the mean price (over shorter intervals) changes. This pattern indicates that a normal distribution is not appropriate for most price analysis, and that a

log, exponential, or power distribution would only apply to a very long-term analysis.

Figure 2.8: Changing distribution at different price levels. A, B, and C are increasing mean values of three shorter-term distributions.

Kurtosis

One last measurement, kurtosis, is needed to describe the shape of a price distribution. *Kurtosis* is the peakedness or flatness of a distribution as shown in Figure 2.9. This measurement is good for an unbiased assessment of whether prices are trending or moving sideways. If you see prices moving steadily higher, then those prices will distribute over a wider range and the frequency and any place on the distribution will be lower than if prices moved back and forth across the same price range.

Figure 2.9: Kurtosis. A positive kurtosis is when the peak of the distribution is greater than normal, typical of a sideways market. A negative kurtosis, shown as a flatter distribution, occurs when the market is trending.

A *positive kurtosis* occurs when the peak of the distribution is greater than normal. A positive kurtosis is typical of a sideways market. A negative kurtosis appears as a flatter than normal distribution, and is associated with a trending market. Steidlmayer's *Market Profile*, discussed in Chapter 18, uses the concept of kurtosis, although the frequency distribution is accumulated dynamically using real-time price changes.

Kurtosis can be calculated as

$$K = \frac{n(n+1)}{(n-1)(n-2)(n-3)} \sum \left(\frac{x_i - \bar{x}}{s} \right)^4 - \frac{3(n-1)^2}{(n-2)(n-3)}$$

where n = the number of prices in the distribution

x_i = the individual prices

s = the standard deviation of prices.

Choosing Between Frequency Distribution and Standard Deviation

You should note that it is more likely that unreliable probabilities will result from using too little data than from the choice of method. For example, we might choose to look at the distribution of one month of daily data, about 23 days; however, it is a very small, unreliable sample. The price changes or returns being measured in one month might be completely different during the next month. Even five years of S&P data will not show that the large price drops in the S&P during

October 1987 or September 2001 were far greater than those in the following months.

Although we can identify and measure skewness, it is difficult to get meaningful probabilities using a standard deviation taken on very distorted distributions. It is simpler to use a frequency distribution for data with long tails on one side and truncated results on the other. To find the likelihood of returns using a trend system with a stop-loss, you can simply sort the data in ascending order using a spreadsheet, then count from each end to find the extremes. You will notice in Figure 2.10 that the largest 10% of the profits covers a wide range, while the largest 10% of the losses is clustered together.

Figure 2.10: Measuring 10% from each end of the distribution. A practical solution for measuring probabilities of a skewed distribution is to count a percentage of values from each end. The dense clustering at low prices will make the lower zone look narrow, while high prices with less frequent data will appear to have a wide zone.

A standard deviation is very helpful for giving some indication that a price move, larger than any we have seen in the data, is possible. Because it assumes a normally shaped curve, a large clustering of data towards one end will force the curve to extend further. While the usefulness of the exact probabilities is questionable, there is no doubt that, given enough time, we will see moves, profits, and losses that are larger than those we have seen in the past.

Standard Error

Throughout the development and testing of a trading system, we want to know if the results we are seeing are as expected. The answer will continuously refer to the size of the sample and the amount of variance that is typical of the data during this period. Readers are encouraged to refer to other sections in the book on sample error and the chi-square test.

A more descriptive measure of error, called the *standard error* (*SE*), uses the variance, which gives the estimation of error based on the distribution of the data using multiple data samples. It is a test that determines how the sample means differ from the actual mean of all the data.

$$SE = \sqrt{\frac{Var}{n}}$$

where Var = the variance of the sample means

n = the number of data points in the sample means

By *sample means* we mean that the data is sampled a number of times, each with *n* data points, and the means of these samples are used to find the variance.

Student's *t*-Test and Degrees of Freedom

When fewer prices or trades are used in a distribution, we can expect the shape of the curve to be more spread out, that is, the peak of the distribution will be lower and the tails will be higher. A way of measuring how close the sample distribution is to the normal distribution (of a large sample of data) is to use the *Student's* t-*test.* The *t* distribution is calculated according to its degrees of freedom (*df*), which is *n* - 1, where *n* is the sample size, the number of prices used in the distribution.

$$t = \frac{Average\ of\ price\ changes}{Standard\ deviation\ of\ price\ changes} \times \sqrt{n}$$

The more data in the sample, the more reliable the results. We can get a broad view of the shape of the distribution by looking at a few values of *t* in Table 2.2, which gives the values of *t* corresponding to the upper tail areas of 0.10, 0.05, 0.025, 0.01, and 0.005. The table shows that as the sample size *n* increases, the values of *t* approach those of the standard normal values of the tail areas.

Table 2.2: Values of *t* Corresponding to the Upper Tail Probability of 0.925

Open table as spreadsheet

Degrees of Freedom (*df*)	Value of *t*
1	12.706
10	2.228
20	2.086
30	2.042
120	1.980
normal	1.960

The values of *t* that are needed to be *significant* can be found in Appendix 1, Table A1.2, "*T*-Distribution." The column headed ".10" gives the 90% confidence level, (".05" is 95%, and ".005" is 99.5% confidence. For example, if we had 20 prices in our sample, and wanted the probability of the upper tail to be .025, then the value of *t* would need to be 2.086. For smaller samples, the value of *t* would be larger in order to have the same confidence.

When testing a trading system, degrees of freedom can be the number of trades produced by the strategy. When you have few trades, the results are not representative of what you might expect over a longer trading history. When testing a strategy, you will find a similar relationship between the number of trades and the number of parameters, or variables, used in the strategy. The more variables used, the more trades are needed to create expectations with an acceptable confidence level.

Two-Sample *t*-Test

You may want to compare two periods to decide whether the price patterns have changed significantly. This is done with a *two-sample* t-*test*:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{v_1^2}{n_1} + \frac{v_2^2}{n_2}}}$$

where x_1 and x_2 = the averages of the prices for periods 1 and 2

υ_1 and υ_2 = the variances of the prices for periods 1 and 2

n_1 and n_2 = the number of prices in periods 1 and 2

The degrees of freedom, *df*, needed to find the confidence levels in Table A1.2, can be calculated as follows, where *s* is the standard deviation of the data values:

$$df = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{(n_1 - n_2)} + \frac{\left(\frac{s_2^2}{n_2}\right)^2}{(n_2 - n_1)}}$$

The Student's *t*-test can also be used to compare the profits and losses generated by a trading system to show that the underlying system process is sound—that the results are consistent over time. Simply replace the data items by the net returns of each trade, the number of data items by the number of trades, and calculate all other values using returns rather than prices to get the student *t*-test value for the trading performance.

[1]Stephen J. Brown and Mark P. Kritzman, *Quantitative Methods for Financial Analysis*, 2nd edition (Dow Jones-Irwin, 1990, pp. 238–241).

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STANDARDIZING RETURNS AND RISK

In order to compare one trading method with another, it is necessary to standardize both the tests and the measurements used for evaluation. If one system has total returns of 50% and the other 250%, we cannot decide which is best unless we know the duration of the test. If the 50% return was over one year and the 250% return over ten years, then the first one is best. Similarly, the return relative to the risk is crucial to performance as will be discussed in Chapter 21. For now it is only important that returns and risk be annualized or standardized to make comparisons valid.

Calculating Returns

The calculation of *rate of return* is essential for assessing performance as well as for many arbitrage situations. In its simplest form, the *one-period rate of return* (R), or the *holding period rate of return* is

$$Return = \frac{Ending\ value - Starting\ value}{Starting\ value} = \frac{Ending\ value}{Starting\ value} - 1$$

$$R = \frac{P_1 - P_0}{P_0} = \frac{P_1}{P_0} - 1$$

where P_0 = the initial investment or starting value

P_1 = the value of the investment after one period

In most cases, it is best to standardize the returns by *annualizing.* This is particularly helpful when comparing two sets of test results, where each covers a different time period. When annualizing, it is important to know that government instruments use a 360-day rate (based on 90-day quarters), but that a 365-day rate is common for most other purposes. The following formulas show 365 days; however, 360 may be substituted.

The *annualized rate of return on a simple-interest basis* for an investment over n days is

$$R_{\text{simple}} = \frac{P_1 - P_0}{P_0} \times \frac{365}{n}$$

The *annualized compounded rate of return is*

$$R_{\text{compounded}} = \left(1 + \frac{P_n - P_0}{P_0}\right)^{\frac{365}{n}}$$

The geometric mean is the basis for the compounded growth associated with interest rates. If the initial investment is \$1,000 (P_0) and the ending value is \$1,600 (P_y) after 12 years (y = 12), there has been an increase of 60%. The simple rate of return is 5%, but the compounded growth shows

Ending value = *Starting value* × (1 + compounded return)^y

$$P_y = P_0 \times (1+R)^y$$

or

$$R = \left(\frac{P_y}{P_0}\right)^{\frac{1}{y}} - 1$$

$$R = \left(\frac{1600}{1000}\right)^{\frac{1}{12}} - 1$$

$$R = .0398, \text{ or about } 4.0\%$$

The use of the standard deviation and compounded rate of return are combined to find the probability of a return objective. In the following calculation,[2] the arithmetic mean of continuous returns is $\ln(1 + R_g)$, and it is assumed that the returns are normally distributed.

$$z = \frac{\ln\left(\frac{T}{B}\right) - \ln(1 + R_g)n}{\sqrt{s \times n}}$$

where z = standardized variable (can be found in Appendix 1)
T = target value or rate-of-return objective
B = beginning investment value
R_g = geometric average of periodic returns
n = number of periods
s = standard deviation of the logarithms of the quantities 1 plus the periodic returns

Indexing Returns

The federal government has defined standards for calculating returns and presenting performance tables to be used by Investment Advisors and Commodity Trading Advisors. This is simply an indexing of returns based on the current period percentage change in account equity. It is the same process as creating any index, and allows trading returns to be compared with, for example, the S&P Index or the Lehman Brothers Treasury Index, on equal footing. Readers should refer to the next section in this chapter, "The Index."

Calculating Risk

While we would always like to think about returns, it is even more important to be able to assess risk. With that in mind, the two most critical types of risk are not normally included in risk measurements. The first is catastrophic risk, which will cause fatal losses or ruin. This is a complicated type of risk because it may be the result of a single price shock. The second is risk due to leverage, or *gearing up* your portfolio. The risks of price shocks and leverage are both discussed in detail later in the book.

Standard risk measurements are useful for comparing the performance of two systems. It is commonly used for evaluating the returns of a single stock or an entire portfolio compared to a benchmark, such as the returns of the S&P 500 or a bond fund. The simplest estimate of risk is the variance of returns, R, over time, where the probability of those returns might change during each time interval. To calculate the variance, it is first necessary to find the mean return, or the expected return, $E(R)$, on an investment:

$$E(R) = p_1R_1 + p_2R_2 + \cdots + p_nR_n$$

$$E(R) = \sum_{i=1}^{n} p_iR_i$$

where $p_1, p_2, \ldots$ = the probabilities of those returns

Σp_i = 1

We can find the standard deviation of these values, in much the same way that we found the standard deviation earlier in this chapter, by squaring the difference between each return and the mean of the returns, then multiplying each value by its associated probability:

$$\begin{aligned} standard\ deviation &= \sqrt{p_1\left[R_1 - E(R)\right]^2 + p_2\left[R_2 - E(R)\right]^2 + \cdots p_n\left[R_n - E(R)\right]^2} \\ &= \sqrt{\sum_{i=1}^{n} p_i\left[R_1 - E(R)\right]^2} \end{aligned}$$

The greater the standard deviation of returns, the greater the risk.

Annualizing Risk

In the securities industry, the use of annualized risk is most common, but monthly data is often used when studies involve shorter time periods. It is a standard in the investment industry to change monthly or even daily returns or risk into annualized values by multiplying by the square root of the number of periods making one year. This reflects the belief that risk does not increase linearly over time, but tends to flatten out after a sharper initial increase. Therefore,

$$Annualized\ risk = Monthly\ risk \times \sqrt{12}$$
$$Annualized\ risk = Daily\ risk \times \sqrt{252}$$

If the monthly risk were 1%, then the annualized risk would be 3.46%. For daily approximations we use 252, the standard for the number of business days, or trading days, in a year. If your returns vary each day, then you will need to use 365 days. Readers should be cautious about relying on annualized values rather than actual risk data, in the event they understate the real risk.

Downside Risk

Investors are more interested in the decline in returns, the downside equity movements, than in profit patterns. It seems sensible that, if you want to know the probability of a loss, then you should study the history of equity drawdowns. The use of only the equity losses is called *lower partial moments,* where *lower* refers to the downside risk and *partial* means that only one side of the return distribution is used. A set of "relative" lower partial moments is the expected value of the tracking error (equity drawdowns, the difference between the actual equity and the annualized returns) raised to the power of n:

$RLPM_n$ = $E[(R - B)^n]$, over the range where $R < B$

= 0, over the range where $R = B$

where R = return on investment

B = benchmark or corresponding regression return at that point in time

E = expected or mean return (described at the beginning of this section)

Therefore, the elements of the probability have only losses or zeros. The value n represents the order or ranking of the relative lower partial moments. When $n = 0$, *RLPM* is the probability of a shortfall, *probability* ($R < B$); when $n = 1$, *RLPM* is equal to the expected shortfall, $E[R - B]$; and when $n = 2$, *RLPM* is equal to the relative lower partial variance.

One concern about using only the drawdowns to predict other drawdowns is that it limits the number of cases and discards the likelihood that higher-than-normal profits can be related to higher overall risk. In situations where there are limited amounts of test data, both the gains and losses will offer needed information. When there is a large amount of data, the use of drawdowns can be a very good measurement. These are discussed in Chapter 23 under the headings "Measuring Return and Risk" and "Ulcer Index."

[2]This and other very clear explanations of returns can be found in Peter L. Bernstein, *The Portable MBA in Investment* (John Wiley & Sons, New York, 1995).

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THE INDEX

The purpose of an average is to transform individuality into classification. When done properly, there is useful information to be gained. Indices have gained enormous popularity in recent years. Where there was only the Value Line and S&P 500 trading as futures markets, now there are stock index futures contracts representing the markets of every industrialized country. The creation of trusts, such as *Spyders* (the S&P 500), *Diamonds* (the Dow Jones Industrials), and *Qs* (QQQ, the Nasdaq 100) have given stock traders a familiar vehicle to invest in the broad market rather than pick individual shares. Industrial sectors, such as pharmaceuticals, health care, and technology first appeared as mutual funds, then as trusts, and now can also be traded as futures. These index markets all have the additional advantage of not being constrained by the uptick rule requiring all short sales to be initiated on an uptick in price.

Index markets allow both individual and institutional participants a number of investment strategies. They can buy or sell the broad market, they can switch from one sector to another, or they can sell an overpriced sector while buying the broad market index. Institutions find it very desirable, from the view of both costs and taxes, to temporarily hedge their cash stock portfolio by selling S&P 500 futures rather than liquidating stock positions. An index simplifies the decision-making process for trading. If an index does not exist, it can be constructed to satisfy most purposes.

The index holds an important role as a benchmark for performance. Most investors believe that a trading program is only attractive if it has a better return-to-risk ratio than a portfolio of 60% stocks (as represented by the S&P 500 index), and 40% bonds (the Lehman Brothers Treasury Index).

Constructing an Index

An index is traditionally used to determine relative value and normally expresses change as a percentage. Most indices have a starting value of 100 or 1000 on a specific date. The index itself is a ratio of the current or composite values to those values during the base year. The selection of the base year is often "convenient" but usually is far enough back to show a representative, stable price period. The base year for U.S. productivity and for unemployment is 1982; for consumer confidence, 1985; and for the composite of leading indicators, 1987. For example, for one market, the index for a specific year is

$$Index\ (year\ t) = \frac{Current\ price\ (year\ t)}{Starting\ price\ (base\ year)} \times 100$$

If the value of the index is less than 100, the current value (year *t*) is lower than during the base year. The actual index value represents the percentage change.

For each year after the base year, the index value adjusted is the product of the previous index value and the percentage change for the current year, where 1.05 is a 5% increase and .95 is a 5% decrease.

$$Current\ index\ value = Previous\ index\ value \times \left(\left(\frac{Current\ price}{Previous\ price} - 1.0\right) + 1.0\right)$$

Leveraged Long or Short Index Funds

As index markets have become more popular, financial engineering has created a wide range of innovative trading vehicles. Mutual funds, such as Rydex and ProFunds, cater to *market timers,* a group of money managers that may trade in and out of the funds each day. These funds track the major index markets closely, but offer unique variations. There are both long and short funds, and each may be leveraged. When you buy a long fund that tracks the S&P 500 (called *Nova* by Rydex), you are simply long the equivalent of the S&P 500. However, when you buy a *short* S&P fund, called *Ursa*, you profit when the S&P index price drops. In addition, both Rydex and ProFunds offer leverage of 1.5 or 2.0 on

these funds, so that a gain of 1.0% in the S&P 500 translates into a gain of 2.0% in ProFunds' *UltraBull* S&P fund; a drop of 1.0% in the S&P would generate a profit of 2.0% in ProFunds' *UltraBear* fund.

The calculation of leveraged long funds is very similar to a simple index; however, a short fund (where you profit from a decline in prices) is compounded to the upside, in the same way as a long fund. The following calculation will create a long and short index that closely approximates those used by Rydex and ProFunds. In addition, it includes the calculation of the daily high and low index values. If you intend to create a leveraged S&P index, start with the cash S&P price, *$SPX.* Use the cash index equivalent for each of the mutual fund indices that you plan to duplicate.

Initial index values for both long and short funds are

$$XC_1 = 100$$

$$XH_1 = XC_1 + 100 \times \left(\frac{H_1}{C_1} - 1.0\right) \times Leverage$$

$$XL_1 = XC_1 + 100 \times \left(\frac{L_1}{C_1} - 1.0\right) \times Leverage$$

Each subsequent index value for long funds are

$$XC_i = XC_{i-1} \times \left(\left(\frac{C_i}{C_{i-1}} - 1.0\right) \times Leverage + 1.0\right)$$

$$XH_i = XC_{i-1} \times \left(\left(\frac{H_i}{C_{i-1}} - 1.0\right) \times Leverage + 1.0\right)$$

$$XL_i = XC_{i-1} \times \left(\left(\frac{L_i}{C_{i-1}} - 1.0\right) \times Leverage + 1.0\right)$$

Each subsequent value for the short funds invert the middle term:

$$XC_i = XC_{i-1} \times \left(\left(\frac{C_{i-1}}{C_i} - 1.0\right) \times Leverage + 1.0\right)$$

$$XH_i = XC_{i-1} \times \left(\left(\frac{H_{i-1}}{C_i} - 1.0\right) \times Leverage + 1.0\right)$$

$$XL_i = XC_{i-1} \times \left(\left(\frac{L_{i-1}}{C_i} - 1.0\right) \times Leverage + 1.0\right)$$

where *XC*, *XH*, and *XL* = the leveraged index closing, high, and low prices
C, *H*, and *L* = the underlying close, high, and low prices or index values.

If there is no leverage, then substitute the value 1 for *leverage* in the equations.

Cross-Market and Weighted Index

It is very convenient to create an index for two markets that cannot be compared because they trade in different units. For

example, if you wanted to show the spread between gold and IBM, you could index them both beginning at the same date. The new indices would both be in the same units (percent) and would be easy to compare.

Most often, an index combines a number of related markets into a single number. A *simple aggregate index* is the ratio of unweighted sums of market prices in a specific year to the same markets in the base year. Most of the popular indices, such as the New York Stock Exchange Composite Index, fall into this class. A *weighted aggregate index* biases certain markets by weighting them to increase or decrease their effect on the composite value. The index is then calculated as in the simple aggregate index. When combining markets into a single index value, the total of all the weights will total 1 and all weights are expressed as a percentage.

U.S. Dollar Index

A practical example of a weighted index is the U.S. Dollar Index, traded on the FINEX division of the New York Board of Trade. It is a trade-weighted geometric average of six currencies: the euro, 57.6%; the Japanese yen, 13.6%; the UK pound, 11.9%; the Canadian dollar, 9.1%; the Swedish krona, 4.2%; and the Swiss franc, 3.6%. The Dollar Index serves as a valuable economic model, but shows only 13.6% representing Asia. It is not a good substitute for a diversified world market portfolio.

The Dollar Index rises when the U.S. dollar rises. Quotes are in foreign exchange notation, where there are 1.25 Swiss francs per U.S. dollar, instead of .80 dollars per Swiss franc as quoted on the Chicago Mercantile Exchange's IMM division. For example, when the Swiss franc moves from 1.25 to 1.30 per dollar, there are more Swiss francs per dollar; therefore, each Swiss franc is worth less.

In the daily calculation of the Dollar Index, each price change is represented as a percent. If, in our previous example, the Swiss franc rises .05 points, the change is 5/125 = .04; this is multiplied by its weighting factor .036 and contributes +.00144 to the index.

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Chapter 2 - Basic Concepts
New Trading Systems and Methods, Fourth Edition
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PROBABILITY

> *Calculation must measure the incalculable.*
> —Dixon G. Watts

Change is a term that causes great anxiety. However, the effects and likelihood of a chance occurrence can only be measured—not predicted. The area of study that deals with uncertainty is *probability.* Everyone uses probability in daily thinking and actions. When you tell someone that you will "be there in 30 minutes," you are assuming:

- Your car will start.
- You will not have a breakdown.
- You will have no unnecessary delays.
- You will drive at a predictable speed.
- You will have the normal number of green lights.

All these circumstances are extremely probabilistic, and yet everyone makes the same assumptions. Actually, the 30-minute arrival is intended only as an estimate of the average time it should take for the trip. If the arrival time were critical, you would extend your estimate to 40 or 45 minutes to account for unexpected events. In statistics, this is called *increasing the confidence interval.* You would not raise the time to two hours because the likelihood of such a delay would be too remote. Estimates imply an allowable variation, all of which is considered normal.

Probability is the measuring of the uncertainty surrounding an average value. Probabilities are measured in percent of likelihood. For example, if *M* numbers from a total of *N* are expected to fall within a specific range, the probability *P* of any one number satisfying the criteria is

$$P = \frac{M}{N}, \qquad 0 < P < 1$$

When making a trade, or forecasting prices, we can only talk in terms of probabilities or ranges. We expect prices to rise 30 to 40 points, or we have a 65% chance of a $400 profit from a trade. Nothing is certain, but a high probability of success is very attractive.

Laws of Probability

Two basic principles in probability are easily explained by using examples with playing cards. In a deck of 52 cards, there are 4 suits of 13 cards each. The probability of drawing a specific card on any one turn is $1/52$. Similarly, the chances of drawing a particular suit or card number are ¼ and $1/13$, respectively. *The probability of any one of these three possibilities occurring is the sum of their individual probabilities.* This is known as the *law of addition.* The probability of success in choosing a numbered card, suit, or specific card (that is, either a 10, or a spade, or the queen of hearts) is

$$P = \frac{1}{13} + \frac{1}{4} + \frac{1}{52} = \frac{18}{52} = 35\%$$

The other basic principle, the *law of multiplication*, states that the *probability of two occurrences happening simultaneously*

or in succession is equal to the product of their separate probabilities. The likelihood of drawing a three and a club from the same deck in two consecutive turns (replacing the card after each draw) or of drawing the same cards from two decks simultaneously is

$$P = \frac{1}{13} \times \frac{1}{4} = \frac{1}{52} = 2\%$$

Joint and Marginal Probability

Price movement is not as clearly defined as a deck of cards. There is often a relationship between successive events. For example, over two consecutive days, prices must have one of the following sequences or *joint events*: (up, up), (down, down), (up, down), (down, up), with the *joint probabilities* of .40, .10, .35, and .15, respectively. In this example, there is the greatest expectation that prices will rise. The *marginal probability* of a price rise on the first day is shown in Table 2.3, which concludes that there is a 75% chance of higher prices on the first day and a 55% chance of higher prices on the second day.

Table 2.3: Marginal Probability

		Day 2 Up	Day 2 Down			
Day 1	Up	.40	.35	.75	Up	Marginal Probability on Day 1
	Down	.15	.10	.25	Down	
		.55 Up	.45 Down			
		Marginal Probability on Day 2				

Contingent Probability

What is the probability of an outcome "conditioned" on the result of a prior event? In the example of joint probability, this might be the chance of a price increase on the second day when prices declined on the first day. The notation for this situation (the probability of *A* conditioned on *B*) is

$$P(A \mid B) = \frac{P(A \text{ and } B)}{P(B)} = \frac{\textit{Joint probability of A and B}}{\textit{Marginal probability of B}}$$

then

$$P(\text{up Day 2} \mid \text{down Day 1}) = \frac{\textit{Joint probability of } (\text{down, up})}{\textit{Marginal probability of } (\text{down Day 1})}$$

$$= \frac{.15}{.25} = .60$$

The probability of either a price increase on Day 1 or a price increase on Day 2 is

P(either) = P(up Day 1) + P(up Day 2) - P(up Day 1 and up Day 2)
= .75 + .55 -.40
=.90

Markov Chains

If we believe that today's price movement is based in some part on what happened yesterday, we have a situation called *conditional probability.* This can be expressed as a *Markov process,* or *Markov chain.* The results, or outcomes, of a Markov chain express the probability of a state or condition occurring. For example, the possibility of a clear, cloudy, or rainy day tomorrow can be related to today's weather.

The different combinations of dependent possibilities are given by a *transition matrix.* In our weather prediction example, a clear day has a 70% chance of being followed by another clear day, a 25% chance of a cloudy day, and only a 5% chance of rain. In Table 2.4, each possibility today is shown on the left, and its probability of changing tomorrow is indicated across the top. Each row totals 100%, accounting for all weather combinations. The relationship between these events can be shown as a continuous network (see Figure 2.11).

Table 2.4: Transition Matrix
Open table as spreadsheet

		Clear	Tomorrow Cloudy	Rainy
	Clear	.70	.25	.05
Today	Cloudy	.20	.60	.20
	Rainy	.20	.40	.40

Figure 2.11: Probability network.

The Markov process can reduce intricate relationships to a simpler form. First, consider a two-state process. Using the markets as an example, what is the probability of an up or down day following an up day, or following a down day? If there is a 70% chance of a higher day following a higher day (which we can say is an uptrend) and a 55% chance of a higher day following a lower day, what is the probability of any day within an uptrend being up?

Start with either an up or down day, and then calculate the probability of the next day being up or down. This is done easily by simply counting the number of cases, given in Table 2.5a, then dividing to get the percentages, as shown in Table 2.5b.

Table 2.5a: Counting the Occurrences of Up and Down Days
Open table as spreadsheet

		Today		
		Up	**Down**	**Total**
	Up	75	60	135
Previous day				
	Down	60	65	125

Table 2.5b: Starting Transition Matrix

Open table as spreadsheet

		Today		
		Up	**Down**	**Total**
	Up	.555	.444	1.00
Previous day				
	Down	.480	.520	1.00

Because the first day may be designated as up or down, it is an exception to the general rule and therefore is given the weight of 50%. The probability of the second day being up or down is the sum of the joint probabilities

$$P(\text{up})_2 = (.50 \times .70) + (.50 \times .55)$$
$$= .625$$

The probability of the second day being up is 62.5%. Continuing in the same manner, use the probability of an up day as .625, the down as .375, and calculate the third day,

$$P(\text{up})_3 = (.625 \times .70) + (.375 \times .55)$$
$$=.64375$$

and the fourth day,

$$P(\text{up})_4 = (.64375 \times .70) + (.35625 \times .55)$$
$$= .64656$$

which can now be seen to be converging. To generalize the probability of an up day, look at what happens on the *i*th day:

$$P(\text{up})_{i+i} = [P(\text{up})_i \times .70] + [(1 - P(\text{up})_i) \times .55]$$

Because the probability is converging, the relationship

$$P(\text{up})_{i+1} = P(\text{up})_i$$

can be substituted and used to solve the equation

$$P(\text{up})_i = [P(\text{up})_i \times .70] + [.55 - P(\text{up})_i \times .55]$$

giving the probability of any day being up within an uptrend as

$$P(\text{up})_i = .64705$$

We can find the chance of an up or down day if the five-day trend is up simply by substituting the direction of the five-day trend (or *n*-day trend) for the previous day's direction in the example just given.

Predicting the weather is a more involved case of multiple situations converging and may be very representative of the way prices react to past prices. By approaching the problem in the same manner as the two-state process, a ⅓ probability is assigned to each situation for the first day; the second day's probability is

$$P(\text{clear})_2 = (.333 \times .70) + (.333 \times .20) + (.333 \times .20)$$
$$=.3663$$

$P(\text{cloudy})_2 = (.333 \times .25) + (.333 \times .60) + (.333 \times .40)$
$= .41625$
$P(\text{rainy})_2 = (.333 \times .05) + (.333 \times .20) + (.333 \times .40)$
$= .21645$

Then, using the second day results, the third day is

$P(\text{clear})_3 = (.3663 \times .70) + (.41625 \times .20) + (.21645 \times .20)$
$= .38295$
$P(\text{cloudy})_3 = (.3663 \times .25) + (.41625 \times .60) + (.21645 \times .40)$
$= .42791$
$P(\text{rainy})_3 = (.3663 \times .05) + (.41625 \times .20) + (.21645 \times .40)$
$= .18815$

The general form for solving these three equations is

$P(\text{clear})_{i+i} = [P(\text{clear})_i \times .70] + [P(\text{cloudy})_i \times .20] + [P(\text{rainy})_i \times .20]$
$P(\text{cloudy})_{i+i} = [P(\text{clear})_i \times .25] + [P(\text{cloudy})_i \times .60] + [P(\text{rainy})_i \times .40]$
$P(\text{rainy})_{i+i} = [P(\text{clear})_i \times .05] + [P(\text{cloudy})_i \times .20] + [P(\text{rainy})_i \times .40]$

where each $i + 1$ element can be set equal to the corresponding ith value; there are then three equations in three unknowns, which can be solved directly or by matrix multiplication, as shown in Appendix 3, "Solution to Weather Probabilities Expressed as a Markov Chain."[3] Otherwise, it will be necessary to use the additional relationship

$$P(\text{clear})_i + P(\text{cloudy})_i + P(\text{rainy})_i = 1.00$$

The results are

$P(\text{clear}) = .400$
$P(\text{cloudy}) = .425$
$P(\text{rainy}) = .175$

Bayes' Theorem

Although historic generalization exists concerning the outcome of an event, a specific current market situation may alter the probabilities. *Bayes' theorem* combines the *original probability* estimates with the *added-event probability* (the reliability of the new information) to get *a posterior* or *revised probability:*

$$\frac{P(\text{Original and added-event})}{P(\text{Added-event})}$$

Assume that the price changes P(up) and P(down) are both original probabilities, and an added-event probability, such as an unemployment report, trade balance, crop report, inventory stocks, or Federal Reserve interest rate announcement is expected to have an overriding effect on tomorrow's movement. Then the new probability P(Up | added-event) is:

$$\frac{P(\text{Up and added-event})}{P(\text{Up and added-event}) + P(\text{Down and added-event})}$$

where *up* and *down* refer to the original historic probabilities, and $P(A \text{ and } B)$ is a joint probability.

Bayes' theorem finds the conditional probability even if the joint and marginal probabilities are not known. The new probability P(up | added-event) is:

$$\frac{P(Up) \times P\,(Added\text{-}event \mid up)}{P(Up) \times P\,(Added\text{-}event \mid up) + P(Down) \times P\,(Added\text{-}event \mid down)}$$

where *P*(Added-event I up) = the probability of the new event being a correct predictor of an upwards move

P(Added-event I down) = the probability of prices going down when the added news indicates up

For example, if a quarter percent decline in interest rates has a 90% chance of causing stock prices to move higher, then

P(Added-event | up) = .90

and

P(Added-event | down) = .10

would be used in Bayes theorem.

[3]A full mathematical treatment of Markov chains can be found in John G. Kemeny and J. Laurie Snell, *Finite Markov Chains* (Springer-Verlag, New York, 1976).

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SUPPLY AND DEMAND

Price is the balancing point of supply and demand. In order to estimate the future price of any product or explain its historic patterns, it will be necessary to relate the factors of supply and demand and then adjust for inflation, technological improvement, and other indicators common to econometric analysis. The following sections briefly describe these factors.

Demand

The demand for a product declines as price increases. The rate of decline is always dependent on the need for the product and its available substitutes at different price levels. In Figure 2.12a, *D* represents normal demand for a product over some fixed period. As prices rise, demand declines fairly rapidly. *D'* represents increased demand, resulting in higher prices at all levels.

Figure 2.12a: Shift in demand.

Figure 2.12b represents the actual demand relationship for potatoes from 1929 to 1939. Although this example is the same as the theoretical relationship in Figure 2.12a, in most cases, the demand relationship is not a straight line. Production costs and minimum demand prevent the curve from going to zero; instead, it approaches a minimum price level. On the higher end of the scale, there is a lag in the response to increased prices and a consumer reluctance to reduce purchasing even at higher prices (called "inelastic demand"). Coffee is well-known for having inelastic demand—most coffee drinkers will pay the market price rather than consume less. Figure 2.12c shows a more representative demand curve, including extremes, where 100 represents the cost of production for a producer. The demand curve, therefore, shows the rate at which a change in quantity demanded brings about a change in price. Note that, although a producer may lose money at 100, demand may force sales at a loss.

Figure 2.12b: Potatoes—U.S. average farm price on December 15th versus total production—1929–1939.

Figure 2.12c: Demand curve, including extremes. *Source* (for Figures 2.12a, b, and c)—Shepherd, Geoffrey S. and G. A. Futrell. *Agricultural Price Analysis* (Iowa State University, Ames, IA, 1969, p. 53).

Elasticity of Demand

Elasticity is the key factor in expressing the relationship between price and demand. It is the relative change in demand as price increases:

$$E_D = \frac{Relative\ change\ (\%)\ in\ demand}{Relative\ change\ (\%)\ in\ price}$$

A market that always consumes the same amount of a product, regardless of price, is called *inelastic;* as price rises, the demand remains the same and E_D is negatively very small. An *elastic* market is just the opposite. As demand increases, price remains the same and E_D is negatively very large. Figure 2.13 shows the demand curve for various demand elasticities.

Figure 2.13: Demand elasticity. (a) Relatively elastic; (b) Relatively inelastic; (c) Normal market.

If supply increases for a product that has existed in short supply for many years, consumer purchasing habits will require time to adjust. The demand elasticity will gradually shift from relatively inelastic (Figure 2.13b) to relatively elastic (Figure 2.13a).

Supply

The supply side of the economic equation is the normal counterpart of demand. Figure 2.14a shows that, as price increases, the supplier will respond by offering greater amounts of the product. Figure 2.14b demonstrates the supply at price extremes. At low levels, below production costs, there is a nominal supply by those producers who must maintain operations due to high fixed costs and difficulty restarting after a shutdown. At high price levels, supply is erratic. There may be insufficient supply in the short term, followed by the appearance of new supplies or substitutes, as in the case of a location shortage. When there is a shortage of orange juice, South American countries are willing to fill the demand; when there is an oil disruption, other OPEC nations will increase production. In most cases, however, it is reduced demand that brings price down.

Figure 2.14: Supply-price relationship. (a) Shift in supply. (b) Supply curve, including extremes.

Elasticity of Supply

The elasticity of supply E_S is the relationship between the change in supply and the change in price:

$$E_D = \frac{Relative\ change\ (\%)\ in\ supply}{Relative\ change\ (\%)\ in\ price}$$

The elasticity of supply, the counterpart of *demand elasticity,* is a positive number because price and quantity move in the same

direction at the same time.

Equilibrium

The demand for a product and the supply of that product cross at a point of *equilibrium.* The current price of any product, or any security, represents the point of equilibrium for that product at that moment in time. Figure 2.15 shows a constant demand line *D* and a shifting supply, increasing to the right from *S* to *S'*.

Figure 2.15: Equilibrium with shifting supply.

The demand line *D* and the original supply line *S* meet at the equilibrium price *P*; after the increase in supply, the supply line shifts to *S'*. The point of equilibrium *P'* represents a lower price, the consequence of larger supply with unchanged demand. Because supply and demand each have varying elasticities and are best represented by curves, the point of equilibrium can shift in any direction in a market with changing factors.

Equilibrium will be an important concept in developing trading strategies. Although the supply and demand balance may not be calculated, in practical terms equilibrium is a balance between buyers and sellers, a price level at which everyone is willing to trade, although not always happy to do so at that price. Equilibrium is associated with lower volatility and often lower volume because the urgency to buy or sell has been removed. Imbalance in the supply-demand-price relationship causes volatility. Readers interested in a practical representation of equilibrium, or price-value relationships, should study "Price Distribution Systems" in Steidlmayer's Market Profile, Chapter 18.

Cobweb Charts

The point at which the supply and demand lines cross is easily translated into a place on a price chart where the direction is sideways. The amount of price volatility during this sideways period (called *noise*) depends upon the price level, market participation, and various undertones of instability caused by other factors. Very little is discussed about how price patterns reflect the shift in sentiment between the supply and demand lines, yet there is a clear representation of this action using *cobweb charts.*

Figure 2.16a shows a static (symmetric) supply-demand chart with dotted lines representing the "cobweb."[4] A shift in the perceived importance of supply and demand factors can cause prices to reflect the pattern shown by the direction of the arrows on the cobweb, producing the sideways market represented by Figure 2.16b. If the cobweb were closer to the intersection of the supply and demand lines, the volatility of the sideways price pattern would be lower; if the cobweb were further away from the intersection, the pattern would be more volatile.

Most supply/demand relationships are not static, and can be represented by lines that cross at oblique angles. In Figure 2.17a the cobweb is shown to begin near the intersection and move outwards, each shift forming a different length strand of the web, moving away from equilibrium. Figure 2.17b shows that the corresponding price pattern is one that shifts from equilibrium to increasing volatility. A reversal in the arrows on the cobweb would show decreasing volatility moving towards equilibrium.

Figure 2.16: Static supply/demand cobweb. (a) Dotted lines represent a shift of sentiment from supply to demand to supply, and so forth. (b) The price pattern likely to result from the cobweb in (a). *Source*—Curtis McKallip, Jr., "Fundamentals Behind Technical Analysis," *Technical Analysis of Stocks & Commodities*, 7, no. 11 (November 1989). © 1989 by Technical Analysis, Inc. Used with permission.

Building a Model

A model can be created to *explain* or *forecast* price changes. Most models explain rather than forecast. Explanatory models analyze sets of data at concurrent times, that is, they look for relationships between multiple factors and their effect on price at the same moment in time. They can also look for *causal,* or lagged relationships, where prices *respond* to other factors after one or more days. It is possible to use the explanatory model to determine the normal price at a particular moment. Although not considered forecasting, any variation in the actual market price from the normal or expected price could present a trading opportunity.

Figure 2.17: Dynamic supply/demand cobweb. (a) Dotted lines represent a cobweb moving away from equilibrium. (b) The price pattern shows increasing volatility. *Source*—Curtis McKallip, Jr., "Fundamentals Behind Technical Analysis," *Technical Analysis of Stocks & Commodities*, 7, no. 11 (November 1989).© 1989 by Technical Analysis, Inc. Used with permission.

Methods of selecting the best forecasting model can affect its credibility. An *analytic* approach selects the factors and specifies the relationships in advance. Tests are then performed on the data to verify the premise. Many models, though, are refined by *fitting* the data, using regression analysis or *shotgun* testing, which applies a broad selection of variables and weighting factors to find the best fit. These models created with perfect hindsight are not likely to be successful at forecasting future price levels. Even an analytic approach that is subsequently fine-tuned could be in danger of losing its forecasting qualities.

The factors that comprise a model can be both numerous and difficult to obtain. Figure 2.18 shows the interrelationship between factors in the cocoa industry. Although this chart is comprehensive in its intramarket relationships, it does not emphasize the global influences that have become a major part of price movement since the mid-1970s. The change in value of the U.S. dollar and the volatility of interest rates have had far greater influence on price than normal fundamental factors for many commodities. Companies with high debt may find the price fluctuations in their stock are larger due to interest rate changes than increases or

decreases in revenues.

Figure 2.18: Cocoa factors. *Source*—F. H. Weymar, *The Dynamics of the World Cocoa Market* (Cambridge, MA—MIT Press, 1968, p. 2).

Models that explain price movements must be constructed from the primary factors of supply and demand. A simple example for estimating the price of fall potatoes[5] is

$$P / PPI = a + bS + cD$$

where P = the average price of fall potatoes received by farmers
PPI = the Producer Price Index
S = the apparent domestic free supply (production less exports and diversions)
D = the estimated deliverable supply
a, b, and c = constants determined by regression analysis

This model implies that consumption must be constant (i.e., inelastic demand); demand factors are only implicitly included in the estimated deliverable supply. Exports and diversion represent a small part of the total production. The use of the *PPI* gives the results in *relative* terms based on whether the index was used as an *inflator* or *deflator* of price.

A general model, presented by Weymar,[6] may be written as three behavior-based equations and one identity:

Consumption

$$C_t = f_C\left(P_t, P_t^L\right) + e_{C_t}$$

Production

$$H_t = f_H\left(P_t, P_t^L\right) + e_{H_t}$$

Inventory

$$I_t = I_{t-1} + H_t - C_t$$

Supply of storage

$$P_t' - P_t = f_p(I_t) + e_p$$

where C = the consumption
P = the price
P^L = the lagged price
H = the production (harvest)
I = the inventory
P' = the expected price at some point in the future
e = the corresponding error factor

The first two equations show that both demand and supply depend on current and/or lagged prices, the traditional macroeconomic theory; production and consumption are therefore dependent on past prices. The third equation, *inventory level,* is simply the total of previous inventories, plus new production, less current consumption. The last equation, *supply of storage,* demonstrates that people are willing to carry larger inventories if they expect prices to increase substantially. The inventory function itself, the third equation, is composed of two separate relationships: manufacturers' inventories and speculators' inventories. Each reacts differently to expected price change.

[4]Curtis McKallip, Jr., "Fundamentals behind Technical Analysis," *Technical Analysis of Stocks & Commodities* (November 1989).

[5]J. D. Schwager, "A Trader's Guide to Analyzing the Potato Futures Market," *1981 Commodity Yearbook* (Commodity Research Bureau, New York).

[6]F. H. Weymar, *The Dynamics of the World Cocoa Market* (MIT Press, Cambridge, MA, 1968).

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Chapter 3: Charting

OVERVIEW

It is very likely that all trading systems began with a chart and, when something is going wrong we come back to a price chart to get a better view of the problem. Nowhere can a picture be more valuable than in price forecasting. Elaborate theories and complex formulas may ultimately be successful, but the loss of perspective is rarely corrected without a simple chart. We should remember the investor who, anxious after a long technical presentation by a research analyst, could only blurt out, "But is it going up or down?" Even the most sophisticated market strategies must capture the obvious trends or reversals. Before any trading method is used, the past buy and sell signals should be plotted on a chart. Those signals should appear at logical points and confirm the technique; otherwise the basis of the strategy or testing method should be questioned, or the rules should be checked for mistakes.

Through the mid-1980s technical analysis was considered only as chart interpretation. In the equities industry that perception is still strong. Most traders begin as chartists, and many return to it or use it along with their other methods. William L. Jiler, a great trader and founder of Commodity Research Bureau, wrote:

> *One of the most significant and intriguing concepts derived from intensive chart studies by this writer is that of characterization, or habit. Generally speaking, charts of the same commodity tend to have similar pattern sequences which may be different from those of another commodity. In other words, charts of one particular commodity may appear to have an identity or a character peculiar to that commodity. For example, cotton charts display many round tops and bottoms, and even a series of these constructions, which are seldom observed in soybeans and wheat. The examination of soybean charts over the years reveals that triangles are especially favored. Head and shoulders formations abound throughout the wheat charts. All commodities seem to favor certain behavior patterns.*[1]

In addition to Jiler's observation, the cattle futures market is recognized as also having the unusual occurrence of "V" bottoms. Both the silver and pork belly markets have tendencies to look very similar, with long periods of sideways movement and short-lived but violent *price shocks*, where prices leap rather than trend to a new level. The financial markets have equally unique personalities. The S&P traditionally makes new highs, then immediately falls back; it has fast, short-lived drops and slower, steadier gains. Currencies show intermediate trends bounded by noticeable major stopping levels while long-term interest rates have long-term directional trends.

Charting remains the most popular and practical form for evaluating price movement, and numerous works have been written on methods of interpretation. This chapter will summarize some of the accepted approaches to charting and the trading rules normally associated with these patterns. Some conclusions are drawn as to what is most likely to work and why. The next chapter covers systems that are derived from these patterns and are designed to take advantage of behavioral patterns found in charts.

[1]William L. Jiler, "How Charts Are Used in Commodity Price Forecasting," *Commodity Research Publications* (New York, 1977).

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FINDING CONSISTENT PATTERNS

A price chart is often considered a representation of human behavior. The goal of any chart analyst is to find consistent, reliable, and logical patterns that can be used to predict price movement. In the classic approaches to charting, there are consolidation forms, trend channels, top-and-bottom formations, and a multitude of other patterns that can only be created by the repeated action of large groups of people in similar circumstances or with similar objectives. The most important of all the chart patterns is the trendline.

Only recently have computer programs been able to interpret chart patterns; however, there are no comprehensive, published studies showing the reliability of chart formations. In all fairness, there are a limitless number of interpretations at any one time. In order to identify a chart price formation, it is first necessary to select the chart resolution (for example, daily or weekly), then a time horizon (long-term or short-term), before a chart interpretation can begin. Given the wide range of choices, it should be surprising that many chart analysts see the same patterns at the same time.

Traditional trading techniques frequently published in the most popular stocks and futures market literature may themselves be the cause of the repeated patterns. Novice speculators approach the problem with great enthusiasm and often some rigidity in an effort to stick to the rules. They will sell double and triple tops, buy breakouts, and generally do everything to propagate the survival of standard chart formations. Because of its following, it is wise to know the most popular techniques, if only as a defensive measure.

What Causes Chart Patterns?

Speculators have many habits which, taken in large numbers, cause recognizable chart patterns. The typical screen trader (not on the exchange floor), or an investor placing his or her own orders, will usually choose an even number—for example, buy Microsoft at $26.00, rather than at $26.15. If even dollar values are not used, then 50¢ and 25¢ are the next most likely increments, in that order. In futures trading the same is true. There are far more orders placed in the S&P Index at 950.00 than at 936.50, or 30-year Treasury bonds at $105\frac{16}{32}$ instead of $105\frac{16}{32}$.

The public is also said to always enter into the bull markets at the wrong time. When the major media, such as the television financial news, syndicated newspapers, and radio, carry stories of dangerously low oil supplies, a new cancer treatment drug, or the devastation of the nation's wheat crop, the public speculator enters in what W. D. Gann calls the *grand rush*, causing the final runaway move before the collapse or the final sell-off before the rally; this behavior is easily identifiable on a chart. Gann also talks of *lost motion*, the effect of momentum that carries prices slightly past its goal. Professional traders recognize that a fast, volatile price may carry as much as 10% farther than its objective. A downward swing in the U.S. dollar/Japanese yen from 1.2000 to a support level of 1.1000 could overshoot the bottom by .0100 without being considered significant.

The behavioral aspects of prices appear rational. In the great bull markets, the repeated price patterns and variations from chance movement are indications of the effects of mass psychology. The greatest single source of information on this topic is Mackay's *Extraordinary Popular Delusions and the Madness of Crowds* originally published in 1841.[2] In the preface to the 1852 edition the author says:

> *We find that whole communities suddenly fix their minds on one object, and go mad in its pursuit; that millions of people become simultaneously impressed with one delusion….*

In 1975, sugar was being rationed in supermarkets at the highest price ever known. The public was so concerned that there would not be enough at any price that they bought and horded as much as possible. This extreme case of public demand coincided with the price peak, and shortly afterwards the public found itself with an abundant supply of high-priced sugar in a rapidly declining market. The world stock markets are often the target of acts of mass psychology. While U.S. traders watched at a distance the collapse of the Japanese stock market from its heights of 38,957 at the end of

December 1989 to its current lows of 7,750 in 2003, a drop of 80%, they were able to experience their own *South Sea Bubble* when the Nasdaq 100 fell 83.5% from its highs of 4,816 in March 2000 to 795 in October 2002. Prices seem to drop suddenly at the time when buyers are most confident, then start the long climb up again. It should not be difficult to understand why contrary thinking has developed a strong following.

Charting is a broad topic taken to great detail; the chart paper itself and its scaling are sources of controversy. A standard bar chart (or line chart) representing highs and lows can be plotted for daily, weekly, or monthly intervals in order to smooth out the price movement over time. The use of large increments representing price levels reduces the volatile appearance of price fluctuations. Bar charts have been drawn on semilog and exponential scales,[3] where the significance of greater volatility at higher price levels is put into proportion with the quieter movement in the low ranges by using percentage changes. Each variation gives the chartist a unique representation of price action. The shape of the chart box and its ratio of height/width will alter subsequent interpretations that are based on angles. Standard charting techniques may draw trendlines at 45- or 30-degree angles across the chart; therefore, the selection of the paper will have a major effect on the results. This chapter uses daily price charts and square boxes unless otherwise noted.

It may be a concern to today's chartist that the principles and rules that govern chart interpretation were based on the early stock market, using averages instead of individual stocks or futures contracts. This is discussed in the next section. For now, refer to Edwards and Magee, who removed this problem by stating that "anything whose market value is determined solely by the free interplay of supply and demand" will form the same graphic representation. They continued to say that the aims and psychology of speculators in either a stock or commodity environment would be essentially the same, that the effect of postwar government regulations have caused a "more orderly" market in which these same charting techniques can be used.[4]

[2]Reprinted in 1995 by John Wiley & Sons, Inc.

[3]R.W. Schabacker, "Stock Market Theory and Practice," *Forbes* (New York, 1930, pp. 595–600).

[4]Robert D. Edwards and John Magee, *Technical Analysis of Stock Trends* (John Magee, Springfield, MA, 1948, Chapter 16).

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WHAT CREATES THE MAJOR PRICE MOVES AND TRENDS?

Prices can move higher for many months or even years, creating what is known as a *bull market*. They can also move down, creating a *bear market*. Although price moves can be as short as a few minutes or as long as ten years, it is the periods of sustained direction that are most important. When recognized, the price trend forms a bias for trading decisions that can make the difference between success and failure. The long-term direction of prices is driven by four primary factors:

1. *Government policy*. When economic policy targets a growth rate of 4%, and the current growth rate is 1%, the Federal Reserve (the "Fed") lowers interest rates to encourage growth. Lowering rates stimulates business activity. The Fed raises interest rates to control inflation by dampening activity. Changing interest rates has a profound impact on the flow of investment money between countries, on international trade, on the value of currencies, and on business activity.

2. *International trade*. When the United States. imports more goods, it pays for it in dollars. That is the same as *selling* the dollar. It weakens the currency. A country that continually imports more than it exports increases its trade deficit. A country that increases its exports strengthens its currency and its economy.

3. *Expectation*. If investors think that stock prices will rise, they buy, causing prices to rise. Expectations can lead an economic recovery although there is no statistical data to support a recovery. *Consumer confidence* is a good measure of how the public feels about spending. The economy is active when consumer confidence is high. A lack of public confidence following the collapse of Enron dampened stock market activity and may have delayed the recovery in 2003.

4. *Supply and demand*. A shortage, or anticipated shortage, of any product causes its price to rise. Too much of a product results in declining prices. These trends develop as news makes the public aware of the situation. A shortage of a product that cannot be replaced causes a prolonged effect on its price, although the shift to a higher price may happen quickly.

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THE BAR CHART AND ITS INTERPRETATION BY CHARLES DOW

The *bar chart*, also called the *line chart*, became known through the theories of Charles H. Dow, who expressed them in the editorials of the *Wall Street Journal*. Dow first formulated his ideas in 1897 when he created the stock averages in order to have a more consistent measure of price movement for stock groups. After Dow's death in 1902, William P. Hamilton succeeded him and continued the development of his work into the theory that is known today. Those who have used charts extensively and understand their weak and strong points might be interested in just how far our acceptance has come. In the 1920s, a New York newspaper was reported to have written:

> *One leading banker deplores the growing use of charts by professional stock traders and customers' men, who, he says, are causing unwarranted market declines by purely mechanical interpretation of a meaningless set of lines. It is impossible, he contends, to figure values by plotting prices actually based on supply and demand; but, he adds, if too many persons play with the same set of charts, they tend to create the very unbalanced supply and demand which upsets market trends. In his opinion, all charts should be confiscated, piled at the intersection of Broad and Wall and burned with much shouting and rejoicing.*[5]

This attitude seems remarkably similar to the comments about program trading that followed the stock market plunge in October 1987, where program trading was condemned as the cause of the crash rather than public confidence. Nevertheless, charting has become part of the financial industry, whether the analyst is interested in the fundamentals of supply and demand or pure price movement. The earliest authoritative works on chart analysis are long out of print but the essential material has been recounted in newer publications. If, however, a copy should cross your path, read the original *Dow Theory* by Robert Rhea;[6] most of all, read Richard W. Schabacker's outstanding work *Stock Market Theory and Practice*, which is probably the basis for most subsequent texts on the use of the stock market for investment or speculation. The most available book that is both comprehensive and well written is *Technical Analysis of Stock Trends* by Robert D. Edwards and John Magee. It is confined entirely to chart analysis with related management implications and a small section on commodities. For the reader who prefers concise information with few examples, the monograph by W. L. Jiler, *Forecasting Commodity Prices with Vertical Line Charts*, and a complementary piece, *Volume and Open Interest: A Key to Commodity Price Forecasting*, can still be found.[7] Two more recent publications that are widely read are John Murphy's *Technical Analysis of the Financial Markets* (New York Institute of Finance, 2000) and Jack Schwager's, *Schwager on Futures: Technical Analysis* (Wiley, 1996), part of a two-volume set.

The Dow Theory[8]

The Dow Theory is still the foundation of chart interpretation and applies equally to stocks, financial markets, commodities, and the wide variety of investment vehicles used to trade them. It is part investor psychology supported by chart analysis. It is impressive that it has withstood the tests of 100 years. Charles Dow was the first to create an index of similar stocks—the Industrials and the Railroads, although today's components are very different from those in 1897. The purpose of the index was to smooth out erratic price movement and find consistency by combining less active stocks. Thin trading causes unreliable price patterns.

Dow's work can be viewed in two parts: his theory of price movement, and the method of implementing his theory. Both are inseparable to its success. Dow determined that the stock market moved as the ocean, in three waves, called *primary*, *secondary*, and *daily fluctuations*. The major advances and declines, lasting for extended periods, were compared to the tides. These tides were subject to secondary reactions called *waves*, and the waves were comprised of *ripples*. In 1897 Dow published two sets of averages in the *Wall Street Journal*, the *Industrials* and the *Railroads* in order to advance his ideas. These are now the *Dow Jones Industrial Average* and the *Transportation Index*. Figure 3.1 shows the past 20 years of history for the three most important averages. Applications of the Dow Theory now use these three major averages, the Industrials, the Transportation, and the Utilities.

Figure 3.1: Dow Industrial, Utilities, and Transportation Indices, 1981–1999. Dow originally created the industrial and railway averages to hide the large, erratic price moves caused by price manipulation and lack of liquidity. Dow Theory has been adapted to use the current versions of the major indices, the Industrials (top panel), the Utilities (center panel), and the Transportation Index (bottom panel).

The Basic Tenets of the Dow Theory

There are six fundamental principles of the Dow Theory that fully explain its operation.

1. The Averages Discount Everything (Except "Acts of God").

At the turn of the twentieth century there was considerably less liquidity and regulation in the market; therefore, manipulation was common. By creating averages, Dow could reduce the frequency of "unusual" moves in a single stock, that is, those moves that seemed unreasonably large or out of character with the rest of the market. Dow's Industrials average the share value of 30 companies; therefore, an odd move in one of those prices would only be $1/30$ of the total, reducing its importance so that it would not distort the results. The average also represented far greater combined liquidity than a single stock. The only large moves that would appear on a chart of the average price were price shocks, or "acts of God."

2. There are Three Classifications of Trends: Primary Trends, Secondary Swings, and Minor Day-to-Day Fluctuations.

The primary trend, also called the *wave*, is the trend on a grand scale. When there is a wave of rising prices we have a *bull market*; when prices are declining there is a *bear market*. A wave is a major move over an extended period of time, generally measured in years. A clear bull market can be seen in the S&P weekly chart (Figure 3.2) from 1984 to mid-1987 and on the monthly chart (see Figure 3.3) from the end of 1987 to early 1998 or into 2000, depending upon whether the decline in 1998 was too large to be included in the extended bull market.

Figure 3.2: S&P primary trend. On a weekly chart, a major bull market (the *primary trend*) can be seen from 1984 through September 1987.

Figure 3.3: Two primary trends. The monthly chart of the S&P shows a bull market from 1984 through September 1987, followed immediately by the major bull market that continued until the peak of 2000. Some analysts would consider the 1998 price drop as the end of the bull market.

Bull and Bear Market Formation (For Monthly or Weekly Prices)

The beginning of a bull or bear market is determined using a *breakout signal*, shown in Figure 3.3, based on large swings in the index value (a complete explanation of breakout signals can be found in Chapter 5. The *bull market signal* occurs at the point where prices confirm the uptrend by moving above the high of the previous rally. The *bear market signal* occurs on a break below the low of the previous decline.

It is commonly accepted that a bull or bear market begins when prices reverse 20% from their lows or highs. In order to get an upwards breakout signal needed for a new bull market, we want to look at support and resistance levels (the previous intermediate high and low prices) separated by approximately a 10% price move based on the index value. This type of signal is called *swing trading*. At the top of Figure 3.4 the horizontal broken line should occur at about 20% below the absolute price highs, and the second peak should be approximately 10% higher than the previous swing low.

Figure 3.4: Bull and bear market signals. Bull and bear markets are recognized using traditional breakout signals, but on a larger scale. A bull market begins when prices rise above the previous resistance level after trading at low levels. The bear market begins when prices break below a previous support level. To signal the start of a primary trend, the decline from the highs, or the rally from the lows, should be greater than 10%.

Bull and Bear Market Phases

In Dow Theory the primary trends develop in three distinct phases, each characterized by investor action. These phases can be seen in the Nasdaq bull market of the late 1990s and the subsequent bear market (see Figure 3.5).

Figure 3.5: Nasdaq from April 1998 through June 2002. A clear example of a bull and bear market with a classic pattern of volume.

The Bull Market

- *Phase 1: Accumulation*. Cautious investors select only the safest and best-valued stocks to buy. They limit purchases to deeply discounted stocks at depressed price levels and consider only primary services and industries, most often buying utilities and high yielding stocks.
- *Phase 2: Increasing volume*. Greater investor participation causes increasing volume, rising prices, and an improving economic picture. A broader range of investors enter the market convinced that the market has seen its lowest prices. Secondary stocks become popular.
- *Phase 3: Final explosive move*. Excessive speculation and an elated general population result in a final explosive move. Everyone is talking about the stock market; people who have never considered investing directly now enter the market. The public is convinced that profits will continue and buying becomes indiscriminate. Investors borrow to buy stocks. Value is unimportant because prices keep rising. Earnings and dividends are ignored.

The Bear Market

- *Phase 1: Distribution*. Professionals begin selling while the public is in the final stages of buying. Stocks are distributed from stronger to weaker hands. The change of ownership is facilitated by less experienced investors who enter the bull market too late and pay what turn out to be unreasonably high prices.
- *Phase 2: Panic*. Prices decline further than at any time during the bull market and fail to rally. The news constantly talks about the end of the bull market. The public sees an urgency to liquidate. Investors who borrowed money to invest late in the bull market, trading on margin or leverage, now speed up the process. Some are forced to liquidate because their portfolio value has dropped below the critical point. The divesting of stocks takes on a sense of panic.
- *Phase 3: Lack of buying interest*. The final phase in the sustained erosion of prices results from the lack of buying by the public. After taking losses, investors are not interested in buying even the strongest companies at extremely undervalued prices. All news is viewed as negative. Pessimism prevails. It is the summer of 2002.

Secondary Trends (Secondary Reactions Using Weekly or Daily Prices)

Secondary reactions are also called *corrections* or *recoveries*. Corrections in bull markets are attributed to the prudent investor taking profits. This profit phase can have an erratic start but is considered complete when prices rise above the previous secondary rally. The bull market is back in force when a new high occurs (see Figure 3.6). *Lines* may be substituted for secondary movements. In Dow Theory, a *line* is a sideways movement lasting from two to three weeks to months, trading in about a 5% range.

Figure 3.6: Secondary trends and reactions. A reaction is a smaller swing in prices that ends when a new high reinstates the bull market. Reactions are identified using smaller swings than those used for bull and bear market. If the bull market is still intact, a trader can buy the breakout confirmation at the end of the reaction.

Characteristics of a Secondary Reaction

- There are a number of clear downswings.
- The movement is more rapid in the reversal (down during a bull market) than in the primary move.
- They last from three weeks to three months.
- If the volume on the price drop is equal to or greater than the volume just prior to the decline, then a bear market is likely. If volume declines during the drop, then a reaction is confirmed.
- The atmosphere surrounding the decline is important. If there is a lot of speculation, then a bear market may develop.

Minor Trends (Using Daily Prices)

In Dow Theory, minor trends are the only trends that can be manipulated. They are usually under six days in duration. Because they are considered market

noise, not affecting the major price direction, they are seen as frequent up and down movements.

3. The Principle of Confirmation.

For a bull or bear market to exist, two of the three major averages (the Industrials, the Transportation, and the Utilities) must confirm the direction. When first created, the Dow Theory required the confirmation on only the Utilities and the Railroads. Although much has changed since Dow devised this rule, the purpose is to assure that the bull or bear market is a widespread economic phenomenon and not an industry-related event.

4. Volume Goes with the Trend.

Volume confirms the price move. Volume must increase as the trend develops, whether it is a bull or bear market. It is greatest at the peak of a bull market or during the panic phase of a bear market.

5. Only Closing Prices are Used.

Dow had a strong belief that the closing price each day was the most important price. It was the evening-up at the end of the day. Professional day traders prefer to liquidate all of their positions before the close of trading, not carrying any open positions overnight. This helps to reverse any artificial moves that occur during the trading session. Although liquidity was a problem during Dow's time, even actively traded stocks in today's market show larger price swings when a larger order is executed during a quiet period. There is always high volume at the close of trading, when investors with short and long time frames come together to decide the fair price.

6. The Trend Persists.

A trend should be assumed to continue in effect until its reversal has been signaled. This rule forms the basis of all trend-following principles. It considers the trend as a long-term price move, and it invests only in the trend direction. The Dow Theory does not express expectations of how long a trend will continue. It simply follows the trend until a signal occurs that indicates a change of direction.

Interpreting Today's S&P Using Dow Theory

After 100 years, can the Dow Theory correctly interpret the major market index, the S&P? Figure 3.7 shows the S&P 500, using continuous, back-adjusted futures prices, from 1994 through the middle of 2003. Early prices can be seen in Figure 3.1. The sustained bull market that began in 1987, or possibly 1984, peaks near the end of the first quarter of 2002. There is a steady increase in volume, as Dow had foreseen, although volume does not peak at the top of the market—it starts to decline noticeably about three months before the top. We will see in the study of volume that volume spikes occur at extremes, but a longer-term volume confirmation is very important. Decline volume at the beginning of 2003 signals a divergence in sentiment that foretells the end of the bull market. Volatility increases as prices move towards the end of the uptrend, another predictable pattern. The price move from 1994 through the peak in 2002 shows both Phase 2 and Phase 3 of the bull market.

Figure 3.7: Dow Theory applied to the S&P. Most of Dow's principles apply to the current marketplace, but some experience and interpretation is necessary.

The price decline in the third quarter of 1998 addresses the following issue: How large should a reversal be in order to change a bull market into a bear market? There are no exact measurements, although most analysts accept 20% as the acceptable size. A 20% drop from a high of 1400 is 1120, very

close to the point where prices stopped their decline and reversed. Because of the speed of the decline and the quick recovery, analysts would not consider this a bear market signal. Some of these decisions require judgment, some experience, and a little hindsight.

Transition from Bull to Bear in the S&P.

Looking again for a 20% reversal from the S&P highs of 1675, we target the price of 1340. This time, volume has declined into the highs and continues to decline quickly. From the second quarter of 2000 through the first quarter of 2001 prices fall sharply, giving back the gains from mid-1997, nearly 3 years. When prices break below 1300 they confirm the previous low at the end of 2000, making it difficult to deny that a bear market is underway.

During the subsequent decline, prices attempted to rally. There are 4 clear cases of a sharp "V" bottom followed by a significant move higher. After the low at 940 at the end of September 2001, prices move to about 1180, above the 20% reversal of 1128. However, after the first reversal to 1075 prices fail to move back above the highs, finally breaking below 1180 and continuing on to make new lows. Although the recovery exceeded 20%, the lack of a confirming breakout can be interpreted as a bull market failure. Not every pattern falls neatly into a rule.

We come to the last year of the S&P chart, where prices have resisted going below 850, and now appear to be moving above the level of 970 and about to confirm a bullish breakout. Is it the end of the bear market? Volume was the highest at the two lowest price spikes, and then declined. Many stocks are undervalued, according to experts, yet those same experts see no reason for the market to rally further because the recent rise has already reflected reasonable expectations for profits and growth in the next year. Who will be correct, Charles Dow or the "talking heads" of the financial news networks?

Dow Theory and Futures Markets

The principles of the Dow Theory are simple to understand. Major price moves are most important and they are confirmed by volume. They follow a pattern created by investor action that seems to be universal when seen from a distance. In order to implement his theory, Dow needed to create an index that minimized the erratic moves in individual stocks due to lack of liquidity and price manipulation.

The primary features of the Dow Theory should hold for any highly liquid, actively traded market. This applies to index futures and most financial futures markets, as well as foreign exchange, which have enormous volume and reflect major economic trends. Because of the distinct products traded as futures, an investor may be able to apply Dow's principle of confirmation using any two of the S&P Index, 10-year Treasury notes, and the U.S. dollar index, in the same way that the Industrials, Utilities, and Transportation indices were used for stocks. When trading in futures, the nearby contract (the one closest to delivery) is always used; however, the total volume of all futures contracts traded for each market must be used in the same way that stock volume is applied.

[5]Richard D. Wyckoff, *Stock Market Technique, Number One* (Wyckoff, New York, 1933, p. 105).

[6]Robert Rhea, *Dow Theory* (Vail-Ballou, Binghamton, NY, 1932).

[7]Two other works worth studying are Gerald Appel, *Winning Market Systems: 83 Ways to Beat the Market* (Signalert, Great Neck, NY, 1974), and Gerald Appel and Martin E. Zweig, *New Directions in Technical Analysis* (Signalert, Great Neck, NY, 1976).

[8]The rules of the Dow Theory in this section are based on a fine article by Ralph Acampora and Rosemarie Pavlick, "A Dow Theory Update," originally published in the *MTA Journal* (January 1978, reprinted in the *MTA Journal*, Fall—Winter 2001). Other parts of this section are drawn from Kaufman, *A Short Course in Technical Trading* (Wiley, 2003).

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CHART FORMATIONS

While Dow Theory is a macro view of price movement, most chart analysis deals with much shorter time periods. Most traders hold positions from a few days to a few weeks, and that is the time frame in which most chart formations are viewed. However, the same patterns can be applied to shorter or longer intervals to satisfy the individual objectives of traders.

Chart analysis uses straight lines and identifies geometric formations on price charts. It analyzes volume only in the broadest terms of advancing and declining. Chart patterns can be classified into the broad groups of:

- Trendlines and channels.
- One-day patterns.
- Continuation patterns.
- Accumulation and distribution (tops and bottoms).
- Retracements.
- Other patterns.

Of these, the most important is the trendline.

The Trend in Retrospect

It is easier to see the trend when looking at a chart after it has occurred. Trying to identify the trend as it is developing is much more difficult. The monthly chart in Figure 3.8 shows a sustained uptrend trend, but there is a slowing of that trend towards the end. Will the upward trend continue? Will prices begin a downward trend? Will they move sideways? The purpose of charting is to apply tools that provide the best chance of identifying, and acting on, the future direction of prices. If wrong, these tools also control the size of the loss.

Figure 3.8: The trend is easier to see after it has occurred. While the upwards trend is clear, are prices going to continue higher, or is this the end of the trend?

The time interval is very important when identifying a trend. Weekly and monthly charts show the major trends more clearly than daily charts. Longer-term charts remove much of the noise that interferes with seeing the bigger picture. Many chartists start by evaluating a weekly or monthly chart, then use the lines and values developed on those charts to create a daily chart. The weekly chart provides direction; the daily chart is used for timing. Remember that the long-term trend is intended to reflect the dominant fundamental direction, the result of economic policy. Short-term traders often use a daily chart for the trend and an hourly, 15-minute chart, or even a tick-chart for trading. Further discussion of this can be found in Chapter 19.

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TRENDLINES

The trendline determines the current direction of price movement, and often identifies at what specific point that direction will change. The trendline is the most popular and recognized tool of chart analysis. Most analysts will agree that *the trend is your friend*.

- An upwards trendline is drawn across the lowest prices in a rising market.
- A downwards trendline is drawn across the highest prices in a declining market.

Figure 3.9 shows a classic downwards trendline, *A*, drawn on a chart of Intel. It connects the highest price of $22 with price peaks at 18, 16.75, and 16.15 before ending at 15.50. When prices move through the trendline heading higher, the downtrend has been penetrated. This may end the downtrend or cause a new downtrend line to be drawn. In this case it was the end of the downtrend.

Figure 3.9: Upwards and downwards trendlines. In this chart of Intel, the downwards trendline is clear and touches four high prices. The upwards trendline needs to be redrawn as prices begin to increase. Alternatively, a single trendline could be drawn that cuts across some of the low prices in order to represent the angle of the upwards trend.

Redrawing Trendlines

Most trendlines are not as long-lived or clear as the downtrend in Intel. The first uptrend line, *B*, is drawn when the first reversal shows a second low point. The upwards trendline *B* is drawn across the lows of points 1 and 2. Although prices do not decline through trendline *B*, rising prices pull back to points 3 and 4, well above the trendline. At that point we choose to redraw the upwards trendline connecting point 2 with 3 and 4, forming what appears to be a stronger trendline. Trendlines are considered more important when they touch more points. However, prices move up faster and we again decide to redraw the trendline connecting points 4 and 5. Trendlines are frequently redrawn as price patterns develop. Care must be taken to draw the lines in a way that touches the most points, although some chart analysts would draw a line that connects points 1 and 5, crossing through points 2, 3, and 4, because the final picture seems to represent the dominant upwards price pattern. This can be seen as the broken line in Figure 3.9.

Support and Resistance Lines

Price movement creates patterns that reflect investors' perception of the current economic situation. Trends result from confidence or concern about the health of business, or the supply and demand of a product. When there is no dominant opinion, prices move sideways in a price range determined by current volatility levels—sometimes wide, sometimes narrow. Because there are always buyers and sellers, prices do not stand still. Investment funds continue to add and withdraw money from the market.

These uncertain periods form a sideways price pattern. The top of this pattern is called the *resistance level* and the bottom is the *support level*. Once established, the support and resistance levels become key to identifying the trend.

A *horizontal support line* is drawn horizontally to the right of the lowest price in a sideways pattern. It is best when drawn through two or more points and may cross above the lowest price if it makes the pattern clear. It represents a firm price level that has withheld market penetration. It may be the most significant of all chart lines. In the chart of gold futures prices (Figure 3.10), the support line is drawn across the bottom of a sideways period, beginning at the bottom on the low price on the left but crossing above the next lowest point. The support line could have been drawn at $200, crossing above the lows of three bars but representing a clear support level.

Figure 3.10: Horizontal support and resistance lines shown on gold futures prices.

A horizontal resistance line serves the same purpose as the support line and is drawn across the highest highs of the sideways interval. It represents the price that resists upwards movement. Resistance lines are not normally as clear as support lines because they are associated with higher volatility which causes erratic price movement. In Figure 3.8 there are two choices for the horizontal resistance line. The most common selection would be the line that begins at point 1 and crosses below the high of point 2. In the same spirit as the support line, a resistance line could have been drawn much lower, crossing above a cluster of highs while penetrating through the bars with tops 1 and 2.

Note the Position of the Closing Price of the Bar

A rule that gives some guidance to support and resistance lines that cross through bars rather than touch the lows, is that the closing prices should be below the resistance line and above the support lines. A price bar that penetrates upwards through resistance but closes lower is considered a failed breakout and confirms the sideways pattern. You may choose to raise the resistance line to the high of that failed bar, but most chartists ignore it, keeping the resistance line at its original position.

Resistance Becomes Support and Support Becomes Resistance

Horizontal support and resistance lines are strong indicators of change. If prices are moving sideways because investors are unsure of direction, then a move through either support or resistance is usually associated with new information that causes investors to act. Whatever the cause, the market interprets this as a new event. Having moved out of the sideways pattern, prices should remain above resistance to confirm the change. If prices have moved higher, then the resistance line becomes a support line. If prices fall below the resistance line, the price move is considered a failed breakout.

A Trendline Is a Support or Resistance Line

The trendlines in Figure 3.8 are also called support and resistance lines. An upwards trendline, drawn across the lows, is a *bullish support line* because it defines the lowest price allowed in order to maintain the upwards trend. The downward trendline, drawn across the highs, is a *bearish resistance line*. These angled trendlines are most reliable when used to identify major price trends. Horizontal lines work well for shorter time frames.

Rules for Trading Using Trendlines

The simplest formations to recognize are the most commonly used and most important: horizontal support and resistance lines, bullish and bearish support and resistance lines, and channels created using those lines. Proper use of these basic lines is essential for identifying the overall direction of the market and understanding the patterns formed as prices move from one level to another. Although charting may be considered a trading system of its own, the price patterns used by chartists have been adapted by computer-oriented analysts and form the basis for automated trading methods. Major chart patterns represent the underlying profitability of chart trading; identifying more complex formations, as we will discuss further, is likely to enhance good performance but rarely compensates for losses resulting from being on the wrong side of the trend.

Once the support and resistance lines have been drawn, a price penetration of those lines creates the basic trend signal (Figure 3.11). The bullish support line defines the upward trend, and the bearish resistance line denotes the downward one. For long-term charts and major trends this is often sufficient. Some traders add the additional rule that once the price has penetrated a trendline, it must remain penetrated for some time period in order to confirm the new trend. Most false penetrations correct quickly.

Figure 3.11: Basic sell and buy signals using trendlines.

Confirming the New Trend Direction

In actual trading, the price crossing the trendline is not as clean as in Figure 3.10. Most often prices that have been moving higher will cross below the trendline, then recross moving higher, then move lower again. The trendline is an important turning point and there may be indecision that is reflected in a sideways price movement before prices reestablish a trend. To deal with this situation, traders may:

- *Wait a set time period* to confirm that prices remain on the new side of the trendline.
- *Wait for a reversal* after the penetration, then enter a trade in the new direction even if the reversal crosses the trendline again.
- *Create a small safety zone* around the trendline and enter the new trade if prices move through the trendline and through the safety zone.

Each of these techniques requires a delay before entering. A delay normally benefits the trader by giving a better entry price; however, if prices fall quickly through an upwards trendline and do not reverse or slow down, then any delay will result in a much worse entry price. Unfortunately, most of the biggest profits result from breakouts that never pull back. Catching only one of these breakouts can compensate for all the small losses due to false signals. Many professional traders may be steady winners, but they do not often profit from the biggest moves.

Trading Rules for Horizontal Support and Resistance Levels

As with angled trendlines, horizontal support and resistance lines show clear points for buying and selling. Also similar to angled trendlines, the horizontal lines become increasingly important when longer time intervals and more points are used to form the lines. The technique for entering trades using horizontal lines is similar to that using angled trendlines; however, the maximum risk of the trade is clearly defined.

- *Buy* when prices move above the horizontal resistance line.
- *Sell* when prices move below the horizontal support line.

Once a long position has been entered, it is not closed out until prices move below the support line. The maximum risk of the trade is the difference between the support and resistance lines. As prices move higher, each swing reversal forms a low from which a new horizontal support line is drawn. After the initial entry, single points are most often used to create the horizontal support and raise the level at which the trade will be closed out. Figure 3.12 shows the pattern of horizontal support and resistance lines as the trade develops.

Figure 3.12: Trading rules for horizontal support and resistance lines.

In Figure 3.12, the initial support and resistance lines are formed based on a sustained sideways period. Each line crosses more than one high or low point. The buy signal occurs when prices move above resistance. Some traders buy immediately when prices move through resistance; others wait to be sure prices close above the resistance line. Once a long position has been entered, the maximum risk is shown as the distance between the support and resistance lines. As prices move higher, they pull back to form relative lows, called *swing lows*.

Once the low is established and prices move higher, a new horizontal support line is drawn. Penetration of this new line is used to exit the trade. Note that the first pullback causes prices to cross below the original resistance line. This is a common occurrence, but the original line no longer holds the importance it had before it was broken. While it should provide support for the pullback (a resistance, once broken, becomes a support), it is more important to record the bottom of the new pullback as the support level. These new support levels need only one point. After the third support level is drawn, prices rally but then fall back through the third level, at which point the long position is closed out. A short position, if any, is not entered until a new sideways price pattern is established and horizontal support and resistance lines can be drawn across more than one point.

Identifying Direction from Consolidation Patterns

It is said that markets move sideways about 80% of the time, which means that sustained directional breakouts do not occur often, or that most breakouts are false and fail to identify a new market direction. Classic accumulation and distribution formations, which occur at long-term lows and highs, attempt to find evolving changes in market sentiment. Because these formations occur only at extremes, and may extend for a long time, they represent the most obvious consolidation of price movement. Even a rounded or saucer-shaped bottom may have a number of false starts. It may seem to turn up in a uniform pattern, then fall back and begin another slow move up. In the long run the pattern looks as if it is a somewhat irregular, but extended, rounded bottom; however, using this pattern to enter a trade in a timely fashion can be disappointing and has resulted in the safe but conservative technique of *averaging in*.

Most other consolidation formations are best viewed in the same way as a simply horizontal sideways pattern, bounded above by a resistance line and below by a support line. If this pattern occurs at reasonably low prices, we can eventually expect a breakout upwards when the fundamentals change. Occasionally prices seem to become less volatile within the sideways pattern, and chartists take this opportunity to redefine the support and resistance levels so that they are narrower. Breakouts based on these more sensitive lines tend to be less reliable because they represent a temporary quiet period inside the normal level of market noise.

Creating a Channel with Trendlines

A *channel* is formed by a trendline and another line drawn parallel to the trendline enclosing a sustained price move. The purpose of the channel is to define the volatility of the price move and establish reasonable entry and exit points. Up to now, the trendline has only been used to identify the major price direction. A long position is entered when the price crosses the trendline moving higher. The trade is held until the price moves below the trendline. However, it is more common to have a series of shorter trades. While the biggest profits come from holding one position throughout a sustained trend, a series of shorter trades each has far less risk and is considered more desirable for the active trader.

Before a channel can be formed, the bullish or bearish trendline must be drawn. A clear uptrend line requires at least two, and preferably three or more major low points on the chart, as shown in Figure 3.13, where points 1, 2, and 3 are used. Once the trendline is drawn, the highest high, point *B*, can be used to draw another line parallel to the upwards trendline. The area in between the two parallel lines is the channel.

Figure 3.13: Trading a price channel. Once the channel has been drawn, buying is done near the support line and selling near the resistance line.

In theory, trading a channel is a simple process. We buy as prices approach the support line (in this case the upwards trendline), and we sell as prices near the resistance line. These buy and sell zones should be approximately the bottom and top 20% of the channel. Because the channel line is used to determine price targets, you might choose to draw the broken line across point *A*. The use of point *A* creates a channel that is narrower than the one formed using the higher point *B*. This allows you to take profits sooner.

If prices continue through the lower trendline after a long position has been set, the trade is exited. The trend direction has changed and a new bearish resistance line, the downward trendline, needs to be drawn using points *B* and *C*. Once the first pull-back occurs leaving a low at point 4, a parallel line is drawn crossing point 4, forming the downward channel shown in Figure 3.14. In a downward trending channel it is best to sell short in the upper zone and cover the short in the lower zone. Buying in the lower zone is not recommended; trades should always be in the direction of the trend.

Figure 3.14: Turning from an upwards to a downward channel. Trades are always entered in the direction of the trend.

When horizontal support and resistance lines are relatively horizontal, or sideways, the channel is called a *trading range*. There is no directional bias in a trading range; therefore, you can enter new long positions in the support zone and enter new shorts in the sell zone. In both cases, penetration of either the support or resistance lines forces liquidation of the trade.

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ONE-DAY PATTERNS

The easiest of all chart patterns to recognize occur in one day. They include gaps, spikes, island reversals, reversal days, inside days, outside days, wide-ranging days, and, to a lesser extent, thrust days. Some of these patterns are important at the moment they occur and others must be combined with other factors.

Gaps

Price *gaps* occur when important news influences the market and there is no trading because the exchange is closed. An *upwards gap* exists when the low of the current day is higher than the high of the previous day. If all trading were 24 hours, then we would see a fast, volatile move, but not a gap. For example, there are three popular ways to trade the S&P 500 index, as futures, traded in the Chicago Mercantile Exchange pit from 8:30 AM to 3:15 PM (Central time). You could also trade the Spyders (SPY) on the AMEX during the same hours, or you could trade the electronic S&P mini-futures contract which trades nonstop from Sunday evening at 6 PM until Friday afternoon at 3:15 PM.

Economic reports are released by the government at 7:30 AM (Central time); therefore, they occur before the S&P pit trading and the Spyders begin trading, but during the electronic S&P e-mini session. There is no gap in electronic trading but the other markets will open sharply higher or lower to adjust to the current e-mini price. This creates frequent opening gaps in those markets.

Gaps can also occur because of a large cluster of orders placed at the point where the stock or futures market is about to open. A large number of buy stop orders and very few sellers will cause the price to jump. It is possible to have a gap during the trading session, immediately following an economic report, or concurrent with a news release of consequence. The events of September 11, 2001, are an extreme example.

In charting, gaps are interpreted differently when they occur within special price patterns. In some cases a gap signals a continued move and in other situations it is expected to be the end of a price move. The four primary gap formations are shown on a chart of Amazon.com in Figure 3.15. They are:

1. The *common gap*, which appears as a space on a chart and has no particular attributes—that is, it does not occur at a point associated with any particular significance. A common gap appears in May 1999 during a downward move.

2. A *breakaway gap* occurs at a point of clear resistance or support. It occurs when there are a large number of buy orders just above a major resistance line, or sell orders below a support line. Most often this is seen after a prolonged period of sideways price movement when most chartists can draw the same horizontal support and resistance lines. The clearer the formation, and the longer the sideways period, the more likely it is that there will be a large breakaway gap. The term "breakaway" requires some hind-sight because it is applied only when the gap results in a continued price move.

   There are two breakaway gaps in Figure 3.15, the first shortly after prices make a new high, the second in the middle of the chart when prices break upwards through a steep downward trendline, and the last near the right of the chart when prices gap through a clear downwards trendline.

   In order to trade a gap, a position must be entered in advance of the gap, as prices approach the support or resistance level. Once a long position is set and prices "gap up" you gain *free exposure*, which is the profit caused by the gap or by a fast market move in your favor. If prices do not gap up they most often drift lower. The position can be exited with a small loss and reentered later.

3. An *exhaustion gap* occurs at the end of a sustained and volatile price move and confirms the reversal. Exhaustion gaps usually occur on the day after the highest price of the upwards move; however, in the Amazon chart it is one day later. Because it signifies a clustering of orders anxious to exit the long side, it has all the signs of being an exhaustion gap.

4. A *runaway gap* occurs at different points during a clear trend and confirms the trend. It does not appear to have any practical use because the trend can stop and reverse just after a runaway gap and it will be renamed an *island top*, or some other formation. When holding a long position, an upwards runaway gap quickly adds profits, but also signifies extreme risk.

Figure 3.15: Price gaps shown on a chart of Amazon.com.

Gaps can also be a hindrance to trading. A long position held when a downward breakaway gap occurs, nearly guarantees that any stop-loss order is executed far away from the order price. If the upwards breakaway gap occurs on light volume, it may be a false breakout. If a short is held, and if you are lucky, prices will fall back to the breakout level and then continue lower. If unlucky, you will be executed at the high of the move. In the final analysis, if the gap breakout represents a major change, a trade should be entered immediately *at the market.* The poor executions will be offset by a single time when prices move quickly and no pullback occurs. A breakaway gap on high volume is usually indicative of a strong move and a sustained change.

Filling the Gap

Tradition states that prices will retrace to *fill the gap* that occurred sometime earlier. Naturally, given enough time, prices will return to most levels; therefore, nearly all gaps will eventually be filled. The most important gaps are not filled for some time.

There is no doubt that the gap represents an important point at which prices move out of their previous pattern and begin a new phase. The breakaway gap will often occur just above the previous normal, or established, price level. With commodities, once the short-term demand situation has passed, prices should return to near-normal (perhaps slightly above the old prices), but also slightly below the gap. When a stock price gaps higher based on earnings, a new product announcement, or a rumor of an acquisition, the price may not return to the previous level in the near future.

A computer study of opening gaps, and a program that performs the study, can be found in Chapter 15. It shows the probabilities of subsequent price moves following gaps, based on different-sized gaps, in a wide selection of markets.

Trading Rules for Gaps

- A common gap is small and occurs with low volume and for no specific reason; that is, it is not the result of an obvious, surprising news release. Active traders will take a position counter to the direction of the gap, expecting the move to reverse and fill the gap, at which point they will take profits. If the gap is not filled within a few days, the trade is liquidated.
- A breakaway gap is the result of bunched orders at an obvious support or resistance area. When a clear sideways pattern has developed, place a buy order just under the resistance level in order to benefit from the jump in prices (free exposure) when the breakout occurs. If a gap occurs on the breakout, then prices should continue higher.
- A runaway gap is often found in the middle of a significant move. It is considered a good point to add to your position because the runaway gap confirms the move and offers additional potential profits.
- An exhaustion gap is best traded as it is being filled and, even at that stage, it is highly risky. Sell during the move upwards, placing a stop above the previous high of the move. If this pattern fails, prices could move higher in an explosive pattern. If you are successive, profits could also be large.

Spikes

A *spike* is a single, highly volatile day where the price moves much higher or lower than it has in the recent past. A spike can only be recognized one day later because the following day must be much lower. It is easiest to show spikes in markets, such as U.S. 30-year Treasury bonds, that respond to frequent economic reports. In Figure 3.16 there is a series of three spikes about four weeks apart.

Figure 3.16: A series of spikes in bonds. From June through October 2002, U.S. bonds show three spikes that represent local tops. The spikes represent clear resistance levels that cause a unique pattern in the upwards move.

An upward spike, as shown in Figure 3.16, represents a local top. It could not be any other way because a spike is a day with above-average volatility and must be bracketed by two lower days. In all three cases shown, the spike represented the high price for at least one week. Because the spike is a clear top, when prices begin to rise again they usually meet resistance at the top of the spike. Chartists draw a horizontal resistance line using the high price of the spike, which encourages selling at that level. After each spike the chart is marked with "failed test," showing the price level where resistance, based on the previous spike, slowed the advance. The spike did not stop the trend, but it did cause a unique pattern.

Quantifying Spikes

A spike has only one dominant feature: a price high or low much higher or lower than recent prices. This must result in volatility that is equally extreme. The easiest way to identify an upside spike is to compare the trading range on the day of the spike to previous ranges and to the subsequent day. This can be programmed in TradeStation by using the *true range* function and satisfying the conditions that the high on the day of the spike is greater than the previous and subsequent highs by the amount of *K* × *average true range* over *n* days,

```
spike = high[1] - highest(high,n)[2] > k*average(truerange,n)[2] and
          high[1] - high > k*average(truerange,n)[2]
```

In this code, *spike* is a logical variable (true-false). A spike that occurs yesterday (where [1] indicates yesterday) is tested to see that the high of the spike is greater than the high of the previous *n* days, greater than the average true range of the same *n* days by a factor of *k*, and also greater than the high of today by the same factor *k.* Note that the use of [2] is to end the true range calculation on the day before the spike. The value of *k* should be greater than .75. Spikes satisfying *k* > 1 are more desirable but less frequent.

Island Reversals

An *island reversal* or an *island top* is a single price bar, or group of bars, sitting at the top of a price move and isolated by a gap on both sides, before and after the island formation. Combined with high volatility, this formation has the reputation of being a major turning point. The gap on the right side of the island top can be considered an exhaustion gap. In Figure 3.17, showing AMR during the first part of 2003, there is one island reversal in mid-April. This single, volatile day has a low that is higher than both the previous day and the following day. It remains the high for the next week but eventually gives way to another volatile price rise. *Island bottoms* also occur, but are less frequent.

Figure 3.17: AMR in early 2003 showing a classic island reversal with examples of other one-day patterns.

Pivot Point Reversals and Swings

A *pivot point* is a trading day, or price bar, that is higher or lower than the bars that come before and after. If the entire bar is above the previous day and the following day, the pivot point reversal is the same as the island reversal. If it is a very volatile upwards day but the low price is not above the high of the surrounding bars, then it is a spike. If it is not a volatile day, then it is a weaker form of a spike. If you were plotting swing highs and lows, the high of an upwards pivot point reversal day would often become the swing high. Some chartists will locate a *swing high* by comparing the high of any day with two or more days before and after. This is the method used in TradeStation's "Swing High Bar" function. The patterns of the days on either side of the high bar are not important as long as the middle bar has the highest high. When more days are used to identify pivot points these reversals are expected to be more significant; however, they take longer to identify.

According to tests by Colby and Meyers,[9] entries that occur based on a breakout of the highs or lows of the pivot points, called *pivot point channels*, are much more reliable than simply entering in the direction of the reversal based on the close of the last bar of the pivot point formation. For traders not interested in this very short-term strategy, a pivot point may help entry timing for any longer term method.

More recently, Colby[10] tested a *Pivot Point Reverse Trading System*, using the following rules:

- *Buy* (and close out short positions) when a pivot point bottom occurs and the close is higher than the previous close.
- *Sell* (and close out long positions) when a pivot point top occurs and the close is lower than the previous close.

Applying these rules to the Dow Jones Industrials (DJIA) for 101 years ending December 2000 showed nearly 7,000 trades (70 per year) with significant profits.

Cups and Caps

Another name given to the pivot point reversals are *cups* and *caps*, each determined by only three price bars. These two formations are associated with trading rules that are identical to pivot point channels applied to the shortest time frame. Contrary to their names, a cup formation identifies a sell signal when the trend is up, while a cap is a setup for a buy signal in a downtrend. Once an uptrend is clear, a cup formation is found using either the daily closes or daily lows. For any three consecutive days, the middle day must have the lowest close or the lowest low. In a cap pattern, the middle day must have the highest high or the highest close of the 3-day cluster. In both cases, the positioning of the highs and lows of the other two days are not important as long as the middle day is lower for the cup and higher for the cap.

The cup will generate a sell signal if:

- The cup formation is the highest point of the uptrend;
- The sell signal occurs within three days of the cup formation; and
- The current price closes below the lowest low (middle bar) of the cup formation.

The signal is false if prices reverse and close above the high of the cup formation, resuming the previous trend. This pattern is only expected to forecast a downward price move of two days; however, every change of direction must start somewhere and this formation could offer an edge. A cap formation is

traded with the opposite rules.

Reversal Days and Key Reversal Days

A day in which there is a new high followed by a lower close is a *downwards reversal day*. An *upwards reversal day* is a new low followed by a higher close. A reversal day is a common formation, as seen in Figure 3.18, the Russell 2000 futures. Some of these days are identified; however, you can find many other examples in Figures 3.15 through 3.18. There have been many studies to determine the importance of reversal days for trading, but these are inconclusive. In Chapter 15 there is a detailed study of reversal days, indicating the likelihood of a subsequent price move based on this reversal pattern and other combinations. A reversal day by itself is not significant unless it can be put into context with a larger price pattern, such as a clear trend with sharply increasing volatility, or a reversal that occurs at the highest or lowest price of the past few weeks.

Figure 3.18: Russell 2000 during the last half of 2002 showing reversal days, key reversal days, inside days, and outside day.

Key Reversals

A *key reversal day* is a more selective pattern, and has been endowed with great forecasting power. It is also called an *outside reversal day*, and is a weaker form of an island reversal. A bearish key reversal is formed in one day by first making a new high in an upward trend, reversing to make a low that is lower than the previous low, and then closing below the previous close. Examples of key reversal days can be seen in Figures 3.16 and 3.17. It is considered more reliable when the prior trend is well-established.

As with reversal days, studies have shown mixed results using the key reversal as a sole trading indicator. The most complete analysis,[11] similar to others, concluded that the performance was "strikingly unimpressive." Even though tests have not proved its importance, traders still pay close attention to key reversals. Because this pattern has kept its importance, we can conclude that other factors unconsciously enter into the selection of key reversal days for trading. A successful trader's senses should not be underestimated; the extent and speed of the prior trend, a change in liquidity, a quieter market *tone*, or some external news may be essential in confirming the important reversals. The job of a system developer is to find those factors that will turn this pattern into a successful indicator. The best place to start is by assuming the attitude of those traders who see a reversal day as an important pattern. As noted earlier, a comprehensive study of reversal days and other patterns can be found in Chapter 15.

The chart in Figure 3.16 shows a number of reversal days during the rapid drop of the Russell 2000 in January 2002. Three patterns of particular interest are the reversal days at the two extreme lows in July and October, 2002, and the high in between, during August. Although there are many other reversal days embedded within other parts of the price move, the reversals off the lows are clearly at higher volatility than most other days, and follow very sharp, accelerating price drops. The reversal day that ends the intermediate high during August does not share these attributes; however, it tops a pattern that is not the dominant trend, but an upwards reaction within a previous sustained downtrend. If we focus on the characteristics of those reversal days that mark price extremes, rather than all reversal days, we should expect successful results.

Programming Key Reversal Days

A key reversal day can be recognized and tested using a computer program. In TradeStation's EasyLanguage the instructions are

```
KeyReversalDown = 0;
if close[1] > overage(close[1],n) and high >= highest(high[1],n) and
      low < low[1] and close < close[1] then KeyReversalDown = 1;
```

where the first term tests for an uptrend over *n*-days, the second term tests that this day is the highest price of the same *n*-days, the third term verifies that a lower low has occurred, and the last term tests for a lower close.

Two-Bar Reversal Patterns

Martin Pring[12] has called attention to a special two-bar reversal pattern that frequently precedes a strong directional change. This pattern consists of two days that are essentially the mirror image of one another. Consider a market in which prices have been moving steadily higher. The first day of the pattern shows a volatile upwards move with prices opening near the lows and closing near the highs. On the following day, prices open where they had closed, trade slightly higher (nearly matching the previous day's highs), then fall sharply to close near the lows, giving back all of the previous day's move.

Following the two-bar reversal to the downside, the next few days should not trade above the midpoint of the reversal pattern. The smaller the retracement, the more likely there will be a good sell-off.

It is easy to explain the psychology of this pattern. The first bar represents the strong bullish feeling of the buyers, while the second bar is seen as complete discouragement at the inability to follow through to even higher levels. It will take some days before traders are willing to test the highs again. More traders may view this as a potential major reversal. High volume can confirm the reversal. The nature of the move to follow depends on the extent of the previous trend and the volatility. Four key factors in predicting a strong reversal are:

1. Stronger preceding trends.
2. Wider, more volatile two-bar patterns.
3. Greater volume than in previous days.
4. Smaller retracements following the two-bar pattern.

Wide-Ranging Days, Inside Days, and Outside Days

Wide-ranging days and *outside days* are typical of higher volatility. A wide-ranging day is a day of much higher volatility than recent days. An outside day must have both a higher high and lower low than the previous day. Inside days are an example of *volatility compression.* All three patterns are very common but indicate that something special has happened. Examples of these patterns are shown in Figure 3.19, a 1-year, active trading period for Tyco ending in July 2000, before any accounting scandal surfaced.

Figure 3.19: Wide-ranging days, outside days, and inside days for Tyco.

Wide-Ranging Days

A *wide-ranging day* is likely to be the result of a price shock, unexpected news, or a breakout in which many orders trigger one another, causing a large increase in volatility. A wide-ranging day could turn out to be a spike or an island reversal. Because very high volatility cannot be sustained, we can expect that a wide-ranging day will be followed by a reversal, or at least a pause. When a wide-ranging day occurs, the direction of the close (if the close is near the high or low) is a strong indication of the continued direction.

Outside Days

An *outside day* often precedes a reversal. An outside day can also be a wide-ranging day if the volatility is high, but when volatility is low and the size of the bar is slightly longer than the previous bar, it provides a weak signal. As with so many other chart patterns, if one day has an unusually small trading range, followed by an outside day of normal volatility, there is very little information in the pattern. Selection is important.

Inside Days

An *inside day* is one where the high is lower than the previous high and the low is higher than the previous low. That is, an inside day is one where both the highs and lows are inside the previous day's trading range.

An inside day represents consolidation, or lower volatility. In turn, lower volatility is most often associated with the end of a price move. After a burst of activity and a surge of upward direction, prices have reached a point where the buyers are already in and the price has moved too far to attract more buyers. Volume drops, volatility drops, and we see an inside day. An inside day is often followed by a change of direction, but that is not guaranteed. We only know that the event that drove prices up is now over. If more news surfaces to ignite prices, the next move could just as easily be up.

In Figure 3.19 there are two inside days at the price peak on the top left of the Tyco chart. The first inside day is followed by a small move lower, then a small move higher, followed by another inside day. This last inside day precedes a major sell-off. On the right top of the chart there are two inside days immediately before another sharp drop.

For those readers interested in these patterns, a quantitative study of wide-ranging, inside days, and outside days can be found in Chapter 15.

Some Notes about One-Day Patterns

One-day patterns are very common; therefore, traders tend to be selective about when they are used. Taken as a group, patterns that are repeated frequently are less reliable and need to be combined with other patterns. Those that occur during periods of low volatility or low volume will also be less dependable.

While a reversal day is clearly a 1-day formation and can be identified at the end of the trading day, and an opening gap is recognized at the moment, most other 1-day patterns occur on one day, but are not clear until the day after. An upwards spike and a downwards pivot point reversal both require the high of the next day to be much lower than the high of the spike or pivot day; and the island reversal must show a gap on the following day. Although they cannot be used at the end of the day on which they occur, these formations are reasonably timely for an active trader.

[9]Tests of pivot point reversals and pivot point channels can be found in Robert W. Colby and Thomas A. Meyers, *The Encyclopedia of Technical Market Indicators* (Dow Jones-Irwin, 1988).

[10]Robert W. Colby, *The Encyclopedia of Technical Market Indicators* (McGraw-Hill, 2003, pp. 510-514).

[11]Eric Evans, "Why You Can't Rely on 'Key Reversal Days,'" *Futures* (March 1985).

[12]Martin Pring, "Twice as Nice: The Two-Bar Reversal Pattern," *Active Trader* (March 2003).

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CONTINUATION PATTERNS

Continuation patterns occur during a trend and help to explain the stage of development of the trend. *A continuation pattern that occurs within a long-term trend is expected to be resolved by continuing in the direction of the trend.* If prices fail to move in the direction of the trend following a major continuation pattern, then the trend is considered over. The primary continuation patterns are triangles, flags, pennants, and wedges. The larger formations of these patterns are more important than the smaller ones.

Symmetric, Descending, and Ascending Triangles

Triangles tend to be larger formations that occur throughout a trend. A *symmetric triangle* is most likely to occur at the beginning of a trend when there is greater uncertainty about direction. A symmetric triangle (see Figure 3.20) is formed by a price consolidation, where uncertainty of buyers and sellers results in decreasing volatility in such a way that prices narrow to the center of the previous trading range. In Figure 3.20 the symmetric triangle is formed at about the level of the previous support. The breakout from a symmetric triangle often marks the beginning of a longer-term trend.

Figure 3.20: Horizontal support and resistance lines shown on gold futures prices.

Formation of a Descending Triangle

Even during a clear downward trend, prices will rally. Because the trend is clear, sellers are anxious to step in and sell these upwards moves, looking for the trend to continue. The top of this mid-trend rally is likely to be the last support point where prices broke out of a previous pattern. In Figure 3.18 the top of the first descending triangle comes very close to the breakout level of the symmetric triangle, and the larger descending triangle towards the lower right of the chart has its high right at the breakout of another descending triangle.

The recent lows of the new trend form a temporary support level and prices may bounce off that level while short-term traders play for small profits. This action forms a descending triangle. As more traders are convinced that prices are still heading lower, rallies off the support level are sold sooner, causing a narrower pattern, until prices finally break below support. The *descending triangle* is complete. In an upwards trend an *ascending triangle* would be formed.

Size of the Triangles

A triangle should take no less than two weeks to form; however, they can span a much longer period, occasionally up to three months. Larger formations represent periods of greater uncertainty. They may be followed by another symmetric triangle, again indicating that traders are undecided about direction. If the symmetric triangle is resolved in the current trend direction, the trend is in full force, and a large price move is expected.

Triangles can be consistent indicators of investor confidence. Because they reflect human behavior they are not always perfect in appearance and not always

consistent in pattern. It takes experience to identify the formation in a timely manner.

Flags

A *flag* is a smaller pattern than a triangle, generally less than three months for the long-term trader, and is formed by a correction in a bull market or a rally in a bear market. A flag is a congestion area that leans away from the direction of the trend and typically can be isolated by drawing parallel lines across the top and bottom of the formation. At the beginning of a trend the flags may not lean away from the direction of the new trend as clearly as during a well-established trend. If the first flag after an upwards breakout leans down, it confirms the new upwards trend.

Figure 3.21 shows an assortment of triangles, flags, and pennants. There are two small flags, one in the middle of the chart and one in the lower right, each leaning upwards as expected in a downtrend. A larger flag slightly below center could also have been a symmetric triangle. Both patterns are resolved by a continuation of the trend.

Figure 3.21: An assortment of continuation patterns. All of these patterns are resolved by prices moving lower. A downward pennant can be found in the middle of the chart.

Pennants

Pennants are irregular triangles normally leaning towards the trend, similar to a descending triangle in a downtrend but without a horizontal support line. A typical pennant can be seen in the middle of Figure 3.19. During a sustained trend, triangles are large, clear formations, with horizontal support or resistance lines, while pennants are consolidation formations requiring only that the lines converge. They usually lean towards the trend but that is not a requirement. A larger pennant should lean in the direction of the trend in a manner similar to a descending triangle; however, a small pennant may serve the same purpose as a flag and lean away from the trend.

Wedges

A pattern that looks as if it is a large pennant, with both sides angling in the same direction, but does not come to a point, is a *wedge*. In an upwards-trending market the wedge should be rising as shown on the right side of the General Electric chart, Figure 3.22, near the end of 1999. The earlier wedge has nearly a horizontal upper line, bridging the pattern between a wedge and a rising triangle. A rising wedge is formed in the same way as an ascending triangle. Investors, convinced that the share price will rise, will buy smaller and smaller reversals even as prices make new highs. In the end, prices continue in the direction of the trend. In a typical rising wedge the lower line has a steeper angle than the upper line.

Figure 3.22: Wedge. A weaker wedge formation is followed by a strong rising wedge near the end of 1999 in this chart of General Electric.

The angle of the wedge should be steeper as the trend becomes clear. The earlier wedge formation shown in Figure 3.22 is nearly symmetric. If we study the bigger picture, we can see that the uncertainty at the beginning of the trend is reflected in the symmetric formation, while the rising wedge occurs after the trend is well established and investors can anticipate a continuation.

Run Days

Triangles, flags, pennants, and wedges represent the best of the continuation patterns. They can be identified clearly while they are still being formed and the direction of the breakout can be anticipated and traded. Other formations, such as *run days*, are not as timely. A run day occurs when the low of that day is higher than the previous *n* days, and the high of the day is lower than the subsequent *n* highs. When it occurs, this pattern confirms that a trend is in effect. The more days used to define the run day, the stronger the pattern. Therefore, a 5-day run day requires 11 days to identify, 5 before the run day and 5 after. Unlike the other continuation patterns, which have a breakout level that can be used as a trading signal, entering a long position after 11 days of a strong upwards move is not likely to be a desirable entry point. There are no trading rules or trading action associated with run days. They simply confirm what you have already seen on charts—that prices have been trending.

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BASIC CONCEPTS IN CHART TRADING

Having covered some of the fundamental chart patterns, there are some additional concepts that should be discussed in order to keep the proper perspective. Charting involves a great deal of subjective pattern identification; therefore, there may be a choice of patterns within the same time interval. There are also many cases where prices nearly form a pattern, but the shape does not fit perfectly into the classic definition.

Major and Minor Formations

Throughout the study of charting, it is important to remember that the same patterns appear in short- as well as long-term charts. An upwards trendline can be drawn across the bottom of a price move that only began last week, or it can encompass a sustained three-year trend in the financial markets, or a six-month move in Amazon.com. In general, formations that occur over longer time intervals are more significant. All-time highs and lows, well-defined trading ranges, trendlines based on weekly charts, and head-and-shoulder formations are carefully watched by traders. Obscure patterns and new formations are not of interest to most chartists, and cannot be resolved successfully unless traders buy and sell at the right points. Charting is most successful when formations are easy to see; therefore, the buy and sell points are likely to attract a large number of orders.

Market Noise

All markets have a normal level of noise. The stock index markets have the greatest amount of irregular movement due its extensive participation, the high level of anticipation built into the prices, and because it is an index. This is contrasted to short-term interest rates, such as Eurodollars, which have large participation but little anticipation and a strong tie to the underlying cash market. In comparison, the effect of news on long-term rates, such as 10-year notes and 30-year bonds, cannot be as clear; therefore, speculation causes greater price fluctuations and movement away from the cash market. The normal level of noise can be seen as the consistent daily or weekly trading range on a chart of the Dow or S&P. When volatility declines below the normal level of noise, the market is experiencing short-term inactivity. An increase in volatility back to normal levels of noise should not be confused with a breakout.

This same situation can be applied to a triangular formation, which has traditionally been interpreted as a consolidation, or a pause, within a trend. This pattern often follows a fast price change and represents a short period of declining volatility. If volatility declines in a consistent fashion it appears as a triangle; however, if the point of the triangle is smaller than the normal level of market noise, then a breakout from this point is likely to restore price movement to a range typical of noise, resulting in a flag or pennant formation. Both of these latter patterns have uniform height that can include a normal level of noise.

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ACCUMULATION AND DISTRIBUTION—BOTTOMS AND TOPS

Most of the effort in charting, and the largest payout in trading, goes into the identification of tops and bottoms. For long-term traders, those trying to take advantage of bull and bear markets, many of these formations can unfold over fairly long periods. These prolonged phases, which represent the cyclic movement in the economy, are called *accumulation* when prices are low and investors slowly buy into their position, and *distribution* at the top, where the invested positions are sold off.

The same formations can occur over shorter periods and are very popular among all traders. As mentioned in the previous section, shorter patterns are not as reliable; nevertheless, they are actively traded. There are many top and bottom formations that are popular and easily recognized. In order of increasing complexity, they are the V-top or V-bottom, the double or triple top or bottom, the common rounded top or bottom, the broadening top or bottom, the head-and-shoulders formation, and the complex top or bottom.

V-Tops and *V*-Bottoms

The V-*top* (actually an inverted "V"), which may also have a spike on the final day, is the easiest pattern to see afterwards, but the most difficult top formation to anticipate and trade. There have been times, such as in 1974, 1980, and 2000, when the frequency of *V*-tops were deceiving. *V*-tops are preceded by critical shortage and demand and magnified by constant new coverage. In 1974, it was a combination of domestic crop shortage, severe pressure on the U.S. dollar abroad, and foreign purchases of U.S. grain that combined to draw public attention to a potential shortage in wheat. The news was so well publicized that novice commodity traders withdrew their funds from their declining stock portfolios and bought any commodity available as a hedge against inflation.

It could not continue for long. When the top came in soybeans, silver, and most other commodities, there was no trading for days in locked-limit markets; paper profits dwindled faster than they were made, and the latecomers found their investments unrecoverable. The public often seems to enter at the wrong time. The case of cattle is an example.

Live cattle prices are based on a combination of consumer demand, substitute foods, current health news, and the price of various feed grains. During 1973 as the price of feed increased, cattle prices rose steadily from under 40¢ per pound to almost 54¢ in August. Prior to that, live beef prices had never been over 37¢ (in 1952). The price of soybean meal, used as a high-protein feed, continued to move prices higher. How high could it go? Between August and October, live-cattle prices formed a V-top and declined back to under 40¢, giving up the eight-month gain in two months. How could the supply and demand factors change so quickly? They can't. Speculation drives prices well beyond their reasonable levels. Fast rises are always followed by fast, usually extensive declines.

The most recent and perhaps the most dramatic of all price moves was the technology bubble of the 1990s, ending with a peak in the Nasdaq index during March 2000. As you can see in Figure 3.23, prices rose faster near the end of the bull market, then collapsed just as quickly. It would have been reasonable to expect the move up to end any time after prices penetrated through 3,000, and difficult to expect them to reach 5,000.

Figure 3.23: A V-top in the Nasdaq index, March 2000.

The psychology of the runaway market is fascinating. In some way, every *V*-top shares a similarity with the examples in Mackay's *Extraordinary Popular Delusions and the Madness of Crowds*. With beef, the consumers do not tend to consider pork, fowl, or fish as an adequate substitute and will accept increased costs longer than expected. As prices neared the top, the following changes occurred:

- The cost became an increasing factor in the standard household budget.
- Rising prices received more publicity.
- Movements for public beef boycotts began.
- Grain prices declined due to the new harvest.

This becomes a matter explained by the *Elastic Theory*. It can be applied to the 1973 soybean and 1980 silver markets as well. The Elastic Theory is based on the principle that when prices get high enough, four phenomena occur:

1. Previously higher-priced substitutes become practical (synthetics for cotton, reclaimed silver).
2. Competition becomes more feasible (corn sweetener as a sugar substitute, alternate energy).
3. Inactive operations start up (Southwest gold mines, marginal production of oil).
4. Consumers avoid the products (beef, bacon, silver).

Consequently, the demand suddenly disappears (the same conclusion arrived at by economists).

Announcements of additional production, more acreage, new products, boycotts, and a cancellation of orders all coming at once cause highly inflated prices to reverse sharply. These factors form a *V*-top that is impossible to anticipate with reasonable risk. There is a natural reluctance to cash in on profits while they are still increasing every day. The situation becomes even more perilous at the end of the move when more investors join the party. These latecomers who entered their most recent positions near the top will show a loss immediately and will need to get out of the trade first; they cannot afford a continued adverse move. Once a reversal day is recognized, there is a mad rush to liquidate. The large number of investors and speculators trying to exit at the same time causes the sharpness in the *V*-top and extends the drop in prices. There is a liquidity void at many points during the decline where there are no buyers and a long line of sellers. A *V*-top or *V*-bottom is always accompanied by high volatility and usually high volume. When the *V*-top is particularly extreme and afterwards it is seen as the high price for some time, it is commonly called a *blow-off*. A true *V*-top or *V*-bottom should become an important medium- or long-term high or low for that market.

Two *V*-Tops in Amazon.com

There is a classic *V*-top in Amazon.com during January 1999, shown in Figure 3.24, and another potential, smaller formation in April. This second one looked as though it was a *V*-top for two days, then quickly disappeared into a broader formation of no particular pattern. A V-top cannot be recognized after only a 1-day downturn. The final peak seen in Amazon in late April 1999 is broader than a classic *V*-top but could still be labeled with the same name.

Figure 3.24: Classic *V*-top in Amazon, January 1999, and two other tops.

When trading, you would expect rising prices to fail when they approach the level of a previous clear *V*-top, which forms significant resistance. In Figure 3.24, where prices began the second *V*-top, declined for two days, rallied for the next three days, then dropped sharply for 2 days, we would normally expect a further decline. In this case, prices made another attempt to break the highs, succeeded, then collapsed. After the last peak, it will be necessary to wait until the price falls below the support level at $75 in order to confirm the downward break, having been fooled on the previous move.

V-Bottoms

V-bottoms are much less common than their upside counterparts. They occur more often in commodity markets where supply and demand can change dramatically and leverage causes surges of buying and selling. Both *V*-tops and *V*-bottoms should be read as a sign that prices have gone too far, too fast. Both buyers and sellers need time to reevaluate the fundamentals to decide where prices should be. *V*-bottoms are usually followed by a rebound and then a period of sideways movement. Two good examples can be found in the crude oil chart, Figure 3.25.

Figure 3.25: Two V-bottoms in crude oil.

Double and Triple Tops and Bottoms

The experienced trader is most successful when prices are testing a major support or resistance level, especially an all-time high in a stock, or a contract or seasonal high or low in futures. The more often those levels are tested, the clearer they become and the less likely prices will break through to a new level without additional fuel. This fuel comes in the form of higher earnings or a change in the fundamental supply and demand factors.

A *double top* is a price peak followed, a few days or weeks later, by another peak, and stopping very close to the same level. A *double bottom*, more common than a double top, occurs when two price valleys show lows at nearly the same level. Because prices are more likely to settle for a while at a lower price than a high one, prices often test a previous support level causing a double bottom.

Tops and bottoms occur at the same level because traders believe that the same reason that caused prices to fail to go higher the first time will be the reason they fail the second time. At some extreme price level this is true, and at other levels there is enough selling to cause prices to stop their rise—at least temporarily. Very high or low prices are the result of speculation rather than the fundamentals of the business or by the supply and demand numbers. In the same way that some stocks will trade at price/earnings ratios far above any rational assessment of business prospects in the near future, commodity prices can be pushed to extremes by crowd psychology without regard to value. Traders, looking for a place to sell an unreasonably high price, target the previous point where prices failed. As prices move higher to test that level, increased speculative selling causes the buyers to realize that something is wrong, and they back away from the market causing prices to drop, forming a double top.

Although a classic double top is thought to peak at exactly the same price, selling in anticipation of the test of the top may cause the second peak to be lower than the first. Figure 3.26 shows one type of double top in crude oil. While some double tops are two sharp peaks, this one looks as though it was gathering energy. It penetrated slightly above the previous high, but could not sustain higher prices. Double tops are rarely perfect.

Figure 3.26: A double top in crude oil.

Double Bottoms

Bottoms are more orderly than tops. They should be quiet rather than volatile. They are caused by prices reaching a level that is low enough for the normal investor to recognize that there is little additional downside potential. Economists might call this the *point of equilibrium*. Neither buyers nor sellers are convinced that prices will continue to move lower. They wait for further news.

Double bottoms will often test the same price level because large position traders accumulate more stock, or increase their futures position, each time the price falls to their target level. Once prices are low there is less chance of absolute loss. Selling a double top can be very risky. The greatest risk when buying a double bottom is that your timing is wrong. If prices do not rally soon, you have used your capital poorly.

Cisco shows a double bottom in Figure 3.27, although it lacks the clear decline in volatility that we would like to see, and that accompanies commodities when they reach a price level near the cost of production. The small spikes down show four attempts to go lower, followed by a faster move up. When prices cross above the highs formed between the two bottom patterns, we have a completion, or *confirmation*, of the double bottom.

Figure 3.27: A double bottom in Cisco.

Traders will start to buy a double bottom when prices slow near previous low levels. They will also look for declining volume or confirmation in the stock price of another related company. Waiting for the breakout above the highs of the bottom formation is a safer signal for a conservative trader, but lost opportunity for a more active one.

Triple Tops and Bottoms

Triple tops and *triple bottoms* are considerably less common than double tops and bottoms; however, of the two, bottoms can be found more readily. Figure 3.28 shows a classic triple top in natural gas. A triple top can be formed from a *V*-top, but in this case, the first peak is an island reversal, the second is a spike, and the third an extended top that ends the move.

Figure 3.28: Natural gas shows a classic triple top.

If we did not have the advantage of seeing the triple top afterwards, each of the individual tops would look as if it were the end of the move. After the first island reversal prices dropped $2; after the second peak there was another large gap down and a one-day loss of more than $1. High volatility is normally associated with an extreme top. By waiting for a confirmation of a decline after the single or double top, the trade would have been entered $1.50 to $2.50 below the top, and that position would be held while prices reversed to test the highs. Selling tops is risky business.

A triple bottom that can be traded is most likely to occur at low prices and low volatility, much the same as a double bottom. They show an inability to go lower because investors are willing to accumulate a position at a good value.

The Danger of Trading Double and Triple Tops

There are many examples of double tops and a smaller number of triple tops. Ideally, there is a lot of money to be made by selling tops at the right place. However, the likelihood of this good fortune happening is less than it appears. Consider why a triple top is so rare. It is because prices continue higher and the potential triple top disappears into a strong bull market pattern.

This happens even more often with double tops. Every time a price pulls back from new highs, then starts moving up again, there is a potential double top. In a prolonged bull market, many double tops disappear in the move higher. Selection of the double top becomes important. This is done using volume, volatility, support and resistance, and sometimes common sense. These confirming indicators are discussed throughout this book. Until then, it is important to recognize the difficulty of deciding whether the current pattern will be a single, double, or triple top, or simply a pause in a bull market.

As with other chart patterns, declining volume would be a welcome confirmation after the formation of the first top and would accompany each additional test of the top.

Extended Rectangle Bottom

Many of the important chart formations can be traded using a penetration of one of the support or resistance lines as a signal. Those with the most potential profitability occur on breakouts from major top or bottom formations. The simplest of all bottom formations, as well as one that offers great opportunities, is the *extended rectangle* at long-term low price levels. Fortunes have been made by applying patience, some available capital, and the following plan:

1. Find a market with a long consolidating base and low volatility. In Figure 3.29, Amazon.com reaches a low in July 2002 with volatility declining. When trading futures, the bottom can be confirmed with decreasing open interest. When evaluating interest rates, use the yield rather than the price, and avoid currencies which have no base price, that is, they have no price level that is considered "low," but instead have a point of equilibrium.

2. Buy whenever there is a test of its major support level, placing a stop-loss to liquidate all positions on a new, low price. Increasing volume should confirm the buying and with futures markets the breakout should be accompanied by increasing open interest.

3. After the initial breakout, buy again when prices pull back to the original resistance line (now a support level). Close out all positions if prices penetrate

back into the consolidation area and start again at Step 2.

4. Buy whenever there is a major price correction in the bull move. These adjustments, or pullbacks, will become shorter and less frequent as the move develops. They will usually be proportional to current volatility or the extent of the price move as measured from the original breakout.
5. Liquidate all positions at a prior major resistance point, a top formation, or the breaking of a major bullish support line.

Figure 3.29: An extended rectangular bottom in AOL from July 2002 through May 2003.

Building positions in this way can be done with a relatively small amount of capital and risk. The closer the price comes to major support, the shorter the distance from the stop-loss; however, fewer positions can be placed. In his book *The Professional Commodity Trader* (Harper & Row), Stanley Kroll discussed "The Copper Caper—How We're Going to Make a Million," using a similar technique for building positions. It can be done, but it requires patience, planning, and capital. The opportunities continue to be there.

This example of patiently building a large position does not usually apply to bear markets. Although there is a great deal of money to be made on the short side of the market, prices move faster and may not permit the accumulation of a large position. There is also exceptionally high risk and the increased risk of false signals caused by greater volatility. The only pattern that allows for the accumulation of a large short position is the rounded top, discussed in the next section. Within consolidation areas for commodities at low levels, there are a number of factors working in your favor: the underlying demand for a product, the cost of production, government price support (for agricultural products), and low volatility itself. There is also a clear support level that may have been tested many times. A careful trader will not enter a large short-sale position at an anticipated top when volatility is high, but instead will join the buyers who contribute to the growing volume and open interest at a well-defined major support level.

Rounded Tops and Bottoms

When prices change direction over a longer time period they can create a rounded top or bottom pattern. A *rounded top* reflects a gradual change in market forces from buyers to sellers. It is a very clear sign that any attempt to move prices higher has been abandoned. Rounded tops often lead to faster and faster price drops as more investors liquidate their long positions or initiate shorts.

In Figure 3.30 we see two classic rounded tops in the German DAX stock index. The first is an example of gathering downside momentum as more investors become aware of the decline. Prices drop faster after a break of the double bottom. The rounded top offers a rare opportunity to accumulate a short position under a relatively low volatility situation.

Figure 3.30: Two rounded tops in the German DAX stock index.

Rounded Bottom

A rounded bottom, similar to a rounded top, is an extended formation where prices gradually turn from down to up. In Figure 3.31 we see a rounded bottom in the Japanese yen followed by a breakaway gap. Similar to the extended rectangle, the rounded bottom offers traders an opportunity to accumulate a large long position. In this case, the sharp rally as prices move through the high of the rounded bottom, followed by a runaway gap, clearly marks the end of the rounded bottom. The breakout can be interpreted as a change in the supply and demand balance. A breakout, whether in stocks or futures, indicates that something new has entered the picture.

Figure 3.31: A classic rounded bottom in the Japanese yen.

Wedge Top and Bottom Patterns

We have seen a wedge formation as a continuation pattern in Figure 3.22, but a large ascending wedge can mark the top of a move and a large descending wedge the bottom. The dominant characteristic of the wedge is that volatility is declining towards the end. In Figure 3.32 there is a declining wedge in the Japanese yen. Volatility compresses until a breakout is inevitable. If the breakout had been to the downside, this wedge would have been interpreted as a continuation pattern. In this example, a breakout in the opposite direction is a strong indicator of a major reversal.

Figure 3.32: A large declining wedge followed by a upside breakout in the Japanese yen.

Head-and-Shoulders Formation

The classic top and bottom formation is the *head and shoulders*, accepted as a major reversal indicator. This pattern, well known to chartists, appears as a left shoulder, a head, and a right shoulder, seen in Figure 3.33. The head-and-shoulders top is developed with the following five characteristics:

1. A strong upward breakout reaching new highs on increasing volume. The pattern appears to be the continuation of a long-term bull move.
2. A consolidation area formed with declining volume. This can look much like a descending flag predicting an upwards breakout, or a descending triangle indicating a downwards breakout.
3. Another upwards breakout on continued reduced volume forms the head. This is the key point of the formation. The new high is not confirmed by increased volume, and prices drop quickly.
4. Another descending flag or triangle is formed on further reduced volume, followed by a minor breakout without increased volume. This last move forms the right shoulder and is the third attempt at new highs for the move.
5. The lowest points of the two flags, pennants, or triangles become the *neckline* of the formation. A short sale is indicated when this neckline is broken.

Figure 3.33: Head-and-shoulders top pattern in the Japanese Nikkei index.

Trading Rules for Head and Shoulders

There are three approaches to trading a head-and-shoulders top formation involving increasing degrees of anticipation:

1. *Wait for a confirmation.*

    a. Sell when the final dip of the right shoulder penetrates the neckline. This represents the completion of the head-and-shoulders formation. Place a stop-loss just above the entry if the trade is to be held only for a fast profit, or place the stop-loss above the right shoulder or above the head in order to liquidate on new strength, allowing a longer holding period.

    b. Sell on the first rally after the neckline is broken. (Although more conservative, the lost opportunities usually outweigh the improved entry prices.) Use the same stops as in Step 1a.

2. *Anticipation of the final shoulder*.

    a. Sell when the right shoulder is being formed. A likely place would be when prices have retraced their way half of the distance to the head. A stop-loss can be placed above the top of the head.

    b. Wait until the top of the right shoulder is formed and prices appear to be declining. Sell and place a stop either above the high of the right shoulder or above the high of the head.

    Both steps 2a and 2b allow positions to be taken well in advance of the neckline penetration with logical stop-loss points. Using the high of the head for a protective stop is considered a conservative approach because it allows the integrity of the pattern to be tested before the position is exited.

3. *Early anticipation of the head*.

    Sell when the right part of the head is forming, on the downwards price move, with a stop-loss at about the high of the move. Although this represents a small risk, it has less chance of success. This approach is for traders who prefer to anticipate tops and are willing to suffer frequent small losses to do it. Even if the current prices become the head of the formation, there may be numerous small corrections that will look like the market top to an anxious seller.

Volume was a recognized part of the classic definition of the head-and-shoulders formation and appeared in Robert D. Edwards and John Magee's *Technical Analysis of Stock Trends*, published in 1948. This no longer is considered as important. There are many examples of successful head-and-shoulders formations that do not satisfy the volume criteria. Nevertheless, declining volume on the head or the right shoulder of a top formation must be seen as a strong confirmation of a failing upwards move, and is consistent with the normal use of volume. There may be head-and-shoulders formations that work without declining volume, but the addition of the right volume pattern must add value to the pattern.

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EPISODIC PATTERNS

There is little argument that all prices change quickly in response to unexpected news. The transition from one major level to another is termed an *episodic pattern*; when these transitions are violent, they are called price *shocks*. Until the late 1990s there were very few price shocks in the stock market, the greatest being the one resulting from the terrorist attacks of September 11, 2001. Otherwise, price shocks can be caused by a surprising election result, the unexpected raising of interest rates by the Federal Reserve, the devaluation of a currency by an important Third World nation, sudden crop loss or natural disaster, or an assassination. While price shocks are most common in futures markets, all markets are continually adjusting to new price levels and all experience occasional surprises. Each news article, government economic release, or earnings report can be considered a mini-shock.

The pattern that results from episodic movement is exactly what one might expect. Following the sharp price movement there is a period when volatility declines from its highs, narrowing until a normal volatility level is found and remaining at that level (Figure 3.32). An upwards price shock, shown in Figure 3.34a, shows that prices settle below their highest levels and continue to decline in volatility. In a market example, Raytheon reacted in this way following 9/11. Because Raytheon is a defense contractor, a terrorist attack implies an increased amount of business from the government. Figure 3.35 shows the price shock, the volatile uncertain price movement immediately afterwards, then a decline in volatility leading to a sideways pattern.

Figure 3.34: Episodic patterns. (a) Upward price shock. (b) Downward price shock.

Figure 3.35: Price shock of 9/11/2001 affects Raytheon.

The downwards price shock, shown in Figure 3.34b, is typical of most stocks following 9/11. There is a sharp initial price drop, then a bounce, both with very high volatility, then prices decline at a slower rate, losing volatility until they settle at a low. This low is often lower than the low of the initial price shock sequence.

Unless the news that caused the price shock was an error, in which case prices immediately move back to levels prior to the news, prices will settle in a new trading range near the extreme highs or lows. It will take time for the market to absorb the consequences of the news, and many traders will find the risk too high to participate.

Price shocks have become the focus of much analytic work. Because a price shock is an unpredictable event, it cannot be forecast. This has a critical effect on the way in which systems are developed, especially with regard to the testing procedures. We understand at the time of the price shock that the event was entirely unexpected. However, years later, when the same prices are analyzed using a computer program, you might find that a trend or charting pattern *predicted* this move. The analysis records the profits and you are now basing your conclusions on false results. These important issues are covered in other parts of this book under the topics "Price Shocks," "Robustness," and "Optimization," found in Chapters 21 and 22.

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PRICE OBJECTIVES FOR BAR-CHARTING

There is some satisfaction in having a price objective for a trade that has just been entered. If this objective can be determined to a reliable degree, those trades would be selected that have the best profit potential as compared to the risk. It is also comforting to know that profits will be banked at a specific point. The most successful objectives are based on straightforward concepts and not complex calculations. There is also a noticeable similarity between the price objective for different chart patterns.

The simplest and most logical price objective is a major support or resistance level established by previous trading. When entering a long position, look at the most well-defined resistance levels above the entry point. These have been discussed in previous sections of this chapter as "support" and "resistance" as well as "tops" and "bottoms." When those prior levels are tested, there is generally a technical adjustment or a reversal. The more well-established the support or resistance level, the more likely prices will stop. In the case of a strong upwards move, volatility often causes a small penetration before the setback occurs. Placing the price objective a reasonable distance below the identifiable major resistance level will always be safe; the intermediate resistance levels can be used for adding positions on technical reversals. The downside objective can be identified in a similar manner: Find the major support level and place a stop just above it.

When trading with chart patterns it pays to be flexible. Regardless of which method you use to identify a profit target, be prepared to take profits sooner if the market changes. For example, you have entered a long in IBM at $30 and set your profit objective at $34. Prices move as predicted and reach $33.50 when volume starts to drop and the price pattern seems to move sideways. An experienced trader will say "close enough" and take the profit. Profit objectives are not perfect, but good guidelines. If you have set a single price target for a long position, and it falls slightly above a resistance level, then the resistance level (the closer point) should be substituted as the price objective.

While waiting for prices to reach the objective, remember to watch for a violation of the current trend; trend changes take priority over profit objectives. If the trade is successful, and the goal is reached as expected, watch for a new pattern. If prices decline after the trade is closed out, then reverse and break through the previous highs or lows, the position may be reentered on the breakout and a new price objective calculated.

Common Elements of Profit Objectives

Most chart formations have a price objective associated with them. The common ground for all of them is volatility. Each chart pattern is larger or smaller because of the price volatility at the time; therefore, the price targets derived from these formations are also affected by volatility. In general, the *price objective reflects the same volatility as the chart formation* and is measured from the point where prices break out of the pattern.

Profit Targets for Consolidation Areas and Channels

The most basic of all formations is the horizontal consolidation area, bounded on the top and bottom by a horizontal resistance and support lines. There are two possible profit targets, shown in Figure 3.36.

Figure 3.36: Price objectives for consolidation patterns and channels. (a) Two objectives for consolidation patterns. (b) Price objective for a channel.

1. For any *horizontal consolidation pattern*, the target is above the breakout of the resistance line at a point equal to the height of the consolidation

area (the resistance level minus the support level added to the resistance level). That makes the expected move equal to the volatility of the consolidation area.

2. With *extended rectangular formations*, the upwards profit target is calculated as the width of the consolidation pattern added to the support level.

Although price objective (2) is a well-known and popular calculation, it becomes unrealistic when the extended formation is very prolonged. The standard calculation, given in (1) is always conservative and practical.

The objective for a channel is just the same as the traditional objective for a horizontal consolidation pattern. Because the channel is at an angle, it is necessary to measure the width of the channel as perpendicular to the angled support and resistance channel lines, then project that width upwards from the point of breakout. The length of the channel does not change the profit target.

Changing Price Objectives with Channels

Price objectives can be found as trends change and new channels are formed. Figure 3.37 shows the change from an upwards to a downwards trend. Once a breakout of an upwards channel has occurred (marked "first point of reversal"), we wait until the low is reached at *a*, followed by the reaction back up to *b*. A resistance line, *1R*, can be drawn from the prior high *h* to the top of the latest move *b*. A line, *1S*, can be constructed parallel to *1R* passing through point *a*, forming the initial downward channel. Price objective 1 is on line *1S* of the new channel and is used once the top at point *b* is determined. Price objective 1 cannot be expected to be too precise due to the early development of the channel. If prices continue to point *c* and then rally to *d*, a more reasonable channel can now be defined using trendlines *2R* and *2S.* The support line will again become the point where the new price objective is placed. The upper and lower trendlines can be further refined as the new high and low reactions occur. The primary trendline is always drawn first, then the new price objective becomes a point on the parallel trendline.

Figure 3.37: Forming new channels to determine objectives.

Targeting Profits after Tops and Bottoms

Because profit targets are based on the volatility of the underlying pattern, the profit targets for all top and bottom formations will seem very much the same. Looking back at Figure 3.26, natural gas, there is a triple top formation. Between each top is a reversal marking an important support level. The first pullback after the island reversal brought prices to 8.20, followed by a test of the top that formed the second peak. The second retracement stopped at 9.00 and was followed by the third peak. When prices finally drop through the highest support level at 9.00 we can treat it as a breakout and sell short.

If this chart showed a double top, then the point where prices fall below the support between two tops *confirms the top*. Breaking this support level indicates that the topping formation is completed. But this was not a double top; therefore, we can take the lower of the two support levels between the three tops as the major confirmation of the pattern. In the natural gas chart the lower support was at 8.20. Using either support level gives a measurement of the triple top pattern based on the volatility of prices.

Calculating the Profit Target

The profit target is found by measuring the height of the top formation and projecting it downwards from the point where the top is confirmed, that is, the break of the support level. For this example profit targets will be calculated based on each of the support levels. The highest price of the move is 10.75. Let's examine two profit targets:

1. Using the support level of 9.00, the height of the top is 10.75 – 9.00, or 1.75. Projecting that downwards from the breakout point of 9.00 gives a profit objective of 7.25. The first major pause in the price drop stopped at about 7.00, still showing high volatility.

2. Based on the second support level of 8.20, the height of the top is 2.65 and the profit objective, measured from the break at 8.20, is 5.55. Prices reach 5.55, but only after stalling at about 6.50.

The first target is very achievable and realistic. Prices are very volatile and a drop of 1.75 could occur very quickly. The second target is less realistic. When targeting a much larger decline, and beginning at a much lower point, it is unrealistic to expect volatility to continue at the same high level. In the

decline of natural gas from January through March, volatility also declines so that by March it appears as though the move is over. Although price targets can often be correct, those that are far away should be viewed with caution.

Profit Targets after a Bottom Formation

The same principle can be applied to calculate the profit target for bottom formations. The distance from the lowest price of the bottom to the confirmation point is projected upwards from the breakout. This method can be applied to any type of bottom formation. In Figure 3.27, the double bottom in Cisco spanned the price range from about 5.00 to 6.25. The volatility of the bottom pattern, 1.25, is projected upwards from the breakout at 6.25 to get the target of 7.50. Because volatility should expand as prices rise, the exact volatility calculation can be used as a conservative measure.

The Head-and-Shoulders Price Objective

In keeping with other price targets, the head-and-shoulders top has a downside objective which is also based on its volatility. This objective is measured from the point where the right shoulder penetrates the neckline and is equal to the distance from the top of the head to the neckline (Figure 3.38). For a major top, this goal seems modest, but it will be a good measure of the initial reaction and is generally safe, even if a new high price is reached later.

Figure 3.38: Head-and-shoulders top price objective.

A very similar example can be found in the Japanese yen (Figure 3.30). The neckline also angles up and to the right, and the price target finds the bottom of the first major support level following the break of the right shoulder. The position of the price objective is so significant that the subsequent drop in prices creates a breakaway gap.

Triangles and Flags

Triangles and *flags* have objectives based on volatility in a manner consistent with other patterns. The triangle objective is equal in size to the initial reaction which formed the largest end of the triangle (Figure 3.39a). It may also be viewed as a developing channel rather than a triangle, with the ascending leg of the triangle forming the primary bullish trendline. The price objective then becomes the same as those used for channels.

Figure 3.39: Triangle and flag objectives. (a) Triangle objective is based on the width of the initial side, *s*. (b) Flag objective is equal to the move prior to the flag formation.

The flag is assumed to occur midway in a price move; therefore, the objective of a new breakout must be equal to the size of the move preceding the flag (Figure 3.39b). Recalling the comments on the problems associated with the decreasing volatility of the triangular formation, the use of the first reaction as a measure of volatility is a safe way to avoid such problems. Using this technique with subsequent flags in a bull move will cause objectives to move farther away, becoming unrealistic.

The Rule of Seven

Another measurement of price objectives, the *Rule of Seven*, is credited to Arthur Sklarew.[13] It is based on the volatility of the prior consolidation formation and computes three successive price objectives in proportion to one another. The Rule of Seven is not symmetric for both uptrends and downtrends. Sklarew believes that, after the initial leg of a move, the downtrend reactions are closer together than the reactions in a bull market. Because the downside of a major bear market is limited, it is usually characterized by consolidation. Major bull markets tend to expand as they develop.

To calculate the objectives using the Rule of Seven, first measure the length *L* of the initial leg of a price move (from the previous high or low, the most extreme point before the first pullback). The objectives are:

1. In an *uptrend*:

   Upwards objective 1 = prior low + ($L \times 7/4$)

   Upwards objective 2 = prior low + ($L \times 7/3$)

   Upwards objective 3 = prior low + ($L \times 7/2$)

2. In a *downtrend*:

   Downwards objective 1 = prior high - ($L \times 7/5$)

   Downwards objective 2 = prior high - ($L \times 7/4$)

   Downwards objective 3 = prior high - ($L \times 7/3$)

The three objectives apply most clearly to major moves. During minor price swings it is likely that the first two objectives will be bypassed. In Sklarew's experience, regardless of whether any one objective is missed, the others still remain intact.

[13]Sklarew, *Chart Analysis*, 1980. (See reference 7.)

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IMPLIED STRATEGIES IN CANDLESTICK CHARTS

For a technique that is reported to have been used as early as the mid-1600s, Japanese candle charts were slow to find their way into the western method of analysis. Candle charts can be related to bar charts but offer additional visual interpretation. The *candles* are created simply by *shading* the piece of the bar between the opening and closing prices: white if the close is higher than the open and black if the close is lower than the open. The shaded area is called the *body* and the extended lines above and below the body are the *shadows.* With this simple change, we get an entirely new way of looking at and interpreting charts. The patterns become much clearer than the Western style of line chart.

Although many candlestick patterns have equivalent bar chart formations, there is an implied strategy in each one. The following summary uses the traditional candlestick names representing the significance of the formation (see Figure 3.40):

- *Doji*, in which the opening and closing prices are the same. This represents indecision, a temporary balancing point. It is neither bullish nor bearish. A *double doji*, where two dojis occur successively, implies that a significant breakout will follow.
- *Engulfing patterns* seem at first to be the same as outside days in bar charting, but the pattern only refers to the part of the bar between the opening and closing prices. Engulfing patterns are considered exceptionally strong signals of price change. A *bullish engulfing pattern* has a black candle followed by a white, indicating a wide range with a higher close. The *bearish engulfing pattern* is white followed by black, showing a lower close on the engulfing day.
- *Morning star* and *evening star* are three-day patterns that show a similarity to an island reversal, but are more specific. In the morning star, a bullish reversal pattern, the first day has a lower close than the open, the second day (called the *star*, similar to the island bottom) has a higher close, and the final reversal day has an even higher close. The bearish reversal is just the opposite, with two higher closes followed by a reversal day with a lower close. If the star is also a doji then the pattern has more significance.
- *Piercing line* and *dark cloud cover* are bullish and bearish reversals. The piercing line, a bullish reversal, begins with a black candle (a lower close) and is followed by a white candle in which the open is below the previous day's low and the close is above the midpoint of the previous day's body (the open-close range). The dark cloud cover is a bearish formation, the opposite of the piercing line.
- *Hammer*, a bullish reversal signal, showing the bottom of a swing, where the body is at the top of the candle, indicating an upwards change of direction, and the shadow is below the body. The body may be black or white.
- *Hanging man*, a bearish reversal pattern where the body of the candle represents the high of a swing, and the shadow lies below in the direction of the reversal. The body may be black or white.
- *Shooting star*, a bearish signal, also occurs at the top of a swing and has its body at the bottom of the candle with the shadow above. The body may be black or white.

Figure 3.40: Popular candle formations.

Although these patterns are similar to Western bar chart formation, none of them are exactly the same. The hammer, hanging man, and shooting star are reversal patterns but can only be compared to the simple pivot point where the middle day is higher or lower than the bars on either side. None of these candle formations is exactly the same as a key reversal day or island reversal. The engulfing pattern is stronger than the typical outside day because the spanning of the prior day's range must be done only by the current day's open-close range.

The analysis of candle charts is a skill involving the understanding of many complex and interrelated patterns. For a brief review of this method, readers are referred to *Schwager on Futures: Technical Analysis*; for full coverage, *Japanese Candlestick Charting Techniques* (New York Institute of Finance, 1991) and *Beyond Candlesticks: New Japanese Trading Techniques*, both by Steve Nison, are recommended.

Quantifying Candle Formations

The preciseness of the candle formations allow some patterns to be tested. The popular engulfing patterns can be defined exactly for a computer program as

> Bullish engulfing pattern = Previous open > previous close and today's open < previous close and today's close > previous open
>
> Bearish engulfing pattern = Previous close > previous open and Today's open > previous close and today's close < previous open

Another technique uses the shadows as confirmation of direction. We can interpret an increase in the size of the upper shadows as strengthening resistance (prices are closing lower each day); an increase in the size of the lower shadows represents more support. One way to look at this is by defining

Upper shadow (white) = high − close	Lower shadow (white) = open − low
Upper shadow (black) = high − open	Lower shadow (black) = close − low

The sequences of upper and lower shadows can be smoothed separately using a moving average to find out whether they are rising or falling.[14]

Another method for determining whether black or white candles dominate recent price movement is to use only the body of the candle, $B = close - open$, and apply a momentum calculation:

$$Body\ momentum = \frac{B_{up}}{B_{up} + B_{down}}$$

where B_{up} = the sum of the days where $B > 0$ (body is white)

B_{down} = the sum of the days where $B < 0$ (body is black)

14 = the recommended number of days

When the body momentum is greater than 70 the whites dominate; when the value is below 20 the blacks dominate.

Pivot Points and Candle Charts

John L. Person suggests that the strategies inherent in candle formations can be combined with support and resistance levels derived from pivot points.[15] He uses the following calculations:

1. Pivot point, $P = (high + low + close) /3$.
2. First resistance level, $R1 = (P \times 2) - low$.
3. Second resistance level, $R2 = P + high - low$.
4. First support level, $S1 = (P + 2) - high$.
5. Second support level, $S2 = P - high + low$.

Once a key formation for a top or bottom is recognized using candle charts, support and resistance levels calculated based on pivot points can be a strong indication of the extent of the following price move. Person used Dow futures to support his study.

[14] Both "shadow trends" and "body momentum" are adapted from Tushar Chande and Stanley Kroll, *The New Technical Trader* (Wiley, 1994).

[15] John L. Person, "Pivot Points and Candles," *Futures* (February 2003).

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PRACTICAL USE OF THE BAR CHART

Trends Are Easier to See in Retrospect

As important as it is to identify the direction of price movement, it is much easier to see the trend afterwards than at the moment it is needed. There is no doubt that all stocks and futures markets have short-term swings and longer-term bull and bear markets. Unfortunately, at the time you are ready to trade, it is not going to be clear whether the current price trend is a short-term pattern that is about to change, or long-term persistent trend.

The availability of powerful computers, quote equipment, and charting programs have made the past patterns clear. It seems natural to expect prices to trend in the future as clearly as they appear on a chart; however, it is never that easy. The eye has a remarkable way of simplifying the chart patterns. The purpose of drawing a trendline is to recognize the direction even though prices can swing up and down violently during that trending interval. A new trend signal to buy or sell always occurs as the trend is changing; therefore, it is at the point of greatest uncertainty.

Success in systematic trading, whether using charts or mathematics, relies on consistency. In the long run it comes down to probabilities. Success can be achieved by recognizing the trend in 60% of the cases. In a typical trend-following system, because individual profits are much larger than losses, it is only necessary to be correct 30% or 35% of the time.

Long-Term Trends Are More Reliable Than Short-Term Trends

Charting is not precise and the construction of the trendlines, other geometric formations, and their interpretation can be performed with some latitude. When using the simplest trendline analysis, it often happens that there is a small penetration of the channel or trendline followed by a movement back into the channel. Some think that this inaccuracy with respect to the rules makes charting useless; however, many experienced analysts interpret this action as confirmation of the trend. The trendline is not redrawn so that the penetration becomes the new high or low of the trend; it is left in its original position.

We must always step back and look for the underlying purpose in each method of analysis, whether interpretive or fully systematic. The trendline is an attempt to identify the direction of prices over some time period. Chartists can use a simple straight line to visualize the direction; they draw the uptrend by connecting the lowest prices in a rising market even though each point used may represent varying levels of volatility and unique conditions. The chance of these points aligning perfectly, or forecasting the perfect price support level, is small. A trendline is simply a guide; it may be too conservative at one time and too aggressive at another; you probably won't know until after the trade is completed. Applied rigorously, charting rules should produce many incorrect signals but be profitable in the most important cases. The challenge of the chartist is to interpret the pattern of prices in context with the bigger picture.

Many price moves are called trends, but the most important and sustained trends are those resulting from government policy, in particular those that affect interest rates. Therefore, the most reliable trends are long-term phenomena because government policy is often long-term. During a period of recession, as we saw in 2001 and 2002, the Federal Reserve continues to lower interest rates, causing a major bull market in all fixed-income maturities. It is easiest to see this trend by looking at a weekly chart of the 10-year Treasury note, rather than an intraday, 1-hour chart. The more detail there is, the more difficult it is to see the long-term trend.

The average daily impact of the long-term trend on prices is very small. For example, if yields were to drop a staggering 2% in one year, a rise of approximately 16 full points in price, the net effect each day would be a change of .064%, or $^{2}/_{32}$ in price. If prices move nearly one full point, $^{32}/_{32}$ or 1%, each day, that upwards bias would be overwhelmed by the daily market noise. It would be difficult to draw a trendline on a daily price chart until prices had drifted higher for many months. Using a weekly chart removes much of this noise and lets the trend become easier to see.

Multiple Signals

Some of the impreciseness of charting can be offset with confirming signals. A simultaneous breakout of a short-term trendline and a long-term trendline is a much stronger signal than either one occurring at different times. The break of a head-and-shoulders neckline that corresponds to a channel support line is likely to receive much attention. Whenever there are multiple signals converging at, or near, a single point, whether based on moving averages, Gann lines, cycles, or phases of the moon, that point gains significance. In chart analysis, the occurrence of multiple signals at one point can compensate for the quality of the interpretation.

Pattern Failures

The failure to adhere to a pattern is equally as important as the continuation of that pattern. Although a trader might anticipate a reversal as prices near a major support line, a break of that trendline is significant in continuing the downward move. A failure to stop at the support line should result in setting short positions and abandoning plans for higher prices.

A head-and-shoulders formation that breaks the neckline, declines for a day or two, then reverses and moves above the neckline is another pattern failure. *Postpattern* activity must confirm the pattern. Failure to do so means that the market refused to follow through; therefore, it should be traded in the opposite direction. This is not a case of identifying the wrong pattern; instead, price action actively opposed the completion of the pattern. Wyckoff calls this "effort and results," referring to the effort expended by the market to produce a pattern that explains the price direction. If this pattern is not followed by results that confirm the effort, the opposite position should be set.

Consider a trading day where prices open above the previous close, move higher, then close lower: a *reversal day*. The expectation is for prices to open lower the next day. If an inside day or a higher open follows, there is a strong sign of higher prices to come. As Thompson concludes, "A strongly suggestive pattern that is aborted is just as valuable as a completed pattern."[16]

Change of Character

Thompson also discusses the completion of a pattern or price trend by identifying a *change of character* in the movement. As a trend develops, the reactions, or pullbacks, tend to become smaller. Traders looking to enter the trend wait for reactions to place their orders; as the move becomes more obvious, these reactions get smaller and the increments of trend movement become larger. When the reaction suddenly is larger, the move is ending; the change in the character of the move signals a prudent exit, even if prices continue erratically in the direction of the trend.

A similar example occurs in the way prices react to economic reports or government action. The first time the Federal Reserve acts to raise rates after a prolonged decline the market is not prepared and bond prices react sharply lower. Before the next meeting of the Fed the market may be more apprehensive, but is likely to be neutral with regard to expectation of policy. However, once there is a pattern of increasing rates following signs of inflation, the market begins to anticipate the action of the Fed. A sharp move in the opposite direction occurs when the government fails to take the expected action.

Bull and Bear Traps

While it is not much of a consolation to those who have gotten caught, a failed downside breakout is called a *bear trap,* and a failed upwards breakout is a *bull trap*. A bear trap occurs when prices fall below a clear support line, generating sell signals. After a few days, prices move back above the support line, often accelerating upwards. A bull trap is a failed breakout of a resistance level. In both cases, prices appear to be continuing in the trend direction, but the final picture is a reversal. Although there is no advice on how to avoid bull and bear traps, the failed reversal should be recognized as soon as possible and the position should be reversed. Bull and bear traps often precede significant price reversals.

As with other top and bottom patterns, a confirmation of the bear trap is complete when prices move above the next higher resistance level. In the case of a failed flag formation in a downward trend, prices would break downward as expected, then reverse. The confirmation occurs when prices move above the top of the failed flag pattern. The same principle would be true of other failed chart formations; the failure is confirmed when prices retrace the entire pattern.[17]

Testing Your Skill

Recognizing a pattern is both an art and science. Not everyone has an eye for patterns; others see formations where no

one else does. The first decision may be the most important: How much of the chart do you use? It is perfectly normal for different time intervals to show different trends. In some cases, arbitrarily cutting the chart at some previous date might cause a clear trend to disappear. The price scale (the vertical axis) of the chart is another variable not considered by some chartists. When applying methods requiring specific angles, the chart paper is expected to have square boxes. Regardless of the shape of the box, the formations may appear different from one piece of chart paper, or computerized page, to another.

The timeliness of the pattern identification is the most serious problem. Can the formation be interpreted in time to act on a breakout, or is the pattern only seen afterwards? At different stages of development, the lines may appear to form different patterns. Before using your charting skills to trade, practice simulating the day-to-day development of prices using the following seven steps:

1. Hold a piece of the paper over the right side of the chart, covering the most recent months, or better still, have someone else give you the partial chart.
2. Look at the chart and analyze the formations.
3. Determine what action will be based on your interpretation. Be specific.
4. Move the paper one day to the right, or have someone else give you the next day's price.
5. Record any orders that would have been filled based on the prior day's analysis. Don't cheat.
6. Determine whether the new day's price would have altered your formations and plans.
7. Return to Step 3 until finished.

This simple exercise might save a lot of money but may be discouraging. With practice you will become better at finding and using formations and will learn to select the ones that work best. Very few traders base their trading decisions entirely on bar charts. Many refer to charts for confirmation of separate technical or fundamental analysis; others use only the most obvious major trendlines, looking for points at which multiple indicators converge. The general acceptance of bar charting analysis makes it a lasting tool.

[16] Jesse H. Thompson, "What Textbooks Never Tell You," *Technical Analysis of Stocks & Commodities* (November/December 1983).

[17] See Christopher Narcouzi, "Winning with Failures," *Technical Analysis of Stocks & Commodities* (November 2001).

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EVOLUTION IN PRICE PATTERNS

A change has occurred in the stock market because of the ability to trade the S&P 500 index directly rather than through buying and selling the individual stocks that make it up. S&P futures have become an active vehicle for both speculation and hedging. If you think that stock prices are about to fall because of a pending interest rate announcement by the Fed, you can protect your portfolio by selling an equivalent amount of S&P futures. Afterwards, when you have decided that prices have stabilized, you can lift your hedge and profit from rising prices. It is an easy and inexpensive way to achieve portfolio insurance.

When institutions and traders buy or sell large quantities of S&P futures, the futures price will drift away from the S&P cash index, representing the weighted average of the actual component stock prices. *Program trading* is the vehicle that continuously monitors this divergence and automatically places orders to buy or sell the actual shares when futures and the index move too far apart. If you have enough capital, and the difference between the S&P futures price and the S&P cash index is sufficiently large, you can buy the S&P futures and sell all of the stocks in the S&P 500 cash index. It is a classic arbitrage that brings prices back together.

But the ability to buy or sell all the stocks in the S&P at the same time has changed the patterns of individual stocks that are part of the S&P index. While at one time these stocks moved largely due to their own fundamentals, they now all move together. It no longer matters that IBM is fundamentally stronger than GE, or that Xerox is at a resistance level and Ford is at support, or even if Enron is under investigation. When you buy the S&P futures you buy all of the stocks at the same time.

Today's technical trader must keep one eye on the individual stock and the other eye on the index. Exxon may have moved above its recent resistance level but stopped because the S&P Index is at its own resistance level, and there are more traders watching the S&P than Exxon. In today's market, you can anticipate when a stock will find support and resistance by looking at the S&P chart rather than at the stock chart.

Figure 3.41 shows the S&P 500 index, GE, and Exxon over the same period from October 1999 through December 2000. The overall pattern of the three markets is remarkably similar, with most tops and bottoms occurring at nearly the same time. Because it is unlikely that the fundamentals of each company would result in such a similar price pattern, we can conclude that the S&P futures, combined with program trading, forces the patterns to be materially the same.

Figure 3.41: Similar patterns in the S&P, GE, and Exxon.

During times when there is no news, the stocks all move together. When there is positive news for a specific company, it will gain over other stocks, but it will still meet resistance where the S&P futures meets resistance. This change in the way stocks are traded reduces the ability to get diversification by trading across sectors and increases risk. Short-term traders will not be as affected as those holding positions longer.

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Chapter 4: Charting Systems and Techniques

OVERVIEW

The rapid growth of computerization has had a great impact on technical trading. The first techniques affected were the moving average and other mathematical trending methods, then easy-to-program indicators, followed by systematic optimization. More recently, econometric analysis, cycles, and pattern recognition have been the subject of new computerized research. Many quote services that offer graphics can convert a bar chart to a point-and-figure chart at the push of a button. Yet the techniques normally used in classic charting, such as trendlines, channels, and special patterns, are not easily automated. However, successful inroads have been made in programming the complicated patterns of Elliott's Wave Theory.

The systems and techniques included in this chapter are those that might be used by traditional chartists. Many of them are classic methods by famous analysts. They do not all require the use of a chart to be followed, but they are clearly interpretations of natural price patterns. The time that it takes for a price to move from one level to the next is not significant in many of these charting systems; it is only the level itself that is important. The common ground in this chapter is that the methods are very specific and do not require chart interpretation. They could be tested using a computer.

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DUNNIGAN AND THE THRUST METHOD

William Dunnigan's work in the early 1950s is based on chart formations and is purely technical. Although an admirer of others' ability to perform fundamental analysis, his practical approach is contained in the statements:

> *"If the economists are interested in the price of beans, they should, first of all, learn all they can about the* price of beans.*" Then, by supporting their observations with the fundamental elements of supply and demand they will be "certain that the bean* prices will reflect these things.*"*[1]

Dunnigan did extensive research before his major publications in 1954. A follower of the Dow Theory, he originally created a *breakaway system* of trading stocks and commodities, but was forced to drop this approach because of long strings of losses. The net results of his system, however, were profitable. He was also disappointed when his "2⅜ Swing Method" failed after its publication in *A Study in Wheat Trading*. But good often comes from failure and Dunnigan had realized by now that different measurements should be applied to each market at different price levels. His next system, the *Percentage Wheat Method*, combined a 2½% penetration and a three-day swing, introducing the time element into his work and perhaps the first notion of *thrust*, a substantial move within a predefined time interval. With the 2½%, three-day swing, a buy signal was generated if the price of wheat came within 2% of the lows, then reversed and moved up at least an additional 2½% over a period of at least three days.

For Dunnigan, the swing method of charting[2] represented a breakthrough; it allowed each market to develop its natural pattern of moves, more or less volatile than any other market. He had a difficult time trying to find one criterion for his charts that satisfied all markets, or even all grains, but established a $2 swing for stocks where Rhea's *Dow Theory* used only $1 moves. His studies of percentage swings were of no help.

The Thrust Method

Dunnigan's final development of the Thrust Method combined both the use of percentage measurements with the interpretation of chart patterns, later modified with some mathematical price objectives. He defines a *downswing* as a decline in which the current day's high and low are both lower than the corresponding high and low of the highest day of the prior *upswing*. If currently in an upswing, a higher high or higher low will continue the same move. The reverse effect of having both a higher high and low would result in a change from a downswing to an upswing. The *top* and *bottom* of a swing are the highest high of an upswing and the lowest low of a downswing, respectively. It should be noted that a broadening or consolidation day, in which the highs and lows are both greater or both contained within any previous day of the same swing, has no effect on the direction.

In addition to the swings, Dunnigan defines the five key buy patterns:

1. *Test of the bottom*, where prices come within a predetermined percentage of a prior low.
2. *Closing-price reversal*, a new low for the swing followed by a higher close than the prior day.
3. *Narrow range*, where the current day's range is less than half of the largest range for the swing.
4. *Inside range*, where both the high and low fall within the prior range.
5. *Penetration of the top* by any amount, conforming to the standard Dow theory buy signal.

All of these conditions can be reversed for the sell patterns. An entry buy signal was generated by combining the patterns indicating a preliminary buy, with a thrust the next day confirming the move. The *thrust* was defined as a variable price

gain based on the price level of the market (for 1954 wheat, this was from ½ to 1½¢). Dunnigan's system attempted to enter the market long near a bottom and short near a top, an improvement on the Dow Theory. Because of the risks, the market was asked to give evidence of a change of direction by satisfying two of the first four patterns followed by a thrust on the next day. Any variance would not satisfy the conditions and an entry near the top or bottom would be passed.

The same buy and sell signals apply to changes in direction that did not occur at prior tops and bottoms but somewhere within the previous trading range. In the event that all the conditions were not satisfied and prices penetrated either the top or bottom, moving into a new price area, the fifth pattern satisfied the preliminary signal and a thrust could occur on any day. This was not restricted to the day following the penetration. If nothing else happened, Dunnigan followed the rules of the Dow Theory to ensure that a major move would not be missed.

It has been said by followers of Dunnigan's method that his *repeat* signals are the strongest part of his system; even Dunnigan states that they are more reliable, although they limit the size of the profit by not taking full advantage of the trend from its start. Repeat signals use relaxed rules not requiring a new thrust because the trend has already been identified. Two key situations for repeat buy signals are:

1. A test of the bottom followed by an inside range (interpreted as market indecision).
2. A closing price reversal followed by an inside range.

A *double thrust* occurs when the first thrust is followed immediately by a second thrust; or, after the first thrust, a congestion area develops, followed by a second thrust in the same direction as the first. Although Dunnigan used a fixed number of points to define his "thrust," today's traders may find the standard deviation of the daily price changes or another volatility measure as a more practical basis for identifying significant price moves.

One-Way Formula

Dunnigan worked on what he hoped would be a generalized version of his successful Thrust Method and called it the "One-Way Formula." Based on his conclusions that the Thrust Method was too sensitive, causing more false signals than he was prepared to accept, he modified the confirmation aspect of the signal and made the thrust into the preliminary signal. He also emphasized longer price trends which smooth performance and reduce signals.

With the upswing and downswing rules remaining the same, Dunnigan modified the thrust to require its entire range to be outside the range of the prior day. For a preliminary buy, the low of the day must be above the high of the prior day. This is a stronger condition than his original thrust yet only constitutes a preliminary buy. The confirmation occurs only if an additional upthrust occurs after the formation of, or test of, a previous bottom. There must be a double bottom or ascending bottom followed by a thrust to get a buy signal near the lows. If the confirmation does not occur after the first bottom of an adjustment, it may still be valid on subsequent tests of the bottom.

For the One-Way Formula, repeat signals are identical to original confirming signals. Each one occurs on a pullback and test of a previous bottom, or ascending bottom, followed by an upthrust. Both the initial and repeat signals allow the trader to enter after a reaction to the main trend. The Dow approach to penetration is still allowable in the event that all else fails. The refinement of the original thrust method satisfied Dunnigan's problem of getting in too soon.

The Square Root Theory

The two previous methods show a conspicuous concentration of entry techniques and an absence of ways to exit. Although it is valid to reverse positions when an opposite entry condition appears, Dunnigan spends a great effort in portfolio management[3] and risk-reward conditions that were linked to exits. By his own definition, his technique would be considered "trap forecasting," taking a quick or calculated profit rather than letting the trend run its course (the latter was called *continuous forecasting*).

A fascinating calculation of risk evaluation and profit objectives is the Square Root Theory. He strongly supported this method, thinking of it as the "golden"[4] key and claiming support of numerous esoteric sources, such as *The Journal of the American Statistical Association*, *The Analyst's Journal*, and *Econometrica*. The theory claims that prices move in a square root relationship. For example, a market trading at 81 (or 9^2) would move to 64 (8^2) or 100 (10^2); either would be one unit up or down based on the square root. The rule also states that a price may move to a level that is a multiple of its square root. A similar concept can be found greatly expanded in the works of Gann (Chapter 14).

[1]William Dunnigan, *Selected Studies in Speculation* (Dunnigan, San Francisco, 1954, p. 7).

[2]W. D. Gann, *How to Make Profits in Commodities* (Lambert-Gann, Pomeroy, WA, 1976). This book devotes a large section to swing charts and includes many examples of markets prior to Dunnigan's work.

[3]Each of his writings on systems contained examples of multiple-fund management of varied risk.

[4]Refers to the Greek description of Fibonacci ratios.

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NOFRI'S CONGESTION-PHASE SYSTEM

Markets spend the greater part of their time in nontrending motions, moving up and down within a range determined by near-stable equilibrium of supply and demand. Most trend followers complain about the poor performance that results from markets that fail to move continuously in one direction. However, their systems are designed to conserve capital by taking repeated small losses during these periods in order to capture the "big move." Eugene Nofri's system, presented by Jeanette Nofri Steinberg, is used during the long period of congestion, returning steady but small profits. Nofri's system does not concern itself with the sustained directional move, therefore the user of the Congestion-Phase System can wait to be certain of a well-defined congestion area before beginning a trading sequence.

The basis of the system is a third-day reversal. If prices are within a congestion range and have closed in the same direction for two consecutive days, take the opposite position on the close of day two, anticipating a reversal. If this is correct, take the profits on the close of trading the next (third) day. Nofri claims a 75% probability of success using this technique, and the Theory of Runs supports that figure. If there is a 50% chance of a move either up or down on day one, there is a 25% chance of the same move on the next day, and 12½% chance on day three. Considering both commissions and variations in the distribution, an assumption of 75% is reasonable.

Because the basis of the Congestion-Phase System is an unlikely run within a sideways price period, the substitution of a four-day run instead of the current three-day run should increase the profitability and reliability of the individual trades while reducing the number of opportunities.

The Congestion-Phase System is only applied to markets within a trading range specifically defined by Nofri. Users are cautioned not to be too anxious to trade in a newly formed range until adequate time has elapsed or a test of the support and resistance has failed. The top of the congestion area is defined as a high, which is immediately followed by two consecutive days of lower closing prices; the bottom of the congestion area is a low price followed by two higher days. A new high or low price cancels the congestion area. Any two consecutive days with prices closing almost unchanged (for example, ±2 ticks) are considered as one day for the purposes of the system. These ranges occur frequently and can be found by charting prices using the last 10 days. In cases where the top or bottom has been formed following a major breakout or price run, a waiting period of 10 additional days is suggested to ensure the continuance of the congestion area and limit the risk during more volatile periods. Remember, systems that trade only within ranges offer many opportunities which should be exercised with patience.

A congestion area is not formed until both a top and bottom can be identified. Penetration of a previous top and formation of a new top redefine the range without altering the bottom point; the opposite case can occur for new bottoms. If a false breakout occurs lasting two or three days, safety suggests a waiting period of seven days. Logical stops are also possible, the most obvious places being the top and bottom of the current congestion area, but closer stops could be formulated based on price volatility.

The Congestion-Phase System can stand alone as a short-term trading method or can be used to complement any longer technique. When trying to improve entry or exit fills, the system qualifies as a timing device—but only within the congestion areas defined by the rules. It is not intended to be used in all situations. The converse of the system says that an entry signal given outside of a congestion area should be taken immediately because longer periods of prolonged movement in one direction are most likely. But in a trading range, the Congestion-Phase System may turn a moving average technique from a loser to a winner.

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OUTSIDE DAYS WITH AN OUTSIDE CLOSE

There are numerous chart patterns that can be profitable if they are properly identified and traded consistently. Unfortunately, any one pattern may not appear very often and traders may become impatient waiting for the opportunities. For others who feel that overall trading success is a combination of small victories, the *outside day with an outside close* is one such successful pattern.

An outside day has the high and low outside the range of the previous day; that is, the high is higher and the low is lower. An outside close is one where the closing price is higher or lower than the prior day's high or low, respectively. This is considered an attempt to move in one direction followed by a strong push in the other direction. If the close was in the direction opposite to a recent price move, this is called a key reversal day;[5] however, because the previous price direction is not distinguished, it is not necessarily a reversal. It may be a renewal of the trend direction.

A brief study by Arnold[6] showed that this pattern proved profitable for a small sample of currencies, metals, and financials using the following three rules:

1. *Buy* on the close of an outside day if the close is above the prior high; *sell* if the close is below the prior low.
2. If buying, place a stop-loss just below the low of the outside day; if selling, place the stop just above the high.
3. Close out the position on the close three days after entry.

After studying exits on days one through five following the trade entry, Arnold concluded that this formation predicts reasonably consistent price movements for the next three days.

[5]See the discussion of key reversals in Chapter 3.

[6]Curtis Arnold, "Your Computer Can Take You Beyond Charting," *Futures* (May 1984).

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ACTION AND REACTION

The human element in the market is not responsible for the ultimate rise and fall of prices, but for the way in which prices find their proper level. Each move is a series of over-reactions and adjustments. Many stock and commodity analysts have studied this phenomenon and base entire systems and trading rules on their observations. Elliott's Wave Principle is the clearest and most well-known of the theories founded entirely on this notion. Frank Tubbs' *Stock Market Correspondence Course* is the first to define the magnitude of these reactions in his Law of Proportion; and, in 1975, the Trident System was based on both the patterns and the size of the action and reaction.

Retracement of a major bull campaign is the most familiar of the market reactions and the one to which almost every theory applies. It is virtually unanimous that a 100% retracement, where prices return to the beginning of the move, encounters the most important support level. The 100% figure itself has been discussed in terms of unity, referring to its behavioral significance. The next most accepted retracement level is 50%, strongly supported by Gann and commonly discussed by experienced speculators. The other significant levels vary according to different theories:

> Schabacker accepts an adjustment of ⅓ or ½, considering anything larger to be a trend reversal.
>
> Angas anticipates 25% reactions for intermediate trends.
>
> Dunnigan and Tubbs look at the larger ½, ⅔, or ¾ adjustment.
>
> Gann takes inverse powers of 2 as behaviorally significant: ½, ¼, ⅛, …
>
> Elliott based his projections on the Fibonacci ratio and its complement (.618 and .382).

Predicting advances to new higher or lower prices is based on prior moves. Gann believed in multiples of the lowest historic price as well as even numbers; prices would find natural resistance at $2, $3, …, at intermediate levels of $2.50, $3.50, …, or at two to three times the base price level. Elliott looked at moves of 1.618% based on a Fibonacci ratio.

Fibonacci Ratios

Along with the most common 1, ½, ⅓, and ¼ retracement values, Fibonacci ratios are considered of equal importance. Fibonacci ratios are found by dividing one number in the *Fibonacci summation series*

> 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 14, …

by the preceding or following value. The series is formed beginning with the values 1, 1 and adding the last two numbers in the series together to get the next value. The numbers in the series, especially those up to the value 21, are often found in nature's symmetry; however, the most important aspect of the Fibonacci sequence is the ratio of one value to the next. Called the Golden Ratio, this value F_N / F_{N+1} approaches 1.618 as N gets large. An unusual quality that has drawn attention is that the inverse $F_{N+1}/F_N = 0.618$.

The Golden Ratio has a long history. The great pyramid of Gizah, the Mexican pyramids, many Greek structures, and works of art have been constructed in the proportions of the Golden Ratio. These and other examples are given in Chapter 14 where they are also shown in context with trading systems. At this time it is important to recognize that many analysts who consider human behavior as the primary reason for the size of a price move and their retracements use the Fibonacci ratio .618 or, less often, its reciprocal 1 - .618 = .382, as very likely targets. Elliott is the most well-known advocate, and applications of his Wave Theory are filled with these ratios.

Retracement rules have not been proved scientifically but they are accepted by most traders. In general terms, the retracement theories, or *revelation methods*, can be categorized as either *proportional retracements* or *time-distance goals*. Proportional retracement states that prices will return to a level which is clearly related, by proportion or ratio, to the length of the prior price move. The larger the move, the clearer the retracement. The percentages and ratios expected to be successful are those that are most obvious: 100%, 50%, 33%, and so on, in addition to the Fibonacci ratio 1.618 and its inverse 0.618. The time-distance rule is popularized in the works of Gann (also found in Chapter 14). Gann's retracement objectives can best be thought of as forming an arc of a circle, with the center at the price peak. The goal is satisfied when prices touch any point on the circle.

Tubbs' Law of Proportion

The technical part of Frank Tubbs' course in stock market trading is intense chart interpretation. The *Law of Proportion* presented in Lesson 9 of the course is a well-defined action-and-reaction law. In cases where the nearby highs or lows of a swing were not broken, Tubbs claims four out of five successful predictions with his principle. The law states:

> *Aggregates and individual stocks tend to run on half, two-thirds, three-fourths of previous moves. First in relation to the next preceding move which was made. Then in relation to the move preceding that.*

Applied to a stock trading at $20, an initial move from $20 to $26, would react ½ to $23, ⅔ to $22, or ¾ to $21.50. Tubbs does allow for traditional price support as a major obstacle to the measured price retracement, and so unity (a 100% retracement) may be added to the three proportions. Figure 4.1 shows subsequent reactions to the stock move just described; the second reversal could be any of three magnitudes (or back to major support at $20.00), ending at $21.50, a ¾ reversal. Reversals 3, 4, and 5 are shown with their possible objectives. The last reversal, 5, becomes so small that the major support levels (horizontal broken lines) are considered as having primary significance, along with proportions of moves 1 and 2. Major support at $20.00 coincides with ½ of move 1 and ⅔ of move 2. This would normally be sufficient to nominate that point as the most likely to succeed. Tubbs indicates that these points rarely occur with exactness, but proportions serve as a valuable guideline. The principle is one of reaction in relationship to an obvious preceding action.

Figure 4.1: Tubbs' Law of Proportion.

Trident

The Trident Commodity-Trading System received its fair share of publicity when it was introduced at the beginning of 1975. An article in the 1977 *Dow Jones Commodities Handbook* had an excellent review of the background of the system and some of the conflicts surrounding its presentation and subsequent successes and failures. The system itself is not unique in concept but in its implementation. It is based upon the principle of price action and reaction with formations similar to the waves of R. N. Elliott. For each price move, there is a point of undervalue and overvalue with subsequent reaction, or adjustments, in price as it moves irregularly in the direction determined by the ultimate balance of supply and demand.

The object of the system is to trade in the direction of the main trend but take advantage of the reactions (or waves) to get favorable entry and exit points. The concept of trading with the trend and entering on reactions is discussed in the context of commodity technical analysis as early as 1942 by W. D. Gann and in the preceding section on action and reaction. The goal is to predict where the reactions will occur and what profit objective to set for each trade.[7] Trident's approach is easy to understand: Each wave in the direction of the main trend will be equal in length to the previous wave in the same direction. The target is calculated by adding this distance to the

highest or lowest point of the completed reaction. As with Elliot's principle, the determination of the tops and bottoms of the waves is dependent on the time element used; the complex form of primary and intermediate waves would hold true with Trident (Figure 4.2).

Figure 4.2: Trident entry-exit.

Because there are inaccuracies in the measurement of behavioral phenomena, Trident emphasizes the practical side of its theory by offering latitude in its choice of entry and exit points. By entering after 25% of the anticipated move has occurred and exiting 25% before the target, there is ample time to determine that the downward reaction has ended before your long position is taken and enough caution to exit well before the next reaction. A critical point in each main trend is midway between the start of the move and the target. If the midpoint is not reached, there is a change in direction of the main trend causing a reevaluation of the main trend and the reactions. A change of direction is considered conclusive if a reversal equal in size to 25% of the last reaction occurs during what was expected to be an extension of the main trend. That 25% value becomes the trailing stop-loss on any trade in the event the objective is not reached.

This discussion is not intended to be a complete representation of the Trident System, but a brief description of its essential ideas. The actual system has substantial refinements and subtleties in target selection for major and minor trends and corrective moves; it includes points to reverse positions based on the trailing stop.

In a later bulletin to Trident users, it was suggested that a modification to the system be implemented with respect to money management. Using a technique similar to the Martingale System, each loss is followed by an increase in the number of positions traded. The trader only has to continue to extend his positions and stay with the system until he wins. A comprehensive version of this classic gambling approach can be found in the sections "Martingales and Anti-Martingales" and "Theory of Runs," both in Chapter 22. The Trident concepts are all reasonable and generally accepted by experienced traders. They include advance and retracement, trade the trend, don't pick tops and bottoms, take the center out of each move, and use a trailing stop.

An Overview of Percentage Retracements

The last few sections have discussed specific retracement levels advocated by well-known market analysts. This section takes a more general approach to percentage retracements, apply these levels to soybeans and the S&P 500, and draw some conclusions about their use. From previous discussions, the most important reversal that follows a sustained trend is a retracement of 100%, where prices give back all of their gains. A 100% pullback means that the reason for the previous price move has disappeared. This is most common for shorter time periods, where prices are driven by a single news event that turns out to be false, or that the initial reaction to a report was incorrect and prices give back all of their gains, often continuing in the opposite direction. For active traders this pattern happens often and produces large price swings, but lasts only a few days.

False news and confused interpretations of economic reports can be quite common. On some days, the government released multiple reports at the same time, 8:30 Eastern time. The statistics can be early reports of retail sales or revised numbers. The government revises its previous GDP numbers each time it releases new ones. In agriculture, the media reports a major problem with crops each year, the result of too little rain or too much rain. In the end, technology wins and there is a record harvest. There are constant rumors of large companies being the target of an SEC probe, or they are about to announce the correction of an accounting "irregularity." When news turns out to be false, the market simply returns to the price level before the news.

For seasonal commodities, such as crops, there are longer patterns of rising and falling prices. In 1988, a shortfall in the soybean crop with dwindling warehoused stocks caused prices to double. After two years of good harvest, inventories were restored and prices

returned to original levels, a 100% retracement. In 2001, the price of soybeans rallied during the growing months, June through August, based on lack of rain. By the end of August prices stopped going up when traders realized that the weather problems affected only a small part of the crop—but a large amount of news coverage on CNN and CNBC. As harvest begins, and the crop size looks normal, prices fall back to the same level as in the spring, showing a 100% retracement.

Many patterns used to analyze stock and index prices come from agricultural futures markets. Traders adopt any technique that works. The much greater liquidity of soybean futures compared to many individual stocks during the middle of the 1900s makes the futures patterns clear. We will look at other examples of soybean prices because for many years they were the most actively traded market. Farmers, grain elevators, and speculators have been doing the same thing since the mid-1800s and there are many examples in soybean patterns. Because agricultural products are highly seasonal, and tend to return to the same price levels periodically, they have excellent examples of retracements.

Retracements Less Than 100%

There is a significant difference between a *full retracement* (100%) and a *partial retracement*. A full retracement says that the previous rally was based on bad information or interpreted incorrectly. But what is the significance of a 50% retracement? Retracements are a common occurrence. They have been compared to the ebb and flow of the tides. Investors buy until they have bought too much, then the sellers come in to correct the overbought situation until the price is back to a level that attracts more buying.

The previous sections have discussed retracements of 50%, 33%, 25%, and 12.5%, as well as 61.8% and 38.2%. The obvious problem is that, if there are so many possible retracement levels, then the price is likely to stop at one of them, even if by chance. Without other information, the most successful retracements are most likely to be the larger ones. Then 100% is the most important and 50% is the next most likely. After that there is 33% and 25%, each of less importance, with 12.5% too small to consider seriously. Fibonacci ratios are an exception; there seems to be good support for expecting mass behavior to be reflected in these ratios.

Including Fibonacci, the most important retracements are 100%, 50%, and 61.8%. Figure 4.3 shows one of each primary retracement on a weekly soybean chart for a four-year period from 1976 to 1980. Markets that have high volume are most likely to conform to standard retracements. This means that index markets, such as the S&P 500, would also show 50% and 61.8% pullbacks, but individual stocks may not. Mass behavior is a function of broad participation and a big picture of economic price movement.

Figure 4.3: Soybean retracements in the late 1970s.

S&P Retracement Levels

The S&P has very high trading volume; therefore, we would expect retracement levels to conform to the rule of large numbers. Unlike an agricultural product, or a stock with a strong seasonal performance, the S&P is not likely to retrace 100% of a longer-term move. We expect that the core inflation rate, added to the investment bias that exists in the United States, to cause a steady rise in the overall price of stocks. Figure 4.4 shows the first part of the bear market that began in 2000. The swing highs and lows are marked with letters beginning with *A* and *C* at the top, with *B* the low between them. The breakdown of the support line drawn horizontally from *B* results in prices reaching *D*, a decline of 100% of the range from *A* to *B*, followed by a retracement of 50% back to *E* (support becomes resistance). Throughout the decline we can find numerous examples of retracement that conform to the expectations of 100%, 50%, and less important, 62%.

Figure 4.4: S&P retracement levels.

Each retracement level is an opportunity for trading. If a rally is expected to stop at a 50% retracement, a sell short order could be triggered automatically at that price. But anticipating a top and selling into a rising market have a high degree of risk. Price movement is not so precise that you can anticipate a target with a great degree of confidence. Targeting a profit level and exiting a trade is considered safe and sensible, but buying when prices are falling quickly is comparable to stepping in front of a moving train. Entering a new trade on a retracement is considered best when there is a confirmation that prices will stop at that retracement level. This may manifest itself as slowing price movement, declining volatility, or declining volume occurring at a point very close to your expected retracement level. If a new high follows on an increase in volume, then you quickly close out the trade and try again later. Common sense is needed in addition to a retracement target.

Thinking about Retracements

Price movement is a combination of two steps forward and one step backwards. Serious students of price patterns say that it moves two steps forward and 1.618 steps backwards. Regardless of who is right, prices rarely move in one direction without reversing.

Anticipating the size of a retracement is an attempt to capitalize on the mass behavior of the investors. The continuous flow of funds in and out of the markets do not occur at random points, but reflect the risk tolerance of each participant. When seen as the action of a large group, the places where prices stop and reverse, in both their forward movement and backwards steps, seem to cluster at specific levels. Retracements are most important after a sustained price move or during a clear trend. It is necessary to gain the support of the investing masses in order to expect consistent patterns.

Interesting observations were made by Tom DeMark[8] about identifying the price move that serves as the basis for measuring retracements. If the market is currently at a low, rather than judging the distance of this drop from the most recent swing high, he chooses to look for the highest point that has occurred since the last time the market traded at this low level. He then finds the most

likely retracement points using the Fibonacci ratios .618 and 1.618, plus Fibonacci "alternative" ratios .382, .50, 1.382, 2.236, and 2.618 applied to the difference between the high and low, added to the current low price.

Trading at Even Numbers

It is said that prices advance and decline to even numbers. A stock is more likely to stall at $10 than at 9.25; the price of gold resists moving below $300, but once it has traded lower, it struggles to go back above $300, then slows at $310 and $320. A study by the New York Federal Reserve confirms the increase in trader activity around even numbers.

It makes sense that investors are more likely to place orders at even numbers. Active traders and longer-term investors do not usually tell a broker to buy at $12.37, but would more likely buy at $12.25 or $12.50. Even more investors would choose $12.00 or $13.00. When Martha Stewart placed her now well-known order to sell Imclone stock, it was at $60, not at an odd value.

A good trader can take advantage of this obvious bias for placing orders by avoiding even numbers and looking for *free exposure* when prices move through those levels. Moves through even numbers can be thought of as minor breakouts. If you want to sell a breakout of Imclone at $60, place your sell order at $60.25 to be ahead of the crowd and take advantage of a short but sharp drop caused by the bunching of orders at even numbers.

[7]Gann's work also discusses this topic specifically.

[8]Thomas R. DeMark, "Retracing Your Steps," *Futures* (November 1995). Also see Chapter 2 of DeMark, *The New Science of Technical Analysis* (Wiley, 1994).

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CHANNEL BREAKOUT

The classic upwards *channel* is formed by drawing a straight line along the bottom points of an upwards trend, then constructing a parallel line that touches the extreme high price of that same time interval, forming an envelope, or channel, around a price move. For a downward channel the trendline is first drawn through the high points of the declining price pattern, then a parallel line is drawn through the lowest low price of that interval. It is easy to do this with a chart and a ruler, but not as simple to transfer this concept to a computer program. Because a channel breakout is basic trading strategy, an automated version may prove useful for identifying key market turning points. The four steps to programming this are as follows:

1. *Create a swing chart to identify key high and low points*. The construction of a swing chart is discussed at the beginning of Chapter 5, followed by a computer program that identifies the swing high and low points (in the section "Programming the Swing High and Low Points"). This method used a percentage, called the minimum swing value, *MSV*, to identify a swing high or low. For example, once a price had declined from its recent high by MSV, that previous high becomes the last *swing high*. The swing highs and lows are therefore only found after the fact. When a larger MSV is used, the points identified as swing highs and lows become farther apart and are considered more important, or *major swings*. By creating two swing charts using a small and a large minimum swing value, we can show both major and minor market price swings (see Figure 4.5).

2. *Find a straight-line trend*. Beginning with the last swing high or swing low, use the least squares linear regression to find the straight line through the center of prices that have occurred since that high or low. This is easily done by using the closing prices as the values of Y, and sequential integers 1, 2, 3, …, t for the values of X through today, t, then solving for a and b, the slope and y-intercept.

   straight line values, $Y = a \times X + b$

3. *Draw the channel bands*. Beginning on the first day of the swing high or low, where $X = 1$, calculate the values of Y for all values of X (1, …, n). Find the two prices that are farthest above and below the regression line. These prices will define the upper and lower channel bands:

   Highest relative price, $H_{max} = max(H_n - (a \times C_n + b))$
   Lowest relative price, $L_{max} = max((a \times C_n + b) - L_n)$

   where a and b = the linear regression solution for the slope and y-intercept

   H, L, and C = the high, low, and closing prices on day n
   max = a function that returns the maximum value

   The channel band is found by adding or subtracting H_{max} and L_{max} from the linear regression straight line formula:

   Upper channel band = $(a \times C_n + b) + H_{max}$

   Lower channel band = $(a \times C_n + b) - L_{max}$

   for all values of n beginning with 1.

4. *Project the bands one period ahead*. In order to know whether the next price has broken through the channel, indicating a change of trend, we project the channel one period ahead using the slope value, a,

   Projected upper channel band at $t + 1 = (a \times C_t + b) + H_{max} + a$

$$\text{Projected lower channel band at } t + 1 = (a \times C_t + b) - L_{\max} + a$$

If the trend is up (the slope $a > 0$) and the next price, either the close or the low, is *below* the projected *lower* band, then the trend has turned from up to down. If the trend is down ($a < 0$) and the next price, either the close or high, is greater than the projected upper band, then the trend has turned up. When the slope, a, is very near zero, we have a sideways channel and the same rules still apply. The use of the closing price to decide the breakout, rather than the high or low, is more conservative.

Because a major channel is considered a strong chart formation, prices that approach the channel, but have not penetrated the band, would be candidates for trades. For example, if the trend is down and prices come within 15% of the upper band, we would want to enter a short position (see Figure 4.6) or add to existing short sales. We do not necessarily want to lift those existing shorts at the bottom of the channel, especially if the downtrend is severe; however, this technique offers a clear and safe way to scale into a trade with more than one entry point. The trade is closed out if the price breaks above the upper channel line in a downtrend or the lower channel line in an uptrend. If the trend is sideways (the slope is near zero) then exiting shorts and reversing to a long position is the preferred strategy.

A minor channel can also be used to signal buys and sells within a major channel. By finding swing points using a smaller minimum swing value, we can wait for a break of the minor channel to signal a new trend direction within the major channel. This gives an added confirmation that prices are moving in your direction before entering.

Figure 4.5: Major and minor swings.

Figure 4.6: Entering near the top of a declining channel.

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MOVING CHANNELS

As computers have become common, channels are frequently constructed as moving bands around prices. Some of these, such as those using a standard deviation, can claim statistical significance (these are discussed in Chapter 8, in particular the section "Bollinger Bands"). A simple mathematical way of representing a moving channel might use the average of the high, low, and close to designate the center of the channel (a substitute for the straight line); the upper and lower bands are constructed using the average daily range. The midpoint of the price move M and range R can be calculated over the past n days as

$$M_t = \frac{1}{3n}\sum_{1}^{n}(H_t + L_t + C_t)$$

$$R_t = \frac{1}{n}\sum_{1}^{n}(H_t - L_t)$$

Then the upper and lower channel bands forecasted for the next day are

$$U_{t+1} = M_t + (M_t - M_{t-1}) + wR_t$$

$$L_{t+1} = M_t + (M_t - M_{t-1}) - wR_t$$

The bands are created by extrapolating the average midpoint and adding or subtracting the average daily range R multiplied by a scaling factor w. A long position is taken when the new price $P_{t+1} > U_{t+1}$; a short is taken when $P_{t+1} < L_{t+1}$. If a *channel profit objective* is needed, it can be calculated at a point equal in distance to the channel width from the channel breakout as follows

Long objective (upper band), $UO_{t+1} = U_{t+1} + 2wR_t$

Short objective (lower band), $LO_{t+1} = L_{t+1} - 2wR_t$

Because the value wR_t represents one-half the band width, $2wR_t$, the objective is an equal band width above or below the breakout point on any day. The objective may remain fixed at the price level determined on the day of the breakout, or preferably, will change each day to remain one band width from the new channel value (Figure 4.7). This method relates closely to volatility measures and more examples can be found in Chapter 20.

Figure 4.7: Channel calculation.

An alternate way of defining a channel would be to forecast one day ahead using the slope of a regression analysis (*linear* for a straight channel, *log* for a curved one) and use the standard deviation of the price changes to define the band. The other rules would remain the same.[9]

[9]For a further discussion of channels, see Donald Lambert, "Commodity Channel Index," *Technical Analysis of Stocks & Commodities* (October 1980), and John F. Ehlers, "Trading Channels," *Technical Analysis of Stocks & Commodities* (April 1986).

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COMBINING TECHNIQUES

Richard D. Wyckoff, popular in the early 1930s, relied solely on charts to determine the motives behind price behavior. He combined the three most popular methods—bar charting, point charts (the predecessor of point-and-figure charts), and waves—to identify the direction, the extent, and the timing of price behavior, respectively.[10]

To Wyckoff, the bar chart combined price and volume to show the direction of the price movement. In general terms, it shows the trading ranges in which supply and demand are balanced. The volume complemented this by giving the intensity of trading, which relates to the *quality* of the long or short position. Wyckoff used *group charts*, or indices, in the manner of Charles Dow, to select the stocks with the most potential, rather than looking only at individual stock price movement. This assures that the move is based on the broader nature of the business, rather than on company politics. In today's market we can use the S&P 500 or sector indices to accomplish the same objective.

Point-and-figure charts are used to condense price action. If prices move from lower to higher levels due to events, the time it takes to reach the new level is unimportant. Point-and-figure charts record events, not time. As long as prices rise without a significant reversal, the chart uses only one column; when prices change direction, a new column is posted (see the point-and-figure section and the swing trading section in Chapter 5). Price objectives can be determined from formations in a point-and-figure chart usually related to the length of the sideways periods, called *horizontal formations*. These objectives are very different and normally closer than objectives found using similar bar chart formations.

The *wave chart*, similar to Elliott's theories (discussed in Chapter 14), represents the behavior of investors and the natural rhythm of the market. Wyckoff uses these waves to determine the points of buying and selling within the limitations defined by both the bar chart and point-and-figure charts. He considered it essential to use the wave charts as a leading indicator of price movement.

Wyckoff used many technical tools but not rigidly. He did not believe in unconfirmed fundamentals but insisted that the market action was all you needed—the market's primary forces of supply and demand could be found in charts. He did not use triangles, flags, and other formations, which he considered to be a type of Rorschach test, but limited his analysis to the most basic patterns, favoring horizontal formations or congestion areas. He used time-based and event-based charts to find the direction and forecast price movement, then relied on human behavior (in the form of Elliott waves) for timing. His trading was successful and his principles have survived.

[10] Jack K. Hutson, "Elements of Charting," *Technical Analysis of Stocks & Commodities* (March 1986).

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COMPLEX PATTERNS

Most charting systems involve a few simple rules, trying to model a price pattern that seems to have repeatedly resulted in a profitable move. The most popular systems are simply a breakout of a previous high or low, either a horizontal pattern or a trend channel. Over the years these approaches have proved to be steady performers. Another group of traders might argue that is it better to be more selective about each trade and increase the expectation of a larger profit than it is to trade frequently in order to win with the long term probabilities—that is, playing a statistical numbers game.

DeMark's Sequential™

Tom DeMark has created a strategy, called a *sequential*, that finds a very overextended price move, one that is likely to change direction, and takes a countertrend position.[11] His selling objective is to identify the place where the last buyer has bought. His rules use counting and retracements rather than mathematical formulas or trendlines. To get a buy signal, the following three steps are applied to daily data:

1. *Setup*. To begin, there must be a decline of at least nine or more consecutive closes that are lower than the corresponding closes four days earlier (*close* — *close*[4] < 0). In the case where today's close is equal to or greater than the close four days before, the setup must begin again.

2. *Intersection*. To assure that prices are declining in an orderly fashion, rather than plunging, the high of any day on or after the eighth day of the setup must be greater than the low of any day three or more days earlier. Note that there can be a delay before the intersection occurs provided that the pattern is not negated by the rules in Step 3.

3. *Countdown*. Once the setup and intersection have been satisfied, we count the number of days in which the close was lower than the close two days ago (*close* < *close*[2]). The days that satisfy this countdown requirement do not need to be continuous. When the countdown reaches 13, we get a buy signal *unless* one of the following conditions occurs:

    a. There is a close that exceeds the highest intraday high that occurred during the setup stage.

    b. A sell setup occurs (nine consecutive closes above the corresponding closes four days earlier).

    c. Another buy setup occurs before the buy countdown is complete. In this case the rules begin again at Step 2. This condition is called *recycling*.

A sequential buy signal is shown in Figure 4.8 for the Deutsche mark. For the sequential pattern, the sell signal is the reverse of the buy. Traders should expect that the development of the entire formation will take no less than 21 days, but typically 24 to 39 days.

Figure 4.8: A *sequential* buy signal in the Deutsche mark. *Source*—Logical Information Machines, Inc. (LIM), Chicago, IL.

Entering the Sequential

Once the buy signal occurs there are three choices for entering the market. The first is to enter on the close of the day on which the countdown is completed; however, this risks a new setup situation which will extend the conditions for an entry. The second requires a confirmation of price direction, the close greater than the close four days ago, but it avoids the possibility of recycling. The third is to enter a long when the close is greater than the high two days earlier, a compromise between the first two techniques.

Exiting the Sequential

A number of exit conditions, consistent with the type of patterns, provide the trader with clear rules to liquidate the current trade. First, the current buy setup is complete and the lowest price recorded does not exceed the furthest price recorded by the recent inactive setup (normally the previous sell setup). If, however, any price recorded in the current buy setup exceeds the furthest price of the previous sell setup, then the position is held until a reverse signal occurs.

Two stop-losses are also recommended. For a buy signal, the true range of the lowest range day of the combined setup and countdown period is subtracted from the low of that lowest day to create a stop-loss. Alternately, the difference between the close and the low of the lowest day is subtracted from the low of the lowest day to form a closer stop-loss.

Thinking about Complex Patterns

There seems to be an extreme contrast between the simplicity of a breakout system and the very complex set of circumstances that produce a signal for DeMark's sequential. The basic breakout system can be tested for robustness by comparing the performance of slightly longer and shorter calculation periods. As the calculation period becomes larger, the trades should become more selective, the profits per trade become larger, and the overall performance profile improves. In the case of a single pattern, such as an island reversal or DeMark's sequential, there is no way to measure robustness in the same terms. For the sequential, there is only one count of 13 days and one pattern. Robustness can only be found by applying this method across different, unrelated markets. Each trader must decide whether this pattern, or any other complex set of rules, produces a better set of trades, or whether it is too demanding to survive the test of time.

[11]Thomas R. DeMark, *The New Science of Technical Analysis* (John Wiley, 1994).

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A STUDY OF CHARTING PATTERNS

There has always been a chasm between academics and practitioners over the value of technical analysis. Financial scholars have referred to charting as "voodoo finance," while technicians believe that their trading success is enough to refute academic conclusions that charting has little value. After all, it took many years of profitable public performance before trend following gained the attention of academics; there is no reason to expect something more complicated to take less time.

Computer Recognition of Chart Patterns

A very credible attempt to quantify charting patterns and assess their value was published by Lo, Mamaysky, and Wang.[12] The authors applied kernel regression as a smoothing technique, then defined ten charting formations in the context of the smoothed price series. For example, a head-and-shoulders top formation is defined in terms of the most recent five local maxima and minima in the smoothed series, E_1, E_2, E_3, E_4, and E_5. In the definitions of the tops, which follow, E_1, E_3, and E_5 are *maxima* and E_2 and E_3 are *minima*; for the bottom formations, which are not shown, E_1, E_3, and E_5 are *minima* and E_2 and E_3 are *maxima*.

Head-and-shoulders top:

$E_3 > E_1$, $E_3 > E_5$

E_1 and E_5 are with 1.5% of their average

E_2 and E_4 are with 1.5% of their average

Broadening top:

$E_1 < E_3 < E_5$

$E_2 > E_4$

Triangular top:

$E_1 > E_3 > E_5$

$E_2 < E_4$

Rectangular top:

1. Tops are within 0.75% of their average
2. Bottoms are within 0.75% of their average
3. Lowest top > highest bottom

Double top:

E_1 and E_b are within 1.5% of their average, where E_1 is a maxima $t_a^* - t_1^* > 22$

The identification of formations used a rolling window of 38 trading days; the notation t represents the first day of the

current window, 37 days back. We interpret the notation $t_a^* - t_1^*$ > 22 to mean that the two extrema E_1 and E_b must be separated by more than 22 days.

Although the definitions are logical, the authors accept the differences between a mathematical definition of a charting formation and the visual, cognitive approach taken by a technical analysis. The human brain can assimilate and recognize more complex and subtle formations than the simple definitions presented in the paper. Then, on the one hand we have a somewhat limiting definition of chart patterns, and on the other we have the way in which humans select which patterns they choose to trade. It is far from certain which approach will yield the best returns.

The ten patterns defined were head-and-shoulders tops and bottoms, broadening tops and bottoms, triangular tops and bottoms, rectangular tops and bottoms, and double tops and bottoms. In an example of the triangular formations, the key points used to identify the pattern did not align to form classic straight line sides; however, the consolidating formation that was recognized is itself a good candidate for analysis.

The success of the formation was measured by the returns over the three days immediately following identification. In addition, the formations were conditioned on the trend of volume, that is, returns were separated into formations that develop with increasing volume and decreasing volume.

Results of the Study

Tests were performed on several hundred U.S. stocks traded on both the NYSE and Nasdaq, from 1962 through 1996. The most common formations, the double top and double bottom, showed more than 2,000 occurrences of each. The next most frequent were the head-and-shoulders top and bottom, with over 1,600 appearances each. As a control, a random, synthetically created price series was also tested and showed only ⅓ the number of head-and-shoulder formations. It argues that charting patterns are formed by the actions of the participants rather than by random events. Based on the number of stocks tested, the head-and-shoulders formation appeared about once each year for each stock.

All but one of the chart formations (the triangular top) showed positive returns for the three days following the identification of the formation. Of these, 5 were rated as *statistically significant*: the head-and-shoulders top, the broadening bottom, the rectangular top, the rectangular bottom, and the double top.

When formations were conditioned on rising or declining volume, the results changed for some of the patterns. In general, rising volume improved results. Falling volume was better for the head-and-shoulders top, and the rectangular top and bottom. Most analysts would expect rising volume to favor bottom formations and declining volume to improve most top formations; an academic study that contests this concept is likely to be viewed skeptically.

On the whole, technical analysis would not be disappointed with the conclusions of this study. Although the chart patterns may not meet the strict definition set by an experienced technician, they did capture the spirit of the formation and showed that positive returns followed. Confirmation is gratifying; any other conclusion would have been ignored.

[12]Andrew W. Lo, Harry Mamaysky, and Jiang Wang, "Foundations of Technical Analysis: Computational Algorithms, Statistical Inference, and Empirical Implementation," *The Journal of Finance* (August 2000).

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Chapter 5: Event-Driven Trends

OVERVIEW

The most basic trend systems are those that base their direction on the reaction of prices to events. These events can be government policy announcements, such as interest rate changes, natural disasters that cause a shortage in supply or an increase in demand, war that interrupts production and shipping, earnings reports, and scandals that affect investor confidence.

The impact of these material events can be long-term, temporary, or even structural, but they always cause an immediate change in price. Everyday news is filled with these items that cause investors to either buy or sell, sometimes offsetting the effects of each other. Most often the result on price movement is small, but occasionally it can be a dramatic price shock.

Among the earliest of trading systems are those that signaled a new upwards trend when prices moved higher than they had been for some time. There is no math required, simply the idea that, if prices moved to a new high or new low, then something important has changed. It is intuitively sensible and has proved to be a successful strategy. As you progress through this book and become familiar with more complex and mathematically intricate techniques, continually ask yourself to what degree the newer methods have improved on the older, simpler ways of recognizing a trend.

We begin the presentation of trading systems with these event-driven trends. A fundamental understanding of these methods is essential to every trader.

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SWING TRADING

A *price swing* is a sustained price movement. An upwards swing ends with a *swing high*, or *peak*, and a downward swing ends with a *swing low*, or *valley*. The distance from a peak to a valley is the *swing*. A swing can be small or large, depending on the sensitivity of the swing chart. You can choose to plot only the major price moves, or you can fill the chart with the smallest of price reversals. The only requirement is that each swing be greater than a minimum, expressed as cents or dollars per share, or a percentage of the current share price. This minimum value, called the *swing filter*, determines the frequency of the swings and therefore the sensitivity of the chart.

Figure 5.1 shows a representation of price movement on the left, and a corresponding swing chart on the right. The minimum size of the swing, or filter, is shown to the right of the swing chart. No swing can be less than the filter size. Note that the swing chart is much smaller than the price chart. It needs one column for each day. If the price swing continues higher, the swing line is extended upwards to the new high, staying in the same column. If there were only 10 swings in six months, the swing chart would have six columns while the bar chart would have about 126 columns, one for each day.

Figure 5.1: A standard bar chart with a corresponding swing chart. (a) Bar chart. (b) Swing chart.

Constructing a Classic Swing Chart

A classic technique for finding the swing highs and lows uses the following seven steps[1] as shown in Figure 5.2. This can be applied to either daily data, or intraday bars; therefore, we will call each new piece of data a *bar*.

1. Begin on a bar (or new day) where the highs and lows are both higher than the highs and lows of the previous bar (an *upswing*), or both lower than the highs and lows of the previous bar (a *downswing*).
2. If prices are in an upswing, connect the highs of the two bars.
3. If the next period continues to have higher highs and higher lows, connect the highs.

4. Ignore bars that have lower highs and higher lows.

5. Continue until a bar occurs that has a lower low *without* making a higher high. This indicates a possible swing change based on the pattern of the next bar.

6. If the next bar has a lower high and lower low, the highest high of the swing is connected to the new lowest low and a swing change has occurred.

7. If the swing reversal fails, the upswing continues when a new higher high and higher low occurs.

This particular method is called a *2-day* (2-period) technique because it requires two periods to identify a swing change. The sensitivity of the swing chart can be reduced by requiring that a swing change only occurs after three or more days where prices reverse their direction. If prices were in an uptrend and a 4-day swing technique was being used, a reversal to a downswing would require four consecutive days with lower lows and no higher highs.

Figure 5.2: Constructing a classic swing chart. *Source*—William Eng, "A Mechanical Trading System," *Technical Analysis of Stocks & Commodities*, 4, no. 7 (July 1986). © 1986 Technical Analysis, Inc. Used with permission.

[1]Based on William F. Eng, "A Mechanical Trading System," *Technical Analysis of Stocks & Commodities* (July 1986). Further information can be found in Eng, *The Technical Analysis of Stocks, Options & Futures* (Probus, 1988).

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CONSTRUCTING A SWING CHART USING A SWING FILTER

A very popular way of creating a swing chart uses a *swing filter* to define the sensitivity of the swings. The swing filter can be a value per share, or a percentage of the current or average share price. The following example uses cents per share. The basic eight rules for creating this swing chart are:

1. Select a stock or futures market and decide your chart sensitivity. Figure 5.3a is a standard bar chart of Merck from the end of 2002 through May 2003. The average price is about $18 and we select a swing filter of 75¢, about 4%.
2. Beginning in December 2002, plot the first bar or day from the high to the low as a vertical line in the first column of the swing chart. The top of the bar is now called the swing high and the bottom is the swing low. Assume that prices are in an upswing. If the assumption is wrong, the chart will correct itself soon.
3. Move to the next day or, if intraday, move to the next bar.
4. If prices are in an upswing, continue with Step 5, otherwise go to Step 7.
5. Prices are in an upswing and the high of the new day is higher than the current swing high. Extend the line higher, staying in the same column, to the point of the new high. Because prices are in an upswing, the lows of the bar are ignored.
6. Prices are in an upswing and the high of the current bar is not higher than the current swing high. Look at the low price. If the swing high minus the current low is less than the swing filter of 75¢, then ignore this new price data. If the swing high minus the current bar low is equal to or greater than the swing filter, then move one column to the right and draw a new vertical line starting at the previous swing high and extending down to the current bar low. Connect the top of the previous bar to the top of the current bar. Continue with Step 3.
7. Prices are in a downswing and the low of the new day is lower than the current swing low. Extend the line lower, staying in the same column, to the point of the new low. Because prices are in a downswing, ignore the highs of the bar.
8. Prices are in a downswing. If the low of the current bar is not lower than the current swing low, then look at the high. If the current high minus the swing low is less than the swing filter of 75¢, then ignore the new data If the current bar high minus the swing low is equal to or greater than the swing filter, then move one column to the right and draw a new vertical line starting at the previous swing low and extending upwards to the current bar high. Connect the bottom of the previous bar to the bottom of the current bar. Continue with step 3.

Figure 5.3a: Merck bar chart, December 2002 through May 2003.

The result can be seen in Figure 5.3b as a swing chart. Note that the swing chart is much smaller than the bar chart, having only about 20% of the bars. The swing chart can be larger or smaller, more sensitive or less sensitive to price movement, as the swing filter becomes larger or smaller.

Figure 5.3b: Corresponding swing chart of Merck using a swing filter of 75 cents.

Rules for Trading a Swing Method

Each vertical line on a swing chart represents a price trend. There are two sets of rules commonly used that enter positions in the trend direction:

1. (Conservative) *Buy* when the high of the current bar exceeds the high of the previous bar. *Sell* when the low of the current bar falls below the low of the previous bar.
2. (Active) *Buy* as soon as a new upswing is recognized. *Sell* when a new downswing is recognized. Both of these occur at the time a new vertical line begins.

Secondary signals are given if the new signal occurs in the same direction as the existing trend. When using the conservative rules, a stop-loss order can be placed at the point of a trend reversal (when the swing direction changes) or at a point of fixed dollar loss.

The Swing Philosophy

The primary advantage of a swing method, and most event-driven trend systems, is that no action occurs if prices move sideways. We will see in the next two chapters that a trend that creates a value for each bar, such as a moving average, has an agenda. That is, prices must continue to advance if the trend is to remain intact. In a swing philosophy, prices can move sideways or stand still within a trend. Prices can move up and down in any pattern as long as they do not violate the lows in an upswing or the highs in a downswing. This characteristic of event-driven systems makes them very robust at a cost of higher risk.

Another benefit of the swing method is that it often signals a new trade at the moment of a significant event. If the news is a surprise to the market, then prices move out of their current trading levels to new highs or new lows. This immediate response is a very positive feature for most traders, who want to act ahead of the crowd.

The following systems are simple variations of the swing method of charting.

The Livermore System

Known as the greatest trader on Wall Street, Jesse Livermore was associated with every major move in both stocks and commodities during the 30-year period from 1910 to 1940. Livermore began his career as a board boy, marking prices on the high slate boards that surrounded the New York Stock Exchange floor. During this time, he began to notice the distinct patterns in the price movement that appeared in the columns of numbers.[2] As Livermore developed his trading skills and eventually took his position as a professional trader, he maintained the habit of writing prices in columns headed Secondary Rally, Natural Rally, Up Trend, Down Trend, Natural Reaction, and Secondary Reaction. This may have been the basis for what is now considered a swing chart.

Livermore's approach to swing trading required two filters, a larger *swing filter* and a *penetration filter* of one-half the size of the swing filter. Penetrations were significant at price levels he called pivot points. A *pivot point* is defined in retrospect as the top and bottom of each new swing and are marked with letters in Figure 5.4.[3]

Figure 5.4: Livermore's trend change rules.

Livermore's trading technique is a unique interpretation of the swing chart. Positions are taken only in the direction of the major trend. A major uptrend is defined by confirming higher highs and higher lows, and a downtrend by lower lows and lower highs, and where the penetration filter is not broken in the reverse direction. That is, an uptrend is still intact as long as prices do not decline below the previous pivot point by as much as the amount of the penetration filter (seen in Figure 5.2). Once the trend is identified, positions are added each time a new penetration occurs, confirming the trend direction. A stop-loss is placed at the point of penetration beyond the prior pivot point. Unfortunately, the penetration filter is not the same as a pivot point and Livermore never revealed how it was calculated. It seems, however, to be a minor percentage (for example, 20%) of the current swing size.

Failed Reversal

In the Livermore system, the first penetration of the stop-loss calls for liquidation of the current position. A second penetration is necessary to confirm the new trend. If the second penetration fails (at point *K* in Figure 5.5), it is considered a *secondary reaction* within the old trend. The downtrend may be reentered at a distance of the swing filter below *K*, guaranteeing that point *K* is defined, and again on the next swing, following pivot point *M*, when prices reach the penetration level below pivot point *L*. It is easier to reenter an old trend than to establish a position in a new one.

Figure 5.5: Failed reversal in the Livermore method.

Percentage Swings

The minimum swing value, which determines the swing high and low points, can be more robust if it is expressed as a percentage of price rather than as a fixed dollar per share or point value. Many markets have doubled in value—or halved—or both—over the past ten years. During quiet market periods stocks will split, causing the new share price to be significantly lower than the day before. Using a fixed value for finding the swing highs and lows will cause the swing chart to be insensitive to price movement at low prices and show frequent changes in swings at higher prices. The swing filter, expressed as a percentage p, avoids this problem.

Minimum swing value $\quad MSV_t = p \times price_t$

This variable swing filter helps to keep the sensitivity of the swings the same over a long period, which is very helpful for back-testing of results. The swing trading rules do not change. We *buy* when prices move up from the recent swing lows by more than the current value of the swing filter MSV_t, and *sell* when prices fall from the swing high by more than the current value of MSV_t. The risk of each trade is always equal to the current value of MSV_t.

Programming the Swing High and Low Points

The following TradeStation EasyLanguage program, KSWING, plots the swing high and low based on a percentage minimum swing value. For percentage swings applied to the interest rate futures markets, *yield* should be used rather than *price*. A very rough approximation of yield from price based on a 6% par value (the price is 100 at 6% yield) is *yield* = 600/*price*.

```
{ KSWING: Finds most recent swing highs and lows.
Plots values on a TradeStation chart. Copyright 1994-95, P. J. Kaufman.
All rights reserved.

Inputs for KSWING:
  swing = price swing in whole % }

input: swing(2.5);
vars: pcswing(0),last(0),curhigh(0),curlow(0),swhigh(0),swlow(0),
      highbar(0),lowbar(0),chighbar(0),clowbar(0),lowp(0),highp(0),
      xclose(0),xhigh(0),xlow(0),divide(4);

pcswing = swing/100.;
{ Adivide@ positions the high or low market on the plot }
divide = 4;
factor = 1;

{ INITIALIZE MOST RECENT HIGH AND LOW }
if currentbar = 1 then begin
   curhigh = close;          { current high }
   curlow = close;           { current low }
   end;

{ SEARCH FOR A NEW HIGH—favor reversals }
if last<>1 then begin

{ REVERSE FROM HIGH IF MINIMUM % SWING }
```

```
if low <curhigh - curhigh*pcswing then begin
   last = 1;                { last high fixed }
   swhigh = curhigh;        { new verified high }
   highbar = chighbar;
   curlow = low;            { initialize new lows }
   lowp = low;              { swing low for plot }
   clowbar = currentbar;
   plot1[currentbar-highbar](high[currentbar-highbar]+
      highp*pcswing/divide,"swinghigh");
   end
else begin
      if high > curhigh then begin
             curhigh = high; { new current high }
         chighbar = currentbar;
      end;
  end;
end;

{ SEARCH FOR A NEW LOW - favor reversal }
if last <> -1 then begin
{ REVERSAL FROM LOW IF MINIMUM % SWING }
if high > curlow + curlow*pcswing then begin
   last = -1;
   swlow = curlow;
   lowbar = clowbar;
   curhigh = high;        { initialize current high }
   highp = high;          { swing high for plot }
   chighbar = currentbar;
   plot2[currentbar-lowbar](low[currentbar-lowbar]-
        lowp*pcswing/divide,"swinglow");
   end
  else begin
   if low < curlow then begin
      curlow = low;
      clowbar = currentbar;
      end;
    end;
 end;
```

Figure 5.6 shows the results of KSWING. The dots above the price peaks are the swing highs of the S&P 500 futures prices, and the dots below are swing lows. The swing filter is 5%; therefore each price swing from a high to a low must show a price difference of at least 5%.

Figure 5.6: Swing high and low points, using a swing filter of 5%, are shown for the S&P 500 futures.

Finding the Swing High and Low Points Automatically Using Excel

Set up your columns with the following data:

```
A   Date
B   High price
C   Low price
D   Closing price
```

Put the minimum swing percentage value in cell C3 (for example, 5% =.05)

Put the following formulas in the corresponding cells. Row 6 initializes the process.

```
E6   =B6 (the current swing high)
F6   =C6 (the current swing low)
G6   =IF(D6>(E6+F6),-1,1) (where -1 is a downswing and +1 is an upswing)
```

Row 7 is the beginning of the repeated process. Row 7 can be copied down.

```
E7   =IF($G6=-1#AND#b7>E6,B7,IF($G6=1,B7,E6))    (the new current low)
F7   =IF($G6=1#AND#C7<F6,C7,IF($G6=-1,C7,F6))    (the new current high)
G7   =IF($G6=-1,IF(C7<E7 - $C$3*D7,1,$G6),IF(B7>F7+$C$3*D7,-1,$G6))
                                                  (test high or low)
H7   =IF($G7=1#AND#G6=-1,E7,H6)                  (the new swing high)
I7   =IF($67=-1#AND#G6=1,F7,I6))                 (the new swing low)
```

Keltner's Minor Trend Rule

One of the classic trading systems is the Minor Trend Rule published by Keltner in his book, *How to Make Money in Commodities* (The Keltner Statistical Service). It is still followed closely by a great part of the agricultural community and should be understood for its simplicity and potential impact on markets. Sophisticated analysts must always remember that a large part of trading activity is the result of straightforward decisions that do not use high technology.

Keltner defines an upward trend by the failure to make new lows (comparing today's low with the prior day) and a downtrend by the absence of new highs. This notion is consistent with chart interpretation of trendlines by measuring upward moves along the bottom and downward moves along the tops. The Minor Trend Rule is a plan for using the daily trend as a trading guide. The rule states that the *minor trend* turns up when the *daily trend* sells above its most recent high; the *minor trend* stays up until the *daily trend* sells below its most recent low, when it is considered to have turned down. In order to trade using the Minor Trend Rule, buy when the minor trend turns up and sell when the minor trend turns down; always reverse the position.

The Minor Trend Rule is a simple short-term trading tool, buying on new highs and selling on new lows. It is a breakout method in the style of *swing trading* and can be used as a leading indicator of the major trend. It requires frequent trading in most markets, with risk varying according to the volatility of the market. Keltner's Minor Trend Rule is the basis for a number of current technical systems that vary the time period over which prior highs and lows are established and consequently increase the interval between trades and the risk of each trade. An advantage of the Keltner approach is that, as with swing trading, it imposes no arbitrary restrictions on the analysis of prices, such as a breakout of 100 points.

Wilder's Swing Index

Another programmable method for determining swings is presented with trading rules in Wilder's *Swing Index System*.[4] Wilder determined that the five most important positive patterns in an uptrend are:

1. Today's close is higher than the prior close.
2. Today's close is higher than today's open.
3. Today's high is greater than the prior close.
4. Today's low is greater than the prior close.
5. The prior close was above the prior open.

In a downtrend, these patterns are reversed.

The *Swing Index*, SI, combines these five factors, then scales the resulting value to fall between 100 and + 100 as follows:

$$SI = 50 \times \left(\frac{(C_t - C_{t-1}) + .5(C_t - O_t) + .25(C_{t-1} - O_{t-1})}{R} \right) \times \frac{K}{M}$$

where K = the largest of $| H_t, - C_{t-1} |$ and $| L_t - C_{t-1} |$

M = the value of a limit move

R = the *true range*, calculated from the following two steps:

1. Determine which is the largest of
   a. $|H_t - C_{t-1}$
   b. $|L_t - C_{t-1}$
   c. $|H_t - L_t|$
2. Calculate R according to the corresponding formula:
   a. $R = |H_t - C_{t-1}| - .5 \times |L_t - C_{t-1}| + .25 \times |C_{t-1} - O_{t-1}|$
   b. $R = |L_t - C_{t-1}| - .5 \times |H_t - C_{t-1}| + .25 \times |C_{t-1} - O_{t-1}|$
   c. $R = |H_t - L_t| + .25 \times |C_{t-1} - O_{t-1}|$

Although the usefulness of the SI cannot be determined without proper testing, the formulas combine factors that seem reasonable. The SI calculation uses three price relationships: the net price direction (close-to-close), the strength of today's trading (open-to-close), and the memory of yesterday's strength (prior open-to-close). It then uses the additional factor of volatility as a percentage of the maximum possible move (*K/M*). The rest of the formula simply scales the results to within the range of -100 to +100. In the first step of the calculation of *R*, the concept of the true range reappears.

The daily values are added together to form an *Accumulated Swing Index* (ASI), which is substituted for the price chart, allowing ready identification of the significant highs and lows as well as clear application of Wilder's trading rules.

The terms used in the trading rules are:

HSP *High swing point*—Any day on which the ASI is higher than both the previous and the following day.

LSP *Low swing point*—Any day on which the ASI is lower than both the previous and the following day.

SAR *Stop and reverse* points (three types)—*Index SAR* points generated by the ASI calculation, *SAR* points applied to a specific price, and *Trailing Index SAR*, which lags 60 ASI points behind the best ASI value during a trade.

The Swing Index System rules are:

1. Initial entry:
   a. Enter a new long position when the ASI crosses above the previous HSP.
   b. Enter a new short position when the ASI crosses below the previous LSP.
2. Setting the SAR point:
   a. On entering a new long trade, the SAR is the most recent LSP; the SAR is reset to the first LSP following each new HSP. A trailing SAR is determined as the lowest daily low occurring between the highest HSP and the close of the day on which the ASI dropped 60 points or more.
   b. On entering a new short trade, the SAR is the most recent HSP; the SAR is reset to the first HSP following each new LSP. The *trailing SAR* is determined as the highest daily high occurring between the lowest LSP and the close of the day on which the ASI rose by 60 points or more.

[2]Edwin Lefèvre, *Reminiscences of a Stock Operator* (Books of Wall Street, Burlington, VT, 1980). First published by George H. Doran, 1923.

[3]Jesse Thompson, "The Livermore System," *Technical Analysis of Stocks & Commodities* (May 1983).

[4]J. Welles Wilder, Jr., *New Concepts in Technical Trading Systems* (Trend Research, Greensboro, NC, 1978).

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POINT-AND-FIGURE CHARTING

There does not appear to be any record of which came first: swing charting or point-and-figure charting. Both methods are very similar; however, point-and-figure has a much more extensive following. Point-and-figure charting is credited to Charles Dow, who is said to have used it just prior to the turn of the twentieth century. This method is similar to swing charting and has three important characteristics:

1. It has simple, well-defined trading rules.
2. It eliminates price reversals that are below a minimum (box) value.
3. It has no time factor (it is *event-driven*). As long as prices fail to change direction by the *reversal value*, the trend is intact.

When point-and-figure charting first appeared, it did not contain the familiar boxes of *X*s and *O*s. The earliest book containing the subject is reported to be *The Game in Wall Street and How to Play it Successfully*, published by Hoyle (not Edmond Hoyle, the English writer) in 1898. The first definitive work on the subject was by Victor De Villiers, who in 1933 published *The Point and Figure Method of Anticipating Stock Price Movement*. De Villiers worked with Owen Taylor to publish and promote a weekly point-and-figure service, maintaining their own charts; he was impressed by the simple, scientific methodology. As with many of the original technical systems, the application was intended for the stock market, and the rules required the use of every price change appearing on the ticker. It has also been highly popular among futures traders in the grain and livestock pits of Chicago. The rationale for a purely technical system has been told many times, but an original source is often refreshing. De Villiers said:[5]

> *The Method takes for granted:*
>
> 1. *That the price of a stock at any given time is its correct valuation up to the instant of purchase and sales (a) by the concensus of opinion of all buyers and sellers in the world and (b) by the verdict of all the forces governing the laws of supply and demand.*
> 2. *That the last price of a stock reflects or crystalizes* everything *known about or bearing on it from its first sale on the Exchange (or prior), up to that time.*
> 3. *That those who know more about it than the observer* cannot *conceal their future intentions regarding it. Their plans will be revealed in time by the stock's subsequent action.*

The unique aspect of the point-and-figure and swing methods is that they ignore the passage of time. Unlike bar charts, you do not make a single vertical mark and then move to the right a uniform distance. Each column of a point-and-figure chart can represent any length of time. The measurement of a significant change in price direction alone determines the pattern of the chart. The point-and-figure chart differs from the swing chart in that each column representing an upswing is a series of boxes containing *X*s and each downswing is shown as a string of *O*s (Figure 5.7).

Silver

854.0	X									
853.0	X	O	X							
852.0	X	O	X	O						
851.0		O	X	O	X					
850.0		O		O	X	O				
849.0				O	X	O				
848.0				O	X	O				
847.0				O						
846.0										

Figure 5.7: Point-and-figure chart.

The original *figure charts* were traditionally plotted on graph paper with square boxes, and only dots, or the exact price, were written in each box. The chart evolved to have prices written on the left scale of the paper, where each box represented a minimum price move. Some point-and-figure chartists then used a combination of *X*s and occasional digits (usually 0s and 5s every five boxes) to help keep track of the length of a move. In some cases the top of an upswing column was connected to the start of a downswing in the next column with a crossbar, and the bottom of a downswing column was connected to the beginning of the next upswing column. This gave the point-and-figure chart an appearance similar to the swing chart. Charts using one, three, and five points per box were popular, where each point represented a minimum price move. In the five-point method, no entry was recorded unless the price change spanned five points.

Point-and-figure charts, which are still commonly used on the floor of the Chicago Mercantile Exchange and the Chicago Board of Trade, are recorded to show the

greatest detail. Each box represents the minimum allowable price move, and reversals of direction use the traditional three-box criteria. Floor traders use the charts to show only the short-term price moves and leave a lot to the interpretation of patterns.

Plotting Prices Using the Point-and-Figure Method

To plot prices on a point-and-figure chart, start with a piece of square-box graph paper and mark the left scale using a conveniently small price increment. For example, each box may be set at 25¢ for Microsoft, 50¢ for IBM, 5.0 points for S&P 500 index, $1 for gold and platinum, 4/32 for 30-year bond futures, 1¢ for soybeans and silver, and so forth (see Figure 5.7). The choice of a box size will make the chart more or less sensitive to changes in price direction as will be seen in later examples. The smaller the box size, the more changes in direction will be seen. This also corresponds to longer and shorter trends or major and minor trends. Therefore, a point-and-figure chartist looking for a long-term price movement will use a larger box size. Box sizes are often related to the current volatility of the markets.

Once the graph paper has been scaled and the prices entered along the left side, the chartist can begin. The first box is entered with the current closing price of the market. If the price of silver is 852.50 and a 1¢ (1¢ = 1.00) box is being used, a mark is placed in the box beside the value 852. An *X* or an *O* is used to indicate that the current price trend is up or down, respectively. Either an *X* or *O* may be used to begin—after that, it will be determined by the method.

The rules for plotting point-and-figure charts are easily shown as a flowchart in Figure 5.8. Preference is given to price movements that continue in the direction of the current trend. Therefore, if the trend is up (represented by a column of *X*s), the new high price is tested first; if the trend is down, the low price is given preference. The opposite price is checked only if the new price fails to increase the length of the column in the direction of the current trend.

Figure 5.8: Point-and-figure daily rules.

The traditional point-and-figure method calls for the use of a *three-box reversal*, that is, the price must reverse direction by an amount equal to 3 boxes from the most extreme box of the last column before a new column can begin (it actually must fill the fourth box since the extreme box is left blank). The importance of keeping the 3-box reversal has long been questioned by experienced point-and-figure traders. It should be noted that the net reversal amount (the box size times the number of boxes in the reversal) is the critical value. For example, a 5-point box for Nasdaq 100 ETF (QQQ) with a 3-box reversal means that QQQ prices must reverse from the lows of the current downtrend by 15 points to indicate that an uptrend has started. The opposite combination, a 3-point box and a 5-box reversal, would signal a new trend at the same time, after a 15-point reversal. The difference between the two choices is that the smaller box size would recognize a smaller continuation of a price move by filling more boxes. Ultimately the smaller box size will capture more of the price move; it is considered the preferable alternative. The choice of box size and reversal boxes will be considered later in more detail.

Point-and-Figure Chart Formations

It would be impossible for the average speculator to follow the original method of recording every change in price. When applied to stocks, these charts became so lengthy that interpretations of common patterns were necessary to select the best trading signals. In 1965, Robert E. Davis published *Profit and Profitability*, a point-and-figure study that detailed eight unique buy and sell signals. The study covered two stocks for the years 1914–1964, and 1100 stocks for 1954–1964. The intention was to find specific bull and bear formations that were more reliable than others. The study concluded that the best buy signal was an *ascending triple top* and the best sell signal was the *breakout of a triple bottom*, both shown in Figure 5.9 and with the other patterns studied in Figure 5.10.

Figure 5.9: Best formations from Davis' study.

Figure 5.10: (a) Compound point-and-figure buy signals. (b) Compound point-and-figure sell signals.

Plotted using daily data, futures prices do not offer the variety of formations available in the stock market. The small number of markets and the high correlation of movement between many of the index and interest rate markets make the limitations of signal selection impractical. Instead, the most basic approach is used, where a buy signal occurs when an *X* in the current column is one box above the highest *X* in the last column of *X*s, and the simple sell signal is an *O* plotted below the lowest *O* of the last descending column. The flexibility of the system lies in the size of the box; the smaller the size, the more sensitive the chart will be to price moves. In 1933, Wyckoff noted that it was advisable to use a chart with a different box size when the price of the stock varied substantially.[6]

Point-and-Figure Trendlines

Bullish and bearish trendlines are commonly used with point-and-figure charts. The top or bottom box that remains blank when a reversal occurs can form the beginning of a descending or ascending pattern at a 45° angle (diagonally through the corners of the boxes, providing the graph paper has square boxes). These 45° lines represent the major anticipated trends of the market. Once a top or bottom has been identified, a 45° line can be drawn down and to the right from the upper corner of the top boxes of *X*s, or up and towards the right from the bottom of the lowest box of *O*s (Figure 5.11). These trendlines are used to *confirm* the direction of price movement and often restrict the basic point-and-figure trading signals so that only long positions are taken when the 45° trendline is up and only

shorts are entered when the trendline is down.

Figure 5.11: Point-and-figure trendlines.

Point-and-Figure Studies

In 1970, Charles C. Thiel, Jr., with Robert E. Davis, completed the first purely futures market point-and-figure study[7] that calculated profitability of a reasonably large sample of markets by varying both the value of a box and the reversal criteria (the number of boxes necessary to start a new column). With the standard three-box reversal and only simple buy and sell formations, the tests showed 799 signals, of which 53% were profitable; the average net profit on all trades was $311 realized in approximately 50 days. The period studied was 1960 through 1969. In the mid-1970s, Zieg and Kaufman[8] performed a computerized study using the same rules but limiting the test period to six months ending May 1974, an extremely active market period. For the 22 commodities tested, 375 signals showed 40% of the trades were profitable; the net profit over all the trades was $306 and the average duration was 12.4 days. It is interesting to note that the most significant difference in the results of the two studies is in the average length of a trade, from 50 in the Thiel and Davis study to 12.4 days in the Zieg and Kaufman tests, indicating a change apparently induced by more volatile markets. Although the two tests varied in many of the details, the results are a strong argument for the consistency of the point-and-figure method as a trading tool.

In its current role, point-and-figure differs from traditional charting because it provides a rigid set of rules for entering long and short positions. Many of the formations are still subject to interpretation and are frequently used that way by floor traders. As a tool for the speculator without access to intraday prices, in need of a charting method with clear rules, point-and-figure fills an important gap. It will tell the trader exactly what penetration of a resistance or support level is necessary to generate a buy or sell signal and exactly where the stop-loss order should be placed to limit risk. It is this well-defined nature of point-and-figure charting that allows computer testing and evaluation.

A complete study of the point-and-figure method involves rules of charting, buy and sell signals, trendlines, geometric formations, and price objectives. A discussion of these features can be found in Chapter 3. They apply equally to point-and-figure charting. They have also been covered effectively in a book by Cohen and another by Zieg and Kaufman.[9] The following sections cover more advanced point-and-figure topics, including its relationship to bar charting, alternate plotting rules, risk-limited trading, and varying box size.

Point-and-Figure Box Size

The box size used in a point-and-figure chart determines the sensitivity, or frequency of signals. The selection of the box size is critical to successful trading. For many years Chartcraft was the only major service that produced a full set of point-and-figure charts for the futures markets, as shown in Table 5.1.

Table 5.1: Point-and-Fiqure Box Sizes [*]

Open table as spreadsheet

		Prior to 1975 [†]		1975 [‡]	1977[‡]	1977 [§]	1986[‡]	2002–2003
Futures Market	**Units**	**Year**	**Box Size**	**Box Size**	**Box Size**	**Box Size**	**Box Size**	**Box Size**
Grains								
Corn	cents	1971	½	2	2	2	1	2
Oats	cents	1965	½	1	1		1	½
Soybeans	cents	1971	1	10	10	5	5	4¼
Soybean meal	pts	1964	50	500	500		100	200
Soybean oil	pts	1965	10	20	20		10	20
Wheat	cents	1964	1	2	2	2	1	1.5
Livestock and Meats								
Live cattle	pts	1967	20	20	20		20	10
Live hogs	pts	1968	20	20	20		20	40
Pork bellies	pts	1965	20	20	20		20	75
Other Agricultural Products								
Cocoa [¶]	pts	1967	20	100	100	50	10	2
Coffee	pts		(20)[†]	100	100	50	100	
Cotton	pts		(20)[†]	100	100		50	90
Lumber	pts		(100)[†]	100	100		100	170

Orange juice	pts	1968	20	20	100	20	100	100
Sugar	pts	1965	5	20	20		10	16
Metals								
Copper	pts	1964	20	100	100	50	50	100
Gold	pts			50	100		400	200
Platinum	pts	1968	200	100	200	200	400	
Silver	pts	1971	100	200	200	400	1000	150

[*]All box sizes use a 3-box reversal and are in *points* (decimal fractions treated as whole numbers) unless otherwise indicated.

[†]Cohen (1972); parentheses indicate approximate values.

[‡]Courtesy of Chartcraft Commodity Service, Chartcraft, Inc., Larchmont, NY.

[§]Chart Analysis Limited, Bishopgate, London. Values are for long-term continuation charts.

[¶]Cocoa contract changed from cents/pound to dollars/ton.

Since the 1970s, every traded commodity has had at least one major price move taking it to levels often greater than twice the normal price. Sugar and silver each topped at 10 times their value in 1970. By 2000 many technology stocks had surged 20 times their value in 1990 only to retreat by as much as 90% in the next few years. These moves necessitate changes in box size in order to control the impact of the increased, and later decreased, volatility. Table 5.1 shows some of the history of changing box sizes, based on a three-box reversal, for agricultural markets during the late 1960s and early 1970s compared to 1986 and 2003. Table 5.2 shows the most likely value for box sizes in 2003 for a selection of more popular international futures markets. Table 5.3 shows the point-and-figure box sizes for a selection of stocks and sector indices.

Table 5.2: Point-and-Figure Box Sizes—Futures 2003

Open table as spreadsheet

Market	Box Size	Market	Box Size
Interest Rates		Index	
Eurodollars	1	e-mini SP	5
5-year notes	3/32	e-mini NQ	5
10-year notes	14/32	DAX	2.5
30-year bonds	21/32	EuroStoxx	50
Eurobund	30	Swiss Market	30
Eurobobl	8		
Energy		Currencies vs. USD	
Crude oil	75	Canadian dollar	5
Heating oil	200	British pound	60
Unleaded gas	200	Swiss franc	54
Natural gas	70	Mexican peso	28
		Japanese yen	10
		Euro	45

Table 5.3: Point-and-Figure Box Sizes—Stocks and Sectors 2003

Open table as spreadsheet

Market	Box Size	Average Price	Market	Box Size	Average Price
AMZN	13	25	Aerospace	17.5	1800
AMR	38	20	Biotech	15	700
AOL	6	13.5	Large banks	8	1000
GE	25	27	Life Insurance	22	1450
IBM	143	72	Semiconductors	1.6	300
INTC	80	17.5			
MRK	162	52			
XOM	50	34			

By noting the price history and box size, the change in the price level and, consequently, the change in volatility, can be related to the change in box size. Most agricultural markets show a pattern of small to large to small box sizes—except for coffee and orange juice, which have remained volatile. Silver and gold maintain large box sizes through the mid-1980s, as a result of their long steady declines; however, the lowest prices reached in the 1990s would necessitate a reduction. We would also expect box sizes for stocks to have increased dramatically at the peak of the bull market in 2000 and then have declined through the next three years. The average price and box size of the stock shown in Table 5.3 are plotted in Figure 5.12. They show a clear relationship between price and box size. We can use this pattern to create a more dynamic point-and-figure chart. Rules for varying box sizes and risks associated with these price and volatility changes are discussed in the last section of this chapter, "Point-and-Figure Variable Box Size."

Figure 5.12: Point-and-figure box sizes are larger when prices are higher or volatility is greater.

Volatility Patterns

Many markets have specific volatility patterns that can impact the selection of point-and-figure box size. In general, volatility increases as prices increase, and it is the volatility that impacts the selection of point-and-figure box size. But there are important exceptions. While most analysts agree that there is a fundamental relationship between interest rates and the stock index markets, their volatility patterns are reversed. Interest rate futures are traded as prices based on discounted face value, as in Eurodollars, or coupons, as in 10-year Treasury notes. Interest rate prices go up when the yield goes down; therefore, volatility tends to decline as interest rate prices rise. Interest rate futures prices would not fit the relationship shown in Figure 3.10; however, if they were converted from price to yield, they would fit perfectly. Therefore, expect the box size of interest rate markets to get smaller as prices rise.

Currencies present another unique problem. There is no low or high price for foreign exchange, only what the market decides. When an economy strengthens, the value of the currency increases; when the economy falters, its currency devalues. Sometimes, as happened in the United States from 1985 to 1995, the government may choose to allow the currency to decline as a way to reduce its debt or reverse a growing trade deficit. Does this mean that the U.S. dollar is "low" and that its volatility will decline? No. With agricultural products, when prices fall to production levels there is less trading and lower volatility, the result of lack of interest. The same is true of stocks. When the share price declines from $50 to $2 the trading becomes quiet. The dollar, however, can continue to decline and its volatility can increase as long as traders believe that the current situation is temporary. Therefore, the volatility of a currency is low when market participants see its price as correct. When everyone agrees that the price is at fair value, it is at the point of *equilibrium.* If prices move away from equilibrium, and the government disapproves of the change in value, economic policy will attempt to move it back; therefore, currency prices can be volatile when they move in either direction away from equilibrium. This makes it difficult to scale prices by a percentage, as we do in later sections.

Crude oil is very similar to currencies in that it has an artificial point of equilibrium. It is the target selling price established by OPEC. This has most often fallen between $22 and $25. For the most part, the world has decided that it can function comfortably when crude oil is in the target range. When prices move sharply higher, as they did during the Gulf War and the Iraqi War, there is a significant increase in volatility that lasts until prices return to a level near the target zone. Unlike other markets, oil prices also increase in volatility as they drop. Low oil prices are not desirable for OPEC, and generally not favored by any nation, including the United States. Therefore, lower prices are followed by cuts in production which bring prices back to the target zone.

Point-and-Figure Trading Risk

> *I go long or short as close as I can to the danger point, and if the danger becomes real I close out and take a small loss.*
> —Jesse Livermore to Richard Wyckoff[10]

The point-and-figure method is simply a trend-following concept, yet in its fully developed form, it is subject to interpretation using trendlines and geometric formations. Why is that necessary? The answer involves the risk of an individual trade. The treatment of the same price move can be seen by looking at both a bar chart and a corresponding point-and-figure chart for the same period (Figure 5.13). The most basic bar chart trading method uses horizontal support and resistance lines to define a trading range; when the resistance line is penetrated, a long position is entered. This is the same concept used in the swing method. A stop-loss is placed below the resistance line in order to close out the trade in the event of a false breakout. An alternate placement of the stop-loss could have been below the support line, allowing the new bull move some latitude to develop.

Figure 5.13: Placement of point-and-figure stops.

Viewing this chart pattern in retrospect makes the selection of the entry point and the placement of stops or reversal of position seem obvious; however, when trading, the choice of the support and resistance lines is not usually as clear. The time to enter a trade after a breakout is never quite certain, and the position for the stop or reversal depends on the volatility of prices and the risk that you are willing to take based on your assessment of the situation.

In contrast to the ambiguity of the bar chart, the point-and-figure method defines the support and resistance levels exactly, establishes a place to buy in advance, and designates the position for the stop-loss below the rectangular congestion area, always at the place where a long position would turn to a short sale. The rigidity of the method allows only one place for the stop-loss and fixes the risk as the difference between the support and resistance lines, a total of five boxes in the example shown in Figure 5.13. In the bar chart, the risk might have been held to the equivalent of two boxes using the closer stop-loss, where the trade is exited on a pullback into the range; however, a very small risk often results in being stopped out of the trend prematurely.

Point-and-Figure Trading Techniques

To review the basic point-and-figure trading signals:

- *Buy* when the filled column of *X*s, the current upswing, rises above the previous column of *X*s by one box.
- *Sell* when the filled column of *O*s, the current downswing, falls below the low of the previous column of *O*s by one box.

Using the basic rules, you are always in the market, reversing from long to short and from short to long, unless you only trade stocks from the long side.

There are alternate methods for selecting point-and-figure entry and exit points that have become popular. Buying or selling on a pullback after an initial point-and-figure signal is one of the more common modifications to the system because it can limit risk and still maintain a logical stop-loss point. Of course, there are fewer opportunities to trade when only small risk is allowed, and there is a proportionately greater chance that the trade will be stopped out because the entry and exit points are close together. There are three approaches recommended for entering on limited risk:

1. *Wait for a reversal back to within an acceptable risk, then buy or sell immediately with the normal point-and-figure stop*. Figure 5.14 shows various levels of risk in IBM with $.50 boxes. The initial buy signal is at $58, with the simple sell signal for liquidation at $54, giving a risk of $4 per share. Instead of buying as prices reach new highs, wait for a reversal following the standard buy signal, then buy when the low for the day penetrates the box corresponding to your acceptable level of risk. Three possibilities are shown in Figure 5.14. Buying into a declining market assumes that the support level (at $54 in this example) will hold, preventing the stop-loss point from being reached. Because of this, the base of the formation should be as broad as possible. The test of a triple bottom or a spread triple bottom after a buy signal is a more reasonable place to go long than a simple buy after a small reversal in the middle of a move.

   It is not advisable to reduce risk by entering on the simple buy signal and placing a stop-loss at the point of the first reversal (three boxes below the highs). The advantage of waiting for the pullback is that it uses the logical support level as a stop. A stop-loss placed nearby following a breakout has no logical basis and will quickly result in a losing trade.

2. *Enter the market on the second reversal back in the direction of the original signal*. As shown in Figure 5.15, the first reversal following a signal may not reach the target risk level. Price movement does not often accommodate our expectations; therefore, a more flexible rule is needed. One technique is to enter a long position on the second upswing. That is, do not enter a long position on the initial buy signal but wait until a three-box reversal has caused a downswing. As the downswing continues, place a trailing buy order at the point where the next upswing would begin, at the fourth box above the lowest box of *O*s. If the order is executed then there is a new position in the direction of the trend; however, the risk has been limited to the value of four boxes, which is the new trend reversal point. In a wide ranging, volatile market, this entry may be better than the original point-and-figure buy signal.

   This technique is frequently used by traders, who firmly believe that a reversal follows immediately after a breakout, to prevent both high risk and false signals. If the pullback that follows the breakout continues in an adverse direction, penetrates the other support or resistance level, and triggers the original system stop-loss, then no entry occurs, thus saving a substantial whipsaw loss. However, if prices continue upward, without a pullback, the trade may be missed entirely. You can read more on this topic in the section "Individual Trade Risk" in Chapter 23.

   The reversal principle in Step 2 can also be effective for building positions. In bar charting (discussed in Chapter 3), a pullback to a bullish support line or a bearish resistance line is a point for adding to a position with a risk limited to penetration of the major trendline. The equivalent procedure using point-and-figure is to add on each reversal back in the direction of the trend using the newly formed stop-loss point to exit the entire position (as shown in Figure 5.16).

3. *Allowing for irregular patterns*. Price patterns are not always orderly, and the price activity at the time of a trend change can be very indecisive. One basic trading principle demands that the market confirms a new high before buying; the first new high might simply be an erratic sideways pattern, or an expanding formation after a period of low volatility. If prices are required to make a new high by more than one box on the next upward thrust, and raise the lowest point of the reversal by another box on the third upward thrust, we are actually demanding that the momentum, or speed of price movement, increase before a position is set.[11] The pattern of higher highs and higher lows is similar to upwards acceleration.

   This technique, which tends to minimize false breakouts, may be modified to increase the confirmation threshold from two to three or four boxes as market volatility increases. If the box size is changed according to volatility, as discussed later in this chapter, confirmation can remain at two boxes.

Figure 5.14: Entering IBM on a pullback with limited risk.

Figure 5.15: Entering on a confirmation of a new trend after a pullback.

Figure 5.16: Three ways to compound positions.

Take It and Run!

From time to time you find yourself the beneficiary of a substantial price where there is an uncomfortably large profit. It is normal to consider how much of the unrealized profits will be returned before the system finally generates an exit signal. At these times, some traders prefer to take the profits. These are decisions that go beyond the area of technical analysis. If the profit currently held in open positions is enough to sustain a life of leisure, a home in the mountains, membership in a country club, and a small investment in a hotel or restaurant to occupy your time, then take it and run! A trading system should not depend on a single, very large profit to work over time. It should have a successful, periodic profile. We can therefore reason that any extremely large profit is a windfall and should be taken. Occasionally, a price shock gives you a windfall profit that has nothing to do with a well-designed system or astute trading. It is another opportunity to take profits.

If you cannot sleep nights and the unrealized profits are just enough to satisfy some important obligations, but one or two adverse days would ruin the opportunity,

then take the profits and begin again with a small investment. While it is important to follow a system in order to benefit from the long-term expectations, investor "risk preference" preempts the act of blindly following all rules. Sometimes you need to reduce the market exposure, whether the current position is a profit or a loss. If you have some risk latitude, a logical place to capture most of the current open profits and still have a chance of increasing those profits is to use the point-and-figure reversal value for your exit. If the three-box reversal represents only 10% of the open profits, then you have a significant chance of profiting from a continuation of the price move. The *reversal value*, the box size times the number of boxes in a reversal (usually three), is meant to indicate a significant contrary move and can be used as an objective indication of a change of direction. One approach to taking profits is shown in Figure 5.17.

Figure 5.17: Cashing in on profits.

In Figure 5.17a, a trailing 3-box reversal value is used for the stop-loss once there is a sustained move of at least 10 boxes. To reenter the move in the same direction, the same technique is used (Figure 5.17b), adding another 4 boxes of profits while keeping the new risk small. In Figure 5.17c, this method lost 4 boxes of the potential profits when the reversal was short lived.

In general, taking small profits in this way does not improve overall profitability because it most often misses the biggest moves. It may, however, reduce the risk of loss at a rate even faster than the reduction in profits, yielding a better reward-to-risk ratio. A new rule should be carefully tested to know its effect on different market conditions. If successful, it should always be used. Selective use is more likely to limit potential profits without reducing losses. This topic is covered thoroughly in Chapter 21.

Alternate Treatment of Reversals

Traditional point-and-figure charting favors the continuing trend. On highly volatile days, broad ranging days (also called *outside days*), it is possible for both a trend continuation and a three-box reversal to occur. Point-and-figure rules require that the trend continuation be recorded and the reversal ignored. Figure 5.18 shows a comparison of the two choices. In the example, prices are in an uptrend when a new one-box high and a three-box reversal both occur on Day 6, as seen in Figure 5.18a. In Figure 5.18b, the traditional approach is taken, resulting in a continuous upward trend with a stop-loss at 7.90. Taking the reversal first as an alternate rule, Figure 5.18c shows the same trend with a stop-loss now at 8.05, 15 points closer.

Day	High	Low
1	$8.02	$7.90
2	$8.11	$7.95
3	$8.13	$7.92
4	$8.18	$7.96
5	$8.25	$8.10
6	$8.32	$8.08
7	$8.40	$8.25

Figure 5.18: Alternate methods of plotting point-and-figure reversals. (a) Sample prices for plotting. (b) Traditional method. (c) Alternate rule taken on day 6.

Plotting the reversal first usually works to the benefit of the trader; both the stop-loss and change of trend will occur sooner. Subsequent computer testing proved this to be true. This alternative does not work when the reversal value is small and broad ranging days (that trigger the optional reversals) occur frequently.

Price Objectives

Point-and-figure charting has two unique methods for calculating price objectives: *horizontal* and *vertical counts.* These techniques do not eliminate the use of the standard bar charting objectives, such as support and resistance levels, which apply here as well.

The Horizontal Count

The time that prices spend in a consolidation area is considered directly related to the size of the subsequent price move. One technique for calculating price objectives is to measure the width of the consolidation (the number of columns) and project the same measurement up or down as the target of the move. The point-and-figure *horizontal count* method is a more exact approach to the same idea.

The upside price objective is calculated as

$$H_U = P_L + (W \times R)$$

where H_U =the upside horizontal count price objective
P_L = the price of the lowest box of the base
W = the width of the bottom formation (number of columns)
R = the reversal value (number of boxes times the value of one box)

To use this formula, the *base* (width of the bottom or top formation) needs to be identified. Count the number of columns, W, not including the breakout column and multiply that width by the value of a minimum reversal, R; then add that result to the bottom point of the base to get the upper price objective. The base can always be identified after the breakout has occurred. For example, Figure 5.19 shows the March 74 contract of London Cocoa (£4 box) forming a very long but clear base. The reversal value is £12 and the width of the base is 19 columns (not counting the last column, which included the breakout). Added to the lowest point of the base (£570) this gives an objective of £798, reached on the left shoulder of the topping formation. Another alternative is the wider base, marked as W_2 = 25. Using this selection results in a price objective of £870, by adding 25 × £12 = £300 to £570, the lowest point of the base.

Figure 5.19: Horizontal count price objectives.

The downside objective is calculated in the same manner as the upside objective:

$$H_D = P_H + (W \times R)$$

where H_D = the downside horizontal count price objective
P_H = the price of the highest box of the top formation
W = the width of the top formation (number of columns)
R = the reversal value

Some examples are given for downside objectives in the same Cocoa diagram (Figure 5.19). A small correction top could be isolated at the £720 level and two possible top widths, W and W , could be chosen. The broader top, W , has a width of nine and a downside objective of £632. The shorter top, W , has a width

of five and a downside objective of £680. Although the closer objective, calculated from W_5, is easy to reach, the farther one is reasonable because it coincides with a strong intermediate support level at about £640.

The very top formation, W_4, was small and only produced a nearby price objective similar to the first downside example; there would be no indication that prices were ready for a major reversal. The top also forms a clear head-and-shoulders pattern, which could be used in the same manner as in bar charting to find an objective. Using that technique, the distance from the top of the head to the point on the neckline directly below is 20 boxes; then downside price objective is 20 boxes below the point where the neckline was penetrated by the breakout of the right shoulder, at £776, giving £696 as the objective.

The horizontal count can also be applied to a breakout from a triangular formation, similar to the one on the very far right in Figure 5.19 (marked "Head-and-shoulders objective"). The width of the formation is the widest point in the center of the triangle, and the upwards objective is also measured from the center, rather than from the bottom of the triangle.

The Vertical Count

The vertical count is a simpler and more definitive calculation than the horizontal count. As with the horizontal count, there is adequate time to identify the formations and establish a price objective before it is reached. The vertical count is a measure of volatility (the amount of rebound from a top or bottom), and can be used to determine the size of a retracement after a major price move. To calculate the upside vertical count price objective, locate the first reversal column after a bottom formation. To do this, a bottom must be established with one or more tests, or a major resistance line must be broken to indicate that a bottom is in place. The vertical count price objective is then calculated:

$$V_{up} = \textit{Lowest box} + (\textit{First reversal boxes} \times \textit{Minimum reversal boxes})$$

The downside vertical count price objective is just the opposite:

$$V_{down} = \textit{Highest box} - (\textit{First reversal boxes} \times \textit{Minimum reversal boxes})$$

where *first reversal boxes* = the number of boxes in the first reversal
minimum reversal boxes = the number of boxes needed for a chart reversal

Examples illustrating the vertical count are easy to find. In the QQQ chart (Figure 5.20), the Nasdaq low is clearly in early October, 2002, followed by an upwards reversal of 13 boxes. Each box is .25, giving a total reversal of $3.25. Multiply the reversal amount by 3, the number of boxes in a reversal, and add that value, 9.75, to the low of $20.00 to get the target of $29.75. That value was reached during May 2003.

Figure 5.20: Point-and-figure vertical count for QQQ. The major low in October 2002 had a reversal of 13 boxes, each with a value of .25, for a total of 3.25. Multiplying by 3 and adding the result, 9.75, to the lowest value $20.00, gives the price objective of 29.75. The second bottom in February 2003 shows a reversal of 7 boxes and gives a target of 28.75

A secondary low in the QQQ chart occurs in February 2003 at $23.50. The first reversal that follows is seven boxes, or $1.75. Multiple 1.75 by three and add the result to the low to get the target of $28.75. The two objectives confirm each other. As a simple measurement tool based on recognizing key highs or lows, the vertical count relies on volatility to determine the extent of the move that follows. It can be quite accurate at times; otherwise it is likely to understate the expected price move.

In Figure 5.21, Intel is used to show frequent possibilities for the point-and-figure vertical count. As with QQQ, the chart uses a box size of 25 points ($0.25) and a 3-box reversal. The low in August 2002 at $19.00 gives a target of $27.25 reached at the end of October. The high in early January 2003 points to a very nice interim low in April, but falls far short of the actual low. Two other midrange price reversals could be used to find additional downside targets, each of which is successful but also fall short of predicting the true low of the stock. The vertical count can be very reliable but should not be expected to serve as a magic wand.

Figure 5.21: Intel vertical count examples. This chart of Intel had many possibilities for the point-and-figure vertical count, all of which understate the actual price move. The vertical count is a good tool for setting initial objectives but it is not a magic wand.

A Study of Point-and-Figure Box Sizes

Throughout the point-and-figure discussion, there has been constant reference to *reversal* value or *three-box reversal*, although no alternative had been suggested. In looking back at Table 5.1, it can be seen that the box sizes used prior to 1971 were generally smaller than the 1975 box sizes. In addition, larger boxes are used for long-term continuation charts of futures markets and smaller ones for individual futures contracts of maximum term 1 to 1½ years. These differences are due to changing price levels and volatility as Wyckoff had suggested.

Prior to 1971, prices had been steadily increasing but at a much slower rate than during 1974 to 1976. During the earlier periods, the price fluctuation of any one market in a single year was easy to anticipate. Since 1969, prices have moved to unprecedented levels, then retreated back to low levels, all with high volatility. In the stock market, share prices in technology and Internet companies skyrocketed to levels 50 times their initial value, peaking in 2000, followed by an equally precipitous drop. Seen as volatility, a normal daily move in the S&P 500 was about 5 points (5.00 in terms of the index price) in 1990, 40 points in 2000 (varying from the smallest of 10 points to many days with high to low ranges of 60 to 100 points), and 15 to 20 points in 2003. In the next sections we will see how these volatility changes are very orderly.

Point-and-Figure Rescaling

In 1969, sugar futures prices were plotted by Charteraft using a five-point scale (5/100 of one cent) and prices ranged from 2.86¢ to 3.95¢ per pound; the possible span of point-and-figure boxes that could be filled on Chartcraft's chart was 22, a total range of $1.10. In 1973, sugar prices went to almost 60¢ per pound, approximately 20 times their 1969 price. The daily trading limits were expanded from ½¢ to 2¢—more than the price had previously moved in one year. The use of a .05 (5¢) point-and-figure box would result in a new reversal column on any day the market failed to continue its prior direction, and it no longer served the function of smoothing the price movement. It would take 1,200 boxes (10 feet of graph paper) to record the moves all the way up to 60.

A practical reason why the sugar scale changed from .05 to .20 boxes or soybeans from 1¢ to 10¢, was the need to fit the point-and-figure chart on a single page, or on part of a page assigned to it each week. Oddly enough, rescaling to fit a piece of paper of constant size has considerable merit. Look at soybeans in 1970—but remember that this method would have been the same for any stock or index that had increased in volatility. The range of the January 1971 soybean futures contract was 251⅝ to 315 and required a page of graph paper with only 64 boxes and an assigned value of 1¢ per box. Table 5.4a shows what happens if the same number of boxes is used each year, changing the scale to accommodate the full price range. The reversal value (the value of four boxes) is forced to increase so that the size of the point-and-figure chart and formations will look the same regardless of the price level. This is called *keeping the sensitivity constant*. The point-and-figure method, with its increased reversal value due to larger box size, will generate about the same number of reversals and, consequently, buy and sell signals at any price level. Had prices increased without the box size increasing, the system would have had more frequent reversals, as in the sugar example, and it would be considered *more sensitive* to price changes. Table 5.4b shows the comparable scaling for the S&P 500 from 1988 (after the "crash") through 1996. During this period, the stock index had an equal number of years with slightly higher volatility as well as years with as much as 50% lower volatility. During the quieter years there would have been very few trading signals.

Table 5.4: Keeping the Size of the Chart the same ➡ Open table as spreadsheet

(a) Soybeans (January Futures Contract)								
Year	**High**	**Low**	**Average**	**Box Size**	**Reversal**	**Total Number of Boxes**	**Reversal Value**	**Reversal as Percentage of Average %**
1971	315	251	283	1.00	3	64	3.00	1.06
1972	346	282	314	1.00	3	64	3.00	0.96

1973	444	300	372	2.25	3	64	6.75	1.81
1974	915	349	632	8.84	3	64	26.53	4.20
1975	961	509	735	7.06	3	64	21.19	2.88
1976	705	439	572	4.16	3	64	12.47	2.18
1977	782	490	636	4.56	3	64	13.69	2.15

Open table as spreadsheet

(b) S&P 500 Futures (Continuous Daily Prices)								
1986	250	205	228	0.70	3	64	2.11	0.93
1987	330	175	253	2.42	3	64	7.27	2.88
1988	280	240	260	0.63	3	64	1.88	0.72
1989	350	280	315	1.09	3	64	3.28	1.04
1990	365	285	325	1.25	3	64	3.75	1.15
1991	410	310	360	1.56	3	64	4.69	1.30
1992	440	390	415	0.78	3	64	2.34	0.56
1993	470	425	448	0.70	3	64	2.11	0.47
1994	480	435	458	0.70	3	64	2.11	0.46
1995	610	460	535	2.34	3	64	7.03	1.31
1996	745	600	673	2.27	3	64	6.80	1.01

The relationship of reversal value to the average price for soybeans from 1971 through 1977, and the S&P from 1988 through 1996 gives a price—volatility relationship, shown in the last column of Table 5.4a. It is important to know to what degree prices will fluctuate as they advance and decline. This can become a valuable risk management tool. Before continuing, certain questions must be asked of this method:

> Why were soybeans started with a 1¢ box… why not ½¢ or 5¢-
>
> Does this price—volatility relationship represent the best approach to rescaling?
>
> How can it be used?

It can only be assumed that the original selection of a 1¢ box for soybeans was a combination of both a smoothing attempt (by choosing a multiple of the minimum price move) and convenience. The convenience part is easy to see; all the box sizes in Table 5.1 were even numbers. The first point-and-figure charts were drawn using the smallest allowable move and were later refined to larger increments to identify long-term trends, and major support and resistance levels. However, it is necessary to find a more logical selection of starting parameters.

To answer the second question, the impact of rescaling on trading must be considered. As prices rise, boxes become larger and the risk becomes proportionately greater. The risk of trading one contract increases at the same rate as the volatility expressed as a percentage of average price. If the box sizes are not increased when prices rise, risk can be kept small, but frequent losses will occur and trading will be limited to extremely short-term trends.

There are few alternatives to rescaling, the two most reasonable being:

1. Assign a value to the box size that keeps the full price range on the same chart page. Box sizes would change in the manner shown in Table 5.4. This should hold the sensitivity of the trading signals constant.
2. Create a chart based on percentage box sizes, similar to a semilog chart. For example, the chart would have a box value of three points at a price of 300 (1% value) and would have a six-point box at a price of 600.

Both approaches effectively increase the box value and risk while reducing the sensitivity of the chart as prices increase.

Solving the Scaling Problem

We can find a reasonable price—volatility scaling relationship by performing a regression analysis on the average price and volatility (box size). The performance of the point-and-figure method can also be tested for specific calendar periods of different average volatility in order to find the best box sizes. We can then use regression to find the relationship between price and box size. We will solve the first method using soybean futures and the second using Amazon.com and the S&P 500 index futures.

A linear regression was performed using the soybean values in Table 5.4a, based on a three-box reversal, with the following results:

$$100 \times \text{volatility} = -28.8 + .485 \times \text{average price}$$
$$\text{box size} = -3.347 + .0147 \times \text{price}$$

The exact box sizes corresponding to specific price levels for soybeans are shown in Table 5.5. Understanding that box sizes must be in practical increments, a variable-box point-and-figure chart can be constructed that changes box size as the price increases according to the table. These box sizes are shown with their corresponding price levels in Table 6.

Table 5.5: Point-and-Figure Price-Volatility Relationship (Method 1)

Open table as spreadsheet

Average price	250	300	350	400	450	500	550	600
Percentage volatility	92	117	140	165	189	214	240	262
Box size	.328	1.06	1.80	2.54	3.20	4.01	4.75	5.49
Average price	650	700	750	800	850	900	950	1000
Percentage volatility	286	311	335	359	383	408	432	456

Box size	6.22	6.96	7.70	8.43	9.17	9.91	10.65	11.38

Table 5.6: Point-and-Figure Variable Box size for Specific Price levels (Method 1)

Open table as spreadsheet

Box	Price	Box	Price	Box	Price	Box	Price	Box	Price
¼	245	2¼	380	4¼	516	6¼	652	8¼	787
½	262	2½	397	4½	533	6½	669	8½	804
¾	279	2¾	414	4¾	550	6¾	686	8¾	821
1	295	3	431	5	S67	7	703	9	838
1¼	312	3¼	448	5¼	584	7¼	720	9¼	855
1½	329	3½	465	5½	601	7½	736	9½	872
1¾	346	3¾	482	5¾	618	7¾	753	9¾	889
2	363	4	499	6	634	8	770	10	906

Scaling by Constant Rate

The second choice of scaling requires answering the question: "Why were soybeans started with a 1¢ box?" The long-term charts show that prior to 1970, prices were relatively stable and fluctuated in normal ranges. Finding the proper box size for the initial interval forms the basis for continuing into more volatile years. In the 1970 study by Thiel and Davis, *Point and Figure Commodity Trading: A Computer Evaluation* (Dunn and Hargitt), they approach the problem of variable box size and reversal value strictly scientifically. They proceeded to test a good sampling of futures markets, varying both the box size and reversal value, and recorded the resulting profits or losses and the reliability of the combination (percentage of profitable trades). For example, the January 66 soybean contract test results are presented in Table 5.7.

Table 5.7: Thiel and Davis's Results, January 66 Soybeans

Open table as spreadsheet

Box Size	Reversal Boxes	Results		
		Profitability	Profit	Per Trade
0.500	4	2 of 12	-14.874	-1.239
0.500	5	2 of 12	-14.874	-1.239
0.500	6	2 of 10	-15.124	-1.512
⋮	⋮	⋮	⋮	⋮
1.000	4	1 of 2	3.00	1.500
⋮	⋮	⋮	⋮	⋮
4.000	1	1 of 1	7.25	7.25
⋮	⋮	⋮	⋮	⋮

The study included the years 1960–1969, with data supplied by Dunn and Hargitt.[12] This coincides exactly with the time interval needed to determine the basic box size and reversal. In their study, Thiel and Davis draw conclusions and present alternatives for their selections, but the interests of this analysis are slightly different. Table 5.8 shows the final choice. The most important part of Table 5.8 is the reversal value, expressed as a percentage of the 10-year fluctuation. This figure represents the best choice of value for rescaling as a fixed percentage of the market's average price. The proper reversal criteria for each price level can now be selected using the rate of increase shown in the first and second formulas and the base price from Table 5.8.

Table 5.8: Optimum Box and Reversal Criteria for 10 Years—1960–1969 (Davis and Thiel)

Open table as spreadsheet

	Approximate Price Range 1960–1969	Average	Box Size	Reversal	Reversal Value		10-Year Fluctuation (%)
Wheat	113–225	169.0	1½¢	3 boxes	4½¢	= $225	2.66
Corn	88–154	121.0	1½¢	4 boxes	6¢	= $300	4.95
Soybeans	196–309	252.0	2¢	3 boxes	6¢	= $300	2.38
Soybean meal	48–102	75.0	75 pts	2 boxes	150	= $150	2.00
Soybean oil	7.3–12.3	9.8	25 pts	1 box	25	= $150	2.55
Cattle	19–34	26.5	20 pts	2 boxes	40	= $160	1.50
Pork bellies	18–55	36.5	25 pts	6 boxes	150	= $540	4.10
Potatoes	1.9–8.4	5.15	5 pts	3 boxes	15	= $75	2.91
Copper	29–52	40.5	50 pts	4 boxes	200	= $500	4.93
Sugar	2–12	7.0	10 pts	5 boxes	54	= $560	7.14
Cocoa	12–51	31.5	25 pts	7 boxes	175	= $525	5.55
Silver	85–245	165.0	100 pts	2 boxes	200	= $200	1.21

For convenience, all box sizes will be chosen to correspond to the standard 3-box reversal. In general, a reversal value of 6¢ for soybeans would be profitable if plotted on a scale of 2 × 3, 3 × 2, 6 × 1, or 1 × 6, where the first number is the box size and the second is the number of boxes for a reversal. By having the percentage reversal value, the box and reversal criteria can be varied in a logical manner as the prices rise or fall. Using the January soybean contract, boxes can be assigned in such a way that the reversal value is close to 2.38% of the annual range (taken from Table 3.6). The results are the parameters shown in Table 5.9.

Table 5.9: Holding the Chart to a 2.38% Reversal Value[*]

Open table as spreadsheet

Soybean Contract	Highest Price	Lowest Price	Annual Range	Reversal Value	Box Size
Jan 71	315	251⅝	63⅜	1½	½
Jan 72	346	284⅞	61⅛	1½	½
Jan 73	444	300	144	3½	1⅛
Jan 74	915	354¼	560¾	13⅜	4½
Jan 75	961	509	452	10¾	3½
Jan 76	705	439½	265½	6⅜	2⅛
Jan 77	782½	490	292½	7	2⅜

[*]All values in cents.

Updated S&P Price-Volatility Relationship

From 1990 through mid-2003 the S&P cash index has had a dramatic price swing. A look at just three time intervals can give a reasonably accurate picture of the price-volatility relationship.

S&P 500 Price—Volatility Relationship

Open table as spreadsheet

Year	Average Price	Daily Volatility	% Volatility	Estimated % Volatility
1990	350	5.00	1.43	1.40
2000	1500	40.00	2.60	2.64
2003	900	17.50	1.90	2.00

When price and volatility are plotted as a scatter diagram, the three points form a near straight line. Solving the linear regression where y is the percentage volatility and x is the average price, we get the y-intercept, b = 1.024, and the slope, a = .0011. The estimated % *Volatility* in the table above is calculated as $a \times$ *average price* + b. These results are very close to the percent volatility estimated from the historic prices.

Changing Box Sizes for Amazon.com from Test Results

Another way of determining the box size is to test which one produces the best results over periods of different volatility. A TradeStation program for testing point-and-figure box sizes, and finding their trading results, appears at the end of this section. If successful, the results should also show a uniform relationship between the box size, the average price during the test interval, and the corresponding market volatility. Amazon.com was selected for this example because it had extremely wide price and volatility ranges for the four years from 1998 through 2001, as seen in Figure 5.22. There are four periods blocked, the first shows low volatility and extends through October 1998, when prices begin a sharp upwards move. The next interval ends February 15, 2000, and includes the highest prices and highest volatility. The third block isolates the decline, which seems to have medium uniform volatility, ending December 31, 2000. The final block returns to low volatility, ending December 31, 2001. The first and last intervals have the greatest similarity.

Figure 5.22: Amazon.com, 4 years 1998–2001, with blocks showing intervals of different price levels and volatility. The optimal box size was found for each of these blocks and used to create a formula for a P&F variable box size.

Based on testing, the best box size for each interval of Amazon.com was:

Best Box Sizes for Amazon.com Based on Testing

Open table as spreadsheet

Interval	Average Price	Best Box Size
1	$12.00	$0.12
2	70.00	2.08
3	55.00	.80
4	14.00	.37

If the four sets of points, average price and best box size, are plotted as in Figure 5.23, a clear relationship between the average price (along the bottom scale) and the box size (left scale) can be seen. If you think this should be represented by a straight line fit, the four sets of points can be input to the least squares fit by applying the Tools/Data Analysis/Regression feature in Excel. The results show that *box size* (in whole cents) = .303 × *price* + 12.23. You might also see the price—box relationship as a curve that increases as price and volatility increase, also shown in Figure 5.23.

Figure 5.23: Point-and-figure price-box relationship for Amazon.com. The four test results are shown with a straight line approximation and a curve representing the percentage relationship between price and box size.

Once the box-price relationship has been established, a point-and-figure chart can be created based on the midpoint of the current price range. For example, if we wanted to begin a point-and-figure chart of Amazon.com, and the share price was trading in the range of $10 to $20, the box size would be established by using $15 in the formula *slope* × *price* + *y-intercept* = *box size*, or .825 × 15 + 5.259 = 17.6 cents. We would then use a box size of between 17 and 18 cents.

TradeStation Point-and-Figure System

```
   { TSM Point & Figure : Point & Figure System
   Copyright 1994-2003, P.J. Kaufman. All rights reserved. }

{ direction & breakout:
   +1 up, +2 up new breakout
    0 none
   -1 dn, -2 down new breakout
   type : 0= normal, 1= 3 month rate, 2= bond
   signal rules:
     buy when upswing is at least one box above prior high box
     sell when downswing is at least one box below prior low box }

inputs:  box(.0010), revboxes(3);
vars:    signal(0), last(0) , boxhigh(0), boxlow(0), xhigh(0), xlow(0),
         xclose(0), newhigh(0), newlow(0), lastlow(0), lasthigh(0),
         trend(0);

   xhigh = high;
   xlow = low;
   xclose = close;

{ SWINGS: Initialize most recent high and low }
   if currentbar = 1 then begin
      boxhigh = intportion(xclose/box);
      boxlow = intportion(xclose/box) + 1;
      if mod(xclose,box) = 0 then boxlow = boxlow - 1;
      if xclose >= (xhigh - xlow) / 2 then
           last = 1
         else
           last = -1;
         end;
   { convert prices to boxes }
   newhigh = intportion(xhigh/box);
   newlow = intportion(xlow/box) + 1;
   if mod(xlow,box) = 0 then boxlow = boxlow - 1;

{ Test for a continuation in the upwards direction }
   if last = 1 then begin

        if newhigh > boxhigh then begin
           print (" New high box in up column");
           boxhigh = newhigh;
           boxlow = boxhigh + 1;
   { Test for long signal )
   if trend < 1 and newhigh > lasthigh then begin
            print (" Trend changes to up");
            trend = 1;
            buy on close;
            end;
         end
   { Failed new high, test for new low }
   else if newlow < boxlow then begin
                    boxlow = newlow;
   { Test if reversal to downside }
                    if boxhigh - boxlow >= revboxes then begin
                       last = -1;
                       lasthigh = boxhigh;
                       boxhigh = boxlow - 1;
   { Test for a trend turn to the downside }
                     if trend > -1 and boxlow < lastlow then begin
                        trend = -1;
                        sell on close;
                        end;
                       end;
                 end;
               end
{ Test for a continuation in the downwards direction }
   else if last = -1 then begin
           if newlow < boxlow then begin
              boxlow = newlow;
              boxhigh = boxlow - 1;
   { Test for short signal }
              if trend > -1 and newlow < lastlow then begin
                 trend = -1;
                 sell on close;
                 end;
                end
   { Failed new low, test for new high }
            else if newhigh > boxhigh then begin
            boxhigh = newhigh;
   { Test if reversal to upside }
            if boxhigh - boxlow >= revboxes then begin
             last = 1;
             lastlow = boxlow;
             boxlow = boxhigh + 1;

{ Test for a trend turn to the upside }
            if trend < 1 and boxhigh > lasthigh then begin
                 trend = 1;
                 buy on close;
                 end;
            end;
      end;
end;
```

Indexing and Log Scale

In all of the price—volatility relationships, the results show that viewing volatility as a percentage of price gives a linear solution. One way to transform prices into a percentage is by indexing. The steps needed to create an index can be found in Chapter 2. The results of plotting a point-and-figure chart of an index will be very close to trying to create a chart with boxes that vary in price by an amount equal to a percentage, and much simpler. If boxes represent a percentage change, they can be marked 95, 96, 97, …, 103, 104, … and so forth, each box represent a 1 percent change in price, where 100 is the base price, the point at which the index started. Because orders are placed as prices, not percentages, you will need to know the corresponding price, not the percentage, whenever you buy and sell.

A logarithmic scale represents a constant 2.33% change in price, equal to a proportional 0.01 logarithmic box size[13] It is interesting that the results of the Davis and Thiel study determined that the optimal box size would be the equivalent of a 2.38% price change over a 10-year period, remarkably close to the logarithmic equivalent. This also supports the common belief that the price—volatility relationship is lognormal.

Price Objectives Using Percentages

If the entire price series has been converted to an index, and plotted on a point-and-figure chart with percentage boxes, then the calculations for horizontal and vertical price objectives are applied to the index values in the normal manner. If prices are used instead of index values or percentages, then the price objectives must also be put into a compounded growth form. For example, a price objective of 5 boxes, each box equal to 2.33%, would be compounded (in spreadsheet notation) as:

Objective = 100 * ((1 + .0233)^5 - 1) = 12.20%

instead of simply 5 * .0233 = .1165, or 11.65%.

Stock Dividends and Splits

When using point-and-figure charts to stocks, an adjustment must be made whenever a stock dividend is issued or the stock splits, because the chart represents the price of one share. Splits and dividends result in stock multiplying factors:[14]

Open table as spreadsheet

Activity	Stock Multiplication Factor
10% stock dividend	1.1
30% stock dividend	1.3
2 for 1 stock split	2.0
3 for 2 stock split	1.5

These multiplication factors can be used to correct the box size of a percentage, or logarithmic point-and-figure chart by *dividing* all the boxes by the multiplication factor; therefore, the new box sizes represent the value of one share.

Variable-Scale Solution

Given the discussions of changing box sizes at different price levels, someone was eventually going to conclude that a single chart with varying box sizes could replace the fixed-box size chart. In addition, a variable-box chart would eliminate the need to rescale as prices changed. Referring again to soybean futures, an equal percentage was used to assign box sizes that increased by ½¢ for corresponding price increases, as shown in the following table:

Open table as spreadsheet

Price Range (¢/bu)	Box Size (¢/bu)
240–286	2
286–351	2½
351–417	3
417–480	3½
480–544	4
544–598	4½
598–648	5
648–725	5½
725–917	6

Once the master chart is constructed, it will never need to be changed. If prices rise above the top of the scale, additional boxes can be numbered with larger increments. Using the standard 3-box method of charting, each January soybean futures contract was plotted in Figure 5.24 and the results are shown in Table 5.10. It should be noted that the number of trades increased as the average price increased throughout the test period. This can be expected since the box size does not increase as quickly at higher prices using the price-volatility relationship. Because of this steady lag, the sensitivity of the system still increases at peak price levels.

Table 5.10: Results Using Equal Percentage Increases (Method 2)

Open table as spreadsheet

	Trades		Net P/L[*] (¢/bu)
	Total	Profitable	
January 1966	2	1	+22
January 1971	4	3	+21
January 1972	3	2	+8½

January 1973	2	1	+93⅜
January 1974	20	9	+23⅜
January 1975	12	7	+554⅜
January 1976	16	7	-175¼
			Total +548⅛
[*]1 ¢ commissions deducted.			

Figure 5.24: Point-and-figure chart for january soybeans using price—volatility scaling.

The size of the chart based on the price-volatility approximation taken from Tables 5.5 and 5.6 is much smaller than the one used for equal percentage increases. Because the box sizes increase so rapidly, the formations appear more uniform at all price levels and the number of trades occurring during each contract was reasonably constant.

Comparing Performance at Different Price Levels

In Figure 5.22, Amazon.com was used to test the best box size at different price-volatility levels. That relationship was shown in Figure 5.23. However, there is much more to learn about risk and reward from the test results. Some of the test statistics are shown in the following table

Open table as spreadsheet

Test Period	Avg Price	No. of Trades	Rel	Total Profit	Avg Profit	Avg Loss	Avg Prof/Avg Loss	Test Interval (in Months)	No. Trades per Month
May 1997–Oct 1998	12	18	44	13.28	2.84	(0.94)	3.02	18	1.00
Oct 1998–Feb 2000	70	15	53	10.01	12.20	(12.51)	.97	16	.94
Feb 2000–Dec 2000	55	13	54	20.12	6.75	(4.53)	1.49	10	1.30
Dec 2000–Dec 2001	14	11	45	8.91	3.14	(1.13)	2.78	12	.92

Bear in mind that these are the best results possible using back-testing. However, we would like to achieve these results in real trading; therefore, we might alter the point-and-figure box size according to the relationship in Figure 5.22 with the expectations that future price patterns will yield profitable results. Under this best case scenario, what can we expect in the performance profile?

The statistics show that the price—volatility relationship carries through to all the results, including the number of trades. At the far right of the table, the number of trades is expressed as trades per month, because the test intervals are not of equal length. They are very similar. From the number of trades we may begin to see that the best point-and-figure parameters are those that attempt to keep the sensitivity of the method the same, regardless of the change in price volatility.

As we look further at the statistics, the most important information is that trading during the highest, most volatile interval (October 1998 through February 2000, with an average price of $70) returns the worst overall profile. Profits are lower than two other periods, but most important is the risk needed to achieve those returns. The average profit on eight trades was $12.20 and the average loss on seven trades was $12.50 for a profit/loss ratio of .97, by far the lowest of the four test periods. This is not unusual. Trading with extreme volatility can yield large profits, but always at exceptionally high risk. When looking back at the performance, the risk of capturing those profits is often too high. These results show the best that could be realized using hindsight. In actual trading, the risk is likely to be higher and the returns lower. Without that consideration, the attempt to scale the point-and-figure box size according to a price—volatility relationship was accomplished successfully.

Selecting Trades

Not all trades are profitable in any trading system. Some analysts prefer point-and-figure charts because both the profit objective and the risk can be identified at the time of entry. The profit objective can be calculated using the vertical or horizontal count, and the risk is the size of the price reversal needed to cause a reversal signal. Trades are then taken only if the return to risk ratio is greater than two.

As with other trending systems, 45-degree trendlines can be drawn to identify the current dominant trend. Trades may be taken only in the direction of that trend. In a bull market, new short signals are ignored until the box is filled that penetrates the upwards bullish trendline. Then the bias switches to the short side.

Recent Applications of Point-and-Figure

Not much new has happened to point-and-figure during the past 100 years; however, there has been renewed interest in using it. Two new books, *Power Investing with Sector Funds* (St. Lucie Press / American Management Association, 1999) by Peter Madlem, and *Point & Figure Charting, Second Edition* (Wiley, 2001) by Thomas Dorsey, show more recent examples of how this technique applies to stocks and sector indices.

[5]Victor De Villiers, *The Point and Figure Method of Anticipating Stock Price Movements* (Trader Press, NY, 1966, p. 8). (Reprint of 1933 edition.)

[6]Richard D. Wyckoff, *Stock Market Technique, Number One* (Wyckoff, New York, 1933, p. 89).

[7]Charles Thiel and R. E. Davis, *Point and Figure Commodity Trading: A Computer Evaluation* (Dunn & Hargitt, West Lafayette, IN, 1970).

[8]Kermit C. Zieg, Jr., and Perry J. Kaufman, *Point and Figure Commodity Trading Techniques* (Investors Intelligence, Larchmont, NY, 1975). This book contains complete tabularized results of both point-and-figure tests.

[9]A. W. Cohen, *How To Use the Three-Point Reversal Method of Point and Figure Stock Market Trading* (Chartcraft, Larchmont, NY, 1972), and Zieg and Kaufman, *Point and Figure Commodity Trading Techniques* (1975).

[10]Wyckoff, *Market Techniques* (1933, p.2)

[11]Adam Hewison, "The Will Rogers Theory of Point & Figure Trading," *Technical Analysis of Stocks & Commodities* (August 1991).

[12]Dunn & Hargitt Financial Services, Inc., West Lafayette, IN.

[13]See Luis Ballesca Loyo, "Price Projections on Point and Figure Charts," *Technical Analysis of Stocks & Commodities* (July 1989).

[14]William G. S. Brown, "Logarithmic Point & Figure Charting," *Technical Analysis of Stocks & Commodities* (July 1995).

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THE *N*-DAY BREAKOUT

Close on the heels of the swing and point-and-figure method is the *rolling breakout*, or *N-day breakout.* In the purist definition, it is not entirely an event-driven method because it is affected by time, but its best feature is that it buys on new highs and sells on new lows, very much the same as event-driven techniques. The *N*-day breakout has become one of the most popular trend-following techniques. Its rules are simply:

- *Buy* when today's high moves above the high of the past *N* days.
- *Sell* when today's low moves below the low of the past *N* days.

Using these basic rules you would always be holding a long or short position, reversing direction whenever there is a new signal. A slightly more conservative set of rules is:

- *Buy* when today's close is above the high of the past *N* days.
- *Sell* when today's close is below the low of the past *N* days.

These rules offer a confirmation of the new direction at the cost of setting the new position later than the first set of rules. The intention of the *N*-day breakout to react immediately to an event that drives prices higher than they have been recently. Figure 5.25 shows a buy and sell breakout in Merck based on a five-day calculation period. The buy signal occurs in early January 2002 when prices turn up after a decline under $54. The third day up after the double bottom makes a new high above the previous five days. Although there is a wide-ranging day four days later, it fails to make a five-day low and the buy signal remains in effect until after prices peak on January 20. Four days later a new low generates a sell signal that is held for the rest of the chart. Two attempts to rally only succeed in making highs above the prior three days, leaving the short sale in place.

Figure 5.25: *N*-Day breakout. Using a breakout period of five days, there is one buy and one sell signal on this Merck chart. After the buy signal, a wide-ranging day fails to post a low that is lower than the previous five days; therefore the buy signal remains in place. When prices move lower after the downward breakout, two attempts at new highs fail to produce a five-day breakout high.

This remarkably simple method can be very effective as a trend system. However, the choice of the calculation period, *N* can change the nature of the technique from one of nearly event-driven to time-driven, as well as from slow-trading to fast-trading. When *N* is less than five days, it is difficult to view this method as event-driven; the highs and lows of the few days used are so close together that prices must continue to post new highs in order to continue an uptrend. It is not being triggered by an event but by the continuation of the trend direction.

The performance profile of the *N*-day breakout is very similar to both the swing and point-and-figure method. It primary characteristic is that using a large value of *N* causes much greater risk. Risk is defined as the difference between the entry price and the point at which an *N*-day high or low would reverse the signal. This is the primary feature that distinguishes event-driven techniques from time-driven methods, such as a moving average.

A "Comparison of Major Trend Systems," including the *N*-day breakout, can be found in Chapter 8 after a discussion of time-based trends. These characteristics are important to the selection of a trending system, and they vary considerably between event-driven and time-based methods.

Donchian's Four-Week Rule

In the mid-1970s, Playboy's *Investment Guide* reviewed Donchian's Four-Week Rule as "childishly simple… was recently discovered to rank premiere among a dozen widely followed mechanical techniques." Donchian applied his method to futures markets, using the following rules:

1. Go long (and cover shorts) when the current price exceeds the highs of the previous four full calendar weeks.
2. Sell short (and liquidate longs) when the current price falls below the lows of the previous four full calendar weeks.
3. When trading futures, roll forward if necessary into the next contract on the last day of the month preceding expiration.

In 1970, *The Traders Note Book* (Dunn and Hargitt Financial Services), rated the Four-Week Rule as the best of the popular systems of the day. Based on 16 years of history, the best performers were December wheat, June cattle, May copper, August bellies, January soybean oil, and May potatoes.

The system satisfies the basic concepts of trading with the trend, limiting losses and following well-defined rules. It bears a great resemblance to the principle of Keltner's Minor-Trend Rule, modified to avoid trading too often. Over the years this technique, classified as a slow breakout system, has shown the greatest longevity. The system is so simple that the only comments about it must also be simple: Can a Four-Week Rule work for all markets? If price volatility in one market increases dramatically, the high and low for a four-week period could present enormous risk, while at the same time lower prices could cause extremely narrow ranges in another market. That characteristic is both a key to its success and a problem for risk control. The performance of the more volatile, whether good or bad, will overwhelm the quiet market. There are two possible solutions. Using traditional portfolio analysis would allow the allocation of assets in such a way that the risk of trading in the two markets would be equalized, if performance justified equal exposure. Another, more modern solution would be to create an adaptive approach using a price-level-modified rule (called "adaptive") that reduces the calculation period (the number of weeks or days) as price and volatility increase. A change of this sort would keep risk on a more even level but still relate to the basic volatility principle of the original system. This approach is discussed in Chapter 17.

Modified for the Final Three Months

One system based on the Four-Week Rule uses only the last 3 months of each futures contract. Beginning 3 months before the delivery month, plot the highs and lows according to the Four-Week Rule. For example, trading December silver, start on September 1 and plot for four weeks. The first time the market price crosses the high or low of that four-week period, take the appropriate long or short position and place a stop-loss of 2½% of the entry price. If not stopped out, liquidate the position on the last day of the month prior to delivery, in this example, the end of November. If stopped out, reenter a new position using the high and low established during the original four weeks.

The theory behind the modification is that breakouts are more valid and larger in the period just prior to delivery. An advantage of the system is that it trades very little and has a low commission burden. The disadvantage is that the stop-loss counteracts the nature of the breakout system and imposes an artificial risk level on a method that uses highs and lows established by the market itself. This feature is likely to harm the robustness of the basic concept.

Modifying the *N*-Day Rule

Computers have allowed us to take many simple ideas and examine them in great detail, sometimes to excess. We have the ability to back-test the *N*-day breakout to find the best choice of *N* over the test period. We could also find the *N*-week breakout that works best. Carrying the process further, we come to the *n*-minute and *n*-tick rules. And, there may be a benefit for continuing to reduce the time interval. If the Four-Week Rule works but the equity drawdown is too large, shortening the time period should improve results. It may not change the return-to-risk ratio of the method, but it will certainly reduce the absolute size of the profits and losses because trades are held for a much shorter time.

In the *N*-day breakout, the determination of *N* is critical to the success of this system. The most obvious approach to finding *N* is by back-testing a broad range of values (as is shown in the next section). It has also been suggested that *N* could be based on the relationship of *normal volatility* to *current volatility*.[15]

$$N_t = N_I \times \frac{V_n}{V_c}$$

where N_t = the number of days used for today's calculation

N_t = the initial number of days used for "normal" markets

V_n = the normal volatility measured over historical data

V_c = the current volatility measured over a fixed period shorter than the period used to define normal volatility, V_n

As the current volatility increases, the number of days used in today's calculation decreases. This may also be classified as an *adaptive* technique.

Testing the *N*-Day Rule

Weekly breakouts, a limited case of the *N*-Day Rule, were tested by Hochheimer and summarized in his report as the *Weekly Price Channel.* Weekly breakouts produce a slow trading system that depends on major moves for profits. About 75% of those futures markets tested in this 1982 study[16] showed higher risk (some very high) than the crossover systems tested earlier (also see Chapter 21).

The original purpose for the *Weekly Rule* was to look at prices only on Friday. The close on Friday is considered important because it is the evening up at the end of the week, in the same sense as the daily close is considered the most important price of the day because all accounts are settled at that price. Traders are attributed with the opinion that holding a position over a weekend is the only thing worse than holding it overnight. This evening-up process is expected to prevent false signals that may occur midday or mid-week during periods of low liquidity.

Typical trading rules for a Weekly Price Channel system use the more conservative choice, confirming the direction based on closing prices:

- *Buy* (and close out shorts) if the closing price on Friday exceeds the highest closing price of the past *N* weeks.
- *Sell short* (and close out longs) if the close on Friday is below the lowest closing price of the past *N* weeks.

Because this model is always in the market, it is possible for the risk to become very high. The initial risk of a new long position is the difference between the highest and lowest closing prices of the past *N* weeks. In addition, even if penetrated, the position is not liquidated until the close of Friday. This could be a very risky proposition; however, that risk is offet by the smoothing effect of only acting once each week. It may be that accepting higher risk is better than being subjected to more frequent false signals. When a series of individual trade losses is viewed as a single, larger loss, the risk of weekly positions may not seem quite so large. The risk relative to your investment is also smaller for stock traders compared to futures traders. Leverage in futures, which can be as high as 20 to 1, magnifies the risk of each trade.

Alternate rules were tested by Hochheimer in his study. Buy and sell signals were taken at the time that the intraday new high or new low occurred. No comparison was available to determine whether the risk was greater or less than the conventional approach. Hochheimer also tested the Weekly Rule with the week ending on days other than Friday. It was not apparent that any one day was better; however, the week ending Friday seems to be supported by liquidation before the weekend and should be favored unless there is a significant reason to choose a different day.

Traders will find the basic breakout method is one of the important trending techniques, and it is used throughout this book as a benchmark study. In Chapter 8 it is included as one of the basic trending methods in "Comparison of Major Trend Systems," and shows 10 years of results for the Eurodollar. Computer and spreadsheet code is also provided to allow further testing.

Avoiding Problems Programming the Weekly Breakout

The Weekly Rule is often thought of as having signals only on Friday; however, when programming this method, it is important to remember that a number of weeks end on Thursday due to holidays. Identifying the last day of the week in advance is a problem for a computer program. Although we can find the day of the week by simply using the function *DayOfWeek* in TradeStation's EasyLanguage, or *WEEKDAY* in Excel, we have already missed the day if the information returned jumps from Thursday to Monday and we discover the gap on Monday.

To avoid this problem, many charting systems provide weekly data on request, rather than daily. The automatic built-in conversion program will correctly change days to weeks. By looking at the high, low, and close of the weekly bar you can decide whether a signal has occurred. Executing on the close will be the last price of the week, regardless of the day on which it occurs.

The *N*-Day Breakout Applied to Stocks

Most literature on breakout systems applies this technique to futures markets. The primary difference between futures and stocks is the leverage; therefore, a small percentage move in futures can still yield a relatively high return. In addition, the cost of trading futures is still lower than the cost of trading stocks, even after the emergence of discount stock brokers. For example, one S&P e-mini contract costs less than $10 for a round-turn commission. At an S&P price of 1,000 and a contract size of 50, a cost of $10 for a purchase of $50,000 of value is .02%, almost negligible in the picture of total costs. While you can trade 1,000 shares of a stock for a flat fee of $9 per side ($18 round-turn), most stocks have a lower price than $50 per share, and trades of less than 1,000 shares may cost $30 per round-turn. While costs are greatly improved, they still limit extremely fast trading in stocks.

To understand the performance of the *N*-day breakout method applied to the stock market, Table 3–8 shows a selection of stocks and stock index markets from May 30, 1998 to May 30, 2003, tested for breakouts periods from 1 to 100. No commissions or slippage were included in the results. In addition to basic performance results, Table 5.11 shows the robustness of the results in the rightmost column. *Robustness* is defined as the percentage of profitable test results. Therefore, if calculation periods 25 through 74 were profitable and all others showed losses, the robustness would be 50%. This simple measure provides a way to establish confidence in expectations of future performance.

Table 5.11: Tests of the N-day breakout on selected stocks and index markets, 5 years ending May 30, 2003. While the breakout system is profitable for most stocks and index markets, there is little consistency. Some stocks, such as AOL, Intel, and Microsoft, and index markets such as Aerospace, Biotech, and the Nasdaq 100, have very robust performance, yielding profits for most choices of *N*. Others, such as Merck, Exxon-Mobile, large banks, and the Dow Industrials, had very few successful calculation periods.

Open table as spreadsheet

		Total PL	No. Prof Trades	Total Trades	% Prof Trades	Average Trade PL	Return Ratio	Best Selection	Test Performance Comments	Profitable Tests
STOCKS	ABX	(3.45)	35	81	43.2	(0.04)	0.91	5	Profits from 3–22	19%
	AMR	3.16	3	8	37.5	0.40	1.09	84	Profits from 76–86	11%
	AMZN	38.27	3	6	50.0	6.38	1.81	61	Profits from 53–96, some	50%

									other	
	AOL #1	140.99	138	316	43.7	0.45	1.55	1	Profits from 1–73, mixed 44–52	77%
	AOL #2	45.31	3	8	37.5	5.66	2.74	60	Slower selection	77%
	GE	24.83	3	4	75.0	6.21	4.14	81	Profits from 68–100, mixed 1–4, 18–23	37%
	IBM	179.99	44	97	45.4	1.86	1.94	5	Profits from 3–22	20%
	INTC	53.41	4	6	66.7	8.90	5.86	75	Profits from 30–100, some other	74%
	MRK	25.39	74	175	42.3	0.15	1.14	3	Profits 1, 3, 4 only	3%
	MSFT	63.30	35	76	46.1	0.83	2.05	6	Profits 3–22, 54–94	61%
	XOM	(0.21)	5	20	25.0	(0.01)	0.32	34	No profitable results	0%
INDEX	Aerospace	23.14	10	16	62.5	1.45	4.55	29	Profits from 13–95, some other	86%
	Biotech #1	10.73	211	591	35.7	0.02	1.19	1	Profits from 7–56, 85–100	65%
	Biotech #2	9.31	3	4	75.0	2.33	7.17	85	Larger profits per trade	65%
	DJIA #1	35.25	129	331	39.0	0.11	1.15	1	Profits from 4–6, 31–34	7%
	DJIA #2	25.13	129	331	39.0	0.08	1.95	32	Better return ratio	7%
	Large banks	2.10	202	575	35.1	0.00	1.03	1	Profits 1, 13 only	2%
	Life insurance	19.52	121	307	39.4	0.06	1.32	2	Profits from 1–6, 29–31, none > 1 0c	9%
	Nasdaq 100	19185	5	10	50.0	1918.50	4.94	40	Profits from 6–8, 14–100	90%
	Semiconductors	9.02	3	4	75.0	2.26	9.67	84	Profits from 64–100, some others	47%
	Software #1	49.62	214	558	38.4	0.09	1.15	1	Profits at 1, 8–15	9%
	Software #2	27.38	30	74	40.5	0.37	1.27	9	Larger profits per trade	9%
	SPX	836.20	2	4	50.0	209.05	3.79	88	Profits 65–81, some others	42%
	Transportation	11.93	6	14	42.9	0.85	2.24	38	Profits 2, 16–49, 51–57, 64–69, some other	53%

The results shown in Table 5.11 are inconsistent. Those results with a high percentage of profitable results, AOL, INTC, MSFT, Aerospace, Biotech, and Nasdaq 100, have great promise for success. Other markets have very few successful calculation periods, including MRK, XOM, the Dow Industrials, Large Banks, Life Insurance, and Computer Software. It is easy to draw the conclusion that the profitable markets had clear trends and the others did not. We may also be able to conclude that those markets with low volatility are less likely to produce successful trending results than those with greater volatility. The Nasdaq 100, perhaps the most volatile of all markets, was successful on all but a few calculation periods. The average of 100 active markets, compared to the 30 in the Dow, may have resulted in a smoother price series that caused fewer false trend signals. Many of these issues are covered later in this book, with greater attention in the "Measuring Volatility" section of Chapter 20, and in Chapter 21.

[15]Andrew D. Seidel and Philip M. Ginsberg, *Commodities Trading* (Prentice-Hall, Englewood NJ, 1983).

[16]Frank L. Hochheimer, *Computerized Trading Techniques 1982* (Merrill Lynch Commodities, New York, 1982).

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Chapter 6 - Regression Analysis
New Trading Systems and Methods, Fourth Edition
by Perry J. Kaufman
John Wiley & Sons © 2005 *Citation*

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Chapter 6: Regression Analysis

Regression analysis is a way of measuring the relationship between two or more sets of data. A stock analyst might want to know the relationship between the price of gold per ounce and the share price of Barrick Gold Corporation (ABX). An economist might want to know how the more complex relationship between interest rates, inflation, and the trade balance changes the value of the U.S. dollar. A hedger or arbitrageur could use the relationship to establish the relative fair value of two related products, such as palm oil and soybean oil, in order to select the cheaper product or to profit from price distortions; or, an investor you might simply want to find the strongest stock in the banking sector. Regression analysis involves statistical measurements to determine the type of relationship that exists between the data studied. Many of the concepts are important in technical analysis and should be understood by all technicians, even if they are not used frequently. The techniques may also be directly used to trade, as is shown at the end of this chapter.

COMPONENTS OF A TIME SERIES

Regression analysis is often applied separately to the basic components of a *time series*. These basic components are the *trend*, *seasonal* (or secular trend), and *cyclic* elements. These three factors are present in all price data. The part of the data that cannot be explained by these three elements is considered *random*, or unaccountable price movement.

Trends are the basis of many trading systems. *Long-term trends* can be related to economic factors, such as changing interest rates, inflation, shifts in the value of the U.S. dollar due to the balance of trade, and even consumer confidence. The reasons for the existence of short-term trends are not always clear. Expectations of a merger or government approval of a new drug, a temporary disruption in oil supply, or a dock-workers slowdown could all be catalysts for higher prices. However, trends that survive for only a few days or weeks cannot be explained by macroeconomic factors, but are usually the result of investor behavior—reaction to the constant flow of minor news and market reports.

Major fluctuations above and below the long-term trend are attributed to *cycles*. Both business and industrial cycles respond slowly to changes in supply and demand. The decision to close a factory or shift to a new crop cannot be made immediately, nor can the decision be easily changed once it has been made. Stimulating economic growth by lowering interest rates is not a cure that works overnight. Opening a new mine, finding new crude oil deposits, or building an automobile assembly plant in another country makes the response to increased demand slower than the act of cutting back on production. Moreover, once the investment has been made, business is not inclined to stop production, even at marginal returns.

Seasonality, the third component of price movement, is a form of cycle that depends on the calendar year. The travel industry is much more active in the summer than winter, and there is a much higher demand for electricity in the summer. Oil refiners shift their concentration from heating oil to gasoline in February and March as winter demand comes to an end, then change back again in the late summer. The fashion industry anticipates the changing seasons in order to introduce their new lines of clothing.

The *random* element of price movement is a composite of everything unexplainable. In later sections ARIMA, or Box-Jenkins methods, will be used to find shorter trends and cycles that may exist in these leftover data. This chapter concentrates on trend identification, using the methods of regression analysis. Seasonality and cycles are discussed in Chapters 8 and 9. Because the basis of a strong trading strategy is its foundation in real phenomena, serious students of price movement and traders should understand the tools of regression analysis to avoid incorporating erroneous relationships into their strategies.

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CHARACTERISTICS OF THE PRICE DATA

A time series is not just a series of numbers, but *ordered pairs* of price and time. There is a special relationship in the way price moves over various time intervals; the way price reacts to periodic reports; and the way prices fluctuate due to the time of year. Most trading strategies use one price per day, usually the closing price, although some methods average the high, low, and closing prices. Economic analysis operates on weekly or monthly average data, but might use a single price (e.g., "week on Friday") for convenience. Two reasons for the infrequent data are the availability of most major statistics such as earnings, consumer confidence, or supply and demand, and the intrinsic long-term perspective of the analysis. The use of less frequent data causes a *smoothing* effect. The highest and lowest prices will usually not appear, and the data will seem less volatile. Even when using daily closing price data, the intraday highs and lows have been eliminated, and the closing prices show less erratic movement.

Selection of the Calculation Period

A regression analysis, which can identify price direction over a specific time period, will not be influenced by cyclic patterns or short-term trends that are the same length as the time interval used in the analysis. For example, if wide seasonal swings occurred during the year but prices ended at about the same level each year (rising slightly due to inflation), a two-year regression line would be a straight line that split the fluctuations in half (see Figure 6.1).

Figure 6.1: A basic regression analysis results in a straight line through the center of prices.

The time interval used in regression analysis is selected to be long (or multiples of other cycles) if the impact of short-term patterns is to be reduced. If you do not want to remove the effects of seasonality or longer cycles, the time interval of the regression analysis should be less than one-half of that period (e.g., a 3- or 6-month trend will show the seasonal price changes). In this way, a regression analysis, or any trend technique, may be used to identify a seasonal or cyclic element.

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LINEAR REGRESSION

When most people talk about regression, they think about drawing a straight line through the center of some period of price movement. At the end of this chapter, and in the discussions and comparisons of trend systems, we will use the slope of the linear regression applied to a single price series to create a trend trading method. But regression is a simple and powerful tool for explaining the relationship between two time series. Those series may be two related stocks or futures markets or, in the case of a single time series, the relationship between price and time.

In this chapter we focus on explaining the price movement of one market by using another. Both are time series, that is, they post a new price each day. We start with the linear relationship between two price series, *X* and *Y*. A linear relationship will try to find the value of *Y* for each value of *X* using the formula for a straight line, $Y = aX + b$, where *a* is the *slope* of the line, and *b* is the *Y-intercept*, the point where the line crosses the *Y* axis when the value of *X* is zero.

The linear regression is also called a *straight-line fit*, or simply a *best fit*. It selects the straight line that comes closest to most of the data points. The result tells you that, for example, for every move of $1 in series *X*, we can expect a move of $1.50 in series *Y*. We will apply a linear regression in two examples, first to explain the price movement of corn based on the price of soybeans, then to explain the price of Barrick Gold Corporation (ABX) based on the price of physical gold.

Explaining, Not Predicting

You may have noticed that we refer to *explaining* the Barrick Gold stock price in terms of the price of gold bullion. We do not say that we can *predict* the price. We are finding the past relationship between two price series. You may decide that this relationship can be used to trade those two markets whenever prices move too far from one another. The regression analysis may establish what you see as a *fair value* for one market based on the price of the other. In order to forecast a price, you will need to establish that conditions at the date of your forecast are likely to be the same as the period over which the regression was calculated. You must also account for the loss of accuracy, or confidence, as you forecast further into the future.

Calculating the Best Straight-Line Fit

The simplest example of linear regression is the one used most often by traders, calculating the best straight-line fit through a selected period of price movement. This is done in the same way as finding the relationship between two price series, except that we will substitute the simple sequence 1, 2, 3, 4, … for the second series. The technique used is called the *method of least squares*.

We choose ten days of price movement in Wal-Mart during March 2002. In order to find the best straight-line fit, we begin with the equation for a straight line

$$Y = a + bX$$

In this equation, *Y* is the dependent variable because it is created from the value of *X*, the independent variable. The slope, *b*, is the relative change in *Y* for every unit change in *X*. Therefore, if $b = 2$ then *Y* moves twice as fast as *X*. The *Y*-intercept, *a*, is an adjustment in the price level to bring *X* and *Y* into alignment. It is also the point at which the straight line crosses the *Y*-axis when $X = 0$.

Method of Least Squares

The *method of least squares* finds the straight line which comes closest to all prices. To do this, calculate the *sum of the squares* of all the differences between the price and the corresponding value of the straight line and choose the line that has the smallest total deviation. The mathematical expression for this is

$$S = \sum (y_i - \hat{y}_i)^2$$

where all uses of Σ impliesy $\sum_{i-1}^{N}$

S	=	the sum of the squares of the error at each of the ten points on the straight line (one point for each price, designated by i = 1, 2, 3, …)
y_i	=	one of the actual prices of Wal-Mart
y_i	=	the estimated value of this price on the straight line
y_i - y_i	=	the difference between the actual value of y_i at i and the predicted line value y_i

Graphically, the individual deviations, or errors, for the first four points may look like those in Figure 6.2. Each actual data point is (1, y_1), (2, y_2), (3, y_3), …, and the corresponding position on the straight line is (1, y_1), (2, y_2), (3, y_3), …. The sum of the squares of the errors is

$$S = \Sigma(y_i - y_i)^2$$
$$= (y_1 - y_1)^2 + (y_2 - y_2)^2 + (y_3 - y_3)^2 + (y_4 - y_4)^2$$

Figure 6.2: Error deviation for method of least squares.

The straight line that causes S to be the smallest possible value will be the best choice for these data points. The square of y_i - y_i is always positive, thereby magnifying the importance of those data points that are farther from the approximated line on either side and reducing the significance of those points for which the approximation is good.

To use the least-squares method for solving the Wal-Mart/time price relationship, look for the solution to the straight line, $Y = a + bX$, expressed as

$$b = \frac{N \sum xy - \sum x \sum y}{N \sum x^2 - (\sum x)^2}$$

$$a = \frac{1}{N}(\sum y - b \sum x)$$

where N = the number of data points (10 in the example)
Σ = the sum over N points

In order to solve these equations, construct a table where all of the individual expressions in the two formulas can be calculated (see Table 6.1).[1] We can now substitute the values on the *Sums* line into the two equations:

$$b = \frac{10(2776.98) - (55)(494.30)}{10(385) - (55)(55)}$$
$$= \frac{27769.8 - 27186.5}{3850 - 3025}$$
$$= .70703$$

$$a = \frac{1}{10}(494.30 - 70703 \times 55)$$
$$= \frac{455.413}{10}$$
$$= 45.5413$$

Table 6.1: Calculations for a Wal-Mart Least Squares Fit

Open table as spreadsheet

	Wal-Mart Price *Y*	Sequence Number *X*	X^2	*XY*	Y^2	Straight Line Value
9/21/2001	44.66	1	1.00	44.66	1994.52	46.25
9/24/2001	47.28	2	4.00	94.56	2235.40	46.96
9/25/2001	48.40	3	9.00	145.20	2342.56	47.66
9/26/2001	49.48	4	16.00	197.92	2448.27	48.37
9/27/2001	49.39	5	25.00	246.95	2439.37	49.08
9/28/2001	49.50	6	36.00	297.00	2450.25	49.78
10/1/2001	49.76	7	49.00	348.32	2476.06	50.49
10/2/2001	51.60	8	64.00	412.80	2662.56	51.20
10/3/2001	52.73	9	81.00	474.57	2780.45	51.90
10/4/2001	51.50	10	100.00	515.00	2652.25	52.61
Sums	494.30	55	385.00	2776.98	24481.69	

The equation for the least-squares approximation is

$$Y = 45.5413. + .70703X$$

Selecting values for *X* and solving for *Y* gives the results shown in the right column of Table 6.1 and drawn along with the original prices for Wal-Mart in Figure 6.3. The straight line approximation increases by .707¢ per day and the approximation line starts at 45.54, where *X* = 0.

Figure 6.3: Wal-Mart prices with the results of the least squares fit. The straight line passes through the center of the price movement, minimizing the error.

Corn Explained by Soybeans

Finding the relationship between corn and soybean prices will tell the farmer whether planting one or the other is a better business decision. We use the same technique, but this time we use two price series instead of letting one be the simple integer sequence. We apply the prices in Table 6.2 to the equation for a straight line

$$Y = a + bX$$

where Y = the price of corn (the *dependent variable*)
X = the price of soybeans (the *independent variable*)
a = the Y-intercept (where the line crosses the Y-axis)
b = the slope (angle of the line)

Table 6.2: Annual Average Corn and Soybean Prices Open table as spreadsheet

	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Corn	1.27	1.19	1.10	1.10	1.05	1.00	.98	1.09	1.12	1.18
Soybeans	2.43	2.26	2.15	2.07	2.03	2.45	2.36	2.44	2.52	2.74

Open table as spreadsheet

	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Corn	1.16	1.24	1.03	1.08	1.15	1.33	1.08	1.57	2.55	3.02
Soybeans	2.98	2.93	2.69	2.63	2.63	3.08	3.24	6.22	6.12	6.33

Open table as spreadsheet

	1976	1977	1978	1979	1980	1981	1982
Corn	2.54	2.15	2.02	2.25	2.52	3.11	2.50
Soybeans	4.92	6.81	5.88	6.61	6.28	7.61	6.05

Source: 1956–1965, Illinois Statistical Service; 1966–1982, Commodity Research Bureau *Commodity Yearbook*.

A table of intermediate calculations, similar to Table 6.1 used for Wal-Mart, is shown in Table 6.3. The sums along the bottom line can be used to solve the equations for a straight line.

Table 6.3: Totals for Corn-Soybeans Least-Squares Solution

Open table as spreadsheet

	i	Corn y_i	Soybeans x_i	x_i^2	$x_i y_i$	y_i^2

1956	1	1.27	2.43	5.90	3.09	1.61
1957	2	1.19	2.26	5.11	2.69	1.42
1958	3	1.10	2.15	4.62	2.36	1.21
1959	4	1.10	2.07	4.28	2.28	1.21
1960	5	1.05	2.03	4.12	2.13	1.10
1961	6	1.00	2.45	6.00	2.45	1.00
1962	7	.98	2.36	5.57	2.31	.96
1963	8	1.09	2.44	5.95	2.66	1.19
1964	9	1.12	2.52	6.35	2.82	1.25
1965	10	1.18	2.74	7.51	3.23	1.39
1966	11	1.16	2.98	8.88	3.46	1.34
1967	12	1.24	2.93	8.58	3.63	1.54
1968	13	1.03	2.69	7.24	2.77	1.06
1969	14	1.08	2.63	6.92	2.84	1.17
1970	15	1.15	2.63	6.92	3.02	1.32
1971	16	1.33	3.08	9.49	4.10	1.77
1972	17	1.08	3.24	10.50	3.50	1.17
1973	18	1.57	6.22	38.69	9.76	2.46
1974	19	2.55	6.12	37.45	15.61	6.50
1975	20	3.02	6.33	40.07	19.12	9.12
1976	21	2.54	4.92	24.21	12.50	6.45
1977	22	2.15	6.81	46.38	14.64	4.62
1978	23	2.02	5.88	34.57	11.88	4.08
1979	24	2.25	6.61	43.69	14.87	5.06
1980	25	2.52	6.28	39.44	15.83.	6.35
1981	26	3.11	7.61	57.91	23.67	9.67
1982	27	2.50	6.05	36.60	15.13	6.25
		Σy	Σx	Σx^2	Σxy	Σy^2
Σ sums		43.38	106.46	512.95	202.35	82.27

Substitute these values into the formulas and solve for *a* and *b*.

$$\begin{aligned} b &= \frac{27(202.35) - (106.46)(43.38)}{27(512.95) - (106.46)(106.46)} \\ &= \frac{5463.45 - 4618.23}{13849.65 - 11333.73} \\ &= .336 \end{aligned}$$

$$\begin{aligned} a &= \frac{1}{27}(43.38 - .336 \times 106.46) \\ &= \frac{7.61}{27} \\ &= .282 \end{aligned}$$

The equation for the least-squares approximation is

$y = .282 + .336x$

Selecting even dollar values of x and solving for y gives the results shown in Table 6.4. The results of the linear approximation are shown in Figure 6.4. The slope of .336 indicates that for every $1 increase in the price of soybeans, there is a corresponding increase of 33.6¢ in corn. This is not far from what would be expected for farm income. Because the corn yield per acre is 2.5 times greater than the soybean yield in most parts of the United States, the ratio 1:2.5 should yield a slope of about .4. Considering areas where soybeans are alternatives to cotton and other crops, and the tendency for midwest farmers to plant mostly corn, a relatively higher price for soybeans is not surprising.

Figure 6.4: Scatter diagram of corn, soybean pairs with linear regression solution.

Table 6.4: Least-Squares Relationship for Corn and Soybeans, 1956–1982

Open table as spreadsheet

Soybeans	x	1.00	2.00	3.00	4.00	5.00	6.00	7.00
Corn	y	.61	.95	1.29	1.63	1.97	2.31	2.65

Gold and Barrick Gold Corporation

To find how the stock price of Barrick Gold Corporation can be explained by the price of physical gold prices, we will take the easier route of using a spreadsheet, and look only at the six months following the tragedy of September 11, 2001. If you have reviewed the method of solving the corn—soybean relationship, you will understand how to interpret the results of the spreadsheet solution.

We first must prepare the data for the Excel solution. We import the prices of ABX and gold into a worksheet and check that the dates are aligned. Next, we index each of the price series, beginning with 100. Each subsequent index value is the previous index value times the current price divided by the previous price. The two index series now are in the same percentage notation, as seen in Table 6.5.

Table 6.5: Setting Up a Spreadsheet for Calculating a Regression Solution

Open table as spreadsheet

	Actual Prices		Indexed Prices		Estimated ABX
	ABX	Gold	ABX	Gold	
9/10/2001	16.11	271.50	100.00	100.00	
9/17/2001	16.65	293.20	103.35	107.99	103.31
9/18/2001	16.70	289.40	103.66	106.59	100.52
9/19/2001	16.80	288.10	104.28	106.11	99.57
9/20/2001	17.35	288.50	107.70	106.26	99.86
9/21/2001	17.17	292.50	106.58	107.73	102.79
9/24/2001	16.67	288.20	103.48	106.15	99.64
9/25/2001	16.32	288.00	101.30	106.08	99.49
9/26/2001	17.34	291.40	107.64	107.33	101.99
9/27/2001	17.62	289.30	109.37	106.56	100.45
9/28/2001	17.35	293.10	107.70	107.96	103.23
10/1/2001	17.70	290.60	109.87	107.03	101.40
10/2/2001	17.95	291.60	111.42	107.40	102.13

10/3/2001	17.10	290.10	106.15	106.85	101.03
10/4/2001	17.00	290.30	105.52	106.92	101.18
10/5/2001	17.25	291.20	107.08	107.26	101.84
10/8/2001	16.86	291.80	104.66	107.48	102.28
10/9/2001	16.44	290.00	102.05	106.81	100.96
10/10/2001	15.95	287.10	99.01	105.75	98.83

Excel provides a fast way of solving the regression problem. Under the menu Tools/Data Analysis/Regression, you will find an input form that allows you to specify the dependent variable, *Y* (enter the columns with ABX prices), and the independent variable, *X* (enter the columns with gold prices). Allow all other values in the menu to default. When finished, the answer will appear on a separate sheet. The two items that we need are the *Y*-intercept and the *X*-variable (the slope). Both can be found as the last two entries in column *B*. For this example, Excel gives the *Y*-intercept as -111.6 and the *X*-variable as 1.99.

The estimated values of ABX based on the daily gold prices are shown in the last column of Table 6.5 and charted, along with the ABX and gold index values, in Figure 6.5. Each estimated value of *ABX* = 1.99 × *price of gold* - 111.6. This says that the price of ABX stock will generally move twice the amount (1.99%) as the price of gold in the same direction on the same day. In Figure 6.5, the regression estimation is very good during the first and last part of the observation period, but lags more in the middle. We can certainly conclude that the price of gold was a strong influence on the movement of ABX share value immediately following 9/11.

Figure 6.5: Estimated price of Barrick Gold based on actual gold prices.

Programming and Spreadsheet Tools

In addition to the regression menu in Excel, there are simple functions that can produce the same results. *Slope(y,x)* returns the slope value, *b*, when you enter the column lists for *Y* and *X*. *Intercept(y,x)* returns the *Y*-intercept, *a*, when you enter the same values for *Y* and *X*. Once you know what to look for, it's easy.

In trading strategy software, such as TradeStation, the functions that calculate linear regression are nearly the same. *LinearRegSlope* or *LinearRegAngle*, *LinearRegValue*, *LinRegIntercept*, all produce the numbers that you need to find the estimated value of the dependent variable. Most often, traders are only interested in the slope as a way to identify the direction

of prices. Using daily data, they add the slope value to the most recent price to project tomorrow's price,

Projected price (1-day ahead) = *Today's price* + *Slope*

If they want to project *n* days ahead, they multiply the slope by 5,

Projected price (5-days ahead) = *Today's price* + 5 × *Slope*

As prices are projected further ahead, there is a much greater chance of error.

[1]Appendix 2 contains a computer program to solve the straight-line equation using the method of least squares, as well as the nonlinear examples later in this chapter.

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LINEAR CORRELATION

Solving the least-squares equation for the best fit does not mean that the answer is useful. In the previous sections we used price series that had a clear relationship; therefore, the results appeared valid. The least-squares method will always give an answer, even when there is nothing that makes one prices series dependent upon the other. You may think that two data items affect one another, such as the amount of disposable income and the purchase of television sets, but that might not be the case. The purchase of television sets may peak just before the Superbowl, for example.

The *linear correlation*, which produces a value called the *coefficient of determination* r^2, or the *correlation coefficient*, expresses the strength of the relationship between the data on a scale from +1 (perfect correlation) to 0 (no relationship). It may be even better to look at r, rather than r^2, because you then know whether the correlation is positive or negative. A negative correlation between two prices series means that when one goes up, the other goes down. When r = +1 there is a perfect positive correlation, when r = 0 there is no correlation, and when r = -1 there is a perfect negative correlation, as shown in Figure 6.6. This is the most practical way to find out whether two price series are moving in a similar manner. If r^2 is less than about .20, then the linear regression has no practical value.

Figure 6.6: Degrees of correlation. (a) Perfect positive linear correlation (r = 1). (b) Somewhat positive linear correlation (r = .5). (c) and (d) No correlation (r = 0). (e) Perfect negative linear correlation (r = -1). *Source*—Mendenhall, William and James Reinmuth. *Statistics for Management and Economics*, 2nd ed. (Wadsworth, Belmont, CA, 1974). Reprinted by permission of the publisher, Duxbury Press.

To calculate the correlation coefficient, r, we use Pearson's Product-Momentum Correlation

$$r = \frac{1}{N}\sum_{i-1}^{N}\left(\frac{x_i - \bar{x}}{s_x}\right)\left(\frac{y_i - \bar{y}}{s_y}\right)$$

Where

$$s_x^2 = \frac{1}{N}\sum_{i-1}^{N}(x_i - \bar{x})^2$$

$$s_y^2 = \frac{1}{N}\sum_{i-1}^{N}(y_i - \bar{y})^2$$

$$\bar{x} = \frac{1}{N}\sum_{i-1}^{N}x_i$$

$$\bar{y} = \frac{1}{N}\sum_{i-1}^{N}y_i$$

In the calculation above, s_x and s_y are the standard deviations and *x* and *y* are the averages. The result *r* is interpreted as follows:

$r = +1$	A perfect positive linear correlation. The data points are along a straight line going upward to the right (Figure 6.6a).
$+1 > r > 0$	The scattered points become more uniformly distributed about a positive approximation line as the value of *r* becomes closer to +1 (Figure 6.6b).
$r = 0$	No linear correlation exists (Figures 6.6c, 6.6d).
$-1 < r < 0$	The scattered points become more uniformly distributed about a negative approximation line as the value of *r* becomes closer to -1.
$r = -1$	A perfect negative linear correlation, the line going downward to the right (Figure 6.6e).

Computer Programs to Find Correlations

Just as with a linear regression, both spreadsheets and trading strategy software have functions to automatically calculate the correlation. Spreadsheets include correlations as part of the statistics when the regression tool is used. If you wanted to create a correlation matrix, or cross-correlations, then you can use the function *correl(list1,list2)*, which calculates only the correlation coefficient for the two series of the same length.

Be careful that the result of the correlation calculation is *r* rather than r^2 which is a common substitution. As discussed in the previous section, using r^2 changes negative values to positive ones so that when $r = -1$ then $r^2 = +1$. This can significantly change your results.

You can also find the correlation calculation in trading strategy software, where a function specifies the independent series, dependent series, and the time period over which the regression will be calculated. In TradeStation, if you want the correlation *r2* of two series, *data1 and data2*, over the past 45 days then

```
R2 = correlation(close of data1, close of data2, 45)
```

The following TradeStation EasyLanguage function can be used to find *r*:

```
TSMCorrelation
Pearson's Product-Momentum Correlation, r (values from -1 to +1)
Copyright 1999-2000, P.J.Kaufman. All rights reserved. }

{x and y are the two series to be compared
 period is the length of the calculation }
```

```
input:   x(numericseries), y(numericseries), period(numericsimple);
vars:    sdx(0), sdy(0), avgx(0), avgy(0), sum(0), ix(0);

TSMCorrelation = 0;
if currentbar >= period then begin
   sdx = stddev(x,period);
   sdy = stddev(y,period);
   avgx = average(x,period);
   avgy = average(y,period);
   sum = 0;

   for ix = 0 to period-1 begin
       sum = sum + ((x[ix]-avgx)/sdx)*((y[ix]-avgy)/sdy);
       end;
TSMCorrelation = sum / period;
end;
```

Correlation Adjustments When Using a Time Series

Because most price analyses involve the use of two time series, precautions should be taken to avoid a dominant trend that can distort the results. A long-term upward or downward trend will overshadow the smaller movements around the trend and exaggerate the correlation. The following three methods may be used to correct the problem:

1. The deviations from the trend (y_i - y_i) may be correlated.

2. The first differences [(y_i - y_{i-1}), (y_i - y_{i-1})] may be correlated.

3. The two series may be adjusted for trend.

The simplest method is the second, which is also very effective. Create two series of differences, then find the correlation of those new series. You should expect any commercial software to detrend the data before calculating the correlation coefficient; however, it is always a good idea to check it.

Forecasting Using Regression

A distinct advantage of regression analysis is that it allows the analyst to forecast price movement. In the case of the linear regression, the forecast is simply an extension of the line. Later in this chapter, there will be other *nonlinear* solutions that are used to predict more complex patterns.

The regression forecast is the basis for the *probabilistic model*. Instead of the cornsoybean relationship, find the slope and *y*-intercept of a straight line using the price of soybeans and sequential time as we did in the first Wal-Mart example, Table 6.3. The result is

$$Y = .987 + .221X$$

where Y = the price of soybeans for the year X

Because the solution substituted the value of 1 for 1956 and 27 for 1982, the average farm income per bushel of soybeans is forecast as 7.32 in 1985 (X = 30) and 8.38 in 1990 (X = 35).

Confidence Bands

Regression analysis includes its own measure of accuracy called *confidence bands*. It is based on a probability distribution of the errors in the fitted equation and the size of the data sample. Looking at Figure 6.4, the straight line cannot touch all the points, but its "goodness of fit" may be measured by using the *standard deviation of the errors* to determine the variance over the total number of data points N. If the actual data points are y_i and their corresponding value on the fitted line y_i, then

$$\sigma = \sqrt{\frac{\sum e^2}{N}}$$

where $e_i = y_i - y_i$

Referring to the table of normal distribution (Appendix 1), the 95% level is equivalent to 1.96 standard deviations. Then, a confidence band of 95%, placed around the forecast line, is written

95% upper band = $y_i + 1.96s$

95% lower band = $y_i - 1.96s$

Figure 6.7a shows the soybean forecast with a 95% confidence band. The points that are outside the band are of particular interest and can be interpreted in one of two ways.

1. They are not representative of normal price behavior and are expected to correct the levels within the bands.
2. The model was not performed on representative or adequate data and should be reestimated.

Figure 6.7: Confidence bands. (a) Soybeans with 95% confidence band. (b) Out-of-sample forecasts lose confidence.

Figure 6.7b also indicates that the forecast loses accuracy as it is further projected; the forecast is based on the size of the sample used to find the regression coefficients. The more data included in the original solution, the longer the forecast will maintain its accuracy.

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NONLINEAR APPROXIMATIONS FOR TWO VARIABLES

The linear regression, also called a *first-order* equation, is the simplest way of finding the relationship between two price series. It uses one multiplier (the slope) and one value (the *Y*-intercept) to scale the magnitude of the price. By adding a third term, cx^2, the approximation can be made much more accurate. The third term, x^2, allows the approximation to use a *parabolic* curve—a single, smooth change of direction. The fourth term, dx^3, adds *inflection*, the ability for the curve to turn up and down at different points. Each time we add one more term, the ability to fit model price series using another becomes better. The general *polynomial* form that approximates any curve is

$$y = a_0 + a_1x + a_2x^2 + \ldots + a_nx^n$$

The first two terms on the right side of the equal sign form the equation for a straight line (where a_0 was called a and a_1 was called b). For most price forecasting, the *second-order* equation, also called *curvilinear*, which uses three terms, is sufficient (Figure 6.8). The corn and soybean prices from Table 6.1 will be used to give examples of this and other nonlinear approximations.

Figure 6.8: Curvilinear (parabolas). *Source*— Reprinted with permission from *Standard Mathematical Tables*, 24th ed. CRC Press, Inc. 1976 pp. 321, 322.

The curvilinear form

$$y = a + bx + cx^2$$

must be solved for the coefficients a, b, and c using the simultaneous equations

$$Na + b\Sigma x + c\Sigma x^2 = \Sigma y$$

$$a\Sigma x + b\Sigma x^2 + c\Sigma x^3 = \Sigma xy$$

$$a\Sigma x^2 + b\Sigma x^3 + c\Sigma x^4 = \Sigma x^2 y$$

The calculations from Table 6.2, including the additional sums for x^3, x^4, and x^2y, can be substituted into the preceding equations. The system of simultaneous linear equations can be solved by the process of matrix elimination[2], a technique that should not be performed without the help of a computer. The matrix solution is used later in this chapter in the section "Multivariate Approximations." An alternate solution can be obtained by continuing with the already familiar least-squares method.

[2]See Appendix 3 for examples of matrix solutions.

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SECOND-ORDER LEAST SQUARES

The concept of least squares can be extended to the curvilinear (second-order) equation by minimizing the sum of the errors[3]

$$S = \sum_{i=1}^{N} (y_i - a - bx_i - cx_i^2)^2$$

First, it is necessary to separate the various intermediate sums before expressing the solution for *a*, *b*, and *c*.

$$S_{xx} = \frac{1}{N} \sum_{i=1}^{N} (x_i - \overline{x})^2$$

$$S_{xy} = \frac{1}{N} \sum_{i=1}^{N} (x_i - \overline{x})(y_i - \overline{y})$$

$$S_{yy} = \frac{1}{N} \sum_{i=1}^{N} (y_i - \overline{y})^2$$

$$S_{xx^2} = \frac{1}{N} \sum_{i=1}^{N} (x_i - \overline{x})(x_i^2 - \overline{x}^2)$$

$$S_{x^2x^2} = \frac{1}{N} \sum_{i=1}^{N} (x_i^2 - \overline{x}^2)^2$$

$$S_{yx^2} = \frac{1}{N} \sum_{i=1}^{N} (y_i - \overline{y})(x_i^2 - \overline{x}^2)$$

The constant values can then be found by substitution into the following equations

$$b = \frac{S_{xy}S_{x^2x^2} - S_{yx^2}S_{xx^2}}{S_{xx}S_{x^2x^2} - (S_{xx^2})^2}$$

$$c = \frac{S_{xx}S_{yx^2} - S_{xx^2}S_{xy}}{S_{xx}S_{x^2x^2} - (S_{xx^2})^2}$$

$$a = \bar{y} - b\bar{x} - c\bar{x}^2$$

The procedure is identical to the linear least squares solution. Fortunately, there are simple computer programs that have already been written to solve these problems. Using a method similar to the program found in Appendix 2, the result is

$$y = .310 + .323x + .002x^2$$

Table 6.6 shows the relationship using selected values of *x*. Notice that this relationship is essentially linear due to the small second-order coefficient. It is not necessary to solve both the linear and curvilinear models because the second-order equation can be used in the linear form when this situation occurs.

Table 6.6: Curvilinear Values for Corn and Soybeans

Open table as spreadsheet

Soybeans	*x*	1.00	2.00	3.00	4.00	5.00	6.00	7.00
Corn	*y*	.63	.96	1.29	1.63	1.97	2.31	2.66

[3]F.R. Ruckdeschel, *BASIC Scientific Subroutines*, Vol. 1 (Byte/McGraw-Hill, Peterborough, NH, 1981).

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TRANSFORMING NONLINEAR TO LINEAR

Two curves that are often used to forecast prices are *logarithmic* (*power*) and *exponential* (see Figure 6.9). The exponential, curving up, is used to scale price data that become more volatile at higher levels. Each of these forms can be easily transformed into linear relationships and solved using the method of least squares. This will allow you to fool the computer into solving a nonlinear problem using a linear regression tool.

Figure 6.9: Logarithmic and exponential. *Source*—Cuthbert Daniel and Fred S. Wood, *Fitting Equations to Data—Computer Analysis of Multifactor Data*, 2nd ed. (New York— John Wiley & Sons, 1980, pp. 20, 21). Reprinted with permission.

To solve the logarithmic relationship, substitute ln *x* for *x,* ln *a* for *a*, and ln *y* for *y*. Instead of using a column of *x*-values in the spreadsheet, create a new column which has the values ln *x*. Create another column with ln *y*. Now solve the regression using ln *x* and ln *y* instead of *x* and *y*. When completed you will have the value of *b*, but you will also have ln *a* instead of *a*. The value of ln *a* must be raised to the power of *e* to get *a*, $a = (\ln a)^e$. The Excel function for the power of *e* is *exp*. Once you have the values *a* and *b*, the logarithmic approximation can be calculated and plotted.

The significant difference in the log and exponential transformations is that the value of *x* is not scaled for the exponential. Taking the original corn and soybean data and performing the natural log functions *ln* for both log and exponential approximations results in the linear form that can be solved using least squares. Selected results from the computer program in Appendix 2 are shown in Table 6.7.

Table 6.7: Log and Exponential Values for Corn and Soybeans

Open table as spreadsheet

Soybeans	*x*	1.00	2.00	3.00	4.00	5.00	6.00	7.00
Corn (log)	*y*	.54	.94	1.30	1.64	1.96	2.26	2.56
(exp)	*y*	.84	1.02	1.24	1.50	1.83	2.22	2.70

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EVALUATION OF TWO-VARIABLE TECHNIQUES

Of the three curve-fitting techniques, the curvilinear and exponential results are very similar, both curving upward and passing through the main cluster of data points at about the same incline. The log approximation curves downward after passing through the main group of data points at about the same place as the other approximations. To evaluate objectively whether any of the nonlinear methods are a better fit than the linear approximation, find the standard deviation of the errors, which gives a statistical measurement of how close the fitted line comes to the original data points. The results show that the curvilinear is best; the logarithmic, which curves downward, is noticeably the worst (see Figure 6.10).

Figure 6.10: Least-squares approximation for soybeans using linear, curvilinear, logarithmic, and exponential models.

In the case of the corn—soybean relationship, the model with the smallest variance makes the most sense. The reality of the production—price relationship supports the selection of the linear (or curvilinear) values.

The use of regression analysis for forecasting the price of soybeans alone has a different conclusion. Although 27 years were used, the last 10 showed a noticeable increase in soybean prices. This rising pattern is best fitted by the curvilinear and exponential models. However, these curves show price forecasts that continue to rise at an increasing rate. Had inflation maintained its double-digit rate, these forecasts would still lead to unrealistically high prices. The logarithmic model, which tends to flatten at the top, turned out to be the best for the actual situation. This shows that the problem of forecasting is more complex than this naive solution. Common sense tells us that prices cannot continue to accelerate upwards. The logarithmic model, which showed the worst statistical results, provided the best forecast. The logarithmic model is similar to the square root technique that is commonly used to estimate volatility of longer time intervals using shorter interval data, as was shown in the section of Chapter 2 called "Annualizing Risk."

To avoid using the wrong solution, most analysts carefully track the major economic factors, such as interest rates,

inflation, and the value of the U.S. dollar. The model must be reestimated whenever these factors change or whenever there is new data that may result in a more accurate solution. They may use a *rolling calculation interval*, dropping off the oldest data and adding the most recent. They may also use *multivariate approximations*, discussed in the next section, which evaluate more than one independent, or causal, variables.

Direct Relationships

The price at which a market trades is often dependent upon the prices of other markets that provide a substitute product, and the cost of production. This is not only true for crops and other commodities, but for pharmaceutical companies providing the same product (such as the cholesterol drugs Lipitor and Zocor), and for airlines vying for passengers on the same route.

The ability to substitute one product for another creates an opportunity for *arbitrage*. In general, if two products provide the same function they should sell at the same price, net of transaction costs, which can include carrying charges, shipping, inspection, and commissions. These relationships are watched carefully when they move apart by more than the transaction costs; traders step in quickly to buy the cheaper one and sell the more expensive one, causing prices to come back into alignment. Arbitrageurs keep the futures and cash prices together; they continually prevent the price of gold in New York, London, and Hong Kong from drifting apart. For interest rate markets, "strips" serve the purpose of preventing the large pool of 3-month rates, 5 and 10-year notes, and 30-year bonds from offering widely different returns when they are at the same maturity. The Interbank market provides the same stability for foreign exchange markets, and the soybean *crush*, energy *crack*, and other processing margins do not stay out of line for long. Competition will keep the prices of Lipitor and Zocor together, and the addition of a generic substitute will cause all three to realign. The following nonfinancial markets have close relationships that can be found using regression analysis.

Open table as spreadsheet

Commodity Product Relationships	Reason
All crops	Income for farmers based on per acre yields
Grains	Protein value used for feed
Livestock and feedgrains	Cost of feed affects the cost of livestock
All livestock	Consumer purchases influenced by price
Sugar and corn	Commercial sweetener substitution
Hogs and pork bellies	Product dependency: bacon prices depend on hog prices
Silver, gold, and platinum	Investor's inflation hedge
Interest rates and stock markets	Investors continually choose between stocks and interest rates
Interest rates and foreign exchange	investors worldwide move money to seek the best returns

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MULTIVARIATE APPROXIMATIONS

Regression analysis is most often used in complex economic models to find the combination of two or more independent variables that best explain or forecast prices. A simple application of annual production and distribution of soybeans will determine whether these factors are significant in determining the price of soybeans. Because the demand for soybeans and its products is complex, we should not expect a very accurate model using only two independent variables. However, the method of solution is the same when you add other factors.

Applying the method of least squares which was used for a simple linear regression, the equation for two independent variables is

$$y = a + bx_1 + cx_2$$

where	y	= the resulting price, in this case soybeans
	x_1	= the total production (supply)
	x_2	= the total distribution (demand)
	a, b, c	= constants, or weighting factors, to be calculated

As in the linear approximation, the solution to this problem will be found by minimizing the sum of the squares of the errors at each point

$$S = \sum_{i=1}^{n} (y_i - \hat{y}_i)^2$$

Substituting y from the previous equation,

$$S = \sum_{i=1}^{n} (y_i - (a + bx_1 + cx_2))^2$$

The solution to the multivariate problem of two independent variables x_1 and x_2 requires the following three least-squares equations:

$$an + b\sum x_1 + c\sum x_2 = \sum y$$

$$a\sum x_1 + b\sum x_1^2 + c\sum x_1x_2 = \sum x_1y$$

$$a\sum x_2 + b\sum x_1x_2 + c\sum x_2^2 = \sum x_2y$$

The procedure for solving the three simultaneous equations is the same as the curvilinear method of coefficient elimination. The sums are calculated in Table 6.8, then substituted into the last three equations:

$$12.00a + 13.546b + 12.582c = 44.4$$

$$13.55a + 15.980b + 14.75c = 53.28$$

$12.58a + 14.75b + 13.86c = 49.264$

Table 6.8: Totals for Multivariate Solution

Open table as spreadsheet

Soybeans									
			Supply	Demend					
			x_1	x_2	x_1^2	x_2^2	x_1x_2	x_1y	x_2y
	y		(Billions)		(Billions)			(Millions)	
1964	1	2.67	.700	.677	.490	.458	.474	1.869	1.808
1965	2	2.88	.845	.738	.714	.545	.624	2.434	2.125
1966	3	2.98	.928	.839	.861	.704	.779	2.765	2.500
1967	4	2.93	.976	.874	.953	.764	.853	2.860	2.561
1968	5	2.69	1.107	.900	1.225	.810	.996	2.978	2.421
1969	6	2.63	1.133	.946	1.284	.895	1.072	2.980	2.488
1970	7	2.63	1.127	1.230	1.270	1.513	1.386	2.964	3.235
1971	8	3.08	1.176	1.258	1.383	1.583	1.479	3.622	3.875
1972	9	3.24	1.271	1.202	1.615	1.445	1.528	4.1 18	3.894
1973	10	6.22	1.547	1.283	2.393	1.646	1.985	9.622	7.980
1974	11	6.12	1.215	1.435	1.476	2.059	1.744	7.436	8.782
1975	12	6.33	1.521	1.200	2.313	1.440	1.825	9.628	7.596
Σ		44.40	13.546	12.582	15.977	13.862	14.745	53.276	49.265

The coefficient matrix solution is[4]

$$\begin{pmatrix} 12.00 & 13.55 & 12.58 & 44.40 \\ 13.55 & 15.98 & 14.74 & 53.28 \\ 12.58 & 14.74 & 13.86 & 49.26 \end{pmatrix}$$

$$\begin{pmatrix} 1 & 1.239 & 1.048 & 3.700 \\ 0 & .6798 & .5451 & 3.145 \\ 0 & .5451 & .6720 & 2.714 \end{pmatrix}$$

$$\begin{pmatrix} 1 & 0 & .1429 & -1.5240 \\ 0 & 1 & .8018 & 4.6264 \\ 0 & 0 & .2349 & .1922 \end{pmatrix}$$

$$\begin{pmatrix} 1 & 0 & 0 & -1.641 \\ 0 & 1 & 0 & 3.9703 \\ 0 & 0 & 1 & .8183 \end{pmatrix}$$

The results show a = -1.641, b = 3.9703, and c = .8183, so that the multiple linear approximation of the price is

$$y = -1.641 + 3.9703x_1 + .8183x_2$$

where x_1 = the production of soybeans in billions of bushels

x_2 = demand in billions of bushels

The coefficient of supply is much larger than the coefficient of demand, therefore it is the principal factor in the determination of price. Had either coefficient of x_1 or x_2 been small, it would have indicated a lack of significance. The selection of which data to use when determining price components is not always obvious and may result in a number of small coefficients. In the example, supply-and-demand figures were used to determine price, but perhaps supply and inflation or demand and inflation would have been better. Further, this method will always give an answer, even when the choice of data is erroneous. To find out which sets of data are best, each combination would have to be tested and the variance of the estimated values compared with the actual prices. The best fit and the best choice should be the one with the smallest variance, provided you have used sensible dependent variables.

Computer programs are available that perform multivariate analysis and allow a large number of items to be input as potentially relevant factors. The *IMSL Math Library* by Visual Numerics, which accompanies Fortran and C compilers, includes a full library of programs that solve linear systems of equations using least squares and many other matrix applications. Recently, *neural networks* and *genetic algorithms* have been used to find solutions to complex problems of supply and demand. Neural nets have the advantage of providing a nonlinear solution. That is, the multivariate answer to the soybean problem says that the effect of supply is always four times greater than the effect of demand; but the neural net solution may qualify that answer by giving a larger weight to supply during years when supply is threatened by bad weather. Neural nets are discussed in Chapter 20.

Selecting Data for an S&P Model

The stock market is driven by a healthy economy and by lower interest rates. A good economy means that there is high employment and consumers are actively buying homes, durable goods, services, and frivolous items with their disposable income. Low interest rates increase corporate profitability by reducing the cost of debt. Economic growth and controlled inflation is delicately orchestrated by the central bank of each country; in the United States, it is the Federal Reserve.

To create a robust S&P model, one that explains the change in S&P prices using economic data, it is necessary to select the most meaningful data. The following was suggested by Lincoln[5] to be used for a six-month S&P forecast:

- *S&P prices*, the closing prices of the Standard & Poor's 500 cash index.
- *Corporate bonds/Treasury bonds*, the BAA corporate bond yield divided by the 30-year Treasury bond yield, normalized by subtracting the historical mean.
- *Annual change in the dollar*, the 12-month change in the dollar, minus 1, which might be based on the Dollar Index traded on the New York Futures Exchange (discussed in Chapter 2), or a comparable weighting of major currencies.
- *Annual change in Federal funds rate*, the 12-month change in the Fed funds rate, minus 1.
- *Federal funds rate/Discount rate*, the Fed funds rate divided by the discount rate, normalized by subtracting the historical mean.
- *Money supply*, M1 money supply, not seasonally adjusted.
- *Annual Consumer Price Index*, the 12-month change in the CPI, minus 1.
- *Inflation/Disinflation index*, the annualized one-month change in the CPI divided by the 12-month change in the CPI, minus 1.
- *Leading economic indicators*, the 12-month change in the leading economic indicators, minus 1.
- *One-month versus 10-month oscillator for the S&P cash index*, the difference between the monthly average and the past 10 months, approximately 200 days.

- *Inflation-adjusted commercial loans*, the inflation-adjusted 12-month growth in commercial loans.

Lincoln used 20 years of monthly values to forecast the S&P price six months ahead. Some of this data is available on a weekly basis and might be adapted to a shorter time frame; however, it is unreasonable to think that an accurate daily forecast is possible using weekly or monthly data. It is also likely that the use of more frequent S&P price data is inconsistent with the monthly statistics and will introduce more noise and make the results less reliable.

One element that is missing from the 11 items listed is a volatility adjustment. There has been a 600% increase in the S&P price over 20 years and volatility is clearly much higher. A simple percentage relationship may not describe this change adequately, but may be used until a better one is substituted. Therefore, those items that become more or less volatile as prices move higher and lower must be corrected using a volatility-normalizing factor. For example, if we consider the initial volatility when the S&P was 100 at the beginning of the data as normal, then when the price is 800 we divide the current volatility by eight to normalize, or even take the square root if the increase in volatility is nonlinear. This type of adjustment would apply to nearly all the items except money supply and the inflation/disinflation index. Remember that, where applicable, yields must always be used for interest rates, not prices.

Generalized Multivariate Solution

In general, the relationship between n independent variables is expressed as

$$y = a_0 + a_1x_1 + a_2x_2 + \ldots + a_nx_n$$

The solution to this equation is the natural extension of the problem in two and three variables. The $n + 1$ equations in $n + 1$ variables are created by summing the $n + 1$ equations developed from the general equation by multiplying the second equation by x_1, the third by x_2, and so on:

$$\begin{aligned}
a_0 n + a_1 \sum x_1 + a_2 \sum x_2 + \ldots + a_n \sum x_n &= \sum y \\
a_0 \sum x_1 + a_1 \sum x_1^2 + a_2 \sum x_1 x_2 + \ldots + a_n \sum x_1 x_n &= \sum x_1 y \\
a_0 \sum x_2 + a_1 \sum x_1 x_2 + a_2 \sum x_2^2 + \ldots + a_n \sum x_2 x_n &= \sum x_2 y \\
&\vdots \\
a_0 \sum x_n + a_1 \sum x_1 x_n + a_2 \sum x_n + \ldots + a_n \sum x_n^2 &= \sum x_n y
\end{aligned}$$

It is not practical to solve this system of equations manually, but it can be done quickly using a single program found in a math library software (such as IMSL mentioned earlier), or even using Excel matrix functions (see a more detailed example in Appendix 3). Those with only a little experience in regression analysis should remember that the model is most accurate within the range of the data points; when projecting outside the bounds of the sample data, the predictive qualities of the regression formula decrease with time. It is most likely that a good solution will be found for interest rates and grain prices, which are trading at the same levels as previous years, but may not be reliable for index markets that have made erratic new highs over the years.

Many dependent variables (x_i) may be used to increase the possibility of finding a good correlation. The predictive quality of this solution will depend on the relevance of the independent variables. It is best to start with the obvious components of a time series, such as inflation, then add standard economic statistics, including the Consumer Price Index and industrial product, as well as supply and demand information specific to the market being evaluated. For both grain and energy markets, the accumulation of inventory, or stocks, is a strong influence on price; these factors also have an expected seasonal variation, which is represented in terms of an index of adjustment. Using monthly data means that you must have a strong tolerance for risk because even the best models do not account for the price fluctuations during the month. Measuring the error of the estimates will help determine whether additional factors are necessary.

Least-Squares Sinusoidal

When you know that there is a seasonal or cyclic pattern to price movement, you can use the trigonometric functions, *sine* and *cosine*, as a special case of multiple linear equations. Observing periodic peaks and valleys in a price series suggests that a cyclic pattern may be present. One of the more well-known uses of cyclic analysis was performed by Hurst in *The Profit Magic of Stock Transaction Timing* (Prentice-Hall), in which there is an interesting example of Fourier analysis applied to the Dow Jones Industrial Averages. A full discussion of cyclic analysis and trigonometric estimations can be found in Chapter 11.

The equation for the approximation of a periodic movement is

$$y_t = a_0 + a_1 t + a_2 \cos\frac{2\pi t}{P} + a_3 \sin\frac{2\pi t}{P} + a_4 t \cos\frac{2\pi t}{P} + a_5 t \sin\frac{2\pi t}{P}$$

which is a special case of the generalized multivariate approximation

$$y = a_0 + a_1 x_1 + a_2 x_2 + a_3 x_3 + a_4 x_4 + a_5 x_5$$

where P = the number of data points in each cycle

x_1 = t, the incremental time element

x_2 = $\cos(2pt/P)$, a cyclic element

x_3 = $\sin(2pt/P)$, a cyclic element

x_4 = $t \cos(2pt/P)$, an amplitude-variation element

x_5 = $t \sin(2pt/P)$, an amplitude-variation element

The number of data points, P, in each cycle would be 12 if you were calculating seasonality using monthly data. If you believe that there is a cycle, then you can find the average number of data points between major price peaks. The term $a_1 t$ will allow for the linear tendencies of the sequence. The term $2p$ refers to an entire cycle and $2pt/P$ is a section (1/P) of a specific cycle t; this in turn adds weight to either the sine or cosine functions at different points within a cycle.

The solution is calculated in the tabular manner of the other methods, using simultaneous linear equations derived in the same way as the generalized multivariate equation, substituting from the table of sums and solving the coefficient matrix for a_0, ..., a_5 using the techniques in Appendix 3.

[4]Matrix elimination is the necessary solution to the multivariate problem. Appendix 3 contains the computer programs necessary to perform its operation.

[5]Thomas H. Lincoln, "Time Series Forecasting: ARAAX," *Technical Analysis of Stocks & Commodities* (September 1991).

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ARIMA

An *Autoregressive Integrated Moving Average* (*ARIMA*) model is created by a process of repeated regression analysis over a moving time window, resulting in a forecast value. An ARIMA process automatically applies the most important features of regression analysis in a preset order and continues to reanalyze results until an optimum set of parameters or coefficients is found. In Chapter 21, the selection and testing of individual parameters within a trading strategy are discussed. This involves approximating their initial value and identifying a testing range. An ARIMA model does all of this as part of its special process. Because it is used to recalculate the *best fit* each time a new piece of data appears, it may be thought of as the first *adaptive process*.

G.E.P. Box and G.M. Jenkins refined ARIMA at the University of Wisconsin[6] and their procedures for solution have become the industry standard. This technique is often referred to as the *Box-Jenkins forecast*. The two important terms in ARIMA are *auto-regression* and *moving average*. *Autoregression* refers to the use of the same data to self-predict, for example, using only gold prices to arrive at a gold price forecast. *Moving average* refers to the normal concept of smoothing price fluctuations, using a rolling average of the past *n* days. The moving average and popular variations are discussed thoroughly in Chapters 5 and 6. This process uses an exponential smoothing technique, which is among the most popular methods.

In the ARIMA process, the autocorrelation is used to determine to what extent past prices will forecast future prices. In a *first-order autocorrelation*, only the prices on the previous day are used to determine the forecast. This would be expressed as

$$P_t = a \times P_{t-1} + e$$

where P_t = the price being forecast (dependent variable)
P_{t-1} = the price being used to forecast (independent variable)
a = the coefficient (constant percentage)
e = the forecast error

In a *second-order autoregression*, the previous two prices are used as follows:

$$P_t = a_1 \times P_{t-1} + a_2 \times P_{t-2} + e$$

where the current forecast P_t is based on the two previous prices P_{t-1} and P_{t-2}; there are two unique coefficients and a forecast error. The moving average is used to correct for the forecast error, e. There is also the choice of a first- or second-order moving average process,

First-order: $E_t = e_t - b \times e_{t-1}$
Second-order: $E_t = e_t - b_1 \times e_{t-1} - b_2 \times e_{t-2}$

where E_t = the approximated error term
e_t = today's forecast error
e_{t-1} and e_{t-2} = the two previous forecast errors
b_1 and b_2 = the two regression coefficients

Because the two constant coefficients, b_1 and b_2, can be considered percentages, the moving average process is similar to exponential smoothing.

The success of the ARIMA model is determined by two factors: high correlation in the autoregression and low variance in the final forecast errors. The determination of whether to use a first- or second-order autoregression is based on a comparison of the *correlation coefficients* of the two regressions. If there is little improvement using the second-order process, it is not used due to its time-consuming calculations. The final forecast is constructed by adding the moving average term, which approximates the errors, back into the autoregressive process

$$P'_t = P_t + E_t + e'$$

where P'_t = the new forecast

e' = the new forecast error

The moving average process is again repeated for the new errors e', added back into the forecast to get a new value P'' and another error e''. When the variance of the errors becomes sufficiently small, the ARIMA process is complete.

The contribution of Box and Jenkins was to stress the simplicity of the solution. They determined that the autoregression and moving average steps could be limited to first- or second-order processes. To do this, it was first necessary to *detrend* the data, thereby making it *stationary*. Detrending can be accomplished most easily by *differencing* the data, creating a new series by subtracting each previous term P_{t-1} from the next P_t. Of course, the ARIMA program must remember all of these changes, or *transformations*, in order to restore the final forecast to the proper price notation by applying these operations in reverse. If a satisfactory solution is not found in the Box-Jenkins process, it is because the data are still not stationary and further differencing is necessary.

Because of the three features just discussed, the Box-Jenkins forecast is usually shown as *ARIMA* (p, d, q), where p is the number of autoregressive terms, d is the number of differences, and q is the number of moving average terms. The expression *ARIMA*(0,1,1) is equivalent to simple exponential smoothing, a common technique discussed in the next chapter. In its normal form, the Box-Jenkins ARIMA process performs the following steps:

- **Specification.** Preliminary steps for determining the order of the autoregression and moving average to be used.
  - *The variance must be stabilized*. In many price series, increased volatility is directly related to increased price. In stocks, the common assumption is that this relationship is *log-normal*, that increasing volatility takes the shape of a logarithmic curve. A simple test for variance stability, using the log function, is checked before more complex transformations are used.
  - *Prices are detrended.* This uses the technique of first differences; however, a second difference (or more) will be performed if it helps to remove further trending properties in the series (this is determined by later steps).
  - *Specify the order of the autoregressive and moving average components*. This fixes the number of prior terms to be used in these approximations (not necessarily the same number). In the Box-Jenkins approach, these numbers are usually small, often one for both. Large numbers require a rapidly expanding amount of calculation, even for a computer.

    How many terms are necessary? This is a critical part of the ARIMA solution and may require manual intervention in the computer program. The object of this step is to find the fewest terms necessary to solve the problem. All ARIMA programs will print a *correlogram*, a display of the autocorrelation coefficients. The correlogram is used to find whether all the trends and well-defined periodic movements have been removed from the series by differencing. Figure 6.11 shows three patterns of correlograms printed by *EASI/ARIMA*. The top scale shows the importance of the coefficients. If they fall within the brackets, they have no importance, and if they fall outside the brackets, they are *highly significant* (greater than two standard deviations, or 95%). The left scale gives the *lag* relationship, that is, the relationship of the current price to the price *n* days ago. An asterisk will appear on line 3 outside the bracket (see Figure 6.9b) if a strong pattern in the lag 3 relationship to current prices has not yet been removed. To remove this, additional differencing of the data must be performed. If successful, the resulting correlogram will appear as in Figure 6.9a, where only the lag 1 and 2 values are outside the bracket. If further differencing results in a pattern shown in Figure 6.11c, all correlation of any importance in the data has been lost. If the pattern in Figure 6.8c were to occur in the first step, it would mean that there is no relationship to be found by autoregression. If it occurs after some differencing has been performed, the data have been differenced too many times.[7]

    The correlogram is one way of visualizing serial correlation, the dependence of current data on previous

data. This same objective will be accomplished differently using a Monte Carlo process to estimate investment risk, discussed in Chapter 23.

- **Estimation: determining the coefficients.** The previous step was used to reduce the number of autoregressive and moving average terms necessary to the estimation process. The ARIMA method of solution is one of minimizing the errors in the forecast. In minimization, it will perform a linear or nonlinear regression on price (depending on the number of coefficients selected), determine the errors in the estimation, and then approximate those errors using a moving average. It will next look at the resulting new error series, attempt to estimate and correct the errors in that one, and repeat the process until it cannot improve results further.

  To determine when an ARIMA process is completed, three tests are performed at the end of each estimation pass:

  - *Compare the change in the coefficient value*. If the last estimation has caused little or no change in the value of the coefficient(s), the model has successfully converged to a solution.
  - *Compare the sum of the squares of the error*. If the error value is small or if it stays relatively unchanged, the process is completed.
  - *Perform a set number of estimations*. Unless a maximum number of estimations is set, an ARIMA process might continue indefinitely. This safety check is necessary in the event the model is not converging to a solution.

Figure 6.11: ARIMA correlograms. (a) Ideal correlogram results, showing significance in the first and second lags only. (b) Significance in the first and third lags, indicating that further trend elimination is necessary. (c) No significant correlations at any lag values.

Once completed, the errors can be examined using an *O*-statistic to check for any trend. If one exists, an additional moving average term may be used to eliminate it.

Forecast Results

Once the coefficients have been determined, they are used to calculate the forecast value. These forecasts are most accurate for the next day and should be used with less confidence for subsequent days (see Figure 6.12).

Figure 6.12: ARIMA forecast becomes less accurate as it is used farther ahead.

What if the forecast does not work? First, the process should be checked to be certain that it was performed properly. Pay particular attention to the removal of trends using the correlogram. Next, check the data used in the process. If the data sample is changing (which can be observed on a price chart), select either a shorter or longer period that contains more homogeneous data, that is, data similar to the current market period.

ARIMA Trading Strategies

In the article that originally piqued the interest of traders,[8] Anon uses a five-day-ahead forecast. If the ARIMA process forecasts an uptrend and if prices fall below the forecast value, the market can be bought with added confidence (expecting lower risk and more profit by buying at a price that is below estimated value). This technique of selecting better entry points may compensate for some of the inaccuracies latent in any forecasting method. The danger of this approach is that prices may continue to move counter to the forecast, so that caution and a stop-loss are also necessary.

Following the Trend

Use the one-day-ahead forecast to determine the trend position. Hold a long position if the forecast is for higher prices, and take a short position if the process is expecting lower prices.

Countertrend Indicator

Use the ARIMA confidence bands to determine overbought/oversold levels. Not only can a long position be entered when prices penetrate the *lowest* 95% confidence band, but they can be closed out when they return to the normal 50% level. Although countertrend trades are tempting, they always carry more risk than trend trading. A conservative trader will enter the market only in the direction of the ARIMA trend forecast. As shown in Figure 6.12, if the trend is up, only the penetrations of a lower confidence band will be used to enter new long positions.

Use of Highs and Lows

The implied highs and lows, as well as the independently forecasted highs and lows, can be the basis for other interesting strategies.[9] The following two are used with intraday prices.

1. Using confidence bands based on the closing prices, buy an intraday penetration of the expected high or sell a

penetration of the expected low, and liquidate the position on the close. Use a stop-loss. Take positions only in the direction of the ARIMA trend.

2. Using the separate ARIMA models based on the daily high and low prices, buy a penetration of the 50% level of the high and sell a penetration of the 50% level of the lows. Liquidate positions on the close. Use a stop-loss.

Slope

The one-day-ahead forecast suggested in "Following the Trend" a few paragraphs earlier is essentially a projection of the slope of the trendline. Because of the frequent erratic price movement, also called *noise*, the purpose of directional analysis, whether regression or moving averages, is to uncover the true direction of prices. Therefore, the slope of the trendline, or the direction of the regression forecast, is the logical answer.

The popular alternate for triggering a new directional signal is a price penetration of an envelope or band value. Using regression analysis, that band can be replaced by a confidence level. While it is true that the number of random, or false penetrations, declines as the confidence band gets farther away from the trendline, so does the total number of penetrations. At any band distance there are still a large number of erroneous signals. The slope itself should be viewed as the best approximation of direction.

Kalman Filters

Kalman offers an alternative approach to ARIMA, allowing an underlying forecasting model (*message model*) to be combined with other timely information (*observation model*). The message model may be any trading strategy, moving average, or regression approach. The observation model may be the specialist's or floor broker's opening calls, market liquidity, or earlier trading activity in the same stock or index market on a foreign exchange—all of which have been determined to have some overriding importance in forecasting.

Assume that the original forecast (message) model can be described as

$$M(P_t) = c_f P_{t-1} + me_t$$

and the observation model as

$$O(P_t) = c_0 P_t + oe_t$$

where *me* and *oe* = the message and observation model errors, respectively

The combined forecast would then use the observation model error to modify the result

$$P'_{t+1} = c_f P'_t + K_{t+1} oe_t$$

where *K* = the Kalman gain coefficient,[10] a factor that adjusts the error term

[10]For a more complete discussion, see Andrew D. Seidel and Philip D. Ginsberg, *Commodities Trading* (Prentice-Hall, Englewood Cliffs, NJ, 1983), or R. E. Kalman, "A New Approach to Linear Filtering and Prediction Problems," *Journal of Basic Engineering* (March 1960).

[6]G.E.P. Box and G.M. Jenkins, *Time Series Analysis: Forecasting and Control*, 2nd ed. (Holden-Day, San Francisco, 1976).

[7]Examples of the correlogram come from Eric Weiss, "Applying ARIMA Forecasts," *Technical Analysis of Stocks & Commodities* (May 1983). Refer to Weiss's two articles on ARIMA in earlier volumes of the same magazine, especially "ARIMA Forecasting" (January 1983).

[8]Louis J. Anon, "Catch Short-Term Profits with ARIMA," *Commodities Magazine* (December 1981).

[9]John F. Kepka, "Trading with ARIMA Forecasts," *Technical Analysis of Stocks & Commodities* (August 1985).

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BASIC TRADING SIGNALS USING A LINEAR REGRESSION MODEL

A linear regression, or straight-line fit, could be the basis for a simple trading strategy similar to a moving average. For example, an *n*-day linear regression, applied to the closing prices, can produce a one-day-ahead forecast price, F_{t+1}. We can use this with the following rules for trading:

- *Buy* when tomorrow's closing price (C_{t+1}) moves above the forecasted value of tomorrow's close (F_{t+1}).
- *Sell* when tomorrow's closing price (C_{t+1}) moves below the forecasted value of tomorrow's close (F_{t+1}).[11]

Adding Confidence Bands

Because the linear regression line passes through the center of price movement during a steady period of rising or falling prices, these rules would produce a lot of buy and sell signals. To reduce the frequency of signals and avoid changes of direction due to market noise, confidence bands are drawn on either side of the regression line. A 90% confidence band is simply 1.65 times the standard deviation of the residuals (*Rt*, the difference between the actual prices and the corresponding value on the regression line as of time *t,* the most recent price). A 95% confidence band uses a multiplier of .196; however, most people use 2.0. The new trading rules using a 95% confidence band would then become

- *Buy* when tomorrow's closing price (C_{t+1}) moves above the forecasted value of tomorrow's close (F_{t+1}) + (2.0 × R_t).
- *Sell* when tomorrow's closing price (C_{t+1}) moves below the forecasted value of tomorrow's close (F_{t+1}) - (2.0 × R_t).

An important difference between a model based on linear regression and one founded on a moving average is the lag. Both methods assume that prices will continue to move according to the pattern identified as of the last price data available. If prices continue higher at the same rate, a moving average system will initially lag behind, then increase at the same rate. The lag creates a safety zone to absorb some minor changes in the direction of prices without indicating that the trend has changed. (See Chapter 7 for a complete discussion of moving averages, and Chapter 8 for a comparison of a linear regression slope trading system with five other popular trending methods.)

A regression model, however, identifies a change of direction sooner by measuring tomorrow's actual price against the projected future price (a straight-line projection for a linear regression). Confidence bands around the straight-line projection will decide the size of the price move up or down needed to change the trend direction. Figure 6.13 shows the changing direction of a rolling linear regression at three points in time compared to a moving average. At the most recent period on the chart the reversal point for the trend direction is much closer using the confidence bands of the regression than the lagged moving average. This may not be the case during the intervals where price changes direction at the bottom of the chart.

Figure 6.13: Linear regression model. Penetration of the confidence band turns the trend from up to down. When prices move steadily up, the regression model will signal a change of direction faster than a moving average.

The use of regression lines works well for prices that are rising or falling steadily and for identifying the long-term direction of price movement. Using only a few days to calculate a regression line is inconsistent with the nature of such a statistical measurement approach, which gains significance with more data. The confidence bands would be very large to reflect the inaccuracy of a small amount of data.

Hochheimer's 1982 study, performed without a confidence band, shows the best selection of the regression interval at 60 to 70 days (the maximum tested was 70 days). Silver had a remarkable 1,615 trades—one each day. Only two markets showed average trade duration greater than two days. We can draw the conclusion that successful regression-based systems seek out longer time periods and that confidence bands are needed to allow the normal amount of market noise without causing a change of direction.

Using the Linear Regression Slope

The slope of the linear regression line, the angle at which it is rising or falling, is a simple and effective way to simplify the usefulness of the regression process. The slope shows how quickly prices are expected to change over a unit of time. The unit of time is the same as the period of data used to find the regression values. When you use a longer calculation period, the slope of the regression line changes slowly; when you use only a few days in your calculation, the slope changes quickly. Using only the slope, you can trade with the following rules:

- *Buy* when the value of the slope is positive (rising).
- *Sell* when the value of the slope is negative (falling).

When using the slope, there is less need for a confidence band because the longer calculation periods smooth out erratic price movement. The linear regression slope will be compared to other trending techniques in Chapter 8.

Adding R^2

The slope is a practical substitution for the regression line and confidence bands, but it can also be misleading. It is possible to

have the same slope value while prices are moving higher in both a smooth pattern or in a very noisy, erratic one. Using the correlation coefficient, R^2, will provide a measurement of the consistency of the price movement.[12]

In order to visualize the way in which the slope and R^2 work together, Figure 6.14 shows IBM prices from late 2001 through early 2002 along with a moving average (plotted in the upper panel with IBM prices), the slope (in the middle panel), and R^2 in the bottom panel. We must first remember that R^2 is always a positive number and that the more data used to calculate its value, the more dependable the answer. Table 6.11 shows the critical values of R^2 in order to reach a 95% confidence level.

Figure 6.14: IBM trend using the slope and R^2. A comparison of buy and sell signals shows that, during this period of short trends, the use of the combination of R^2 and the linear regression slope provide a much greater amount of information about price move than the moving average. Both methods would have been very profitable.

In Figure 6.14 a horizontal line is drawn in the lower panel at the .13 level for R^2. When R^2 goes above this line it provides a confirmation that the slope represents the trend. The trading rules are:

- *Buy* when the slope is rising and R^2 is above .13. *Close out* the trade when either the slope declines below zero or R^2 falls below .13.
- *Sell short* when the slope is falling and R^2 is above .13. *Close out* the trade when either the slope rises above zero or R^2 falls below .13.

Table 6.9: Calculation Period with Corresponding Critical Values of R^2 at the 95% Confidence Level

Open table as spreadsheet

Period	R^2 Critical Value (95% Confidence)
5	0.77
10	0.40
14	0.27

20	0.20
25	0.16
30	0.13
50	0.08
60	0.06
120	0.03

In the case of IBM (shown in Figure 6.14), the trends are very smooth and both a moving average or a combined slope-R^2 trading method would be very profitable. Using the slope alone to buy when it crosses above zero and sell below zero would give results very similar to the moving average. However, the use of R^2 adds considerable information about the quality of the trend that is likely to help during more difficult price patterns.

[11]These rules were used by Frank Hochheimer and Richard Vaughn in *Computerized Trading Techniques 1982* (Merrill Lynch Commodities, New York, 1982).

[12]See Rudy Tesco, "LRS + R-Squared = The 95% Solution," *Technical Analysis of Stocks & Commodities* (February 2003).

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MEASURING MARKET STRENGTH

One of the natural applications of the linear regression is to measure and compare the strength of one market against another. For example, we might want to ask, "Which market is leading the other, gold or the Barrick Gold stock prices?" Earlier in this chapter we created a simple regression model to explain the price of Barrick in terms of physical gold. The same price data can be used to find a different relationship between those two markets.

In order to have sensible results, the data must be changed to percentages beginning on the same date, November 26, 2001, near the lowest price levels. It is the same method used early and shown in Table 6.5. Instead of explaining the price movement of one market in terms of another, each of the two indexed price series will be treated separately. The slope of the indexed series will be found by performing a linear regression of that series against time (a series of sequential integers beginning with 1). Figure 6.15 shows very unexpected results.

Figure 6.15: Simple linear regressiion for indexed gold and Barrick Gold prices. The unexpected results show that the downtrend in the later part of the Barrick prices cause the regression to see those prices as declining.

Figure 6.15. Simple linear regression lines for indexed gold and Barrick Gold prices. The unexpected results show that the downtrend in the later part of Barrick prices cause the regression to see those prices as declining.

The results of this regression plus yield a daily slope of -.06 for ABX with a *y*-intercept of 129.45, and a daily slope of +.08 for gold with an intercept of 101.87. Gold shows a normal, slow uptrend while ABX is a slight downtrend. The two regression lines in Figure 6.15 are clearly moving in opposite trends. The sharp rise in Barrick prices in advance of the

Iraqi war are correcting, while gold prices are showing more stability. The slope values show that gold may not be strong at this point, but ABX prices are weaker. This technique of comparing two or more markets using linear regression is discussed further in Chapter 13.

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Chapter 7: Time-Based Trend Calculations

OVERVIEW

The purpose of all trend identification methods is to see past the underlying noise in the market, those erratic moves that seem to be meaningless, and find the current direction of prices. Because there may be more than one trend at any one time, caused by short-term events and long-term policy, it is likely that one trader will search for the strongest, or most dominant trend, while another will seek a series of shorter-term moves. Each objective has both benefits and compromises. The technique that is used to uncover the particular type of trend depends upon whether any of the trend characteristics are known. Does the stock or futures market have a clear seasonal or cyclic component, such as the travel industry or coffee prices; or, does it respond to long-term monetary policy because of debt or direct investment in interest rates? The more you know about the reasons why prices trend, the better you will be able to find the most reliable calculation for separating the price direction from market noise.

Chapter 6 produced models by finding relationships between two or more price series, or just one series and time. Once you know that there is a fundamental relationship between data, based on measuring the properties of dependence and correlation, a formula can be found that expresses one price movement in terms of the other prices and economic data. The predictive qualities of these methods are best when applied to data that has been seen before, that is, prices that are within the range of historic data. Forecasting reliability decreases sharply when values are extrapolated outside the previous occurrences. This phenomenon is also true of other trending methods. Because of the way we test and define the final trend calculation, it is based on the movement of historical data; when prices move to new levels, the results of the model often deteriorate.

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Chapter 7 - Time-Based Trend Calculations
New Trading Systems and Methods, Fourth Edition
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FORECASTING AND FOLLOWING

There is a clear distinction between forecasting the trend and finding the current trend. Forecasting, predicting the future price, is much more desirable but very complex. As shown in the previous chapter, it involves combining those data that are most important to price change, and the results are still uncertain. A better model is measured by a smaller amount of uncertainty in its forecast, and determined by its confidence level. There is always lower confidence as you try to forecast further into the future.

The techniques most commonly used for evaluating the direction or tendency of prices both within prior ranges or at new levels are called *autoregressive* functions. Unlike forecasting models, they are only concerned with evaluating the current price direction. This analysis is normally used to conclude that prices are moving in an upward, downward, or sideways direction. From this simple building block, it is possible to form rules of action and develop complex strategies of anticipation.

All of these techniques make the assumptions that past data can be used to predict future price movement, and that the direction of prices today is the most likely forecast of the direction of prices tomorrow. For the most part, these assumptions have proved to be true. From a practical viewpoint, these trending methods are more flexible than the traditional regression models, but to achieve success they introduce a lag. A *lag* is a delay in the identification of the trend. Great effort has been spent trying to reduce this lag.

In an autoregressive model, one or more previous prices determine the next sequential price. If P_t represents today's price, P_{t-1} yesterday's price, and so on, then tomorrow's expected price will be

$$P_{t+1} = a_0 + a_1P_t + a_2P_{t-1} + \ldots + a_tP_1 + e$$

where each price is given a corresponding weighting a_i and then combined to give the resultant price for tomorrow $P_{t+1} + e$ (where e represents an error factor). The simplest example is the use of yesterday's price alone to generate tomorrow's price:

$$P_{t+1} = a_0 + a_1P_t + e$$

which you may also recognize as the formula for a straight line, $y = a + bx$, plus an error factor.

The autoregressive model does not have to be linear; each prior day can have a nonlinear predictive quality. Thus each expected price P_{t+1}, could be represented by a curvilinear expression, $P_{t+1} = a_0 + a_1P_t + a_2P^2_{t-1} + e$, or by an exponential or logarithmic formula, $\ln P_{t+1} = a_0 + a_1 \ln P_t + a_2 \ln P_{t-1} + e$, which is commonly used in equity analysis. All of these expressions could then be combined to form an autoregressive forecasting model for P_{t+1}. In going from the simple to the complex, it is natural to want to know which of these choices will perform best. Traditionally, the best method will be the one that yields the highest return for the lowest risk; however, every investor has a personal risk preference. The answer can only be found by applying and comparing different methods, and experiencing how they perform when actually traded. At the end of Chapter 8 there is a comparison of popular trending systems, and Chapter 21 will show testing methods that are most likely to lead to robust results. Throughout this book there will be comparisons of systems and methods that are similar.

Least-Squares Model

The least-squares regression model is the same technique that was used in the previous chapter to find the relationship between two markets—Barrick Gold and physical gold, corn and soybeans—or to find how price movement could be explained by the main factors influencing them, supply and demand. Most trading systems depend only on price; therefore, we will look again using the least-squares model with time as the independent variable and price as the dependent variable. The regression results will be used in an autoregressive way to forecast the price n-days ahead, and we will look at the accuracy of those predictions. The slope of the resulting straight line or curvilinear fit will determine the direction of the trend.

Error Analysis

A simple error analysis can be used to evaluate the predictive qualities of this method. Using General Electric (GE) prices shown in Figure 7.1, we choose the period from February 18, 2003, through April 30, 2003, and calculate regression slope and intercept for a rolling 20 days. This period is part of an upturn in prices and appears reasonably uniform and a good candidate for price

forecasting.

Figure 7.1: General Electric price from February 18 through April 30, 2003.

Using an Excel spreadsheet shown in Table 7.1, we enter the date and prices for GE in columns *A* and *B*, then calculate the regression slope and intercept for the past 20 days (columns *C* and *D*) using the functions *slope* and *intercept*. The 1- to 5-day ahead forecasts (columns *E-I*) are calculated as

$$N\text{-day ahead forecast} = Slope \times Sequence\ number + Intercept + (n - 1) \times Slope$$

where the *sequence number* is a sequential integer used as a substitute for time in the regression solution. You will recognize the first part of the formula as that of a straight line. The last term, $(n - 1) \times slope$, adds the value of one day's slope for every 1-day ahead forecast. The forecast error is shown in columns *J-N.* As we would expect from the discussion in the previous chapter, the average forecast error gets larger as the forecast is projected further out. The 1-day ahead forecast shows an average error of -$0.17 and, surprisingly, the subsequent forecast errors get smaller. We can see that this is misleading by looking at the standard deviation of the errors, which show an increasing pattern from one to four days. We can clear up the picture by looking at the forecast errors for 20, 10, and 5 days collectively.

Table 7.1: General Electric Regression and Forecast Calculations

Open table as spreadsheet

	Price of			Quarterly Data Forecast *N*-Days Ahead					Error in Forecast Using Quarterly Data				
Date	**GE**	**Slope**	**Intercept**	**1-Day**	**2-Day**	**3-Day**	**4-Day**	**5-Day**	**1-Day**	**2-Day**	**3-Day**	**4-Day**	**5-Day**
3/17/2003	26.27	-0.035	25.38	23.15	23.11	23.08	23.04	23.01	-3.25	-3.87	-3.77	-4.96	-3.72
3/18/2003	26.40	-0.031	25.27	23.31	23.28	23.25	23.22	23.19	-3.67	-3.57	-4.75	-3.51	-3.79
3/19/2003	26.98	-0.025	25.13	23.52	23.49	23.47	23.44	23.42	-3.33	-4.51	-3.26	-3.54	-3.18
3/20/2003	26.85	-0.002	24.19	24.04	24.04	24.04	24.03	24.03	-3.96	-2.69	-2.94	-2.57	-2.41
3/21/2003	28.00	0.009	23.79	24.38	24.39	24.39	24.40	24.41	-2.35	-2.59	-2.21	-2.04	-1.62
3/24/2003	26.73	0.018	23.39	24.64	24.66	24.67	24.69	24.71	-2.34	-1.94	-1.77	-1.34	-0.79
3/25/2003	26.98	0.028	22.98	24.91	24.94	24.97	24.99	25.02	-1.69	-1.50	-1.06	-0.51	-1.11

3/26/2003	26.60	0.036	22.62	25.14	25.17	25.21	25.24	25.28	-1.30	-0.86	-0.29	-0.89	-1.77
3/27/2003	26.44	0.044	22.22	25.37	25.41	25.45	25.50	25.54	-0.66	-0.09	-0.68	-1.55	-2.01
3/28/2003	26.03	0.051	21.86	25.55	25.60	25.66	25.71	25.76	0.05	-0.53	-1.39	-1.84	-1.87
3/31/2003	25.50	0.057	21.54	25.70	25.76	25.81	25.87	25.93	-0.43	-1.29	-1.74	-1.76	-1.83
4/1/2003	26.13	0.064	21.14	25.90	25.96	26.03	26.09	26.15	-1.15	-1.59	-1.60	-1.67	-1.91
4/2/2003	27.05	0.072	20.72	26.14	26.21	26.29	26.36	26.43	-1.41	-1.42	-1.47	-1.70	-0.87
4/3/2003	27.55	0.081	20.27	26.41	26.49	26.57	26.65	26.73	-1.22	-1.27	-1.49	-0.65	-0.65
4/4/2003	27.63	0.089	19.82	26.68	26.77	26.85	26.94	27.03	-1.08	-1.29	-0.45	-0.44	-0.62
4/7/2003	27.76	0.096	19.46	26.91	27.01	27.11	27.20	27.30	-1.15	-0.29	-0.27	-0.45	-0.46
4/8/2003	28.06	0.101	19.15	27.15	27.25	27.35	27.45	27.55	-0.15	-0.13	-0.30	-0.31	-0.75
4/9/2003	27.30	0.106	18.86	27.33	27.44	27.54	27.65	27.75	-0.05	-0.21	-0.22	-0.65	-0.08
4/10/2003	27.38	0.108	18.70	27.48	27.59	27.70	27.80	27.91	-0.17	-0.17	-0.60	-0.03	-0.58
4/11/2003	27.65	0.111	18.52	27.64	27.75	27.86	27.97	28.08	-0.12	-0.55	0.03	-0.52	-0.08
4/14/2003	27.76	0.114	18.33	27.80	27.91	28.03	28.14	28.25	-0.50	0.08	-0.46	-0.02	-0.74
4/15/2003	28.30	0.117	18.13	27.98	28.10	28.22	28.34	28.45	0.15	-0.39	0.06	-0.65	-0.94
4/16/2003	27.83	0.118	18.06	28.11	28.23	28.34	28.46	28.58	-0.38	0.07	-0.65	-0.93	-0.52
4/17/2003	28.49	0.121	17.85	28.29	28.41	28.53	28.65	28.77	0.13	-0.58	-0.86	-0.45	-0.34
4/21/2003	28.16	0.124	17.62	28.46	28.58	28.70	28.83	28.95	-0.53	-0.81	-0.40	-0.28	-0.57
4/22/2003	28.99	0.128	17.41	28.65	28.78	28.91	29.03	29.16	-0.74	-0.32	-0.20	-0.49	-0.24
4/23/2003	29.39	0.131	17.19	28.86	28.99	29.12	29.25	29.38	-0.24	-0.12	-0.40	-0.15	-0.07
4/24/2003	29.10	0.133	17.04	29.03	29.16	29.30	29.43	29.56	-0.08	-0.36	-0.10	-0.02	
4/25/2003	29.11	0.134	16.96	29.18	29.32	29.45	29.59	29.72	-0.34	-0.08	0.00		
4/28/2003	29.52	0.136	16.86	29.35	29.48	29.62	29.76	29.89	-0.05	0.03			
4/29/2003	29.40	0.136	16.84	29.49	29.62	29.76	29.89	30.03	0.04				
4/30/2003	29.45	0.135	16.89	29.60	29.74	29.87	30.01	30.14					
									-1.17	-1.20	-1.23	-1.25	-1.24
									Average error in forecast				

Comparing the Errors of Different Time Intervals

The same example can be repeated using smaller calculation periods of 10 and 5 days to get the results shown in Table 7.2. Looking first at 1-day forecast error, there is a progressively larger standard deviation and larger average error as the calculation period increases from 5 to 20 days. From this we can conclude that the 5-day forecast is more accurate than the 20-day forecast for projecting 1-day ahead. Moving to the 2-day ahead forecast, it can be seen that the pattern quickly begins to break down. The average error and the standard deviation are smallest for the 5-day period, then 20 days, then 10 days. Continuing to the 5-day forecast at the right, the order has reversed, so that the 20-day period has the smallest error and the 5-day period has the largest error.

Table 7.2: Summary of Forecast Errors

Open table as spreadsheet

Days in Period		Error in Forecast				
		1-Day	2-Day	3-Day	4-Day	5-Day
20	Average error in forecast	-0.17	-0.13	-0.08	-0.04	0.05
	Standard deviation of errors	0.89	0.98	1.03	1.07	0.98
	High (95% confidence)	1.57	1.79	1.94	2.06	1.98
	Low (95% confidence)	-1.91	-2.04	-2.10	-2.13	-1.88
10	Average error in forecast	-0.10	-0.04	0.02	0.08	0.18
	Standard deviation of errors	0.82	1.07	1.32	1.55	1.70
	High (95% confidence)	1.51	2.06	2.61	3.11	3.52
	Low (95% confidence)	-1.71	-2.14	-2.57	-2.96	-3.16
5	Average error in forecast	-0.09	-0.03	0.03	0.09	0.19
	Standard deviation of errors	0.57	0.81	1.15	1.50	1.89
	High (95% confidence)	1.02	1.55	2.28	3.03	3.89
	Low (95% confidence)	-1.20	-1.62	-2.22	-2.85	-3.51

The inconsistency in the pattern of forecast results requires a different view of the problem. It is necessary to accept the fact that forecasted results are inaccurate and that the error can be very large, even when trying to predict tomorrow's price. Instead, the problem can be reduced to something simpler.

Limiting the Forecast to Direction

Using the results of the 5-day calculation period from March 17, 2003, through April 30, 2003, the 1-day ahead forecast shows that it anticipated a higher price 16 of 31 days (see Table 7.3). Its forecast of the direction was correct 21 of 31 days, or 67%. Therefore, the slope of the regression is a reasonably accurate predictor of direction. If we limit our objective to the direction of price movement, rather than trying to predict an exact price, there are a number of tools that work. While the trend calculations discussed in this chapter can range from simple to complex, the resulting trend is always used in the same way—to determine direction, not price. The process of smoothing previous prices is intended to uncover direction by removing the effects of noise.

Table 7.3: Forecasting Direction Using a 5-Day Calculation Period. Although the exact price forecast has a large degree of inaccuracy, the direction of the forecast (up or down) is very good.

Open table as spreadsheet

Date	Price of GE	Slope	Intercept	1-Day Ahead	Forecast Direction	Forecast Accuracy
3/17/2003	26.27	0.77	11.01	26.39	up	true
3/18/2003	26.40	0.63	13.57	26.72	up	true
3/19/2003	26.98	0.43	17.52	26.96	down	true
3/20/2003	26.85	0.31	19.90	27.05	up	true
3/21/2003	28.00	0.39	18.30	27.68	down	true
3/24/2003	26.73	0.17	23.13	27.33	up	true
3/25/2003	26.98	-0.01	27.40	27.08	up	false
3/26/2003	26.60	-0.15	30.83	26.73	up	false
3/27/2003	26.44	-0.32	35.40	26.30	down	true
3/28/2003	26.03	-0.19	31.79	26.17	up	false
3/31/2003	25.50	-0.35	36.19	25.60	up	true
4/1/2003	26.13	-0.19	31.59	25.76	down	false

4/2/2003	27.05	0.13	22.27	26.49	down	false
4/3/2003	27.55	0.46	12.22	27.37	down	false
4/4/2003	27.63	0.57	8.60	27.91	up	true
4/7/2003	27.76	0.38	14.55	27.99	up	true
4/8/2003	28.06	0.22	20.03	28.06	down	true
4/9/2003	27.30	-0.01	27.91	27.65	up	true
4/10/2003	27.38	-0.10	31.08	27.43	up	true
4/11/2003	27.65	-0.09	30.96	27.45	down	false
4/14/2003	27.76	-0.03	28.58	27.58	down	false
4/15/2003	28.30	0.24	18.40	28.15	down	true
4/16/2003	27.83	0.15	21.58	28.09	up	true
4/17/2003	28.49	0.17	20.83	28.36	down	true
4/21/2003	28.16	0.10	23.95	28.31	up	true
4/22/2003	28.99	0.17	21.00	28.70	down	false
4/23/2003	29.39	0.36	12.64	29.30	down	true
4/24/2003	29.10	0.25	17.80	29.32	up	true
4/25/2003	29.11	0.20	19.70	29.35	up	true
4/28/2003	29.52	0.08	25.56	29.38	down	true
4/29/2003	29.40	0.04	27.19	29.39	down	false
4/30/2003	29.45	0.10	24.46	29.51		

Forecast Error and the Risk of Trend Trading

The error analysis is useful in showing the risk of trend trading, and the results can be generalized for most trend methods. The smallest error was -1.29 for the 1-day ahead forecast of the 5-day calculation period (the 95% confidence level of -1.20 added to the mean of -.09), which is a 4.6% error at the average share price of $28. In order to succeed at trend following, or any other trading method, you must be prepared to assume the risk of that method. In this case, the linear regression forecasted the correct price direction nearly 68% of the time, but trading it successfully requires that you sustain an interim loss of at least 4.6%. If the same method were applied to futures on stocks with leverage of 5.0 (depositing 20% of the purchase amount), the risk would have been 23% of your investment. Part of choosing a trading method is accepting the risk and reward characteristics.

Using Error Analysis for Trading

The best predictive model can be found by applying error analysis to any forecasting technique. For a proper comparison, the forecasting methods should be evaluated over the same time interval using the same calculation period. It may be insightful to compare the forecasts for 2- and 3-days ahead, rather than only 1-day ahead.

Having selected the most accurate forecast model, the size of the most recent previous predictive error can be used to resolve trading decisions. Consider the following three situations:

1. The previous prediction and the actual price are very close, within one standard deviation of expectations; therefore, we continue to follow the trend strategy, holding a trade in the direction of the forecast.
2. The most recent forecast error is between one and three standard deviations of expectations; therefore, we are cautious, yet understand that this is most likely to be market noise and the direction of the trend remains the same.
3. Today's forecast error is greater than three standard deviations. This is unusual; therefore, we can assume that, if the price change is also a change of direction, then prices are in the process of trend change.

When using short calculation periods, anything under 30 days, there will be a larger-than-expected occurrence of forecast errors exceeding three standard deviations. The short interval does not have enough data points to create a robust distribution and, combined with the fat tail to the right, price changes that are relatively large are good indications of trend direction.

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THE MOVING AVERAGE

The simplest and most well-known of all smoothing techniques, used to remove market noise and find the direction of prices, is the *moving average (MA).* Using this method, the number of elements to be averaged remains the same, but the time interval advances. Using a series of prices, P_0, P_1, P_2, … , P_t, a moving average measured over n of these prices, or data points, at time t would be

$$MA_t = \frac{P_t + P_{t-1} + \ldots + P_{t-n+1}}{n} = \frac{\sum_{i=1}^{n} P_{t-i+1}}{n}, \quad n \le t$$

In other words, today's moving average value is the average (arithmetic mean) of the most recent n data points. For example, using three points (n = 3) to generate a moving average:

$$MA_3 = (P_1 + P_2 + P_3) / 3$$
$$MA_4 = (P_2 + P_3 + P_4) / 3$$
$$\vdots$$
$$MA_t = (P_{t-2} + P_{t-1} + P_t) / 3$$

If P_t represented a price at a specific time t, the moving average would smooth the price movement. When more prices, n, are used in the average, each price will be a smaller part of the average and have less effect on the final value. Five successive prices are called a *5-day moving average.* When the next sequential price is added and the oldest is dropped off, the prior average is changed by of the difference between the old and the new values. If

$$MA_5 = (P_1 + P_2 + P_3 + P_4 + P_5) / 5$$

and

$$MA_6 = (P_2 + P_3 + P_4 + P_5 + P_6) /5$$

then $c = P_2 + P_3 + P_4 + P_5$ can be substituted for the common part of the moving average. M_6, the most recent value, can be solved in terms of M_5, the previous value, to get

$$MA_6 = MA_5 + (P_t - P_{t-n}) / 5$$

This also gives a faster way to calculate a moving average. It can be seen that the more terms in the moving average, the less effect the addition of a new term will have:

$$MA_t = MA_{t-1} + (P_t - P_{t-n}) / n$$

The selection of the number of terms, called the *calculation period*, is based on both the predictive quality of the choice (measured by the error) and the need to determine price trends over specific time periods. For outright trading, the calculation period is chosen for its accuracy in identifying trend and the risk tolerance of the trader. Slower trends, using longer calculation periods, are usually better indicators of price direction, but involve larger risk. The stock market has adopted the 200-day moving average as its benchmark for direction; however, traders find this much too slow for timing buy and sell signals.

The length of a moving average can be tailored to specific needs. A 63-day moving average, ¼ of 252 business days in the year, would be sensitive to quarterly changes in stock price, minimizing the significance of price fluctuations within a calendar quarter. A simple yearly calculation period, 252 days, would ignore all seasonality and emphasize the annual growth of the stock. Any periodic cycle that is the same length as the moving average length is lost; therefore, if a monthly cycle has been identified, then a moving average of less than 10 days (half the cycle length) would be best for letting the moving average show that cycle. Using a moving average to find seasonal and cyclic patterns is covered in Chapters 10 and 11. At this point it is sufficient to remember that if there is a possibility of a cyclic or seasonal pattern within the data, care should be taken to select a moving average that is out of phase with that pattern (that is, not equal to the cycle period).

The length of the moving average may also relate to its commercial use. A jeweler may purchase silver each week to produce bracelets. Frequent purchases of small amounts keeps the company's cash outlay small. The purchaser can wait a few extra days during a week while prices continue to trend downward but will buy immediately when prices turn up. A 6-month trend cannot help him because it gives a long-term answer to a short-term problem; however, a 5-day moving average may give the trend direction within the jeweler's time frame.

User-Friendly Software

Fortunately, we have reached a time when it is not necessary to perform these calculations the long way. Spreadsheet programs and specialized testing software provide simple tools for performing trend calculations as well as many other more complex functions discussed in this book. The notation for many of the different spreadsheets and software is very similar and self-explanatory:

Open table as spreadsheet

Function	Spreadsheet Notation	TradeStation Notation
Sum	`sum(list, period)`	`summation(value, period)`
Moving average	`average(list, period)`	`average(value, period)`
Standard deviation	`stdev(list, period)`	`stddev(value, period)`
Maximum value	`max(list, period)`	`highest(value, period)`
Minimum value	`min(list, period)`	`lowest(value, period)`

In both spreadsheet and *TradeStation* notation, *period* is the calculation period. In the spreadsheet, *list* is the column notation, for example B1:B20, specifying the first 20 cells in column *B*; and, for *TradeStation*, *value* is the closing daily price series, *close* or *C*.

What Do You Average?

The closing or daily settlement is the most common price applied to a moving average. It is generally accepted as the "true" price of the day and is used by many analysts for calculation of trends. A popular alternative is to use the average of the high, low, and closing prices, representing some sort of center of gravity. You may also try the average of the high and low prices, ignoring the closing price entirely.

Another valid component of a moving average can be other averages. For example, if P_1 through P_t are prices, and MA_t is a 3-day moving average on day *t*, then

$$MA_3 = (P_1 + P_2 + P_3) / 3$$

$$MA_3 = (P_2 + P_3 + P_4) / 3$$

$$MA_5 = (P_3 + P_4 + P_5) / 3$$

and

$$MA'_5 = (MA_3 + MA_4 + MA_5) / 3$$

where MA'_5 is a *double-smoothed* moving average, which gives added weight to the center points. Double smoothing can be very effective and is discussed later in this chapter. Smoothing the highs and lows independently is another

technique that creates a representation of the daily trading range, or volatility. This has been used to identify normal and extreme moves, and is also discussed in Chapter 8.

Types of Moving Averages

Besides varying the length of the moving average and the elements that are to be averaged, there are a great number of variations on the moving average.

Accumulative Average

An *accumulative average* may be used for a long-term trend. It does not satisfy the strict definition of a moving average because it adds data but does not discard any; therefore, it is cumulative. It is traditionally started at the beginning of the data, or the test period, and continued until the end of the evaluation interval. Due to the accumulation of prices and the constant increase in the length of the average, the effect of the additional price at day t on the moving average will be $(P_t - AVG) / t$, where AVG is the average of all prices from the beginning through t. The impact of one day becomes very small after one year of data, approximately 252 days; therefore, the accumulative average approaches the average of the entire interval. Because analysis requires that we do not look ahead, the accumulative average is the only representation of the average available. Computationally, it is only necessary to keep the cumulative total of all prices and the number of days in order to get the new accumulative average.

Reset Accumulative Average

A *reset accumulative average* is a modification of the standard accumulative average and attempts to correct for the loss of sensitivity as the number of trading days becomes large. This alternative allows you to reset or restart the moving average whenever a new trend begins, a significant event occurs, or at some specified time interval, for example, at the time of quarterly earnings reports or at the end of the current crop year.

Truncated Moving Averages

Truncated moving averages are the most common, and they are also called *simple moving averages.* This has already been discussed. If you think of calculating the simple moving average by adding a new day and dropping off the oldest one, there is an interesting and useful twist to this technique. The *average-modified method* adds the price of the new day and subtracts the last moving average value. With the simple moving average, day 6 was calculated as

$$MA_6 = MA_5 + (P_6 - P_1) / 5$$

With the average-modified method, this becomes

$$MA_6 = MA_5 + (P_6 - MA_5) / 5$$

The average-modified version is convenient because only the prior moving average value and the new price are necessary for each calculation. The substitution of the moving average value tends to smooth the results even more than a simple moving average but far less than the accumulative average. It prevents the difference $(P_6 - P_1)$ from becoming too extreme and it effectively cuts the possible range in half and dampens the end-off impact.

Weighted Moving Average

The *weighted moving average* opens many possibilities. It allows the significance of individual or groups of data to be changed. It may restore proper value to parts of a data sample, or it may incorrectly bias the data. A weighted moving average is expressed in its general form as

$$W_t = \frac{w_1 P_{t-n+1} + w_2 P_{t-n+2} + \cdots + w_{n-1} P_{t-1} + w_2 P_t}{w_1 + w_2 + \cdots + w_n} = \frac{\sum_{i=1}^{n} w_i P_{t-n+1}}{\sum_{i=1}^{n} w_i}$$

The weighted moving average at time t is the average of the previous n prices, each price having its own weighting factor w_i. There is no restriction on the values used as weighting factors, that is, they do not have to be percentages that all total to 1. The most popular form of this technique is called *front-loaded* because it gives more weight to the most recent data and reduces the significance of the older elements. Therefore, for the front-loaded weighted moving average (see Figure 7.2)

$$w_1 = w_2 = \cdots = w_n$$

Figure 7.2: A comparison of moving averages.

The weighting factors w_i may also be determined by regression analysis, but then they may not necessarily be front-loaded. A common modification to front-loading is called *step-weighting* in which each successive w_i differs from the previous weighting factor w_{i-1} by a fixed increment

$$c = w_i - w_{i-1}$$

Then a 5-day front-loaded, step-weighted average would have weighting factors increasing by c each day, $w_1 = 1$, $w_2 = 2$, $w_3 = 3$, $w_4 = 4$, and $w_5 = 5$. In general, for an n-day front-loaded step-weighted moving average:

$$
\begin{aligned}
w_{t-n+1} &= 1 \\
&\vdots \\
w_{t-1} &= n - 1 \\
w_t &= n
\end{aligned}
$$

A computer program for calculating an n-day, front-loaded, linearly-weighted moving average (*LWMA*) on day t is

```
1 sum = 0;
2 w = 0;
3 for i = t - n + 1 to t begin
4     w = w + 1;
5     m = t - i;
6     sum = sum + w*price[m];
7     end;
8 LWMA = sum/w
```

In line 6, the term *price*[*m*] represents the price *m* days ago. When $m = 0$ then *price*[0] is the most recent day t; *price*[1] is the price on day t-1.

If simple linear step-weighting does not represent the relationship between sequential data, then a percentage relationship a between w_i elements can be used,

$$w_{i-1} = a \times w_i$$

If $a = .90$ and $w_5 = 5$, then $w_4 = 4.5$, $w_3 = 4.05$, $w_2 = 3.645$, and $w_1 = 3.2805$. Each older data item is given a weight of 90% of the more recent value.

Weighting by Group

Prices may also be weighted in groups. If every two consecutive data elements have the same weighting factor, P_t is the most recent price, n is the calculation period (preferably and even number), and there are $n/2$ weights, then

$$W_t = \frac{w_1 P_{t-n+1} + w_1 P_{t-n+2} + w_2 P_{t-n+3} + w_2 P_{t-n+4} + \cdots + w_{n/2} P_{t-1} + w_{n/2} P_t}{2 \times \left(w_1 + w_2 + \cdots + w_{n/2}\right)}$$

For two or more data points using the same weighting, this formula can be regrouped as

$$W_t = \frac{w_1 (P_{t-n+1} + P_{t-n+2}) + w_2 (P_{t-n+3} + P_{t-n+4}) + \cdots + w_{n/2} (P_{t-1} + P_t)}{2 \times \left(w_1 + w_2 + \cdots + w_{n/2}\right)}$$

Any number of consecutive data elements can be grouped for a step-weighted moving average. Because there can be any number of combinations, there is no simple, automatic method for calculating anything other than a linearly-weighted average. In TradeStation's *EasyLanguage*, the function *waverage(price series,n)* returns the value of a weighted average that gives the most recent price the weight of *n.*

If the purpose of weighting is to reproduce a pattern that is intrinsic to price movement, then either the *geometric average*, $G = (p_1 \times p_2 \times p_3 \times \ldots \times p_n)^{1/n}$, discussed in Chapter 2, or *exponential smoothing*, explained later in this chapter, may provide better tools.

Standard Deviation Moving Average

A unique trend calculation technique uses the standard deviation of prices. This method creates a comparatively smooth trendline, *StdAvg*, by modifying the moving average value with a percentage of the standard deviation of prices. The following instructions in TradeStation's *EasyLanguage* use 5% of a 30-period standard deviation, and a 15-period moving average; however, each of these values can be changed. The result is shown on a plot of GE in Figure 7.3.

```
SD = StdDev(close,30);
SDV = (SD - SD[1]) / SD;
StdAvg = Average(close,15) + .05*SDV;
```

Figure 7.3: GE plotted with a 15-day standard deviation moving average.

Plotting Lags and Leads

Moving averages can also be plotted with *leads* and *lags*, each having a major impact on the interpretation. The conventional plot places the moving average value MA_t directly above or below the last price P_t used in the calculation. An average of any sort is said to be *lagging* actual price movement. When prices have been trending higher over the calculation period, the value MA_t will be lower than the most recent price P_t; therefore, it will be plotted below the actual prices. When prices are declining, the moving average will be plotted above the prices (see Figure 7.4).

Figure 7.4: Plotting lag and lead for a 10-day step-weighted moving average with weighting factors of 10, 9, 8, … , 1.

The moving average values can be plotted so they *lead* or *lag* the most recent price used in the calculation. If it is to *lead* by 3 days, the value MA_t is plotted three periods ahead on the chart, on day $t + 3$; if it is to *lag* by 2 days, it is plotted at $t - 2$. In the case of leading moving averages, the analysis attempts to compensate for the time delay by treating the average as an n-day-ahead forecast rather than a concurrent statement of direction. A penetration of the forecasted line by the price may be used to signal a change of direction. The lag technique may serve the purpose of *phasing* the moving average, putting it in tune with a specific cycle. A 10-day moving average, when lagged by 5 days, will be plotted in the middle of the actual price data. This technique is covered later.

Comparison of Moving Average Methods

The comparison in Table 7.4 confirms that simple moving averages, calculated over short-time intervals, actually smooth

price turns and make it easier to identify short-term trends. To see this clearly, the prices and calculations with declining values (a *downward trend*) are shaded in gray. In the *Price* column there are 18 sequences where prices were rising or falling. Using a 3-day, 5-day, and 10-day simple moving average, those changes of direction are reduced to 11, 9, and 5, respectively. The longer calculation period shows the most smoothing.

Table 7.4: Comparison of Moving Averages Methods[*]

Open table as spreadsheet

		Simple Moving Averages			5-Day Average Modified	Cum Average	10-Day Linearly Weighted
	Price	3-Day	5-Day	10-Day			
930316	64.59						
930317	64.23						
930318	65.26						
930319	65.24						
930322	65.07						
930323	65.14						
930324	64.98						
930325	64.76						
930326	65.11						
930329	65.46	65.11	65.09	64.98	78.10	65.46	65.08
930330	65.94	65.50	65.25	65.12	75.67	65.07	65.26
930331	66.10	65.83	65.47	65.31	73.76	65.16	65.43
930401	66.87	66.30	65.90	65.47	72.38	65.29	65.72
930402	66.56	66.51	66.19	65.60	71.22	65.38	65.92
930405	66.71	66.71	66.44	65.76	70.31	65.47	66.12
930406	66.19	66.49	66.49	65.87	69.49	65.51	66.20
930407	66.14	66.35	66.49	65.98	68.82	65.55	66.25
930408	66.64	66.32	66.45	66.17	68.38	65.61	66.37
930412	67.33	66.70	66.60	66.39	68.17	65.70	66.58
930413	68.18	67.38	66.90	66.67	68.17	65.83	66.90
930414	67.48	67.66	67.15	66.82	68.04	65.90	67.05
930415	67.19	67.62	67.36	66.93	67.87	65.96	67.12
930416	66.46	67.04	67.33	66.89	67.59	65.98	67.03
930419	67.20	66.95	67.30	66.95	67.51	66.03	67.09
930420	67.62	67.09	67.19	67.04	67.53	66.10	67.21
930421	67.66	67.49	67.23	67.19	67.56	66.16	67.32
930422	67.89	67.72	67.37	67.37	67.62	66.22	67.45
930423	69.19	68.25	67.91	67.62	67.94	66.33	67.78
930426	69.68	68.92	68.41	67.86	68.29	66.44	68.15
930427	69.31	69.39	68.75	67.97	68.49	66.54	68.42
930428	69.11	69.37	69.04	68.13	68.61	66.62	68.63
930429	69.27	69.23	69.31	68.34	68.75	66.71	68.83
930430	68.97	69.12	69.27	68.59	68.79	66.77	68.95
930503	69.11	69.12	69.15	68.78	68.85	66.84	69.04
930504	69.50	69.19	69.19	68.97	68.98	66.92	69.17

930505	69.70	69.44	69.31	69.17	69.13	67.00	69.31
930506	69.94	69.71	69.44	69.38	69.29	67.08	69.45
930507	69.11	69.58	69.47	69.37	69.25	67.13	69.40
930510	67.64	68.90	69.18	69.17	68.93	67.14	69.08
930511	67.75	68.17	68.83	69.01	68.69	67.16	68.83
930512	67.47	67.62	68.38	68.85	68.45	67.16	68.55
930513	67.50	67.57	67.89	68.67	68.26	67.17	68.30
930514	68.18	67.72	67.71	68.59	68.24	67.20	68.21
930517	67.35	67.68	67.65	68.41	68.07	67.20	67.99
930518	66.74	67.42	67.45	68.14	67.80	67.19	67.68
930519	67.00	67.03	67.35	67.87	67.64	67.19	67.48
930520	67.46	67.07	67.35	67.62	67.60	67.19	67.40
930521	67.36	67.27	67.18	67.45	67.56	67.19	67.35
930524	67.37	67.40	67.19	67.42	67.52	67.20	67.34
930525	67.78	67.50	67.39	67.42	67.57	67.21	67.41
930526	67.96	67.70	67.59	67.47	67.65	67.22	67.50
No. Trends	18	11	9	5	5	3	5

[*]The gray areas of the table show downtrends.

The 5-day average modified method, which subtracts the average price each day, shows results similar to the 10-day simple moving average. Removing the average serves to create a slower process. The cumulative average, which uses all the data rather than dropping off the oldest, smoothes prices the most and shows the fewest trends; as time increases, the trend created by the cumulative average will become less responsive. For this short sample interval, the 10-day linearly weighted average was identical to the average modified and very similar to the 10-day simple average; however, because it weights the recent data 10 times greater than the oldest, this similarity will not continue. A closer look shows that the trend values are very different.

If the trending calculations were to be used for trading in the simplest form, the price in the left column would be bought when the trend turned up and sold when the trend turned down. Using this very small sample of prices, the results of trading show the significant differences between the smoothing methods summarized below.

Open table as spreadsheet

	Prices	3-Day MA	5-Day MA	10-Day MA	5-Day Avg Mod	Cum Avg	10-Day Lin Wt
Number of trend changes	18	11	9	5	5	3	5
Gross profit/loss	7.08	-0.56	-1.8	3.32	3.68	1.24	3.68
% Profitable trades	53%	30%	44%	75%	80%	75%	80%

The summary shows that the slower trends, those methods that used more days in the calculation, tend to be more profitable than the results of faster trend trading. In addition, the trades are usually more reliable, that is, they will be profitable more often. However, there is always a trade-off between positive and negative features. The slower trends hold trades longer; therefore, they are exposed to greater risk. These conclusions will be supported when trending systems are discussed in the next chapter. For now, it is important to see that most trending methods observing the same time interval will be profitable or not profitable at the same time, based on the trending quality of the underlying price series.

Triangular Weighting

While the simple moving average or linear regression treats each price equally, exponential smoothing and linear step-weighting put greater emphasis on the most recent data. There is an entire area of study in which the period of the dominant cycle is the basis for determining the best trend period. *Triangular weighting* or *triangular filtering*[2] is a related

concept that attempts to uncover the trend by reducing the noise in both the front and back of the trend window (the data being used in the current calculation), where it is expected to have the greatest interference. Therefore, if a 20-day weighted average is used, the 10th day will have the greatest weight, while days 1 and 20 will have the smallest.

To implement triangular weighting, begin with the standard formula for a weighted average, calculated for *n* days as of the current day *t*,

$$W_t = \frac{\sum_{i=1}^{n} w_i P_{t-n+i}}{\sum_{i=1}^{n} w_i}$$

where *n* is also called the size, or width, of the window. For triangular weighting, the weighting factors w_i will increase linearly from 1 to the middle of the window, at n/2, then decrease to the end at *n*. This has a slightly different form when the period is odd or even,

$w_i = i$,	for i = 1 to *integer*((n + 2)/2)
$n - i + 1$,	for i = *integer*((n + 2)/2) + 1 to n (even values of n)
$n - i$,	for i = *integer*((n + 2)/2) + 1 to n (odd values of n)

where *integer* is a function that returns the integer portion, and for odd values of *n*, the weighting factor has the value *i* when *i* ranges from 1 to *n*/2 (rounded up with the help of the function *integer*) and the value of *n* - *i* from *n*/2 to *n.* Instead of a triangular filter, which climbs in equal steps to the middle value having the greatest importance, a Guassian filter can be used, which weights the data in a form similar to a bell curve. Here, the weighting factors are more complex, but the shape of the curve may be more appealing,

$$w_i = 10^x \quad and \quad x = \frac{3}{2} \times \left(1 - \frac{2i}{n}\right)^2$$

Triangular weighting is a surrogate for cycle analysis. Two techniques that use this method successfully, Hilbert and Fischer transforms, can be found in Chapter 11.

Pivot-Point Weighting

Too often we limit ourselves by our experience. When a weighted moving average is used, it is normal to assume that all the weighting factors should be positive; however, that is not a requirement. The *pivot-point moving average* uses reverse linear weights (e.g., 5, 4, 3, …) that begin with a positive value and continue to decline even when they become negative.[3] In the following formula, the pivot point, where the weight is zero, is reached about ⅔ through the data interval. For a pivot-point moving average of 11 values, the eighth data point is given the weight of 0:

$$PPMA_t(11) = (-3P_{t-10} - 2P_{t-9} - 1P_{t-8} + 0P_{t-7} + 1P_{t-6} + 2P_{t-5} + 3P_{t-4} + 4P_{t-3} + 5P_{t-2} + 6P_{t-1} + 7P_t)/22$$

The intent of this pattern is to reduce the lag by front-loading the prices. The divisor is smaller than the usual linear weighted average (where the sum of 1 through 11 is 66) because it includes negative values. The general formula for an *n*-day pivot-point moving average is[4]

$$PPMA_t(n) = \frac{2}{n(n+1)} \sum_{i=1}^{n} (3i - n - 1) P_i$$

A computer program to calculate the pivot-point moving average, linearly weighted for the most recent *N* prices, is:

```
sum = 0;
for I = 1 to N begin
    M = N - I + 1;
    sum = sum + P[M]*(3*I - N - 1);
```

```
5      end;
6 PPMA = sum*(2/(N*(N+1))
```

where lines 2–5 calculate the sum of the prices times the weighting factor, and line 6 divides that sum by the sum of the weighting factors (after multiplying the top and bottom of the fraction by the value 2).

The negative weighting factors actually reverse the impact of the price move for the oldest data points rather than just give them less importance. For a short interval this can cause the trendline to be out of phase with prices. The application of this method should be limited to longer-term cyclic markets, where the inflection point, at which the weighting factor becomes zero, is aligned with the cyclic turn or can be fixed at the point of the last trend change.

[1]Robert T.H. Lee, *Power Tools for Traders* (MegaCapital Limited, Hong Kong, 1997).

[2]J. J. Payne, "A Better Way to Smooth Data," *Technical Analysis of Stocks & Commodities* (October 1989).

[3]Patrick B. Lafferty, "End-Point Moving Average," *Technical Analyisis of Stocks & Commodities* (October 1995).

[4]Don Kraska, "Letters to S&C," *Technical Analysis of Stocks & Commodities* (February 1996, p. 12).

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GEOMETRIC MOVING AVERAGE

The geometric mean is a growth function that is very applicable to long-term price movement. It was introduced in Chapter 2. It is especially useful for calculating the components of an index. The geometric mean can also be applied to the most recent *n* points at time *t* to get a geometric average similar in function to a moving average

$$G_t = \left(P_{t-n+1} \times P_{t-n+2} \times \cdots \times P_{t-1} \times P_t\right)^{(1/n)} = \left(\prod_{i=1}^{n} P_{t-i+1}\right)^{(1/n)}$$

The daily calculation is more complicated but, as shown in Chapter 2, could be rewritten as

$$\begin{aligned} \ln G_t &= \frac{\ln P_{t-n+1} + \ln P_{t-n+2} + \cdots + \ln P_{t-1} + \ln P_t}{n} \\ &= \frac{1}{n}\left(\sum_{i=1}^{n} \ln P_{t-i+1}\right) \end{aligned}$$

This is similar in form to the summation of a standard moving average based on the arithmetic mean and can be written in either spreadsheet or program code as

```
GA = average(log(price),n)
```

Note that some software will use the function *log* although the calculation is actually the *natural log*, *ln.* Other programs will allow the choice of *log*(*value*) or *ln*(*value*). A weighted geometric moving average, for *n* days ending at the current day *t*, would have the form

$$\begin{aligned} \ln G_t &= \frac{w_1 \ln P_{t-n+1} + w_2 \ln P_{t-n+2} + \cdots + w_{n-1} \ln P_{t-1} + w_n \ln P_t}{w_1 + w_2 + \cdots + w_n} \\ &= \frac{\sum_{i=1}^{n} w_i \ln P_{t-i+1}}{\sum_{i=1}^{n} w_i} \end{aligned}$$

The geometric moving average itself would give greater weight to lower values without the need for a discrete weighting function. This is most applicable to long data intervals where prices had a wide range of values. In applying the technique to recent index or stock prices, this distinction is not as apparent. For example, if the historical index values vary from 10 to 1000, the simple average of those two values is 505 and the geometric average is 100, but for the three sequential prices of 56.20, 58.30, and 57.15, the arithmetic mean is 57.2166 and the geometric is 57.1871. A 5-, 10-, or 20-day moving average of stock prices, compared to geometric averages of the same intervals, show negligible differences. The geometric moving average is best applied to long-term historic data with wide variance, using yearly or quarterly average prices.

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DROP-OFF EFFECT

All trend calculations are distinguished by the *drop-off effect*, a common way of expressing the abrupt change in the current value when a significant older value is dropped from a fixed-period calculation. Simple moving averages, linear regressions and weighted averages all use a fixed period, or window, for determining the trend. When an unusually volatile piece of data becomes old and is removed from the calculation window, there can be a sudden jump in the trend value caused by this drop-off effect. For an *n*-period moving average, the importance of the oldest value being dropped off measured by the difference between the new price being added to the calculation, *t*, and the one being removed, *t* - *n*, divided by the number of periods,

$$\textit{Drop-off effect} = (P_t - P_{t-n}) / n$$

A front-weighted average, in which the oldest values have less importance, reduces this effect because older, high volatility data slowly becomes a smaller part of the result before being dropped off. Exponential smoothing. Discussed next, is by nature a front-loaded trend and has less exposure to the drop-off effect.

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EXPONENTIAL SMOOTHING

Exponential smoothing may appear to be more complex than other techniques, but it is only another form of a weighted moving average. It can also be more accurately called *percentage smoothing*, and has the added advantage of being simpler to calculate than any other method discussed; only the last *exponentially smoothed* value E_{t-1}, and the smoothing constant a (a percentage), are necessary to compute the new value. The technique of exponential smoothing was developed during World War II for tracking aircraft and projecting their position: the immediate past is used to predict the immediate future.

The terms of the geometric progression

$$a^0, a^1, a^2, a^3, \ldots, a^n$$

are assigned to the weighting factors of a weighted moving average

$$W_t = \frac{w_1 P_{t-n+1} + w_2 P_{t-n+2} + \ldots + w_{n-1} P_{t-1} + w_n P_t}{w_1 + w_2 + \ldots + w_n}$$

in reverse order, where w_n, the weighting factor assigned the value a, $w_{n-1} = a^2$, $w_{n-2} = a^3$, and so forth. If a = ½, which is also called *50% smoothing*, the resulting sequence of weighting factors is

$$1, \tfrac{1}{2}, \tfrac{1}{4}, \tfrac{1}{8}, \ldots, (\tfrac{1}{2})^n$$

where $a^0 = 1$ and $a^1 = a$. This shows the rapidly decreasing importance of each older price. Substituting the geometric progression into the equation for the weighted moving average gives the exponential solution

$$E_t = \frac{a^n P_{t-n+1} + a^{n-1} P_{t-n+2} + \ldots + a^2 P_{t-1} + a P_t}{a^n + a^{n-1} + \ldots + a^2 + a}$$

The Common Form of Exponential Smoothing

The common use of exponential smoothing takes a much simpler yet very flexible form,

$$E_t = E_{t-1} + a\,(P_t - E_{t-1})$$

where E_t and E_{t-1} = today's and yesterday's exponential smoothing values
P_t = today's price
a = the smoothing constant, $0 = a = 1$.

It may be easier to visualize the effect of the smoothing process with a = .10 by thinking of it as moving the exponential trendline closer to the current price by 10% of the distance between the price and the previous trendline value. In Figure 7.5, using a smoothing constant of .10, the distance from the new price P_t and the previous trendline value E_{t-1} is $P_t - E_{t-1}$. The new trendline value is 10% closer to the price because the distance between P_t and E_{t-1} is reduced by .10 × $(P_t - E_{t-1})$. Therefore,

New exponential value = Previous exponential value + a % of (Today's price - Previous exponential value)

Figure 7.5: Exponential smoothing. The new exponential trendline value, E_t, is moved closer to the new price, P_t, by 10% of the distance between the new price and the previous exponential trendline value E_{t-1}.

The smoothing process can be started by letting $E_1 = P_1$ and calculating the next value:

$$E_2 = E_1 + a\ (P_2 - E_1)$$

The percentage smoothing constant, a, will determine the number of calculations necessary to wind up the data. A longer-term smoothing, where the percentage is small and a is closer to 0, will take more data for the smoothed line, E_t, to reach a stable value.

Diminishing Importance of Older Data

An important feature of exponential smoothing is that all data previously used continues to be part of the new result although with diminishing significance. In general:

$$E_t = a\ (P_t + (1 - a)P_{t-1} + (1 - a)^2 P_{t-2} + \ldots + (1 - a)^n P_{t-n} + \ldots)$$

For example, if the smoothing constant $a = .10$, add 10% of the new difference to the old average:

$$E_t = E_{t-1} + .10\ (P_t - E_{t-1})$$

Each new calculation reduces all data from points 1 through $t - 1$ by 10%; the next calculation for $t + 1$ will cause the data from t through 1 to be reduced again by 10%. Therefore, at any time t the impact of data used at a previous time k is based on the number of days elapsed, $t - k$, and the smoothing constant a. Let the significance $P_k - E_{k-1} = k = D_k$. Then on day k we have

$$k = a \times D_k$$

$$k + 1 = a \times D_k - a \times a \times D_k$$

$$\vdots$$

$$k + n = aD_k - (a^2 D_k + a^3 D_k + \ldots + a^{n=1} D_k)$$

$$= a\, D_k - \sum_{i=2}^{n+1} a^i\, D_k \qquad \textit{(written in summation form)}$$

$$= D_k \left(a - \sum_{i=2}^{n+1} a^i \right) \to 0 \quad as \quad n \to \infty$$

This shows that the significance of the data on day *k* goes to zero as *n* gets infinitely large. As an example, an investor makes a deal to buy 10% of the outstanding shares of stock in a corporation where there are *t*-1 investors. There are now *t* investors. Afterwards, the corporation decides that it needs more money and takes in another investor and gives the new investor 10% of the total outstanding shares. There are now *t* + 1 investors, and the original *t* share owners are all diluted by 10%; the previous investor *t* who bought 10% now owns 9%. Yet another investor buys 10% of the total and there are now *t* + 2 investors. Investor *t* has 8.1% of the stock (10% less than before). As more investors are added, *t*'s stock holding dwindles to 7.29%, 6.561%, and 5.9049%. Even though the number of shares that are held remain the same, each previous owner holds a less significant part of the whole. No matter how many investors are added at 10%, the original shareholders never disappear, but have some decreasingly small percent of the whole. In exactly the same way, the original price used in exponential smoothing always retains some relevance; using a standard moving average of *n* days, the (*n* + 1)th day is dropped off and ceases to have any impact.

Smoothing and Restoring the Lag

As a trend continues in its direction, the exponentially smoothed trendline will lag farther behind. By selecting a smoothing constant nearer to 1, the magnitude of this lag will be lessened but it will not disappear, just as using a smaller number of days, or shorter period, will limit the lag of a simple moving average. If the lag is considered the predictive error *et* in the exponential smoothing calculation, then

$$e_t = P_t - E_t$$

where E_t is the exponential trendline value corresponding to the most recent price P_t. The same exponential smoothing technique can be applied to the lag, the pattern of increasing or decreasing errors, to get

$$ERR_t = ERR_{t-1} + a(e_t - ERR_{t-1})$$

The difference between the original smoothing value and this *second-order smoothing* of the errors ERR_t is added back into the approximation to get an adjusted trendline

$$EE_t = E_t + ERR_t$$

If the new error, the difference between the first-order exponential E_t and the second order approximation EE_t, is smaller than the original error e_t, then EE_t is an improvement in the forecast. This process can be continued to *third-order* smoothing by applying the same method to the difference between the current price and the second-order trend EE_t.

Comparison of Exponential Smoothing Methods

The single and double exponential smoothing methods, as well as the analysis of restoring the forecast error, are compared in Figure 7.6 and Table 7.4. In Table 7.5, which shows the Swiss franc during a very volatile period in 1993, the gray areas in Table 7.5 are downtrends, and the exponential smoothing constants are all .10. The first calculation, a single exponential smoothing *Exp* in column 3, reduces the number of trend changes from 46 in the raw price series to 9,

and captures the two primary upwards and downwards trends. Double smoothing, *Dbl Exp* in column 4, eliminates three of the false trend changes in column 2, but adds additional lag to the calculation, seen when the last downtrend is entered on June 16 (7 days after the single exponential). Correction of the errors, shown in column 5 as *Exp Error*, adds sensitivity back to the trend changes, but removes some of the lag. The change in lag can been seen when the major downtrend is entered on June 7, one day ahead of *Exp* and eight days ahead of *Dbl Exp.*

Table 7.5: Comparison of Exponential Smoothing Techniques Applied to Swiss Franc from *TradeStation* Continuous Daily Data

Open table as spreadsheet

	Price	Exp	Dbl Exp	Exp Err	Exp Error	Smoothed Error	Price Change	Exp Change	Dbl Exp Change
930316	64.59	64.59	64.59	64.59	0.00				
930317	64.23	64.55	64.59	64.52	-0.32	-0.03	-0.36	-0.04	-0.04
930318	65.26	64.62	64.59	64.66	0.64	0.03	1.03	0.07	-0.03
930319	65.24	64.69	64.60	64.77	0.55	0.09	-0.02	0.06	-0.02
930322	65.07	64.72	64.61	64.84	0.35	0.11	-0.17	0.04	-0.01
930323	65.14	64.77	64.63	64.90	0.37	0.14	0.07	0.04	-0.01
930324	64.98	64.79	64.64	64.93	0.19	0.14	-0.16	0.02	-0.01
930325	64.76	64.78	64.66	64.91	-0.02	0.13	-0.22	-0.00	-0.01
930326	65.11	64.82	64.67	64.96	0.29	0.14	0.35	0.03	-0.00
930329	65.46	64.88	64.69	65.07	0.58	0.19	0.35	0.06	0.01
930330	65.94	64.99	64.72	65.25	0.95	0.26	0.48	0.11	0.02
930331	66.10	65.10	64.76	65.44	1.00	0.34	0.16	0.11	0.02
930401	66.87	65.28	64.81	65.74	1.59	0.46	0.77	0.18	0.04
930402	66.56	65.40	64.87	65.94	1.16	0.53	-0.31	0.13	0.05
930405	66.71	65.53	64.94	66.13	1.18	0.60	0.15	0.13	0.06
930406	66.19	65.60	65.00	66.20	0.59	0.60	-0.52	0.07	0.06
930407	66.14	65.65	65.07	66.24	0.49	0.58	-0.05	0.05	0.06
930408	66.64	65.75	65.14	66.37	0.89	0.62	0.50	0.10	0.06
930412	67.33	65.91	65.21	66.61	1.42	0.70	0.69	0.16	0.07
930413	68.18	66.14	65.31	66.97	2.04	0.83	0.85	0.23	0.09
930414	67.48	66.27	65.40	67.14	1.21	0.87	-0.70	0.13	0.09
930415	67.19	66.36	65.50	67.23	0.83	0.86	-0.29	0.09	0.09
930416	66.46	66.37	65.59	67.16	0.09	0.79	-0.73	0.01	0.08
930419	67.20	66.46	65.67	67.24	0.74	0.78	0.74	0.08	0.08
930420	67.62	66.57	65.76	67.38	1.05	0.81	0.42	0.12	0.09
930421	67.66	66.68	65.86	67.51	0.98	0.83	0.04	0.11	0.09
930422	67.89	66.80	65.95	67.65	1.09	0.85	0.23	0.12	0.09
930423	69.19	67.04	66.06	68.02	2.15	0.98	1.30	0.24	0.11
930426	69.68	67.30	66.18	68.43	2.38	1.12	0.49	0.26	0.12
930427	69.31	67.51	66.32	68.69	1.80	1.19	-0.37	0.20	0.13
930428	69.11	67.67	66.45	68.88	1.44	1.21	-0.20	0.16	0.13
930429	69.27	67.83	66.59	69.06	1.44	1.24	0.16	0.16	0.14
930430	68.97	67.94	66.72	69.16	1.03	1.22	-0.30	0.11	0.13
930503	69.11	68.06	66.86	69.26	1.05	1.20	0.14	0.12	0.13
930504	69.50	68.20	66.99	69.41	1.30	1.21	0.39	0.14	0.13
930505	69.70	68.35	67.13	69.58	1.35	1.22	0.20	0.15	0.13

930506	69.94	68.51	67.27	69.76	1.43	1.24	0.24	0.16	0.14
930507	69.11	68.57	67.40	69.74	0.54	1.17	-0.83	0.06	0.13
930510	67.64	68.48	67.50	69.45	-0.84	0.97	-1.47	-0.09	0.11
930511	67.75	68.40	67.59	69.21	-0.65	0.81	0.11	-0.07	0.09
930512	67.47	68.31	67.67	68.96	-0.84	0.65	-0.28	-0.09	0.07
930513	67.50	68.23	67.72	68.74	-0.73	0.51	0.03	-0.08	0.06
930514	68.18	68.23	67.77	68.68	-0.05	0.45	0.68	-0.01	0.05
930517	67.35	68.14	67.81	68.47	-0.79	0.33	-0.83	-0.09	0.04
930518	66.74	68.00	67.83	68.17	-1.26	0.17	-0.61	-0.14	0.02
930519	67.00	67.90	67.84	67.96	-0.90	0.06	0.26	-0.10	0.01
930520	67.46	67.85	67.84	67.87	-0.39	0.02	0.46	-0.04	0.00
930521	67.36	67.80	67.83	67.78	-0.44	-0.03	-0.10	-0.05	-0.00
930524	67.37	67.76	67.83	67.70	-0.39	-0.07	0.01	-0.04	-0.01
930525	67.78	67.76	67.82	67.71	0.02	-0.06	0.41	0.00	-0.01
930526	67.96	67.78	67.82	67.75	0.18	-0.03	0.18	0.02	-0.00
930527	68.97	67.90	67.82	67.98	1.07	0.08	1.01	0.12	0.01
930528	69.79	68.09	67.85	68.33	1.70	0.24	0.82	0.19	0.03
930601	69.53	68.23	67.89	68.58	1.30	0.34	-0.26	0.14	0.04
930602	69.52	68.36	67.94	68.79	1.16	0.43	-0.01	0.13	0.05
930603	69.17	68.44	67.99	68.90	0.73	0.46	-0.35	0.08	0.05
930604	67.41	68.34	68.02	68.66	-0.93	0.32	-1.76	-0.10	0.04
930607	67.96	68.30	68.05	68.55	-0.34	0.25	0.55	-0.04	0.03
930608	67.62	68.23	68.07	68.40	-0.61	0.16	-0.34	-0.07	0.02
930609	67.18	68.13	68.08	68.18	-0.95	0.05	-0.44	-0.11	0.01
930610	67.65	68.08	68.08	68.09	-0.43	0.01	0.47	-0.05	0.00
930611	68.08	68.08	68.08	68.09	-0.00	0.00	0.43	-0.00	0.00
930614	68.06	68.08	68.08	68.08	-0.02	0.00	-0.02	-0.00	0.00
930615	67.16	67.99	68.07	67.91	-0.83	-0.08	-0.90	-0.09	-0.01
930616	66.59	67.85	68.05	67.65	-1.26	-0.20	-0.57	-0.14	-0.02
930617	66.77	67.74	68.01	67.46	-0.97	-0.28	0.18	-0.11	-0.03
930618	65.95	67.56	67.97	67.15	-1.61	-0.41	-0.82	-0.18	-0.05
930621	65.89	67.39	67.91	66.87	-1.50	-0.52	-0.06	-0.17	-0.06
930622	65.48	67.20	67.84	66.56	-1.72	-0.64	-0.41	-0.19	-0.07
930623	65.69	67.05	67.76	66.34	-1.36	-0.71	0.21	-0.15	-0.08
930624	65.30	66.88	67.67	66.08	-1.58	-0.80	-0.39	-0.18	-0.09
930625	65.37	66.73	67.58	65.87	-1.36	-0.85	0.07	-0.15	-0.09
930628	65.70	66.62	67.48	65.76	-0.92	-0.86	0.33	-0.10	-0.10
930629	66.12	66.57	67.39	65.75	-0.45	-0.82	0.42	-0.05	-0.09
930630	65.37	66.45	67.30	65.61	-1.08	-0.85	-0.75	-0.12	-0.09
930701	65.64	66.37	67.21	65.54	-0.73	-0.83	0.27	-0.08	-0.09
930702	65.54	66.29	67.11	65.46	-0.75	-0.83	-0.10	-0.08	-0.09
930706	65.47	66.21	67.02	65.39	-0.74	-0.82	-0.07	-0.08	-0.09
930707	65.45	66.13	66.93	65.33	-0.68	-0.80	-0.02	-0.08	-0.09

930708	65.50	66.07	66.85	65.29	-0.57	-0.78	0.05	-0.06	-0.09
930709	64.70	65.93	66.76	65.11	-1.23	-0.82	-0.80	-0.14	-0.09
930712	64.82	65.82	66.66	64.98	-1.00	-0.84	0.12	-0.11	-0.09
930713	65.27	65.76	66.57	64.96	-0.49	-0.81	0.45	-0.05	-0.09
930714	65.62	65.75	66.49	65.01	-0.13	-0.74	0.35	-0.01	-0.08
930715	65.36	65.71	66.41	65.01	-0.35	-0.70	-0.26	-0.04	-0.08
930716	65.85	65.73	66.34	65.11	0.12	-0.62	0.49	0.01	-0.07
930719	66.09	65.76	66.29	65.24	0.33	-0.52	0.24	0.04	-0.06
930720	66.28	65.81	66.24	65.39	0.47	-0.42	0.19	0.05	-0.05
930721	66.07	65.84	66.20	65.48	0.23	-0.36	-0.21	0.03	-0.04
930722	66.03	65.86	66.16	65.55	0.17	-0.31	-0.04	0.02	-0.03
930723	65.22	65.79	66.13	65.46	-0.57	-0.33	-0.81	-0.06	-0.04
930726	65.19	65.73	66.09	65.38	-0.54	-0.35	-0.03	-0.06	-0.04
930727	65.19	65.68	66.05	65.31	-0.49	-0.37	0.00	-0.05	-0.04
930728	65.59	65.67	66.01	65.33	-0.08	-0.34	0.40	-0.01	-0.04
930729	64.80	65.58	65.97	65.20	-0.78	-0.38	-0.79	-0.09	-0.04

Figure 7.6: Comparison of exponential smoothing techniques. A simple .10 smoothing (*Exp*) is compared with a double-smoothed series (*Dbl Exp*), which applies the smoothing constant .10 first to prices, then to the smoothed series, and also to a smoothed series with the forecast error corrected (*Exp Err*).

Four other columns in Table 7.5 show the change in the four trend methods. The change in the trendline is the same concept as change in slope. It makes the process more sensitive to directional changes and speeds up the process. Looking at the column *Dbl Exp Change*, which is the change in the double exponential, *Dbl Exp*, the number of trend changes increases from 4 to 13.

If the smoothing methods were to be treated as simple trend-following systems (with no transaction costs subtracted),

buying when the trend turns up and selling when it turns down, we can see below that the much slower double exponential and the exponential with error correction were not profitable; two other methods were more successful. The simple exponential performed in much the same way as the moving averages shown in the previous comparative study (Table 7.3). The technique that records the trend by observing the change in the value of the double exponential smoothing shows very good returns. As previously stated, this method compensates for the extreme lag in the double exponential and turns this example from a loss to a profit. This approach is studied further as *velocity* and *acceleration* in Chapter 9.

Open table as spreadsheet

	Prices	Exp	Dbl Exp	Exp Err Corrected	Dbl Exp Change
Number of trend changes	46	9	4	12	13
Gross profit/loss	4.79	0.83	-0.13	-0.75	2.51
% Profitable trades	37%	50%	50%	25%	50%

Each of these smoothing methods has particular benefits that may not be seen in this very short example. If the technique is of conceptual interest then it should be studied across a broad sample of data. These alternatives all offer good possibilities for identifying the trend. It may also appear that simply following the direction of prices, a 1-day trend, is the most profitable trend trading method. However, the gross profit of 4.79 should be viewed as 10.4 cents per trade. Given the cost of trading, including commissions and slippage, it is unlikely that this gross profit will turn into a satisfactory net profit.

Double Smoothing

In order to make a trendline smoother, the period of a moving average may be increased or the exponential smoothing constant decreased. This succeeds in reducing the short-term market noise at the cost of increasing the lag. An alternative to increasing the calculation period is *double smoothing*, that is, the trend values can themselves be smoothed. This will slow down the trendline, but gives weight to the previous values in a way that may be unexpected.

A double-smoothed 3-day moving average, *MA*, would take the most recent 3 moving average values, calculated from prices, and use them in another 3-period average to get a double-smoothed moving average, *DMA*:

$$MA_3 = (P_1 + P_2 + P_3) / 3$$

$$MA_4 = (P_2 + P_3 + P_4) / 3$$

$$MA_5 = (P_3 + P_4 + P_5) / 3$$

then

$$DMA_5 = (MA_3 + MA_4 + MA_5) / 3$$

By substituting the original prices, $P_1, \ldots, P_5$, into the equation for DMA_5 we find out that

$$DMA_5 = (P_1 + 2P_2 + 3P_3 + 2P_4 + P_5) / 9$$

This shows that double smoothing results in *triangular weighting*, where the middle values have more importance than the end values, and changes the nature of the process which began with the equal weighting of the simple moving average. For exponential smoothing the result is also different. Because the most recent value in exponential smoothing receives the full weight of the smoothing constant, *a*, the double smoothing

$$DE_t = DE_{t-1} + a(E_t - DE_{t-1})$$

causes the nearby value *t* to be smoothed twice by *a*, or $a \times a$, and older values as well. Therefore, the net effect of using a constant of $a = .10$ for exponential double smoothing will result in a weighting that is much closer to using the square root of *a*, approximately .031. Figure 7.5 and Table 7.5 give an example of this method.

Double Smoothing of Price Changes

To avoid the compounded lag produced by double smoothing yet take advantage of the smoother trendline, William Blau has substituted the price changes, $P_t - P_{t-n}$, for the price itself.[5] The smoothing is then performed on this accelerated

price series and the smoothed result restores the speed of the series back to normal. When n = 1, the price changes are called the *first difference*, or *speed.* In effect, the smoothed series does not have a lag. Blau found this to be a successful proxy for long-term trends, where the first smoothing may be as long as 300 periods, and the second a much shorter 5 periods.

To calculate the double smoothing of price change (in the following chapters this will be called *momentum*), follow the same method as exponential smoothing. First calculate the smoothed momentum, SM_t, substituting the price change, P_t - P_{t-n}, for the price, P_t, normally used. Next, perform another exponential smoothing using the smoothed momentum instead of price. The result is the double-smoothed momentum, DSM_t.

$$SM_t = SM_{t-1} + a \times ((P_t - P_{t-n}) - SM_{t-1})$$
$$DSM_t = DSM_{t-1} + a \times (SM_t - DSM_{t-1})$$

As an example of this basic approach, start with the 10-day momentum, $M(10)_t = P_t - P_{t-10}$, and smooth the momentum values using a .05 smoothing constant. Smooth the resulting values again using the same .05 smoothing constant. The result is shown in the bottom panel of Figure 7.7 applied to Microsoft. The trendline is no longer in the same units as price; therefore, it cannot be plotted in the same panel as Microsoft prices. However, the trendline is very smooth and the points at which the trends turn show very little lag. It is particularly interesting that the double smoothing of price change produces trend changes at points that are very different from the other smoothing techniques. This method is discussed in detail in Chapter 9 under the headings "True Strength Index" and "Double-Smoothed Stochastics."

Figure 7.7: Double-smoothed price changes. Instead of applying exponential smoothing to the price, Blau used the price changes. In this example, the 20-day price changes are smoothed twice, first with a .05 smoothing constant, then with 10. The result is a very smooth trendline with only a small lag.

[5]William Blau, *Momentum, Direction, and Divergence* (John Wiley & Sons, New York, 1995).

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RELATING EXPONENTIAL AND STANDARD MOVING AVERAGES

It is much easier to visualize the amount of smoothing in a 10-day moving average than with exponential smoothing where *a* = .10 (which can be called *10% smoothing*). Although we try to relate the speed of both techniques, the simple moving average is equally weighted and the exponential is front weighted; therefore, they produce a very different pattern. Because the exponential smoothing never completely discards the old data, a 50% smoothing appears slower than a 2-day moving average, a 10% smoothing is slower than a 10-day moving average, and a 5% smoothing is slower than a 20-day moving average.

To illustrate the difference in the trend patterns, a series of numbers from 1 through 15 and back to 1 will be used to compare a 5-day moving average with an equivalent 20% exponential smoothing. Figures 7.8 and 7.9, and Table 7.6, show the relationship between the moving average and exponential smoothing. During the period of constant increase and decrease of at least 5 consecutive days, the 5-day moving average stabilizes and follows the price series with constant lag of 1, equal to the price change (seen in column 4 of Table 7.6). During the same period of constant rise the exponential smoothing approaches the lag of 1 but only gets as close as .95. Had the steady rise been longer, it would eventually reach 1. Because the exponential always has some residual value of old data, it effectively has a slightly slower trend. This can be seen when the exponential trend changes direction 4 prices after the peak. The moving average changes direction 3 prices after the peak.

Table 7.6: Comparison of Lag between Standard and Exponentially Smoothed Moving Averages
Open table as spreadsheet

				Change		
Price	**Standard 5-Day**	**5-Point 20% Exp**	**Standard 20% Exp**	**5-Day**	**5–20% Exp**	**20% Exp**
1	—	1.00	1.00	—	—	—
2	—	1.20	1.20	—	—	—
3	—	1.56	1.56	—	Not enough	—
4	—	2.05	2.05	—	data	—
5	3	2.64	2.64	—	—	—
6	4	3.64	3.31	1.00	1.00	.67
7	5	4.64	4.05	1.00	1.00	.74
8	6	5.64	4.84	1.00	1.00	.79
9	7	6.64	5.67	1.00	1.00	.83
10	8	7.64	6.54	1.00	1.00	.87
11	9	8.64	7.43	1.00	1.00	.89
12	10	9.64	8.34	1.00	1.00	.91
13	11	10.64	9.27	1.00	1.00	.93
14	12	11.64	10.22	1.00	1.00	.95
15	13	12.64	11.17	1.00	1.00	.95
14	13.6	13.24	11.74	.60	.60	.57
13	13.8	13.52	11.99	.20	.28	.25
12	13.6	13.54	11.99	-.20	.02	.00
11	13	13.36	11.79	-.60	-.18	-.20
10	12	12.36	11.43	-1.00	-1.00	-.36
9	11	11.36	10.95	-1.00	-1.00	-.48
8	10	10.36	10.36	-1.00	-1.00	-.59
7	9	9.36	9.69	-1.00	-1.00	-.67

6	8	8.36	8.95	-1.00	-1.00	-.74
5	7	7.36	8.16	-1.00	-1.00	-.79
4	6	6.36	7.33	-1.00	-1.00	-.83
3	5	5.36	6.46	-1.00	-1.00	-.87
2	4	4.36	5.57	-1.00	-1.00	-.89
1	3	3.36	4.65	-1.00	-1.00	-.92

Figure 7.8: Comparison of trend lag. Exponential smoothing never quite reaches a constant lag and changes direction one price after the moving average trendline.

Figure 7.9: Comparative changes in straight and exponential moving averages.

In Figure 7.8 it is clear that the standard moving average has an end-off effect. Five points after prices change direction the moving average has no memory of the previous price move. The exponential trendline takes much longer to adjust to the abrupt change.

Because the "equivalent" exponential smoothing constant of .20 creates a trend slightly slower than the 5-day moving average, we can reason that a slightly larger smoothing constant, greater than .20, might be a very close substitute for a 5-day moving average with the benefit of less data needed for calculation. To form the specific relationship between exponential smoothing and standard moving averages, create a table showing the significance of each oldest day in the exponential calculation. In Table 7.7, the .50 smoothing constant gives 50% of the total value to the current price, 25% to the prior day, 12½% to the next oldest, until the 7th oldest day adds only .8% to the total value of the exponential moving average. Table 7.8 accumulates these weights to show how much of the calculation has been completed by the elapsed number of days printed across the top of the table. The values in Table 7.8 are plotted in Figure 7.9. The most recent days (on the left) receive the bulk of the significance; the oldest prices are of little impact. The .10 smoothing calculation is 90.1% complete by day 22; the total remaining days added together only account for 9.9% of the value.

Table 7.7: Evaluation of Exponential Smoothing—Significance of Prior Data

Open table as spreadsheet

Weighting (%)	Past Number of Days																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1.00	100.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
.90	90.0	9.0	.9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.80	80.0	16.0	3.2	.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.70	70.0	21.0	6.3	1.9	.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.60	60.0	24.0	9.6	3.8	1.5	.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.50	50.0	25.0	12.5	6.3	3.1	1.6	.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.40	40.0	24.0	14.4	8.6	5.2	3.1	1.9	1.1	.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.30	30.0	21.0	14.7	10.3	7.2	5.0	3.5	2.5	1.7	1.2	.8	—	—	—	—	—	—	—	—	—	—	—	—
.20	20.0	16.0	12.8	10.2	8.2	6.5	5.2	4.2	3.3	2.7	2.1	1.7	1.4	1.1	.9	—	—	—	—	—	—	—	
.10	10.0	9.0	8.1	7.3	6.6	5.9	5.3	4.8	4.3	3.9	3.5	3.1	2.8	2.5	2.3	2.1	1.8	1.7	1.5	1.3	1.2	1.1	1.0

Table 7.8: Evaluation of Exponential Smoothing—Significance of Prior Data

Open table as spreadsheet

Weighting (%)	Total Inclusion through *N*th Day																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1.00	100.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.90	90.0	99.0	99.9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.80	80.0	96.0	99.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.70	70.0	91.0	97.3	99.2	99.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.60	60.0	84.0	93.6	97.4	99.0	99.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.50	50.0	75.0	87.5	93.8	96.9	98.5	99.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.40	40.0	64.0	78.4	87.0	92.2	95.3	97.2	98.3	99.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.30	30.0	51.0	65.7	76.0	83.2	88.2	91.8	94.2	96.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.20	20.0	36.0	48.8	59.0	67.2	73.8	79.0	83.2	86.6	89.3	91.4	93.1	94.5	95.6	96.5	—	—	—	—	—	—	—	—
.10	10.0	19.0	27.1	34.4	41.0	46.8	52.2	57.0	61.3	65.1	68.6	71.8	74.6	77.1	79.4	81.5	83.3	85.0	86.5	87.8	89.1	90.1	91.1

Figure 7.10 relates the fully calculated exponential smoothing (within 1%) to the standard moving average. Find the smoothing constant on the left scale, and the equivalent number of days in a standard moving average will be along the bottom. Observe in the summary that, if you perform an optimization with equally-spaced exponential smoothing constants, there is an unexpected distribution relative to past days.

Open table as spreadsheet

Equating Standard Moving Averages to Exponential Smoothing									
Smoothing constant	.10	.20	.30	.40	.50	.60	.70	.80	.90
Standard (*n*-day average)	20	10	6	4	3	2.25	1.75	1.40	1.15

Figure 7.10: Graphic evaluation of exponential smoothing and moving average equivalents.

If the equally distributed smoothing constants shown are used for testing, half of the tests will analyze moving averages of three days or less. If the testing program is to relate to the standard moving average, reverse the process, finding the smoothing constant for a known number of days. The distribution of calculation periods used for testing will be important when finding robust system parameters, and is discussed in Chapter 21.

Open table as spreadsheet

Equating Exponential Smoothing to Standard Moving Averages										
Standard (*n*-day average)	2	4	6	8	10	12	14	16	18	20
Smoothing constant	.65	.40	.30	.235	.20	.165	.14	.125	.11	.10

The distribution of smoothing constants is very close to logarithmic and is plotted on a log scale in Figure 7.10. This can be seen because the line representing the relationship between the smoothing

constant and the moving average days is nearly straight. When testing a sample of exponential smoothing constants, it is best to use a logarithmic distribution of smoothing constants. This will create closer values taken at the smaller numbers and yield a more representative distribution of results. Other issues of test selection are discussed in Chapter 21.

Best Approximation of Smoothing Constants

The standard conversion from the number of days to a smoothing constant *s* was given by Hutson[6] as

$$s = \frac{2}{n+1}$$

where *n* = the equivalent number of days in the standard (linearly weighted) moving average

In addition, *second-* or *third-order exponential smoothing*, based on the weighting of the past 2 or 3 days' prices, may be desirable. This is the exponential equivalent of step-weighting. Its general form is

$$s_p = 1 - \left(1 - \frac{2}{n+1}\right)^{\frac{1}{p}}$$

A comparison of the standard moving average days with first-, second-, and third-order exponential smoothing is shown in Table 7.9.

Table 7.9: Comparison of Exponential Smoothing Values

Open table as spreadsheet

Moving Average Days (*n*)	1st-Order Order *p* = 1	2nd-Order *p* = 2	3rd Order *p* = 3
3	.500	.293	.206
5	.333	.184	.126
7	.250	.134	.091
9	.200	.106	.072
11	.167	.087	.059
13	.143	.074	.050
15	.125	.065	.044
17	.111	.057	.039
19	.100	.051	.035
21	.091	.047	.031

Estimating Residual Impact

The primary difference between the standard moving average and exponential smoothing is that prices remain as part of the exponentially smoothed value indefinitely. For practical purposes, the effect of the oldest data may be limited. A general method of approximating the smoothing constant c for a given level of residual impact is given by

$$s = 1 - RI^{1/n}$$

where *n* = the number of moving average days that will be equivalent to the smoothing constant

RI = the level of residual impact expressed as a percentage (e.g., .05, .10, .20).

Table 7.10: Comparison of Exponential Smoothing Residual Impact

Open table as spreadsheet

n	2/(*n* + 1)	*RI*(%)	10% *RI*	5% *RI*
5	.333	13.17	.369	.451
10	.182	13.44	.206	.259
15	.125	13.49	.142	.181
20	.095	13.51	.109	.139

A lower percent implies more residual impact.[7]

The approximation for the smoothing constant, given in the previous section as $2/(n + 1)$, can be shown to have a consistent residual impact of between 13 and 14%. The use of the preceding formula, as shown in Table 7.10, would allow the specific adjustment of residual impact.

[6]Jack K. Hutson, "Filter Price Data: Moving Averages vs. Exponential Moving Averages," *Technical Analysis of Stocks & Commodities* (May/June 1984).

[7]Donald R. Lambert, "Exponentially Smoothed Moving Averages," *Technical Analysis of Stocks & Commodities* (September/October 1984).

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Chapter 8: Time-Based Trend Systems

The previous chapters developed the tools for calculating trends—a traditional moving average, weighted averages, exponential smoothing, and regression. To profit from identifying the trend requires the use of trading rules and the selection of specific parameters that define the trend speed and an acceptable level of risk, among other factors. This chapter first discusses those rules that are necessary to all trading strategies, then gives examples of actual systems. The selection of trend speed is handled only briefly here but is continued with a detailed analysis of these and other systems throughout the book, and especially in Chapter 21. Towards the end of this chapter, a section on viewing sequences of trends may prove interesting to the analyst trying to be innovative.

WHY TREND SYSTEMS WORK

Trend analysis is the basis for many successful trading programs. Whether these programs are trend following, taking positions in the direction of the trend, or mean reverting, taking positions contrary to price movement, identification of the trend is an essential component. Trend systems work because

- Long-term trends capture large price moves caused by fundamental factors, primarily initiated by government policy and reflected in interest rates, foreign exchange, and the balance of trade.
- Prices are not normally distributed but have a *fat tail.* The fat tail means that there are an unusually large number of directional price moves that are longer than would be expected if prices were randomly distributed.

Time Intervals, Market Maturity, and Trends

Trends are most easily seen using long-term charts, weekly rather than daily data, or daily rather than hourly data. The farther you step back from a chart, the clearer the trend. This concept translates into better performance when using longer-term trends. While there are always fast trends that show profits in back-testing, they tend to be less stable and inconsistent in their returns. Trends using longer calculation periods are more likely to parallel an economic reality, such as the progressive lowering of interest rates by the central bank (the "Fed" in the United States) or a plan to allow the dollar to weaken in order to stimulate exports and reduce debt.

Diverse markets may have very different trending qualities. Interest rates futures, money markets, and utility stocks are among the many investment vehicles closely tied to government rate policy and reflect the same long-term trend; this trend can persist for years. Foreign exchange is more complex and is constrained by monetary policy that prefers the exchange value to remain within a target range. When currencies rise or fall outside the range, governments prefer that they move slowly. Most foreign exchange markets show clear but shorter trends compared to interest rates.

The stock market presents another level of difficulty. Individual stocks are driven by many factors, including competition, government regulation, management competence, and consumer confidence. Because the volume of trading in individual shares may vary considerably from day to day, these factors do not often net out as a clear trend. Stock prices may run up sharply on anticipation of better earnings or approval of a new drug, and reverse just as quickly within a few days. Liquidity, or volume, is an important element in the existence of a steady trend.

Individual stocks are also affected by concurrent trading in the index markets. When the S&P futures or Spyders are bought and sold, all stocks within that index are bought and sold. If one company in the S&P 500 has just announced the loss of a major contract, but the overall market is strong, the share price of the suffering company may be dragged higher by arbitrage due to massive buying of the S&P index. This behavior makes for erratic price patterns in individual stocks.

Emerging markets are the exception. The introduction of a new market, such as the fictitious East European Stock Index, would be lightly traded but may be very trending. Initial activity would be dominated by commercials, such as banks, all of

which would have a similar opinion on the economy of Eastern Europe. A small number of traders with the same opinion will cause very clear trends in the new market price. As the public adds liquidity it also introduces noise, which in turn makes the trends less clear. Finding the trend then requires a longer time interval. More on the relationship of trends and market noise can be found in Chapter 20.

The Fat Tail

The *fat tail* is a statistical phenomenon caused by a combination of market fundamentals and human behavior. The net effect is that prices persist in movement in one direction much longer than can be explained by random distribution. As a simple example, consider coin flipping as a classic way to produce a random distribution. In a random distribution of 100 coin tosses,

- 50 will be a head or a tail followed by the opposite head or tail.
- 25 will be two heads or two tails in a row.
- 12½ (if we could have halves of tosses) will be 3 heads or 3 tails in a row.
- about 6 will be 4 heads or 4 tails in a row.
- about 3 will be 5 in a row.
- 1 or 2 will be 6 in a row of either heads or tails.

If price moves are substituted for coin flips, then heads would be a move up and tails a move down. If the pattern of up and down price moves follows a random distribution (and the up and down moves were of the same amount), then it would not be possible to profit from a trend system. But prices are not normally distributed. Price runs have a fat tail, which means that, instead of one run of 6 out of 100 days of trading, we may see a run of 12, or 3 runs of 6. That distribution is enough to make trend trading profitable.

There is another question to be asked. If there are more runs of longer duration for every 100 daily price moves, what is the shape of the rest of the distribution? Figure 8.1 gives a theoretical representation of an actual price distribution compared to a random distribution. The extra movement that goes into creating the fat tail comes from the sequence of short runs. There are fewer runs of 1 and 2 and more runs greater than 6. The total remains the same. Readers interested in this subject should read the section "Gambling Techniques—The Theory of Runs" in Chapter 22.

Figure 8.1: Distribution of runs. The shaded area shows the normal distribution of random runs. The solid dark line

represents the distribution when there is a "fat tail." In the fat tail distribution there are few short runs and an unusually large number of longer runs.

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BASIC BUY AND SELL SIGNALS

Using a moving average as the benchmark trend calculation, the smoothed moving average trendline will lag the actual current market price regardless of the calculation period. When the calculation period is longer, the lag is greater. In rising markets, this lag will cause the moving average to be below the price; in falling markets, it will be above. When prices change direction, the trendline and the actual market prices cross because the trend is slow to reflect the new market direction. In Figure 8.2, IBM prices start their decline at the beginning of 2002. The classic 200-day moving average is still rising when prices cross in mid-January. About three weeks later the 200-day trendline first turns down.

Figure 8.2: IBM prices with a 200-day moving average. The lag in the moving average provides an opportunity for buy and sell signals.

Buy and Sell Signals Based on Price Crossings

The act of prices crossing a trendline provide the opportunity for the most popular basic trading signals

- *Buy* when rising prices *cross* the trendline.
- *Sell* when declining prices *cross* the trendline.

Even with these simple rules, there are important choices to be made. *Buy when rising prices cross the trendline* means that you would buy during the trading session the moment prices cross the trendline value. As seen in Figure 8.2, prices may cross back and forth through the trendline before settling on a final direction. If you subscribe to the belief that the closing price of the day is the most reliable price, then unnecessary trading signals can be avoided by using the rules

- *Buy* when rising prices *close* above the trend line.
- *Sell* when declining prices *close* below the trend line.

Another school of thought prefers the average of high and low prices, or the average of the high, low, and closing prices. A buy or sell signal occurs when the new average (*high* + *low*)/2 or (*high* + *low* + *close*)/3 is above or below the current trendline value. In both of these cases, the averages could not be calculated until the end of day because none of the three component values would be known until trading had stopped.

Buy and Sell Signals Based Only on the Trendline

The trendline represents the netting of all prices. The change in the value of the trendline from the previous calculation to the current one is its direction—up, down, or unchanged. The direction of the trendline is a candidate for generating trading signals.

- *Buy* when the current change in the trendline is up.
- *Sell* when the current change in the trendline is down.

The purpose of calculating the trendline is to uncover the direction of prices even when the price patterns appear volatile and erratic. You could therefore conclude that the trendline itself is the most reliable indicator of price direction. The penalty for using the trendline as a trading signal is its lag. Figure 8.2 shows that prices cross below the trendline about three weeks ahead of the point where the trendline turns down. The benefit using the trendline signal is that the trend turn is clear. There is a single trading signal when the trendline turns down compared to four consecutive days where IBM prices crossed back and forth through the trendline, giving *false* signals.

The choice is not always clear. For faster trading in volatility markets, the rule for price crossings is best. For longer-term trends, signals using the trendline are more reliable.

Anticipating the Trend Signal

Consistency is important. The system that is tested and the one that is traded should be the same. In this book the closing price is referenced for most of the calculations; however, any combination of open, high, low, and close could be substituted. To find out if a trading signal occurred on any day, wait until the close of trading, calculate the new moving average or trendline value, and then see whether a crossing occurred or the direction of the trendline changed according to the basic buy and sell rules.

The process of waiting for the close of trading to perform the necessary calculations and generate a signal requires that orders be placed in the after-hours market or on the next day's open. While the trading system is indicating a new buy or sell signal as of the close of trading, you are entering the market significantly late. You are not following the system. To have the best chance of generating results similar to the trend system you would need to buy and sell at the same time that the system buys and sells—on the close.

To correct this problem, calculate in advance the closing price that would result in a new trading signal. For example, if IBM had been in a downtrend and the trendline was $1 above yesterday's closing price, then at what price would IBM need to close in order to cause the trendline to turn up? For a moving average the answer is very simple. If you were using a 10-day moving average, the critical point is the price 10 days ago. Therefore, if today's close is greater than the price 10 days ago, the new 10-day moving average trendline value would be higher than the previous value; if today's close is lower than the price 10 days ago, then the trendline direction would be down. In general, the critical turning point is

N-day moving average turning point = Price n days ago

Knowing the value of the turning point allows you to act a few minutes before the close of trading. The results will keep actual performance much closer to expected performance.

Profile of a Simple Moving Average System

Using the moving average trendline as the basis for system signals, we chose a 63-day calculation period, equal to the number of business days in a calendar quarter. The profile of results is typical of any moving average system. Figure 8.3 shows the Nasdaq 100 index, which can be traded as the Exchange-Traded Fund (ETF) QQQ on AMEX. Buy and sell signals are generated from the direction of the trendline; no fees were subtracted from the results.

Figure 8.3: A trend system for Nasdaq 100. Applying a 63-day moving average and taking the trading signals from the direction of the trendline results in a typical trend system profile.

The buy and sell signals in Figure 8.3 show that the major upwards move and the first downwards reaction are captured. After that there are a number of buy and sell signals that react to changes in the trendline although no significant trends follow. Figure 8.4 itemizes the trades for the period on the chart, a one-year period from August 1999 to September 2000. Figure 8.5 is a performance summary showing that during this year there were 13 trades, of which only 5 were profitable (about 38%). Nevertheless, the large profit due to the five months of steadily higher prices more than offset many smaller losses.

TradeStation Strategy Performance Report

Trade #	Date	Type	Cnts	Price	Signal Name	Entry P/L	Cumulative
22	8/10/1999	Sell	1	2163.770	Sell		
	8/11/1999	SExit	1	2241.800	Buy	(7803.000)	(26279.000)
23	8/11/1999	Buy	1	2241.800	Buy		
	10/15/1999	LExit	1	2403.810	Sell	16201.000	(10078.000)
24	10/15/1999	Sell	1	2403.810	Sell		
	10/18/1999	SExit	1	2362.110	Buy	4170.000	(5908.000)
25	10/18/1999	Buy	1	2362.110	Buy		
	10/19/1999	LExit	1	2362.250	Sell	14.000	(5894.000)
26	10/19/1999	Sell	1	2362.250	Sell		
	10/20/1999	SExit	1	2466.290	Buy	(10404.000)	(16298.000)
27	10/20/1999	Buy	1	2466.290	Buy		
	4/13/2000	LExit	1	3553.810	Sell	108752.000	92454.000
28	4/13/2000	Sell	1	3553.810	Sell		
	4/27/2000	SExit	1	3692.570	Buy	(13876.000)	78578.000
29	4/27/2000	Buy	1	3692.570	Buy		
	5/2/2000	LExit	1	3627.310	Sell	(6526.000)	72052.000
30	5/2/2000	Sell	1	3627.310	Sell		
	7/13/2000	SExit	1	3956.670	Buy	(32936.000)	39116.000
31	7/13/2000	Buy	1	3956.670	Buy		
	7/27/2000	LExit	1	3681.630	Sell	(27504.000)	11612.000
32	7/27/2000	Sell	1	3681.630	Sell		
	8/3/2000	SExit	1	3623.500	Buy	5813.000	17425.000
33	8/3/2000	Buy	1	3623.500	Buy		
	8/4/2000	LExit	1	3618.630	Sell	(487.000)	16938.000
34	8/4/2000	Sell	1	3618.630	Sell		
	8/7/2000	SExit	1	3710.390	Buy	(9176.000)	7762.000
35	8/7/2000	Buy	1	3710.390	Buy		
	9/12/2000	LExit	1	3666.870	Sell	(4352.000)	3410.000
36	9/12/2000	Sell	1	3666.870	Sell		

Summary | Trades | Analysis | Annual | Monthly | Weekly | Daily | Win/Loss | Time | Graphs | Settings

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Figure 8.4: Sample of trades from Nasdaq 100 trend system. Sample trades show mostly smaller losses and one very large profit.

Performance Summary: All Trades			
Total Net Profit	$113,996.000	Open position P/L	$930.000
Gross Profit	$442,547.000	Gross Loss	($328,551.000)
Total # of trades	56	Percent profitable	28 57%
Number winning trades	16	Number losing trades	40
Largest winning trade	$160,730 000	Largest losing trade	($32,936.000)
Average winning trade	$27,659.188	Average losing trade	($8,213.775)
Ratio avg win/avg loss	3.367	Avg trade (win & loss)	$2,035.643
Max consec. Winners	3	Max consec. losers	8
Avg # bars in winners	55	Avg # bars in losers	12
Max intraday drawdown	($131,333.000)		
Profit Factor	1.347	Max # contracts held	1
Account size required	$131,333 000	Return on account	86.80%

Figure 8.5: Performance profile for Nasdaq 100 trend system. Results show a typical conservation of capital profile—many small losses and a few large profits.

Trend systems are considered in a class categorized as *conservation of capital.* The typical profile is many small losses and a few large profits, very similar to this example. If we look further at the return profile of the entire period from August 1997 through March 2003, we can see that the performance of this example is in line with most trend systems:

- The percentage of profitable trades is low—less than 29%.
- The average winning trade was 3.4 times greater than the average losing trade.
- The average losing trades was held for 12 days while the average winning trade was held 55 days.

These statistics show that losses are taken quickly and profitable trades are held as long as possible. It is a profile that has proved successful over time.

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BANDS AND CHANNELS

Thus far, a trend system consists of a buy or sell signal based entirely on the direction of the trendline or a price penetration of the trendline. The trend seems to identify the major price moves, but it often has a series of small losses as prices move sideways at the point where they cross the trendline. The trendline itself might waver up and down slightly before heading off in one direction. It seems reasonable that the time of trend change might be one of indecision in the marketplace. The simplest way to avoid, or *filter*, these price variations is by using a band.

A *band* is an area surrounding a trendline above and below that acts as a zone of commitment for the trader and allows time, as measured by price movement and risk, for prices to settle into their new direction. While *band* is a general term that can be used for all trendlines, it is commonly called a *channel* when it surrounds a straight-line trend, calculated using a linear regression.

Bands can be created in many ways, one of the most popular being a percentage of the current price or the current trendline value. A percentage band that is formed from a moving average trendline will be

(upper band) $B_U = p \times MA_t$

(lower band) $B_L = MA_t/p$

where p = a percentage, expressed as 1.05 for 5%

MA_t = today's moving average value

Therefore, if the moving average value is 75 and the band is 3%, the upper band is 77.25 and the lower band is 72.815. Because the moving average is much smoother than the price series, the band will be uniform around the moving average, narrowing and widening slightly as prices decline and rise.

If the current price P_t is used to calculate the band instead of the moving average trendline, then the formula has more steps,

(upper band) $B_U = MA_t + P_t \times p$

(lower band) $B_L = MA_t - (P_t - (P_t/(1 + p)))$

where p = 5% is expressed as .05. The band will vary in width at a much faster rate using price. If the moving average trendline was 75 but was lagging prices, which were 90, then a 3% upper band would be 77.7 and the lower band 72.37. The band created from prices would show noticeable irregularity as prices moved up and down.

If only a small buffer zone is needed, rather than one that adjusts over time, then a band based on *absolute point value* could be used. For example, stocks trading between $20 and $40 could have a $1 band. If your goal is to avoid a few very small variations around the time of trend change, then an absolute point value band may be the best solution.

Volatility Sensitive Bands

Bands based on price are relatively stable; however, at high prices volatility can be extreme. Creating a band that is more responsive to volatility may improve the reliability of trend signals. The *independent smoothing* of the high and low prices over any calculation period forms a natural *volatility band.* Although it may be practical to use the same smoothing technique or the same time interval (e.g., 10-day or 10% smoothing constant) for the high, low, and closing prices, it is not a requirement. If the same smoothing criterion is used, the band will be uniform with respect to the moving average of the closing price; if not, all three trendlines may weave around one another.

A *volatility function* can also be used to create a band. Rather than the simple percentage calculation, the band may be increased at a multiple of a price—volatility relationship. All of the methods of forming bands are subject to *scaling.* Scaling is accomplished using a value as a multiplier or *scaling factor*; it increases or reduces the sensitivity of any technique used for calculating the band. If S is a scaling factor, then the following bands can be constructed:

$B = M_t \pm S \times c \times M_t$	(percentage smoothing)
$B = M_t \pm S \times c \times P_t$	(percentage smoothing using price)
$B = M_t \pm S \times R$	(fixed risk using absolute point value)
$\left.\begin{array}{l} B_U = S \times f(H_t) \\ B_L = S \times f(L_t) \end{array}\right\}$	(independent smoothing of highs or lows)
$B = M_t \pm S \times (H_t - L_t)$	(volatility of high-low)
$B = M_t \pm S \times V(P_t)$	(volatility function at price level)
$B = M_t \pm S \times V(M_t)$	(volatility at moving average level)

When $S = 1$, the scaling effect is nullified; for $S > 1$, the width of the band is increased; and for $S < 1$, the band width is reduced.

Different bands are not mutually exclusive. A variable band may be used to time the entries and exits subject to a maximum risk established by another band. It may also be convenient to have separate exit and entry bands, the first more sensitive, such that a reversal of position is not always necessary. An exit band may be based on the intraday high or low prices—while entries are determined by closing prices.

Bollinger Bands

Perhaps the simplest and most robust measurement of price volatility is the standard deviation of the prices themselves, calculated over recent price history. Introduced by John Bollinger, bands formed using the standard deviation popularly called *Bollinger bands*.[1] In its normal use, Bollinger bands are combined with other techniques to identify extreme price levels. It is suggested than an intermediate-term trend can viewed using the value of two standard deviations of price changes over the past 20 periods, plotted above and below a 20-day moving average. Because the standard deviation represents a confidence level, and prices are not normally distributed, the choice of two standard deviations equates to an 87% confidence band (if prices were normally distributed, two standard deviations would contain 95.4% of the data).

Figure 8.6 shows Cinergy (CIN) plotted with a traditional Bollinger bands of length 20. You will notice that once the price moves outside either the upper or lower band, it remains on one side the moving average trendline with only a few violations. The width of the band varies considerably with the volatility of prices.

Figure 8.6: Cinergy trend signals using a traditional Bollinger band. Trading signals are much more reliable although they are delayed using the band.

In TradeStation, the upper and lower Bollinger bands can be found with the instructions

```
BBTop = BollingerBand(Price, Length, StdDevUp);
BBBot = BollingerBand(Price, Length, StdDevDn);
```

where *Length* = 20
StdDevUp = +2
StdDevDN= -2

The moving average calculation period and the period over which the standard deviation is calculated are both 20.

Bollinger bands can also be applied effectively to multiple time frames. An excellent example that uses a combination of weekly and daily data applied to the S&P 500 is seen in Figure 8.7. The price pattern follows the weekly Bollinger band higher, where the daily and weekly prices come together during the week of July 14.

Figure 8.7: Combining daily and weekly Bollinger bands. *Source*—Chart created using *The Fibonacci Trader* by Robert Krausz. Used with permission from Fibonacci Trader Corporation, St. Augustine, FL. *www.fibonaccitrader.com*.

Rules for Using Bands

Regardless of the type of band that is constructed, rules for using bands to generate trading signals are limited. The first decision to be made is whether trading strategy is one that is always in the market (a *reversal strategy*), changing from long to short and back again as the bands are penetrated. If so, the following rules apply:

- *Buy* (close out shorts and go long) when the price penetrates (closes above) the upper band.
- *Sell* (close out longs and go short) when the price penetrates (closes below) the lower band.

This technique is always in the market with a maximum risk (without execution costs) equal to the width of the band at the time of entry (see Figure 8.8). Alternately, you may prefer to exit from each trade when prices move into the zone between the bands.

- *Buy* (go long) when prices penetrate the upper band. Close out longs when prices reverse and go below the moving average value (the center of the band).
- *Sell* (go short) when prices break below the lower band. Cover your shorts when prices penetrate upwards through the moving average value.

Figure 8.8: Simple reversal rules for using bands.

The band is then used to enter into new long or short trades, and the actual trendline at the center of the band is used for liquidation. If prices are not strong enough to penetrate the opposite band on the close of the same day, the trade is closed out but not reversed. The next day, penetration of either the upper or lower band will signal a new long or short trade, respectively.

This technique allows a trade to be reentered in the same direction in the event of a false trend change. If a pullback occurs after a close-out while no position is being held (as shown in Figure 8.9), an entry at a later date might be at a better price. A disadvantage occurs when the price changes direction and moves so fast that both the close-out and the new signal occur on the same day. Reversing the position immediately would be better in a fast market.

Figure 8.9: Basic rules for using bands.

The high and low of the day may also be used as penetration criteria. Again using the outer bands for entry and the moving average for exit, apply the following rules:

- *Buy* when the high of the day penetrates the upper band and close out longs when the low of the day penetrates the moving average.
- *Sell* when the low of the day penetrates the lower band and cover shorts when the high penetrates the moving average.

With both the first and second set of rules, risk is limited to half of the full band width. In the second case, the chances of exiting one trade and remaining neutral are greater than the first.

Timing the Order

The type of execution order placed when following a system will effect its results over the long term. The use of a band with a single moving average identifies change of trends when a breakout occurs. Buying at the point of the upside breakout or selling during a downside breakout often results in poor entry prices, and has been known to place the trader in a new trend at the point where prices are ready for a technical correction. The most frequent complaints of trend followers are that their new positions usually show losses and that it takes a long time before the technical correction ends and the new trend returns to its entry price level. In an attempt to overcome these problems, a number of rules can be used:

Buy (or *sell*) on the close after an entry signal has been indicated.

- *Buy* (or *sell*) on the next day's open following a signal.
- *Buy* (or *sell*) with a delay of 1, 2, or 3 days after the signal.
- *Buy* (or *sell*) after a price retracement of 50% (or some other value) following a signal.
- *Buy* (or *sell*) when prices move to within a specified risk relative to a reversal or exit point.

These modifications are for the purpose of entering a new position and seeing an immediate profit or preventing excessive risk. Some of these rules can be categorized as *timing* and others as *risk management.* If intraday prices are used to signal new entries and exits, a rule may be added that states:

Only one order can be executed in one day; either the liquidation of a current position or an entry into a new position.

The goal of improving exit and entry points is well worth spending time and effort. With limited capital, conservation of the investment is important when a large percentage of trades are normally expected to lose money. Better entry points will improve overall performance and increase staying power.

Once you have decided on a timing rule, you must test it carefully. The perception of improvement does not always live up to expectations. In tests on trend-following systems conducted over many years, positions calculated on the close but delayed until the next open improved execution prices about 75% of the time but resulted in smaller overall total profits. Why? Fast breakouts never retraced to allow the trader to enter at a better price. Therefore, while three out of four executions returned a better price, the net improvement was completely offset by the one breakout that kept going.

The Compromise between Reliability and Delay

As with most trading techniques, the benefits of one approach can also have negative factors. The use of a band around a trendline improves the reliability of the trading signal and reduces the total number of signals. The wider the band, the fewer signals. Both of these characteristics are significant benefits. But wider bands mean delayed entries; therefore, you cannot capture as much of the trend and the average profits will be smaller. If the bands are too wide then the average profits can decline to zero. The use of wider bands also means greater risk on each trade. It will be necessary to trade smaller positions or capitalize the account with a larger investment.

These are serious choices that must be made with every trading program. Although there are classic solutions to this problem discussed in Chapters 23 and 24, traders must choose the methods that complement their risk preference.

Bollinger on Bollinger Bands

While most trading strategies buy when there is an upwards penetration of the top band and sell when prices move below the lower band, the use of Bollinger bands is usually mean-reverting, or counter to the price direction. However, this can be unnecessarily risky, especially when prices are volatile. Bollinger recommends confirming a downside penetration using other indicators, primarily those based on volume and market breadth. If prices are moving lower but volume is not increasing and negative breadth is not confirming the downward move, then a buy signal is realistic.[2]

Bollinger uses the concept that volatility is cyclic, but without a regular period. He sees very low volatility as a forecast for high volatility and very high volatility forecasting low volatility. Based on this, a major price rally with dramatically higher volatility, that expands the bandwidth to extremes, should be sold when the bandwidth begins to narrow. This only applies to upwards price moves.

[1]John A. Bollinger, Bollinger Capital Management, Inc. P.O. Box 3358, Manhattan Beach, CA 90266, www.bollingerbands.com.

[2]John Bollinger, "John Bollinger of Bollinger Bands Fame," *Technical Analysis of Stocks & Commodities* (May 2002).

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APPLICATIONS OF SINGLE TRENDS

For any trend technique, the selection of the trend speed (calculation period)—or for regression and charting, the interval over which you will define the trend—is the most important decision in the ultimate success of the trading system. Entry rules and timing improve performance but are considered refinements rather than primary elements. The calculation period determines the frequency of trading and the type of the trend that will be targeted. Deciding the calculation period is more important than the method of identifying the trend. You can be profitable using a simple moving average, regression, breakout, or any other technique—if you can settle on the right time interval.

The previous sections have used examples of calculation periods without any claim that one time interval was better than another. We have discussed that the long-term trend mimics government policy of interest rates or economic growth; therefore, there is good reason to choose a longer calculation period. For most traders, the risk of using this long time frame is unacceptable; they prefer smaller profits and smaller losses associated with faster trading. There are now computer software strategy development programs that make it easy to test a range of calculation periods to find the one that performed best in the past. This technique is called *back-testing* and is discussed in Chapter 21. But the power of the computer is not always as good as simple human reasoning and common sense. The computer is best for validating an idea, not for discovering one.

Before the computer, analysts struggled with the same problem of finding the best calculation period. At first the trend period was based on multiples of calendar periods, such as a week or a month, expressed as trading days. When these technical methods were limited to a small group of analysts, this approach was very successful. Many traders still subscribe to the idea that certain time intervals have value and that trading based on these intervals still has significant impact on the market. The most popular intervals for selection have been: 3 days, the expected duration of a short price move; 5 days, a trading week; 20 to 23 days, a trading month; and 63 days, a calendar quarter. Implied volatility calculations traditionally use 20 days.

More recently, a class of adaptive trends has appeared. These techniques attempt to change the speed of the trend based on a characteristic of price movement, such as volatility or noise. These techniques are another alternative to optimization and are discussed in Chapter 17.

The following sections include classic examples of well-known systems that use one and two trends, as well as a comparison of trading performance of the most popular single-trend techniques that use a broad range of calculation periods.

MPTDI (A Step-Weighted Moving Average)

In 1972, Robert Joel Taylor published a system called the "Major Price Trend Directional Indicator" (MPTDI), which was reprinted in summary form in the September 1973 *Commodities Magazine* (now *Futures*). The system was promoted and implemented through Enterex Commodities in Dallas and was tested in 1972 on historical data provided by Dunn and Hargitt Financial Services in West Lafayette, Indiana. It was one of the few well-defined published systems and served as the basis for much experimentation for current technicians and aspiring analysts.

MPTDI is a moving average with a band. Its unique feature is that the calculation period and band width change based on price volatility, the current trading range. Because the method has distinct trading ranges (called *steps*), the method is called a *step-weighted moving average.* It is unique in its complete dependence on incremental values for all aspects of the system: the moving average, entry, and stop-loss points. For example, Table 8.1 shows what conditions might be assigned to gold.

Table 8.1: MPTDI Variables[*]
Open table as spreadsheet

Average Trading Range	Number of Days in Calculation	Weighting-Factors Progression	Entry Signal Penetration	Approximate Stop-Loss Point
50–150	25 days	TYPE A	100 pts	150 pts
150–250	20 days	TYPE B	200 pts	300 pts
250–350	15 days	TYPE C	250 pts	350 pts
350–450	10 days	TYPE D	350 pts	450 pts
450+	5 days	TYPE E	450 pts	550 pts

[*]100 points = $1 per ounce.

If gold were trading in an average range of 250 to 350 points each day ($2.50 to $3.50 per ounce), the weighting factor for the moving average would be TYPE C, indicating medium volatility (TYPE A is lowest). Using TYPE C with a 15-day moving average, the most recent 5 days are given the weight 3, the next 5 days 2, and the last 5 days are weighted by 1. The buy and sell signals use the corresponding *entry signal penetration* of 250 points above the moving average as a buy signal and 250 below as a sell entry. The highs or lows of intraday trading are used to activate the entry based on values calculated after the close of trading on the prior day. A stop-loss point is fixed at the time of entry

equal to the value on the same line as the selected volatility. The penetration of the stop-loss will cause the liquidation of the current trade. A new signal in the reverse direction will serve as both the exit point for the current trade and the entry point for a new trade.

There is a lot to say in favor of the principles of MPTDI. It is individualized with respect to markets and self-adjusting to changing volatility. The stop-loss serves to limit the initial risk of the trade and allow the coordination of a money management approach. The fixed risk differs from moving averages using standard bands because a moving average and its band can back away from system entry points on a gradual reversal of the price trend. But there are some rough edges to the system. The incremental ranges for volatility, entry points, and stops seem to be a crude measure. Even if they are accurate in the center of the range, they must get doubtful at the extremes where volatility causes a change from one range to another.

MPTDI sets the groundwork for a smoother, more adaptive process. Before such a process can be developed, however, it is necessary to study price movement at discrete levels, such as those shown in MPTDI. From discrete relationships it is possible to generalize a continuous relationship. These methods are covered in Chapter 17.

The Volatility System

Another method that includes volatility and is computationally simple is the Volatility System.[3] Signals are generated when a price change is accompanied by an unusually large move relative to average volatility. If the average volatility measured over *n* days is

$$V_t = \frac{1}{n}\sum_{i=1}^{n} R_{t-i+1}$$

where *R* = the maximum of

a. $|H_i - C_{i-1}|$

b. $|H_i - L_i|$

c. $|L_i - C_{i-1}|$

and H_i = the high on day *i*
C_i = the close on day *i*
L_i = the low on day *i*

Trading rules are given as

- *Sell* if the close drops by more than $k \times V(n)_{t-1}$ from the previous close.
- *Buy* if the close rises by more than $k \times V(n)_{t-1}$ from the previous close.

The value of *k* is generally about 3.0.

Note that the current price change is compared to the previous volatility calculation. Systems that use volatility or breakouts should always compare the new volatility calculation against the previous one, not inclusive of the new value.

The 10-Day Moving Average Rule

The most basic application of a moving average system was proposed by Keltner in his 1960 publication, *How to Make Money in Commodities* (The Keltner Statistical Service, Kansas City, 1960). Of three mechanical systems presented by Keltner, his choice of a moving average was based on performance and experience. The system itself is quite simple: a 10-day moving average based on the average of the daily high, low, and closing prices, with a band on each side formed from the 10-day moving average of the high-low range. A buy signal occurs on penetration of the upper band and a sell signal when the lower band is broken; positions are always reversed.

The 10-day Moving Average Rule is basic, but it does account for the fundamental volatility principle by using the high-low range as a band, and serves as an example of the actual use of moving averages. Keltner expresses his preference for this particular technique because of its identification of minor rather than medium- or long-term trends, and there are some performance figures that substantiate his conclusion. As an experienced trader, he prefers the speed of the 10-day moving average, which follows the market prices with more reasonable risk than slower methods. A side benefit to the selection is that the usual division required by a moving average calculation can be substituted by a simple shift of the decimal place; in an era before the pocket calculator, who knows how much impact that convenience had on Keltner's choice?

Triple Exponential Smoothing

A triple exponential smoothing technique was described by Hutson as another approach to trend following.[4] Substituting the log of the price to account for growth, he applied an exponential smoothing three times using the same smoothing constant. A buy signal was generated when the triple-smoothed trendline rose for two consecutive days; a sell signal followed a two-day decline in the trendline.

The calculation period selected would normally be faster for triple smoothing than for a single smoothed line (less than a 20-day equivalent, when $2/(n + 1)$ is used to convert the *n* days to a smoothing constant). It is interesting to see what actually happens when a series is

smoothed three times. For example, a triple smoothing of a straight 3-day moving average gives the following:

$$P = (P_1, P_2, \ldots, P_t)$$

where P_t = the price on day t

The single moving average at day t is

$$MA_t = \frac{\left(P_{t-2} + P_{t-1} + P_t\right)}{3}$$

Smoothing the new series *MA* gives the double-smoothed series *MA'*

$$MA'_t = \frac{\left(MA_{t-2} + MA_{t-1} + MA_t\right)}{3}$$

$$MA'_t = \frac{\left(P_{t-4} + 2P_{t-3} + 3P_{t-2} + 2P_{t-1} + P_t\right)}{9}$$

and the third smoothing gives

$$MA''_t = \frac{\left(MA'_{t-2} + MA'_{t-1} + MA'_t\right)}{3}$$

$$MA''_t = \frac{\left(P_{t-6} + 3P_{t-5} + 6P_{t-4} + 7P_{t-3} + 6P_{t-2} + 3P_{t-1} + P_t\right)}{27}$$

The effect of the weighting puts increased importance on the middle values, reducing the significance of both ends.

With exponential smoothing the effect of multiple smoothing treats the first, second, third trendlines in the same way as price, giving the most recent calculation the full value of the smoothing constant and reducing the impact of previous smoothing by that same amount. The previous trendlines continue to have some impact on the current value, but at a decreasing rate.

For example, using a smoothing constant of .50, the second exponential smoothing would take the form

$$E'_t = .5E'_{t-1} + \left(.5 - .5^2\right)E_{t-1} + .5^2 P_t$$

The second smoothing, E', gets the full value of the .5 smoothing constant, the first smoothing, *E*, gets reduced by the square of the smoothing constant, and the value of the current price, P_t, is weighted by the square of the smoothing constant. Therefore, the price has the least importance, the first smoothing the next most importance, and the double smoothing the greatest importance. The same pattern holds for the third smoothing.

The Parabolic Time/Price System

One of the primary complaints about trend-following systems is that the built-in lag causes too much of the unrealized profit to be lost. In the Parabolic Time/Price System,[5] Wilder has reduced the lag by increasing the speed of the trend (shortening the days) whenever prices achieve new profitable levels. The philosophy of the Parabolic System is that time is the enemy. Once a position is entered, it must continue to be profitable or it will be liquidated.

The Parabolic Time/Price System is always in the market; whenever a position is closed out, it is also reversed. The point at which this occurs is called the *Stop and Reverse* (SAR). When plotted, the SAR is similar to a trendline although it has a decreasing lag (the distance between the current price and the trendline), as shown in Figure 8.10.

Figure 8.10: Parabolic Time/Price System applied to intraday prices of the ETF SPY.

Begin with a smoothing constant increment, *SI*, suggested by Wilder as .02. The speed of the smoothing will be increased by the value of *SI* each day after a position has been entered. To calculate the SAR value, first assume a long or short position. If the market has recently moved lower and is now above the lows of that move, assume a long position. Call the lowest price of the previous short trade, or the recent lowest price when you begin, the *SAR initial point* (SIP) because it will be the starting point for the SAR calculation ($SAR_1 = SIP$). The entry point for the new long position will be above the SAR_1 value. When entering a new trade, reset the *acceleration factor*, $AF_t = .02$.

While holding a long position, record the highest high price of the trade as *highest*; if the position is short then record the lowest low price as *lowest.* Calculate the current SAR value for long positions using the highest price

$$SAR_t = SAR_{t-1} + AF_t \times (Highest - SAR_{t-1})$$

and calculate the new SAR value for short positions using the lowest price

$$SAR_t = SAR_{t-1} + AF_t \times (Lowest - SAR_{t-1})$$

Notice that *lowest* is always below SAR for short positions, therefore the value that changes SAR becomes negative.

After calculating the new value SAR_t, the smoothing constant *AF* is increased by the incremental value .02 each day that a new high value occurs (for a long position); however, *AF* is not allowed to get larger than .20.

(for a long position) if $high_t > highest$ then $AF_t = AF_t + SI$

As the cumulative value of the smoothing constant gets larger, the SAR value moves closer to the current price in a curve that appears to be parabolic, as shown in Figure 8.10.

The parabolic system is essentially an exponential smoothing where the smoothing constant increases the speed of the trend every day. An additional rule prevents frequent reversals by not allowing the SAR to enter the price range of the most recent two days:

> If *long*, the SAR may never be greater than the low of today or the prior day. If it is greater than this low, set the SAR to that low value. A reversal will occur on a new intraday low that penetrates the SAR.
>
> If *short*, the SAR is calculated in the same way based on the highs.

Wilder's Parabolic Time/Price System embodied a new and interesting idea—varying the exponential smoothing constant. The trend speed

could also be changed by varying the moving average days, but not as effectively. The constant increment of .02 and the limitations of the range, .02 to .20, can both be changed to make the system more or less sensitive to price changes. Traders might want to relate the changing speed to more basic price phenomena, such as volatility or momentum. For those readers interested in the further development of this method, the Parabolic Time/Price System is combined with Directional Movement (described in Chapter 23) to form the Directional Parabolic System, discussed in Chapter 9. The problem of changing the speed of the trend is also the main focus of Chapter 17.

The Master Trading Formula

Another method for varying the trend speed is Mart's *Master Trading Formula.*[6] It uses an exponential smoothing formula where the smoothing constant and band are calculated daily, based on market volatility. Mart averages the daily *true range* (using the maximum range of yesterday's close and today's high and low) and the net price movement over the same interval to define a *correlated volatility factor.* This value is then used to look up a smoothing constant in a modified log-scale table, where an 8% smoothing (24-day equivalent) is used for the lowest volatility and a 33% smoothing (2-day equivalent) for the greatest volatility, with the median value at 14% (13-day equivalent).

A band is also placed around the trendline, based on an inverse relationship to the correlated volatility factor. The band is widest when there is low volatility and the smoothing constant produces a slow trend; it is narrowest in fast, highly volatile markets.

Rules for trading Mart's Master Formula are the same as a channel breakout method. The system is always in the market, taking long positions when the upper band is broken and short positions when the lower band is crossed.

Raschke's First Cross

Although we usually trade a trend from the beginning to end based on some smoothing method, Linda Bradford Raschke has shown that a selected piece of the trend move can be a very reliable trade. It is also necessary to introduce the idea of *momentum*, which will be the subject of the next chapter. Her *First Cross* system enters a trend trade on the first pullback after an initial trend signal based on a faster momentum indicator. Momentum is the subject of the next chapter, but we will use it here as the difference between two trends. To create this program we need

```
slowMA     Slow moving average
fastMA     Fast moving average
osc        Moving average oscillator
trend      Moving average of oscillator
```

The oscillator is the difference between the fast- and slow-moving averages

```
osc = fastMA - slowMA
```

A buy or sell entry signal is a three-step process (comments on right):

B1.	$osc_{t-1} > trend_t$ and $osc_t <= trend_t$	*osc* crosses *trend* moving down
B2.	$low_t > low_{t-1}$	low of the current bar is rising
B3.	buy	
S1.	$osc_{t-1} < trend_t$ and $osc_t <= trend_t$	*osc* crosses *trend* moving up
S2.	$high_t < high_{t-1}$	high of the current bar is declining
S3.	sell	

Although Raschke does not discuss exits, a likely exit rule for the First Cross system should maintain its short-term nature. You might use this method to time an entry into a longer-term trend using the first pullback. Or, you might want to trade only the short period isolated by the first pullback until this initial impulse is exhausted. If you choose the second method, you might try the following sequence for an exit condition:

X1.	$close_{t-1} > close_{t-2}$	close of bar turns up (confirms trend)
X2.	$close_t < close_{t-1}$	the current close turns down
X3.	exit long	

Raschke's idea is an excellent example of selectivity. First, you recognize that the beginning of a trend is different from other times. As traders recognize a change of direction there is an increasingly strong move. Because most systems lag the market, they are often too late or miss the first part of the turn which could create large profits. As an alternative, this technique waits for the first move to be exhausted, then enters in anticipation of another fast surge as the new trend reasserts itself. Once these early moves are over, the general trend move may not be as easy to work with, and you may find yourself trying to enter as the trend comes to an end.

[3]Richard Bookstaber, *The Complete Investment Book* (Scott, Foresman, Glenview, IL, 1984, p. 231).

[4]Jack K. Hutson, "Good TRIX," *Technical Analysis of Stocks & Commodities* (July 1983).

[5]J. Welles Wilder, Jr., *New Concepts in Technical Trading Systems* (Trend Research, Greensboro, NC, 1978).

[6]Donald S. Mart, *The Master Trading Formula* (Winsor Books, Brightwaters, NY, 1981).

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COMPARISON OF MAJOR TREAD SYSTEMS

A section on trends cannot be complete without looking at the comparative performance of the six most popular approaches, both event-driven (discussed in Chapter 3) and time-driven:

1. *MA*, Simple moving average.
2. *EXP*, Exponential smoothing.
3. *LRS*, Linear regression slope.
4. *NDB*, *N*-day breakout.
5. *SWG*, Swing breakout.
6. *PF*, Point-and-figure.

Trading Rules

To see the characteristics of each system, the trading rules will be as simple as possible. Only the basic buy and sell signals will be used. All six systems are always in the market. That is, once they enter a long or short position, they always reverse on a new signal, going from long to short, or short to long. There are no stop-losses or other risk control rules; therefore, each system will show its own, natural risk profile. A $100 round-turn transaction charge was applied to each trade to cover commissions and slippage. Without a transaction charge, the very fast trading systems will show much better results than they can achieve in real trading. Table 8.2 summarizes the type of system, calculation method, and trading rules.

Table 8.2: Summary of Six Major Trending Systems
Open table as spreadsheet

System Type	Formulas	Rules

1. **Simple moving average**
 	
MA is the average of previous *n*-day closing prices.
	`MA = Sum(close,n) / n`
	`MA = Average(close,n)`
	`MAchange = MA - MA[1]`
		`BUY if MAchange > 0`
		`SELL if MAchange < 0`
		
		(the moving average turns up or down)

2. **Exponential smoothing**
 	
EXP is a weighting of the recent closing price by a percentage, *s* (called the *smoothing constant*).
	`EXP=EXP[1]+s*(close-EXP[1])`
	`EXPchange = EXP - EXP[1]`
		`BUY if EXPchange > 0`
		`SELL if EXPchange < 0`
		
		(the trend turns up or down)

3. **Linear regression slope**
 	
LRS is the slope (angle) of a straight line found using a least-squares regression.
	`LRS =`
	
	`n*Sum(x*c) -Sum(x)*Sum(c)`
	`_____`
	`n*Sum(x*x) -Sum(x)*Sum(x)`
	
	where *c* is the *close*, and x are the integers, 1, 2, 3, …, *n*. representing the time intervals.
		`BUY if LRS > 0`
		`SELL if LRS < 0`
		
		Buy when the *LRS* turns up (slope is positive), and *sell* when the *LRS* turns down (slope is negative).

4. ***N*-day breakout**
 	
Signals occur when the current price reaches a new high or low (a "breakout") for either intraday and end of day, based on the previous *n*-days.
	`nhigh =`
	`highest(high[1],n-1)`
	
	`nlow =`
	`lowest(low[1],n-1)`
		`BUY if high > nhigh`
		`  and close > close[1]`
		`SELL if low < nlow`
		`  and close < close[1]`
		
		Buy when the current high price is greater than the highest price of the past *n* days, and the *close* is higher than the previous *close[1]*.

5. **Swing breakout**
 	
Signals occur when the current high or low price exceeds the previous swing high or low price. A swing is a price move that begins with a reversal of a minimum percentage value.
	swhigh is the highest price that occurs before a price decline of $p^*swhigh$, where *p* is a percent.
	
	swlow is the lowest price that occurs before a rally of p^*swlow, where *p* is a percent.
		`BUY if high > swhigh`
		`SELL if low < swlow`
		
		Buy when the current high exceeds the previous swing high. *Sell* when the current low falls below the previous swing low.

6. **Point-and-figure**
 	
Signals occur when the current high or low price exceeds the previous high or low, which is formed by filling boxes of a preset point size.
	Same rules as Swing Breakout, except that new highs and lows are recorded only if they exceed a preset box size. A reversal is recorded if a minimum of 3 boxes can be filled, not including the current box.	`BUY if high > PFhigh + 1 box`
		`SELL if low < PFlow - 1 box`
		
		Buy when the current high exceeds the previous PF swing high by at least one box. Sell when the current low falls below the previous PF swing low by at least 1 box.

Varying the Speed of the Trend

For a fair comparison, each system must be tested with a wide range of fast and slow trends. For systems 1 through 4, the calculation period, or *n* days, determines the trend speed. For the swing breakout, a larger percentage swing makes the trend less sensitive to price movements. With point-and-figure, a larger box size also equates to less sensitivity, or a slower trend. The box size is always multiplied by three to get the reversal size.

Test results shown in Table 8.3 for Eurodollar futures use calculation periods from 4 days to 200 days to include a broad range of trading from very short-term to very

long-term. The number of trades vary from over 500 in 10 years (about 2500 days) to 6 trades in 10 years.

Table 8.3: Eurodollar Results for Six Systems (1985–1994)

Open table as spreadsheet

Systems	Rules
1. Moving average (MA) 2. Exponential smoothing (EXP) 3. Linear regression slope (LRS) 4. Swing breakout (SWG) 5. Point-and-figure (P&F) 6. *N*-day breakout (NDAY)	1. TradeStation closed-out trades only 2. First 200 days used for initialization 3. Commissions and slippage at $100 per trade 4. Test data from 1/1 /84 to 3/31/94 unless indicated 5. TYPE = 0, standard; 1, 3-month rate; 2, bonds

1. MOVING AVERAGE	2. EXPONENTIAL SMOOTHING	3. LINEAR REGRESSION SLOPE
1. No memory of past period. 2. Whips limit minimum number of trades (need filter). 3. Mostly small losses.	1. Some memory of past prices. 2. Whips limit minimum number of trades (need filter). 3. Mostly small losses.	1. Projects direction as mean (economics). 2. Price penetration does not cause whips. 3. Losses can be larger than MA or EXP.

	1. MOVING AVERAGE						2. EXPONENTIAL SMOOTHING						3. LINEAR REGRESSION SLOPE					
	Days	#Prf	#Trds	Rel	Radj%	%/Tr	Days	#Prf	#Trds	Rel	Radj%	%/Tr	Days	#Prf	#Trds	Rel	Radj%	%/Tr
ED	4	131	433	30.3	-79	-0.18	4	136	515	26.4	-88	-0.17	4	171	557	30.7	-90	-0.16
	8	88	274	32.1	51	0.19	8	90	316	28.5	-17	-0.05	8	91	259	35.1	-4	-0.02
	16	51	182	28.0	134	0.74	16	51	214	23.8	44	0.21	16	41	127	32.3	27	0.21
	32	37	111	33.3	566	5.10	32	32	117	27.4	365	3.12	32	21	55	38.2	238	4.33
	50	31	95	32.6	208	2.19	50	25	87	28.7	91	1.05	50	16	39	41.0	216	5.54
	75	17	65	26.2	267	4.11	75	19	73	26.0	135	1.85	75	13	29	44.8	156	5.38
	100	15	43	34.9	281	6.53	100	22	51	43.1	257	5.04	100	5	15	33.3	141	9.40
	150	8	21	38.1	468	22.29	150	12	27	44.4	472	17.48	150	8	11	72.7	279	25.36
	200	9	44	20.5	5	0.11	200	9	42	21.4	5	0.12	200	1	6	16.7	105	17.50
Avg	70.6	43.0	141	30.6	211.2	4.56	70.5	44.0	160.2	30.0	140.4	3.18	70.5	40.8	122	38.3	118.7	7.50
SD				4.9	199.4					7.7	176.7					14.3	114.7	
A-sd				25.7	11.7					22.3	-36.3					24.0	3.9	

4. *N*-DAY BREAKOUT	5. SWING BREAKOUT (type=1)	6. POINT-AND-FIGURE
1. Signals on natural level without memory. 2. Whips mostly on expanding market swings. 3. Risk increases with range.	1. Uses natural levels to give signals. 2. Fewer whips unless expanding market. 3. Risk increases with swing size.	1. Signals on natural level plus filter. 2. Fewer whips unless expanding market. 3. Risk increases with range.

	4. *N*-DAY BREAKOUT						5. SWING BREAKOUT (type=1)						6. POINT-AND-FIGURE					
	Days	#Prf	#Trds	Rel	Radj%	%/Tr	%	#Prf	#Trds	Rel	Radj%	%/Tr	Box	#Prf	#Trds	Rel	Radj%	%/Tr
ED	4	108	283	38.2	84	0.30	0.25	134	381	35.2	-67	-0.18	0.004	126	406	31.0	-78	-0.19
	8	58	143	40.6	240	1.68	0.50	132	371	35.6	-47	-0.13	0.008	124	368	33.7	-60	-0.16
	16	29	77	37.7	188	2.44	0.75	105	279	37.6	36	0.13	0.016	96	275	34.9	-15	-0.05
	32	17	37	45.9	459	12.41	1.00	80	217	36.9	157	0.72	0.025	70	180	38.9	84	0.47
	50	12	27	44.4	347	12.85	1.50	57	137	41.6	69	0.50	0.033	59	147	40.1	133	0.90
	75	8	15	53.3	423	28.20	2.00	34	83	41.0	94	1.13	0.050	34	83	41.0	115	1.39
	100	6	13	46.2	215	16.54	2.50	18	51	35.3	404	7.92	0.067	23	62	37.1	73	1.18
	150	4	7	57.1	431	61.57	3.00	14	33	42.4	375	11.36	0.083	17	40	42.5	337	8.43
	200	1	6	16.7	106	17.67	4.00	10	17	58.8	458	26.94	0.100	11	28	39.3	307	10.96
						17.07	5.00	7	15	46.7	123	8.20	0.133	7	16	43.8	264	16.50
												5.7	0.167	2	10	20.0	-4	-0.40
Avg	70.6	27.0	67.6	42.2	277.0		2.1	59.1	158.4	41.1	160.2					36.6	105.1	3.55
SD				10.9	134.4					6.9	178.4		0.062	51.7	146.8	6.4	121.7	
A-sd				31.3	142.6					34.2	-18.2					30.2	-16.6	

EXPLANATION OF COLUMNS:

Column 1: days, number of days in the calculation period; %, percentage of price for minimum swing criteria; box, box size in points; reversal criteria is 3 x box. Column 2: #Prf, number of profitable trades. Column 3: #Trds, total number of trades. Column 4: Rel, reliability, the percentage of profitable trades. Column 5: Radj%, risk-adjusted 10-year returns, Radj% = PL/MaxDrawdown. Column 6: %/Tr, profit per trade in %.

Different Trend Philosophies

The moving average, exponential, and linear regression are traditional *time-series processes*, that is, each day is a small part of the total calculation. This can make it very difficult for a single large price jump to cause a change in the direction of the trend and, consequently, the trading signal. It also introduces a lag. For very fast trends, each price will have more importance than for slower trends.

The *N*-day breakout, swing breakout, and point-and-figure systems all depend on a price breakout. A signal occurs when the market makes a new high or low for the calculation period. Therefore a single big price move often causes a new signal. Breakout systems can be considered *event-driven*, while a moving average system requires a trend to *evolve.* Because an event-driven system gives a signal at the moment prices make new highs or lows, there is no lag.

Different Risk Profiles

Another way to see the differences and similarities of the six systems is to compare their risk profiles. Even when the returns are similar, the risk of the moving average technique is remarkably different from the breakout methods.

Moving Averages and Exponential Smoothing

Both the moving average and exponential smoothing return a weighted average. The simple moving average uses equal weighting and the exponential gives more importance to the most recent value, according to the percentage smoothing constant, *s.*

Both systems are considered *conservation-of-capital* methods because they keep losses small. When current price levels are trading near the *n*-day average, it takes very little to change the trendline from up to down and back to up. Although this is annoying to traders, it is the conservation-of-capital benefit. Table 8.3 shows that the minimum number of trades were 42 to 44 for these systems, far greater than the other four strategies. The whipsaws tend to increase as the trends become very slow, because prices will get caught moving back and forth through the trendline. This undesirable quality is the reason for using a filter, or band, with most trend systems. In Table 8.3 the number of trades doubled when the trend slowed from 150 to 200 days.

Breakout Systems

The swing breakout, point-and-figure and *N*-day breakout systems can all be grouped as high-risk strategies. Once a buy signal has occurred because of new high prices, the trade is reversed only when new low prices occur. The initial risk at the time of the trade signal is then

Initial breakout risk = Highest high - Lowest low

for the *n*-day period. The rate at which risk declines is different for each of these systems. The swing breakout and point-and-figure systems reduce risk each time a new swing low occurs only if that low is higher than the previous swing low (see Figure 8.11). The *N*-day breakout reduces risk if the oldest day (the nth day), which is dropped off, is also the lowest prices; otherwise, its risk is the same as the other breakout systems.

Figure 8.11: Swing breakout risk patterns. As prices move lower, the swing highs become the point where signals reverse. This pattern is the same for point and figure.

Linear Regression

The linear regression method, which creates a straight-line forecast, is very different from other two classes of trending systems. Although it is calculated as a time series process, unlike exponential smoothing it does not change direction when prices move up or down through the trendline. It can be far less sensitive to change than a moving average. It is possible that a very large, but fast price drop, which recovers quickly, will not cause the slope of the regression line to turn down.

The least squares method puts the greatest importance on those prices closest to the straight-line estimate. The regression line is very sluggish to change direction when a larger number of days is used. Because of this pattern, it can have a mixture of large and small losses. Its statistics fall somewhere in between a traditional moving average and a breakout system.

Frequency of Trades

You might notice that the number of trades varies considerably across systems. This reflects their risk. The longer you hold a trade, the greater the risk exposure. The two smoothing systems (1 and 2) cut losses short; therefore, they show the largest number of trades for a slow trend.

Breakout systems can trade very little if they enter on a new high after a volatile market period. A long position can be held for months waiting for the swing low to move up. An expanding range, one that makes a new high, followed by a new low and another new high, can create a trade with an unpleasantly high risk.

Expectations

Expectations help us recognize when test results are wrong and, even more importantly, when actual trading varies too far from test results. Common sense goes a long way towards keeping your work correct. Consider an engineer who is building a bridge over a large river. The data entry clerk incorrectly enters one value with the decimal shifted to the left one place: The final plans show a 10-foot bridge over a 100-foot river. Fortunately, the engineer had estimated the results and expected an answer between 80 and 120. When different systems are tested for different calculation periods we should have a good idea of the expected results. Fast and slow trading each have their own patterns; breakout and moving averages have distinct risk profiles that could not be switched between the two. Understanding these differences is important to success.

Similar Systems Give Similar Results

We expect the first two systems, the moving average and exponential smoothing, to be very similar in their performance profiles; the last two, swing and point-and-figure,

should also be similar to each other. We expect the *N*-day breakout to have the highest risk because volatility increases over time. The *n*-day high and low should create a much larger range than the most recent swing high and low. Of course, we expect slower systems to be more profitable than faster ones because longer periods reflect fundamental price movements.

For all systems, the rules are nearly the same, buy when the trend turns up and sell when it turns down. You will find that the overall pattern of profitability with respect to the calculation periods is remarkably similar for all trend systems. Therefore, if a trend exists, all of the techniques will be profitable, but each type of trend method will have its own risk profile. We will look to confirm our expectations in the next section where we test a sample of different markets and different trends.

Robust Testing

To get the most value from these tests (an approach covered in detail in Chapter 21), there needs to be as much consistency as possible between tests. The following standards are set:

1. *Test periods.* All markets and all tests covered the same 5-year period, ending May 30, 2003. This is a particularly difficult interval for trend following because it catches the end of the extended bull market, which ended in 2000, and includes three years of erratic, downward price movement. It will show the differences between the techniques much more than if the test included the previous five years of an extremely uniform upwards movement.

2. *Range of trend speeds.* The first four systems, which used the number of days for the calculation period, were tested from 4 to 150. The swing and point-and-figure systems values that produced results including a range from many trades to few trades.

3. *Simple returns.* For these tests, only the simple accumulated returns were used. There were no transaction costs considered. The complete testing process will be discussed in Chapter 21.

4. *Type of results.* Results will show the returns for each type of system over the range of calculation periods. Similarly, we are interested in the number of trades, the profits per trade, and the comparable risk of these techniques.

Which System Is Best?

It all comes down to which system is best. Using the Nasdaq 100 as an example, the price pattern tested is shown in Figure 8.12 and the test results in the six charts in Figure 8.13. The chart at the top left, 8.13a, is an excellent example of the typical comparative results of the first four systems, MA, EXP, LRS, and NBO. The cumulative profit/loss is on the left scale and the calculation period on the bottom. Although there are differences between the individual system results, the overall picture shows a very uniform pattern of returns at each calculation period.

Figure 8.12: Nasdaq 100 test period

Figure 8.13: Test results for trending methods applied to Nasdaq 100 index, NDX, for five years ending May 30, 2003. Charts a–d compare the first four systems, e shows swing and f shows point-and-figure. (a) Cumulative returns. (b) Number of trades. (c) Profits per trade. (d) Maximum drawdown. (e) Swing cumulative returns with number of trades. (f) Point-and-figure cumulative returns with number of trades.

The conclusion that must be drawn from the chart of total NDX returns is that the four trending systems have very similar performance. If there is a trend in the data, then each of the four methods should be profitable. For a specific calculation period, such as 64 days, the LRS method may be slightly better than the others, but it is the worst performer using a 44-day calculation period. These details are the result of minor price patterns that cause varying profits and losses on individual trades. It is the big picture that is important. If there is a trend, then any one of these methods will work; if there is no trend, then none of them will work. If another stock or index is tested and one method showed profits while the other three lost, it is best to conclude that there is no reliable trend, rather than that you have discovered a better method.

Different Risk Profiles

Although the returns in Figure 8.13a are remarkably similar, the four systems can have very different risk profiles. The first indication of this is seen in Figure 8.13b, the number of trades. The MA and EXP techniques are very similar and show nearly identical frequency of trading in the top two lines of the chart. The NBO shows the fewest trades and LRS in the middle for faster calculation periods, but similar to NBO for longer intervals. The MA and EXP trade frequency seems insensitive to the increasing calculation periods because there are periods where the trendlines move nearly sideways, fluctuating up and down by a small amount, causing frequent, small losses. The LRS and NBO approaches are very different. For the NBO, which is easier to visualize, the highs and lows get farther apart as the calculation period gets larger; therefore, it is more difficult to enter a new trade and equally difficult to exit one.

The increased risk and reward of holding the trade longer is shown in Figure 8.13c, where the NBO profits per trade increase sharply as the calculation period increases. The MA and EXP methods show a very small upwards tendency compared to the the dramatic risk in both the LRS and NBO returns. The difference in the number of trades and the size of the indivual trade returns are both the benefit and risk of these systems. It is why some analysts continue to chose the simple moving average while others prefer one of the last two methods. It is not the returns that matter here, but the way in which these returns are achieved.

The maximum drawdown, Figure 8.13d, returns to the pattern similar to Figure 8.13a, although this is not always the case. The individual trade losses using LRS and NBO will be much larger than either MA or EXP; consequently, there will be times when the total drawdowns are much larger. This will be shown in other examples.

Swing and Point-and-Figure Results

Because the SW and PF methods are event-driven, they do not use a calculation period and cannot be placed on the same chart as the first four systems. To decide the trend direction, the swing method uses a percentage price move and the point-and-figure method uses a fixed box size. As these values get larger, the sensitivity of the method decreases, as does the number of trades. This can be seen in Figures 8.13d and 8.13f, where the number of trades is plotted along with the cumulative returns. Because it uses a percentage, the swing method shows a very uniform, classic decrease in the number of trades, while the point-and-figure technique declines steadily but never gets very small.

The return patterns of these two methods are remarkably different for techniques that seem similar. We can explain this by noting that the incremental box size of the point-and-figure method does not work as well as the percentage changes of the swing method as those values get larger. However, point-and-figure has been a technique used by floor traders for a century, and they focus on the very small box sizes, which correspond to the profitable section in Figure 8.13d.

Return Patterns in Other Markets

Remembering that the test period, mid-1999 through May 2003, was an erratic period for many stocks and index markets, it is useful to compare the results of the first four trend systems. Figure 8.14 shows a side-by-side view of the underlying prices and the cumulative returns of the four systems over the range of calculation periods.

(a) Amazon.com prices

(b) Amazon.com returns

(c) General Electric prices

(d) General Electric returns

(e) S&P 500 cash index

(f) S&P 500 cash index returns

(g) Biotech index

(h) Biotech index returns

(i) 10-Year Treasury Notes continuous futures prices

(j) 10-Year Treasury Notes returns

(k) Natural gas continuous futures

(l) Natural gas returns

(m) Gold continuous futures

(n) Gold returns

(o) Soybean continuous futures

(p) Soybean returns

Figure 8.14: Selection of stock, index, and futures with trend system return patterns. It is not always easy to relate the price pattern to its success trading a trend system. For successful trend results the price movement must continue in one direction, but with small price corrections. Larger, erratic correction during a trend will cause whipsaw losses. The broad range of markets show clearly that no one trend method is better than the others all the time. Trend results show a common pattern for each market

An overview of the charts in the right column of Figure 8.14, showing cumulative returns, show that there is a striking similarity in the performance of all four systems, regardless of the market or the price patterns. When one system is profitable, all are profitable. The chart of natural gas returns, (l), shows peak returns from about 24 to 50 days, then steady declines as the calculation interval becomes longer. Both the S&P index (f) and GE (d) have similar patterns, favoring the long calculation periods in order to profit from the steady decline that began in October 2000. Despite what seems to the eye as clear downwards and upwards trends in Amazon.com, none of the trend techniques are able to capture profits across the range of calculation periods. Although the LRS system posts the best returns for calculation periods greater than 60 days, the picture represented by all trend systems is not profitable; therefore, it would be risky to trade any trend method.

Viewing Results by Frequency of Trades

The returns for techniques using a calculation period based on days gives a good picture of performance, but it is also helpful to be able to compare methods, such as the swing breakout, that does not use days as a basis for speed. When we look closely at the pattern of performance, it becomes clear that each technique has a special sensitivity to price movement based on its method of calculation. For example, doubling the swing percentage does not reduce trades as quickly as doubling the days in the *N*-day breakout. This causes the average results of the two systems to rise and fall at a different rate on the chart; in turn, this may cause you to interpret the results

differently. The way to correct this misalignment is to compare returns at the points where the systems have the same number of trades. The same number of trades can be considered the same *price sensitivity.*

Figure 8.15 shows risk-adjusted returns (return divided by risk) for the Eurodollar futures (left scale) plotted against the frequency of trades (bottom scale). Returns for those tests with more trades are at the right and slower trading is at the left. As with the previous charts, the big picture tells the story. Those tests that produced the most trades, greater than 300 over a 10-year period, all posted losses. As the frequency of trading slowed, the profits increased, regardless of the method. As the number of trades increase, moving towards the right on the chart, profits disappear. We can conclude that trending systems, in general, are a robust trading vehicle for Eurodollars over this test period, but only if we take a slower approach.

Figure 8.15: Eurodollar results by total trades. Plotting all systems by total trades (the bottom scale) shows a clear drop in performance as trading becomes more frequent.

Impact of Transaction Costs

The test results shown in the previous sections did not include any transaction costs, such as commissions or execution slippage. Commissions can vary considerably based on the size of the order, and slippage is based on both the order size and the overall trading volume in the market. But the impact of transaction costs can change the pattern of results. One way to visualize this is by looking at the profits per trade rather than the cumulative returns. Profits per trade tell you how much room you have for transaction costs.

Using gold as an example, Figure 8.16 plots both total returns and profits per trade together. It may appear as though there is an opportunity for profit by trading the breakout system for very short calculation periods of four or five days, although the middle periods from 70 to 90 days have a broader area of profits. It is clear from the darker line, profits per trade, that there is not enough room for costs. Gross profits from very fast trading show that the returns on each trade are very small—too small to net profits after transaction costs—while the middle range is slightly improved in terms of the profits per trade.

Figure 8.16: Comparison of net returns and profits per trade. Using the results of the *N*-day breakout (NDB) for gold, the profit opportunity at the very left of the chart disappear when viewed as profits per trade.

Programming the Six Systems

TradeStation EasyLanguage Code

In this example, all six systems are included in a single program, written in TradeStation's EasyLanguage. The individual strategies are written as User Functions rather than separate systems. This adds flexibility, and allows us to use the same programs at another time. A *User Function* is a small program or subprogram which can be referenced (*called*) from other programs. This shared program saves you from repeating the rules and calculations for each new program.

The User Functions perform the unique calculations for each of the six strategies, and they all return the same notation to indicate the action of the specific system

signal = 0, no position
= 1, buy or hold long position
= -1, sell or hold short position

Note that the final statement of the User Function sets the User Function name equal to the value of the signal. Each program also references a variable *type* which indicates that the market being processed is, or is not, an interest rate.

type = 0, not an interest rate market
= 1, discounted interest rate (e.g., Eurodollars, U.S. Treasury bills, U.K. short sterling)
= 2, coupon interest rate, nominally 6% (e.g., U.S. Treasury bonds, U.S. Treasury notes, U.K. Long Gilt, Eurobund)

System

A *system* has buy and sell orders, equity calculations, and other statistics. Parameter values can be set from the appropriate menu. Our systems will reference a User Function to find the signal for each strategy. Because each of the systems would be identical, except for the one line that calls the user function, only one system is shown.

Indicator

An indicator is a program that displays the value of key points or calculations on a chart. An indicator can identify the high and low points of a swing (as in *Kswing*), or show a separate graph on a split page (as in *KLRS*).

```
{ KMA : Moving Average User Function
  Copyright 1994-2004, P J Kaufman. All rights reserved. }

{ period = length of moving average trend
  filter = whole % trend change to give signal
  lag = 0 to enter on close, n to enter n-days later
}
  input:period(numericsimple), filter(numeric), lag(numericsimple);
  vars:ma(0), change(0), signal(0);

  signal = signal[1];
{ moving average for testing anticipation }
  ma = Average(close,period);
  change = (ma - ma[1])*100/close[1];
{ long signal }
  if lag >= 0 and change[lag]>filter then signal=1;
{ short signal )
  if lag >= 0 and change[lag]<-filter then signal=-1;
  KMA = signal;
```

```
{ KEXP exponential User Function
  Copyright 1994-2004, P J Kaufman. All rights reserved. }

{ period = length of exponential trend
  filter = whole percent trend change to give signal
  lag = 0 to enter on close, n to enter n-days later
}
  input:period(numericsimple), filter(numeric), lag(numericsimple);
  vars:exp(0), change(0), signal(0);

  signal = signal[1];
{ Exponential smoothing for testing anticipation }
  Exp = SmoothedAverage(close,period);
  change = (Exp - Exp[1])*100/close[1];

{ long signal }
  if lag >= 0 and change[lag]>filter then signal=1;
{ short signal }
  if lag >= 0 and change[lag]<-filter then signal=-1;
  KEXP = signal;
```

```
{ KLRS : Linear Regressin Slope User Function
Copyright 1994-1998, P J Kaufman. All rights reserved.
Method of least squares to calculate slope }

Inputs: period(numericsimple);
vars: sumx(0), sumx2(0), sumy(0), sumxy(0), n(0), k(0), top(0), bot(0),
slope(0), yint(0);

{ Time = x, the independent variable, e.g., 1, 2, 3, ...
  Close = y, the dependent variable }

{ standard sum of integer series }
  sumx = period*(period+1) / 2;
  sumx2 = period*(period+1)*(2*period+1) / 6;
  sumy = summation(close,period);
  sumxy = 0;
  n = period;
  for k = 0 to period-1 begin
      sumxy = sumxy + n*close[k];
      n = n - 1;
      end;
  top = period*sumxy - sumx*sumy;
```

```
  bot = period*sumx2 - sumx*sumx;
  if bot<>0 then slope = top / bot;
{ yint = (sumy - slope*sumx) / period; }
  KLRS = slope;
```

```
{ KLRSignal : Linear Regression Slope signal User Function
  Copyright 1994-2004, P J Kaufman. All rights reserved. }

{ period = length of exponential trend
  filter = whole % trend change to give signal
}
  input:period(numericsimple), filter(numeric), lag(numeric);
  vars:slope(0), signal(0);

{ Call linear regression slope User Function }
  slope = KLRS(close,period);
  signal = signal[1];
{ long signal : slope is be up by more than filter }

  if lag >= 0 and slope[lag]>filter then signal = 1;
{ short signal : slope is down by more than filter }
  if lag >= 0 and slope[lag]<-filter then signal = -1;
  KLRSignal = signal;
```

```
{ KNDB : N-Day Breakout User Function
  Copyright 1994-2004, P J Kaufman. All rights reserved. }

{ INPUT for N-day Breakout System signal rules:
  BUY when high is above N-day high and close > prior close
  SELL when low is below N-day low and close < prior close }


  input: period(numeric);
  vars: nhigh(0), nlow(0), signal(0);
  nhigh = highest(high[1],period-1);
  nlow = lowest(low[1],period-1);
{ Buy and sell signals }
  signal = signal[1];
  if high > nhigh and close > close[1] then signal = 1;
  if low < nlow and close < close[1] then signal = -1;
  KNDB = signal;
```

```
{ KSWG : User Function to determine swing direction and new swing highs
  or lows
  Copyright 1994-1998, P J Kaufman. All rights reserved. }

{ INPUT for KSWG
  swing in whole percent
  direction & breakout:
      +1 up, +2 up breakout
      0 none
      -1 dn, -2 dnbreakout
  type : 0= normal, 1= 3 month rate, 2= bond
  signal rules:
     buy when upswing is above prior upswing
     sell when downswing is below prior downswing }
input: swing(numeric), type(numericsimple);
vars: minswing(0), last(0) , curhigh(0) , curlow(0), swhigh(0) ,
swlow(0), swingdir(0), signal(0);

minswing = swing*close/100;
if type=1 then minswing = swing*(100-close) / 100;
if type=2 then minswing = swing*(164-close) / 100;
{ SWINGS: Initialize most recent high and low }
if (currentbar = 1)then begin
    curhigh = close;    {current high}

    curlow = close;     {current low}
    end;
{ Search for a new high }
if last<>1 then begin
     if high > curhigh then curhigh = high;    {new current high}
     if low < curhigh - minswing then begin
        last = 1;            {last high fixed}
        swhigh = curhigh;    {new verified high}
        curlow = low;        {initialize new lows}
        end;
      end
{ Search for a new low }
  else begin
    if last <> -1 then begin
        if low < curlow then curlow = low;
        if high > curlow + minswing then begin
           last = -1;
           swlow = curlow;
           curhigh = high; {initialize current high}
           end;
         end;
       end;
{ Buy and sell signals }
  signal = signal[1];
  swingdir = 0;
  if last = 1 then begin
      swingdir = -1;
      if curlow < swlow then signal = -1;
      end;
  if last = -1 then begin
      swingdir = 1;
      if curhigh > swhigh then signal = 1;
      end;
  KSWG = signal;
```

```
{ KPF : Point & Figure User Function
  Copyright 1994-2004, P J Kaufman. All rights reserved. }
```

```
{ INPUT for KMA_PF_System, swing in whole percent
  direction & breakout:
    +1 up, +2 up breakout
    0 none
   -1 dn, -2 dnbreakout
  type : 0= normal, 1= 3 month rate, 2= bond
  signal rules:
     buy when upswing is above prior upswing

     sell when downswing is below prior
         downswing }

input: box(numeric), revboxes(numeric);
vars: minswing(0), last(0) , curhigh(0) , curlow(0), swhigh(0) ,
swlow(0), swingdir(0), signal(0);

{ For percentage calculations:
  minswing = swing*close/100;
  if type=1 then minswing = swing*(100-close) / 100;
  if type=2 then minswing = swing*(164-close) / 100; }
  minswing = box*revboxes;
{ SWINGS: Initialize most recent high and low }
if currentbar = 1then begin
    curhigh = close; {current high}
    curlow = close; {current low)
    end;
{ Search for a new high }
if last<>1 then begin
   if high > curhigh+boxsize then curhigh = high; { new current high }
      if low < curhigh - minswing then begin
         last = 1; {last high fixed)
         swhigh = curhigh; {new verified high}
         curlow = low; {initialize new lows}
      end;
    end
{ Search for a new low }
  else begin
    if last <> -1 then begin
        if low < curlow-boxsize then curlow=low;
        if high > curlow+minswing then begin
           last = -1;
           swlow = curlow;
           curhigh = high; {initialize current high}
           end;
         end;
    end;
{ Buy and sell signals }
  signal = signal[1];
  swingdir = 0;
  if last = 1 then begin
      swingdir = -1;
      if curlow < swlow then signal = -1;
      end;
  if last = -1 then begin

    swingdir = 1;
    if curhigh > swhigh then signal = 1;
    end;
KPF = signal;
```

System

The following system can be used for any of the six methods by changing the braces (comment notation):

```
{ System Signals
  Copyright 1994-2004, P J Kaufman. All rights reserved. }

{ type = 0, default,
         1, 3-month rate
         2, long-term rates
period = length of calculaton
swing = swing filter in whole percent (i.e., 1.5 = 1 1/2 percent)
filter = whole % trend change to give signal
}
input:type(0), period(0), swing(0), box(0), revboxes(0), filter(0),
lag(0);
vars:signal(0);

{ Call User Function }
  signal = KMA(period,filter,lag);
{ signal = KLRSignal(period); }
{ signal = KNDB(period); }
{ signal = KSWG(type); }
{ signal = KPF(box, revboxes); }
  if signal = 1 then buy at close;
  if signal = -1 then sell at close;
```

Indicator

The KMA Swing Indicator plots the high and low swing points above and below the corresponding prices. Select the *scale-by-price* feature.

```
{ KMA SWING: Finds most recent swing
  highs and lows.
  Copyright 1994-2004, P J Kaufman. All rights reserved.

  Inputs for KMA SWING:
  swing = price swing in %
  type = 0, normal; , 3-month rate; 2, bond rate
  index = 0, treat as price;

         1, create index series
}
input: swing(1.5), type(0), index(1);
vars: pcswing(0), last(0), curhigh(0), curlow(0),
      swhigh(0), swlow(0), highbar(0), lowbar(0),
      chighbar(0), clowbar(0), lowp(0), highp(0),
```

```
      aclose(0), ahigh(0), alow(0), xclose(0),
      xhigh(0), xlow(0), factor(1);
pcswing = swing/100.;
aclose = close;
ahigh = high;
alow = low;
factor = 1;
if type 0 then factor = -1;
{ Adjust prices if interest rates }
if type = 1 then begin
    aclose = 100. - close;
    ahigh = 100. - low;
    alow = 100. - high;
    end;
if type = 2 then begin;
   aclose = 164. - close;
   ahigh = 164. - low;
   alow = 164. - high;
   end;
{ Initialize most recent high and low }
if currentbar = 1 then begin
   if index = 0 then begin
        xclose - aclose;
        xhigh = ahigh;
        xlow = alow;
        end
      else begin
       xclose = 100.;
        xhigh = ahigh*100 / aclose;
        xlow = alow*100 / aclose;
        end;
   curhigh = xclose; {current high}
   curlow = xclose; {current low}
   end
   else begin
     if index = 0 then begin
        xclose = aclose;
        xhigh = ahigh;
        xlow = alow;
        end

     else begin
        xclose = xclose[1] + (aclose - aclose[1])*100 / aclose[1];
        xhigh = xclose[1] + (ahigh - aclose[1])*100 / aclose[1];
        xlow = xclose[1] + (alow - aclose[1])*100 / aclose[1];
        end;
      end;
{ Search for a new high - favor reversals }
if last1 then begin
{ Reverse from high if minimum % swing }
   if xlow < curhigh - curhigh*pcswing then begin
     last = 1; {last high fixed)
     swhigh = curhigh; {new verified high}
     highbar = chighbar;
     curlow = xlow; {initialize new lows}
     lowp = low;
     clowbar = currentbar;
     plot1[currentbar-highbar](high[currentbar-highbar]
        + factor*highp*pcswing/4,"swinghigh");
     end
   else begin
   if xhigh > curhigh then begin
     curhigh = xhigh; {new current high}
     chighbar = currentbar;
     end;
   end;
  end;
{ Search for a new low - favor reversal }
if last <> -1 then begin
{ Reversal from low if minimum % swing }
  if xhigh > curlow + curlow*pcswing then begin
     last = -1;
     swlow = curlow;
     lowbar = clowbar;
     curhigh = xhigh; {initialize current high}
     highp = high;
     chighbar = currentbar;
     plot2[currentbar-lowbar](low[currentbar-lowbar] -
        factor*lowp*pcswing/4,"swinglow");
     end
   else begin
     if xlow < curlow then begin
        curlow = xlow;
        clowbar = currentbar;
        end;
     end;
  end;
```

Spreadsheet Code

- In the following Excel code, the "$" precedes a row or column that is fixed (i.e., it does not get copied down).
- Moving average, exponential and *N*-day breakout share the same page, as do the swing breakout and point-and-figure system.
- The price data is not repeated to save space

General description:

A6	Date (YYMMDD)
B6	High price
C6	Low price
D6	Closing price

C3 Test period, swing % or box size

C5 Point and figure number of reversal boxes All data starts in row 7.

```
MOVING AVERAGE
C3   period (e.g., 5 day)
E3   filter (e.g., .10 for OEX data)
Repeated process (copy down)
E11  MA   =avg(D7:D11)
F11  Dir  =if(E11-E10>$E$3,1,if(E11-E10<-$E$3,-1,F10))
G11  Entry=if(and(F11=-1,F10<>-1),"Sell",if(and(F11=1,F10<>1),"Buy"," "))

EXPONENTIAL SMOOTHING
C3   period (e.g. 5 day)
E3   filter (e.g., .10 for OEX data)
G3   smoothing constant 1/($C$3+1)
Initialize
E6   EXP    +D6
Repeated process (copy down)
E7   EXP    =E6+$G$3*(D7-E6)
F7   Dir    =if(E7-E6>$E$3,1,if(E7-E6<-$E$3,-1,F6))
G7   Entry  =if(and(F7=-1,F6<>-1),"Sell",if(and(F7=1,F6<>1),"Buy"," "))

N-DAY BREAKOUT
Repeated process (copy down). There are no constants and no
initialization
E11 Nhigh =max(B6:B10)
F11 Nlow  =min(C6:C10)
G11 Dir   =if(and(B11>E11,D11>D10),1,if(and(C11<F11,D11<D10),-1,G10))
H11 Entry =if(and(G11=-1,G10<>-1),"Sell",if(and(G11=1,G10<>1),"Buy"," "))

SWING BREAKOUT
C3          Minimum swing percentage
E6 CurH     =B6
F6 CurL     =C6
G6 H/L      =if(D6>(E6+F6)/2,-1,1)
E7 CurH     =if($G6=1,if(B7>E6,B7,E6),B7)
F7 CurL     =if(SG6=-1,if(C7<F6,C7,F6),C7)
G7 H/L      =if($G6=-1,if(C7<E7-$C$3*E7,-1,G6),if(B7>F7+$C$3*F7,1,G6))
H7 PrevSwH =if(and(G7=-1,G6=1),E7,H6)
17 PrevSwL =if(and(G7=1,G6=-1),F7,I6)
```

NOTE: The point-and-figure spreadsheet code varies slightly from the TradeStation code. It is a more accurate representation of the exact point-and-figure charting method (favoring reversals when possible).

```
POINT AND FIGURE
C3  Point and figure box size
C5  Number of reversal boxes
E6 CurH     =int(B6/$C$3)
F6 CurL     =int((C6+$C$3)/$C$3)
G6 Dir      =if(D6>(E6+F6)/2,1,-1)

E7 CurH     =if($G6=1,if(int(b7/$C$3)>E6,int(B7/$C$3),E6),int(B7/$C$3))
F7 CurL     =if($G6=-1,if(int((C7+$C$3)/$C$3)<F6,int((C7+$C$3)/$C$3)),
            F6,int((C7+$C$3)/$C$3))
G7 Dir      =if(and(G6=-1,int((B7/$C$3)>F7+$D$3-1)),1,if(and(G6=1,
            int((C7+$C$3)/$C$3)<E7-($D$3-1)),-1,G6))
H7 LastH    =if(and(G7=-1,G6=1),E7,H6)
17 LastL    =if(and(G7=1,G6=-1),F7,I6)
J7 Entry    =if(and(G7=-1,int((C7-$C$3)/$C$3)<I7),"Sell",
            if(and(G7=1,int(B7/$C$3)>H7),"Buy"," "))

LINEAR REGRESSION SLOPE
C3   period (e.g.,5)
E3   filter (e.g. 0)

Initialize
E6   TimeX 1
G   X^2   =E6*E6(copy down)
J   XY    =E6*D6(copy down)

Normal processing (copy down all cells)
E7   TimeX =E6+1
F1   SumX =sum(E6:E10)
G10  X^2   =E10*E10
H10  SumX^2=sum(G6:G10)
I10  SumY  =sum(D6:D10)

J10  XY    =E10*D10
K10  SumXY =sum(J6:J10)
LI0  Slope =($C$3*K10-F10*I10)/($C$3*H10-F10*F10)
M10  Dir   =if(and(L10>$E$3,L9<$E$3),1,if(and(L10<-$E$3,L9>-$E$3),
           -1,M10))
N10  Entry =if(and(M10=-1,M9<>-1),"Sell",if(and(M10=1,M9<>1),"Buy"," "))
```

In order to verify that the correct code was entered into the spreadsheet, Figure 8.17 shows a sample of the opening lines of the spreadsheet using sample data. The columns E, F, G, and H have been repeated for each of the moving average, exponential smoothing and *N*-day breakout systems. In Figure 8.18 this approach has been taken for the swing breakout and point-and-figure systems using the same data.

Open table as spreadsheet

	Data				Moving Average			Exponential			*N*-day Breakout			
Row	A Date	B High	C Low	D Close	E MA	F Dir	G Entry	E EXP	F Dir	G Entry	E *N*high	F Nlow	G Dir	H Entry
6	921231	400.88	396.64	396.64				396.64						
7	930104	398.72	395.71	396.28				396.58						
8	930105	396.50	394.72	395.65				396.43						
9	930106	396.61	394.37	395.78				396.32						
10	930107	396.68	390.26	391.30	395.13			395.48						
11	930108	391.31	387.30	389.93	393.79	-1	Sell	394.56	-1	Sell	400.88	390.26	-1	Sell

12	930111	391.75	389.61	391.16	392.76	-1		393.99	-1		398.72	387.30	-1	
13	930112	391.72	388.25	391.65	391.96	-1		393.60	-1		396.68	387.30	-1	
14	930113	394.11	390.72	393.50	391.51	-1		393.58	-1		396.68	387.30	-1	
15	930114	396.33	393.36	396.25	392.50	1	Buy	394.03	1	Buy	396.68	387.30	-1	
16	930115	400.33	395.75	397.17	393.95	1		394.55	1		396.33	387.30	1	Buy
17	930118	397.47	396.19	397.18	395.15	1		394.99	1		400.33	388.25	1	
18	930119	398.44	394.88	395.92	396.00	1		395.14	1		400.33	388.25	1	
19	930120	397.23	394.01	394.06	396.12	1		394.96	-1	Sell	400.33	390.72	1	
20	930121	395.97	392.67	395.51	395.97	-1	Sell	395.05	-1		400.33	393.36	1	
21	930122	398.11	395.33	396.75	395.88	-1		395.34	1	Buy	400.33	392.67	1	
22	930125	400.99	396.75	400.61	396.57	1	Buy	396.22	1		398.44	392.67	1	
23	930126	403.93	400.49	401.14	397.61	1		397.04	1		400.99	392.67	1	
24	930127	401.23	397.70	399.41	398.68	1		397.43	1		403.93	392.67	1	
25	930128	400.69	398.51	400.40	399.66	1		397.93	1		403.93	392.67	1	
26	930129	401.91	399.14	401.57	400.63	1		398.53	1		403.93	395.33	1	
27	930201	404.84	401.57	404.84	401.47	1		399.59	1		403.93	396.75	1	
28	930202	404.84	402.70	404.19	402.08	1		400.35	1		404.84	397.70	1	
29	930203	408.42	404.19	408.02	403.80	1		401.63	1		404.84	397.70	1	
30	930204	410.02	408.02	409.39	405.60	1		402.92	1		408.42	398.51	1	
31	930205	409.69	407.33	409.39	407.17	1		404.00	1		410.02	399.14	1	

Figure 8.17: Sample spreadsheet results for the moving average, exponential, and *N*-day breakout systems.

Open table as spreadsheet

	Data				S wing B Breakout						Point-and-Figure					
ROw	A Date	B High	C Low	D Close	E CurH	F CurL	G H/L	H SwHi	I SwLo	J Entry	E CurH	F CurL	G Dir	H LastH	I LastL	J Entry
6	921231	400.88	396.64	396.64	400.88	396.64	1	0.00	0.00		200	199	-1	200	0	
7	930104	398.72	395.71	396.28	398.72	395.71	1	0.00	0.00		199	198	-1	200	0	
8	930105	396.50	394.72	395.65	396.50	394.72	1	0.00	0.00		198	198	-1	200	0	
9	930106	396.61	394.37	395.78	396.61	394.37	1	0.00	0.00		198	198	-1	200	0	
10	930107	396.68	390.26	391.30	396.68	390.26	-1	0.00	390.26		198	196	-1	200	0	
11	930108	391.31	387.30	389.93	396.68	387.30	1	396.68	390.26	Sell	195	194	-1	200	0	
12	930111	391.75	389.61	391.16	391.75	387.30	-1	396.68	387.30		195	194	-1	200	0	
13	930112	391.72	388.25	391.65	391.75	388.25	-1	396.68	387.30		195	194	-1	200	0	
14	930113	394.11	390.72	393.50	394.11	390.72	-1	396.68	387.30		197	194	1	200	194	
15	930114	396.33	393.36	396.25	396.33	393.36	-1	396.68	387.30		198	197	1	200	194	
16	930115	400.33	395.75	397.17	400.33	395.75	1	400.33	387.30		200	198	1	200	194	
17	930118	397.47	396.19	397.18	397.47	395.75	1	400.33	387.30		200	199	1	200	194	
18	930119	398.44	394.88	395.92	398.44	394.88	1	400.33	387.30		200	198	1	200	194	
19	930120	397.23	394.01	394.06	397.23	394.01	1	400.33	387.30		200	198	1	200	194	
20	930121	395.97	392.67	395.51	395.97	392.67	-1	400.33	387.30		200	197	-1	200	194	
21	930122	398.11	395.33	396.75	398.11	392.67	-1	400.33	392.67		199	197	-1	200	194	
22	930125	400.99	396.75	400.61	400.99	396.75	1	400.99	392.67		200	197	1	200	197	
23	930126	403.93	400.49	401.14	403.93	396.75	-1	400.99	396.75	Buy	201	201	1	200	197	Buy
24	930127	401.23	397.70	399.41	403.93	397.70	1	403.93	396.75		201	199	1	200	197	
25	930128	400.69	398.51	400.40	400.69	397.70	1	403.93	396.75		201	200	1	200	197	
26	930129	401.91	399.14	401.57	401.91	397.70	-1	403.93	397.70		201	200	1	200	197	
27	930201	404.84	401.57	404.84	404.84	401.57	-1	403.93	397.70	Buy	202	201	1	200	197	Buy
28	930202	404.84	402.70	404.19	404.84	402.70	-1	403.93	397.70		202	202	1	200	197	Buy
29	930203	408.42	404.19	408.02	408.42	404.19	1	408.42	397.70		204	203	1	200	197	Buy
30	930204	410.02	408.02	409.39	410.02	404.19	-1	408.42	404.19	Buy	205	205	1	200	197	Buy
31	930205	409.69	407.33	409.39	410.02	407.33	-1	408.42	404.19		205	204	1	200	197	Buy
32	930208	411.51	408.58	409.62	411.51	408.58	-1	408.42	404.19	Buy	205	205	1	200	197	Buy
33	930209	409.62	406.80	407.78	411.51	406.80	1	411.51	404.19		205	204	1	200	197	Buy
34	930210	408.46	405.77	408.10	408.46	405.77	1	411.51	404.19		205	203	1	200	197	Buy
35	930211	410.90	408.10	409.08	410.90	405.77	-1	411.51	405.77		205	205	1	200	197	Buy
36	930212	409.23	406.26	406.26	410.90	406.26	1	410.90	405.77		205	204	1	200	197	Buy
37	930216	406.26	396.38	397.08	406.26	396.38	-1	410.90	396.38		205	199	-1	205	197	
38	930217	397.30	394.34	396.82	406.26	394.34	1	406.26	396.38	Sell	198	198	-1	205	197	Sell
39	930218	401.01	391.60	396.10	401.01	391.60	-1	406.26	391.60		200	196	1	205	196	

Figure 8.18: Sample spreadsheet results for the swing breakout and point-and-figure systems.

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TECHNIQUES USING TWO TRENDLINES

There are many situations where two trends of different periods can solve a problem better than one. It is often the case that there is a dominant, long-term trend. This trend can be driven by government economic policy, such as lowering interest rates in order to stimulate growth. Trends based on fiscal policy can last for years, and trades that track steadily declining interest rates, declining utility stock prices, or improved returns for companies with high debt, can be very successful. Most traders, however, are not likely to hold a single long-term trade for the full period of its move. Even if convinced of the ultimate outcome of the trade, there can be very large price swings along the way. Many traders would rather enter and exit the market many times, in the direction of the longer-term trend, each time taking a small profit but with much smaller risk. The final result may be smaller total profits, but a much more comfortable risk level for each trade.

The technique of trading in the direction of the long-term trend can be implemented with two simple moving averages or a combination of any two trendlines of different speeds. The slower trendline, using a longer calculation period, identifies the primary trend. The faster trendline is used for timing. It is not a requirement that the faster technique is a trendline; any method that analyzes a shorter time period than the primary trend can be used as a timing device. Typically, a 3-day moving average could act as a timing technique for a 10-day average; however, a delay of one, two, or three days could also be considered as timing an entry or exit. Waiting for a price reversal of one or two days after an initial trend signal might also improve entries when tracking a 10- or 20-day trend.

In this section, we will use the same trending techniques that have already studied to create a system. The longer calculation period will represent the major trend and the shorter period will be used for timing. Consider the idea that a good entry point is when there is a recent short-term surge of prices in the direction of the major trend. To implement this plan, select two moving averages, one noticeably faster than the other, and apply one of the following sets of rules (also shown in Figure 8.19):

- *Buy* when the faster moving average crosses the slower moving average going up. *Sell* when the faster moving average crosses the slower moving average going down.
- *Buy* when the current price crosses above both moving averages and close out long positions when prices cross below either moving average. *Sell* when the current price crosses below both moving averages and close out short positions when prices cross above either moving average.
- *Buy* when the faster trendline turns up and the slower trendline is up. *Sell* when the faster trendline turns down and the slower trendline is down. Exit the trade when the two trendlines are moving in opposite directions.

Figure 8.19: Three ways to trade systems using two moving averages. (a) Enter and exit when the trendlines cross. (b) Buy and sell when the price crosses the trendlines, staying out of the market when prices are between the trendlines. (c) Enter when both trendlines are moving in the same direction; exit when they conflict.

The first set of rules always has a position in the market, results, going from long to short and back again as the faster trend crosses the long-term trend. Of the three techniques, it is the slowest to respond to price change because the fast trendline may need to decline for a number of days before it crosses the slower trendline.

The second and third sets of rules create a *neutral zone*, when prices are between the two trendlines, where no position is held. They both attempt to extract the stronger portion of the price move, where prices are above or below both trendlines. Rule 2 uses a price penetration to create a signal; therefore, it would respond faster than Rule 3. When a price penetration was used for signaling buy and sell signals with one trendline, there tended to be many false signals, where prices moved back and forth across the trendline. With two trendlines that situation is partially eliminated because the position changes from long to neutral; although a small price reversal near the trendline can cause another buy signal.

The third rule has a neutral zone and uses the trend direction, rather than a price penetration, to determine the market position. It will avoid many of the false signals caused by prices, but will be slower to respond than Rule 2.

In order to reduce the problem of whipsaws caused by erratic penetration of the trendlines in Rule 2, yet maintain a faster response to price change than Rule 3, traders have put a small band around each of the trendlines. With this technique

prices move higher through the upper band before a buy signal occurs and then back through the lower band before that signal is reversed. It is a small safety zone that can eliminate the frequency of bad trades in proportion to the size of the band. With this technique you would want the band to be small; otherwise, you will interfere with the natural process that is the benefit of the two trendlines.

Donchian's 5- and 20-Day Moving Average System

The combined use of two moving averages has always been popular among professional advisors. The most well-known is Donchian's 5- and 20-Day Moving Average,[7] a method claiming one of the longest recorded trading histories, beginning January 1, 1961. There is no explanation for the selection of these two values, but in 1961 when moving averages were considered state-of-the-art, they were a reasonable choice. The selections can be justified because of their close relationship to the number of trading days in a week and a month. Even now, the use of calendar periods—such as 21 and 63 days for a month and a quarter, respectively—may pick up trends driven by the action of major fund managers as they rebalance their portfolio each month, and also respond to price direction resulting from quarterly earnings reports.

Donchian's idea is to use a volatility—penetration criterion relative to the 20-day moving average, but with some added complication. The current price penetration must not only cross the 20-day moving average but also exceed any previous 1-day penetration of a closing price by at least one volatility measure. In this way Donchian places a flexible band around the 20-day trendline. One volatility measure can be calculated as the average true range over one or more days.

The 5-day moving average serves as a liquidation criterion (along with others) and is also modified by prior penetration and volatility. These features tend to make Donchian's approach an early rendition of self-adjusting rules. To maintain a human element, Donchian requires execution of certain orders to be delayed a day if the signals occurred on specific weekdays or before a holiday. The combination of different factors is generally the result of refinement over years of actual operation.

The success of a system is a combination of its simplicity and practical application. The successful history of the 5- and 20-Day Moving Average System indicates that two trends selected without testing, combined with a small band to filter false signals, can be the basis for a sound trading method.

[7]Richard D. Donchian, "Donchian's 5- and 20-Day Moving Averages," *Commodities Magazine* (December 1974).

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MORE THAN TWO TRENDS

If two trendlines can improve trading, it should follow that three or more are even better—but it doesn't. With the use of two trendlines, there is a primary trend identifier and a timing device. The addition of another trendline must fulfill a distinct purpose. If Rule 2 for two trendlines was adapted to three trendlines, we would get a buy signal when prices moved above the fastest of the three trendlines and would exit when prices crossed back through any one of the trendlines. The most likely result is that the middle trendline is not used at all. The signals are all produced by the trends of the fastest and slowest trendlines. The results of multiple trendline systems using two and three moving averages are covered in Chapter 21.

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COMPREHENSIVE STUDIES

Because computerized testing programs have made it easy for anyone to test any number of trends in combination, there have been very few comprehensive studies published since 1990. Nevertheless, there is a great deal to learn from putting the results of various systems and markets side by side. Earlier in this chapter there is an informative comparison of six major trending systems; other studies have been included in Chapter 21. Among them are systems similar to the single- and double-moving average methods just discussed as well as the selection of a third trend for entry timing. An important objective of the testing process is the longevity of the parameters selected; this discussion can also be found in Chapter 21.

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SELECTING THE RIGHT MOVING AVERAGE[8]

Up to now, the selection of the *right* moving average, the one that will work in the future, has only been discussed in general terms. The best moving average speed for institutional or commercial participants may be very different from that of an active trader. For example, a mutual fund receives new investments that must be moved into the market, collectively, once or twice each month. In the same way, a cattle feed lot will choose one time each month to preprice new inventory. A 3-day moving average might generate 5 to 10 buy and sell signals in one month, each the result of a 2-day price move—an ineffective tool for either participant looking for just one place to enter the market. A calculation period of 10 days may come closer to generating the one buy signal needed for the fund and one sell signal best for the hedger. The trader is not concerned about the frequency of trades, only the returns and risk.

For the trader or speculator, the *right* moving average speed is the one that produces the best performance profile. This profile could be simply maximum profits, or it could be a more complex combination of profits, equity variation, and time in the market. In Chapter 21, the computerized testing is used to find the combination of speed, stop-loss, and other rules that best satisfy a preset objective; a computer, however, is not always necessary.

Computer testing of a trend system or other trading strategies sometimes leads to solutions that are highly fitted. The computer may find that a three-day moving average was more profitable with lower risk than a 20-day period, which was only slightly worse in performance. Our logic tells us that the results of the 3-day system will be more difficult to attain in real trading because execution costs will have a larger impact. An occasional fast market may cause the execution price to be far off from the price achieved by the system signal. A slower trend selection is more conservative and more likely to return the expected results. Fewer trades, with a longer holding period, have larger profits per trade. They are less affected by poor executions. However, each trader must add common sense and experience to make a reasonable selection.

Dominant seasonal factors are an important influence on the calculation period of the trend. While some stocks, such as travel and leisure, can be highly seasonal, their seasonal price patterns can be overwhelmed by a strong trend in the overall market, as measured by the S&P 500. However, a grain trader knows that the seasonal price pattern forms a complete cycle each year. At best we can expect one long upwards move followed by a shorter, faster decline. Not all trend speeds can capture the profits in this pattern. For example, if the uptrend lasts for six months, a 6-month moving average will not see any of it; therefore, a moving average not much longer than one quarter of the length of the trend, and perhaps shorter, is necessary. If computerized testing of a large range of moving average calculation periods results in a "best" moving average period of six months or more, that choice should be interpreted as a failure to capture the seasonal move and an attempt to trade the much longer year-to-year trend.

Selecting the Trend Speed

Simply looking at a price chart will show the trends of the market. The trends that two traders see is often different. Some traders immediately focus on long-term price trends; others see much shorter movements. To find your own best trend speed without the use of a computer, mark on a chart the beginning and end of each price move that you would like to capture. These trends may occur every few days, or only three or four times each year.

Using a daily price chart of IBM from July 2000 through May 2002 (Figure 8.20), the tops and bottoms of the major price swings that we would like to capture were circled. Noting that each gridline on the chart represents one month, there were eight tops and bottoms over a total period of 22 months. The average price swing was then 2¾ months, nearly one calendar quarter. Because it is so close to a quarterly value, which is the period of earnings reports, we will choose three months as the average swing period. Applying the rule of thumb that the trend can be isolated using a calculation period of one-quarter of the swing period, the moving average period becomes 16 days.

Figure 8.20: Finding the moving average calculation period from the average span of peaks and valleys.

Applying a 16-day moving average system to the two years of IBM price data, buying and selling whenever the trendline changes direction, the trade results are shown in Table 8.4. There are a total of 36 trades, of which 20 were profitable (no transaction costs were used)—a very high percentage for a trend-following system. Total profits were better than $114 per share, on an average share price of about $100, showing that it is not necessary to optimize using a computer to create a successful trading program.

Table 8.4: Performance of 16-Day Moving Average Applied to IBM from July 2000 through May 2002

Open table as spreadsheet

Trade #	Entry Date	Entry Order	Entry Price	Exit Date	Exit Order	Exit Price	Profit/Loss	Total P/L
1	6/29/2000	Sell	114.00	7/20/2000	SExit	117.25	-3.25	-3.25
2	7/20/2000	Buy	117.25	7/24/2000	LExit	112.50	-4.75	-8.00
3	7/24/2000	Sell	112.50	7/25/2000	SExit	112.00	0.50	-7.50
4	7/25/2000	Buy	112.00	9/18/2000	LExit	123.25	11.25	3.75
5	9/18/2000	Sell	123.25	11/9/2000	SExit	99.44	23.81	27.56
6	11/9/2000	Buy	99.44	11/10/2000	LExit	93.00	-6.44	21.12
7	11/10/2000	Sell	93.00	11/13/2000	SExit	97.44	-4.44	16.68
8	11/13/2000	Buy	97.44	11/27/2000	LExit	98.44	1.00	17.68
9	11/27/2000	Sell	98.44	12/5/2000	SExit	103.38	-4.94	12.74
10	12/5/2000	Buy	103.38	12/6/2000	LExit	96.75	-6.63	6.11
11	12/6/2000	Sell	96.75	1/5/2001	SExit	94.00	2.75	8.86
12	1/5/2001	Buy	94.00	2/20/2001	LExit	111.50	17.50	26.36
13	2/20/2001	Sell	111.50	4/5/2001	SExit	98.21	13.29	39.65
14	4/5/2001	Buy	98.21	5/11/2001	LExit	111.81	13.60	53.25
15	5/11/2001	Sell	111.81	5/15/2001	SExit	113.58	-1.77	51.48

16	5/15/2001	Buy	113.58	5/23/2001	LExit	117.40	3.82	55.30
17	5/23/2001	Sell	117.40	5/24/2001	SExit	119.60	-2.20	53.10
18	5/24/2001	Buy	119.60	5/29/2001	LExit	115.27	-4.33	48.77
19	5/29/2001	Sell	115.27	6/5/2001	SExit	1 16.97	-1.70	47.07
20	6/5/2001	Buy	116.97	6/12/2001	LExit	117.25	0.28	47.35
21	6/12/2001	Sell	117.25	6/22/2001	SExit	112.87	4.38	51.73
22	6/22/2001	Buy	112.87	6/25/2001	LExit	112.65	-0.22	51.51
23	6/25/2001	Sell	112.65	7/31/2001	SExit	105.21	7.44	58.95
24	7/31/2001	Buy	105.21	8/6/2001	LExit	106.51	1.30	60.25
25	8/6/2001	Sell	106.51	8/10/2001	SExit	104.95	1.56	61.81
26	8/10/2001	Buy	104.95	8/17/2001	LExit	104.59	-0.36	61.45
27	8/17/2001	Sell	104.59	10/5/2001	SExit	98.02	6.57	68.02
28	10/5/2001	Buy	98.02	1/11/2002	LExit	120.31	22.29	90.31
29	1/11/2002	Sell	120.31	3/4/2002	SExit	105.90	14.41	104.72
30	3/4/2002	Buy	105.90	3/6/2002	LExit	106.30	0.40	105.12
31	3/6/2002	Sell	106.30	3/12/2002	SExit	108.50	-2.20	102.92
32	3/12/2002	Buy	108.50	3/26/2002	LExit	102.90	-5.60	97.32
33	3/26/2002	Sell	102.90	5/22/2002	SExit	84.00	18.90	116.22
34	5/22/2002	Buy	84.00	5/24/2002	LExit	83.10	-0.90	115.32
35	5/24/2002	Sell	83.10	5/28/2002	SExit	82.08	1.02	116.34
36	5/28/2002	Buy	82.08	5/31/2002	LExit	80.45	-1.63	114.71

Another approach to finding the trend period is to consider the worst price retracement. In the IBM chart the move from $87 to $105, beginning in November 2000 and lasting about two months, is the one to avoid. Remembering that a trend is neutralized with regard to a price move when the trend period is the same length as the total move, we apply a moving average of 42 days. This method successfully avoids the price correction and holds the downtrend, but the much slower trend nets a significant loss over the two-year period. It is best to accept the frequent small losses that are natural in a trend-following system than attempt to remove them.

[8]Perry J. Kaufman, "Moving Averages and Trends" in Todd Lofton (Ed.), *Trading Tactics: A Livestock Anthology* (Chicago Mercantile Exchange, Chicago, 1986).

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MOVING AVERAGE SEQUENCES: SIGNAL PROGRESSION

Consider the case where you have selected a 20-day moving average to trade. You enter the day long Biotech and you get a sell signal. However, you are unaware that the 19-day and 21-day moving averages did not get sell signals. This means that the day that was dropped off the calculation 20 days ago caused a slight shift not seen by the other neighboring trends. This can be an important piece of information when assessing the reliability of the trend signal.

A moving average is simply a consensus of direction. It is an approximation of values intended to steer a trader to the right side of the market at the right time. It is most fallible when prices are changing direction or going sideways. Any information that clears up the problem is helpful. For any trend system, it is best to see a steady progression of trend changes from the short term to the long term. This is seen in the following illustration, where *u* is an uptrend and *d* is a downtrend associated with the calculation period above those letters:

Example E1: Orderly Trend Change

Open table as spreadsheet

Moving Average Period in Days																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Trend	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	u	d	d	d	d	d	d

In the example, prices have turned up in such a way that the trend calculation periods 1 through 19 show uptrends, while calculation periods from 20 and higher have not yet turned. Unfortunately, normal price movement is not often as uniform as this example. The shorter-term trends can be very erratic, and often appear in smaller, alternating groups of up and down trends (see Example E2). This is easily explained because adding and subtracting one day when only two, three, or four days are used in the moving average calculation can quickly change the direction of the trend. As you get to longer intervals, such as 20, 30, and 50 days, this is not the case, and in reality, it does not happen often. Yet when it does, the trend change is not to be trusted.

Example E2: Erratic Trend Change for the Short Calculation Periods

Open table as spreadsheet

Moving Average Period in days																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Trend	u	u	d	d	u	d	u	u	u	u	u	u	u	u	u	u	u	u	u	d	d	d	d	d	d

There are also cases where the longer trend begins to reassert itself and the results appear the same as in E1; however, the trend change occurs from the longer-term down (from right to left instead of left to right). The case we must watch for satisfies neither of these, but occurs in erratic pattern, such as in Example E3. Here we see a dominant long-term uptrend with the very short end turning down. Because of another downturn a few days ago, which then disappeared, this most recent downturn also caused a *shadow* turn in the 20-day range. Is it a leading indicator or a false signal? All indications are that smooth changes in a trend are more reliable precursors of change. Another case is given in the second line of E3. Here, the smooth trend change from up to down is occurring from left to right; however, as it gets to 13 days, it also jumps ahead to 19 and 20 days, leaving days 14 through 18 still in an uptrend. For trends in this faster range, it appears best to wait for all fastest trends to change. As the calculation period becomes longer, it is unrealistic to expect all faster trends to be the same; therefore, you will need to settle for an orderly change in a group of trends faster than the target trend period.

Example E3: Progression of Trend Changes

Open table as spreadsheet

Moving Average Period in Days																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Trend	d	d	d	d	u	u	u	u	u	u	u	u	u	u	u	u	u	u	d	d	u	u	u	u	u
Trend	d	d	d	d	d	d	d	d	d	d	d	d	d	u	u	u	u	u	d	d	u	u	u	u	u

An example of this process is shown in Figure 8.21. Moving average calculation periods of 5 to 50 days are shown in increments of five days for a total of 44 consecutive days. This illustration points out how the long-term uptrend (X) is breached by shorter-term, less consistent trends. Perhaps the best trend is the one with the majority of Xs or Os on the same line.

Open table as spreadsheet

Moving Average Period										

Day	5	10	15	20	25	30	35	40	45	50
1	X	X	X	X	X	X	X	X	X	X
2	O	O	X	X	X	X	X	X	X	X
3	O	X	X	X	X	X	X	X	X	X
4	X	X	X	X	X	X	X	X	X	X
5	X	X	X	X	X	X	X	X	X	X
6	X	X	X	X	X	X	X	X	X	X
7	X	X	X	X	X	X	X	X	X	X
8	O	X	X	X	X	X	X	X	X	X
9	X	O	O	O	X	X	X	X	X	X
10	O	O	O	O	O	X	X	X	X	X
11	O	O	O	O	X	X	X	X	X	X
12	O	O	O	O	O	O	O	X	X	X
13	O	O	O	O	X	X	X	X	X	X
14	X	O	O	O	O	O	X	X	X	X
15	O	O	O	O	O	O	O	O	O	X
16	O	O	O	O	O	O	O	O	O	O
17	O	O	O	O	O	O	O	O	O	O
18	O	O	O	O	O	O	O	O	O	O
19	X	O	O	O	O	O	O	O	O	O
20	X	O	O	O	O	O	O	O	O	O
21	X	X	X	O	O	O	O	X	X	X
22	X	X	X	X	O	X	X	X	X	X
23	X	X	X	O	O	O	O	X	X	X
24	X	X	X	X	O	O	O	X	X	X
25	X	X	X	X	O	O	O	X	X	X
26	O	X	X	O	O	O	O	O	O	X
27	O	O	O	O	O	O	O	O	O	O
28	O	O	O	O	O	O	O	O	O	O
29	O	X	X	X	O	O	O	O	O	X
30	X	X	X	X	X	O	O	O	X	X
31	X	X	X	X	X	O	O	O	O	X
32	X	X	X	X	X	X	X	X	X	X
33	X	X	X	X	X	X	X	X	X	X
34	X	X	X	X	X	X	X	X	X	X
35	X	X	X	X	X	X	X	X	X	X
36	X	X	X	X	X	X	X	X	X	X
37	X	X	X	X	X	X	X	X	X	X
38	O	X	X	X	X	X	X	X	X	X
39	O	O	X	X	X	X	X	X	X	X
40	O	O	X	X	X	X	X	X	X	x
41	O	X	X	X	X	X	X	X	X	X
42	X	X	X	X	X	X	X	X	X	X
43	X	X	X	X	X	X	X	X	X	X
44	X	X	X	X	X	X	X	X	X	X

Figure 8.21: Sequences of moving averages.

Averaging the Sequences

The idea of requiring consistency in a range of trends can be automated by selecting a range of calculation periods preceding a *target* period, finding the trend signal (an *uptrend* or *downtrend*), and then deciding according to one of these two rules:

1. Average the final trend values to get the average trend result. Compare the previous average result with the current value to determine the direction of the trend.

2. Scan the trend directions for consistent progression.

When selecting the range of calculation periods, start from 1 if the target period is small (i.e., your intended trend is 15 days). If you are looking at an intermediate trend period, for example, 30 days, you may want to include the range from 20 to 30, or 20 to 32. A few up-and-down price moves that make the short-end erratic should not alter the medium-term trend direction. By extending the calculation periods slightly past the target period you gain confirmation at the cost of a small lag.

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LIVING WITH A TREND-FOLLOWING PHILOSOPHY

The advantages and disadvantages of trend systems are similar to most other types of trading strategies. The first question that a trader should ask is: "What can I expect from a trend approach?" The calculation period of the trend will change the profitability, the size of individual profits and losses, and the reliability of the trading signals. This is covered thoroughly in Chapter 22. Fast trends enter trades on the first strong move that constitutes a price reversal; longer calculation periods take more time to identify a trend change. No matter what speed or how well-timed, a trend signal can never buy at the lows and sell at the highs of a price move; consequently, watching where a trend signal occurs is frustrating. The moving average system will rarely enter or close out a position at just the right place. It can only extract profits from the middle of a trend and hold losses to a minimum. The size of the risk and of the returns are intrinsic to the speed of the trend, although the risk/reward ratio may be similar for many calculation periods applied to the same trend technique.

Trend-following methods have been the simplest, most successful trading methods for decades. It seems fair to conclude that this is the result of price trends created by economic policy and investor anticipation. Economists have proved that it is hard to predict the beginning and end of these trends; however, a trend system simply recognizes that they currently exist and doesn't question why or how long they will last. The success of a particular trend system, as with all other systems, can only be judged by its actual performance; thus, the weekly or monthly accumulated results should be studied to see that they have the same general profile as the expected results collected from historic testing.

Slower trends will lag further behind a sustained price move. Professional traders prefer faster trends and portfolio managers favor the slower ones. Slower trend systems show larger risk; therefore, a diversified portfolio can help offset risks in individual markets with concurrent profits in other markets. The advantage of diversification and long-term trends is that each market will move in the direction of the trend a majority of days, even though that may mean only 6 out of 10. A portfolio of 10 markets, each with a 60% probability of a move in the trend direction, should result in 6 of them moving in a profitable direction. It is more likely that all of them will be profitable on the same day than it is that all will be losers.

When trading only one stock or index market, individual trade risk can be kept small using faster trends. This does not mean that the risk of a faster trend system is necessarily smaller than a slower method. A sequence of small losses can collectively total the same size loss as in one trade of a much slower trend system.

Slower trends are more likely to endure than faster ones. These slower trends often profit from fundamental market changes, such as seasonality, production cycles, and inflation. They stick to a trend while it develops. The faster trends are attempting to catch shifts in market psychology, short-term cycles caused by trading patterns and current events, and wide swings in high-priced, uncertain markets. The patterns that make fast trading profitable also change quickly. A 3-day moving average may be highly profitable for one month, then produce a string of losing trades the next month.

"Take Your Profits and Let Your Losses Run"

One of the oldest market truths is "Take your losses and let your profits run." Trend following succeeds because of the fat tail—the unusually long sustained price moves that yield large profits. These less frequent profits are needed to offset a large number of smaller losses. The nature of the system is to cut losses short, resulting in a majority of small, losing trades. Many traders become impatient with the way a trend system produces its profits, as well as the lag that is intrinsic to its operation.

This impatience leads traders to take preemptive profit-taking, although they are using a trend system. It is inevitable that a trader will want to close out a trade that has a $1,000 profit when the trend change is lagging far behind and would capture only $300 in gains. However, taking profits places an arbitrary limit on the gains of individual trades while the losses remain the same size. That is the same as "take your profits and let your losses run," a method in direct conflict to

the trend-following philosophy. You cannot have both frequent profits and large profits that offset the losses. Don't cut the good trades short.

Using Other Reasons to Exit a Trend Trade

A very long-term trend will often find the direction of the underlying economic fundamentals. For example, interest rates have been declining for nearly all of the 1990s and have continued into 2003. To profit from this move, a slow trend system can track the 10-year Treasury note futures contract, a municipal or corporate bond index, or any number of varying maturity funds. If a 200-day trend were used, then there would be a lag of 100 days. That is, for a bond fund, the current value of the trendline would reflect the bond prices at the midpoint of the calculation period. If interest rates had been steadily lowered at total of 2% during the past year, then the trendline would be lagging about 1% behind current price levels. That can translate into a large loss in unrealized gains.

One advantage of macrotrends is that they are based on a sustained economic policy. If that policy changes then the trend is over, even if the trendline has not yet reversed direction. You can safely exit the position at that time. Considering the example of holding a long position in a bond fund, you have profited from rising bond prices (falling interest rates) intended to offset slow economic growth and high unemployment. At some point the policy will be successful and inflation or overheated growth may be of more immediate importance. The central bank, the Fed, then raises rates (or strongly hints that a rate hike is likely) and signals a shift in policy. You can safely conclude that the justification for the long-term uptrend is over and that the trendline is due to turn down. Because the very slow trend lags far behind the actual market price, it may be six months before the trendline actually signals a change of position. This will occur after a large part of your profits has been given back to the market. Exiting the trade when the fundamentals change would be a safe way of capturing more profits and being exposed to less market risk—provided those fundamentals are the ones that were driving the market and your profits.

The Dilemma of a Two-Trend System

The earlier discussion of a system based upon two trendlines rather than one explained that its advantage was to reduce the risk of trading a slow trend by breaking the longer trades into smaller parts. The total profits may be smaller but the risk is proportionately smaller. The overall characteristics of the two-trend system will be favorable.

The dilemma of a 2-trend system is in deciding which two trends to use. When testing on a computer, there are a number of choices that all appear better than the results of any one trend. The more combinations of trendlines, the more likely there will be results that appear better. To separate the most likely candidates for success from the ones that are simply overfitted, you will need to stay focused on the long-term trend. The purpose of the long-term trend was to align itself with an economic reality. The purpose of the short-term trend was to reduce the risk that is the natural outcome of holding a trade for a long time. For the best chance of success using a 2-trend system, you will need to reject all combinations of trends that make the longer holding period shorter than needed to follow the macro trend. First start by finding the successful long-term trend, then look for shorter trends that make the return and risk profile more acceptable.

Anticipating a Trend Change

Convenience can have hidden costs. When using a trending system with daily data, it is convenient to calculate the new trendlines after the close of trading, giving yourself until the next morning to organize and plan your orders. For faster trend traders this convenience will cost a substantial part of their profits.

Timing is an important part of a trading system; therefore, if the trendline changed direction from down to up as of the market close, then buying the next morning is too late. If the trend was right, the price will most likely gap open higher, offering a worse price than the previous close. For much slower trending systems, the timing of the entry and the size of the expected profits can absorb some of this slippage. However, fast trading with small profits per trade will not survive.

Anticipating the price at which a trendline will change direction is simple; it gives you the opportunity of executing the order concurrent with the trend change at the close of trading. As discussed earlier in this chapter, for a simple moving average of 10 days, the price at which the trendline will change is the price 10 days ago. In general, for an n-day moving average,

$$\text{Price of trend change for an } n\text{-day average} = \text{Price}_{n-10}$$

For exponential smoothing, the last value of the trendline is always the turning point. In the calculation $E_t = E_{t-1} + s \times (P_t - E_{t-1})$, the term $(P_t - E_{t-1})$ turns from positive to negative when the current price, P_t, moves below the previous trend

value, E_{t-1}. Whenever possible, trade as close as possible to the time of the system signal.

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Chapter 9: Momentum and Oscillators

OVERVIEW

The study of momentum and oscillators is an analysis of price changes rather than price levels. Among technicians, momentum establishes the speed of price movement and the rate of ascent or descent. Analysts use *momentum* interchangeably with *slope*, the angle of inclination of price movement as measured using a straight line for the price movement and a horizontal line representing time (Figure 9.1). Momentum is also thought of as *force* or *impact*; it is often considered using terms of Newton's Law, which can be restated loosely as *once started*, *prices tend to remain in motion in a somewhat straight line*.

Figure 9.1: Geometric representation of momentum.

Indicators of change, such as momentum and oscillators, are used as leading indicators of price change. They can identify when the current trend is no longer maintaining its same level of strength, that is, they show when an upwards move is decelerating. Prices are rising, but at a slower rate. This gives traders an opportunity to begin liquidating their open trend trades before prices actually reverse. As the time period for the momentum calculation shortens, this indicator becomes more sensitive to small changes in price. It may be interpreted as a *countertrend* method. The change in momentum, also called *rate of change* or *acceleration*, is even more sensitive and anticipates change sooner.

Before beginning a discussion of various momentum calculations, a brief comment on terminology is necessary to understand how various techniques are grouped together. The use of a single price, such as Microsoft at $25.50 or gold at $350, has no direction or movement implied. We are simply relating a price level and not implying that prices are going up or down.

Next, we describe the speed at which prices are rising or falling. To know the speed, it is not enough to say that the S&P rose three points; you must specify the time interval over which this happened—"the S&P rose three points in one hour." When you say that you drove your car at 60, you really imply that you were going 60 miles per hour, or 60 kilometers per hour. This description of speed, or distance covered over time, is the same information that is given by a single momentum value. Then, if the *daily* momentum of the Nasdaq 100 is + 10, it is rising at the rate of 10 points per day.

The last measure is the change in speed, which is either acceleration or deceleration. The price of AOL may have risen by $1.50 in the past week, indicating an average speed of $1.50/5, or a rise of 30¢ per day; however, it started rising slowly and increase its speed over the week. Perhaps AOL rose 10¢ on Monday, 20¢ on Tuesday, 30¢ on Wednesday, 40¢ on Thursday and 50¢ on Friday, increasing in speed (or "accelerating") by 10¢ each day. This is a very different picture than a constant rise of 30¢ each day. The term rate of change (ROC) will also be used to describe acceleration; when the *rate of change* is zero, we are talking about speed and momentum.

You will see in this chapter that speed is a more sensitive measurement than price level, and acceleration is more sensitive than speed. We will begin with the least sensitive indicator, momentum, increase to acceleration, and then address the variations and applications, including *divergence*, the most popular use of momentum indicators.

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MOMENTUM

Momentum is the difference between two prices taken over a fixed interval. It is another word for *speed*, the distance covered over time. For example, today's 5-day momentum value *M* would be the difference between today's price P_t and the price five days ago:

5-day momentum, $M = P_t - P_{t-5}$

Using notation familiar to many programmers:

5-day momentum = price - price[5]

or

n-day momentum = price - price[n]

where the notation [n] refers to the price *n* days ago.

The momentum value M_t increases as the change in price increases over the 5-day period. Figure 9.1 shows how momentum is related to slope, that is, a greater price increase over the same time interval, ending at price P'_t, will cause the price difference to increase; therefore, the angle *a'* will be greater than angle *a*. For example, if the 5-day change in price is an increase of 100, then the momentum is simply 100, but the speed is 100/5 = 20. If prices increase by 100 points over a 10-day time interval, the momentum would still be 100 but the speed, or slope, would be 100/10 = 10. When calculating momentum, the interval of the calculation must always be stated. To avoid confusion, we state that the 5-day momentum is 20 and the 10-day momentum is 10.

The 5-day momentum, which we will now show as $M(5)_t$ can range in value from the maximum upwards move to the maximum downwards move that the price can make in five days; the momentum is zero if prices are unchanged after five days. For stocks, there is no actual limit on the maximum price range over any time interval. In cases such as Enron, prices could collapse to zero in short order. From a practical view, most stocks and futures markets have a history of volatility that relates to their price level. The higher the price, the greater the price moves. When the price of gold rose to $800 per ounce, the 5-day momentum could have been as high as $100 per ounce. When it fell to $250 and investors lost interest, it may have shown a $1 per ounce change over five days.

Figure 9.2 shows a typical pattern of momentum. Smooth prices are used to make the relationship between price change and momentum clear. During the first 15-day cycle prices rise steadily, peaking on day 9. As prices rise at a slower rate during days 5 through 9 the momentum declines but remains above zero. As long as the 5-day momentum is greater than zero, prices are rising. The highest momentum value occurs on day 3 when prices have the largest positive slope value.

Figure 9.2: Price (top) and corresponding momentum (bottom).

On day 10 the momentum value is zero. Looking at the price chart, this occurs when the 5-day change in price is zero. The lowest momentum value occurs on day 16 when the prices are declining at the greatest negative slope. When prices reach their lowest point the momentum is rising.

If prices always moved in the smooth pattern shown in Figure 9.2, then momentum would be a perfect leading indicator. You could buy when momentum turned up and sell when it turned down, and be ahead of the change in price direction. Unfortunately, prices movement is irregular; consequently, momentum is irregular. Because momentum contains valuable information, we will look at a number of systematic ways to evaluate momentum and improve trading. These focus on extreme momentum values and momentum patterns, all of which have proved to be valuable additions to trading strategies.

Characteristics of Momentum

Momentum is a way of smoothing price movement, and can serve the same purpose as a trend. Although the momentum values are not as smooth as a moving average, larger momentum periods reduce the extremes seen in the price chart. One key advantage of momentum is that it does not have the lag that exists in a moving average.

The AOL chart (Figure 9.3) compares 20- and 40-day moving averages at the top with 20- and 40-day momentum along the bottom. The 40-day (dark line) is smoother and peaks at about the same place as the price. The faster 20-day momentum is not as smooth but peaks sooner than the 40-day momentum and actually leads the price movement. The peaks of the faster momentum represent the maximum price move over a 20-day period. Had prices continued higher at the same rate, the 20-day momentum

would have turned sideways.

Figure 9.3: 20- and 40-day momentum compared to a 20- and 40-day moving average, applied to AOL.

The 20-day and 40-day momentum lines both peak significantly sooner than their moving average equivalents, showing that the speed represented by momentum is a more sensitive measure than the direction of a trendline. The cost of this leading indicator is the increased noise seen in the erratic pattern of momentum compared to the smoothness of the trendline.

Momentum can be used as a trend indicator by selling when the momentum value crosses downward through the horizontal line at zero and buying when it crosses above the zero line. Because there is more noise in momentum than in the equivalent moving average, you would want to draw a small band around the zero line about the width of the small variations in momentum. A sell signal would be given when the momentum falls below the lower band and a buy when it moves upward through the upper band.

Momentum as a Percentage: Rate of Change

Rate of change (ROC) is another way of viewing price change, speed, or velocity. It is distinguished from the previous definition of momentum because it is calculated as a percentage rather than a difference.

$$n\text{-day momentum} = P_t - P_{t-n}$$

$$n\text{-day rate of change} = P_t/P_{t-n} \text{ or } 100 \times P_t/P_{t-n}$$

Rate of change can be expressed as a decimal percentage or whole percentage, whichever is convenient. Rate of change may also be calculated as $(P_t - P_n)/P_n$, which is similar to P_t/P_n; however, this form is not useful for continuous compounding.

Expressing momentum as a percentage helps normalize the high and low momentum values over time. That is, it will automatically adapt to changing volatility. This helps standardize trading rules. Analysts should be aware, however, that *momentum studies* use the difference in price, while *rate-of-change studies* use the percentage calculation.

Momentum as the Difference between Price and Trend

It is common for the term *momentum* to refer to the difference between today's price and a corresponding moving average value, in a manner similar to *beta*, which indicates the relative strength of a stock compared to an index. The properties of this new value are

the same as standard momentum. As the momentum becomes larger, prices are moving away from the moving average at a faster rate. As it moves towards zero, the prices are converging with the moving average.

The upper panel of Figure 9.4 shows a 20-period moving average plotted on a daily chart of Intel during the 14 months ending May 2003. The center panel shows the standard 20-period momentum, the difference between prices that are 20 days apart. The bottom panel is the difference between the price and the 20-day moving average. The range of values for the center panel is approximately +6 to -11, and the scale on the lower panel is +3 to -7. Because a trendline lags behind price movement, the difference between the price and trendline is smaller at points where there are larger price swings and typically larger momentum values.

Figure 9.4: Momentum as *relative strength*, the difference between prices and a moving average (lower panel), compared to the traditional momentum calculation (center panel)

A comparison of the two lower panels of Figure 9.4 also shows that there is a slight shift to the left in the lower panel using the trendline. Therefore, using the price-trendline difference results in the momentum values reaching extremes sooner than the traditional momentum calculation, which could prove to be a trading advantage. This momentum calculation has also been called *relative strength* because it is measured relative to a moving average.

Timing an Entry

Momentum is a convenient way of identifying good entry points based on small price reversals within a trend that are not large enough to change the direction of the trend. By choosing a much shorter time period for the momentum calculation (for example, 6 days) to work in conjunction with a longer trend of 30 to 50 days, the momentum indicator will show frequent opportunities within the trend. The short time period for the momentum calculation assures you that there will be an entry opportunity within about three days of the entry signal; therefore, it becomes a practical timing tool.

Momentum as a Trend Indicator

The momentum value is a smoothing of price changes and can serve the same purpose as a standard moving average. Many applications use momentum as a substitute for a price trend. By looking at the net increase in prices over the number of days

designated by an *n*-day momentum indicator, intermediate fluctuations are ignored, and the pattern in price trend can be seen. The longer the span between the observed points, the momentum calculation period, the smoother the results. This is equivalent to faster and slower moving averages.

To use momentum as a trend indicator, the momentum span is selected and plotted as in Figure 9.5. A buy signal occurs whenever the value of the momentum turns from negative to positive and a sell signal is when the opposite occurs. If a band is used to establish a neutral position or a commitment zone, as discussed in the previous chapter, it should be drawn around the horizontal line representing the zero momentum value.

Figure 9.5: Trend signals using momentum.

In order to find the best choice of a momentum span, a sampling of different values could be tested for optimum performance, or a chart could be examined for some natural price cycle. Identify the significant tops and bottoms of any bar chart and average the number of days between these cycles, or find the number of days that would closely approximate the occurrences of these peaks and valleys. These natural cycles will often be the best choice of momentum calculation interval (Figure 9.6a). Momentum and oscillators, however, are just as often used to identify abnormal price movements and for timing of entries and exits in conjunction with a longer-term trend.

Figure 9.6: Relationship of momentum to prices. (a) Tops and bottoms determine momentum value. (b) Corresponding momentum.

Identifying and Fading Price Extremes

An equally popular and more interesting interpretation of the momentum chart is based on an analysis of tops and bottoms. All momentum values are bounded (although somewhat irregularly) in both directions by the maximum move possible during the time interval represented by the span of the momentum. The conditions at the points of high positive and negative momentum are called *overbought* and *oversold*, respectively.

A market is *overbought* when it can no longer sustain the strength of the current upwards trend and a downward price reaction is imminent; an *oversold* market is ready for an upward move. Faster momentum calculations (those using shorter calculation periods) will reach these maximum values more often and stay there for extended periods of high upward or downward momentum. The use of a large momentum period, however, will produce values that rarely test its limits. If the momentum system uses the horizontal zero line to enter and exit trades, it is of no consequence how often the bounds are touched; once a position is entered, the high momentum condition serves as positive reinforcement for the trade. However, the maximum positive and negative momentum values can be measured and used to anticipate the end of a trend. For this purpose, momentum values that are too fast will obscure the trading signals—the momentum value must be allowed to reach its full value.

A system can take advantage of the momentum extremes by *fading the price movement* (selling rallies and buying declines). This is done by drawing two horizontal lines on the momentum chart (Figure 9.6b) above and below the zero line in such a way that the tops and bottoms of the major moves are isolated. These lines may be selected visually so that once the line is penetrated, prices reverse shortly afterwards. Another selection might simply be based on a percentage of the maximum possible momentum value. A third statistical approach would be to use a multiple of the standard deviation of momentum values to position the horizontal lines above and below the zero momentum line. Using two standard deviations would position the lines so that about 5% of all momentum values penetrate above and below the two horizontal lines.

When positioning these bands, there is always a trade-off between finding more trading opportunities and entering the market too soon. This can be a complicated choice and is discussed in "System Trade-Offs" in Chapter 22. Once these lines have been drawn, the basic trading rules will be one of the following:

- *Aggressive.* Enter a new long position when the momentum value penetrates the lower bound; enter a new short position when the value penetrates the upper bound.

- *Minor confirmation.* Enter a new short position on the first day the momentum value turns down after penetrating the upper bound (the opposite for longs).
- *Major confirmation.* Enter a new short position when the momentum value penetrates the upper bound moving lower (the opposite for longs).
- *Timing.* Enter a new short position after the momentum value has remained above the upper bound for *n* days (the opposite for longs).

To close out a profitable short or long position there are the following alternatives (the rules are symmetrical for longs and shorts):

- *Most demanding.* Close out long positions or cover shorts when the momentum value satisfies the entry condition for a reverse position.
- *Moderately demanding.* Cover a short position when the momentum penetrates the zero line, minus one standard deviation (or some other target point partway between the zero line and the lower bound).
- *Basic exit.* Cover a short position when the momentum value becomes zero.
- *Allowing an extended move.* Cover a short position if the momentum crosses the zero line moving up *after* penetrating that line moving down.

The *basic exit*, removing your trade when the momentum reaches the zero line, should be your first choice. It is based on the conservative assumption that prices will return to the center of the recent movement. It is less reasonable to assume that prices will continually move from overbought to oversold and back again. Most statisticians would agree that the mean is the best forecast of future prices, and the zero momentum value represents the *mean*. You may try to increase the profits by assuming that the momentum value will penetrate the zero line by a small amount because there is always a level of noise. However, if you require a larger penetration of zero to cause an exit, many of the exit opportunities will be lost.

Risk Protection

A protective stop-loss order should be used whenever you trade against the current price momentum. This is most important with the *aggressive* entry, which advocates selling when the momentum value moves above the upper threshold line, regardless of how fast prices are rising. While the other entry options allow for a logic positioning of a stop-loss, entry 1 does not. You will simply need to decide, based on historic momentum values, where to limit your risk. With the other entry options, stops may be placed using one of the following techniques:

- Place a protective stop above or below the most extreme high or low momentum value.
- Follow a profitable move with a trailing, nonretreating stop based on fixed points or a percentage.
- Establish zones that act as levels of attainment (using horizontal lines of equal spacing) and do not permit reverse penetrations once entered.

Risk protection must be flexible in the way it deals with volatility. As prices reach higher levels, increased volatility will cause momentum tops and bottoms to widen; at lower levels, prices may not be active enough to penetrate the upper or lower bounds. A wide penetration level established when technology stocks were at their peak in 2000 would not give any signals in 2003. The narrow thresholds set for coffee when prices were 50¢ per pound with a maximum daily trading range of 2¢ would not work with coffee at $2.50 per pound and volatility of 4¢ per day—every trade would be stopped out. Therefore, both the profits and risk of a trade entered at extremes must increase with volatility and higher prices. Stops could be based on a percentage of price or a multiple of volatility.

Entry option 1 remains the greatest problem for controlling risk, where a short signal is given when prices are very strong. If an immediate reversal does not occur, large open losses may accrue. To determine the proper stop-loss amount, a computer test was performed using an immediate entry based on penetration of an extreme boundary and with a stop-loss at the close of the day for risk protection. The first results were thought to have outstanding profits and consistency until it was discovered that the computer had done exactly the opposite of what was intended—it *bought* when the momentum crossed the upper bound and placed a close stop-loss *below* the entry. It did prove, for a good sampling of futures markets, that high momentum periods continued for enough time to capture small but consistent profits. It also showed that entry rule 1, anticipating an early reversal, would be a losing strategy. One should never forget that declining momentum does not mean that prices are falling.

Profit Targets for Fading Extreme Moves

The most reasonable exit for a short entered at an extreme momentum high, or a long position entered at a low, is when the momentum returns to near zero. Prices do not have an obligation to go from extreme lows to extreme highs; however, any extreme can be expected to return to normal, which is where momentum is zero.

Returning to zero does not mean that all trades will be profitable. If there has been a strong upwards move that lasted longer than the calculation period of the momentum, then prices will be higher when momentum finally returns to zero. Depending on the extent of the move in terms of price change and time, the final price level where momentum becomes normal could be higher than the short sale entry level.

The number of profitable trades can be increased by targeting a momentum level that is more conservative than zero. That is, if a long was entered at an extreme low, a sell would be placed 5% or 10% below the zero momentum line, based on the distance between the buying threshold line and zero. Trades that *almost* return to normal would then be closed out with profits, although the average size of the profit would be smaller. To increase the size of the profits per trade you would target the opposite side of the zero momentum line; therefore, if you held a long position you would wait until the momentum value was greater than zero by 5% or 10% of the range. The success of taking profits early or late depends on the amount of noise in the momentum values as it fluctuates near the zero value. In many cases where extreme prices are followed by a sideways pattern, momentum will fluctuate around zero so that there is ample opportunity to exit the trade with a better price.

High-Momentum Trading

Some professional traders have made a business of trading in the direction of the price move only when momentum exceeds the *high threshold level* rather than anticipating a change of direction. There is a small window of opportunity when prices are moving fast. They will usually continue at the same, or greater, momentum for a short time, measured usually in minutes or hours. There is a lot of money to be made in a short time—but at great risk if prices reverse direction sooner than expected.

Price patterns have changed over the past 10 years. There are many more day traders. When one stock breaks out above a previous high, everyone sees it as an opportunity for profit. Buy orders start to flow and volume increases. Stocks that are normally ignored can attract large volume when prices make a new high. Traders ride the rising prices for as long as possible, watching to see when volume begins to drop, then they exit. Some may just target a modest profit and get out when that target is reached.

High-momentum trading is a fast game that requires tools that allow you to scan a wide range of stocks. You are looking for one that has made a new high after a long, quiet period. You may also constantly sort stocks by the highest momentum values. You need to stay glued to your screen; enter fast, and exit fast. It is a full-time commitment.

Moving Average Convergence/Divergence (MACD)

Many of the practical problems of fading prices using momentum are solved with the *Moving Average Convergence / Divergence* (MACD),[1] developed by Gerald Apple. The MACD uses momentum calculated as the difference between two trends, produced using exponential smoothing. This momentum value was further smoothed to give a signal line. The most common presentation of MACD uses the difference between a 12-day and 26-day exponential smoothing. The *signal line*, used to produce trading recommendations, is a 9-day smoothing of today's MACD subtracted from today's MACD. The MACD can be created as follows:

> *Step 1:* Choose the two calculation periods—for example, slow=40, fast=20. Calculate the percentage smoothing values using $2/(N + 1)$, where N is 40 or 20.
>
> *Step 2:* Calculate the slow trendline using the smoothing value .0243.
>
> *Step 3:* Calculate the fast trendline using the smoothing value .0476.
>
> *Step 4:* The *MACD line*, the slower oscillating line in the bottom panel of Figure 9.5, is calculated as the fast trendline minus the slow trendline. When the market is moving up quickly the fast smoothing will always be above the slow and the difference will be positive. This is done so that the MACD line goes up when prices go up.
>
> *Step 5.* The *signal line* is the 9-day smoothing (using a percentage of .10) of the MACD line. The signal line is slower than the MACD; therefore, it can be seen in the bottom panel of Figure 9.7 as the lower line when prices are moving higher.

Figure 9.7: MACD for AOL. The *MACD line* is the faster of the two trendlines in the bottom panel; the *signal line* is the slower. The histogram is created by subtracting the slower signal line from the MACD line. This histogram shows the relative strength or weakness of the MACD compared to the signal line.

In TradeStation code, the function *SmoothedAverage* refers to an exponential smoothing and the MACD is created as

```
MACD = SmoothedAverage(close,12) - SmoothedAverage(close,26)
signalline = MACD - SmoothedAverage(MACD,9)
```

The 20- and 40-day momentum lines, corresponding to the MACD line and the histogram, are shown in the center panel of Figure 9.7. It is clear that the MACD process smoothes these values significantly; therefore, it makes trading signals easier to see.

Reading the MACD Indicator

The MACD is normally seen as it appears at the bottom of Figure 9.5. The MACD line is higher in an uptrend and lower in a downtrend. The histogram is created by subtracting the slower signal line from the MACD line. When the histogram is above zero it confirms the uptrend.

The 40/20 MACD line is similar to the 40-day momentum line. We can compare the MACD in the lower panel with the 20- and 40-day momentum in the center panel and see that the peaks and valleys are in about the same place, but the MACD line is much smoother. The MACD is a variation of momentum because it is the difference between two trendlines.

You should note the point at which the MACD and signal lines turn down in May 2001, compared to the corresponding moving averages that are shown with prices in the top panel of the chart. The MACD leads the moving averages in showing the downturn and has only slightly more up-and-down variation in its values. The signal line, a 3-day smoothing of the MACD also leads the moving averages in the downturn and is equally as smooth.

Trading the MACD

The most common use of the MACD is as a trend indicator. For this purpose, only MACD and signal lines are used in the following way:

Buy when the MACD line (faster) crosses upwards through the signal line (slower).

Sell when the MACD line crosses from above to below the signal line.

In the bottom panel of Figure 9.7, the buy signals that occur right after an extreme low in April and October of 2001 generated large gains. Unfortunately, there were many other crossings that generated losses; therefore, it is necessary to select which trades to enter. As in the previous discussion of fading extreme momentum, threshold levels were established at historically high and low momentum values, and horizontal lines are shown at the +2.00 and -2.00 momentum values. In Figure 9.7, sell signals would have been taken only after the MACD value had been above +2.00, and buy signals only when the MACD value had fallen below -2.00. The trading signals that satisfy these conditions are the *buy* signal in April, a *sell* in May, and a *buy* in October.

In this case, the threshold lines are based on observing the MACD movement for less than one year, and *fitting* the threshold lines to the MACD values. This method is guaranteed to be successful for Figure 9.7, but may not work well at other times. If prices are less volatile in the future there may not be any MACD values that penetrate above or below the threshold lines. If prices are more volatile there may be false signals above and below the thresholds. Using a much longer time period for your chart will also give you a better view of the possible range of MACD values.

Selecting the best threshold levels is a difficult problem. The most practical solution may be to make a judgment as to the price level and volatility of the next six months and determine the threshold levels based on historic data showing the same profile. Or, you can monitor the current levels and change them slowly as you see price volatility getting higher or lower.

The purpose of the threshold levels is to buy or sell after momentum has reached a relative extreme. This may also be accomplished by combining the MACD with major support and resistance levels drawn on a chart. If prices near a major resistance level as they move higher, then slow, look for the first MACD sell signal.

An equally important use of MACD is for divergence signals. *Bearish divergence* occurs when prices are rising but the MACD values are falling. Because this technique applies to many indicators in addition to the MACD, it is covered in detail in the section "Divergence" towards the end of this chapter.

[1]From John D. Becker, "Value of Oscillators in Determining Price Action," *Futures* (May 1994).

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OSCILLATORS

Because the representation of the momentum index is that of a line fluctuating above and below a zero value, this technique has often been termed an *oscillator*. Even though it does oscillate, the use of this word is confusing. In this presentation, the term *oscillator* will be restricted to a specific form of momentum, or rate-of-change indicator, which is *normalized* and expressed in terms of values that are limited to the ranges between +1 and -1, +1 and 0, or 100 and 0 (as in percent).

To transform a standard momentum calculation into the normalized form with a maximum value of +1 and a minimum value of -1, divide the momentum calculation by its maximum attainable value. As we have already discussed, there is a practical maximum value but not a guaranteed maximum. For example, we could look at the highest 5-day momentum for AOL in the history of its trading and find that it moved about $20 in mid-December 1999 when the price was close to $100. To be safe, we could assume a $25 maximum. However, 5-day price moves in 2003 are likely to be closer to $1 while AOL trades at $10. The maximum normalized momentum value now is likely to be in the range of +.2 to -.2. It is unlikely to see values much higher in the near future.

Because of extreme changes in price levels and volatility over the years, it is not practical to create an oscillator based on a fixed historical maximum. Most oscillators use *rolling values*, that is, they divide the current value by the maximum value over that past, for example, 20 days. Although the time interval of the divisor may vary, the use of a rolling calculation causes the oscillator value to self-adjust to changes in price or volatility. As seen in the AOL example, when AOL was at about $100 it posted a 5-day price change of $20. At $10, it posted a 5-day change of $1. Considering exceptionally high volatility at exceptionally high prices, there may be a consistent 15% maximum volatility for AOL across the years.

The following sections show how a number of useful oscillators are calculated. In each case, the purpose is to have the indicator post high values when prices are at a peak and low values when they are in a valley. Prices should reverse direction soon after the oscillator records values near its extremes.

Relative Strength Index

One of the most popular indicators for denoting overbought and oversold conditions is the *Relative Strength Index* (RSI) developed by Welles Wilder.[2] It provides added value to the momentum concept by scaling all values between 0 and 100. It is more stable than momentum because it uses all the values in the calculation period rather than just the first and last. It is a simple measurement that expresses the relative strength of the current price movement as increasing from 0 to 100. It is calculated as

$$RSI = 100 - \left(\frac{100}{1+RS}\right) = 100 \times \left(\frac{RS}{1+RS}\right)$$

where

$$RS = \frac{AU}{AD}$$

AU = the total of the upwards price changes during the past 14 days

AD = the total of the downwards price changes (used as positive numbers) during the past 14 days

Once the first calculation has been made, both the *AU* and *AD* values can be calculated daily using an *average-off* method:

$$AU_{\text{today}} = AU_{\text{prior}} - \frac{AU_{\text{prior}}}{14} + Today's\ upwards\ price\ change$$

$$AD_{\text{today}} = AD_{\text{prior}} - \frac{AD_{\text{prior}}}{14} + Today's\ downward\ price\ change$$

This method essentially drops an average value and adds the new value, if any. All price changes are treated as positive numbers. The daily calculation of the RSI becomes a matter of simple arithmetic. Wilder has favored the use of the 14-day measurement because it represents one-half of a natural cycle. He has set the significant threshold levels for the RSI at 30 and 70. The lower level is indicative of an imminent upturn and the upper level of a pending downturn. An example of an RSI plot is shown along with the stochastic indicator in the next section.

Use of the RSI often requires interpretation in the manner of standard chart analysis. Lines are drawn across the tops of the RSI values to indicate a downtrend. A plot of the RSI can be interpreted in the same manner as a bar chart, with the head-and-shoulders formation as the primary confirmation of a change in direction. Wilder himself used the RSI top and bottom formations shown in Figure 9.8. A break of the reaction bottom between the declining tops is a sell signal. In addition, the *failure swing*, or divergence (discussed later in this chapter), denotes an unsuccessful

test of a recent high or low RSI value.

Figure 9.8: RSI top formation.

Wilder created other popular indicators. One of these is a momentum calculation call the *Average Directional Movement* (ADX). The ADX is a byproduct of the *Directional Movement* and is discussed in Chapter 23.

Modifying the RSI

An obvious objection to the RSI might be the selection of a 14-day *half-cycle*. Maximum divergence is achieved by using a moving average that is exactly one-half the length of the dominant cycle, but 14 days may not be that half-cycle. If a 14-day calculation period is too short, then the RSI would remain outside the 70-30 zones for extended periods rather than signaling an immediate turn. In practical terms, a 14-day RSI means that a sustained move in one direction that lasts for more than 14 days will produce a very high RSI value and is likely result in losses if a short position was entered. If the RSI shows high and low values frequently, then increase the overbought and oversold levels by moving them from 70-30 to 80-20. This will cause a signal to be given at a more extreme level.

The generalized program code for an *n*-day RSI, without using the average-off method, is

```
sumup = 0;
sumdn = 0;
for i = 1 to n begin
    if close - close[i] > 0 then
       sumup = sumup + close - close[1]
       else sumdn = sumdn + close[1] - close;
    end;
RSI = 100 - (100 / (1 + (sumup/sumdn)));
```

A study by Aan[3] on the distribution of the 14-day RSI showed that the average RSI top and bottom value consistently grouped near 72 and 32, respectively. Therefore, 50% of all RSI values fall between 72 and 32, which can be interpreted as *normally distributed*, equivalent to. 675 standard deviations. This would suggest that the 70-30 levels proposed by Wilder are too close together to act as selective overbought/oversold values, but should be moved farther apart.

The frequency at which the market will reach these extreme levels can be adjusted by changing the 14-day calculation period. If the interval is shortened, the RSI will reach extremes more often and trades will have higher risk. If the time period is increased, there will be safer but fewer trades based on RSI extremes (discussed in more detail in Chapter 17). It is always safer to err on the side of less risk. If there are too many trades being generated by the RSI, a combination of a longer interval and higher confidence bands will be an improvement.[4]

Further Smoothing with *N*-Day Ups and Downs

Instead of increasing the number of days in the RSI calculation period, a smoother indicator can be found by increasing the period over which each of the *up* and *down* values are determined. The original RSI method uses 14 individual days, where an *up day* is a day in which the price change was positive. Instead, we can replace each 1-day change with a 2-day change, or an *n*-day change. If we use 2-day changes, then a total of 28 days will be needed, so that each 2-day period does not overlap another; there will be 14 sets of two days each. Using 14 sets of 2 will give a smoother indicator than using 28 single-day changes.

Net Momentum Oscillator

Another variation on the RSI is the use of the difference between the sum of the up days and the sum of the down days, called a *net momentum oscillator*.[5] If you consider the unsmoothed $RSI = 100 \times (S_u/(S_u + S_d))$ then the net momentum oscillator would be $CMO = 100 \times (S_u - S_d)/(S_u + S_d)$. This method replaces some of the indicator movement lost to smoothing in the normal RSI, and shows more extremes. This may also be done by shortening the number of periods in the RSI calculation.

Stochastics

The *stochastic* indicator, created by George Lane, is an oscillator that measures the relative position of the closing price within a past high—low range. It is based on the commonly accepted observation that closing prices tend to resist penetrating the high prices of the past few days, the

place where a horizontal resistance line would be drawn on a chart. Similarly, in a downtrend prices must be able to close below the lows of the past few days. When the market is about to turn from up to down, for instance, it is often the case that the highs are higher than previous days, but the closing price settles nearer the low of the day, failing to indicate a continuation of the uptrend. This makes the stochastic oscillator different from most oscillators which are normalized representations of the *relative strength*, the difference between the closing price and a selected trend speed. The stochastic also uses the high, low, and closing prices, while the RSI only uses the closes.

The three indicators that result from the stochastic measurement are called *%K*, *%D*, and *%D-slow*. These indicators show increasingly slower interpretation of price movement, with %D being the most popular as a single indicator; however, %D and %D-slow are often used together to produce a trading signal. Calculation of these indicators for today's value *t* are

$$\text{Initial } \%K_t = 100 \times \frac{C_t - L_t(5)}{R_t(5)}$$

$$\%D = \text{“}\%K\text{-slow”} = \frac{\%K_t + \%K_{t-1} + \%K_{t-2}}{3} = \frac{\left(\sum_{i=t-2}^{t} \%K_i\right)}{3}$$

$$\%D_t\text{-slow} = \frac{\left(\sum_{i=t-2}^{t} \%D_i\right)}{3}$$

where C_t = today's closing price

$L_t(5)$ = the low price of the last 5 days

$R_t(5)$ = the range of the last 5 days (highest high minus lowest low) as of today.[6]

[6]Harry Schirding, "Stochastic Oscillator," *Technical Analysis of Stocks & Commodities* (May/June 1984). For a pocket computer version of these calculations, see C. F. Johnson, "Stochastic Oscillator Program for the HP-41C(V)," *Technical Analysis of Stocks & Commodities* (September/October 1984).

Calculating the 10-Day Stochastic for Nokia

Using an Excel spreadsheet, each of the stochastic components can be calculated in only a few columns. In Figure 9.9, the historic prices for Nokia are imported into columns A—D. The six 10-day stochastic calculations are:

1. In column *E* find the 10-day high, not including today, using the function *Max*.
2. In column *F* find the 10-day low, not including today, using the function *Min*.
3. In column *G* calculate the high—low range by subtracting *F* from *E*.
4. In column *H*, row *n*, calculate the raw stochastic %K as (Dn-Fn)*100/Gn.
5. In column *I*, the %Kslow is the 3-day average of %K, column *H*.
6. In column *J*, %Dslow is the 3-day average of %K-slow, column *I*.

A	B	C	D	E	F	G	H	I	J
				10-day	10-day	10-day	10-day		
Date	High	Low	Close	High	Low	Range	Stochastic *%K*	*%K-slow*	*%D-slow*
1/2/1996	2.50	2.45	2.50						
1/3/1996	2.55	2.41	2.44						
1/4/1996	2.39	2.29	2.34						
1/5/1996	2.30	2.19	2.21						
1/8/1996	2.23	2.19	2.19						
1/9/1996	2.20	2.14	2.19						
1/10/1996	2.20	2.07	2.16						
1/11/1996	2.27	2.15	2.27						
1/12/1996	2.26	2.18	2.19						
1/15/1996	2.21	2.10	2.12	2.55	2.07	0.48	10.4		
1/16/1996	2.25	2.12	2.25	2.55	2.07	0.48	37.5		
1/17/1996	2.30	2.18	2.20	2.39	2.07	0.32	40.6	29.5	
1/18/1996	2.30	2.23	2.29	2.30	2.07	0.23	95.7	57.9	
1/19/1996	2.33	2.25	2.30	2.33	2.07	0.26	88.5	74.9	54.1

1/22/1996	2.37	2.27	2.37	2.37	2.07	0.30	100.0	94.7	75.8
1/23/1996	2.37	2.31	2.34	2.37	2.07	0.30	90.0	92.8	87.5
1/24/1996	2.37	2.34	2.37	2.37	2.10	0.27	100.0	96.7	94.7
1/25/1996	2.40	2.30	2.30	2.40	2.10	0.30	66.7	85.6	91.7
1/26/1996	2.35	2.26	2.35	2.40	2.10	0.30	83.3	83.3	88.5
1/29/1996	2.36	2.30	2.35	2.40	2.12	0.28	82.1	77.4	82.1
1/30/1996	2.41	2.37	2.37	2.41	2.18	0.23	82.6	82.7	81.1
1/31/1996	2.38	2.30	2.34	2.41	2.23	0.18	61.1	75.3	78.5
2/1/1996	2.45	2.35	2.43	2.45	2.25	0.20	90.0	77.9	78.6
2/2/1996	2.45	2.38	2.41	2.45	2.26	0.19	78.9	76.7	76.6
2/5/1996	2.45	2.39	2.45	2.45	2.26	0.19	100.0	89.6	81.4
2/6/1996	2.48	2.45	2.45	2.48	2.26	0.22	86.4	88.4	84.9
2/7/1996	2.44	2.31	2.36	2.48	2.26	0.22	45.5	77.3	85.1
2/8/1996	2.39	2.31	2.34	2.48	2.26	0.22	36.4	56.1	73.9

Figure 9.9: Excel example of 10-day stochastic for Nokia.

The raw stochastic in column *H* of the spreadsheet shows that values reach 100% three times. This happens when prices close at or above the highest prices of the past 10 days. For the first occurrence of 100% on 1/27/1996 the closing price of 2.37 was the high of that day and higher than the highs of the past 10 days. On 1/24/1996 the same high of 2.37 was equal to the high of the past 10 days. When calculating the stochastic, today's close is compared to the range of the previous 10 days; the range does not include today's values. The smoother values in columns *I* and *J* will reach 0 or 100% less often but will also *lag* because of the smoothing.

Comparing the Stochastic to Momentum and the RSI

The calculations for momentum, RSI, and the stochastic are very different; therefore, we would expect a chart of these indicators to vary considerably from one another. However, there are surprising similarities among the three, as shown in the comparison in Figure 9.10. In order to bring the peaks of the RSI in line with those of momentum and the stochastic, it is necessary to use a shorter calculation period; therefore, the momentum and stochastic are calculated over 20 days while the RSI uses only 10 days.

Figure 9.10: Comparing the stochastic (bottom) with momentum (2nd panel) and RSI (3rd panel).

By altering the calculation period of the RSI, the plot of the RSI is remarkably similar to that of momentum. Looking closer, there are sharper peaks in the momentum values compared to the RSI; the RSI tends to be flatter at both the tops and bottoms. The main advantage of the RSI over momentum is that it conforms to the 70-30 threshold values with reasonable consistency. You can expect a price reversal shortly after penetration of either extreme.

The stochastic, especially %D-slow, is noticeably smoother than either momentum or the RSI, and has more uniform peaks. While both momentum and RSI peak values fall significantly in November 2001, the stochastic values move above the 70% threshold and offer a clear sell signal. In general, the smoothness of the slowest stochastic indicator makes its interpretation easier and removes the need to draw trendlines across the indicator values.

Trading the Stochastic

Traditionally, the stochastic can be traded by using a combination of a slower and faster calculation to give signals, or by combining extreme values with a trend. To use the stochastic by itself, %D and %D-slow can take on the role of the faster indicator and the slower signal line in the same way as the MACD and its signal line were used. The fastest calculation, %K, is not often used due to its instability.[7] Figure 9.11 shows the two 20-day calculations along the bottom of an S&P futures continuation chart from December 2001 through September 2002.

Figure 9.11: 20-Day stochastic (bottom) and a 60-day moving average for the S&P futures continuation series.

The downtrend in the S&P during 2002 produces two good sell signals using the stochastics. The slower %D penetrates above the 80% threshold and crosses the signal line moving down. A third peak touches near 70% and may produce a additional sell signal if the threshold was set lower. The lower threshold is a problem that is typical of momentum indicators. During a sustained downtrend, the indicator values will penetrate the lower threshold, often remaining there for extended periods. The most practical solution is to combine the stochastic signals with a trend.

The 60-day moving average, shown along with prices in the upper part of Figure 9.11, indicates a downtrend for the entire period of the chart. Using the relatively slow 20-day stochastic, the penetration of the upper 80% threshold gives very good timing for short sale entries, and avoids the problems of an unfavorable distribution of stochastic values. The 20-day stochastic does not indicate where to exit the downtrend. A faster stochastic can be used to produce frequent sell signals that can be exited when the stochastic falls to the lower threshold. During a downtrend the stochastic value can be expected to spend most of its time at low levels; therefore, trades do not need to be removed when the stochastic touches 50% (as would be necessary if prices were moving sideways).

Left and Right Crossovers

Typically, the faster %K-slow will change direction sooner than the %D-slow, crossing the %D-slow line while it is still moving in the prior trend direction. The opposite case, when the %D-slow turns first, indicates a slow, stable change of direction and is a more favorable pattern (Figure 9.12a). Using a 7-day stochastic calculation, the following patterns can be interpreted:

Hinge. A reduction in the speed of either the %K-slow or %D-slow lines, shown as a flattening out, indicates a reversal on the next day (Figure 9.12b).

Warning. An extreme turn in the faster %K-slow (from 2 to 12%) indicates at most two days remaining in the old trend.

Extremes. Reaching the extreme %K-slow values of 0 and 100 requires seven consecutive days of closes at the highs (or lows). The test of these extremes, following a pullback, is an excellent entry point.

Set-up. Although the line chart shows higher highs and lows, if the %D-slow line has lower lows, a *bear market set-up* has occurred. Look for a selling opportunity on the next rally (Figure 9.12c).

Failure. An excellent confirmation of a change in direction occurs when %K-slow crosses %D-slow (after penetrating the extreme level), then pulls back to the %D-slow line, but fails to cross it again (Figure 9.12d).

Figure 9.12: Lane's patterns. (a) Left and right crossings. (b) Hinge. (c) Bear market set-up. (d) %K-slow failure.

Creating a Stochastic from the RSI

Any series or indicator value can be converted to a raw stochastic, *%K*, without adding lag by replacing the closing price with the indicator value. This creates a measure of where that indicator lies in its high—low range over the period selected and may simplify the comparison needed to generate buy and sell signals. A stochastic created from an RSI would be[8]

$$n\text{-}day\ StochRSI = \frac{RSI_{\text{today}} - RSI_{\text{n-day low}}}{RSI_{\text{n-day high}} - RSI_{\text{n-day low}}}$$

William's Oscillators

Larry Williams has been known for his development of trading methods based on oscillators since his publication of the *A/D oscillator* in 1972. Although they have changed over the 14 years spanning these systems, some similarities are apparent in Williams' three techniques that follow.

A/D Oscillator

In 1972, Jim Waters and Larry Williams published a description of their *A/D Oscillator* in *Commodities* magazine. For their method, *A/D* means accumulation/distribution rather than the popular notation of advance/decline, a well-known indicator for stocks. They used a unique form of relative strength, defining *buying power* (BP) and *selling power* (SP) as

BP = high - open

SP = close - low

where the values used were today's open, high, low, and closing prices. The two values, BP and SP, show the additional buying strength (relative to the open) and selling strength (compared to the close) in an effort to measure the implied direction of the day's trading. The combined measurement, called the *Daily Raw Figure* (DRF) is calculated as

$$\text{DRF} = \frac{\text{BP} + \text{SP}}{2 \times (\text{high} - \text{low})}$$

The maximum value of 1 is reached when a market opens trading at the low then closes at the high: *BP - SP = high - low.* When the opposite occurs and the market opens at the high and closes on the lows, the DRF is 0. Each price series develops its own patterns, which can be smoothed or traded in many ways similar to a momentum index. The Waters-Williams A/D Oscillator solves problems of volatility and limit moves in futures markets. DRF completely adjusts to higher or lower trading ranges because the divisor itself is a multiple of the day's range; because each day is treated independently, the cumulative values of the momentum index are not part of the results.

This day-to-day evaluation causes DRF to vary radically and requires some smoothing technique or cycle interpretation to make it usable. As an example, look at the January 1977 soybean contract for the two months before delivery, November and December 1976. Table 9.1 shows the calculations for the daily raw figure and for the smoothed DRF using an exponential moving average with a smoothing constant of .30 (selected

arbitrarily). DRF is plotted as the solid line on a scale of .00 to 1.00 in Figure 9.13 and is extremely erratic in its movements. The dotted line is the smoothed DRF. Once plotted, two horizontal lines can be drawn to isolate the peaks and bottoms of DRF; the top part becomes a zone representing an overbought condition and the bottom zone represents oversold. This is the same method used for other momentum and oscillator calculations. Note that these lines were drawn after the DRF was plotted and cannot be considered as predictive; however, in the article by Waters and Williams, their example of soybean oil had lines drawn in a similar place. Corresponding broken lines were drawn to indicate the overbought and oversold state for the smoothed DRF.

Table 9.1: A/D Oscillator—January 1977 Soybeans

					DRF			30% DRF Smoothing		
1976 Date	Open	High	Low	Close	DRF	DRF* Signal	Price	30% Smoothed DRF	30% Smoothed Signal*	Price
11-01	682	686	674¾	678½	.34			.34		
11-03	679	683	655	658½	.13			.28		
11-04	658	676	658	671½	.87	Sell		.45		
11-05	674	678	665	673½	.48		674	.46		
11-08	673	685	671	674¼	.54			.48		
11-09	673	673	660	666	.23			.41		
11-10	667	676½	665	675	.85	Sell		.54		
11-11	660	662½	645	651	.24		660	.45		
11-12	652	658	650½	653	.57			.49		
11-15	652	652	627	632½	.11	Buy		.37	Buy	
11-16	639½	655	636½	654¼	.90	Sell	639½	.53		639½
11-17	653	671	649	668½	.85		653	.63		
11-18	667	674½	658	666½	.48			.58		
11-19	670	691	669½	678¾	.70			.62		
11-22	680	691	675½	690½	.84	Sell		.68	Sell	
11-23	689	696½	674½	675¾	.20	Buy	689	.54		689
11-24	681	686	678½	680	.43		681	.51		
11-26	678	681½	670½	671¾	.21	Buy		.42		
11-29	670	675	661½	672	.57		670	.46		
11-30	668	677½	666	674½	.78			.56		
12-01	676	681½	673	677	.56			.56		
12-02	678	681½	675	679½	.61			.57		
12-03	679	687	679	685¾	.92	Sell		.68	Sell	
12-06	690	698½	689	696½	.84		690	.73		690
12-07	700	700	690	690½	.02	Buy		.51		
12-08	691	708	691	706	.94	Sell	691	.64		
12-09	705	712	702	703	.40		705	.57		
12-10	704	704	696	696½	.03	Buy		.41		
12-13	693	695	690½	691½	.33		693	.38	Buy	
12-14	696	701½	694	701	.83	Sell		.52		696
12-15	701	702	684	687	.11	Buy	701	.39	Buy	
12-16	688½	692	685	690½	.64		688½	.47		688½
12-17	690	690	676	677½	.05	Buy		.34	Buy	
12-20	680	684½	679½	683¼	.82	Sell	680	.49		680
12-21	682	688	679	687½	.80		682	.58		
12-22	688	693	686½	689¼	.60			.59		
12-23	689	693	684½	692½	.71			.62		
12-27	695	705	694	700¾	.76			.66		
12-28	701	706½	697½	705¾	.76			.69	Sell	
12-29	708	710	699	699½	.11	Buy		.52		708
12-30	703½	708	698	706½	.65		703½	.56		

Basic DRF Performance†		30% Smoothed DRF Performance†	
16 signals		7 signals	
4 compounded signals		3 compounded signals	
12 profits		5 profits	
Average profit	13.08¢	Average profit	22.10¢
4 losses		2 losses	
Average loss	14.25¢	Average loss	6.50¢
Net profit/loss	99.96¢	Net profit/loss	97.50¢

*Signals taken the following day on open.
†No commissions have been deducted.

Figure 9.13: A/D Oscillator.

The rules for using the A/D Oscillator were not defined in the *Commodities* magazine presentation, but some simple rules could be:

- *Sell* when the DRF (or smoothed DRF) penetrates into the overbought zone. Close out all accumulated long positions (if any) and go short on the open of the next trading day. Exit the short sale if the raw or smoothed DRF makes a new high for this move.
- *Buy* and exit the long position when the opposite conditions occurs.

If the DRF (or smoothed DRF) enters an overbought or oversold zone more than once without the opposite zone being entered, one additional position is added at each reentry. Following these rules, the A/D Oscillator showed excellent success for both the raw and smoothed values. Accepting the after-the-fact designation of zones, the results still show that the method is viable and that a smoothing technique can be applied to DRF to vary the speed of trading.

Waters and Williams used a simple 10-day momentum for their example of the A/D Oscillator. The choice of interval can be determined by examining the tops and bottoms of a chart for the natural cycle of the prices.

In reviewing the A/D Oscillator, there are modifications to be considered. Conceptually, the value of the oscillator should be +1 when prices are rising rapidly. The most extreme example is a futures market with a locked-limit no-trading day, representative of the strongest (or weakest) market (most futures markets have eliminated the traditional trading limits). But for that case, the open, high, low and closing prices are all the same and DRF cannot be determined because the divisor is zero.

A more basic problem concerns gap openings. A much higher opening with a stronger close would also upset the resulting DRF value. For example, the following trading occurs:

Open table as spreadsheet

	Open	High	Low	Close	DRF	ΔDRF	ΣΔDRF
Monday	43.00	44.00	40.00	41.00	.25		
Tuesday	42.00	42.00	39.00	40.00	.17	-.17	-.17
Wednesday	38.50	38.50	38.00	38.00	.00	+.17	.00
Thursday	42.00	42.00	39.00	40.00	.17	-.33	-.33
Friday	40.00	43.00	40.00	42.00	.83	+.50	+.17

Note that on Wednesday, the DRF indicates that the momentum has reversed, but in fact the price is falling rapidly and gives no indication of recovering; it may actually be gaining momentum. On Thursday the price soars up and closes in the midrange, but the DRF shows a new downward momentum. The problem seems to be related to lack of association with the prior closing price. The daily movement can take on different appearances if the entire range was above or below the closing price. To form this link, replace the current high or low with the prior closing price, in the manner of the *true range* calculation, if that price was outside the current trading range. The following example shows that the results smoothed out and leaves the trend intact.

Open table as spreadsheet

	Open	High	Low	Close	DRF	ΔDRF	ΣΔDRF
Monday	43.00	44.00	40.00	41.00	.25		
Tuesday	42.00	42.00	39.00	40.00	.17	-.17	-.17
Wednesday	38.50	(40.00)	38.00	38.00	.37	+.04	.13
Thursday	42.00	42.00	(38.00)	40.00	.25	-.12	-.25
Friday	40.00	43.00	40.00	42.00	.83	+.58	+.33

Linking the Current Day with the Prior Day.

Another oscillator can be constructed using the highs and lows relative to the prior close:

$$O_t = \frac{H_t - C_{t-1}}{H_t - L_t}$$

The two days are linked together and the ratio of the high price relative to the prior close is measured against the total range for the day. For the normal case, $H_t = C_{t-1}$, $= L_t$; but if C_{t-1} replaces either H_t or L_t to extend the range, the value of O_t will be either 1 or 0 for these extreme cases. As with the A/D Oscillator, the values derived from this method may also be smoothed.

Oscillators are not the only tools for measuring momentum or for determining overbought or oversold conditions. Because momentum is very different from either a charting technique or a moving average, it is valuable either on its own or as a confirmation of another method.

A word of caution: Trading against the trend can be exciting and profitable, but at considerably greater risk than a trend-following system. The problem with selling an overbought condition is that it is much more difficult to hold losses to a minimum. A long position may be entered while prices are falling fast, and they continue to fall at the same speed after you have bought. Even a relatively quick exit may sustain substantial losses.

%R Method

After the publication of Williams' *How I Made One Million Dollars…Last Year…Trading Commodities* (Conceptual Management, 1973), the *%R* oscillator became well known. It is a simple way of calculating where today's closing price fits into the recent trading range. Using the last 10 days, define

$$\%R = \frac{Buying\ power}{Range} = \frac{High_{10} - Close_{today}}{High_{10} - Low_{10}}$$

Williams' 10-day *%R* is actually a *10-day stochastic*, using the high price rather than the low price in the numerator; therefore, it is the complement (100 minus the 10-day stochastic) of the original stochastic calculation. With a chart that has 0 at the top and 100 at the bottom, a value below 95% will give a buy signal, and one over 10% a sell. Williams viewed this as a timing device to add positions within a major technical or fundamental trend. This same approach was discussed with regard to the stochastic, and is shown in Figure 9.8. Trades were not to be entered if they contradicted the major market direction. Readers should refer to the earlier section in this chapter, "Stochastics," for more information.

The Ultimate Oscillator

In the *Ultimate Oscillator*, Williams seems to combine his original idea of the A/D Oscillator with a great deal of Wilder's RSI.[9] He adds the unique feature of three concurrent time periods in order to offset the negative qualities of the short time period used for the *%R*, without slowing the system too much. The Ultimate Oscillator uses the following steps:

1. Calculate today's *buying pressure* B_t by subtracting the *true low* from the closing price. The true low is today's low or yesterday's close, whichever is lower.
2. Calculate today's *true range* R_t, by taking either the greater of today's high and low, today's high and yesterday's close, or yesterday's close and today's low.
3. Total the buying pressure B_t separately over the three intervals 7, 14, and 28 days, designated as SB_7, SB_{14}, and SB_{28}.
4. Total the true range R_t over the same three periods, SR_7, SR_{14}, and SR_{28}.
5. Divide the sum of the buying pressures by the corresponding true range, that is, SB_7/SR_7 and scale by multiplying the 7-day value by 4 and the 14-day value by 2. All three calculations are now in the same scale.

Notice that the nearest seven values for the buying pressure and the true range are each used seven times, that is, they are multiplied by both the scaling factors of 4 and 2, and used once more in the 28-day calculation. Williams has created a step-weighted momentum, assigning values of 7, 3, and 1 to the first 7 days, second 7 days, and last 14 days, respectively. The last 14 days account for only 10% of the total.

The rules for using this oscillator (Figure 9.14) are:

1. A sell set-up occurs when the oscillator moves above the 50% line, peaks at a high value, declines and then moves higher. If the oscillator fails to move above the peak on the next rally, a short sell order can be placed when the oscillator fails on the right shoulder. This is a traditional top confirmation signal.
2. Short positions are closed out when a long signal occurs, when the 30% level is reached, or if the oscillator rises above 65% (the *stop-loss* point) after being below 50%.
3. A buy signal is given using the opposite formation as the short signal (rule 1).
4. If a long position is held, close out longs when a short signal occurs, when the 70% level is reached, or if the oscillator falls below 30% (after being above 50%).

Figure 9.14: Williams' Ultimate Oscillator.

Relative Vigor Index

John Ehlers, who has contributed extensively in the mathematical analysis of prices, in particular using cycles, has created the *Relative Vigor Index* (RVI), a very smoothed momentum indicator.[10] The basic form of RVI is

$$RVI = (Close - Open) / (High - Low)$$

However, the final RVI uses a 4-day symmetric weighting of the *close — open* in the numerator, and a similar symmetric weighting of the *high — low* in the denominator.

RVI is conceptually similar to the A/D Oscillator; however, the RVI is smoothed in a special way that targets a particular price cycle and eliminates the 2-bar cycle and associated unwanted frequencies. While it is preferable that the price series be analyzed for its cycle period, Ehlers suggests using 10 as the nominal value. The RVI is calculated as

$$N_t = [(C_t - O_t) + 2 \times (C_{t-1} - O_{t-1}) + 2 \times (C_{t-2} - O_{t-2}) + (C_{t-3} - O_{t-3})]/6$$

$$D_t = [(H_t - L_t) + 2 \times (H_{t-1} - L_{t-1}) + 2 \times (H_{t-2} - L_{t-2}) + (H_{t-3} - L_{t-3})]/6$$

$$Numerator_t = \Sigma N_i,\ i = t - n + 1,\ t$$

$$Denominator_t = \Sigma D_i,\ i = t - n + 1,\ t$$

$$RVI = Numerator_t/Denominator_t, \text{ while denominator}_t \neq 0$$

$$RVI\ signal\ line_t = (RVI + 2 \times RVI_{t-1} + 2 \times RVI_{t-2} + RVI_{t-3})/6$$

where O_t, H_t, L_t, and C_t are today's open, high, low, and closing prices and n is the calculation period, nominally 10.

The RVI signal line is used in the same manner as the MACD signal line. After a peak in the RVI value, showing an overbought situation, the sell signal occurs the first time that the RVI crosses the RVI signal line moving lower.

[2]J. Welles Wilder, Jr., *New Concepts in Technical Trading Systems* (Trend Research, Greensboro, NC, 1978).

[3]Peter W. Aan, "How RSI Behaves," *Futures* (January 1985).

[4]For another interesting approach to RSI optimization, see John F. Ehlers, "Optimizing RSI with Cycles," *Technical Analysis of Stocks & Commodities* (February 1986).

[5]Tushar S. Chande and Stanley Kroll, *The New Technical Trader* (Wiley, 1994).

[7]It is common practice to use the notation *%K* and *%D* to mean *%K-slow* and *%D-slow*, respectively. All writings on the stochastic use the smoothed values, rather than the initial *%K* calculation, regardless of the omission of "*-slow.*" Any use of *%K* in this text also refers to *%K-slow* unless specifically stated.

[8]Tushar Chande and Stanley Kroll, *The New Technical Trader* (Wiley, 1994).

[9]Larry Williams, "The Ultimate Oscillator," *Technical Analysis of Stocks & Commodities* (August 1985).

[10]John F. Ehlers, "Relative Vigor Index," *Technical Analysis of Stocks & Commodities* (January 2002).

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DOUBLE-SMOOTHED MOMENTUM

The most recent contributions to the study of momentum have been made by William Blau.[11] In addition to creating new momentum indicators, he has added substantial value to the old ones. Also refer to his work on double smoothing of momentum in Chapter 7.

True Strength Index

Much of Blau's work combines double smoothing of momentum values (1-period price differences) which has surprisingly little calculation *lag*. By using the momentum, he has based the calculations on values more sensitive than price, then slowed them down by smoothing. In effect, he speeds up the price movement, then slows it down. The net result is that the final index value has less lag than we would normally expect, and the index line is much smoother than a standard moving average. Blau refers to this as *using momentum as a proxy for price*. One of Blau's most popular indicators is the *True Strength Index* (TSI) which combines these features:

$$TSI(close, r, s) = \frac{100 \times SmoothedAverage(SmoothedAverage(close - close[1], r)s)}{SmoothedAverage(SmoothedAverage(absvalue(close - close[1]), r), s)}$$

where *r* = the calculation period of the first momentum smoothing
s = the calculation period of the second momentum smoothing
close-*close*[1] = the 1-day momentum
SmoothedAverage(*price*,*period*) = the TradeStation function for exponential smoothing using *price* over the calculation period.
AbsValue = the TradeStation function for absolute value

The True Strength Index can be programmed in TradeStation, where the two smoothing periods are *smooth1* and *smooth2*, as:

```
num = smoothedaverage(smoothedaverage(close-close[1],smooth1),smooth2);
denom = smoothedaverage(smoothedaverage(absvalue
        (close-close[1]),smooth1),smooth2);
TSI = 100*num / denom;
```

The numerator and denominator of the TSI differ only in that the denominator takes the absolute value of the price changes (the 1-day momentum). This guarantees that the denominator will be at least as large as the numerator. The 1-day momentum is first smoothed over the period *r*, and then the result is smoothed over the period *s*. The relationship between the standard momentum (the difference in prices over *r* days) and the TSI can be seen in Figure 9.15. The standard 20-day momentum indicator has the typical erratic pattern of prices, and a slight lead ahead in identifying the peaks. The TSI is much smoother with peaks and valleys lagging prices slightly. TSI buy and sell signals can be created by smoothing the TSI signal line using a 3-period moving average, then buying when the TSI crosses the signal line after a high or low value was reached. The slight lag in the TSI seems a small problem compared to the extreme noise of the momentum calculation.

Figure 9.15: Comparing the TSI with 10-20-20 smoothing (bottom) to a standard 20-period momentum (center) using INTC from January 2001 through March 2002.

Double-Smoothed Stochastics

Because of Blau's great interest in double smoothing, he defines the general form of a double-smoothed stochastic as:

$$DS(q,r,s) = \frac{100 \times SmoothedAverage(SmoothedAverage(close - Lowest(low,q),r),s)}{SmoothedAverage(SmoothedAverage(Highest(high,q) - Lowest(low,q),r),s)}$$

where *close* - *Lowest*(*low,q*) = the numerator of Lane's raw stochastic, the lowest low over the past *q* periods
Highest(*high,q*) - *Lowest*(*low,q*) = the denominator of Lane's stochastic, the greatest high-low range over the past q periods
SmoothedAverage((…, *r*),*s*) = an exponential smoothing of the numerator, first calculated over *r* periods, then over *s* periods

TRIX

Similar to Blau's double smoothing is *TRIX*, a triple-smoothed exponential that is most often used as an oscillator. Introduced by Jack Hutson,[12] it is created using the following steps. Typically, 9 and 12 days are used as the calculation periods for exponential smoothing. This method has been applied to daily, hourly, or even one-minute price data.

1. Calculate the log of the closing prices (daily or intraday bars). This implicitly corrects for price volatility; however, it is commonly omitted from the calculation.
2. Calculate the *n*-period exponential smoothing of the closing prices or the log of the closing prices to get *trend* 1.
3. Calculate the n-period exponential smoothing of *trend* 1 to get *trend* 2.
4. Get the 1-period differences of trend 2 by subtracting each value from the previous value.
5. Scale the results by multiplying by 10,000. This step may also be omitted.

The resulting TRIX indicator acts as an oscillator due to Step 4. It can be very smooth when the calculation periods are larger; it also and reduces the lag because of the differences. If we take a lead from Blau's work, this oscillator can be smoothed further without increasing the lag by taking the *m*-period difference (*m* greater than 1) rather than the *one*-period difference.

TRIX can be used as a trend indicator by buying when the value of TRIX crosses above zero and selling when it crosses below zero. It can produce buy and sell signals sooner by buying when the TRIX value is rising for two or three consecutive periods, and selling when TRIX is falling for two or three consecutive periods. Because the triple smoothing results in a very smooth TRIX value, trading signals can safely use the change in TRIX as an advance indicator of trend.

Forecast Oscillator

In Chapter 7, the difference between the price and the trendline value was smoothed and added to the trend value to get what was originally defined a *double-smoothed trendline*. Instead, the difference between the current price and the corresponding forecast (trend-line) price can be calculated as a percentage and treated as a momentum indicator *%F*.[13]

This oscillator is not bounded; however, by giving the value as a percentage, there will be more consistency over very long test periods.

$$\%F = 100 \times \frac{Close_{\text{today}} - Close_{\text{previous}}}{Close_{\text{today}}}$$

For practical purposes, a 3-period smoothing of *%F* gives more consistency. When *%F* = 0, the trendline and prices are moving parallel to one another; when *%F* > 0 the market is accelerating away from the trendline; when %F < 0 prices are slowing down and the two series are converging. Traders interested in this technique should also read the section "Velocity and Acceleration" later in this chapter.

An Oscillator to Distinguish Between Trending and Sideways Markets

The lack of predictability of trending markets is the greatest problem for the analyst. The work found under the topics "Ranking of Markets for Selection" and "Directional Movement" in Chapter 23 discusses that issue. Based on the idea that the trend component is stronger when price is farther from fair value, and the noise (sideways movement) is greater when price is near value, an oscillator can be created to show the strength of the trend component based on this concept,

$$Strength\ \ Oscillator = \frac{Average((Close_{\text{today}} - Close_{\text{previous}},\ \ n))}{Average((High_{\text{today}} - Low_{\text{today}}),\ \ n))}$$

As the trend increases, the average change in closing prices becomes larger relative to the high—low range for the day. During an unusual period, when the market gaps open, it would be possible for the differences in the closing prices to become larger than the daily range. In a sideways market both the change in the closes and daily range will get smaller, but the net price change over period n should be close to zero. This oscillator can be smoothed by taking the change in price over two or three days (for example, $close_t$ - $close_{t-3}$, rather the most recent day, as well as taking the high-low range over the same number of days.

Adding Volume to Momentum

A momentum indicator can also incorporate volume by multiplying the price change over *n* periods by the total volume over that same period. The use of a cumulative period will help to stabilize the volume, which is often erratic when seen as only one day's activity. Although the sum of the volume over the period can be used, the average volume will appear to be the same magnitude and can be plotted against a volume chart. That gives the *momentum-volume indicator* (*MV*) as follows, shown mathematically and in programming notation:

$$MV = (Price_t - Price_{t-n}) \times \frac{\sum_{i=t-n}^{t} volume_i}{n}$$

```
MV = (close - close[n])*average(volume,n)
```

Alternately, the price change over *n* periods could have been divided by *n* to give a per unit value. This section will include those techniques that combine price change and volume; for methods that do not use price, see Chapter 12.

Scaling by a Percentage or Volatility

The same conversions can be applied to momentum with and without volume. Using a percentage rather than price will add some robustness over long test periods. Because volatility often increases when prices rise faster than a fixed percentage of price, momentum can be scaled according to a shorter measure of true range. If the true range is averaged over 20 to 65 days, approximately one month to one quarter, then the 1-day change in price will become a relative momentum value. By using a much longer period for averaging the true range, you can create a stable profile of the volatility changes in the underlying market.

(Percentage momentum with volume)

```
%MV = (close - close[n]) / close[n] * average(volume,n)
```

(Momentum with volume scaled by True Range)

```
TRMV = (close - close[n]) / average(truerange,p) * average(volume,n)
```

where *truerange* is always calculated for the most recent period, and the average of the 1-day true range for the past *p* days is *average(truerange,p)*.

Volume-Weighted RSI

In the same way that the RSI adds the positive days and divides by the sum of the negative days, it is possible to weight each day by its volume to add another factor, called *money flow*,[14] to the calculation. A positive or upwards day is when the average of today's high, low and close (*high* + *low* + *close/3*) is greater than the previous average. Each average is then multiplied by the volume, giving the daily money flow, and a ratio of the past 14 days is used to create a *money ratio* and finally a *money flow index*, both steps similar to Wilder's RSI.

$$Money\ flow = Volume \times \frac{High + Low + Close}{3}$$

$$Money\ ratio = \frac{14\text{-}day\ positive\ money\ flow}{14\text{-}day\ negative\ money\ flow}$$

$$Money\ flow\ index = 100 - \frac{100}{1 + Money\ ratio}$$

Herrick Payoff Index

Using the change in the underlying value of the futures contract, rather than only the change in price, the *Herrick Payoff Index* [15] (HPI) combines volume and open interest to generate an indicator that is not bounded as in the basic momentum calculation, but scaled down to a manageable value and smoothed using a .10 smoothing factor, *s* (about 19 days). The daily value is:

$$HP = cf \times V_t \times (M_t - M_{t-1}) \times \left[1 + \left(\frac{M_t - M_{t-1}}{|M_t - M_{t-1}|}\right)\left(\frac{2 \times |OI_t - OI_{t-1}|}{\min(OI_t, OI_{t-1})}\right)\right]$$

and the index is an exponential smoothing of the individual daily calculations:

$$HPI_{today} = HPI_{previous} + s \times (HPI_{today} - HPI_{previous})$$

where

t	= today
$t - 1$	= the previous day
cf	= the converstion factor (value of a one point move)
V_t	= today's volume
$(M_t - M_{t-1})$	= the difference in the mean values, $M = (high + law)/2$ || (vertical bars) denote absolute value
$\|OI_t - OI_{t-1}\|$	= the absolute value of the change in open interest (for futures)
$min(OI_t, OI_{t-1})$	= the smaller of the open interest for today or the previous day
s	= the smoothing constant (normally .10)

The expression that divides the change in mean prices by the absolute value of the same change is used to create a +1 or -1 value. This complex formula for HPI can also be written in programming code as

```
HP = BigPointValue * volume * ((high-low)/2 - (high[1]-low[1])/2) *
        (1 + ( ( (high-low)/2 - (high[1]-low[1])/2) /
           absvolue( (high-low)/2 - (high[1]-low[1])/2) ) *2 *
        (absvalue(opint - opint[1]) / lowest(opint,2) ) )

HPI = smoothedaverage(HP,19)
```

Most analysts who use the Herrick Payoff Index divide the HPI by 100,000 to reduce the value to a more usable level. The final series, when seen along with prices, may appear volatile and require an interpretation using trendlines. This is due to the fluctuations in volume and open interest, which are smoothed over 20 days, rather than a longer period. The Herrick Payoff Index may be helpful, despite its volatility, because it is a combination of factors not included in most other indices. It has patterns that appear to lead price change to compensate for its noisy behavior.

Comments on the Use of Volume

Volume is an important piece of information, but it can be difficult to interpret. It fluctuates in a much larger range than price, and may be 50% higher or lower from day to day. While it indicates market interest and potential volatility, there are many days for which a high or low volume does not have a consistent reaction.

In general, adding volume to an indicator results in a more volatile, erratic series. Therefore, the first steps in using volume are:

1. Create a long-term, smoothed volume series.
2. Locate days with extremely high volatility to identify only those exceptional days which should be followed by high volatility.
3. Low volume should not be determined by a single day, but by either a few unusually low days together or by a decay in the smoothed volume over a modest time period.

[11]William Blau, *Momentum, Direction and Divergence* (Wiley, 1995).

[12]Referenced in Robert W. Colby, *The Encyclopedia of Technical Market Indicators* (McGraw-Hill, 2003) as "Good Trix" by Jack K. Hutson, *Technical Analysis of Stocks & Commodities* (Vol 1:5).

[13]Chande and Kroll (see footnote 5).

[14]Gene Quong and Avrum Soudack, "Volume-Weighted RSI: Money Flow," *Technical Analysis of Stocks & Commodities* (March 1989).

[15]From the original *CompuTrac* manual, which is now the Dow Jones Telerate division.

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VELOCITY AND ACCELERATION

In physics, momentum is called *speed* or *velocity*. It is the amount of change measured over a specific period of time. It is also called *rate of change*. When traveling in a car, your speed might be 30 miles per hour. When prices are moving higher, they may be averaging $1 per week. There are two types of velocity: *average* and *instantaneous*. The *average velocity* is simply calculated as the mean velocity over a fixed distance and for a fixed time interval. In working with stock and futures prices, the time interval used is days and the distance is measured in points; if silver moved 40 points in six days, its average velocity is

$$\bar{v} = \frac{40}{6} = 6\,\frac{2}{3} \text{ points per day}$$

In general, the average velocity is expressed

$$\bar{v} = \frac{D}{T}$$

where D = the total elapsed distance over the time interval T

Velocity is the same as the simple measurement of momentum. For a geometric interpretation of momentum, the change in price, D, can be related to the length of the momentum span, T, to get the same results for average velocity as for slope. Physicists prefer to draw velocity (the average over period T) and instantaneous velocity (the speed at exactly one point) in their own way, shown in Figure 9.16.

Figure 9.16: (a) Average velocity. (b) Instantaneous velocity.

The *instantaneous velocity*, υ, which is the velocity calculated at a specific point in time, may be different from velocity. In order to determine the instantaneous velocity, a mathematical technique called *differentiation* is used. It effectively looks at smaller and smaller time intervals and consequently smaller distances on the price curve until the slope calculation is reduced to a single point. The result of the process of differentiation is called the *derivative* and is expressed

$$v_t = \lim_{\Delta_{t \to 0}} \frac{\Delta D}{\Delta t} = \frac{dD}{dt}$$

This shows that the velocity taken at any point is the result of the time interval (t) becoming progressively smaller without actually reaching zero. The symbol delta (Δ) represents the change in price (ΔD) and the corresponding change in time (Δt). The rules for differentiation can be found in any advanced mathematics book. Only the results are presented here. The velocity υ_t represents the speed or momentum of the price at the point in time t. If υ gets larger for t_0, t_1, t_2, …, then the velocity is increasing; if υ gets smaller, the velocity is decreasing. Because the velocity also denotes direction, it can be both positive and negative in value and appear similar to a momentum indicator.

Acceleration is the change in velocity. In the same way that we find the change in price D over time period t, we can find the change in velocity over time period t. Therefore, if you are driving at 30 miles per hour when you enter the acceleration ramp of the freeway, and after one minute you are driving 60 miles per hour, you have changed speed at the

rate of 30 miles per hour per minute. Fortunately, we do not need to be concerned about the units of time when we apply these techniques to prices. The units are always the same, whatever they are. When S&P prices have been moving higher at an average speed of 10 points per week and then begin posting increases of 15 points per week, then 20 points per week, prices are accelerating at the rate of 5 points per week per week. Mathematically, velocity can be substituted for price in the equation for υ_t to get acceleration, a_t.

$$a_t = \lim_{\Delta_{t \to 0}} \frac{\Delta V}{\Delta t} = \frac{dV}{dt}$$

Finding the Velocity and Acceleration of Different Techniques

Differentiation can be applied to many different formulas that have been discussed previously, including those that represent a straight line, curved lines, and various trendlines. The result of the first differentiation gives you the component that represents velocity, and the result of the second differentiation is the component of acceleration. Of course, some of the basic equations have constant velocity and cannot be used for a velocity trading plan because the values never change. The straight line, simple and weighted moving averages, and exponential smoothing all have constant velocities. Only those equations with *second-order smoothing will* work.

When the process of differentiation is applied to the equation for velocity, it results in the rate of change of the speed with respect to time, or *acceleration.* This type of acceleration tells whether the velocity is increasing or decreasing at any point in time. The acceleration, also called the *second derivative*, adds another dimension to momentum and may improve the timing of trades.

Let's assume that the velocity and acceleration have been calculated (Table 9.2). The following are the possible combinations that can occur:

Open table as spreadsheet

Velocity	Acceleration	Price movement
+	+	Price is moving up at an increasing rate
+	0	Price is moving up at a constant rate
+	-	Price is moving up at a decreasing rate
0	0	Price is static
-	+	Price is moving down at a decreasing rate
-	0	Price is moving down at a constant rate
-	-	Price is moving down at an increasing rate

Table 9.2: Equations for Velocity and Acceleration

Open table as spreadsheet

	Basic Equation	Velocity at x_t^*	Acceleration at x_t^*
Straight line	$y_t = a + bx_t$	$v_t = b$	$a_t = 0$
Curvilinear	$y_t = a + bx_t + cx_t^2$	$v_t = b + 2cx_t$	$a_t = 2c$
Logarithmic (base a)	$y_t = \log_a x_t$	$v_t = (\log_a e)/x_t$ or $v_t = 1/(x_t \ln a)$	$a_t = -1/(x_t^2 \ln a)$
Logarithmic (natural log)	$y_t = \ln x_t$	$v_t = 1/x_t$	$a_t = -1/x_t^2$
Exponential	$y_t = e^{ax_t}$	$v_t = ae^{ax_t}$	$a_t = a^2 e^{ax_t}$
Moving average	$y_t = \frac{x_t + x_{t-1} + \ldots + x_{t-n+1}}{n}$	$v_t = 1$	$a_t = 0$
Weighted moving average	$y_t = \frac{a_1 x_t + a_2 x_{t-1} + \ldots + a_n x_{t-n+1}}{n}$	$v_t = \frac{a_1 + a_2 + \ldots + a_n}{n}$	$a_t = 0$
Exponential smoothing	$y_t = y_{t-1} + c(x_t - y_{t-1})$	$v_t = c$	$a_t = 0$

*Because velocity and acceleration are time derivatives, all equations implicitly include the factor $\frac{d(x_t)}{d_t}$ as part of the right member.

Using the acceleration feature, a change of velocity (or momentum) can be detected or the strength of a current price move can be confirmed.

Using Velocity and Acceleration to Identify a Sideways Market

The combination of velocity and acceleration can give a good indication of whether prices are moving in a directional or sideways pattern. When velocity is near zero, the speed of price movement is near zero. That is the same as saying that prices have not changed over the time interval *t.* However, that is not enough.

During the interval *t*, prices may have moved sharply higher then sharply lower. By chance, they are unchanged after time *t* although they are still moving lower quickly. The acceleration will tell you that prices are moving even though they are at the same level as *t* periods ago. To identify a sideways pattern, both the velocity and acceleration must be near zero.

Quick Calculation of Velocity and Acceleration

A less precise but very convenient way of determining velocity and acceleration is the calculation of *first* and *second differences.* The purpose of these values is to find more sensitive indicators of price change, and most traders find this quick calculation satisfactory. The results can be used in exactly the same way as the formal mathematical results. Consider the following two examples:

1. A price series 10, 20, 30, 40, … is moving higher by a constant value each day. The first differences are 10, 10, 10, …, showing a consistent velocity of 10. The second differences, formed by subtracting sequential values in the first-difference series, are 0, 0, 0, …, showing that there is no change in speed; therefore the acceleration is zero.

2. Another price series is shown with its first and second differences as

Open table as spreadsheet

Time	1	2	3	4	5	6	7	8	9	10	11	12
Series	10	15	20	30	45	50	45	35	25	20	25	40
Velocity		+5	+5	+10	+15	+5	-5	-10	-10	-5	+5	+15
Acceleration			0	+5	+5	-10	-10	-5	0	+5	+10	+10

where velocity values are the first differences, and acceleration the second differences. The original series has two turns in the trend direction clearly shown by the velocity and acceleration as changes in the sign of the numbers. The velocity continues to be positive through the sixth value as the underlying price moves from 10 to 50. Whenever prices change direction, the velocity changes sign. The basic upward trend can be associated with a positive velocity and a downward trend with a negative one.

The acceleration, or second difference, shows the change in speed. At the sixth item, the acceleration becomes negative, even though the velocity was positive, because prices moved higher at a slower rate. They had been gaining by 5,10, and 15 points each day, but on day 6 the gain was only 5 points. This reversal in acceleration was a leading indicator of a trend change. A similar situation occurred on day 8, when the acceleration slowed and reversed on day 10, one day ahead of the actual price reversal.

The relationship between velocity and acceleration using first and second differences can be interpreted using the same logic as previously discussed. Velocity and acceleration are increasingly more sensitive directional indicators; the slightest variation in price movement causes the acceleration to change. It is an indicator of great value when it is used selectively.

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HYBRID MOMENTUM TECHNIQUES

Moving Average Projected Crossovers

If moving averages can successfully be used to identify the trend direction, it follows that a projection of the moving average will be valuable in anticipating when the trends will change. If a moving average trading strategy used a single trend, the forecasted price (*CP*1) at which the standard *N*-day moving average line would cross is

$$CP1 = \frac{\text{Sum of last } N-1 \text{ prices}}{N-1} = \frac{\left(\sum_{t-N+2}^{t} P_i\right)}{(N-1)}$$

That is, an *n*-day moving average would cross the next price at the value equal to the *n*-1-day moving average. The price (*CP*2) needed to cause two moving averages to cross is

$$CP2 = \frac{N \times (\text{Sum of last } N-1 \text{ prices}) - M \times (\text{Sum of last } M-1 \text{ prices})}{(M-N)}$$

where *N* and *M* are the lengths of the two moving averages.[16]

The projected crossover price is most useful when it is likely that a trend change will occur within a few days, that is, when the two moving averages begin converging and become close in value. Acting on the expected price would give the trader a great advantage in order execution. A chart of this, however, may not appear to be much different than a simple *relative strength* indicator. The difference between the price and the moving average line constitutes the relative strength.

The change in the projected crossover is considered a more valuable tool by Lambert. He creates a *Market Direction Indicator* (MDI) with the following formula:

$$MDI = \frac{100 \times (Crossover\ price_{\text{previous}} - Crossover\ price_{\text{today}})}{Average\ of\ past\ 2\ day's\ prices}$$

The point at which the MDI crosses the zero line moving higher is a buy signal, and the point where it crosses moving lower is a sell signal.

Combining a Trend and an Oscillator

Directional Parabolic System

The *Directional Parabolic System*[17] is a combination of two of Wilder's well-known techniques, *Directional Movement* and the *Parabolic Time/Price System.* Directional Movement is covered fully in Chapter 23. It gained popularity as a method of selecting the futures markets that were most likely candidates for trend-following systems. The Parabolic Time/Price

System is covered in Chapter 17. Although a full reading of both techniques are necessary, the essence of the combined systems may be understood with the following definitions:

+DM14	The 14-day upward Directional Movement, the sum of the current high prices minus the previous high prices.
-DM14	The 14-day downward Directional Movement, the sum of the previous low prices minus the current low prices.
ADX	The Average Directional Movement Index, calculated by smoothing the Ratio of the net of +DM14 and -DM14 by the sum of the same values.
DPS	The Directional Parabolic stop-loss.

Although shown as -DM14, the downward Directional Movement is a positive number based on the sum of those days that closed lower. The ADX is a ratio of the +DM14 and -DM14 such that it represents the positive direction of the index. Therefore, the ADX is an oscillator such that, when its value is greater than 50, it means that price movement is upwards. Directional Movement is combined with the Parabolic Time/Price System according to the following rules:

1. If the ADX is up, take only long Parabolic System trades; if the ADX is down, take only short trades.
2. If the two systems conflict, no trade is entered. A trade may be entered at the time they agree.
3. If a position is held, the Parabolic stop is used. (The stop is now called the DPS instead of the SAR because it no longer requires a reversal of position.)
4. If no position is held, the Directional Movement *equilibrium point* is used (the high or low of the day on which the +DM14 crosses the -DM14).

Directional Parabolic Revision.

In 1980, the entry rules were revised to include an added use of the ADX when it is greater than the +DM14 or the -DM14. Because the ADX serves as an oscillator and indicates turning points in the trend, when the ADX exceeds the magnitude of the current +DM14 or -DM14 and reverses, the current position should be closed out. If the ADX remains above both the +DM14 and -DM14, the market is extremely strong and liquidation should stop. The ADX is intended to be a leading indicator for liquidation only. Reversal of the current position only occurs when the Parabolic stop has been penetrated and the new trade agrees with the direction of the Parabolic System.

The addition of an oscillator to a trend-following system allows trades to be closed out at more favorable prices than the usual trend exits. If the new direction carries through and the position is reversed, the added feature has worked perfectly; however, if prices turn back in the original direction, a reentry may not be possible. The revised rules are unclear concerning reentry into a position if prices fail to penetrate the DPS and signal a reversal. A reentry might occur if the ADX falls below both the +DM14 and -DM14, indicating that prices are no longer extreme, then turns back in the trend direction. Once reestablished, the DPS can be used and additional exits using the revised rules would apply.

Cambridge Hook

An indicator that combines Wilder's RSI with other basic indicators is the *Cambridge Hook*.[18] It is intended to identify an early reversal of the current trend by combining the following indicators. The following conditions apply to an existing upwards trend:

- An outside reversal day (a higher high followed by a lower close).
- Wilder's RSI must exceed 60% (moderately overbought).
- Volume and open interest must be increasing.

The result is a high likelihood of a downward trend reversal (the opposite applies to upward trend reversals). Protective stops are placed above the high of the hook on the day that signaled a downward reversal.

[16]Donald R. Lambert, "The Market Directional Indicator," *Technical Analysis of Stocks & Commodities* (November/December 1983). This article also contains a BASIC computer program to calculate the MDI.

[17] J. Welles Wilder, Jr., *Chart Trading Workshop 1980* (Trend Research, Greensboro, NC, 1980).

[18] Elias Crim, "Are You Watching the 'Right' Signals?" *Futures* (June 1985).

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MOMENTUM DIVERGENCE

Divergence occurs when two price series move apart. The Dow Jones Industrials and Dow Jones Utilities are diverging if the Industrials are rising while the Utilities are falling. Divergence between these two markets has always been considered a leading indicator of a downturn in the economy. The S&P 500 is also watched in relationship to the 10-year Treasury note, the benchmark long-term rate. Notes usually counterbalance moves in the stock market. When the S&P rallies, the price of notes falls to reflect the anticipation of higher interest rates. When the S&P and the price of notes both rise, or both fall, something special is happening. When prices diverge with an indicator, such as an unsmoothed momentum or the MACD, the direction of prices are expected to follow the direction of momentum.

Momentum divergence is measured by comparing the direction of prices with the direction of the momentum indicator value over the same time interval. Most often, this is done by connecting the peaks of the price movement when prices are rising (or the valleys of the price declines). Connecting only the peaks and valleys of both prices and momentum avoids the problems associated with erratic data. Figure 9.17 shows three examples of a 20-day momentum divergence for Intel.

Figure 9.17: Momentum divergence.

A *bearish divergence* is one that anticipates a downturn in prices. Because momentum is the leading indicator, a bearish divergence occurs when prices are rising while the momentum values are falling. This can be seen in the middle of Figure 9.17 where line 2 shows sharply rising prices at the same time that line *B* shows clearly falling momentum values. Price follows momentum, and a sharp decline lasts for all of December 2002.

A *bullish divergence* is formed when prices are declining while momentum values are rising. Two examples of a bullish divergence can be seen in Figure 9.17 marked with *1* and *3* on the price chart and *A* and *C* on the momentum indicator.

The important points to remember about a divergence are:

- Prices and momentum must be moving in opposite directions. It is not correct to say there is a bullish divergence when momentum is rising quickly while prices are moving sideways or slightly higher. They *must* be moving in opposite directions.

- The greater the divergence, the more likely prices will change direction soon. That is, when prices are moving up very sharply and momentum is clearly moving lower, then the likelihood of a fast change of direction for prices is much greater than if prices were gradually rising while the momentum was slowly falling.
- A divergence can be interpreted as a market that is rising slower and slower. Each successive peak is closer to the previous peak, or each successive peak occurs after more and more time has elapsed. This may appear similar to a rounding top before prices start down.
- Divergence that occurs over a longer time period (for example, months) will forecast a larger price reversal than a divergence formed over hours or days.

Momentum divergence allows you to use a momentum indicator effectively without regard to the absolute highs and lows of the momentum values, which was a problem determining overbought and oversold conditions. Regardless of how high momentum goes, the divergence occurs when the values decline or rise relative to prices. The absolute values of momentum are not relevant.

An Amazon.com Example Using Momentum Peaks

Momentum divergence is an important concept. The following example, applied in Figure 9.18, uses the method of momentum peaks with MACD, plus an additional rule. Use the following steps:

1. Find the swing highs on the chart. This can be done simply by looking at the highest peaks. In Figure 9.18 there are two significant peaks, one in January 1999 and the other at the end of April 1999. There is a peak slightly earlier in April; however, that is part of the price move that ends with a rally to 110.
2. Draw a line connecting the January and April peaks.
3. There will be two corresponding peaks in the MACD lines directly below the price chart. Connect the two peaks in the MACD line.
4. The line drawn across the price highs is clearly rising. The line across the MACD peaks is clearly falling; therefore, the pattern indicates a *bearish divergence*. Prices confirm the divergence by dropping from 110 to 70 in less than two weeks, and below 50 in the same move.

Figure 9.18: An example of divergence in Amazon.com.

There is also an unmarked bullish divergence on the chart. Prices bottom in June and August with clearly rising lows in the MACD occurring at the same time. The August price low marks the bottom of the move and a rally follows.

Trading Rules for Divergence

There are a number of alternative rules for trading a momentum divergence, each differing in the amount of anticipation.

MACD Divergence

The simplest of rules is based on using the MACD to create a bearish divergence. Once the second rising price peak is identified, along with the corresponding MACD peak, the divergence sell signal comes when the MACD line crosses the signal line as it moves lower. This is seen in Figure 9.18 at the end of April. The trade is exited when the MACD value becomes zero, or if a price objective is reached, based on a top formation. The same rules apply to a bullish divergence.

General Rules for Trading Momentum Divergence

1. *Enter a short position when the divergence is identified, provided prices have not already reached the correction level or profit target.* Bearish divergence is recognized after the second momentum peak has crested; therefore, it is possible that the momentum value will be near neutral (the midpoint value). The neutral momentum is the normal profit because we cannot expect high momentum to alternate with low momentum, but we can expect high or low momentum to correct to neutral, or zero. Waiting until the divergence is extremely clear is often too late. Momentum will have achieved most of its correction. An alternative is discussed in the following section, Anticipating the Divergence.

2. *Enter a short position using MACD when the MACD line crosses the signal line after the divergence formation is recognized.* MACD offers a clear signal: The crossing of the faster MACD line with the slower signal line. This is a basic buy or sell signal and applies equally to divergence patterns.

3. *Exit the short position when the current momentum moves above the last momentum peak.* A new momentum high, following a divergence signal, indicates that the divergence has disappeared and there is no basis for this trade. The exact price at which this occurs may be calculated one day in advance for most momentum indicators.

4. *Exit the short position when the market has corrected or an objective has been reached.* Once the momentum has declined to the midpoint level of 50 for the RSI and stochastic, or zero for the simple momentum, it should be considered neutral and cannot be expected to continue on to negative values. A price objective can also be set using volatility or support levels.

5. *Exit the MACD short divergence when the MACD crosses the signal line moving higher.* MACD provides a signal that may allow the divergence trade to be held longer, or exited quickly. In Figure 9.18 the MACD line gives at the beginning of May and does not give another buy signal to close out the trade, until mid-June. This adds considerable profit to the trade.

6. *Allow the short divergence position to convert to a short trend position.* If the MACD is not used, then a simple trend, such as a moving average, can be substituted. A short divergence signal can be converted to a short trend signal using, for example, one of the trends that creates the MACD.

Anticipating the Divergence

Divergence signals are often recognized too late. When the second momentum peak is recognized, especially when the divergence is very severe, the momentum values are already near their neutral value, 50 or zero. Anticipating the divergence signal can be a more successful approach to trading.

Bearish divergence can be anticipated at the point where prices move above their previous resistance level. This is shown in Figure 9.18 with the line market *horizontal resistance.* Once prices move higher there is always a potential divergence. If the current value of momentum is lower than the value of momentum at the previous price peak, an *anticipated divergence* sell signal exists. The short sale is now entered as prices are rising as long as the current momentum value is below the last peak momentum value. For Amazon.com, that means holding a short position while prices continue higher. The trade is exited if the momentum value continues higher and exceeds the previous peak momentum value. This method offers the best opportunity for profiting from the entire downward reversal, but at higher risk. A less risky alternative would be to divide trading capital into three parts, then

- *Sell* the first third when prices make a new high and the MACD value is much lower.
- *Sell* the second part when the MACD value moves to within 15–20% of the previous MACD high.
- *Sell* the third part when the MACD value crosses the signal line heading down.

If there is only one choice, it is better to take the second signal. If there are two choices, take the first and second. If you only take the third sell signal, when the MACD crossed the signal line, prices will have already dropped significantly and you will be disappointed with your entry price and the lack of profit opportunity.

Exiting a Divergence Trade

A bearish divergence is a special case of overbought prices. Prices have reached new highs but have slowed down and give every sign of wanting to reverse direction. As with other overbought situations, once prices have returned to a neutral position, the trade is over. For divergence, that happens when the value of the MACD reaches zero. It is possible to play for a small penetration of zero, because of market noise, but there is a tradeoff between adding a small amount of profit to each trade and missing a few additional profit targets. As mentioned earlier, divergence can be combined with a simple trend system so that, when prices approach the profit target moving lower, the trade can be continued by shifting to the trend system if the trend has turned down. In that way the trend entry timing can be improved for special situations where a divergence pattern has formed.

The Divergence Disappears.

Not all trades reach their profit targets. Once a short sale has been entered following one or more of the bearish divergence rules, that trade should be exited if the MACD, or momentum value, rises above the last momentum peak. For example, a bearish divergence followed after a momentum peak of 95 was followed by a second peak of 85. After entering a short position, momentum drops to 75, then prices rally. Momentum now moves above 85 and the divergence pattern has disappeared. Exit the trade. Prices are now rising faster than they were at the time you entered the short position and a renewal of the uptrend is indicated.

Single, Double, and Triple Divergences

In fewer cases, double and triple bearish divergences will occur. A double bearish divergence is one in which three momentum peaks are declining with prices rising at each corresponding momentum peak. Most often, the second momentum peak is only slightly lower than the first, and the last peak drops off noticeably, indicating that a drop in price is soon to follow. Multiple divergences are expected to be more reliable than single divergency, and represent a prolonged period in which prices are rising at a slower and slower rate, in the manner of a rounded top.

Alternating Divergence Peaks

A common bearish pattern is where a lower momentum peak falls between two declining peaks. For example, the first momentum peak is at 90, the next at 60 and the last at 75. When studying the price and momentum charts, most analysts will ignore the lower peak in the middle and consider only the 90-75 divergence. In the following section, this combination can be automated by looking at the most recent momentum peak, *i*, and the previous two momentum peaks, *i* - 1 and *i* - 2, along with their corresponding prices.

Identifying Divergence Using a Computer Program

The peaks or valleys of any momentum indicator can be compared to the corresponding peaks or valleys of the price series that was used to calculate the momentum values. In a programmed version of divergence, the stochastic indicator is used instead of either a simple momentum or the MACD. Price peaks and valleys are first identified using the swing technique explained in Chapter 5. Momentum values are then chosen corresponding to those price extremes. All other momentum values are ignored for the purpose of deciding on the entry signal. If the momentum peaks are declining and the price peaks are rising, there is a bearish divergence. If momentum peaks are rising and the price peaks are falling, there is a bullish divergence.

In addition to the standard single divergence, the following program recognizes a double divergence, the combination of three rising price peaks and three declining momentum peaks.

It is easier to find divergence by looking at a chart on a quote screen than to program it into a computer. Translating what you see into a systematic analysis of divergence signals is very difficult. You will find that this program does not always find the divergence that seems obvious to the eye. A divergence may be missed when there is a steady rise in prices that do not create swing highs, even though there is a corresponding steady decline in momentum. This situation is addressed using *slope divergence*.

```
{ TSM Divergence:
  Single and double divergence using TSM SWING and TSM INDEX
  Copyright 1994-2003, P J Kaufman. All rights reserved. }
{ INPUT for TSM SWING
  diverge    1=single divergence, 2=double divergence
  swing      price swing in %
  strength   decline in current indicator high (or low) in percent, from
               last high
  length     number of periods in stochastic
  type       0=normal price, 1= discounted rates, 2=coupon rates
  exit       value added or subtracted from 50 for exit criteria
  fastx      close-out when slowK stochastic touches this value
}
input: diverge(1), swing(2.0), strength(5), length(5), type(0), exit(0),
    fastx(10);

vars: pcswing(0), last(0), curhigh(0), curlow(0), swhigh(0), swlow(0),
    swhigh1(0), swlow1(0), highbar(0), highbar1(0), STslowk(0),
    lowbar(0), lowbor1(0), chighbar(0), clowbar(0), exittype(0),
    STtoday(0), SThigh(0), STlow(0), curSThigh(0), curSTlow(0),
    xhigh(0), xlow(0), xclose(0),signal(0),
    highclose(0), lowclose(0), chighprice(0), clowprice(0);

pcswing = swing/100.;
STslowk = SlowK(length);
STtoday = SlowD(length);

xclose = close;

xhigh = high;
xlow = low;
if type = 1 then begin
    xclose = 100. - close;
    xhigh = 100. - low;
    xlow = 100. - high;
    end;
if type = 2 then begin
    xclose = 600/close;
    xhigh = 600/low;
    xlow = 600/high;
    end;
{ SWINGS: INITIALIZE MOST RECENT HIGH AND LOW }
if currentbar = 1 then begin
{ Initialize curhigh and curlow }
   curhigh = xhigh;           {current high price}
```

```
   curlow = xlow;             {current low price}
   end;

{ SEARCH FOR A NEW HIGH }
if last<>1 then begin
     if xhigh > curhigh then begin
        curhigh = xhigh;      {save values at new high}
        curSThigh = STtoday;
        chighbar = currentbar;
        end;
     if xlow < curhigh - curhigh*pcswing then begin
        last = 1;              {last high fixed}
        if type = 0 and exittype = -1 then exittype = 0;
        if type <> 0 and exittype = 1 then exittype = 0;
        swhigh1 = swhigh;      {previous high}
        highbar1 highbar;
        swhigh = curhigh;      {new verified high}
        highbar = chighbar;
        curlow = xlow;         {initialize new lows}
        if type = 0 then begin
              SThigh = curSThigh;
              highclose = swhigh;
              end
            else begin
              STlow = curSThigh;
              lowclose = close[currentbar - highbar];
            end;
         clowbar = currentbar;
         end;
      end;

{ SEARCH FOR A NEW LOW }
if last <> -1 then begin
   if xlow < curlow then begin
     curlow = xlow; {save values at new lows}
     curSTlow = STtoday;
     clowbar = currentbar;
     end;
   if xhigh > curlow + curlow*pcswing then begin
   last = -1;
   if type = 0 and exittype = 1 then exittype = 0;
   if type <> 0 and exittype = -1 then exittype = 0;
   swlow1 = swlow;
   lowbar1 = lowbar;
   swlow = curlow;
   lowbar = clowbar;
   curhigh = xhigh; {initialize current high}
   if type = 0 then begin
         STlow = curSTlow;
         lowclose = swlow;
         end
       else begin
         SThigh = curSTlow;
        highclose = close[currentbar - lowbar];
      end;
    chighbar = currentbar;
    end;
  end;


{ DIVERGENCE LOGIC }
if type = 0 then begin
      chighprice = curhigh;
      clowprice = curlow;
      end
    else begin
      chighprice = high[currentbar - lowbar];
      clowprice = low[currentbar - highbar];
    end;


{ SINGLE DIVERGENCE }
if diverge = 1 then begin
If ((type = 0 and last = -1) or (type <> 0 and last = 1)) and
    exittype <> -1 and close > highclose and high = chighprice and
    STslowk > fastx and (STtoday[1] > 50+exit or STtoday < STtoday[1]) and
    STtoday < SThigh - strength then begin
     sell on close;

     signal = -1;
     exittype = 0;
     end;
if ((type = 0 and last = 1) or (type <> 0 and last = -1)) and
    exittype <> 1 and close < lowclose and low = clowprice and
    STslowk < 100-fastx and (STtoday[1] < 50-exit or
      STtoday > STtoday[1]) and
    STtoday > STlow + strength then begin
     buy on close;
     signal = 1;
     exittype = 0;
     end;
  end;

{ DOUBLE DIVERGENCE - MIN ON CURRENT STOCH ONLY ]
if diverge = 2 then begin
```

```
    If last = -1 and xhigh = curhigh and STslowk > fastx and
       (STtoday[1] > 50+exit or STtoday < STtoday[1]) then begin
       If xclose > swhigh and swhigh > swhighl and
          STtoday < SThigh - strength and
          SThigh < SlowD(length)[currentbar - highbar1] then begin
          if type = 0 then begin
              sell on close;
         signal = -1;
         exittype = 0;
         end
      else begin
         buy on close;
         signal = 1;
         exittype = 0;
         end;
       end;
     end;
if last = 1 and xlow = curlow and STslowk < 100-fastx and
  (STtoday[1] < 50-exit or STtoday > STtoday[1]) then begin
  if xclose < swlow and swlow < swlow1 and
      STtoday > STlow + strength and
      STlow > SlowD(length)[currentbar - lowbar1] then begin
      if type = 0 then buy on close else sell on close;
      end;
    end;
  end;

{ Get out if divergence disappears or swing reverses }
if (STtoday > SThigh or STtoday=100) and signal=-1 then begin
    exitshort on close;

    signal = 0;
    exittype = -1;
    end;
if (STtoday < STlow or STtoday=0) and signal=1 then begin
    exitlong on close;
    signal = 0;
    exittype = 1;
    end;

{ Get out if Stochastic reverses after crossing thresholds }
if STslowk <= fastx or (STtoday[1] < 50+exit and STtoday > STtoday[1])
    and signal=-1 then begin
    exitshort on close;
    exittype = -1;
    signal = 0;
    end;
if STslowk >= 100-fastx or (STtoday[1] > 50-exit and STtoday < STtoday[1])
    and signal=1 then begin
    exitlong on close;
    signal = 0;
    exittype = 1;
    end;

print(date:6:0,high:3:2,low:3:2,close:3:2,highclose: 3:2,loweclose: 3:2);
print(curhigh:3:2,curlow:3:2,swhigh:3:2,swlow:3:2);
print(STtoday:3:1,STlow:3:1,SThigh:3:1,STslowk:3:1,
  signal:3:0,exittype:3:0);
```

Slope Divergence

One of the problems in using peak prices and peak momentum values is that some of the most obvious divergence situations are missed. Prices can move higher or lower steadily, without large swings, while momentum moves the other way. This will happen during a very orderly rounded top or rounded bottom formation. Without peaks that can be identified using a swing analysis, this pattern is missed.

An alternative technique is to analyze the slope of both the price movement and the momentum indicator over the same time interval. This can be done using a spreadsheet function, *slope*, or the TradeStation function *LinearRegSlope*, over a specified time interval. Because momentum is a way of detrending the price series, the period used for the calculation should not be too long; otherwise the slope values of the momentum will tend towards zero.

Divergence can be any combination of conflicting directions between the slope of price and the slope of momentum, including prices rising faster than momentum, momentum rising faster than prices, or the opposite. However, classic analysis has focused on momentum as a leading indicator of a change in the price trend, which limits the combinations to:

- Prices rising and momentum falling (a *bearish divergence*).
- Prices falling and momentum rising (a *bullish divergence*).

The *strength* of a bearish divergence, which is helpful when selecting which situations are best for trading, can be determined primarily by the momentum slope, but can also be assessed as the net difference between the rising slope of prices and the falling slope of momentum. When comparing the two slopes, care must be taken because the angle of price movement can be far greater than the angle of momentum movement.

Slope Divergence Using Double Smoothing

Double smoothing, discussed earlier in this chapter, is a tool that represents the trend of momentum but may not show many momentum peaks; therefore, it becomes a good indicator for slope divergence. In Figure 9.19 there is a long upwards move in the Nasdaq 100 throughout 1999. The price swings are relatively small and may not be picked up using a swing value that worked during prior years. At the same time there is a steady

decline in momentum, represented by a double smoothing of 20-20-20 (a 20-day momentum, smoothed twice using 20-day exponentials). Lines are drawn through both prices and momentum to show the slope of the corresponding movement.

Figure 9.19: Slope divergence of Nasdaq 100 using double smoothing.

One way to produce a trading signal for the two slope calculations is to monitor their relative movement. While they remain constant or are moving apart, no action is taken. Once the slope values begin to converge beyond a threshold value representing normal variance, a short sale signal is produced. After that, normal price targets apply. If the price slope continues to decline the trade should be held. If the momentum slope rises above its value at the time of the short sale signal, the trade should be exited, or if the slopes begin to diverge significantly, the trade should also be exited.

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SOME FINAL COMMENTS ON MOMENTUM

Because momentum and oscillators are very different from either a charting technique or moving averages, they have become important in technical analysis. However, when the time interval for calculation is small, these indicators can be highly unstable, jumping from frequent overbought signals to just as frequent oversold ones. Momentum indicators with longer and shorter calculation periods have the common problem of risk control. The method implies that a position should be entered contrary to the direction of price movement. Unusually large losses may result from this style of trading.

It is not likely that a momentum indicator can be found that will identify only the trades that will be profitable; therefore, momentum is most often used as a timing tool within another more conservative strategy. In this approach, the calculation period is tuned to allow the momentum values to reach extremes with a certain frequency. Momentum values that are not extremes give us very little useful information. Consider a trending strategy where each trade is held for an average of 20 days. A fast oscillator can be created to provide entry timing. If you are willing to wait up to two days to enter a trade after the trend signal has been given, then construct a 10-period oscillator of 1-hour bars, or a three-period oscillator of daily bars. Test the oscillator to see if it generates at least one, but preferably two, oversold signals during each 2-day period. If so, use it to time your entry and you are likely to be buying dips rather than rallies.

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Chapter 10: Seasonality

OVERVIEW

Chapter 6 introduced prices as a time series and identified its four components as the trend, the seasonal pattern, the cycle, and chance (random) movement; it included various ways of finding the trend using statistical analysis and forecasting techniques. Chapter 7 then showed various ways to calculate trends. Of all techniques, the trend is overwhelmingly the most popular foundation for trading systems. In this and the next chapter we turn our attention to two other principal components, the seasonal and cyclic movements.

Seasonality is a cycle that occurs yearly. It is most often associated with the planting and harvesting of crops, which can directly affect the feeding and marketing of livestock. Normally, prices are higher when a product is not as readily available, or when there is a greater demand relative to the supply, as often occurs with food or heating oil during the winter months and electricity during mid-summer. For grain, the season is dominated by planting, harvest, and weather-related events that occur in between. Most crops have been produced in the northern hemisphere, but South American soybeans and orange juice have become a significant factor since the early 1980s, as have Australian and New Zealand beef and lamb, resulting in a structural change in seasonal patterns. Globalization has not only affected financial markets, but nearly everything we purchase.

Consumer habits can cause a seasonal pattern in metals and stocks as weather does for agricultural products. Passenger airline traffic, along with the travel and hotel industry, is much more active in the summer than in the winter, and profits of those companies that are not diversified reflect that seasonality. Gasoline is in high demand during the summer, when most of the population in the northern hemisphere makes room for each other at the beach. Eastman Kodak once had a classic pattern caused by much more active picture-taking during the summer months, which was also reflected in the price of silver, used to make film.

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A CONSISTENT FACTOR

Even when the impact of seasonality on agricultural products is not clear from the price patterns, it is still there. Consider the following factors that do not change:

- More corn, wheat, and soybeans are sold during harvest than at any other time of year because there is not enough available storage to hold all of the new crop. Rental storage, when available, requires a minimum three-month charge. Lack of storage and the need for immediate income result in greater sales and cause prices to decline.
- Because feedgrains are harvested only once each year, forward contracts include a storage cost as part of the total carrying charge. Therefore, each forward delivery price should be higher within the same crop year.

Sometimes the price pattern of forward months do not seem to reflect the added costs of carry. Occasionally these markets even invert and the nearest delivery trades at a price higher than the deferred months, a situation familiar to crude oil and copper. The cost of carry, however, still exists in an inverted or *backwardation* market. Extreme short-term demand pushes the nearest delivery much higher, while the events causing price disruption are expected to be temporary. The normal carry is still there; it is just overwhelmed by temporary demand.

Seasonal stocks reflect the same factors as agricultural products. While holiday travel may vary by 10% in a given year, there is still a strong seasonal pattern. The profitability of a company may decline, sending share prices lower, during a poor travel year, yet the seasonality is still there.

It is important to be able to identify seasonal patterns. Seasonal patterns can bias the size of the positions traded throughout the year, and they can identify changes in risk. The methods for finding them are simple, and made more so by the use of a spreadsheet program on a computer. These will be discussed in this chapter along with some practical applications.

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THE SEASONAL PATTERN

Seasonal patterns are easier to find than the longer-term cycles or economic trends, because they must repeat each calendar year. Although any 12-month period can be used to find the seasonal pattern, academic studies in agriculture usually begin with the new crop year for grains, just following harvest, when prices tend to be lowest. This approach makes the carrying charges, which increase steadily throughout the new crop year, more apparent. For uniformity, the examples in this chapter always begin with a calendar year, which assumes no knowledge of where the season starts, and can be equally applied to stocks. They always include carrying charges as an integral part of the market price.

United States agricultural production is considered to be the standard for "seasonal," even though a wheat crop is harvested continuously throughout the year in different parts of the world. Prices are expected to be lower during the U.S. harvest and highest during the middle of the growing season. The influence of world stocks and anticipated harvest from other major producers in South America or Russia will cause an overall dampening or inflating of prices, rather than change the seasonal pattern. While the cost of transporting grain to the United States is not practical except for special products, each purchaser in the world market will select a supplier at the best price. This fungibility has a direct impact on the U.S. market, which must alter its local price based on export demand.

Industrial commodities have seasonal price variation based on demand. Silver, although increasingly used in electronics as a conductor, is also consumed for jewelry and photography, and has served as a general hedge against inflation. It still shows a seasonal pattern of greater demand during the summer months. Almost half of all copper is used in electrical and heat conductivity, with much of it in the form of an alloy with nickel and silver. Its seasonality is heavily related to the housing industry, where it is required for both electrical and water systems. New sources of ore are introduced infrequently, and the possibility of discovery or expansion is rarely seen in price movement as short-term anticipation. The primary supply problems in copper are related to labor as well as social and political changes in producing countries.

There are many businesses with finished products that have seasonal demand and their publicly traded stock prices will reflect that tendency. Because the shares in a company are far removed from buying and selling the raw materials that they use, even major oil companies, such as Exxon, may not show a seasonal pattern similar to crude oil or its refined products. As with Eastman Kodak, these firms have thoroughly diversified and the impact of a $1.00 increase in a barrel of oil, or a $.50 increase in an ounce of silver, will have only a small effect on the profitability of the firm, and may be the cause of stock prices advancing or declining. Yet some industries, such as airlines, still show seasonal patterns and the same procedures given here can be used to find them.

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POPULAR METHODS FOR CALCULATING SEASONALITY

Seasonal patterns are most often calculated using monthly data, although some studies have tried to pinpoint their periodic turns to specific days. As with most other analysis, closer observation and shorter time periods also bring more noise and erratic results. With this in mind, the seasonal studies in this chapter will use monthly data and keep an eye towards the big picture.

An Important Note about the Data

There is one important caveat about the futures prices used in some of these examples: They were created using a computer program that averaged the prices of continuous, back-adjusted futures data. Continuous futures data are much easier to study than many individual delivery months. To create a continuous data series it is necessary to close the price gap between the old futures contract and the new one, then adjust all the data backwards to reflect the value of that closed gap. The continuous data works well for trend analysis, but the oldest data may be much higher or lower than actual prices at that time due to the aggregate effect of adjusting dozens of gaps. In the case of soybeans, the prices in the mid-1970s are about $2 per bushel higher. In other cases, such as interest rates, prices that have been adjusted back 25 years can actually become negative because of gap-adjusting. A precise seasonal analysis will need to use continuous cash prices, rather than a constructed series, in order to have valid percentages. Results of these examples, however, show seasonality similar to studies that use cash data because the process uses the relative change from one period to the next. Results cannot be expressed as percentage changes when using continuous futures data because the starting prices are not the real prices at the time.

You may see a similar problem in stock data that has been adjusted for splits over many years, although the number of splits will be far less than the number of futures contracts. The following terminology and concepts will also be of help.

Basic Calculation Components

Average Prices

Finding the seasonal pattern does not need to be complicated; however, some basic rules must be followed to get sound results. For most analysts it is easiest to begin with a spreadsheet, where the months are recorded in each column and the rows represent years (see Table 10.1). The average monthly price, placed in each cell, can give a good indication of seasonal patterns by simply averaging each column and plotting the results as shown in the first of four summary lines at the bottom. The major criticism of this technique is that it ignores the changing price levels over time. For example, a 25-year study of soybeans will use prices that vary from $6 to $15 per bushel; price changes at the $15 level, which will be much more volatile, could overwhelm other years.

Table 10.1: A Simple Spreadsheet of Soybean Continuous Prices Used to Calculate Seasonality, January 1969-March 1994

Open table as spreadsheet

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1969		864.25	861.49	862.19	863.01	858.69	858.80	860.54	861.87	867.16	868.03	864.93
1970	867.63	869.54	869.60	872.78	874.63	884.77	897.16	886.76	886.35	899.88	903.66	893.26
1971	898.53	897.55	893.45	880.20	886.94	904.42	921.19	914.26	906.00	910.26	902.01	901.48
1972	895.65	902.05	919.41	929.94	926.67	921.09	923.55	933.46	938.41	939.28	964.17	1,014.17
1973	1,041.85	1,160.47	1,207.83	1,237.30	1,479.24	1,742.11	1,614.95	1,625.46	1,447.32	1,386.66	1,366.76	1,400.54
1974	1,421.55	1,440.51	1,421.02	1,349.11	1,333.74	1,338.68	1,494.40	1,564.05	1,550.65	1,641.64	1,557.45	1,502.73
1975	1,397.31	1,316.00	1,296.59	1,309.60	1,259.08	1,257.19	1,309.94	1,362.02	1,322.94	1,274.00	1,223.55	1,200.99
1976	1,202.23	1,206.63	1,198.87	1,199.08	1,242.14	1,346.01	1,390.06	1,343.23	1,374.02	1,334.56	1,354.S6	1,378.63
1977	1,405.80	1,429.39	1,530.15	1,674.19	1,654.75	1,528.26	1,338.09	1,282.88	1,276.89	1,281.76	1,341.63	1,339.57
1978	1,318.89	1,308.17	1,405.67	1,432.15	1,457.25	1,430.45	1,402.49	1,401.79	1,429.71	1,462.75	1,450.14	1,454.29
1979	1,455.56	1,507.17	1,512.11	1,487.64	1,468.67	1,512.75	1,490.85	1,444.92	1,443.93	1,402.70	1,385.35	1,372.22
1980	1,349.35	1,345.31	1,296.90	1,258.64	1,265.33	1,273.88	1,381.11	1,389.58	1,443.61	1,462.46	1,503.93	1,376.24
1981	1,331.45	1,295.86	1,274.55	1,303.43	1,265.01	1,215.83	1,217.81	1,166.05	1,128.24	1,120.83	1,099.49	1,073.70
1982	1,071.16	1,061.58	1,043.26	1,069.54	1,066.54	1,031.98	1,014.69	970.88	942.15	925.95	952.31	946.44
1983	962.06	966.88	966.84	997.69	975.11	946.78	1,001.16	1,180.75	1,219.30	1,161.25	1,126.77	1,087.83
1984	1,050.26	1,013.08	1,063.32	1,061.60	1,115.75	1,044.36	925.35	905.08	881.33	884.79	882.83	851.28
1985	839.61	828.53	827.95	832.40	801.97	802.49	783.00	749.13	749.08	741.63	734.20	744.80
1986	751.60	732.11	734.80	727.88	736.89	731.60	729.80	712.85	721.77	723.93	738.30	730.17
1987	730.95	721.58	724.00	746.27	786.56	790.14	760.89	745.75	765.98	779.60	801.36	827.67
1988	844.45	839.96	845.47	884.14	941.81	1,141.24	1,089.10	1,054.39	1,047.42	983.19	947.68	955.57
1989	944.82	908.12	921.08	878.15	871.92	865.17	853.74	803.79	799.35	784.18	793.12	784.49

1990	765.99	759.18	775.75	782.14	794.74	766.06	764.33	760.61	762.74	749.39	707.18	703.31
1991	676.36	676.92	677.86	678.95	657.93	647.31	618.11	645.13	657.74	623.35	612.85	607.04
1992	617.61	623.71	634.11	616.58	638.74	646.25	600.35	581.62	585.24	575.91	592.95	601.81
1993	604.95	595.58	606.53	614.75	623.34	624.38	723.39	690.78	656.85	633.55	678.65	697.77
1994	705.29	685.07	683.95									
Average (Avg)	1,006.04	998.28	1,007.41	1,027.45	1,039.51	1,050.08	1,044.17	1,039.03	1,031.96	1,022.03	1,019.54	1,012.44
Adj Avg (Nrm)	-1.83	-2.59	-1.70	0.26	1.43	2.46	1.89	1.39	0.70	-0.27	-0.52	-1.21
Median (Mdn)	944.82	905.085	920.245	929.94	941.81	946.78	925.35	933.46	938.41	925.95	947.68	946.44
Adj Median (NMdn)	1.118	-3.08	-1.45	-0.42	0.85	1.39	-0.91	-0.04	0.49	-0.84	1.48	1.35

Indexing the Data

A simple way to adjust for price differences over time is by indexing data, where each new entry is based on a percentage change from the previous value. This method will work well for seasonal studies, but must use unadjusted cash data. Because the futures monthly average prices for these examples were created from continuous data, they cannot be used for this purpose; however, stock data will work. Begin by giving the first monthly average price, for example, $25, the index value of 100. Each subsequent monthly average price increases or decreases the index by the percentage change. If the second month had an average price of $27, then 100 × 27 / 25 = 108, an increase of 8%. If the third month showed an average of $26 then the index value becomes 108 × 26 / 27 = 104. This method can be found in the section "The Index" in Chapter 2. Once the data has been indexed, the average results are interpreted as percentage changes.

Percentage Change

Percentage changes can be calculated directly rather than by indexing. Over the many years needed for a seasonal study, prices may increase by a factor of two or three, and the magnitude of volatility at these different levels will vary significantly, distorting the results. To correct for the problems associated with a long-term increase or decline in price, a monthly percentage change can be directly substituted for the average price. The use of percentages makes most of the volatility changes appear normal. It is a simple and very credible method for finding seasonality, but its results can be more erratic than the sophisticated calculations found in the next section.

Table 10.2 shows percentage monthly changes for UAL, the parent company of United Airlines. Along the bottom are the average monthly changes and the percentage of years that the average changes were positive. In April the average change in share price was up 6.4%. During the 16 years included, 81% of those years posted increases in share price.

Table 10.2: UAL Monthly Percentage Changes and Monthly Averages

Open table as spreadsheet

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1984								0.099	-0.005	0.062	0.028	0.035
1985	0.062	0.003	0.003	-0.051	0.063	0.170	0.017	0.025	-0.095	-0.052	0.012	0.029
1986	0.016	0.114	-0.017	0.048	0.018	-0.085	-0.071	0.038	0.078	0.018	0.003	-0.015
1987	-0.350	0.015	0.039	0.180	0.047	0.245	0.044	0.025	0.024	-0.098	-0.188	-0.024
1988	0.028	0.004	0.114	0.014	0.014	0.078	0.072	-0.035	-0.006	0.062	0.025	0.077
1989	0.045	0.103	-0.050	0.035	0.031	0.018	0.325	0.449	0.145	-0.194	-0.219	-0.047
1990	-0.075	-0.156	0.104	0.082	-0.028	0.013	0.013	-0.329	-0.076	-0.012	0.015	0.108
1991	0.100	0.160	0.051	0.057	-0.013	-0.018	-0.040	-0.025	-0.071	-0.004	-0.011	0.021
1992	0.146	-0.001	-0.007	-0.120	-0.057	-0.054	-0.013	-0.072	0.034	0.055	0.048	-0.004
1993	0.048	-0.040	-0.025	0.174	-0.014	-0.066	0.033	0.097	-0.019	0.015	0.008	0.017
1994	-0.020	-0.022	-0.094	-0.015	-0.039	-0.007	0.158	0.064	-0.058	-0.084	0.087	-0.055
1995	0.064	-0.001	0.011	0.167	0.033	0.117	0.131	0.031	0.096	0.046	0.106	0.027
1996	-0.156	0.042	0.152	0.077	0.034	0.000	-0.095	0.000	-0.061	-0.030	0.152	0.159
1997	-0.039	0.008	0.135	0.082	0.047	-0.019	0.019	0.039	0.054	0.109	-0.062	0.040
1998	0.000	-0.021	0.011	0.030	-0.108	-0.040	0.079	-0.178	-0.047	-0.052	0.024	-0.058
1999	0.026	-0.009	0.154	0.130	-0.041	-0.181	0.011	-0.026	0.065	-0.016	0.025	0.109
2000	-0.106	-0.196	-0.011	0.138	-0.016	-0.059	0.016	-0.105	-0.087	-0.162	-0.039	-0.017
2001	0.094											
Average	-0.007	0.000	0.036	0.064	-0.002	0.007	0.044	0.006	-0.002	-0.020	0.001	0.024
%+months	0.65	0.50	0.63	0.81	0.50	0.44	0.75	0.59	0.41	0.41	0.71	0.59

The bar chart in Figure 10.1 shows the monthly changes, expressed as whole percentages, that appear along the bottom of Table 10.2. Share prices increase noticeably in March, April, July, and December. The slowest months are August through November. These increases include advanced ticket purchases, so that the increase in March and April are likely to reflect summer holiday travel.

Figure 10.1: Monthly percentage changes for UAL, August 1984 through January 2001.

A typical seasonal chart is created by plotting the cumulative monthly changes, as shown in Figure 10.2. The large consecutive increases during March and April appear as a sharp gain near the beginning of the chart. The overall seasonality seems to be less important than the strong upwards trend. This reflects the strong price gain from about $8 to $90 throughout the 1990s and the initial downturn after 2000, and avoids the events of 9/11/2001 that overwhelmed price movement. Figure 10.3 shows the corresponding percentage of months with positive percentage changes and can be used to confirm the seasonal trend. The importance of this example is that a strong trend can overwhelm the seasonality. The techniques that follow will try to correct this problem.

Figure 10.2: Seasonality of UAL showing strong underlying trend from 1984 through 2000.

Figure 10.3: UAL percentage of months with positive percentage changes in share price.

Detrending

Detrending, as seen in the previous section, is essential to finding a clear seasonal pattern. Although seasonality will always affect prices, a strong trend can overwhelm the seasonal movements. Detrending can be accomplished by using linear regression, moving averages, yearly averages, first differences, as well as the more complicated techniques of *link relatives* and *X*-11. Detrending will remove the upwards bias in Figure 10.2. These are discussed later in this chapter.

Median Price

The median is the "middle price" of a series of values that have been sorted in numerical order. Instead of using an average monthly price, the individual daily prices can be sorted and the middle one chosen, or instead of using the monthly averages, the middle average price can be chosen. In general, using the median value should improve results because it ignores the extreme prices that occur during some unusual years. An extreme price can affect the average but not the median, which always returns a typical price. For example, if the average September price of heating oil was 50¢ per gallon for four years, but reached $1.00 per gallon during one year, then the average would be 60¢ and the median would be 50¢. Later in this chapter you might note that a large difference between the median and the average prices indicates that there were a few volatile years mixed in with mostly normal patterns. The median is not often used because it is inconvenient to calculate.

Effects of a Few Volatile Years

All seasonal calculations can be distorted by a few very volatile years that show large percentage changes, especially during a time when there is not normally a strong seasonal bias. For example, if heating oil prices were stable for four years, or tended slightly lower, then jump 100% in one unusual period, the result of an OPEC announcement coupled with low inventories, the average will show a seasonal increase of 20%. In fact, that is what happens in many markets where one or two unrelated events cause a price change that can be interpreted as seasonal. In a computerized environment, the use of the median (discussed above) or more data can prevent mistakes; however, common sense will also show that a single extreme year distort the averages. It does serve to point out the risk of seasonal trading, which will post extremes only in the direction of higher prices.

A Program to Create a Table of Monthly Price Changes

Creating a table of price changes in order to evaluate seasonality is a tedious task. The UAL monthly changes, shown in Table 10.2, were created using the following TradeStation system. The results are written to a file named *seasonal.txt* in a directory named *test*. *Seasonal.txt* is a blank-delimited file that can be imported to a spreadsheet. To avoid overwriting this file, and losing its content, rename it before running the program again. The program has no inputs. It will automatically run and produce the output table as soon as it is loaded into the chart workspace. This program can be modified to produce detrended results.

```
{ TSM Save seasonal (monthly) data
  Copyright 1999-2004, P.J. Kaufman. All rights reserved. }

{ Writes an ASCII file with name "c:\test\seasonal.txt" that needs to be
  renamed with the market/stock name }
  vars: cmonth(0), pmonth(0), ix(0), k(0);
  array: months[12](0);

  if currentbar = 1 then begin
{ Writes an ASCII file with a name created from the data series }
  print(File("C:\test\seasonal.txt"),"year jan feb mar apr may jun jul
  aug sep oct nov dec");
  for ix = 1 to 12 begin
     months[ix] = 0;
     end;
  k = 0;
  end;
```

```
    cmonth = month(date);
    pmonth = month(date[1]);
    if cmonth  pmonth and currentbar > 1 then begin
       months[pmonth] = months[pmonth] / k;
  { if end of year then print and clear arrays }
    if pmonth = 12 then begin
      print(File("C:\test\seasonal.txt"),@year(date[1]):4:0,months[1]:6:3,
                  months[2]:6:3,months[3]:6:3,months[4]:6:3,months[5]:6:3,
                  months[6]:6:3,months[7]:6:3,months[8]:6:3,
                  months[9]:6:3,months[10]:6:3,months[11]:6:3,
                           months[12]:6:3);
       for ix = 1 to 12 begin
                 months[ix] = 0;
                 end;
       end;
  { new month begins }
    k = 0;
    end;
  months[cmonth] = months[cmonth] + close;
  k = k + 1;

  { if end of data output final records }
    if lastbaronchart and cmonth = pmonth then begin
       months[cmonth] = months[cmonth] / k;
       print(File("C:\test\seasonal.txt"),year(date[1]):4:0,months[1]:6:3,
               months[2]:6:3,months[3]:6:3,months[4]:6:3,months[5]:6:3,
               months[6]:6:3,months[7]:6:3,months[8]:6:3,
               months[9]:6:3,months[10]:6:3,months[11]:6:3,months[12]:6:3);
       end;
```

Yearly Averages

The most basic way of measuring or describing seasonality is by the monthly variation from the yearly average or, for agricultural products, from the average of the crop year. These values are usually calculated as a ratio or percentage. The results of this technique, using the 1975 corn prices, can be seen in Table 10.3. During this one year, the highest prices occur in January and August and the lowest at the end of the year after harvest, confirming what we might expect of the corn season (with the exception of the January high). The average price for 1975 was 2.92 and the extent of variation throughout the year ranges, coincidentally, 13.7% above and below the average. By applying this method to the 20 years of data for corn shown in Table 10.4, the percentage variation can be shown in the corresponding Table 10.5. For those who prefer using negative percentages to show when values are below the average, simply subtract 100 from each number.

Table 10.3: Percentage of Monthly Corn Prices to the Average

Open table as spreadsheet

	Avg	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Price[*]	2.70	3.07	2.86	2.67	2.68	2.66	2.68	2.72	2.95	2.76	2.62	2.33	2.37
Percent	100.0	113.7	105.9	98.9	99.2	98.5	99.2	100.7	109.2	102.2	97.0	86.3	87.8

[*]Midmonth U.S. farm price, 1975.

Table 10.4: Corn Cash Prices

Open table as spreadsheet

Year	Avg	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1956[*]	1.30	1.14	1.16	1.19	1.32	1.41	1.44	1.45	1.46	1.45	1.12	1.22	1.23
1957	1.25	1.22	1.16	1.18	1.18	1.20	1.20	1.21	1.22	1.13	1.04	.98	1.01
1958	1.10	.97	.98	1.04	1.18	1.20	1.23	1.23	1.24	1.15	1.02	.94	1.04
1959	1.09	1.05	1.06	1.08	1.17	1.18	1.19	1.17	1.17	1.09	.96	1.00	.99
1960	1.03	1.03	1.04	1.04	1.09	1.11	1.11	1.11	1.09	1.07	.97	.82	.92
1961	1.01	.99	1.03	1.04	.98	1.04	1.04	1.06	1.04	1.02	1.00	.91	.94
1962	.98	.94	.95	.96	.98	1.03	1.03	1.02	1.01	1.00	.94	.91	1.00
1963	1.11	1.03	1.05	1.06	1.09	1.12	1.19	1.21	1.21	1.23	1.04	1.02	1.20
1964	1.13	1.12	1.09	1.13	1.15	1.18	1.17	1.14	1.14	1.17	1.05	1.04	1.14
1965	1.18	1.16	1.17	1.19	1.22	1.25	1.26	1.24	1.20	1.18	1.10	1.04	1.13
1966[†]	1.25	1.19	1.20	1.17	1.19	1.21	1.20	1.27	1.34	1.35	1.29	1.26	1.29
1967	1.17	1.28	1.26	1.28	1.26	1.25	1.26	1.21	1.11	1.12	1.04	.97	1.03
1968	1.04	1.04	1.06	1.06	1.06	1.09	1.07	1.04	.99	1.01	.96	1.04	1.05
1969	1.12	1.08	1.09	1.09	1.12	1.19	1.18	1.08	1.18	1.15	1.12	1.07	1.09
1970	1.24	1.12	1.14	1.13	1.15	1.18	1.21	1.24	1.27	1.38	1.34	1.29	1.39
1971	1.27	1.42	1.43	1.43	1.41	1.38	1.43	1.36	1.19	1.11	1.00	.97	1.08
1972	1.17	1.09	1.09	1.10	1.13	1.15	1.13	1.14	1.15	1.22	1.19	1.20	1.42
1973	1.86	1.39	1.35	1.37	1.42	1.16	1.99	2.03	2.68	2.15	2.17	2.18	2.39
1974	2.92	2.59	2.76	2.68	2.41	2.45	2.57	2.91	3.37	3.30	3.45	3.32	3.27
1975	2.70	3.07	2.86	2.67	2.68	2.66	2.68	2.72	2.95	2.76	2.62	2.33	2.37
Average		1.30	1.30	1.29	1.31	1.32	1.38	1.39	1.45	1.40	1.32	1.28	1.34
1976		2.44	2.48	2.50									

[*]1956–1965 midmonth Illinois farm prices (U of I).

[†]1966–1975 midmonth U.S. farm prices (CRB Yearbook).

The long-term seasonality, called the *seasonal adjustment factor*, is the monthly average of the percentages shown in Table 10.5 and appears at the bottom of Table 10.5 and in Figure 10.4. These values must be divided by 100 before they can be used as percentages. In both cases, the analysis has been separated into two periods, 1956–1970 and 1971–1975, to indicate the changing volatility and slight change in pattern. The shaded area in Figure 10.4 represents the range in the percentage variation for the 1956–1970 period, and the broken lines show the corresponding 1971–1975 results. Figure 10.4 shows that the traditional seasonality can also have sharp fluctuations, in intervals of short duration. The more recent period reflects the traditional seasonal highs and lows, but shows that there is a considerable wide range of other possibilities. All methods of determining seasonality will be influenced by those years in which unusual, overwhelming factors caused prices to move counter to normal seasonal patterns. A later section will discuss the advantages of distinguishing seasonal and nonseasonal years.

Figure 10.4: Changes in volatility and variations in seasonal patterns for corn.

A general formula for the monthly average is:[1]

$$APP_i = 100\left\{\frac{1}{N}\left[12\sum_{n=1}^{N}\left(P_{in} \Big/ \sum_{j=1}^{12} P_{jn}\right)\right]\right\}, i = 1,12$$

where APP_i = the Average Percentage Price in month i

i = the calendar month from 1 to 12

N = the number of years in the analysis

P_{jn} = the average price for month j of year n

This formula may be applied to weekly or quarterly average prices by changing the 12 to 52 or 4, respectively.

The use of an annual average price can bias a clear seasonal pattern because of its inability to account for a long-term trend in the price of the stock or futures market. If the rate of inflation in the United States is 6%, there will be a tendency for a commodity price, such as gold, to be .5% higher each month, resulting in a trend toward higher prices at the end of the year. Longer trends, such as the steady rise in grain prices from 1972–1975, followed by a longer decline in the 1980s, will obscure or even distort the seasonality unless the trend is removed. Seasonality is still a major factor influencing price variation, even when there is a dominant trend.

Removing the Trend

Jake Bernstein, most well-known for his seasonal studies,[2] uses the method of first differences to remove the trend from prices before calculating the seasonal adjustment factor. He offers the following steps for determining the cash price seasonality:

1. Arrange the data used in a table with each row as one year. Columns can be daily, weekly, or monthly although most analyses will use monthly.

Average prices are preferred for each period (see Table 10.1).

2. Compute a second table of month-to-month differences by subtracting month 1 from month 2, month 2 from month 3, and so on. This new table contains *detrended* values.

3. Calculate the sum of the price differences in each column (month) in the new table. Find the average for that column by dividing the number of years of data (columns may have different numbers of entries). This is the average price change for that month.

4. From the table, count the times during each month (column) that prices were up, down, or unchanged. This will give the frequency (expressed as a percent) of movement in each direction.

Bernstein adds the average monthly changes together, expresses the frequency of upwards price changes, and presents the results of corn in Figure 10.5. The monthly prices changes of UAL are shown in Table 10.2 and the frequency of movement of UAL is shown in Figure 10.3.

Figure 10.5: Seasonal price tendency in monthly cash average corn prices (1936–1983). *Source*—Jacob Bernstein, *Seasonal Concepts in Futures Trading* (Wiley, New York, 1986, p. 31).

Using Bernstein's method, the seasonal price tendency for corn, shown in Figure 10.5, are based on the averages in Table 10.5. While Figure 10.5 shows a clear pattern for corn, where monthly price changes fluctuate around the zero horizontal line, the same method did not remove the upwards bias of UAL shown in Figure 10.2. Normally, the method of first differences will remove the trend; however, corn prices remained in a narrow price range for the 20 years shown in the Table 4. UAL began started at about $9 and ended at $40, a gain of more than a factor of 4.

The Method of Link Relatives

Another technique for identifying seasonal price variations and separating them from other price components involves the use of *link relatives*. In Table 10.6, each month during 1960 and 1961 is expressed as a percentage by taking the ratio of that average monthly price to the average price of the preceding month (found in Table 10.4) in a manner similar to an index.

Table 10.5: Corn Price as Percentage Average (Annual)

Open table as spreadsheet

Year	Avg	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1956	1.30	87.6	89.2	91.5	101.5	108.5	110.8	111.5	112.3	111.5	86.1	93.8	94.6
1957	1.25	97.6	92.8	94.4	94.4	96.0	96.0	96.8	97.6	86.9	86.9	75.4	80.8
1958	1.10	88.2	89.1	94.5	107.3	109.1	111.8	111.8	112.7	88.5	92.7	85.4	94.5
1959	1.09	96.3	97.2	99.1	107.3	108.2	109.2	107.3	107.3	100.0	88.1	91.7	90.1
1960	1.03	100.0	101.0	101.0	105.8	107.8	107.8	107.8	105.8	103.9	94.2	79.6	89.3
1961	1.01	98.0	102.0	103.0	97.0	103.0	103.0	104.9	103.0	101.0	99.0	90.1	93.1
1962	.98	95.9	96.9	97.9	100.0	105.1	105.1	104.1	103.1	102.0	95.9	92.8	102.0
1963	1.11	92.8	94.6	95.5	98.2	101.0	107.2	109.0	109.0	110.8	93.7	91.9	99.1
1964	1.13	99.1	96.5	100.0	101.8	104.4	103.5	100.9	100.9	103.5	92.9	92.0	100.9

1965	1.18	98.3	99.1	100.8	103.4	105.9	106.8	105.1	101.7	100.0	93.2	88.1	95.8
1966	1.25	95.2	96.0	93.6	95.2	96.8	96.0	101.6	107.2	108.0	103.2	100.8	103.2
1967	1.17	109.4	107.7	109.4	107.7	106.8	107.7	103.4	94.9	95.7	88.9	82.9	88.0
1968	1.04	100.0	101.9	101.9	101.9	104.8	102.9	100.0	95.2	97.1	92.3	100.0	101.0
1969	1.12	96.4	97.3	97.3	100.0	106.2	105.3	96.4	105.3	102.7	100.0	95.5	97.3
1970	1.24	90.3	91.9	91.1	92.7	95.2	97.6	100.0	102.4	111.3	108.1	104.0	112.1
1956–1970	Avg	96.3	96.9	98.1	100.9	103.9	104.7	104.0	103.9	101.5	94.3	90.9	96.1
1971	1.27	111.8	112.6	112.6	111.0	108.7	112.6	107.1	93.7	87.4	78.7	76.4	85.0
1972	1.17	93.2	93.2	94.0	96.6	98.3	96.6	97.4	98.3	104.3	101.7	102.6	121.4
1973	1.86	74.7	72.6	73.6	76.3	62.4	107.0	109.1	144.1	115.6	116.7	117.2	128.5
1974	2.92	88.7	94.5	91.8	82.5	83.9	88.0	99.6	115.4	113.0	118.1	113.7	112.0
1975	2.70	113.7	105.9	98.9	99.2	98.5	99.2	100.7	109.2	102.2	97.0	86.3	87.8
1971–1975	Avg	96.4	95.8	94.2	93.1	90.1	100.7	102.8	112.1	104.5	102.4	99.2	106.9

After the initial calculation of 1960 and 1961 link relatives, it is necessary to find the average (or the median, which is preferred if an adequate sample is used) of the monthly ratios expressed in rows 1 and 2. The average in row 3 represents monthly variation as a percentage of change; each calculation is a function of the preceding month. Thus far, this is the same as Bernstein's average monthly price changes, expressed as a percent of the prior price.

In order to establish a fixed base in the manner of an index, *chain relatives* are constructed using January as 100; each monthly chain relative is calculated by multiplying its average link relative by the average link relative of the preceding month. The March chain relative is then 1.005 × 1.025 = 1.030, and February remains the same because it uses January as a base.

A constant trend throughout the test period can be found by multiplying the December chain relative 4 by the January average link relative. If prices show no tendency for either upward or downward movement, the result would be 1.00; however, inflation should cause an upward bias and therefore the results are expected to be higher. From line 4, the December entry multiplied by the January entry on line 3 gives .946 × 1.047 = .990, leaving a negative factor of. 1% unaccounted for. This means that the 1960–1961 years showed a .1% downward bias; therefore, the expected rate of inflation was offset by some other economic factor, such as the accumulation of grain stocks by the U.S. government.

Table 10.6: Corn Prices Expressed as Link Relatives

Open table as spreadsheet

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1. 1960	1.040	1.010	1.000	1.048	1.018	1.000	1.000	.982	.982	.907	.845	1.122
2. 1961	1.053	1.040	1.010	.942	1.061	1.000	1.019	.981	.981	.980	.910	1.031
3. Average	1.047	1.025	1.005	.995	1.040	1.000	1.010	.982	.982	.944	.878	1.077
4. Chain relatives	1.000	1.025	1.030	1.000	1.035	1.040	1.010	.992	.964	.927	.829	.946
5. Corrected chain relatives	1.000	1.024	1.028	.997	1.032	1.036	1.005	.986	.958	.920	.822	.937
6. Indices of seasonal variations	1.022	1.046	1.050	1.019	1.054	1058	1.027	1.007	.979	.940	.840	.957

The chain relatives must be corrected by adding the negative bias back into the values, using the same technique as in computing compound interest. For example, from 1967–1977, the Consumer Price Index increased from 100 to 175, a total of 75% in 10 years. To calculate the annual compounded growth rate for that period, apply the formula:

$$Compound\ rate\ of\ growth = \sqrt[N]{\frac{Ending\ value}{Starting\ value}} - 1$$

where N = the number of years or the number of periods over which the growth is compounded

$$R = \sqrt[10]{\frac{175}{100}} - 1$$

$$= 1.05755 - 1$$

$$= .05755$$

This indicates a compounded rate of inflation equal to 5.75% per year. In the case of corn, if the trend had been positive, that is, greater than 1.00 instead of .990, the growth rate would be subtracted from each month to offset the upward bias. In this case, the results are added back into the chain relative to compensate for the negative influence. A .1% decline, compounded over 12 consecutive entries, gives:

$$R = \sqrt[12]{\frac{.99}{1.00}} - 1$$

$$= .99916 - 1$$

$$= -.00084$$

This is a compounded deflation of about 8/100 of 1%. The corrected chain relative was found by multiplying the February entry by (1 + *R*) = .99916, March by $(1 + R)^2$ = .99832, and December by $(1 + R)^{11}$ = .99076.

The chain relatives have been calculated on a base of January, which was important in order to correct the compounded bias throughout the test period. The final step is to switch the corrected chain relatives to a base of the average value. The average (.97875) of line 5 is used to create line 6, taking the ratio of the corrected chain relative entries to their average. The final result is the *Index of Seasonal Variation.* The accuracy of this result can be proved by averaging the entries of line 6, which will be 1.00. A complete study of seasonality using this method can be found in Courtney Smith, *Seasonal Charts for Futures Traders* (Wiley, 1987).

The Moving Average Method

The moving average is a much simpler yet very good technique for determining seasonal patterns and removing the trend. Looking again at the cash corn prices in Table 10.4, take the average quarterly prices for the years 1960–1965 rounded to the nearest cent. More practical results may be obtained by repeating this procedure for monthly prices.

Because every four entries completes a season, a 4-quarter moving average is calculated and recorded in such a way that each value lags 2½ quarters, corresponding to the center of the four points used in the calculation. Column 2 of Table 10.7 shows the 4-quarter moving average positioned properly; Figure 10.6 is a plot of both the quarterly corn prices and the lagged moving average. By using the exact number of entries in the season, the moving average line is not affected by any seasonal pattern.

Table 10.7: Seasonal Adjustment by the Moving Average Method

		Average Quarterly Price	4-Point Moving Average	Corresponding 4-Point Values	Seasonal Adjustment Factor	Seasonal Index
1960	Jan–Mar	104				
	Apr–Jun	110				
	Jul–Sep	109	103¼	103	+6	1.06
	Oct–Dec	90	102¾	101¾	−11¾	.88
1961	Jan–Mar	102	100¾	100⅛	+1⅞	1.02
	Apr–Jun	102	99½	100⅛	+1⅞	1.02
	Jul–Sep	104	100¾	99⅞	+4⅛	1.04
	Oct–Dec	95	99	98⅞	−3⅞	.96
1962	Jan–Mar	95	98¾	98⅜	−3⅜	.96
	Apr–Jun	101	98	98	+3	1.03
	Jul–Sep	101	98	99¼	+1¾	1.02
	Oct–Dec	95	100½	102	−7	.93
1963	Jan–Mar	105	103½	106⅛	−1⅛	.99
	Apr–Jun	113	108¾	110¾	+2¼	1.12
	Jul–Sep	122	112¼	113¼	+8¾	1.08
	Oct–Dec	109	113¾	114¼	−5¼	.95
1964	Jan–Mar	111	114¾	113⅞	−2⅞	.97
	Apr–Jun	117	113	113⅞	+4⅛	1.04
	Jul–Sep	115	112¾	112⅞	+1½	1.01
	Oct–Dec	108	114¼	113½	−7⅛	.94
1965	Jan–Mar	117	116	116¾	−¼	1.00
	Apr–Jun	124	117½	117⅝	+6⅜	1.05
	Jul–Sep	121				
	Oct–Dec	109				

Figure 10.6: Detrending corn using a moving average with a yearly period.

Because there was an even number of points in the moving average, each calculation falls between two original data points. Column 3 of Table 10.7 is constructed by averaging every two adjacent entries in column 2 and placing the results in a position corresponding to the original data points. This avoids smoothing the initial prices. The difference of column 1 minus column 3 is the *seasonal adjustment factor* (column 4) in cents per bushel; the *seasonal index* (column 5) is the ratio of column 1 divided by column (3). The periodic fluctuation of prices becomes obvious once these values have been recorded. A generalized seasonal adjustment factor and seasonal index is calculated by taking the average of the quarterly entries for the five complete years (Table 10.8).

Table 10.8: Average Seasonal Variation Using the Moving Average Method

Open table as spreadsheet

Average of All Years	Seasonal Adjustment Factor	Seasonal Index
Jan–Mar	-1.15	.988
Apr–Jun	+3.53	1.052
Jul–Sep	+4.43	1.042
Oct–Dec	-7.00	.932

Moving Average Detrending of UAL

Applying the moving average method to UAL prices yields a much better seasonal pattern than originally shown in Figure 10.2. Beginning with monthly average prices, we calculate the 12-month moving average, placing the moving average value in the 7th position of the data used for the average. Ideally, the average should be placed in the position between months 6 and 7, but the 7th position was used as a practical solution. For example, when averaging prices from January 1995 through December 1995, the average was placed in the cell corresponding to July 1995. Moving forward one month, the average of February 1995 through January 1996 was placed in the cell corresponding to August 1995, and so forth.

Once a table of 12-month moving average values has been calculated, subtract the moving average value from the corresponding average monthly price. This gives a table of detrended average monthly prices. By averaging the columns you get the average detrended seasonal change for each month. Adding the months from January through December produces the seasonal pattern shown in Figure 10.7. There is a clear, continuous upwards bias from April through September, and a downward tendency during the other four months. The upwards seasonal bias results in an average price increase of about $5 each year. This chart shows monthly change in share price. Percentage change can be found by dividing the monthly price changes by the corresponding moving average value.

Figure 10.7: Seasonal pattern of UAL using the moving average method.

X-11

The seasonal adjustment method X-11 (Census Method II-X-11) has been most widely used for creating a seasonally adjusted series of such information as car and housing sales, as well as other consumer products. It is very thorough, using moving averages to detrend the data, and includes both an initial estimation and reestimation. Because it is widely used by economists, an outline of its calculations follows.[3]

1. Calculate a centered 12-month moving average (MA). Subtract this MA from the original series to get an initial detrended seasonal series in the same manner as the moving average method.
2. Apply a weighted 5-period MA to *each month separately* to get an estimate of the seasonal factors.
3. Compute a centered 12-month MA of the seasonal factors (Step 2) for the entire series. Fill in the six missing values at either end by repeating the first and last available MA values. Adjust the seasonal factors from Step 2 by subtracting the centered 12-term MA. The *adjusted seasonal factors* will total approximately zero over any 12-month period.
4. Subtract the seasonal factor estimates (Step 3) from the initial detrended seasonal series (Step 1). This is the *irregular component series* used for outlier adjustment.
5. Adjust the outliers in Step 4 by the following procedure:
   a. Compute a 5-year moving standard deviation s of the irregular component series (Step 4).
   b. Assign weights to the series components c_i as follows:

      0 if $c_i > 2.5s$

      linearly scaled from 0 to 1 if $2.5s = c_i = 1.5s$

      1 if $c_i < 1.5s$

   Use this weighting function to adjust the detrended series in Step 1.
6. Apply a weighted 7-period MA to the adjusted series (Step 5) to get the *preliminary seasonal factor*.
7. Repeat Step 3 to standardize the seasonal factors.
8. Subtract the series resulting in Step 7 from the original series to find the *preliminary seasonally adjusted series*.
9. To get the trend estimate, apply a 9-, 13-, or 23-period *Henderson's weighted moving average*[4] to the seasonally adjusted series (Step 8). Subtract this series from the original data to find a second estimate of the detrended series.
10. Apply a weighted 7-period MA to each month separately to get a second estimate of the seasonal component.

11. Repeat Step 3 to standardize the *seasonal factors*.

12. Subtract the final seasonal factors from the original series to get the final *seasonally adjusted series*.

Winter's Method

Another technique for forecasting prices with a seasonal component is Winter's method,[5] a self-generating, heuristic approach. It assumes that the only relevant characteristics of price movement are the trend and seasonal components, which are represented by the formula

$$X_t = (a + bt)S_t + e_t$$

where X_t = the estimated value at time t

$(a + bt)$ = a straight line that represents the trend

S_t = the seasonal weighting factor between 0 and 1

e_t = the error in the estimate at each point

If each season is represented by N data points, S_t repeats every N entries, and

$$\sum_{t=1}^{n} S_t = 1$$

The unique feature of Winter's model is that each new observation is used to correct the previous components a, b, and S_t. Without that feature, it would have no applicability to price forecasting of housing starts, employment, or other seasonal data. Starting with two or three years of price data, the yearly (seasonal) price average can be used to calculate both values a and b of the linear trend. Each subsequent year can be used to correct the equation $a + b_t$ using any regression analysis. Winter's method actually uses a technique similar to exponential smoothing to estimate the next a and b components individually. The seasonal adjustment factors are assigned by calculating the average variance from the linear component, expressed as a ratio, at each point desired. As more observations are made, each component can be refined and it will take on the form of the general long-term seasonal pattern.

A Comparison of Seasonality Using Different Methods

Heating oil and soybeans represent two fundamentally sound seasonal markets. Even before we see the resulting patterns, we can expect heating oil to post higher prices during the winter months and soybeans to be high during the summer growing period. Refiners shift their priority from gasoline to heating oil beginning in mid-summer in anticipation of the winter season, while soybeans are subject to speculative volatility during planting and growing seasons when the yield is still uncertain.

For the purposes of comparison, we will use four basic methods of calculating seasonality: average price, median price, percentage change from the previous month, and the moving average deseasonalizing. For our purposes, more complicated methods are unnecessary. Neither heating oil or soybeans has a strong price trend during the years analyzed; therefore, the problem seen in UAL will not appear.

Figure 10.8a shows that the peak price for heating oil is most likely to come in October, well ahead of the coldest months of the year. According to these techniques, it is the anticipation of winter that drives prices up, while February and March, typically colder, show lower average prices as most consumers use up the oil they had committed to buy during the previous September and October. Three of the methods for calculation gave similar results, while *%Change* seems to lead by one month.

Figure 10.8a: Heating oil seasonal patterns. Results are very uniform with %Change leading the other methods by one month. Peak prices come in October, during the time of greatest accumulation, with lower prices in February and March when consumers are normally depleting inventory.

When applied to soybeans, all four basic seasonal calculations produce patterns that show the expected winter and summer cycles, with most lines rising and falling smoothly throughout the year (see Figure 10.8b). Here again it should be noted that the seasonal pattern of the percentage price changes leads the normal and detrended methods because it acts in the same way as momentum; a decline in the percentage change does not mean that current prices are lower than the previous month, but that prices did not increase by as much as the previous month.

Figure 10.8b: Soybean seasonal patterns. The four basic calculations show soybean prices peaking in June and reaching lows in February. The use of the median gives results in July that are much lower than the average, and higher during the period November through January, indicating that here

were unusually extreme moves during those months that distort the average.

The four methods confirm that seasonal patterns exist. Although you may choose one of these techniques over the other, viewing them together shows the possible variance of the patterns.

Seasonal Volatility

Consistent seasonal patterns can be confirmed by a corresponding increase in volatility as the season reaches its peak as seen in Figure 10.9. In this soybean chart, the peak volatility in June, represented by one standard deviation of price equal to about 12%, shows that there is a 68% chance that soybeans will vary in price by 24% in June. For the purpose of confirming the validity of the seasonal results, the steady increase and decrease in volatility surrounding the peak month of June indicates a building of the seasonal concerns that cause wide fluctuations. If a single price shock had occurred unrelated to seasonality, there would be a sharp increase in volatility during one month, perhaps declining afterwards, but with no steady growth of volatility leading up to this event.

Figure 10.9: Soybean monthly price variation.

Weather Sensitivity

The effects of changes in weather, especially extremes in weather, are an inseparable part of the agricultural market's seasonal effects. Without weather, the price of an agricultural commodity would lack the surprises that cause them to jump around during the growing period. Once planted, you would have a very good idea of the expected supply; one-half of the supply—demand equation would be constant each year. For insurance companies, hurricane season (from late summer through early fall) contains the same uncertainty.

Each agricultural product, and those firms impacted by changing agricultural prices, has its own particular sensitivity to weather. Grain planting can be delayed due to rain, causing some farmers to switch from corn to soybeans; hot weather during pollination will significantly reduce yields; a freeze in September can stop the ripening process and damage production. Freezes are of greater concern than droughts and affect more products. In general, patterns of crop sensitivity to weather depend upon their location in the northern or southern hemisphere. Active trade between world markets show that crops grown primarily in the northern hemisphere are affected by weather developments in the southern hemisphere. In Table 10.9 major weather events are shown separated into southern and northern hemisphere. Figure 10.10 combines the soybean and corn weather sensitivity charts[6] to show the effects of both southern and northern hemisphere weather.

Table 10.9: Weather Related Events in Southern and Northern Hemispheres

Open table as spreadsheet

	Southern Hemisphere	Northern Hemisphere
January		OJ peak for Florida freeze Heating oil cold or hot
February	Corn pollination in S. Africa and Argentina Soybean pod development	Heating oil cold or hot
March		
April		Cotton planting
May		Soybean planting
June		Cotton boll development
July	Coffee freeze Brazil	Sugar: heat in Russia

	OJ freeze Brazil Cocoa pod development in W. Africa and pod rot in Brazil	Corn pollination
August		Soybean pod development
September		Atlantic hurricanes affect sugar, orange juice, heating oil Corn freeze
October		Soybean freeze Cotton harvest
November	Coffee in Brazil rainy season	Soybean harvest Corn harvest
December		Heating oil cold or hot

Figure 10.10: Weather sensitivity for soybeans and corn. *Source*—Smith Barney.

Measuring Weather Sensitivity

While a weather sensitivity chart, such as the one shown in Figure 10.10, may appear to have a strong similarity to a standard seasonal chart, they are actually very different. Weather sensitivity is a measurement of potential price volatility. It could simply be the highest price that the market reached during a period in which the weather event occurred. Those more adept at statistics would want to record the increase in price from the average during those months in which weather was a factor, then show the price representing the 95% confidence level, about two standard deviations.

A thorough approach to measuring weather sensitivity is to record the temperature each day and find out whether it is unusually far above or below the average. Information available from the U.S. weather or meteorological service will give you both regional weather and measurements of effective heat. It is the cumulative effect of heat that is damaging to a crop, rather than a high temperature for one day. In addition, the amount of crop damage is not simply a linear relationship with rising temperatures but is more likely to start slowly and increase quickly once critical levels of time and heat are reached.

The demand for heating oil can be closely estimated by recording the temperature relative to population, so that a widespread hailstorm in August does not have the same impact in Montana as it does in Ohio. This has an immediate effect on futures prices, and a ripple effect on related businesses. During sustained cold periods, increased production of heating oil will mean decreased production of gasoline, driving those prices higher.

[1]David Handmaker, "'Low-Frequency Filters for Seasonal Analysis," in Perry J. Kaufman, *Handbook of Futures Markets* (Wiley, New York, 1984).

[2]Jacob Bernstein, *Seasonal Concepts in Futures Trading* (Wiley, New York, 1986).

[3]A more detailed account of X-11 and Henderson's weighted moving average (Step 9) can be found in Abraham, Bovas, and Johannes Ledolter, *Statistical Methods for Forecasting* (Wiley, New York, 1983, pp. 178–191). Their book also includes a computer program for "seasonal exponential smoothing."

[4]A specialized symmetric assignment of weighting values. A specific example can be found in Abraham, Bovas, and Johannes Ledolter, *Statistical Methods for Forecasting* (Wiley, New York, 1983, p. 178).

[5]

Winter's method, as well as other advanced models, can be found in Douglas C. Montgomery and Lynwood A. Johnson, *Forecasting and Time Series* (McGraw-Hill, New York, 1976), and Abraham and Ledolter (1983).

[6] Jon Davis, *Weather Sensitivity in the Markets* (Smith Barney, October 1994).

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SEASONAL FILTERS

Seasonal filters identify periods during the year in which a long or short position would be favored based upon a clear seasonal pattern. These periods are normally chosen from the results of a calculation that uses detrended data; however, where there is a large difference between the median value and the average value, we should expect the median value to be more representative of expected price movement. A large difference between the median and average also tells us that there have been extreme prices and high volatility during those months. It is reasonable to expect the median price, but there is much greater risk when the average and median diverge. This can be seen in Table 10.10, showing monthly soybean prices as a percentage of the annual average price. The double-digit values in 1973, 1977, and 1988 are enough to cause the averages at the beginning of the year to be lower than the median, and June, July, and August to be higher than the median. This bias is mainly the result of only 3 of 24 years.

Table 10.10: Monthly Soybean Prices as a Percentage Difference from the Average Annual Price, February 1969—December 1993

Open table as spreadsheet

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
69		0.17	-0.15	-0.07	0.02	-0.48	-0.47	-0.26	-0.11	0.50	0.60	0.25
70	-1.83	-1.62	-1.61	-1.25	-1.04	0.11	1.51	0.33	0.28	1.82	2.24	1.07
71	-0.31	-0.42	-0.88	-2.35	-1.60	0.34	2.20	1.43	0.52	0.99	0.07	0.01
72	-4.10	-3.42	-1.56	-0.43	-0.78	-1.38	-1.12	-0.06	0.47	0.57	3.23	8.58
73	-25.18	-16.67	-13.26	-11.15	6.23	25.10	15.97	16.73	3.93	-0.42	-1.85	0.57
74	-3.16	-1.87	-3.20	-8.10	-9.14	-8.81	1.80	6.55	5.63	11.83	6.10	2.37
75	7.98	1.69	0.19	1.20	-2.71	-2.85	1.22	5.25	2.23	-1.55	-5.45	-7.20
76	-7.34	-7.00	-7.60	-7.58	-4.26	3.74	7.14	3.53	5.90	2.86	4.36	6.26
77	-1.25	0.41	7.48	17.60	16.24	7.35	-6.01	-9.89	-10.31	-9.96	-5.76	-5.90
78	-6.65	-7.41	-0.51	1.37	3.15	1.25	-0.73	-0.78	1.20	3.53	2.64	2.94
79	-0.10	3.44	3.78	2.10	0.80	3.83	2.32	-0.83	-0.90	-3.73	-4.92	-5.82
80	-0.94	-1.24	-4.79	-7.60	-7.11	-6.48	1.39	2.01	5.98	7.36	10.40	1.03
81	10.25	7.30	5.54	7.93	4.75	0.67	0.84	-3.45	-6.58	-7.19	-8.90	-11.09
82	6.26	5.31	3.49	6.10	5.80	2.37	0.66	-3.69	-6.54	-8.14	-5.53	-6.11
83	-8.32	-7.86	-7.86	-4.92	-7.08	-9.78	-4.59	12.52	16.19	10.66	7.38	3.67
84	7.91	4.09	9.25	9.08	14.64	7.31	-4.92	-7.00	-9.44	-9.09	-9.29	-12.53
85	6.79	5.38	5.31	5.87	2.00	2.07	-0.41	-4.72	-4.73	-5.67	-6.62	-5.27
86	2.82	0.16	0.52	-0.42	0.81	0.09	-0.16	-2.48	-1.26	-0.96	1.00	-0.11
87	-4.46	-5.68	-5.37	-2.46	2.81	3.28	-0.55	-2.52	0.12	1.90	4.74	8.18
88	-12.45	-12.92	-12.34	-8.34	-2.36	18.32	12.91	9.32	8.59	1.93	-1.75	-0.93
89	11.07	6.75	8.28	3.23	2.50	1.71	0.36	-5.51	-6.03	-7.82	-6.76	-7.78
90	1.10	0.21	2.39	3.24	4.90	1.11	0.89	0.39	0.68	-1.09	-6.66	-7.17
91	4.33	4.42	4.56	4.73	1.49	-0.15	-4.66	-0.49	1.46	-3.85	-5.47	-6.36
92	1.32	2.32	4.03	1.15	4.78	6.02	-1.51	-4.59	-3.99	-5.52	-2.73	-1.27
93	-6.34	-7.79	-6.09	-4.82	-3.49	-3.33	12.00	6.95	1.70	-1.91	5.07	8.03
Avg	-0.94	-1.29	-0.42	0.16	1.25	2.06	1.44	0.75	0.20	-0.92	-0.96	-1.38
Mdn	-0.63	0.16	-0.15	-0.07	0.81	1.11	0.66	-0.26	0.47	-0.96	-1.75	-0.11

Using the examples of heating oil, soybeans, and UAL, which were discussed in the previous section, we can select the months with the largest and most reliable seasonal price moves as the best choice for seasonal filters. We can also separate the year into upwards and downwards cycles to allow for a wider range of trades. The following periods could be considered for heating oil and soybeans:

Open table as spreadsheet

	Best Choice (Partial Year)	Full-Year Seasonal Patterns
Heating oil	Long from August! to November 1 Short from November 1 to March 1	Long from April 1 to October 1 Short from November 1 to March 1
Soybeans	Long from Mar 1 to Jul 1 Short from Jul 1 to Nov 1	Long from Mar 1 to Jul 1 Short form Jul 1 to Mar 1
UAL	Long from April 1 to June 1 Short September 1 to November 1 Short in January	Long from April 1 to October 1 Short from October 1 to April 1

One practical note is needed here. Although there may appear to be a statistical benefit to selling heating oil in the later part of winter, there is also extreme risk. Prices jumped 40% from March to April 1982, and 20% during the same period in 1983. We must also consider that the Gulf War, which pushed prices higher from August 1990, conformed by chance to the seasonal pattern; in reality, it could have happened any time during the year. These special situations do not always cause prices to rise. In 1986, Saudi Arabia decided to dump oil in a politically motivated effort to drive prices down, successfully pushing crude oil under $10 per barrel.

Years with Similar Characteristics

Seasonal studies often yield results that are not as clear as desirable, and these results may be rejected because of the obvious lack of consistency. Often, this is caused by a few years that conflict with the normal seasonal patterns due to special events. David Handmaker[7] shows that separating the data into *analogous years* can give strikingly better results.

For example, crop production is primarily determined by weather. Poor weather will cause sharp rallies during the growing season whereas good weather results in a dull, sideways market. Bad weather develops slowly. A drought is not caused by the first hot day but prolonged days of sunshine and no rain. Similarly, delayed planting due to wet fields or a late winter will set the stage for an underdeveloped crop. A trader can see the characteristics of a developing weather market in time to act on it.

In Figure 10.11a, the seasonal corn pattern has been separated into those years with good weather and those with bad weather. In a later study by ContiCommodity,[8] soybean seasonality was separated into *bull* and *bear* years (Figure 10.11b). Bull years include all bad weather years but also years with such incidents as the 1973 Soviet grain sale. Because other events are not confined to the growing months, they may distort rather than clarify the patterns. Bear would represent mostly good weather patterns; however, markets that decline steadily during the year following a bull market would also be included.

Figure 10.11: (a) Corn price seasonality separated into all years, years with good weather, and years with bad weather. (b) Soybeans (10 years) shown with separate bull years (5 years) and bear years (5 years).

During the bad weather years, the corn chart shows a prolonged rise during the primary growing months, May through August. The study of bull years for soybeans shows a longer sustained rise from the beginning of the new crop in October into the following June. In the case of good weather and bear markets, corn shows a rise from May to June, some sideways hesitation from June to July (possibly the last anticipation of bad weather), then a return to previous price levels. For bear years soybeans have steady declines through April and then a short rally through the summer.

The corn analysis shows a critical point around July 1, when the market decides that the weather is not a factor. The soybean analysis is completely different showing nearly the opposite patterns for bull and bear markets. Because the resulting pattern of combining both bull and bear markets looks very similar to the bull pattern, the magnitude of the bull moves must overwhelm the overall picture. In fact, the magnitude of the bull moves are often three to four times greater than the price change in bear markets.

Updating Bull, Bear, and Nonseasonal Market Patterns

Both the Handmaker and ContiCommodity studies ended in the early 1980s and while grain fundamentals have essentially remained the same, the use of more data and recent years can only help understand seasonality better. Using the soybean average prices expressed as a percentage of average annual price in Table 10.10, we separated the years from 1969 to 1993 into bull and bear categories, where bull years (and bear years) had significantly higher (or lower) prices at the end of the year than at the beginning. Table 10.11 parts

a and b, which also give the prices as a percent of the average annual price, shows that there were about the same number of years in each category. The averages at the bottom of those tables indicate that both bull and bear years had a price swing of about 10% over the year.

Table 10.11: Bull, Bear, and Nonseasonal Market Patterns

Open table as spreadsheet

a. Bull years begin at relatively low levels, peak during the summer but remain high at the end of the year.

b. Bear years decline steadily after April and do not reflect the concerns that often drive prices higher during the summer.

c. Nonseasonal years follow years in which the harvest months of September–October posted higher prices than the summer months. These years revert back to what we expect of normal seasonal patterns.

(a) Soybean Bullish Years (Prices Higher at the End of the Year)												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
70	-1.83	-1.62	-1.61	-1.25	-1.04	0.11	1.51	0.33	0.28	1.82	2.24	1.07
72	-4.10	-3.42	-1.56	-0.43	-0.78	-1.38	-1.12	-0.06	0.47	0.57	3.23	8.58
73	-25.18	-16.67	-13.26	-11.15	6.23	25.10	15.97	16.73	3.93	-0.42	-1.85	0.57
74	-3.16	-1.87	-3.20	-8.10	-9.14	-8.81	1.80	6.55	5.63	11.83	6.10	2.37
76	-7.34	-7.00	-7.60	-7.58	-4.26	3.74	7.14	3.53	5.90	2.86	4.36	6.26
78	-6.65	-7.41	-0.51	1.37	3.15	1.25	-0.73	-0.78	1.20	3.53	2.64	2.94
80	-0.94	-1.24	-4.79	-7.60	-7.11	-6.48	1.39	2.01	5.98	7.36	10.40	1.03
83	-8.32	-7.86	-7.86	-4.92	-7.08	-9.78	-4.59	12.52	16.19	10.66	7.38	3.67
87	-4.46	-5.68	-5.37	-2.46	2.81	3.28	-0.55	-2.52	0.12	1.90	4.74	8.18
88	-12.45	-12.92	-12.34	-8.34	-2.36	18.32	12.91	9.32	8.59	1.93	-1.75	0.93
93	-6.34	-7.79	-6.09	-4.82	-3.49	-3.33	12.00	6.95	1.70	-1.91	5.07	8.03
Average	-7.34	-6.68	-5.84	-5.03	-2.10	2.00	4.16	4.96	4.55	3.65	3.87	3.80
(b) Soybean Bearish Years (Prices Lower at the End of the Year)												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
75	7.98	1.69	0.19	1.20	-2.71	-2.85	1.22	5.25	2.23	-1.55	-5.45	-7.20
77	-1.25	0.41	7.48	17.60	16.24	7.35	-6.01	-9.89	-10.31	-9.96	-5.76	-5.90
79	-0.10	3.44	3.78	2.10	0.80	3.83	2.32	-0.83	-0.90	-3.73	-4.92	-5.82
81	10.25	7.30	5.54	7.93	4.75	0.67	0.84	-3.45	-6.58	-7.19	-8.96	-11.09
82	6.26	5.31	3.49	6.10	5.80	2.37	0.66	-3.69	-6.54	-8.14	-5.53	-6.11
84	7.91	4.09	9.25	9.08	14.64	7.31	-4.92	-7.00	-9.44	-9.09	-9.29	-12.53
85	6.79	5.38	5.31	5.87	2.00	2.07	-0.41	-4.72	-4.73	-5.67	-6.62	-5.27
86	2.82	0.16	0.52	-0.42	0.81	0.09	-0.16	-2.48	-1.26	-0.96	1.00	-0.11
89	11.07	6.75	8.28	3.23	2.50	1.71	0.36	-5.51	-6.03	-7.82	-6.76	-7.78
90	1.10	0.21	2.39	3.24	4.90	1.11	0.89	0.39	0.68	-1.09	-6.66	-7.17
91	4.33	4.42	4.56	4.73	1.49	-0.15	-4.66	-0.49	1.46	-3.85	-5.47	-6.36
92	1.32	2.32	4.03	1.15	4.78	6.02	-1.51	-4.59	-3.99	-5.52	-2.73	-1.27
Average	4.87	3.46	4.57	5.15	4.67	2.46	-0.95	-3.08	-3.78	-5.38	-5.59	-6.38
(c) Soybean Nonseasonal (Prices Higher during the Previous September-October than Summer)												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
71	-0.31	-0.42	-0.88	-2.35	-1.60	0.34	2.20	1.43	0.52	0.99	0.07	0.01
73	-25.18	-16.67	-13.26	-11.15	6.23	25.10	15.97	16.73	3.93	-0.42	-1.85	0.57
75	7.98	1.69	0.19	1.20	-2.71	-2.85	1.22	5.25	2.23	-1.55	-5.45	-7.20
77	-1.25	0.41	7.48	17.60	16.24	7.35	-6.01	-9.89	-10.31	-9.96	-5.76	-5.90
79	-0.10	3.44	3.78	2.10	0.80	3.83	2.32	-0.83	-0.90	-3.73	-4.92	-5.82
81	10.25	7.30	5.54	7.93	4.75	0.67	0.84	-3.45	-6.58	-7.19	-8.96	-11.09
84	7.91	4.09	9.25	9.08	14.64	7.31	-4.92	-7.00	-9.44	-9.09	-9.29	-12.53
Average	-0.10	-0.02	1.73	3.49	5.48	5.96	1.66	0.32	-2.94	-4.42	-5.17	-5.99

Bull and bear years are nearly opposite in pattern, as seen in Figure 10.12, and cross at about the same price in June. This causes the seasonal pattern using all years to peak in June. As interesting as it is to know that there are an equal number of years going the opposite directions within a seasonal pattern, the bull and bear tables were created after the fact and cannot be traded unless you know in advance that a bull or bear year will occur. Instead, it is possible to look at *nonseasonal years*, those in which the price of soybeans was higher during the harvest months of September and October than during the previous summer months.

Figure 10.12: Soybean seasonality, a comparison of filtered years.

One important quality of crops is that each year we begin again; a shortage one year does not mean a shortage the next year. This is seen in the chart of nonseasonal years in Figure 10.12. After a nonseasonal year, prices rally early, because traders are nervous about planting and shortages, but the reality of a good crop and normal demand drive prices steadily lower during the second half of the year. The pattern is typically seasonal and very well defined by large swings.

Seasonality for Trading

Whatever method is used to find the seasonal pattern, it is equally important to apply it properly when trading. First, select a market that has a dominant seasonal pattern. Crops always qualify and have a relatively uncomplicated pattern. Livestock tends to be more complex than other commodities because of the joint dependency on both feedgrain prices as well as their own production and consumption factors. Both crops and livestock have primarily supply-oriented seasonal trends, depressed at harvest and highest during the growing months—or depressed in the fall when the livestock supply becomes greatest due to liquidation before winter. Metals patterns are caused by demand and may not be seasonal, but have longer trends based on macroeconomic factors. The exception is copper, which has a large demand from housing.

Stocks also have levels of complexity. Diversified companies obscure any seasonal factors. It is necessary to find companies whose primary income is from a single, seasonal source. Many airlines qualify, as do firms in the travel and leisure sector. It is not clear that share prices of the major oil companies, such as Exxon-Mobil, vary directly with the price of oil. Refining margins and vertical integration of retail gas stations (with mini-markets) make the profitability of these companies much less dependent upon the varying cost of supplies.

When trading seasonal futures markets, select a delivery month most likely to reflect the pattern to be traded. If a sharp rise in soybeans is expected in July, trade the August (old crop) or November (first new crop) contract. Nearer delivery months will show the largest price changes; deferred contract prices will show a smaller effect because time brings adjustments in demand or supply. Trading the nearest delivery is particularly important with nonstorable commodities, such as livestock. A change in the cost of available grain will primarily affect cattle currently being fed.

Exceptions occur in seasonal patterns as they do in any model. There are events that may overwhelm normal seasonality such as runaway interest rates or inflation, rapid change in the U.S. dollar, or a Soviet grain sale. Even though the seasonal variation still exists, the size of the price change resulting from these other factors is much greater and tends to obscure the seasonality. It is usually easy to recognize a nonseasonal pattern—prices simply go steadily up when they normally go down, or down when they are expected to go up. From 1972 to 1974, corn prices increased steadily with only small adjustments in September and October. Once this variation occurs, it may be wise to wait until another season has reestablished the normal pattern.

The systems and methods that follow are based entirely on seasonal patterns and may be used alone or as a filter for other strategies.

Seasonal Studies and Key Dates

Most agricultural commodities exhibit traditional, reliable price moves at one or more periods throughout the year. The grains grown in the northern hemisphere have a high likelihood of a rally during the late spring and early summer, when the chance of drought has the greatest effect on yield. When prices show the normal harvest lows, followed by a modest rise and sideways pattern throughout the winter, the potential is good for a rally during the early growing season. Because prices start at relatively low levels, the risk of holding a long position is small. Once prices have moved higher, there is rarely a season where a short sale of corn, soybeans, cotton, or sugar will not net a good profit within the two months before harvest begins.

Seasonal studies are intended to provide information on when the largest move will occur. The following studies—Grushcow and Smith (1980), ContiCommodity (1983), and Bernstein (1986)—will be used to compare the seasonality in some of the more active commodities. A summary of the results is shown in Table 10.12. Each study offers a different perspective on seasonality. Grushcow and Smith analyze both cash and individual futures markets over a fairly long period and present complete statistics; ContiCommodity used mostly the past 10 years, but included a unique volatility analysis; Bernstein, the most recently published study, gave the most complete background on calculations, including separate studies of bullish and bearish years and an exceptionally long time period for cash market analysis.

Table 10.12: Results of Seasonal Studies

Open table as spreadsheet

	J-F	F-M	M-A	A-M	M-J	J-J	J-A	A-S	S-O	O-N	N-D	D-J
Corn												
24 years[*]	.5	-1.1	1.6	3.6	3.4	.5	1.5	-5.3	-8.5	-1.3	.5	2.1
10 years[†]	2.2	-1.3	-2.3	-1.2	2.3	7.7	4.5	1.4	-7.5	-1.3	-6.4	1.8
46 years[‡]	-.6	2.0	3.0	2.9	2.3	3.8	-1.5	-3.2	-6.7	-3.7	5.4	1.5
%[*]	58	58	67	92	50	46	50	54	88	63	83	71
%[‡]	52	60	80	72	45	59	62	63	82	60	82	70
Soybeans												
24 years[*]	7.4	7.5	8.4	9.5	6.4	-.7	-1.3	-25.8	-7.5	4.2	5.8	.3
10 years[†]	-2.3	21.1	23.7	12.6	20.0	14.7	-11.7	-14.9	-46.7	-9.8	-8.9	2.1
42 years[‡] [§]	3	11	8	8	3	-1	-5	-20	-8	10	3	2
%[*]	67	50	67	50	42	38	58	83	63	75	67	79
%[‡]	62	53	57	51	42	37	64	74	64	76	72	70
Cattle												
25 years[*]	-.4	.1	.6	.1	-.1	.4	.4	-.3	-.4	-.5	-.1	.4
10 years[†]	1.4	.2	.8	1.8	.4	-1.2	-.4	-.7	-1.3	-.5	-.3	-.2
50 years[‡] [§]	1	12	13	4	-1	7	3	4	-9	-9	-2	2
%[*]	64	60	48	44	56	60	56	44	76	64	52	72
%[‡]	52	70	59	52	52	59	55	42	60	71	51	62
Orange Juice												

10 years[*]	-1.6	-.1	-.3	-.9	-.9	-.3	.1	-.2	1.2	-2.3	-.3	1.7
10 years[†]	-1.9	2.4	-1.1	-.7	.0	1.6	1.8	2.3	.2	.0	.0	-4.7
34 years[‡]	27	14	4	-3	-8	-1	1	3	-2	-2	-13	-4
%[*]	78	45	67	56	45	45	56	67	45	45	56	56
%[‡]	61	64	50	58	50	65	66	81	61	40	67	62
Coffee												
22 years[*]	-.2	.9	-.5	-.4	.1	.1	-.7	-.3	.1	.3	-.5	.1
8 years[†]	-6.5	1.8	7.6	5.0	-.3	3.3	-11.5	-2.0	4.3	-8.6	4.7	2.2
53 years[‡] [§]	0	-10	2	-4	1	4	18	2	19	-10	-4	-2
%[*]	41	64	50	50	59	46	46	55	41	64	50	77
%[‡]	56	58	43	53	50	48	56	56	51	59	54	49

[*] Grushcow and Smith (change in price).

[†] ContiCommodity (% change in seasonal factor).

[‡] Bernstein (% change in seasonal factor).

[§] Approximate values.

% refers to the reliability of monthly seasonality.

The number of years in the seasonal analysis counts heavily in determining the normal patterns. As Table 10.12 shows, the ContiCommodity results, based on a maximum of 10 years, are often quite different from the other two studies. For trading safety, it would be best to select those patterns that have proved reliable over many years; however, because inconsistency in the past 10 years cannot be ignored, a trader must be able to identify nonseasonal, bullish, or bearish patterns.

The conclusions that seem consistent throughout all studies are:

Corn and soybeans. September and October show major harvest pressure.

Cattle. An end of the year liquidation and mid-winter rally.

Coffee and juice. No common moves in the three studies.

Some commodities are more seasonally consistent than others. Both the coffee and orange juice markets were expected to show patterns that reflect a rise as the possibilities of a freeze increase; however, those patterns did not appear. Because we know that the freeze concerns must appear in the prices, we can infer that the normal seasonality of these products is distorted by the inconsistent and highly volatile periods that follow a freeze. These markets would be candidates for an *analogous years* study in which you compare only those years with common factors.

The three studies shown here, as well as most others, include recommended trades based on key dates, which reflect the patterns in Table 10.11a. By selecting those trades common to all of them, you have found those that are most reliable. In a summary by Bernstein, which catalogs commodities by those months with the highest reliability, the agricultural products are clearly the most seasonal. The only nonagricultural market that shows any consistent seasonality is copper. Although there may be interesting arguments for the forces of demand on silver, currencies, and financial markets, their inconsistency is apparent and they are not candidates for seasonal trading.

Seasonal Calendar

Because Bernstein's work covers the cash markets over an extremely long period, it must be considered the most reliable source of basic seasonal patterns. Table 10.13 is part of the weekly seasonal calendar which appears in *Seasonal Concepts in Futures Trading*. The numbers in the table show those weeks with consistent historic moves. Weeks of 64% and higher represent upwards moves; weeks of 36% and lower display downward trends. This calendar can be extremely useful when combined with some simple trading logic which asks, "Is the market acting in a seasonal manner?" *before* the position is entered.

Table 10.13: Seasonal Calendar Open table as spreadsheet

	Mar Corn	May Corn	Jul Corn	Sep Corn	Dec Corn	Mar Wheat	May Wheat	Jul Wheat	Sep Wheat	Dec Wheat	Mar Oats	May Oats	Jul Oats	Sep Oats	Dec Oats	Jan Soybeans	Mar Soybeans	May Soybeans	Jul Soybeans	Aug Soybeans	Sep Soybeans	Nov Soybeans	Jan Soybean Meal	Mar Soybean Meal	May Soybean Meal	Jul Soybean Meal	Sep Soybean Meal	Dec Soybean Meal	Mar Soybean Oil	May Soybean Oil	Jul Soybean Oil	Sep Soybean Oil	Dec Soybean Oil	Feb Live Cattle	Apr Live Cattle	Jun Live Cattle	Aug Live Cattle	Oct Live Cattle
1 Jan				76			29				66	66					29		37							33			35									
2											66			66					64	64									66						64			
3	66							22	23	37							66										29			77	66					64		
4							27			33	37						37			37					33			66	66				66			66		
5 Feb						31		35	37	31								66		64	70			28			37	37	70	64	62			64		76		
6		27				64				75	66													37										66			75		
7	35										31	37	33						64	64												66		76		64		
8	35	29				22	27				27						70									35				33							37	
9 Mar	66						35		31	25		23	37	37			35			35				66	35	23	23	35						77	76	66		
10								27	37	31														66	64		70		70	66							66	66
11				72		35		35	23	29														37	35								66	70				
12																		37	37											33					37			
13 Apr			66	66			72		79			76	64	81				78		64					70	70				72					72	76	71	
14		77										66	64					70	64			63					70	66						64	66	76		
15							37		33									35		25								37								64	75	66
16							33						25	37				26	23						29	17				33		66						
17			27					22				22																										
18 May							37		29	18		83						76				36					29	29		70				64			66	
19	35											82	76						75											27						64		33
20	70				66			33											70	64	66				64			70						70				66
21						37		33									66										64	75	27		33					70	75	66
22 Jun				37					31	29				37		64	35		23	33	37		66		66	31		31			27	33	22		64		64	
23	33		33	35		76			35	28			37	37					64									76				33	66	66				
24	76			76		33			64	82							70		37				64	81	66		66	66	70	33		66	66					33
25	33			27	36				37	29						76		64		70			72							72							66	
26 Jul	66		70	66	63								64						75			66				64		66	70		72		72	66	77		73	
27			66						64				29	26						64			66		76			64							37			77
28		35						64						35		13		23				63		66	29			64						33				
29	22	22			21									31		25	17	29		33	25	15	33	20	35		29	25		29								
30		27		23	36		27																															
31 Aug					35	33															28						35	35				64						
32											70			66													35	35								66		
33											66			66										37				37										
34							83		64			64		66	66	37											70	75		33								
35 Sep				35			72		70	64		66		37							37			37			29	35	27	64		29	10					37
36									64									66	64		35				64					64			64	66	35			70
37			31								70					29		29	29			66			29		76	66		27				37				
38	29				31										35		33											37						66				
39																																			37			
40 Oct											64				64	76		64	64			36	72										35	33				
41						66		72		64						25		35	35			73		66		36		76	64				72					
42					63							66										35							23						27		31	
43							27	33			70																	64						33		35		
44 Nov			27		66	37	33		26			72				31	33		64			77	66		70									70	72	13	64	
45										35					79	64					76		75		64										64	70	75	
46																29	33	35						66						16				66	70	76		
47			64						64												37				35			37	29	66			27			66		
48 Dec							29		35						66	64							66		66	72			66	33								
49	18		35								33					66												70					33					
50												35				29	66	25	33	29			35	31					66	29				66	66			
51												64			35	35	27	37	37	35	31								11	27	22			64			66	
52							66																															

Open table as spreadsheet

	Dec Live Cattle	Mar Feeder Cattle	Apr Feeder Cattle	Sep Feeder Cattle	Oct Feeder Cattle	Nov Feeder Cattle	Feb Live Hogs	Apr Live Hogs	Jun Live Hogs	Jul Live Hogs	Aug Live Hogs	Oct Live Hogs	Dec Live Hogs	Feb Pork Bellies	Mar Pork Bellies	May Pork Bellies	Jul Pork Bellies	Aug Pork Bellies	Mar Cocoa	May Cocoa	Jul Cocoa	Dec Cocoa	Jan Orange Juice	May Orange Juice	Sep Orange Juice	Nov Orange Juice	Mar Sugar	May Sugar	Jul Sugar	Oct Sugar	Mar Coffee	May Coffee	Jul Coffee	Sep Coffee	Dec Coffee	Mar Cotton	May Cotton	Jul Cotton	Oct Cotton	Dec Cotton	Jan Lumber	Mar Lumber	May Lumber	Jul Lumber	Sep Lumber	Nov Lumber
1 Jan									66					64		37							31	35	29								63				75	87	86				66				
2							70	77			76			70	66										35			77	70		63		66						75			66				28	
3			66						66	80	76				66	64	64		35		33		37								27	18	27					64			30		69			
4									73	64						66		62						35				35				66	75					35	33				69		64	
5 Feb		70								64	66			64	81														35		63		63	72	81								71	69		69	66
6	66						64								37				64										70			66	91	75	63								15			64	63
7																	35		35	33					35						72		33		70	35	37	18	37								76
8		20			36			35	66									66		66				35	29	33	62	72	35		36	25		66		64	64	70	68			21	7	28	72	28
9 Mar	80	80	70		63			66									70		75		66										70	66			72							30		35	16	
10					63	70																	25		31		64	29	37	36	36	33		33			37	35	31							33	
11				35					33									64	35	27	27		26	29	12	16		27	37	36	80	75		83	72			35				35	69			30

12	37				63							73					66				68						22					66	33				70		75				15		25	35
13 Apr									66		70	64						79					31	64		70							75	36	36										36	7	
14	72		90	80	63	90		77	78	87		71				33		31			38		31		37	37				36		66	66	66	72		66								33	
15			80	81	72	66						33				66		78		66			75					33	37					63	63									70			
16					81											23		23		22	38		75	64	76	76					63	66	75		27		29	26								
17										64	64																																30				
18 May				30	33	30			66	73																77		33		36	72			72	80		75		68		27		30	7	25	23
19					27				80							27			37	29	27								35		72			66	63		76			70					35	33	35
20				70						29	31						35		64		66		68		35						36		75	72	72			70		66	23					25	
21				63	81	80											17	35				33	68										66		36	35		37	31	35	69				28	83	14
22 Jun						77					35	26	27	35			35	23					33			64				64						29				29				78	33	83
23	33			36		30				31					37				37			33	35			33	33			36	36		33				70		37		66					35
24	70				36					70				70			70				66					35			33	36				27	70				75	69				75	64
25				72	63						64		66				70		76	77			66		35	27			29		36			33												
26 Jul	66				72	66					35				66		75					72							35						36	64											
27				36	80									64					64	77	66	72	73			66									36		68				37	30					35
28				36	27												66				77	64			64				29							70		35		72		15		35		28
29											35				37											64				36	63			66			76					?			66	71
30				27																																											
31 Aug					36							66					64		64	66										36					64											
32				72	63						76	66	72						64		36				70						63			66	80											28
33					36						70			76	66			64		33			37								72			66	63	37			37							71
34				63		30						37	38						64	83			73				66			66	27				36	64	64		37						66	
35 Sep	70			63		80						73	66	70	66		81		70			77	73		82	66		76			36	75			36				66							
36				63	72	70							66							33		66			70	66					72			66	36		35	35			30					69
37						70									37															36			63	33	63	35	35		37		25	7			25	28
38						30																	75					27	37	36	63 63	66			63	23 23	37	29	12			35	23	28		
39	27																			33			81	82		64	11		35			36	33		81					33						28
40 Oct	33				70							31		29		33	29	23								64												81	66	75					
41													27		31				29	33				76			72	66	70	68	36			63	27	70	68	68		76						
42	35				36													37	70				75	64		66	72	64	75		66	75	83					37					69			28
43	22													66	33		75			72	64		80			72					90	66	75	83	63	64	64			66	66	71	76	71		
44 Nov							82	83	71				72	64	66	72		66	70	29												63	63													71
45	70												77	70			80		25	33	33					70		72	70		63		63	66		35	35	35	37	35	84	69	69			64
46		70					84						77									27					66		64						63		64	66				64				
47																											64				72	75	75	66			35		37							
48 Dec							64							35			35		64	66		72						64	70			72	66		63						33			30		
49	33		66										66														66	33			72	83	83	75	63	64		35					69	76	85	83	
50													76		37	66	64						26	18			33		35					63										76		66	
51									64					73		77	76																														
52																																																

[7]David Handmaier, "Low-Frequency Filters in Seasonal Analysis," *Journal of Futures Markets* (Vol 1., No. 3, Wiley, New York, 1981).

[8]ContiCommodity, *Seasonality in Agricultural Futures Markets* (ContiCommodity Services, Chicago, 1983).

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SEASONALITY AND THE STOCK MARKET

There has been a great deal of conflicting opinion on the seasonal patterns of the stock market. One prominent analyst has been quoted as saying that November through April captures the best upwards move, while another equally respected analyst publicly proclaims the best interval to be April through August.[9] While it might not be possible to explain this inconsistency, the increased popularity of the index markets, futures, and exchange traded funds (ETFs)—broad market measures and sectors—allows analysts to study seasonality much more easily than ever before. Market participation has broadened and patterns may change. The results of seasonal studies found in this chapter may have shifted slightly.

The Holiday Effect for Stocks

Arthur Merrill is acknowledged as the pioneer in seasonal timing in stocks, publishing his comprehensive work on this topic in 1966.[10] In his studies of price movement before and after major holidays, Merrill demonstrates a strong bullish tendency in advance of a holiday with a weak day immediately following. Remembering the bullish bias of the stock market (about 54% of all days were higher from 1897 to January 1964), Merrill's results are shown in Table 10.14. In relation to trading, this would indicate the possibility of a sharp trending move prior to or throughout a holiday season.

Table 10.14: Merrill's Holiday Results

Open table as spreadsheet

Period Tested	Holiday or Holiday Period	% Upward Moves
1897–1964	Day prior to all holidays	67.9%
1897–1964	Day after all holidays	50.8
1897–1964	Thanksgiving to New Year	74
1897–1964	July 4th to Labor Day	69
1931–1965	Before Christmas	74
1931–1965	Before New Year	75

Norman Fosback[11] confirmed Merrill's results by studying the returns based on a strategy that bought two days prior to a major holiday and exited on the day prior to the holiday, rather than waiting until the day following the holiday. Fosback's strategy yielded returns of 880% from 1928 through 1975 with 70% of the trades profitable, while holding long positions during the remaining days of the year would have lost 41%. Therefore, the net gains for the year were all associated with the few days prior to major holidays. In addition, the returns on holiday trading were accomplished by a risk exposure of only a few days each year. According to an updated study by Freeburg, the strategy used by Fosback is still profitable, but not as impressive. Freeburg also showed that the same strategy was profitable for U.S. 30-year Treasury bond futures as well as corporate bonds.

The Month-End Effect

It seems sensible that, if you are willing to take the opposite position to the crowd, there are profits to be made. One such strategy takes advantage of month-end liquidation. Perhaps some investors close out positions before the end of the month in order to realize profits or losses; this is even more likely to happen at the end of a quarter or the calendar year. This effect could be helped by large funds that may exit positions to balance redemptions. Merrill, Fosback, and Freeburg all confirm the success of a strategy that buys on the last day of the month, or the second to the last day, then exits the trade on the fourth trading day of the new month. That takes advantage of large-scale, month-end liquidation, followed by resetting positions. Freeburg confirmed that this strategy was still viable for both the S&P Index and bonds, although not as profitable as when these markets had limited participation through 1975.

The Hirsch Strategy

One of the most popular of all seasonal strategies is from the work of Yale Hirsch. He simply bought on the first day of November and sold on the last day of April, holding the position for six months.[12] In addition to satisfying certain tax requirements, this avoided the period most traders consider the summer doldrums. More recently, the Hirsch strategy would have taken a loss in October 1987 but recovered by the end of that year; it also would have avoided the disaster of 9/11/2001 and benefited from the subsequent recovery. Hirsch had discovered that virtually all gains in the stock market took place during those six months.

Hirsch's original strategy benefited from reinvesting dividend income during the six months that you were not in the market. That advantage has diminished, but leveraged investing can replace that loss. Using futures, exchange traded funds, or leveraged funds available through Rydex and ProFunds can make up the difference.

The January Effect

Another bias in the pattern of prices may be seen in the action of the stock market during the month of January. There are many investors who are not as anxious to trade in and out of the market as professional managers and speculators. It is perfectly sensible to look for a pattern in the way many of the long-term investors set positions at the beginning of the year, the result of a reallocation of their portfolios, or resetting positions liquidated before the end of the year for tax reasons.

If January is a leading indicator of stock market movement throughout the rest of the year, a combination of patterns should be considered based on the few days immediately after the year begins, and the net market direction for the month of January.[13] Using the Dow Industrials as a stock market indicator, the January pattern was viewed from 1900 to 1989 in two parts, 1900–1937 and 1938–1989. The results are shown in Figure 10.13 for all years and Table 10.15 for the past 52 years.

Figure 10.13: Results of January patterns. *Source*— Jay Kaeppel, "The January Barometer," *Technical Analysis of Stocks & Commodities*.

Table 10.15: The January Barometer Patterns, 1938–1989

Open table as spreadsheet

	S&P 500		
Pattern	**During First 5 Days of the Year**	**By the End of January**	**Expectations for Feb–Dec**
1	Declines	Further decline	Bearish

2	Declines	Less decline, but loss for the month	Bearish
3	Declines	Gain for the month	Bullish
4	Advances	Further gains	Bullish
5	Advances	Less gain, but gain for the month	Bullish
6	Advances	Loss for the month	Bearish

Figure 10.13 shows that the early part of the century had no significant pattern. There were nearly the same number of bullish and bearish indications resulting in a larger number of incorrect predictions. The past 52 years are very different, with a much larger number of correct moves. One should note, however, that the ratio of up to down moves is more than 7:1. During the past 10 years it is likely that this pattern would continue to be successful if the prognosis was a bull market. To offset the market bias, it should be noted that the patterns shown in Table 10.15 are very logical. The direction of the first five days, confirmed by a continuation in that pattern for the balance of January, is then followed by the same pattern for the year. In the case where the market changes direction after the first five days and nets a loss for the month, the pattern conforms to the new direction for the balance of the year.

Risks of September and October

It is easy to point out the spectacular events of September and October: The tragedy of September 11, 2001; Black Monday, October 28,1929; and the market crash of October 19, 1987. However, these months have other negative attributes that are not as noticeable. Freeburg has found 17 *ricochet rallies* in October since 1950. He defines a richochet rally as a price rise of at least 5% within 10 days as measured from the S&P monthly low. June ran a distant second place with only 10 rallies. Therefore, while October may hold the record for the most volatile price moves and the most risk, it also has great opportunity for timing an entry into a new position.

While not as spectacular as October, September seems to capture consistency in underperformance in both recent years and throughout the past 100 years. Is this a remarkable coincidence or is it likely to continue? The argument seems strong that investor behavior would continue; however, September can be a profitable month simply by chance without changing the probabilities very much.

[9]An excellent summary of seasonal studies in the stock market can be found in Nelson F. Freeburg's reports, *Formula Reseach* (Formula Research, Inc., 4745 Poplar Ave., Suite 307, Memphis, TN 38117-4408). Material from this section was drawn from Vol. VI, nos. 10–11, December 2000 and August 2001. Also recommended is Steve Moore, "Playing the Seasonals," *Active Trader* (Vol. 1, No. 8, November 2000).

[10]Arthur A. Merrill, *Behavior of Prices on Wall Street* (Analysis Press, Chappaqua, NY, 1966). It is currently available from Analysis Press, 3300 Darby Road, #3325, Haverford, PA.

[11]Norman G. Fosback, *Stock Market Logic* (Dearborn Financial, 1998).

[12]Nelson Freeburg, see footnote 9.

[13]Jay Kaeppel, "The January Barometer: Myth And Reality," *Technical Analysis of Stocks & Commodities* (July 1990).

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COMMON SENSE AND SEASONALITY

Most comprehensive works on seasonality include not only agricultural markets but currencies, interest rates, and indices. Very little is available on stocks. Common sense tells us that the primary feedgrains follow a clear seasonal pattern based upon a single crop year. This calendar cycle also applies to coffee, cocoa and oranges, although competition from South America has limited the extreme moves that resulted from a freeze in Florida's orange groves. Grain seasonality has been slowly changing as well, as Brazil continues to improve their production of soybeans and Asian countries become a greater factor. Cattle and hog prices, dependent upon the cost of feed, and still marketed more actively in the fall because of weather, show a strong seasonal trend even though they have a growth and feeding cycle that is not confined to a calendar year. Livestock patterns have adjusted to long-term competition from Australia and New Zealand.

These agricultural markets are reasonable candidates for seasonal analysis, but may require careful study to identify shifting patterns in competition and storage. What about Treasury bonds or the Japanese yen? Should we look for seasonal patterns in the financial markets? We can argue that certain listed companies and even market sectors are highly dependent upon seasonal business. However, can we say that the demand on money is higher in the summer than in the winter. Or that enough tourists convert their currencies to yen when they visit Japan during the summer that this effect drives the value of the yen consistently higher? Are automobile exports from Japan stronger or weaker during a certain season, so that there is a predictable pattern? These scenarios are highly unlikely, and we have no assurance that cars will be sold off with the coming of winter in the way that grain must be harvested. In financial markets the players can choose their time to act; they can hedge their commitments or wait for a better opportunity. This choice makes price patterns uncertain. The study of seasonality should be limited to those markets that depend on weather and seasons, on Mother Nature or consumer behavior, either directly or indirectly.

Being Too Specific about Targets

Nature is not precise, so selecting an *optimal day* of the year to enter a long position is not likely to work. Small shifts in fundamentals, such as the building of additional storage, allows farmers to change their selling habits slightly. The right day to buy or sell in 1975 is not likely to be the right day this year. Even weekly data may be too specific. Seasonal patterns are best seen using monthly data. The most we might expect is to know that the seasonal high in corn usually occurs in July but sometimes in June or August; the harvest lows are likely in September but could be in October or November. We must first be aware of the big picture, then study how the specific pattern develops each year. There are other timing tools, such as overbought and oversold indicators, that can help narrow the moment of opportunity within an expected window of time.

Recognizing Nonseasonal Years and External Factors

The studies of bull and bear market years shown in this book should make it clear that seasonality is not at all consistent. Only a few years can cause prices to show extreme seasonal highs during the summer, while there are years in which the patterns are influenced by external factors and do not show normal seasonality. Seasonality, although a clear concept and a fact of nature, is not a trivial analysis when applied to trading. Each year must be observed and categorized, then a reasonable trading plan must be defined for that situation.

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Chapter 11: Cycle Analysis

OVERVIEW

The cycle is another basic element of price movement, along with the trend and seasonality, but it is more difficult to evaluate; therefore, it is often overlooked. Cycles come in many forms—seasonality, production startup and shutdown, inventory or stocks, behavioral, and astronomical. Seasonality is a special case of a calendar or annual cycle. Seasonality was covered in the previous chapter and its special features are not considered here. Some of the cycles are clearly *periodic*, having regular intervals between peaks and valleys; others are more uniform in their *amplitude* (height) but irregular in period. The most definitive and regular cycle remains the seasonal, which is determined by periodic physical phenomena, the changing of the year.

This chapter discusses the major commodity cycles that result from business decisions, government programs, long-term market characteristics and phenomena. Short-term cycles are usually attributed to behavior and will be covered in Chapter 15. There are a few important ways to find the cycle, the most common being *trigonometric curve fitting* and *Fourier* (*spectral*) *analysis.* Both require a computer and will be explained in the following sections. John Ehlers introduced *Maximum Entropy Spectral Analysis* (MESA), which finds price cycles based on small amounts of data, at the same time avoiding some of the problems inherent in other methods. Examples of solutions will be included in the explanation of the methods and applications will follow. Computer programs that solve the trigonometric problems can be found in Appendix 4 along with additional examples.

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Chapter 11 - Cycle Analysis
New Trading Systems and Methods, Fourth Edition
by Perry J. Kaufman
John Wiley & Sons © 2005 *Citation*

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CYCLE BASICS

The cycle, along with the trend and seasonality, comprise the three orderly components of price movement. The fourth is noise, which includes everything not accounted for in the first three. To find any one component we must remove the others. In previous chapters we found that we can eliminate the trend by taking the first differences of the data, that is, subtracting the previous value from the current value. In the previous chapter on seasonality we used the simple technique of subtracting a 1-year moving average (a 12-period average applied to monthly data) from the original price series to remove the seasonal pattern. By finding the first differences and subtracting the 1-year average we are left with the cycle and the unaccountable price movement, which we call *noise*.

Even when the seasonal pattern is eliminated, most cycles are still based on the periodic effects in our universe. After the 1-year orbit of our planet around the sun, there is the 28-day lunar cycle; converted to business days, this gives the very familiar 20-day reference that remains overwhelmingly popular among all analysts. Other planetary effects, which should by no means be discarded offhand, can be found in Chapter 14 under the topic "Financial Astrology." The possibility cannot be eliminated that planetary motion may account for, besides seasonality, the effects of mass behavior, which can produce the consistency of any cycle that repeats with a fixed period.[1]

Cycles can be complex and difficult to see because there are often a combination of larger and smaller patterns, and cycles within cycles, all acting at the same time. Nevertheless, they exist and they are real. The cycles that appear to be most imporant are either long-term or the sum of a number of subcycles that come together at peaks or valleys. This gives us a way to identify one point on a cycle; we must remember that, when the individual components are found, there may be a number of smaller patterns that cause this effect. A reference to *harmonics*, just as in music, means that a smaller cycle is a fraction of the larger cycle, for example, its cycle length is ½, ⅓, ¼, … of the larger. When two cycles are synchronized, their peaks or valleys occur at the same time. Any price series can be decomposed into individual cycles and represented as the sum of multiple cycles.

Observing the Cycle

Before selecting a market for cycle analysis, it is necessary to observe that a dominant cycle exists; it is also useful to know why it exists in order to avoid uncovering spurious patterns. This is most easily done for markets in which you can clearly identify the fundamental or industrial reasons for cycles. The basis for a cycle could be a pattern of holding inventory, the fixed time needed for breeding and feeding of livestock, seasonality, the time necessary for closing a mining operation then starting it up again, expansion or contraction of business based on disposable income, or other economic factors.

The Cattle Cycle

Using cattle as an example, Figure 11.1a shows a clear 9- to 11-month cycle in futures prices[2] over a 6-year period from 1980 through 1985. The peaks and valleys vary by up to one month, making the pattern reliable for use as part of a long-term trading strategy. Although feedlots in the Southwest have made the supply of cattle more evenly distributed throughout the year, there are still a large number of ranchers in the North who send their cattle to market in the early fall to avoid the difficulties of feeding during a harsh winter. This causes generally lower prices in the fall and higher prices in the mid-winter when supplies are low.

(a)

(b)

Figure 11.1: (a) Nine- to 11-month cycle in live cattle futures prices. (b) The cattle cycle, 1997–2002.

A similar pattern can be seen more recently in Figure 11.1b. During the past six years the peaks of the cycle are consistently 12 months apart, although the valleys are not as consistent, most often coming within a few months after the peaks. The overall picture shows that cattle prices continue to have a clear cycle, driven by the fundamentals of production.

The Swiss Franc Cycle

The Swiss franc cycle (denominated as Swiss franc/U.S. dollars on Chicago's International Monetary Market) shown in Figure 11.2a is quite different.[3] There are two likely cycles: the primary one (shown using letters at the peaks and valleys) and a subcycle (marked with numbers). The subcycle ranges from 24 to 35 weeks with a 40% variance compared to 20% for cattle. Most important, the cycle in the Swiss franc cannot be attributed to any specific fundamental cause. There is certainly a long-term cycle based on the strength and weakness of the U.S. economy with respect to the Swiss economy, or the relative attractiveness of U.S. interest rates. There is also the general ebb and flow of the U.S. trade balance and, of course, investor behavior. Unlike cattle, these patterns do not need to be rigid.

Figure 11.2: (a) Cycle in Swiss franc futures, 1975–1979. The lettered peaks and valleys show the choice for a primary cycle; the numbered peaks and valleys show a likely subcycle. (b) Cycle in Swiss franc futures, 1997–2002.

Looking at Swiss franc prices from 1997 through 2002 there are obvious peaks and valleys that continue a cyclic pattern (see Figure 11.2b). Although they are crisp in appearance, the cycle period now has an average period of about 38 weeks with a range from 30 to 52 weeks. The new cycle falls about midway between the periods of the previous primary and subcycles. Although the cycles seem clear, the change in period and the variance between cycle tops will make a systematic strategy difficult.

Early Cycle Identification

A simple way to begin the search for major cycles is to look at a long-term chart, displayed as weekly rather than daily prices. The dominant half-cycle can be found by locating the obvious price peaks and valleys, then averaging the distance between them. A convenient tool for estimating the cycle length is the Ehrlich Cycle Finder.[4] It is an expanding device with evenly spaced points, allowing you to align the peaks and valleys and to observe the consistency in the cycle. For finding a single pattern, it is just as good as some of the mathematical methods that follow. It is best to have at least eight cycle repetitions before concluding that you have a valid cycle.

Cycles can be obscured by other price patterns or market noise. A strong trend, such as the one in Swiss francs (Figure 10.2a) or the seasonal movement of crops, may overwhelm a less pronounced cycle. Classic cycle identification requires that these factors first be removed by detrending and then by deseasonalizing. The resulting data will then be analyzed and the trend and seasonal factors added back once the cycle has been found. To find a subcycle, the primary cycle should be removed and a second cycle analysis performed on the data. This can be a tedious process. In order to bypass these steps, the methods that follow (trigonometric regression and spectral analysis) can locate the dominant cycle and subcycles at one time using integrated processes.

The Kondratieff Wave

Much of the popularity of cycles is due to the publicity of Nicolai Kondratieff's 54-year cycle, known as the *K-wave*. During its documented span from about 1780 to the present, it appears to be very regular, moving from highs to lows and back again. In Figure 11.3 the Kondratieff wave is shown with the Wholesale Price Index as a measure of economic health.[5] With only three full cycles completed, it is difficult to tell if the overall trend is moving upwards, or whether the entire pattern is just a coincidence.

Figure 11.3: The Kondratieff Wave. *Source*—Walker, Jeff, "What K-wave?" *Technical Analysis of Stocks & Commodites* (July 1990).

The forecast of the K-wave, shown in Figure 11.3, indicates a sharp decline in wholesale prices due at about the year 1990, the millenium's equivalent to the depression of the 1930s. In fact, the 1990s posted remarkable gains in the stock market, peaking at the beginning of 2000. According to the chart pattern, this peak should be followed by 10 to 20 years of downturn in the economy, in which case we are just at the beginning. In order to make the Kondratieff wave fit the actual price movement, the last two peaks (1920 and 2000) would be 80 years apart, rather than 54 years.

Although we all accept the existence of an economic cycle, pinpointing the peaks and valleys is impractical. Even if the 54-year period varied only by 10%, we could be entering an investment position five years too soon or too late. Determining long-term cycles for any market has the same problem—the actual price pattern will never correspond exactly to the predicted peaks and valleys that most often come at regular intervals. Fortunately, there are other choices. Shorter-term cycles do not need to have the same constant period, and the way in which cycles interact with other strategy components will make them more flexible.

Terminology

Before getting technical about the measurement and calculation of cycles, there are a few terms that describe most of the concepts discussed throughout this chapter. Note that the use of *wave* and *cycle* are interchangable.

Cycle or wave. A recurring process that returns to its original state.

Amplitude. The height of the wave (cycle).

Period. The time needed to complete one wave (cycle).

Frequency. The number of cycles that repeat every 360°.

Phase. A measurement of the starting point or offset of the cycle relative to a benchmark wave.

Phase angle. Locates the position within the cycle measured as the minute hand of a clock moving clockwise, where 0° is three o'clock.

Left and right translation. The tendency for a cycle peak to fall to the left or right of the center of the cycle.

[1]See the section "The Moon" in Chapter 14.

[2]Jacob Bernstein, "Cycle and Seasonal Price Tendencies in Meat and Livestock Markets," in Todd Lofton (ed.), *Trading Tactics* (Chicago Mercantile Exchange, Chicago, 1986).

[3]Jacob Bernstein, *The Handbook of Commodity Cycles* (Wiley, New York, 1982).

[4]Ehrlich Cycle Finder Company, 2220 Noyes Street, Evanston, IL 60201.

[5]Jeff Walker, "What K-wave?" *Technical Analysis of Stocks & Commodities* (July 1990).

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UNCOVERING THE CYCLE

Before resorting to the highly mathematical methods for finding cycles, there are some simple approaches that may serve many traders. For example, if you believe that the dominant cycle has a 20-day period, then you simply create a new price series by subtracting the current data from a 20-day moving average. This removes the trend that may obscure the cycle. This is the same method used for removing seasonality, which subtracted the values of a one-year trend from the corresponding prices.

Most oscillators, such as a stochastic or RSI, can also serve to identify a price cycle; however, if you want to see the peaks and valleys of a 20-day cycle, you will need to use a calculation period for the oscillators that is no more than 10 days.

Enhancing the Cycle

Removing the Trend Using Triangular Weighting

The cycle can become more obvious by removing the price trend. The use of two trendlines seems to work very well in most cases.[6] First smooth the data using two exponential moving averages, where the longer average is half the period of the dominant cycle (using your best guess), and the shorter one is half the period of the other. Then create an MACD indicator by subtracting the value of one exponential trend from the other; the resulting *synthetic* series avoids the lag inherent in most methods.

One method for enhancing the cycle is the use of *triangular weighting* instead of exponential smoothing. The weighting is *triangular* because it creates a set of weighting factors that are smallest at the ends and largest in the middle. You must first decide the calculation period and the weighting factor for the center price. For practical purposes, it is only necessary to give the center price the weight of 2.0. Because there needs to be a center price, the triangular weighting method will eliminate the oldest price if the calculation period is an even number.

The weighting factors begin with the value 2.0/(P/2), and increase by the same value. If the calculation period P=10, the weighting begins at t-P+2, or t-8, eliminating the oldest value in order to have an odd number of prices. The weighting factors, w_i, are then .4, .8. 1.2, 1.6, 2.0, 1.6, 1.2, .8, and .4. The triangular average is

$$TMA_t = (w_1 \times P_{t-P+2} \times w_2 \times P_{t-P+3} + \ldots + w_{P-1} \times P_t) / P$$

Enhancing the cycle requires that you calculate two triangular averages, one of which is half the period of the other, then take the difference of the two. The smooth curve of the triangular MACD in Figure 11.4 shows what appears to be a regular cyclic pattern in the price of IBM.

Figure 11.4: A Triangular MACD shows an apparent cycle in IBM. *Source*—A. Bruce Johnson, "Finding Cycles in Time Series Data," *Technical Analysis of Stocks & Commodities*, 8, no. 8 (August 1990). © 1990 Technical Analysis, Inc. Used with permission.

Trigonometric Price Analysis

Most cycles can be found using the trigonometric functions *sine* and *cosine*. These functions result in what are called *periodic waves* because they repeat every 360° or 2p (2 pi) radians, where p = 3.141592. Because radians can be converted to degrees using the relationship

$$1 \text{ degree} = \frac{2\pi}{360}$$

all the work that follows will be in degrees. Some other notation that is used are:

Amplitude (a). The height of the wave from its horizontal midpoint (the x-axis).

Period (T). The number of time units necessary to complete one wavelength (cycle).

Frequency (ω). The number of wavelengths that repeat every 360°, calculated as $\omega = 1/T$.

A simple sine wave fluctuates back and forth from +1 to -1 (0, +1, 0, -1, 0) for each cycle (one wavelength) as the degrees increase from 0° to 360° (see Figure 11.5). To relate the wavelength to a specific distance in boxes (on graph paper), simply divide 360° by the number of boxes in a full wavelength, resulting in the box size (in degrees). For example, a 100-box cycle would give a value of 3.6° to each box. The wavelength can be changed to something other than 360° by using the frequency, ω, as a multiplier of the angle of the sine wave, f,

$$\sin \omega f$$

Figure 11.5: Sinusoidal (sine) wave.

If $\omega > 1$, the frequency increases and the wavelength shortens to less than 360°; if $\omega < 1$, the frequency decreases and the wavelength increases. Because ω is the frequency, it gives the number of wavelengths in each 360° cycle. To change the *phase* of the wave (the starting point), the value b is added to the angle

$$\sin (\omega f + b)$$

If b is 180°, the sine wave will start in the second half of the cycle; the phase value b serves to shift the wave to the left. The *amplitude* can be changed by multiplying the resulting value by a constant a. Because the sine value ranges from +1 to -1, the new range will be $+a$ to $-a$ (Figure 11.6). This is written $a\sin(\omega f + b)$.

Figure 11.6: Compound sine wave.

There are few examples of price movement that can be represented by a single wave; therefore, two sine waves must be added together to form a *compound wave:*

$$y = a_1 \sin(\omega_1 f + b_1) + a_2 \sin(\omega_2 f + b_2)$$

Each set of characteristic variables, a_1, ω_1, b_1, and a_2, ω_2, b_2, can be different, but both waves are measured at the same point f at the same time. Consider an example that lets the phase constants b_1 and b_2 be zero. Then

$$y_1 = 3 \sin 4f$$
$$y_2 = 5 \sin 6f$$
$$y = y_1 + y_2$$

Figure 11.6 shows the individual regular waves y_1 and y_2, and the compound wave y over the interval 0° to 180°. Note that both y_1 and y_2 began the normal upward cycle at 0°; by 180°, however, they are perfectly out of phase. During the next 180°, the two waves come back into phase.

When combining periodic waves, it is useful to know the maximum and minimum amplitude of the resulting wave. Because the peaks of the two elementary waves do not necessarily fall at the same point, the maximum amplitude of either wave may not be reached. A mathematical technique called *differentiation* is used to find the maximum and minimum amplitudes. The first derivative, with respect to angle f, is written dy/df or y', where y is the formula to be differentiated. The rules are:

$$\frac{d}{d\phi}(\sin\ \phi) = \cos\ \phi; \qquad \frac{d}{d\phi}(\cos\ \phi) = -\ \sin\ \phi$$

$$\frac{d}{d\phi}(\sin\ \omega\phi) = \omega\ \cos\ \omega\phi$$

$$\frac{d}{d\phi}(\sin(\omega\phi + b)) = \omega\ \cos(\omega\phi + b)$$

$$\frac{d}{d\phi}(a_1\sin(\omega_1\phi + b_1) + a_2\sin(\omega_2\phi + b_2))$$
$$= a_1\omega_1\cos(\omega_1\phi + b_1) + a_2\omega_2\cos(\omega_2\phi + b_2)$$

Applying this method to the previous example,

$$y = 3\ \sin\ 4\phi + 6\ \sin\ 5\phi$$
$$\frac{dy}{d\phi} = y' = 12\ \cos\ 4\phi + 30\ \cos\ 5\phi$$

The points of maximum and/or minimum value occur when $y' = 0$. For $y'_1 = 12 \cos 4f$, the maxima and minima occur when $4f = 90°$ and 270 ($f = 22½°$ and 67½°) (Figure 8.6). For $y'_2 = 30 \cos 5f$, the maximum and minimum values occur at $5f = 90°$ and 270° ($f = 18°$ and 54°). It must be pointed out that the first derivative identifies the location of the extreme highs and lows, but does not tell which one is the maximum and which is the minimum. The second derivative, y'', calculated by taking the derivative of y', is used for this purpose as follows:

If $y'(x) = 0$ and $y''(x) > 0$, then $y(x)$ is a minimum.

If $y'(x) = 0$ and $y''(x) < 0$, then $y(x)$ is a maximum.

Then, $y_1 = 22½°$ and $y_2 = 18°$ are maxima and $y_1 = 67½°$ and $y_2 = 54°$ are minima.

Anyone interested in pursuing the analysis of extrema will find more complete discussions in a text on calculus. Rather than concentrating on these theoretical aspects of curves[7], consider a practical example of finding a cycle in the price of scrap copper, shown in Table 11.1 and charted in Figure 11.7. The price peaks seem evenly spaced, occurring at mid-1966, January 1970, and January 1974, about four years apart. The solutions to these problems are tedious; therefore, calculations will be performed using the computer programs in Appendix 4.

Table 11.1: Dealer's Buying Price, No. 2 Heavy Copper Scrap at New York[*]

Open table as spreadsheet

Average Quarterly Price (¢/lb)				
Year	**1st**	**2nd**	**3rd**	**4th**
1963	22.12	22.46	22.17	22.00
1964	23.18	24.56	25.57	30.59
1965	28.23	33.77	35.90	40.05
1966	46.22	51.48	40.76	40.16
1967	36.51	29.30	30.36	36.42
1968	39.75	30.07	29.08	32.13
1969	38.94	42.95	43.38	46.23
1970	47.70	46.98	35.78	27.35
1971	25.40	29.45	27.15	28.48

1972	32.74	33.53	30.01	29.25
1973	36.82	45.07	55.13	65.51
1974	66.56	70.06	47.30	35.62
1975	32.06	31.46	35.75	36.46
1976	38.22	43.24	45.46	38.96
1977	37.08	38.72	34.01	33.00
1978	35.07	40.23	41.63	44.95
1979	51.12	63.71	59.56	63.38

[*]Based on prices from the American Metal Market.

Figure 11.7: Copper prices 1963–1979.

The results obtained by using actual copper prices will not be as clear as using fictitious data. It is important to be able to understand the significance of practical results and apply them effectively.

Because trigonometric curves fluctuate above and below a horizontal line of value zero, the first step is to detrend the data using the least-squares method. This results in the equation for a straight line representing the upward bias of the data. The value of the detrending line is then subtracted from the original data to produce copper prices that vary equally above and below the line from positive to negative values.

The straight line $y = a + bx$, which best represents the trend, can be found by solving the least-squares equations:

$$b = \frac{N\Sigma xy - \Sigma x \Sigma y}{N\Sigma x^2 - (\Sigma x)^2}$$

$$a = \frac{1}{N}(\Sigma y - b\Sigma x)$$

To do this, let x be the date and y be the price on that date. For convenience, instead of letting x = 1967, 1967¼, 1967½, …, let x = 1, 2, 3, …. The solution, using a computer program in Appendix 2 (also an integral part of the programs in Appendix 4) or the handcalculation method, is

$$y = 28.89 + .267x$$

Figure 11.7 shows the original copper prices and the regression line. The original prices can now be detrended using the equation above, subtracting the line values from the corresponding prices. Complete step-by-step results for this example can be found in Appendix 4. The detrended data is now used in the general trigonometric single-frequency wave:

$$y_t = a \cos \omega t + b \sin \omega t$$

The variable t replaces f in order to consider the angle in integer units rather than in degrees. This will be more convenient to visualize and to chart.

To find the frequency ω, it is necessary to first solve the equation

$$\cos \omega - \tfrac{1}{2}\alpha = 0$$

using the system of equations,

$$\begin{aligned} ay_2 &= y_1 + y_3 \\ ay_3 &= y_2 + y_4 \\ &\vdots \\ ay_{n-1} &= y_{n-2} + y_n \end{aligned}$$

This is expressed as a summation (similar to least-squares) in which the values for c and d must be found:

$$a\Sigma c^2 = \Sigma cd$$

where $c = y_n$

$d = y_{n-1} + y_{n+1}$

Summing the detrended values c^2 and cd gives Σc^2 = 6338.4 and Σcd = 9282.2, resulting in a = 1.464. The value for a is substituted into the intermediate equation and solved for the frequency ω:

$$\begin{aligned} \cos \omega - \tfrac{1}{2}(1.464) &= 0 \\ \cos \omega &= .732 \\ \omega &= 42.9 \end{aligned}$$

The period T is 360/42.9 = 8.4 calendar quarters. The last step in solving the equation for a single frequency is to write the normal equations:

$$a\Sigma \cos^2 \omega t + b\Sigma \cos \omega t \sin \omega t = \Sigma y_t \cos \omega t$$

$$a\Sigma \sin \omega t \cos \omega t + b\Sigma \sin^2 \omega t = \Sigma y_t \sin \omega t$$

and solve for a and b, where t = 1, … , 40, and ω = 42.9. As in the other solutions, a computer program is best for

finding the sums (using detrended data) necessary to solve the equations. The sums are

$a\Sigma \cos^2 \omega t \quad \Sigma \sin \omega t \cos \omega t \quad \Sigma y_t \cos \omega t$

$S \sin^2 \omega t \quad Sy_t \sin \omega t$

Then, *a* and *b* can be found by substituting in the following equations:

$$b = \frac{\sum y_t \sin \omega t \sum \cos^2 \omega t - \sum y_t \cos \omega t}{\sum \sin^2 \omega t \sum \cos^2 \omega t - \sum \cos \omega t \sin \omega t}$$

$$a = \frac{\sum y_t \cos \omega t - b \sum \cos \omega t \sin \omega t}{\sum \cos^2 \omega t}$$

The results a = -.603 and b = 1.831 give the single-frequency curve as:

$$y_t = -.603 \cos 42.9t + 1.831 \sin 42.1t$$

Taking t = 1 to be 1967 and t = 68 to be 1979¾ and adding back the trend, the resulting periodic curve is shown in Figure 11.8.

Figure 11.8: Copper prices 1963–1979—single frequency copper cycle manually scaled to approximate amplitude.

The single-frequency curve shown in Figure 11.8 matches seven out of the eight peaks in copper; however, it is not much more than could have been done using the Ehrlich Cycle Finder. A single-frequency curve can be created simply by identifying the most dominant peaks, averaging the distance (period), and applying the single-frequency formula.

Two-Frequency Trigonometric Regression

The combination of more than one set of sine and cosine waves of varying amplitudes and frequencies creates a better fit

than a single-frequency solution. This is analogous to the use of a second-order (curvilinear) solution instead of the first-order linear. The equation for the two-frequency cycle is

$$y_t = a_1 \cos \omega_1 t + b_1 \sin \omega_1 t + a_2 \cos \omega_2 t + b_2 \sin \omega_2 t$$

To find the results of this complex wave, apply the same techniques used in the single-frequency approach to the detrended copper data. The algebra for solving this problem is an expanded form of the previous solution, and the use of a computer is a requirement. The programs necessary to solve this one appear in Appendix 4. The frequencies ω_1 and ω_2 are found by solving the quadratic equation:

$$2x^2 - a_1 x - (1 + a_2/2) = 0$$

where $x = \cos \omega$, using the standard formula:

$$x = \frac{\alpha_1 \pm \sqrt{\alpha_1^2 + 8(1 + \alpha_2/2)}}{4}$$

The same least-squares method as before can be used, derived from the general form:

$$a_1(y_n + y_{n+2}) + a_2 y_{n+1} = y_{n-1} + y_{n+3}$$

The least-square equations for finding a_1 and a_2 are:

$$a_1 S\, c^2 + a_2 S\, cd = S\, cp$$

$$a_1 S\, cd + a_2 \Sigma\, c^2 = S\, dp$$

where $c = y_n + y_{n+2}$
$d = y_{n+1}$
$p = y_{n-1} + y_{n+3}$

These equations can be solved for a_1 and a_2 using:

$$\alpha_2 = \frac{\sum dp \sum c^2 - \sum cp \sum cd}{\sum d^2 \sum c^2 - (\sum cd)^2}$$

$$\alpha_1 = \frac{\sum cp - \alpha_2 \sum cd}{\sum c^2}$$

Then, ω_1 and ω_2 are calculated from the two solutions x_1 and x_2 of the quadratic equation. The next step is to solve the normal equations to find the amplitudes a_1, b_1, a_2, and b_2:

$$a_1 \Sigma \cos^2 \omega_1 t + b_1 \Sigma \cos \omega_1 t \sin \omega_1 t + a_2 \Sigma \cos \omega_1 t \cos \omega_2 t + b_2 \Sigma \cos \omega_1 t \sin \omega_2 t = \Sigma y_t \cos \omega_1 t$$

$$a_1 \Sigma \sin \omega_1 t \cos \omega_1 t + b_1 \Sigma \sin^2 \omega_1 t + a_2 \Sigma \sin \omega_1 t \cos \omega_2 t + b_2 \Sigma \sin \omega_1 t \sin \omega_2 t = \Sigma y_t \sin \omega_1 t$$

$$a_1 \Sigma \cos \omega_2 t \cos \omega_1 t + b_1 \Sigma \cos \omega_2 t \sin \omega_1 t + a_2 \Sigma \cos^2 \omega_2 t + b_2 \Sigma \cos \omega_2 t \sin \omega_2 t = \Sigma y_t \cos \omega_2 t$$

$$a_1 \Sigma \sin \omega_2 t \cos \omega_1 t + b_1 \Sigma \sin \omega_2 t \sin \omega_1 t + a_2 \Sigma \sin \omega_2 t \cos \omega_2 t + b_2 \Sigma \sin^2 \omega_2 t = \Sigma y_t \sin \omega_2 t$$

Once the sums are obtained, the final step is to create a 4 × 5 matrix to solve the four normal equations for the coefficients a_1, b_1, a_2, and b_2. When plotting the answer it will be best to plot the original 2-frequency equation in its component forms as well as in combination:

$$y_t' = a_1 \cos \omega_1 t + b_1 \sin \omega_1 t$$
$$y_t'' = a_2 \cos \omega_2 t + b_2 \sin \omega_2 t$$
$$y_t = y_t' + y_t''$$

where a_1 = 3.635
b_1 = -.317
a_2 = -.930,
b_2 = .762

The solution to the two-frequency problem gives the following values:

a_1 = .535, x_1 = .830

and

a_2 = .133, x_2 = -.764

and finally the frequencies:

ω_1 = 33.9 and ω_2 = 139.8

correspond to 10.6 and 2.6 calendar quarters (Figure 11.9).

Figure 11.9: Two-frequency trigonometric approximation.

Fourier Analysis: Complex Trigonometric Regression

Developed by the French mathematician John Baptiste Joseph Fourier, *Fourier analysis* is a method of complex

trigonometric regression, which expresses any data set as a series of sine and cosine waves of the same type as discussed in the previous section.

Assuming that there is a cycle and that there are *N* data points in each repetition of this cycle, the Fourier method of analysis shows that the *N* points lie on the regression curve:

$$y_i = 1 + \sum_{k=1}^{(N/2)} \left(u_k \cos \frac{2\pi ki}{(N/2)} + v_k \sin \frac{2\pi ki}{(N/2)} \right)$$

where the regression coefficients u_k and υ_k are given by:

$$u_k = \frac{1}{(N/2)} \sum_{i=1}^{N} y_i \cos \frac{2\pi ki}{(N/2)} \qquad k = 1, 2, \ldots, \frac{N}{2}$$

$$v_k = \frac{1}{(N/2)} \sum_{i=1}^{N} y_i \sin \frac{2\pi ki}{(N/2)} \qquad k = 1, 2, \ldots, \frac{N}{2}$$

$$\upsilon_{N/2} = 0$$

It is important to see that the mean of all the points on one cycle is equal to 1. The *N* values of y_i will have the property

$$\sum_{i=1}^{N} y_i = N$$

Applying the Fourier series to the seasonal component will help clarify this method. Seasonal data form the most obvious cycle. Using average monthly prices, detrended to avoid letting the trend overwhelm the cycle, let *N* = 12. It is also known that seasonally adjusted prices will vary about the mean; hence the weighting factors will have the same property as the above equation. With this information, the trigonometric curve that approximates the seasonals can be generated and compared with the results of other methods.[8]

Excel provides Fourier analysis as an analytic add-in under Tools/Data analysis. If it is not available when you open the Tools menu you will need to install it by following the instructions. It comes with the basic Excel software. The software requires detrended input with the data in powers of 2 (e.g., 64, 128, 256, 512).

Spectral Analysis

Derived from the word *spectrum*, spectral analysis is a statistical procedure that isolates and measures the cycles within a data series. The specific technique used is the Fourier series as previously discussed, although other series have also been used.

When studying the cycles that comprise a data series, it is important to refer to their *phase* with respect to each other. Phase is the relationship of the starting points of different cycles. For example, if one cycle has the same period as another but its peaks and valleys are exactly opposite, it is 180° *out of phase*. If the two cycles are identical in *phase*, they are *coincident*. Cycles with the same period may lead or lag the other by being out of phase to various degrees.

A tool used in spectral analysis to visualize the relative significance of a series' cyclic components is the *periodogram*. Weighting the cyclic components in the periodogram will yield the more popular *spectral density* diagram, which will be used to illustrate the results of the spectral analysis. *Density* refers to the frequency of occurance. Figures 11.10a and 11.10b show the spectral density of a series composed of three simple waves (*D* is the Fourier series made up of waves *A*, *B*, and C).[9] The cycle length, shown at the bottom of the spectral density chart, corresponds exactly to the cycle length of the component waves *A*, *B*, and *C*. The spectral density, measured along the left side of Figure 11.10b, varies with the amplitude squared of the cycle and the magnitude of the noise, or random price movements, which obscures the cycle. In Figure 11.10b, the result is based on a series composed of only three pure waves. Had there been noise of the

same magnitude as the underlying cycle amplitude, those cycles identified by the spectral analysis would have been completely obscured. Readers who have studied ARIMA will recognize the similarity between the spectral density and the correlogram.

Figure 11.10: Spectral density. (a) A compound wave D, formed from three primary waves, A, B, and C. (b) Spectral density of compound wave D.

As in trigonometric regression analysis, the other basic price components can distort the results. A noticeable trend in the data must be removed or it may be interpreted as the dominant cycle. The familiar methods of first differencing or linear regression can be used to accomplish this. The seasonal component is itself a cycle and does not need to be removed from the series. Because spectral analysis identifies both the seasonal and cyclic component, the success of the results will depend on the strength of these waves compared to the noise that remains. In applying this technique to real data, it would not be surprising to see the results demonstrated in Figure 11.11. Three subcycles of length 10, 20, and 40 days are shown as part of a 250-day (seasonal) cycle. Notice that, as the cycle lengthens, the width of the spectral density representation widens. This does not mean that the wider peaks are more important.

Figure 11.11: 10-, 20-, and 40-day cycles, within a 250-day seasonal.

The trader is most interested in those cycles with greater spectral density, corresponding to a larger price move. The minimum amount of data necessary to find these cycles must include the full cycle that might be identified. For example, to see any seasonal pattern, a minimum of 12 months are needed. More data is better when using spectral analysis to confirm the consistency of the cycle. A single year is not enough to support any seasonal findings.

Weighting Factors

The most important part of spectral analysis is finding the proper estimators, or weighting factors, for the single-frequency series of cosine waves. When looking for long-term cycles, it is very important to remember that the trend and seasonal components must be removed because the method of spectral analysis will consider these the dominant characteristics and other cycles may be obscured.

As in the other trigonometric formulas, the basic time-series notation is used, where y_t, t = 1, 2, …, N are the data points and y_t will be the resulting estimated points on the spectral analysis. Then

$$\hat{y}_t(\omega) = \frac{1}{\pi}\left(c_0 + 2\sum_{k=1}^{N-1} c_k \cos \omega k\right)$$

where

$$c_k = \sum_{i=1}^{N-k} \frac{(y_t - \overline{y})(y_{t+k} - \overline{y})}{N}$$

Methods of performing spectral analysis vary due to the choice of weighting functions that compensate for the fact that the

accuracy of c_k decreases as k increases. The two most popular techniques for handling this problem introduce an estimator λ_k called a *lag window* and a truncation point $M < N$ so that the values of c_k for $M < k < N$ are no longer used and the values of c_k for $k < M$ are weighted by λ_k.

The spectral analysis approximation is then written:

$$\hat{y}_t(\omega) = \frac{1}{\pi}\left(\lambda_0 c_0 + 2\sum_{k=1}^{M} \lambda_k c_k \cos \omega k\right)$$

where λ_k can be either of the following:

Tukey window

$$\lambda_k = \frac{1}{2}\left(1 + \cos\frac{\pi k}{M}\right) \qquad k = 0, 1, \ldots, M$$

Parzen window

$$\lambda_k = \begin{cases} 1 - 6\left(\frac{k}{M}\right)^2 + 6\left(\frac{k}{M}\right)^3 & 0 \le k \le \frac{M}{2} \\ 2\left(1 - \frac{k}{M}\right)^3 & \frac{M}{2} \le k \le M \end{cases}$$

Using a Fast Fourier Transform Program

There are computer programs that apply a *Fast Fourier Transform* to perform a spectral analysis and create a Fourier power spectrum such as the one in Figure 11.10b. Anthony Warren's approach[10] can be found in Appendix 5 written in BASIC program code. The program detrends the data and reduces endpoint discontinuity, which can produce large unwanted cycles. This is accomplished by multiplying the data by a bell-shaped *window* and extending the endpoints to give a more definitive structure to the detrended data, without affecting the results (as discussed in the previous section).

A second filter is applied using selected moving averages. The moving average will reduce or eliminate the importance of those cycles, which are equal to or shorter than two times the length of the moving average, letting the more dominant cycles appear. For example, the use of a 10-day moving average will eliminate cycles of length less than 20 days (frequencies greater than 12.5 per year). Figure 11.12 shows the output of the computer program.

Figure 11.12: Output of spectral analysis program. *Source*—Jack K. Hutson, "Using Fourier," *Technical Analysis of Stocks & Commodities* (January 1983, p. 10).

Subsequent works by Warren and Hutson[11] present a computer program to calculate moving average—weighted filters using linear, triangular, and Hanning weights.

Interpreting the Results of the Fourier Power Spectrum

Both Figures 11.10b and 11.12 show a power spectrum resulting from a Fourier transform. Figure 11.10b is an ideal representation, where the cycles stand out with no ambiguity; Figure 11.12 is more realistic, showing both the dominant cycles and a certain amount of variance around those values. In the power spectrum, the cycle power shown along the *y*-axis is the cycle amplitude squared. In Figure 11.10a cycle *D* peaks at a price of about 425, which yields a spectral density, or *spectral power*, of 180,625 when squared, corresponding roughly to the 40-day cycle in Figure 11.10b.

Using the information from the beginning of this chapter, the frequency is the inverse of the cycle length; therefore, if the cycle length is 40 days, the frequency $F = 360/40 = 9$. The sine wave changes phase at the rate of 9 degrees per day, completing one full cycle every 40 days.

A fast method for observing the possible results is to use weekly rather than daily data. This will be a close approximation for low frequency waves but will be less representative for the high frequencies. Averaging the data points can yield results very similar to the daily analysis.

Using Excel's Fourier Analysis

The Excel spreadsheet program provides a convenient application of Fourier analysis. It is a data analysis add-in that is available for most users and simply must be added from the start-up disk. This can be done by going to Tools/Add-Ins and following the instructions for Data Analysis. Once the program has been loaded, it is accessed in the dropdown menu Tools/Data Analysis/Fourier Analysis. The following steps will create the spreadsheet shown in Figure 11.13.[12]

1. Load your data into a worksheet. Monthly data is best for finding longer-term cycles, ranging from three months to a few years. In Figure 11.13 the data is shown in the first five columns *A*–*E*.

2. The Fourier analysis program will only take the amount of data equal to a power of 2, that is, 2, 4, 8, 16, …, 1024, 2048, 4096. It will not accept more than 4096 data values. Using monthly data keeps the quantity well within those constraints; however, you may need to use only the most recent 256 or 512 data points.

3. Remove the trend by taking the first differences of the data. The first differences are C_t - C_{t-1}, carried down in the column marked "1st diff."

4. Go to Tools/Data Analysis/Fourier Analysis and enter the data points from the column "Close" as the input, and the corresponding cells from column *G*. Column *G* will become the output, "Fourier result using 1st differences."

5. Note that most of the numbers in column *G* are *imaginary*. The term *imaginary* is a mathematical term that refers to the result of taking the root of a negative number. To create a usable value, apply the function *IMABS* to each value in column *G* and store it in column *H*.

Open table as spreadsheet

UAL Corporation (UAL), Monthly prices (Jan 1980 to Apr 2000)							IMABS (col G)
DATE	HIGH	LOW	CLOSE	VOLUME	1 st diff	Fourier result using 1 st differences	
Jan-80	12.688	10.500	12.000	2364800	0.000	45.875	45.88
Feb-80	12.188	9.438	9.438	5664400	-2.562	-16.6460997418329-43.3674684801265i	46.45
Mar-80	9.688	8.313	9.188	2977600	-0.250	-40.9032772666529+53.0087706309169i	66.96
Apr-80	9.313	6.750	7.375	4928800	-1.813	-28.228521269412-85.3135425653248i	89.86
May-80	8.875	7.313	8.375	3250000	1.000	15.1065558671812-51.8290770939573i	53.99
Jun-80	8.688	7.375	8.250	3826800	-0.125	116.372821168534+26.4239899715158i	119.34
Jul-80	11.313	8.188	11.250	7187600	3.000	-71.0210851533166+34.7835590146579i	79.08
Aug-80	12.063	10.188	10.313	6678400	-0.937	40.502309096266-16.1046363166668i	43.59
Sep-80	11.438	9.250	9.500	5081200	-0.813	10.9287528827893-30.6717886464659i	32.56
Oct-80	10.500	8.375	9.500	8592800	0.000	-2.86574485424502+57.1890691130842i	57.26
Nov-80	10.438	8.688	9.375	4068000	-0.125	21.0141952804253-215.984728374081i	217.00
Dec-80	9.813	7.625	8.750	6905200	-0.625	122.199459997136+143.402733870175i	188.41

Figure 11.13: An Excel spreadsheet for using Fourier analysis to find monthly cycles in UAL.

Only the first 12 rows of 256 input rows are shown in Figure 11.13. These will represent the significance of the monthly cycles 1 through 12. The larger numbers indicate a dominance of that monthly cycle. In Figure 11.14 these values are shown as a bar chart which is intended to represent the spectral density. The bars increase to a peak at six months, fall off, then show much higher values in months 11 and 12. This is interpreted as a dominant 11- to 12-month cycle, and a less important but clear 6-month cycle. Intuitively, this seems correct because we expect air travel to be seasonal. The sixth month, June, is strong for income (which could be bookings for July and August), but holiday bookings in November and December provide much greater income.

Figure 11.14: A bar chart representing the monthy cycles of UAL using Excel's Fourier Analysis.

[6]In his article, "Finding Cycles in Time Series Data," *Technical Analysis of Stocks & Commodities* (August 1990), A. Bruce Johson credits John Ehlers for his work in the use of two exponential trends. See John Ehlers, "Moving Averages, Part 1" and "Moving Averages, Part 2," *Technical Analysis of Stocks & Commodities* (1988).

[7]A more specific presentation of trigonometric curve fitting can be found in Claude Cleeton, *The Art of Independent Investing* (Prentice-Hall, 1976, Chapter 8). The material covered in this section is carried further in that work.

[8]A continuation of this development can be found in Warren Gilchrist, *Statistical Forecasting* (Wiley, London, 1976, pp. 139–148); a more theoretical approach is to be found in C. Chatfield, *The Analysis of a Time Series: Theory and Practice* (Chapman and Hall, London, 1975, Chapter 7).

[9]William T. Taylor, "Fourier Spectral Analysis," *Technical Analysis of Stocks & Commodities* (July/August 1984).

[10]Anthony Warren, "A Mini Guide to Fourier Spectrum Analysis," *Technical Analysis of Stocks & Commodities* (January 1983). A very useful series of articles on spectral analysis has been published in *Technical Analysis* beginning in January 1983, authored by both Anthony W. Warren and Jack K. Hutson. Much of the information in this section was drawn from that material.

[11]Anthony Warren and Jack K. Hutson, "Finite Impluse Response Filter," *Technical Analysis of Stocks & Commodities* (May 1983).

[12]The author gratefully acknowledges the help of John Ehlers in the interpretation of Excel's Fourier Analysis.

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MAXIMUM ENTROPY

Maximum Entropy Spectral Analysis (MESA) is a technique created by John Ehlers[13] that filters noise (*entropy*) from a time series and exposes the useful cycles.[14] It provides a very practical alternative to Fourier analysis and makes it possible to find cycles using a very small amount of data. The use of Fourier transforms requires at least 256 data points and a minimum of 16 consistent cycles of 16 bars. That would eliminate the possibility of uncovering cycles for the short-term trader.

Ehlers describes the existence of short-term cycles as a natural phenomenon.[15] It is part of the process that causes rivers to meander back and forth as water seeks to flow in a straight line, or a drunkard who walks through an alley bumping against the walls but moving steadily forward. From these patterns, useful cycles can be found about 20% of the time. The presence of a useful cycle, or the lack of one, can be a valuable piece of information for a trader.

Using the Phase Angle

In an ideal situation, where the market cycle can be shown as a pure sine wave, the phase angle constantly increases throughout the cycle, beginning at 0° and ending at 360° (equal to 0°). The phase angle then drops to zero when the new cycle begins and increases again at a constant rate until it ends at 360°. This repeated pattern forms a *sawtooth* chart shown in Figure 11.15 (further description of the phase angle can be found in the next section, "Hilbert Transform"). Although the cycle goes from peak to value, the phase angle moves constantly in one direction.

Figure 11.15: The phase angle forms a sawtooth pattern. *Source*—John Ehlers, "Cycle Analysis and Intraday Trading," *Technical Analysis of Stocks & Commodities*, 11, no. 4 (February 1993). © 1993 Technical Analysis, Inc. Used with permission.

In the practical analysis of short-term cycles, Ehlers compresses tick data into bars of equal numbers of ticks, then examines the phase for uniformity. Once found, the uniform phase, which appears as a sawtooth chart, will become erratic as the short-term cycle begins to break down, marking the end of the current market event. Ehlers creates an *instantaneous trendline* after removing the dominant cycle, and uses it together with a smoothed price trendline to generate trading signals. A trend exists if the smoothed price line has not crossed the instantaneous trendline within the last half-dominant cycle. The mathematics of MESA is extensive but Ehlers makes it remarkably clear, along with simple summaries of important points, in the second edition of *MESA and Trading Market Cycles*.

Ehlers' Lateral Shift in Thinking

At first glance the use of only a small amount of data needed by MESA seems to contradict the basic rules of statistics, which demand that results be

based on as much data as possible in order to be reliable. But Ehlers, who has been the dominant influence in cycles since about 1990, is too knowledgeable to have made such a simple mistake. His book *Mesa and Trading Market Cycles*[16] which focuses on the use of short-term cycles based on short sample time periods, used this very attribute turned inside out when applied to cycles.

Ehlers' objective is to find very short-term cycles. By definition, these cycles must be the result of human behavior, rather than based on market economics, because fundamentals are not usually relevant to periods of only a few days, and are not likely to have a regular pattern when they make a rare appearance. If very short-term cycles exist, they will not continue for long periods, and you must recognize them quickly if they are to be useful; therefore, short-term cycles are found by analyzing only a small amount of recent data.

Then how does it help to find a short-term cycle based on a small amount of data, if it is not statistically dependable? In a lateral shift, Ehlers uses the existence of a short-term cycle to tell if prices are in a sideways pattern or trending. If a short-term cycle exists, then the market cannot be trending. Ehlers has no interest in trading the cycle, which is surprising for a cycle expert, but prefers the dependability of the trend. He has, instead, attempted to solve one of the most difficult problems facing the analyst, trying to distinguish between a trending and sideways market. If a short-term cycle exists, then the market is not trending. Ehlers develops this method throughout his book.

Finding the Cycle Using the Hilbert Transform

Ehlers is able to recognize the cyclic component of price movement using very little data as contrasted with the traditional regression methods. In one technique, using the *Hilbert Transform*,[17] only a small part of one cycle is needed to form a picture of the entire process. This allows the cycle to be shown as an indicator with only a modest amount of lag.

The Hilbert Transform is based on the separation of the cycle phase, represented by a *phasor*, into two components, the *Quadralure* and *InPhase*, shown in Figure 11.16. The left circle with a single arrow points to the current position of the cycle based on the phasor being straight up (270°) at the cycle peaks and straight down (90°) at the cycle valleys. The cycle begins when the phasor is pointing to the right (0°). The right circle separates the phasor into its horizontal and veritical components, InPhase and Quadrature, respectively. The *phase angle*, shown as θ (theta), is the arctangent of the ratio of the Quadrature and InPhase components. Ehlers reduces the equations for the Hilbert Transform to:

Quadrature

$Q = .0962 \times price_t + .5769 \times price_{t-2} - .5769 \times price_{t-4} - .0962 \times price_{t-6}$

InPhase

$I = price_{t-3}$

Figure 11.16: A cycle with the phasor and phase angle. *Source*—Adapted from John F. Ehlers, *Rocket Science for Traders* (Wiley, 2001).

These equations make it possible to write a simple TradeStation indicator (shown in Figure 11.17) to plot the results of the Hilbert Transform for any data series. Although there are some penalties for truncating the Hilbert Transform, which is an infinite series, those penalties should not affect the use of this method for trading.

```
{Ehlers' Hilbert Transform Indicator
Copyright 2003, John Ehlers. All rights reserved.
Detrending added by P J Kaufman }

Inputs: price((H+L)/2), alpha(.07), detrendper(12);
Vars:   smooth(0),cycle(0),g1(0),i1(0),deltaphose(0),
        phasesum(0),oldphasesum(0),count(0),DC(0),period(0),
        i2(0),g2(0),alphal(.1),series(0);

if detrendper = 0 then
       series = price
   else
       series = price - average(price,detrendper);

smooth = (series + 2*series[1] + 2*series[2] + series[3])/6;
cycle = (1 - .5*alpha)*(1 - .5*alpha)*(smooth - 2*smooth[1] +
        smooth[2]) + 2*(1 - alpha)*cycle[1] - (1 - alpha)*
        (1 - alpha)*cycle[2];
if currentbar < 7 then cycle = (series - 2*series[1] +
                               series[2])/4;

q1 = (.0962*cycle + .5769*cycle[2] - .5769*cycle[4] -
     .0962*cycle[6])*(.5 + .8*period[1]);
i1 = cycle[3];

if q1 <> 0 and q1[1] <> 0 then deltaphase = (i1/q1 - i1[1]/q1[1])/
(1 + i1*i1[1]/(q1*q1[1]));
```

```
if deltaphase < 0 then deltaphase = deltaphase[l];
if deltaphase > 1.1 then deltaphase = 1.1;

phasesum = 0;
oldphasesum = 0;
for count = 0 to 40 begin
phasesum = oldphasesum + deltaphase;
if phasesum >= 6.28318 and oldphasesum < 6.28318
   then dc = count + 1;
oldphasesum = phasesum;
end;

period = .2*dc + .8*period[l];
plot1(period,"period");
```

Figure 11.17: TradeStation code for the Hilbert Transform.

Applying the Hilbert Transform to soybean monthly prices gives the results shown in Figure 11.18. The continuous, back-adjusted series is shown at the top of the chart. Continuous data is preferable in this case to avoid any odd jumps in prices when one contract is rolled to another at expiration. The second panel shows the detrended data, calculated by subtracting the 12-period moving average from the corresponding price. Because we know that seasonality dominates the soybean cycle, the 12-month trend is an easy decision. This center panel is for information only and is not used in the Hilbert Transform indicator, which has a built-in detrending option.

Figure 11.18: Hilbert Transform applied to soybean monthly data. The top panel shows continuous, back-adjusted soybean prices, the middle panel is the detrended price series, and the bottom panel is the result of the Hilbert Transform.

The bottom panel in Figure 11.17 is the result of first detrending the monthly data, then applying the Hilbert Transform with *alpha* = .07. The Hilbert Transform creates sharp peaks and valleys at the points where the cycle is expected to be at maximum and minimum value. There is usually one peak and one valley each year, and the minimum level often coincides with late summer or early fall, when harvest yield is known and there is a surplus (or anticipated surplus) of soybeans. Peaks are less regular because each year presents different problems. Sometimes the greatest uncertainty is during April and May if very wet weather delays planting; often a dry spell during June through August raises fears of drought, driving prices up. In addition to the normal weather problems, export contracts can affect the price of soybeans any time during the year. During the 1970s and 1980s there were many surprises with regard to exporting grain to the Soviet Union; now, the biggest unknown is China. Cancellation of a large export deal can force prices lower even during the critical growing months.

The same method can be applied to weekly data. If the obvious major cycle is yearly, then a 52-period average can be used to detrend the data. The

results of this approach can be seen in the pattern of AMR (Figure 11.19). The Hilbert Transform indicator does a very good job of locating relative peaks. The highest and lowest values of the indicator could be used for sell and buy signals.

Figure 11.19: Hilbert Transform and Fisher Transform applied to weekly AMR data.

The Fisher Transform

It is well known that prices are not normally distributed; that is, a chart of price changes, or price minus a trendline (detrended prices), does not appear to be a bell-shaped, symmetric curve. We have already discussed some of the idiosyncrasies of price movement in earlier chapters, including the fat tail of trend-following performance, or the increase in volatility with price. The distribution of prices is called a *probability density function* (PDF), and the normal, bell-shaped curve is a *Gaussian* PDF.

The way in which prices move between two bands is very similar to the probability density function of a sine wave,[18] which spends more time in the vicinity of the peaks and valleys (where it changes direction) than in the middle (where it moves the fastest). Figure 11.20a shows two cycles of a sine wave with the PDF to the right (Figure 11.20b). Although the PDF is normally shown with the phasor angle along the bottom, as in (Figure 11.20c), this chart is drawn to represent a typical frequency distribution. The peaks of the sine wave occur when the phasor angle is 270° and the lowest points when the angle is 90°. The frequency of the peaks (the top of the chart) and valleys (the bottom of the chart) are much greater than the frequency of the other angles, especially 0° and 180°.

Figure 11.20: Probability Density Function (PDF) of a sine wave.

The same PDF can be seen in price movement if we form a channel around the prices and measure the relative position of prices within that channel. The channel high (*MaxH*) is simply the maximum price during period *p*, and the channel low (*MinL*) is the minimum price during the same period *p*. The value used in the distribution is calculated

$$x = .5 \times 2 \times (P_t - MinL)/(MaxH - MinL) - .5) + .5 \times x_{t-1}$$

The Fisher Transform takes this distribution and changes it to one that is approximately Gaussian with the following formula:

$$y = .5 \times \ln\left[\frac{1+x}{1-x}\right]$$

where x = the input
y = the output
ln = the natural log

The result of applying the Fischer Transform to AMR can be seen in the bottom panel of Figure 11.18, below the result of the Hilbert Transformation. In this case, the period for the calculation of the bands was 13 weeks, one calendar quarter, chosen in order to emphasize the seasonality of the market. Values for the Fisher Transform range from +1.0 to -1.0. The peaks of the Fisher Transformation are remarkably in-line with the price peaks, and show very little lag compared to the Hilbert Transformation. The bottoms are also good, although there is a tendency for values to remain low during a sustained downward move in the same manner as the Relative Strength Indictor (RSI) or the stochastic. The Fisher Transform produces clearer, sharper turning points than a typical momentum-class indicator. A TradeStation program for creating the Fisher Transform appears in Figure 11.21. A *trigger* is also included that corresponds to the MACD *signal line*. When the Fisher Transform value crosses the trigger moving lower, then a sell signal occurs. Experience shows that the best signals are those occurring just after an extreme high or low value and not after a turning point where the value is near zero.

```
{ Ehlers' Fisher Transform  Indicator
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Inputs: price((H+L)/2), len(10);
Vars:he Fisher Transform range from +1.0 to 1.0. he Fisher
Transform range from +1.0. to 1.0. he Fisher Transform range from
+ 1.0 to 1.0. he Fisher Transform range from +1.0 to 1.0. he
Fisher Transform range from +1.0 to 1.0.
0),minL(0),Fish(0),x(0);

maxH = highest(price,len);
minL = lowest(price,len);
x = .5*2*((price - minL)/(maxH - minL) - .5) + .5*valuel[1];
if x > .999 then x = .999;
if x < -.999 then x = -.999;
Fish = .5*log((1 + x)/(1 - x)) + .5*Fish[1];

plot1(Fish,"Fisher");
plot2(Fish[1],"Trigger");
```

Figure 11.21: TradeStation code for Ehlers' Fisher Transform.

[13]John F. Ehlers, *MESA and Trading Market Cycles*, second edition (John Wiley & Sons, 2001).

[14]Anthony Warren, "An Introduction to Maximum Entropy Method (MEM), *Technical Analysis of Stocks & Commodities* (February 1984). See the bibliography for other articles on this topic.

[15]John F. Ehlers, "How to use Maximum Entropy," *Technical Analysis of Stocks & Commodities* (November 1987).

[16]John F. Ehlers, *MESA and Trading Market Cycles* (John Wiley & Sons, New York, 1992).

[17]John F. Ehlers, *Rocket Science for Traders* (John Wiley & Sons, New York, 2001, Chapter 6).

[18]This section is adapted from John Ehlers, *Cybernetic Analysis for Stocks & Commodities* (John Wiley & Sons, New York, 2004, Chapter 1).

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CYCLE CHANNEL INDEX

A trend-following system that operates in a market with a well-defined cyclic pattern should have specific qualities that do not exist in a basic smoothing model. In order to confirm the cyclic turning points, which do not often occur precisely where they are expected, a standard moving average should be used, rather than an exponentially smoothed one. Exponential smoothing always includes some residual effect of older data, while the moving average uses a fixed period that accommodates the characteristics of a cycle. The cyclic turning point will use part of the data that represents about one-fourth of the period, combined with a measure of the relative noise in the series which may obscure the turn.

These features have been combined by Lambert[19] into a *Commodity Cycle Index* (CCI), which is calculated as follows:

$$\mathrm{CCI}_t = \frac{x_t - \bar{x}_t}{.015\mathrm{MD}}$$

where x_t = $(H_t + L_t + C_t) / 3$ is the average of the daily high, low, and close

$\bar{x}_t$ = $\sum_{i=1-N+1}^{t} x_i$, the moving average over the past N days

MD = $\sum_{i=1-N+1}^{t} \left| x_i - \bar{x} \right|$, the mean deviation over the past N days

N = the number of days selected (less than ¼ cycle)

Because all terms are divided by N, that value has been omitted. In the CCI calculations, the use of .015MD as a divisor scales the result so that 70% to 80% of the values fall within a +100 to -100 channel. The rules for using the CCI state that a value greater than +100 indicates a cyclic turn upward; a value lower than -100 defines a turn downward. Improvements in timing rest in the selection of N as short as possible but with a mean-deviation calculation that is a consistent representation of the noise. The CCI concept of identifying cyclic turns is good because it accounts for the substantial latitude in the variance of peaks and valleys, even with regular cycles.

[19] Donald R. Lambert, "Cycle Channel Index," *Commodities* (1980), reprinted in *Technical Analysis of Stocks & Commodities*.

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PHASING

One of the most interesting applications of the cyclic element of a time series is presented by J. M. Hurst in *The Profit Magic of Stock Transaction Timing* (Prentice-Hall). He uses *phasing* or synchronization of a moving average to represent cycles. This section highlights some of the concepts and presents a simplified example of the method. It is already known that to isolate the cycle from the other elements, the trending and seasonal factors should be subtracted, reducing the resulting series to its cyclic and remaining noise parts. In many cases, the seasonal and cyclic components are similar but the trend is unique. Hurst treats the cyclic component as the dominant component of price movement and uses a moving average to identify the combined trend cycle.

The system can be visualized as measuring the oscillation about a straight-line approximation of the trend (a best-fit centered line), anticipating equal moves above and below. Prices have many long- and short-term trends, depending on the interval of analysis. Because this technique was originally applied to stocks, most of the examples used by Hurst are long-term trends expressed in weeks. For futures the same technique could be used by using a continuous back-adjusted series of the nearest delivery.

As a simple example of the concept, choose a moving average of medium length for the trending component. The *full-span* moving average may be selected by averaging the distance between the tops on a price chart (a rough measure of the cycle). The *half-span* moving average is then equal to half the days used in the full-span average.

The problem with using moving averages is that they aways lag. A 40-day moving average is always 20 days behind the price movement. The current average is normally plotted under the most recent price, although it actually represents the average of the calculation period that occurred at the previous chart point that is lagged by half the value of the average. This method applies a process called *phasing*, which aligns the tops and bottoms of the moving average with the corresponding tops and bottoms of the price movement. To phase the full- and half-span moving averages, lag each plot by half the days in the average; this causes the curve to overlay the prices (Figure 11.22). Then project the phased full- and half-span moving averages until they cross. A line or curve connecting two or more of the most recent intersections will be the major trendline. The more points used, the more complicated the regression formula for calculating the trend; Chapter 6 discusses a variety of linear and nonlinear techniques for finding the best fit for these intersections. Once the trendline is calculated, it is projected as the center of the next price cycle.

Figure 11.22: Phasing.

With the trend identified and projected, the next step is to reflect the cycle about the trend. When the phased half-span average turns down at point *A* (Figure 11.23), measure the greatest distance *D* of the actual prices above the projected trendline. The system then anticipates that prices will cross the trendline at point *X* and decline an equal distance *D* below the projected centered trendline. Once the projected crossing becomes an actual crossing, the distance *D* can be measured exactly and the price objective firmed. The rules for using this technique are:

1. Calculate the full-span moving average for the selected number of days; lag the plot by half the days. If the full-span moving average uses *F* days, the value of the average is calculated at $t - F/2$, where t is the current day. Call this phased point PH_t.

2. The half-span moving average is calculated for *H* days and plotted at $t - H/2 + PH_t$.

3. Record the points where the two phased averages PH_i and PF_i cross and call these points X_n, X_{n-1}, ….

4. Find the trend by performing a linear regression on the crossing points X_n, X_{n-1}, …. For the straight line, $Y_T = a + bX_T$.

5. Record the highest (or lowest) values of the price since the last crossing, X_n.

6. Calculate the projection of the half-span by creating a straight line from the highest (or lowest) half-span value since the last crossing A to the last calculated half-span value. This equation will be $Y_c = c + dX_c$.

7. Find the point at which the projected trendline crosses the projected cyclic line by setting the equations equal to one another and solving for X and Y. At the point of crossing $(X_T, Y_T) = (X_c, Y_c)$, giving two equations in two unknowns, which is easily solvable (X is time in days; Y is price).

8. If the half-span is moving down, the maximum price reached since the last crossing is subtracted from the Y coordinate of the projected crossing. This distance D is subtracted again from the Y coordinate to determine the price objective. If the half-span is moving up, the price objective uses the minimum price and reflects the distance above the projected crossing. It should be noted that this calculation of distance is simplified because the trend is established by a straight line; for nonlinear fits, the measurement of D will be more complicated.

9. Recalculate the moving averages (Step 1), the half-span projection (Step 6), the projected crossing (Step 7), and price objective (Step 8) each day until the actual crossing occurs. At that time D is fixed.

10. Follow the trading rules:

    a. Enter a new long position when the half-span moving average turns up; cover any existing short positions regardless of the price objective.

    b. Enter a new short position when the half-span moving average turns down; close out any long positions.

    c. Close out both long and short positions if the price objective is reached. An error factor of 10% of the height of the full cycle (lowest to highest point) should be allowed. Therefore, the price objective should be reduced by 10%.

Figure 11.23: Finding the target price.

This approach to cycles should be studied carefully as an example of a complex problem solved using elementary mathematics. There are many techniques for determining trends and a number of seasonally oriented systems, but a cyclic approach is rare. While Hurst's explanation is more complete and more sophisticated, the interpretation presented in this section should be considered only a reasonable approximation.

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Chapter 12: Volume, Open Interest, and Breadth

OVERVIEW

Patterns in volume have always been tied closely to chart analysis of both the stock and futures markets. It is a valuable piece of information that is not often used, and one of the few items, other than price, that is traditionally considered valid data for the technician. Nevertheless, there has been little research published that relates these factors to futures markets; its popular use has assumed the same conclusions as in stock market analysis.

The stock and futures markets have two other measures of participation that are related, yet not the same. In equities, the large number shares being traded allow for measurements of *breadth.* In the same way that the stock index has become a popular measure of overall market trend, the *breadth of the market* is the total number of stocks that have risen or fallen during a specific period. When you have the ability to view the bigger picture of market movement, breadth seems to be a natural adjunct to the index.

In futures, *open interest* is the measurement of those participants with outstanding positions; it is the netting out of all open positions (longs and short sales) in any one market or delivery month, and gives an understanding of the depth of participation and anticipated volume. A market that trades only 10,000 contracts per day but has an open interest of 250,000 is telling the trader that there are many participants who will enter the market when the price is right. These are most likely to be commercial traders, using the futures markets for hedging.

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A SPECIAL CASE FOR FUTURES VOLUME

In futures markets, where you trade contracts for delivery in specific months, the volume of each contract is available, along with the total volume of all contracts—that is, the total volume of that market. Spread transactions within that market, for example, buying the March delivery and selling June, are not included in the reported volume. Volume data is officially posted one day late, but estimates are available for many markets during the day. Total volume of crude oil is estimated every hour; it is released to news services and is available on the Internet.

Individual contract volume is important to determine the delivery month that is most active. Traders find that the best executions are most likely where there is greatest liquidity. Analysts, however, have a difficult time assessing trends in volume because there is a natural increase in volume as a contract moves towards delivery, from second month out to the nearby, and traders roll their positions to the closest delivery month. There is a corresponding decline in volume as a contract approaches its delivery date. Because spread volume is not posted, movement between delivery months does not affect the volume patterns.

Each futures market has its unique pattern of volume for individual contracts. Some, such as the interest rates, shift abruptly on the last day of the month prior to delivery, because the exchange raises margins dramatically for all traders holding positions in the delivery month. Currencies are very different and tend to trade actively in the nearest month up to one or two days before that contract goes *off the board* While volume increases slightly in the next deferred contract, anyone trading sizable positions will need to stay with the nearby contract to the end.

Other than for determining which contract to trade, and perhaps the size of an order that the market can absorb, an analysis of volume as discussed in this chapter must use total volume (the aggregate of all contracts) in order to have a series that does not suffer the patterns of increasing and decreasing participation based on the coming and going of individual delivery months. When traders roll from the nearby to the next deferred contract, the transactions are performed as a spread and those trades are not included in the volume figures. Because positions are closed out in one contract and opened in another there is no change in the open interest.

The stock market equivalent to using total volume would be to add the volume for all stocks in the same sector or industrial group. This would help to smooth over those periods when the volume is concentrated in a few stocks following a news release, only to switch the next week when other stocks in the same sector are noticed.

Tick Volume

The popularity of quote machines and fast trading requires a measurement of volume that can be used immediately to make decisions. Because total volume is not available on a timely basis to day traders, *tick volume* has become a substitute. Tick volume is the number of recorded price changes, regardless of volume, that occur during any times interval. Tick volume relates directly to actual volume because, as the market becomes more active, prices move back and forth from bid to asked more often. If only two trades occur in a five-minute period, then the market is not liquid. From an analytic view, tick volume gives a reasonable approximation of true volume and can be used as a substitute. From a practical view, it is the only choice. Higher-than-normal tick volume at the beginning of the day implies higher volume throughout the day. Tick volume patterns are discussed later in this chapter.

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VARIATIONS FROM THE NORMAL PATTERNS

The *W* Intraday Pattern

One final note of warning when using intraday volume or volume indicators to confirm price direction is that the patterns in volume have a dominant *W* pattern throughout the day. They begin high, drop quickly, increase modestly near midday, fall again, then increase significantly towards the close of trading. To decide that a buy signal is more important near the end of the trading day because volume was rising is not necessarily correct; volume is always higher at the beginning and end of the day. You may conclude, in general, that those two periods produce more reliable trading signals; however, an intraday volume confirmation must be compared against the normal volume for that time of day.

Open interest and market breadth have seasonal patterns. In agricultural markets, farmers hedge in larger numbers during the growing season than in the winter, raising the open interest. In stocks, there is a lot of activity associated with the end-of-year positioning for tax purposes and traditional rallies during holiday seasons. Volume is low during the summer when many investors take their vacation. While this predictable market activity may be enough to confirm your positions, it does not indicate that something special is occurring. These variations are discussed in detail later in this chapter.

Variance in Volume

Nearly all volume analysis uses smoothed or averaged data because volume can vary substantially from one day to the next. As an example, Table 12.1 shows the breakdown of Microsoft (MSFT) volume for the five years from June 1998 through May 2003. While the volume was higher during the price peak of January 2000, the overall numbers show consistency at an average of 70 million shares per day.

Table 12.1: Microsoft Daily Volume by Year from June 1998 through May 2003

Open table as spreadsheet

Period	Average	StDev
Jun98–May99	62,861,035	21,511,856
Jun99–May00	64,512,077	34,741,178
Jun00–May01	83,915,101	35,621,716
Jun01–May02	64,638,359	21,125,063
Jun02–May03	79,584,139	22,129,923
Jun98–May03	71,105,478	27,832,841

Table 12.1 also shows the standard deviation of the daily volume changes, which is about 38% of the average volume. One standard deviation of this magnitude says that 68% of the days will show *changes* in daily volume ranging from 41 million to 101 million shares. Looking at it in reverse, 32% of the days will show changes in volume less than or greater than 41 and 101 million shares. Compare that to the price of Microsoft during the same period, which ranged from $20 to $60 but had 1 standard deviation of $0.957—that is, the daily change in price was less than $1, or about 2.9% of the $33.38 average price. Keep in mind that this variance is the motivating factor behind most of the volume indicators and strategies.

Volume Spikes

Madness is the exception in individuals but the rule in groups.
—Nietzsche[1]

A *volume spike* is a single day on which the volume was much higher than the previous day—at least twice as high, perhaps three or four times. A volume spike is a warning that something is changing, most likely the result of a surprising news release or new economic data. It could be the crescendo of a few days of rising volume associated with sharply rising or falling prices.

A volume spike is a clear, positive action by investors. It implies that a very large number of investors, perhaps even the general public, all hold the same opinion on the direction of the market and feel compelled to act on that opinion at the same time. It is the result of mass behavior discussed by Mackay in his famous book, *Extraordinary Popular Delusions and the Madness of Crowds* (Farrar, Straus, and Giroux, 1932). A volume spike means that everyone has jumped into the boat at the same time. Traditional interpretation of a volume spike is that it indicates the end of a price move.

AOL shows three good examples of volume spikes in Figure 12.1. The highest volume days in April, August, and September 1999, and in January 2000 all occur at the bottom of a price move. Prices reverse direction immediately after the spike, and usually that reversal is substantial. A volume spike does not indicate the strength of the price reversal, it simply tells you that the current move is exhausted. It may turn out to be a major top or bottom, or simply a local turning point.

Figure 12.1: Amazon price and volume showing three major volume spikes and declining volume while prices rise at the end of 1999.

Volume spikes are a good example of extremes and the clearest cases for trading. The theory of a spike is that, when everyone has entered the market, there is no one left to buy (or sell) and prices must reverse. The crowd is always wrong—at least their timing is always wrong.

Drop in Volume

Although a drop in volume is less impressive than a volume spike, it can be equally important. Volume can decline because there is little interest in a stock or futures market, which often happens when prices are very low. Volume can

also drop when a price reaches equilibrium, the price at which buyers and sellers agree is *fair value.* Volume may also drop on the day before a holiday, or just by chance. While there are seasonal and other predictable patterns associated with a decline in volume, they all represent uncertainty.

Low activity is considered a lack of confirmation of price movement, whether it occurs over one day or over several months. In Figure 12.1 there is a steady decline in the average volume from October 1999 through the end of 1999 while prices moved steadily higher. This period had only one-half the volume traded earlier in the year and is interpreted as a lack of investor support for higher prices. Having been hurt earlier in the year, more investors stood aside on the second rally and, while prices did top the previous highs, we know that Amazon.com would not see the December 1999 highs again. This declining pattern fits the standard interpretation of volume.

[1]Quoted by David Cassidy, *Trading on Volume* (McGraw-Hill, 2001).

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STANDARD INTERPRETATION

The interpretation of volume has been part of the trading culture from its beginning. Volume is always considered in combination with price movement:

Open table as spreadsheet

Volume	Price	Interpretation
Rising	Rising	Volume confirms price rise
Rising	Falling	Volume confirms price drop
Falling	Rising	Volume indicates weak rally
Falling	Falling	Volume indicates weak pullback

This interpretation shows that *volume confirms direction.* When volume declines it indicates that a change of direction should follow because there is no general support for the price move. Therefore, *volume normally leads price.*

The classic interpretation of volume was published in the monograph by W. L. Jiler, *Volume and Open Interest: A Key to Commodity Price Forecasting*, a companion piece to his most popular *Forecasting Commodity Prices with Vertical Line Charts* (see the bibliography in the back of this book).

In both the futures and stock markets, volume has the same interpretation, when volume increases it is said to confirm the direction of prices. Price changes that occur on very light volume are less dependable for indicating future direction than those changes associated with relatively heavy volume. An additional uncertainty exists for stocks that are not actively traded, and for low prices shares where the total dollar volume can be small. In these cases it might be best to look at the accumulated volume of similar companies or its sector.

Volume and Open Interest

Open interest is a concept unique to futures markets, but helps to explain the depth of the market as well as trader expectation. New *interest* in a market is the result of new buyers and sellers meeting, which increases the open interest, the net of all outstanding contracts being traded. The following table explains the combinations of buyers and sellers that changes open interest:

Open table as spreadsheet

Buyer	Meets	Seller	Change in Open Interest
New		New	Increase in open interest
New		Old	No change in open interest
Old		New	No change in open interest
Old		Old	Decrease in open interest
Where	"New" buyer (seller) is a trader with no market position seeking to be long (short).		
	"Old" buyer (Seller) is a trader who had previously entered a short (long) position and seeks to exit.		

When the open interest increases while prices rise quickly, it is commonly interpreted as more traders entering long positions. This may seem strange because for every new buyer of a futures contract there must be a new seller; however, the seller is likely to be someone looking to hold a position for a few hours or days, looking to profit from the normal ups and downs of price movement. The position trader, who is willing to sit for much more time holding a long position, is the one who is attributed with the open interest. In reality, no one knows. However, if prices keep rising, the shorts are more

likely to be forced out while the longs have staying power.

The traditional interpretation of changes in volume and open interest (for futures markets) can be summarized as:

Open table as spreadsheet

Volume	Open Interest	Interpretation
Rising	Rising	Confirmation of trend
Rising	Falling	Position liquidation (at extremes)
Falling	Rising	Slow accumulation
Failing	Falling	Congestion phase

Three generally accepted notions for the use of volume and open interest are:

1. Open interest increases during a trending period.
2. Volume may decline but open interest builds during an accumulation phase. Volume occasionally spikes.
3. Rising prices and declining volume/open interest indicate a pending change of direction.

There is a traditional interpretation for the combined movement of price direction, volume, and open interest.

Open table as spreadsheet

Prices	Volume	Open Interest	Interpretation
Rising	Rising	Rising	New buyers are entering the market.
Falling	Falling	Falling	Longs are being forced out; the downtrend will end when all sellers have liquidated their positions.
Rising	Falling	Falling	Short sellers are covering their positions causing a rally. Money is leaving the market.
Falling	Rising	Rising	New short selling. Bearish money is entering the market.

Exceptions

No method is without exceptions, including volume patterns in the stock market. There are days or periods when volume is expected to change, and must be considered in the analysis. For example, volume is expected to decline:

On the first day of the week.

On the day before a holiday.

During the summer.

The most important exception to rising prices and rising volume is the volume spike, which signals a change of direction rather than a confirmation.

Volume is also higher on *triple witching day* (or *quadruple witching day* if you include futures on stocks), when S&P futures, options on futures, and options on the individual stocks all expire at the same time.

In the futures markets, there are similar patterns. Lighter volume exists during holiday periods and summer months, but may be heavier on Fridays and Mondays during a trending market or a weather market for agricultural products (uncertainty over rain, drought, or frost over the weekend). Liquidation often occurs before the weekend and positions are reentered on the first day of the next week.

Richard Arms' Equivolume

Most of the techniques for using volume discussed in this chapter will multiply or accumulate volume, creating an index which rises faster as volume increases. *Equivolume*, a charting method introduced by Richard Arms, takes the unique

approach of substituting volume for time along the bottom scale of a chart. When volume increases, the price bar is elongated to the right, rather than the standard approach of extending the height of the bar.

There are no systematic methods for using Equivolume included here and its applications parallel standard chart interpretations; however, analysts can represent this type of chart by creating a new price series in which the daily closing price is repeated based on the relative volume. For example, if the normal volume day causes a closing price to be repeated 10 times, then a day with twice the volume will repeat that price 20 times, and a day with half the volume will show 5 prices. This approach may cause a short-term moving average trend to look strange; however, a linear regression or long-term trend should reflect the importance of varying time.

Herrick Payoff Index

The *Herrick Payoff Index* (HPI) is the only popular calculation that combines price, volume, and open interest. It is designed to gauge the strength of the current trend, and has been applied primarily to futures prices. Because it adds volume and open interest to a momentum calculation, it can be found in Chapter 9 along with some other indicators that use volume as an added feature.

Volume Is a Predictor of Volatility

Most often high volume and high volatility occur at the same time. It is easy to see on a chart that one confirms the other. However, not all days that have high volume also have high volatility. Even on days with high volume, the price can close nearly unchanged from the previous day. We need to look at those days as a sign of *potential volatility*—a large number of traders all with their own objectives somehow managed to offset each other. Tomorrow, if there is an imbalance in the buyers and sellers, and volume is still high, prices could break out in either direction. Therefore, *high volume means high risk*, even on those days when it does not materialize.

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VOLUME INDICATORS

Both the stock and futures markets are familiar to indicators that use only volume, or those that add volume, intending to make other calculations more robust. The following section gives the most popular of these indicators, most of which originate in the stock market; many use the number of advancing and declining stocks. Readers should note the way in which the data is used from one technique to another and consider the significance of these changes. They are discussed at the end of this section.

Volume Momentum and Percentage Change

The most basic of volume indicators are momentum and rate of change. These techniques treat volume as price. For momentum this means finding the change in volume over a specific time interval; percentage change measures the size of the volume change relative to the starting value.

$$Volume\ momentum = Volume_{\text{today}} - Volume_{n\text{-days ago}}$$

$$Volume\% = \frac{Volume_{\text{today}} - Volume_{n\text{-days ago}}}{Volume_{n\text{-days ago}}}$$

Because of the high variance in volume from day to day, volume momentum tends to increase the erratic pattern. It will be necessary to smooth the volume momentum in order to have a useful indicator.

Volume Oscillator

Visualizing the pattern of volume can be very helpful, and the simplest way to do this is with a *volume oscillator*, which addresses the issue of erratic data by using two smoothed values. A volume oscillator is a two-step process and may use trends of any calculation period.

1. Calculate the 14-day moving average and the 34-day moving average of volume.
2. Plot the difference between the 14-day and 34-day averages.

Once calculated, the oscillator values are normally displayed as a histogram, shown in the center panel of Figure 12.2. Using the difference between the 14- and 34-day averages of volume, the volume oscillator is a good visual representation of the increases and decreases in volume. Looking at the Microsoft chart in Figure 12.2 from mid-January 2000 through the end of March 2000, we see an increase in relative volume (two upwards waves) as prices drop, then a clear drop in volume when prices begin to rally in mid-March. As prices reached their peak at the end of March, the volume oscillator had fallen to near zero. On the next rally, beginning in June, the increase in volume is modest. It quickly turns negative as prices flatten out in July 2000, a prediction of what was to come.

Figure 12.2: A volume oscillator (center panel) based on the difference between 14-and 34-day moving averages.

On-Balance Volume

Made famous by Joseph Granville, *On-Balance Volume*[2] is now a byword in stock analyst circles. On days when prices close higher, it is assumed that all volume represents the buyers; on lower days, the volume is controlled by the sellers. The volume is then added or subtracted from a cumulative value, *OBV,* to get today's value.

IF Today's price change > 0 *then* $OBV_{today} = OBV_{previous} + Volume_{today}$

IF Today's price change < 0 *then* $OBV_{today} = OBV_{previous} - Volume_{today}$

The result is a volume-weighted series, which serves to smooth out the erratic nature of the data. In the following formula, the expression in parentheses simply uses the closing prices to produce a value of + 1, 0, or -1, which then determines whether today's volume will be added or subtracted from the volume series:

$$OBV_{\text{today}} = OBV_{\text{previous}} + \left(\frac{Close - Close_{\text{previous}}}{Absvalue(Close - Close_{\text{previous}})} \right) \times Volume$$

Determining the OBV manually is a simple accumulation process as follows, as shown in Table 12.2.

Table 12.2: Calculating On-Balance Volume

Open table as spreadsheet

Closing Price	Daily Volume (in 1000s)	On-Balance Volume
310	25	25
315	30	55
318	27	82
316	15	67
314	12	55
320	28	83

In Table 12.2, there was greater volume on days in which prices rose and lower volume on declining days. This is expected in a market with a clear

uptrend. The advantage of recording the OBV is in observing when the trend of the prices diverges from the OBV values. The general interpretation of OBV is given in Table 12.3.

Table 12.3: Interpreting On-Balance Volume

Open table as spreadsheet

Price Direction	OBV Direction	Interpretation
Up	Up	Clear uptrend
	Sideways	Moderate uptrend
	Down	Weak uptrend near reversal
Sideways	Up	Accumulation period (bottom)
	Sideways	No determination
	Down	Distribution period (top)
Down	Up	Weak downtrend near reversal
	Sideways	Moderate downtrend
	Down	Clear downtrend

Because a volume series has many erratic qualities caused by large variations in volume from day to day, it is most often used by applying a trend from 1 to 100 weeks, then identifying a simple volume direction when the OBV value crosses the trend. An upward trend in volume is interpreted as a confirmation of the current price direction, while a downturn in volume can be liquidation or uncertainty. It is intended that the OBV values be used instead of price for making trading decisions.

In Figure 12.3, the same Microsoft chart as Figure 12.2, the OBV is plotted along with the volume at the bottom of the chart. The pattern of the OBV is very similar to the pattern of prices in the top panel even though it is created from volume. The primary difference between the price chart and the OBV line is that the peak is shifted from the end of 1999 to the end of March 2000. On the OBV line, the low in November is more significant than it appears in the prices and it shows a breakout of the lows slightly ahead of the point where prices breakout higher.

Figure 12.3: On-Balance Volume (bottom panel).

Another use of OBV is as a confirmation of price direction. If prices reach new highs, but the OBV line does not reach new highs, then the upwards move is not well supported. In Figure 12.3 prices move sharply higher in December 1999 but the OBV fails to exceed the previous highs made in October. The OBV pattern rejects the upwards breakout. A few months later, in March 2000, the OBV reaches new highs but prices fail. In each case, the lack of cross-confirmation would have kept you setting new long positions at what turned out to be the long-term top of the equities markets.

Simple Variation in OBV

An indicator that closely resembles On-Balance Volume is a running total of the days when volume increases minus the days when volume declines. That is, add 1 to the cumulative value on a day when today's volume is greater than the previous day; otherwise, subtract 1. This *Volume Count*

Indicator (VCI) can be written as:

$$VCI_{\text{today}} = VCI_{\text{previous}} + \frac{Volume_{\text{today}} - Volume_{\text{previous}}}{Absvalue(Volume_{\text{today}} - Volume_{\text{previous}})}$$

Volume Accumulator

A variation on Granville's OBV system is Mark Chaiken's *Volume Accumulator* (VA). Instead of assigning all the volume to either the buyers or the sellers, the Volume Accumulator uses a proportional amount of volume corresponding to the relationship of the closing price to the intraday mean price. If prices close at the high or low of the day, all volume is given to the buyers or sellers as in the OBV calculation.[3] If the close is at the midrange, no volume is added. This can be accomplished with the following calculation, where the *high*, *low*, and *close* are today's prices:

$$VA_{\text{today}} = VA_{\text{previous}} + \left(\frac{Close - Low}{High - Low} - .50\right) \times 2 \times Volume_{\text{today}}$$

Price and Volume Trend, the Positive Volume Index, and the Negative Volume Index

The *Price and Volume Trend* (PVT) applies volume to the percentage price change from close to close, which can be positive or negative. The *Positive Volume Index* (PVI) and *Negative Volume Index* (NVI) take the approach that a single indicator that adds and subtracts volume based on market direction is not as informative as two separate series that can be viewed at the same time. Both use the rate of change, ROC, expressed as a percentage.[4]

$ROC_{\text{today}} = (Close_{\text{today}} - Close_{\text{previous}}) / Close_{\text{previous}}$

$PVT_{\text{today}} = PVT_{\text{previous}} + ROC_{\text{today}} \times Volume_{\text{today}}$

If $Close_{\text{today}} > Close_{\text{previous}}$ *then* $PVI_{\text{today}} = PVI_{\text{previous}} + Volume_{\text{today}}$

If $Close_{\text{today}} < Close_{\text{previous}}$ *then* $NVI_{\text{today}} = NVI_{\text{previous}} + Volume_{\text{today}}$

In Norman Fosback's *Stock Market Logic*, the author studied stock trends from 1941 through 1975 and concluded that:

- If the *PVI* trend is *up* there is a 79% chance that a bull market exists.
- If the *PVI* trend is *down* there is a 67% chance that a bear market exists.
- If the *NVI* trend is *up* there is a 96% chance that a bull market exists.
- If the *NVI* trend is *down* there is a 50% chance that a bear market exists.

In order to decide the trend of either the *PVI* or *NVI*, 6-month (127-day) or 1-year (255-day) moving average was applied to the individual index values.

Aspray's Demand Oscillator

Using direction to separate volume into two series of *Buying Pressure* and *Selling Pressure*, Aspray then nets them into his own *Demand Oscillator*.[5] Note that during a rising market the Selling Pressure has been *divided* by a percentage of the volume, which has been scaled to be greater than 1. The following calculations show the separate steps needed to create Aspray's *Demand Oscillator*.

For rising prices:

$$Buying\ Pressure_{\text{today}} = Volume_{\text{today}}$$

$$Selling\ Pressure_{\text{today}} = \frac{Volume_{\text{today}}}{\left(K \times \frac{Close_{\text{today}} - Close_{\text{previous}}}{Close_{\text{previous}}}\right)}$$

For declining prices:

$$Buying\ Pressure_{\text{today}} = \frac{Volume_{\text{today}}}{\left(K \times \frac{Close_{\text{today}} - Close_{\text{previous}}}{Close_{\text{previous}}}\right)}$$

$$Selling\ Pressure_{\text{today}} = Volume_{\text{today}}$$

and where

$$K = \frac{3 \times Close_{\text{today}}}{Avg(Highest(High_{\text{today}}, 2) - Lowest(Low_{\text{today}}, 2), 10)}$$

and

$$Demand\ Oscillator_{\text{today}} = BP_{\text{today}} - SP_{\text{today}}$$

K is a volatility scaling factor which is 3 times the closing price divided by the 10-day moving average of the 2-day high-low range, and has a value likely to be well over 100. For example, if the S&P is trading at 1,000 and the average volatility is 15 full points (which is very high for a 10-day average), then *K* = 3000/15 = 200.

Tick Volume Indicator

In a manner similar to Wilder's RSI, Blau double-smoothes the tick volume as a way of confirming price direction. The *Tick Volume Indicator*, seen in Figure 12.4, is calculated as

$$TVI(r,s) = \frac{100 \times DEMA(upticks, r, s) - DEMA(downticks, r, s)}{DEMA(upticks, r, s) + DEMA(downticks, r, s)}$$

Figure 12.4: Blau's Tick Volume Indicator. *Source*—William Blau, *Momentum*, *Direction*, and *Divergence* (Wiley 1995, p. 45).

TVI ranges from -100 to +100 and *DEMA* (Double Exponential Moving Average) is the double smoothing of the downticks or upticks. The exponential smoothing is first calculated over *r* bars, and the result of that smoothing is again smoothed over the past *s* bars. More about this double-smoothing technique can be found in Chapter 7. This technique differs from Blau's price smoothing because it does not first create a momentum series; therefore, the *TVI* will be lagged slightly less than half the sum of the two calculation periods.

Variable Moving Averages for Volume

A unique approach taken by Christian Fries[6] uses the relationship between the number of shares outstanding, the current price, and the volume of the next period or the next trade to create an *Elastic Volume-Weighted Moving Average* (eVWMA). Using the difference between the number of outstanding shares and the number of shares being traded he creates a weighting factor. That weighting factor causes the previous trend value to have more importance when fewer shares are traded and less weight when relatively more shares are traded. The net effect is that the weighted average is more responsive to change when relatively more shares are traded.

$$eVWMA_t = \frac{(OS_t - Volume_t) \times eVWMA_{t-1} + Volume_t \times Close_t}{OS}$$

where *OS* = the number of outstanding shares.

Programming Volume Indicators

Volume indicators are easy to program on either a spreadsheet or in TradeStation's Easy Language. The following examples include only some of the indicators discussed in this chapter; the others are very similar and can be added using the same form.

Spreadsheet Code

Using Excel, the following spreadsheet shows the Eurodollars beginning in April 1993. The calculations for On-Balance Volume, Volume Accumulator, and Price-Volume Trend are shown in the rightmost three columns. The spreadsheet code for these calculation are shown after the sample output.

```
Col Name   Start Row
A   Date    5
B   High    5
C   Low     5
D   Close   5
E   Volume  5
F   OBV     7      =IF(D7-D6>0,F6+F7,IF(D7-D6<0,F6-E7,F6))
G   VACC    7      =G6+(((D7-C7)/(B7-C7))-0.5)*2*E7
H   PVT     7      =H6+E7*(D7-D6)/D6
I   MAP     45     =AVG(D26:D45)
J   PX      48     =(I48-I46)*100/I45
K   MA      45     =AVG(D6=D45)
L   MADIFF  48     =K48-K45
M   MAV     45     =AVG(F26:F45)         [for OBV]
N   VX      48     =(M48-M45)*100/M45
0   DVG     48     =IF(J48*N48<0,J48-N48,0)
P   OBV VX Signal from row 49
                   =IF(AND(L49<0,L48<=0,N49<=$D$3),"buy",
                       IF(AND(L49<0,L48<=0),"exitS",
                       IF(AND(AND(L49<=0,L48<0),N49<=$D$3),"sell",
                       IF(AND(L49<=0,L48<0),"exitL",
                       IF(L49<$D$3,"exitALL"," "))))))
Q OBV VX DVG Signal from row 49

                    =IF(AND(L49<0,L48 <=0,N49 <=$D$3,
                        ABS(049) <=$E$3),"buy",
                        IF(AND(L49 <0,L48 <=0),"exits",
                        IF(AND(L49 <=0,L48 <0,N49 <=$D$3,
                        ABS(049) <=$E$3),"sell",
                        IF(AND(L49 <=0,L48 <0),"exitL",
                        "exitALL"," "))))))
R Mom Osc25        =(AVG(E22:E25) - AVG(E25:E6))*100/AVG(E22:E25)
S Avg Mom45        =AVG(R26:R45)
T StDev Mom 45     =STDEV(R26:R45)
U Mom Signal 45    =IF(AND(L45>0,L44 <=0,R45 <=S45-$F$3*T45),"buy",
                       IF(AND(L45 <0,L44 <=0),"exitS",
                       IF(AND(L45 <=0,L44 <0,R45 <= S45-$F$3*T45),"sell",
                       IF(AND(L45 <=0,L44 <0),"exitL"," ))))
V ROC25            =(E25-E6)*100/E6
W Avg ROC45        =AVG(V26:V45)
X StDev ROC 45     =STD(V26:V45)
Y ROC Signal 45    =IF(AND(L45 <0,L44 <=0,V45 <= W45-$F$3*T45),"buy",
                       IF(AND(L45 <0,L44 <=0),"exitS",
                       IF(AND(L45 <=0,L44 <0,V45 <= W45-$F$3*T45),"sell",
                       IF(AND(L45 <=0,L44 <0),"exitL"," ))))
```

TradeStation's EasyLanguage Code

The following program code gives an example of a TradeStation *strategy* that uses one of eight volume measurements to filter the entry or exit of a trade. When the input *ttype* is negative, the input values are treated as an entry filter; when *ttype* is positive, the values are used for an exit filter.

```
{ PJK Volume : Create a volume filter
   Copyright 1995-2003, PJKaufman. All rights reserved. }

inputs:   period(20), ttype(1), maxdn(0), maxdvg(0), npsd(.5), ddays(3);
vars:     px(0), vx(0), Kvol(0), map(0), mav(0),sdiff(0),
             madays(0),ma(0), dvg(0),   nd(0),
          madiff(0), avgv(0), sdv(0), tentry(0), avg2(0), type(0), sc(0),
             avghl(0), signhl(0);

{ Exit type   = 1, On-Balance Volume
              = 2, Chiakin Volume Accumulator
              = 3, Negative Volume Index
              = 4, Positive Volume Index
              = 5, Price and Volume Trend
              = 6, Volume oscillator (npsd used for exit level)
              = 7, Volume rate of change
              = 8, Low volume exit
For entry filter use negative type

{ test exit }
type = ttype;
if type < 0 then begin
   tentry = 1;
   type = absvalue(ttype);
end;

{ price index }
map = average(close,period);

if ddays < 1 then nd = 1 else nd = ddays;
if map[nd] = 0 then px = 0 else px = (map - map[nd])*100 / map[nd];

{ On-Balance Volume }
```

```
   if type = 1 then begin
      if close > close[1] then KMAvol = KMAvol + volume
         else if close < close[1] then Kvol = Kvol - volume;
      end;

   { Chaikin Volume Accumulator }
   if type = 2 then Kvol = Kvol +(((close - low) /
      (high - low)) - 5)*2*volume

   { Negative Volume Index }
   if type = 3 then begin
      if volume < volume[1] then Kvol = Kvol[1] +
         (close - close[1])*Kvol/close[1]
         else if Kvol = 0 then Kvol = volume
         else Kvol = Kvol[1];
   end;

   { Positive Volume Index }
   if type = 4 then begin
      if volume < volume[1] then Kvol = Kvol[1] +
         (close - close[1])*Kvol[1]/close[1]
         else if Kvol = 0 then Kvol = volume
         else Kvol = Kvol[1];
         end;

   { Price and Volume Trend }
   if type = 5 then Kvol = Kvol +volume*(close - close[1]) / close[1]

   { Volume oscillator }
   if type = 6 then
      Kvol = (average(volume,ddays) - average(volume,period))
         *100/average(volume,ddays);

   { Volume rate-of-change }
   if type = 7 then begin
      if Kvol = 0 then Kvol = volume;
      if volume[period] = 0 then Kvol = Kvol[1] else Kvol =
      (volume - volume[period])*100/volume[period];
      end;

   { Moving average of price }
   madays = 2*period;
   ma = average(close,madays);
   madiff = ma - ma[nd];

   if type < 6 or type = 9 then begin
      mav = average(Kvol,period);
      if [nd] = 0 then vx = 0 else vx = (mav - mav[nd])*100/mav[nd];
      sdiff = px - vx;
   { record divergence only }

   if vx*px < 0 then dvg = sdiff else dvg = 0;
      if madiff > 0 and madiff[1] <= 0 then begin
         exitshort at market;
      if tentry = 0 and (vx <= maxdn and absvalue(dvg)
            <= maxdvg) then buy at market;
         end;
   if madiff < 0 and madiff[1] <= 0 then begin
      exitlong at market;
      if tentry = 0 and (vx <= maxdn and absvalue(dvg)
         <= maxdvg) then sell at market;
      end;
   if vx < maxdn and absvalue(dvg) > maxdvg then begin
      exitlong at market;
      exitshort at market;
      end;
   end;

if type = 6 or type = 7 then begin
    avgv = average(Kvol,period);
    sdv = stddev(Kvol,period);
    if tentry = 0 then begin
       if (madiff > 0 and madiff[1] <= 0) or Kvol
          <= avgv-npsd*sdv then exitshort at market;
    if (madiff < 0 and madiff[1] >= 0) or Kvol
       <= avgv-npsd*sdv then exitlong at market;
    if madiff > 0 and madiff[1] <= 0 then buy at market;
    if madiff < 0 and madiff[1] >= 0 then sell at market;
    end
else begin
   if madiff > 0 and madiff[1] <= 0 then exitshort at market;
   if madiff < 0 and madiff[1] >= 0 then exitlong at market;
   if madiff > 0 and madiff[1] <= 0 and Kvol
      <= avgv-npsd*sdv then buy at market;
   if madiff < 0 and madiff[1] >= 0 and Kvol
      <= avgv-npsd*sdv then sell at market;
   end;
end;

{ Low volume exit, comparing slow and fast average }
if type = 8 then begin
   avgv = average(volume,period);
   avg2 = average(volume,ddays);

   if tentry = 0 then begin
      if (madiff > 0 and madiff[1] <= 0) or avg2

         <= avgv*npsd then exitshort at market;
```

```
      if (madiff < 0 and madiff[1] >= 0) or avg2
         <= avgv*npsd then exitlong at market;
      if madiff > 0 and madiff[1] <= 0 then buy at market;
      if madiff < 0 and madiff[1] >= 0 then sell at market;
      end
   else begin
      if madiff > 0 and madiff[1] <= 0 then exitshort at market;
      if madiff < 0 and madiff[1] >= 0 then exitlong at market;
      if madiff > 0 and madiff[1] <= 0 and avg2
         <= avgv*npsd then buy at market;
      if madiff < 0 and madiff[1] >= 0 and avg2
         <= avgv*npsd then sell at market;
      end;
   end;
```

[2]Robert W. Colby and Thomas A. Meyers, *The Encyclopedia of Technical Market Indicators* (McGraw-Hill, 2003), is a comprehensive study of most market indicators, including On-Balance Volume and some other techniques included in this section.

[3]Both OBV and the Volume Accumulator are characterized as "momentum" systems. See Chapter 9 for more information on similar techniques.

[4]Dennis D. Peterson, "Positive Volume Index," *Technical Analysis of Stocks & Commodities* (April 2003). Also Norman G. Fosback, *Stock Market Logic* (The Institute for Economic Research, 1985)

[5]Thomas Aspray, "Fine-Tuning the Demand Index," *Technical Analysis of Stocks & Commodities* (June 1986), and "Demand Oscillator Momentum," *Technical Analysis of Stocks & Commodities* (September 1989).

[6]Christian P. Fries, "Elastic Moving Averages," *Technical Analysis of Stocks & Commodities* (June 2001).

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BREADTH INDICATORS

Market breadth measures the imbalance between the number of advancing and declining stocks on a given day. It is the percentage of rising stocks to the total number of stocks traded. In general, more advancing issues should add confidence to an upwards price move in the same way that volume confirms price. A net increase in the S&P 500 while more issues are declining should generate concern that the upwards move is poorly supported.

The information for advances and declines is published along with stock prices each day. You may also want the volume of advancing issues and the volume of declining issues. Both of these values can be found in the *Wall Street Journal* under "Trading Activity."

Market breadth indicators are best used as a confirmation of price direction. The table below shows that the interpretation of market breadth is the same as the relationship between volume and price.

Open table as spreadsheet

Market Breadth	Price	Interpretation
Rising	Rising	Breadth confirms price rise
Falling	Falling	Breadth confirms price drop
Falling	Rising	Breadth does not confirm price rise
Rising	Falling	Breadth does not confirm price drop

The measurement of breadth must relate to what you are trading. If 75% of the stocks in the Dow rise, the S&P Small Cap Index can still be lackluster or declining. Investors shift from small-cap stocks to the S&P 500 and then to the Dow when they are looking for safety. The breadth of the overall market, or the breadth of large caps, is not enough to confirm an upwards trend in the small caps.

Separating Advancing from Declining Volume

The most basic of all techniques for determining market breadth is the *Advance-Decline Index*, which creates a new series by adding the net of the number of advancing and declining stocks each day. Unchanged issues are ignored.

$$Advance\text{-}Decline\ Oscillator_{today} = Advances_{today} - Declines_{today}$$

$$Advance\text{-}Decline\ Index_{today} = Advance\text{-}Decline\ Index_{previous} + Advances_{today} - Declines_{today}$$

In some of the techniques that follow, only the oscillator, or single-period calculation, may be shown. An index can be created by accumulating these values.

Sibbett's Demand Index

One method that smooths volume by using the total activity of the past 10 days is James Sibbett's *Demand Index*. The technique bears a resemblance to the approach used in Wilder's RSI. It can be used as an oscillator with individual daily values or accumulated into an index. The individual days are calculated as:

$$Demand\ \ Index_{\text{today}} = \frac{Sum(upside\ \ volume,10)}{Sum(downside\ \ volume,10)}$$

where *sum* is a function that sums the past 10 days of upside and downside volume. These values can be found in the *Wall Street Journal* under the heading "Trading Activity." Arthur Merrill, another well-known stock analyst, has suggested applying 5 days to this same technique.

Bolton-Tremblay

Introducing the net advancing stocks compared to the number of stocks that were unchanged, the Bolton-Tremblay approach also includes a form of geometric weighting of the results. In the following calculation, *BT* is the daily Bolton-Tremblay value and *BTI* is the index resulting from accumulating the individual daily values.

$$BT_{\text{today}} = \frac{Advancing_{\text{today}} - Declining_{\text{today}}}{Unchanged_{\text{today}}}$$

$$if\ BT_{\text{today}} > 0\ then\ BTI_{\text{today}} = BTI_{\text{previous}} + \sqrt{BT_{\text{today}}}$$

$$if\ BT_{\text{today}} < 0\ then\ BTI_{\text{today}} = BTI_{\text{previous}} - \sqrt{BT_{\text{today}}}$$

The Bolton-Tremblay calculation will have large spikes on days when the advancing or declining breadth is very strong, which make the unchanged number of stocks in the denominator very small.

Schultz

Schultz chose to look at the advancing stocks only as a percentage of the total stocks which puts the results in the convenient range of 0 to 100:

$$Schultz\ \ A/T_{\text{today}} = Schultz\ \ A/T_{\text{previous}} + \frac{Advancing_{\text{today}}}{Advancing_{\text{today}} + Declining_{\text{today}} + Unchanged_{\text{today}}}$$

McClellan Oscillator

Similar to the Advance-Decline Index, the *McClellan Oscillator* does not accumulate the net change in breadth, but looks at the individual changes as an oscillator bounded by the total number of stocks traded on the exchange.

$$McClellan\ Oscillator_{\text{today}} = Advances_{\text{today}} - Declines_{\text{today}}$$

Upside/Downside Ratio

A simple *Upside/Downside Ratio* (UDR) has also been used; however, the ratio value has no symmetry. When the declining volume is very low, for example, only 20% of the total volume, the UDR will have a value of 4.0. In contrast, if the advancing volume is low, the ratio is limited to the range between 0 and 1. This is a familiar pattern for advancing and declining prices expressed as a percentage. High values of the UDR are expected to precede a bull market period.

$$UDR = \frac{Volume\ of\ advancing\ stocks_{\text{today}}}{Volume\ of\ declining\ stocks_{\text{today}}}$$

Arms Index (TRIN)

Richard Arms explains the relationship between the number of advancing and declining stocks, and the up and down volume, in the *Arms Index*, more popularly known as *TRIN*, the *trader's index*.

$$TRIN_{\text{today}} = \frac{Advancing\ stocks_{\text{today}}\ /\ Declining\ stocks_{\text{today}}}{Volume\ of\ advancing\ stocks_{\text{today}}\ /\ Volume\ of\ declining\ stocks_{\text{today}}}$$

Thrust Oscillator

Tushar Chande's *Thrust Oscillator* (TO) uses the same values as *TRIN* but creates a bullish oscillator by multiplying the number of advancing stocks by the volume of the advancing stocks and subtracting the comparable declining values, then dividing by the sum of the two.

$$TO_{\text{today}} = 100 \times \frac{Adv\ stocks_{\text{today}} \times Volume\ of\ adv\ stocks_{\text{today}} - Decl\ stocks_{\text{today}} \times Vol\ of\ decl\ stocks_{\text{today}}}{Adv\ stocks_{\text{today}} \times Volume\ of\ adv\ stocks_{\text{today}} + Decl\ stocks_{\text{today}} \times Vol\ of\ decl\ stocks_{\text{today}}}$$

The Thrust Oscillator is used as an overbought/oversold indicator to complement another strategy that would decide on the major direction of the market. Values of ±30 may be used to identify overbought and oversold levels, respectively.

When studying both the Arms Index (TRIN) and the Thrust Oscillator (TO) it would seem sensible to express all the component values as percentages of the whole. That is, the number of advancing and declining stocks should each be divided by the total number of stocks, and the volume of the advancing and declining stocks should each be divided by the total volume of all shares traded. This would make those days with low relative volume less important. In the current calculations, inactive days might produce highly distorted values.

Is One Volume or Breadth Indicator Better Than Another?

The final test of a successful indicator is whether it adds value to your trading decisions. This can be determined by programming the indicator into total strategy and testing the rules over a reasonable historic time period. Before doing that, we should decide what an increase or decrease in volume or breadth is telling us, and how we will use that information for trading. Volume and breadth indicators are more difficult than those that use price because the values have greater variance. That makes translating a sound concept into a profitable strategy more difficult. If performance testing does not confirm our expectations, then the way in which the technique was implemented did not work as planned.

Looking at the previous selection of indicators, we see that small net changes in price can result in all volume being designated to one market direction. This is the case with Granville's *On-Balance Volume* and in the Bolton-Tremblay method. Is it reasonable to add all volume to the accumulated index if the S&P gained only a fraction of one point? On a single day this may seem to be arbitrary, but just as in many basic systems, over a long period of time the net effect of this decision is sound.

We should also notice that these volume indicators fail to account for a range of noise that is similar to the erratic movement of prices; that is, there is a normal variation in volume that does not mean anything special. At the other extreme, these indicators fail to isolate *outliers*, such as volume or breadth spikes, that result from price shocks and are associated with high volatility.

The changes made by Mark Chaiken, which take a percentage of volume based on the relative close of prices within the daily range, seem very sensible and avoid the all-or-nothing technique used in On-Balance Volume. Sibbett's Demand Index, by using the sum of ten days' volume, avoids this problem completely and smoothes out results, a situation often needed when using the highly variable values of volume and breadth.

It has been suggested that the Demand Index, which simply accumulates the net of advances minus declines, be used with the absolute value of the daily calculation, advances minus declines. That would give the same value when advances outnumbered declines by the same amount as declines outnumbering advances. This calculation would lose information by failing to distinguish the market direction. Unless taking the absolute value of any advance-decline formula makes sense, it should not be done, even if historical testing shows a better result than other methods.

By seeing these indicators close together, they appear to be a collection of minor manipulation of data. The resulting indicator values still require interpretation using trend lines, divergence, or new highs and lows. Instead of having to interpret only the difficult movements of prices, we have added an equally difficult series of volume or breadth. While it is clear that volume and breadth contribute to the understanding of a price move, you must first be able to test whether you can use that information profitably. Perhaps the easiest way is to look at the extreme situations first.

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INTERPRETING VOLUME AND BREADTH SYSTEMATICALLY

Most systematic approaches to volume apply a long-term smoothing method to the data, then identify trend changes to confirm price direction. This can be implemented with any of the accumulation indices, but not with single-day momentum or oscillator values. For the oscillators, most analysts have taken the approach that high volume confirms a new price direction; therefore they look for a reversal signal at the same time as peak or near-peak volume. If they do not occur at the same time, a volume peak should precede a trend change. A decline in volume has also been used to confirm direction, but it is more likely to indicate that prices have reached equilibrium, and that a further advance or decline requires additional confirmation.

Identifying a Volume Spike

A volume spike is one of the clearest and best examples of useful volume information. In its most obvious form, a volume spike is a day when the volume is at least twice that of other days over a period generally longer than one month, most likely longer than three months. Volume spike may come in clusters due to an unstable political or economic situation; however, it is associated with the end of a major price move and high-volume days that become too frequent are suspicious and may no longer qualify as spikes.

A simple spike can be measured as exceeding a threshold, T, where T is a multiple of the average volume, $AV = average(volume,n)$, over the recent n days. Then a volume spike exists if today's volume is greater than the average volume times its multiplier, $V_t > T \times AV$.

Most cases are not as clear as a 1-day spike following much lower volume. More likely, volume has increased significantly over the past two or three days, culminating in a spike that is much higher than the average volume, but may only be 25% higher than the previous day. The solution to this is to lag the average volume so that it does not reflect the increasing volume of the recent few days.

We will make the assumption that volume that results in a spike takes no longer than three days to develop. We can safely say that the average volume, lagged five days, should not reflect the recent rise in volume. Then a volume spike would be identified when

$$V_t > \frac{\sum_{i=t-n-5}^{t-5} V_i}{n}$$

The right part of this formula is the average volume over n days beginning t-n-5 days ago and ending t-5 days ago. If t is today, then the average volume stops five days ago; therefore, it is not influenced by recent volume data.

Moving Average Approaches

A straightforward way of using volume is to calculate a 10-day moving average of the volume to be used as a confirmation of a 20-day trend position.[7] By simply requiring the current volume to be greater than the average volume over those past 10 days, you introduce the idea of greater participation associated with the new trend. An additional important benefit is that this volume condition acts as a filter, eliminating a substantial number of trades. If the net returns are the same, the volume-filtered approach is far better because you are out of the market more, reducing your risk and not reversing your position every time there is a new signal.

A similar method was proposed by Waxenberg.[8] A 10-day moving average of the volume is calculated as the normal

level, and a change in trend must be confirmed by a 20% increase in volume above this norm. (The 20% band acts as an additional smoothing filter, but may be replaced by a longer trend and smaller band.) Extremes in a trending move can be found at points that exceed approximately a 40% volume increase. Applied to the stock market, Waxenberg used the extreme volumes to indicate the end of a sell-off. To add more flexibility over longer test periods, and to adapt more quickly to volatility changes, Bollinger bands (based on two standard deviations, or 95% probability) can be substituted for the fixed percentage bands.

Alternately, using 13 days of volume, subtract the total down volume from the total up volume. A plot of the results will serve as a momentum indicator from which overbought and oversold levels can be identified. If these values are unstable due to lack of liquidity, they may be smoothed using a short-term moving average.

Advance-Decline System

Advance and decline values, as with most volume figures, can be more useful if they are smoothed. By combining peak values of the net of smoothed advancing and declining shares with a directional move in price, Conners and Hayward have created a basic system structure that they named CHADTP[9] (Conners-Hayward Advance-Decline Trading Patterns). This system tries to identify reversal patterns by applying the following steps:

1. Add the past 5 days of advancing issues on the New York Stock Exchange.
2. Add the past 5 days of declining issues on the New York Stock Exchange.
3. Subtract the 5-day sum of declining issues (Step 2) from the advancing issues (Step 1).
4. Divide by 5 to get the average daily value.

$$CHADTP = (Sum(AdvancingNYSE,5) - Sum(DecliningNYSE,5)) / 5$$

To trade using this oscillator, Conners and Hayward have determined that ±400 are the extreme levels where the values have been overbought and oversold. Based on this, we can apply the following rules to the S&P futures:

1. *Sell* when CHADTP > +400 and the SP futures trades 10 basis points below the low of the previous day; *buy* when CHADTP < -400 and the S&P futures trades 10 basis points above the high of the previous day.
2. Note that the oscillator does not have to exceed its recent extremes on the day of the buy or sell signal.
3. Timing is best if the signal occurs at the same time as a newspaper commentary indicating "depressed volume," or volume significantly below the 3-month average, which is seen as an excess of cash waiting to enter the market.

This system targets returns over a 5- to 7-day period. A drop in the oscillator, which results in values in the midrange, is an opportunity to exit. A standard price oscillator can be constructed to generate overbought and oversold signals within this time frame. An opposite entry signal would reverse the position.

[7]Alex Saitta, "A Price and Volume-Based System," *Technical Analysis of Stocks & Commodities* (March 1996).

[8]Howard K. Waxenberg, "Technical Analysis of Volume," *Technical Analysis of Stocks & Commodities* (March 1986).

[9]Laurence A. Conners and Blake E. Hayward, *Investment Secrets of a Hedge Fund Manager* (Probus, 1995).

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AN INTEGRATED PROBABILITY MODEL

If there is a noticeable relationship between price, volume and open interest (or market breadth), then a probability model can be constructed to test its importance.[10] To do this it is necessary to construct a 1-day-ahead forecast using a simple linear regression model, then back-test weighting factors for each element. Because of powerful software products, this has become a very manageable process. Using TradeStation's EasyLanguage, each 1-day-ahead forecast is determined using the previous *n* days:

Price forecast:	*Pf*	= *Price* + *LinearRegSlope*(*close,n*)
Volume forecast:	*Vf*	= *Volume* + *LinearRegSlope*(*volume,n*)
Open interest forecast:	*Of*	= *Opint* + *LinearRegSlope*(*opint,n*)
On-Balance Volume forecast:	*OBVf*	= *OBV* + *LinearRegSlope*(*OBV,n*)

The function *LinearRegSlope* returns the 1-period increase or decrease in the input value based on a straight-line fit of the past *n* days. That value can be added to the current price, volume, open interest, or On-Balance Volume to get the 1-day-ahead forecast. The calculation period *n* can be selected by subtracting the actual next-day value from the forecast and creating an error series which can be measured using a standard deviation. The number of days, *n*, that generates the smallest standard deviation is the best forecast period. It is likely that the optimal forecast period will differ for each of the four items above and this becomes a matter of concern. Is there a reason why the forecast period should be the same for all of the predictions? If we are independently trying to forecast volume, then fixing the periods at the same length does not seem necessary. If we are trying to discover whether a change in volume is related to a change in price, as we are here, then the same period does seems important. These and other testing issues are thoroughly discussed in Chapter 21.

Having found the four 1-day-ahead forecasts, an index can be created that gives one weight w_1 to the price forecast and the remaining weights, 1- w_1, to a combination of the other three factors. This assumes that price is the most important predictor of price. Then

$$Forecast\ index = w_1 Pf + (1 - w_1) \times (w_2 Vf + w_3 Of + w_4 OBVf)$$

This formula can be back-tested for values of w_1, w_2, w_3, and w_4 between 0 and 1. The final index can be used instead of price for determining the trend. It will still require a moving average, or some smoothed line, to signal new uptrends and downtrends; however, the results, if successful, should be more reliable than using only price.

One advantage of testing the weighting factors is that, if one of the four elements is not helpful in predicting a trend, the weighting factor should be zero. Another approach, that does not cluster the nonprice data together, would be to treat each item separately in the classic form:

$$Forecast\ index = w_1 Pf + w_2 Vf + w_3 Of + w_4 OBVf$$

where the sum of the four weights, $w_1 + w_2 + w_3 + w_4 = 1$. The sum of the weighting factors should always be equal to 100%.

[10]Based on the May 1995 "CSI Technical Journal," Commodity Systems Inc., Boca Raton, Florida.

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INTRADAY VOLUME PATTERNS

Identifying increases and decreases in volume during the trading day must consider the patterns caused by the flow of orders during the day, and the way traders enter orders. Because there is no timely reporting of actual trading volume on the New York Stock Exchange or any other futures or stock exchange, the pattern of intraday volume can only be evaluated using tick volume as a practical substitute. To create a meaningful chart of 30-minute volume patterns, the first 30 minutes of the day was used as a benchmark, and each subsequent interval was compared with the first 30-minute tick volume and recorded as a percentage of that initial value. Figure 12.5 shows the results of three futures markets, Eurodollars, S&P 500, and Deutschemarks (now replaced by the euro) taken over a 1-year period using the nearest delivery month.

(a)

(b)

(c)

Figure 12.5: Patterns of 30-minute tick volume, 1993. (a) Eurodollars, (b) Deutschemarks, (c) S&P 500.

Although these charts use 1993 data, the pattern of volume is remarkably unchanged today. The shapes of the volume distribution for the three markets shown in Figure 12.5 are similar in that the greatest volume is at the beginning and end of the trading day; they are very different, however, in their internal patterns. Eurodollars, which have the highest volume of all futures markets, show much larger volume on the open and closing 30-minute periods.

It should not be surprising to see the extreme clustering at both ends of the trading day. Orders enter the market early in reaction to news and events that occurred after the close of the previous day's trading. Many analysts based trading decisions on the previous day's data but perform their calculations and analyses after the close. The end of day is active due to liquidation of the positions of day traders who do not want overnight risk, the need to anticipate tomorrow's move based on decisions made using today's price data, or simply because many traders use the closing prices to make decisions. For most traders, the closing price is the most dependable value of the day.

There is a typical rounded bottom formation on most charts, with lowest volume in the late morning when traders take their breaks. Deutschemarks (Figure 12.5c) differ from the others by showing more sustained high volume through late morning. This is because the European markets are open during that period. The London financial markets officially operate until 5 P.M. (12 noon in New York, 6 P.M. in Frankfurt), to overlap U.S. trading as much as possible. Volume on the IMM Deutschemark contract tapers off after European business hours end. This same relationship now exists in the European Currency Unit, the *euro.*

When trading is based on an increase in volume, these intraday patterns must serve as the normal pattern. To decide whether there is a volume increase that confirms for a trade to be entered at 11 A.M., you must compare today's 30-minute volume for the 11 A.M. interval with the previous average volume for this *same period only.* This is equivalent to deseasonalizing or detrending the data. Even with this precaution, an increase in volume for a thinly traded stock or futures market may appear significant because the 30-minute volume jumped 300% during the middle of the trading day. This can easily be misleading. You will need to consider the sample error in low-volume markets or require much larger volume changes, or a minimum level of volume, to be more certain. Unless you can prove otherwise, trading signals generated during the low-volume periods in the middle of the day should be assumed to be unreliable.

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FILTERING LOW VOLUME

It seems clear that minutes, hours, or even days that have little market activity are likely to be associated with uncertain price direction. If the British pound moves $.50 in the midafternoon of the U.S. market, we know that volume is normally light because the London and European markets are closed. The intention of a volume indicator is to identify positive moves in volume that can be used as a confirmation of price direction. Eliminating those days with low volume, or with marginal price moves, may increase the dependability of the volume indicator.

Removing Low-Volume Periods

Including low-volume periods in a volume index may make the index movements unreliable. There is a similar situation in statistics, where a number of statistical values are slightly skewed to one side. Each value on its own is not noticeably important, but collectively they cause a bias. Some analysts believe that the collective weight creates significance, while others favor ignoring values that are so small they are insignificant and perhaps confusing.

When you ignore the individual values, there is no collective value. In the same way, by ignoring days with low volume, you do not risk the chance of posting a series of days, all of which may qualify as uncertain, that collectively result in a confirmation of a new price direction. In order to remove the uncertain days, measure the volume against a threshold created using the average volume minus one or two standard deviations of the volume. Using a 1-standard deviation filter will remove the lowest 16% of the days; a 2-standard deviation filter removes only 2.5% of the days.

This type of filter is best applied to a volume index, such as On-Balance Volume. For example, we find that the average volume on the New York Stock Exchange is 1.5 billion shares, and 1 standard deviation of the volume is .25 billion shares. We decide that the volume filter is 2 standard deviations; therefore, any day with volume below 1.0 billion shares will be ignored. Applying this to On-Balance Volume, where *volumefilter* = 1.0, we would use the following program or spreadsheet steps:

```
Volumethreshold = average(volume, n) ( volumefilter*stddev(volume, n)
if volume < volumethreshold then VFOBV = VFOBV[1]
   else VFOBV = VFOBV[1] + ((close - close[1])/
      (absvalue(close - close[1])) * volume
```

where *n* = the same calculation period for the average and standard deviation

Removing Volume Associated with Small Price Moves

Indicators such as On-Balance Volume post all volume as either a positive or negative contribution to the index, based on the direction of prices on that day. It is fair to question the validity of posting all volume to the upside when the S&P 500 closed up a minimum move of 25 basis points (+.25) or the Dow closed up 1 point. It could just as easily have closed down that amount. In a manner similar to filtering low-volume periods, periods in which prices moved very little may be eliminated by using a standard deviation of the price changes as a filter. Days that are within ±.10 or ±.25 standard deviations of the average would be ignored. The Price-Filtered On-Balance Volume, *PFOBV*, would then be found using the code:

```
pricethreshold = average(price - price[1], n) +
   f*stddev(price - price[1],n)
if absvalue(price - price[1]) < price threshold then PFOBV = PFOBV[1]
   else PFOBV = PFOBV[1] + ((close - close[1])/
      (absvalue(close - close[1])) * volume
```

where *n* = the number of periods in the average and standard deviation

f = the number of standard deviations used to filter minimum volume

Note that, in the case of a minimum price threshold, the rules look at price change, which can be positive or negative. For a volume threshold there is only a one-sided test using the value of volume.

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MARKET FACILITATION INDEX

In weighing the likelihood that prices are indicating a direction, rather than a false start, the tick volume compared to the price range for the same period, called the *Market Facilitation Index*,[11] can measure the willingness of the market to move the price. This concept is interesting because it is not clear that high volume results in a large price move, although it appears to set up the conditions for high volatility. If the Market Facilitation Index increases, then the market is willing to move the price; therefore trading profits are more likely.

$$Market\ Facilitation\ Index = \frac{Trading\ range_{\text{today}}}{Volume_{\text{today}}} = \frac{High_{\text{today}} - Low_{\text{today}}}{Volume_{\text{today}}}$$

The results of combining the change in tick volume and the Market Facilitation Index are interpreted as:

Open table as spreadsheet

Tick volume	Market Facilitation Index	Interpretation
Up	Up	Confirmation of direction
Down	Down	False direction, do not take trade
Down	Up	Poor entry timing, approach with caution
Up	Down	Potential new trend, end of old trend

[11] Bill Williams, *Trading Chaos* (John Wiley & Sons, 1995).

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Chapter 13: Spreads and Arbitrage

OVERVIEW

Positions taken in opposing directions in related markets, contracts, options, or shares are generally referred to as a *spread* or *straddle.* When a long and short sale are entered simultaneously in two related stocks, the strategy is called *pairs trading.* When the dynamics of the spread can be definitively calculated, such as the price of two bonds of the same maturity and the same grade, or the price of gold in two different locations, the transaction can be considered an *arbitrage.* For futures markets, the most common use of the term *spread* relates to two delivery months of the same market. This can also be called an *intramarket spread,* an *interdelivery spread,* or a *calendar spread.* For example, a trader may take a long position in March Treasury bonds and sell short the June contract (for the same year). The expectation is that prices will rise (yields fall) and that near-term delivery will rise faster than the deferred, netting a larger profit on the long position and a smaller loss on the short sale. An *intermarket spread* can be taken in two stocks of the same industry group, such as American Airlines and UAL. General economic news will affect the airline stocks in the same way, but better management of one company will cause that stock to gain over the other. In the stock market this is also called *pairs trading.*

An *intercommodity spread* is the simultaneous purchase of one commodity and the sale of another related commodity. This is most common using the index markets, such as the S&P 500, Russell 2000, Dow, and an increasing number of others. An *intermarket spread* refers to the purchase and sale of a similar commodity trading on two different exchanges, such as wheat on the Chicago Board of Trade and Kansas City wheat, or Brent North Sea crude oil traded in London and West Texas Intermediate (WTI) traded in New York.

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DYNAMICS OF FUTURES INTRAMARKET SPREADS

A spread is most often a way to reduce both the risk and, consequently, the potential profit that exists in an outright long or short position. An *intramarket spread* is placed in two delivery months of the same market, a combination of futures and physicals in the same market, or in two options of different strike prices or maturities. The reduction in risk depends on the relationship between successive delivery months, which varies considerably with the market traded. These can be summarized as follows:

- *Financial markets* nearest to delivery react faster and with greater magnitude to changing interest rates, economic data, and supply and demand situations. The deferred contracts will respond slower because the lasting effect on the market is not as clear.

- *Precious metals* markets, such as gold, platinum, and silver, were once considered *pure carry markets*. Successive delivery months would always trade at a higher price due to the interest rate component of holding the physical product in inventory. If the price of the metal rises or interest rates rise, the cost of carry increases and the spread between months widens. If metal prices or interest rates decline, the spread narrows. If metal prices and interest rates move in opposite ways, the effect on the spread is dampened to varying degrees. There has been an evolution in the industrial use of precious metals, primarily gold and platinum in electronics, which has increased the consumption and changed the price patterns to reflect a more industrial look.

- *Industrial metals*, such as copper, will show normal carrying charges under most circumstances but are affected by demand to the extent that prices have been known to *invert* for significant periods of time. Because of its fundamental changes, silver prices inverted for the first time in 1997.

- *Foreign exchange* rates are dependent on the prevailing economic outlook for the specific country, combined with their balance of trade. A stable economy will show nearly unchanged forward rates; a weakening economy will cause the deferred contracts to be discounted. Prices tend to become more volatile as they move away from equilibrium, whether higher or lower. Countries prefer to see their exchange rates change slowly. A fast rise in value, which adversely affects exports, may be met with Central Bank intervention, as has often been seen in the Japanese yen. This makes for a bumpy price pattern. Because exchange rates are quoted in terms of other currencies, everything must be viewed as relative to another economy.

- *Agricultural products (crops)* contain a well-defined carrying charge within each crop year, which begins at the end of harvest. Expected variations in both supply and demand have made delivery month patterns differ from one another; however, prices rarely achieve *full carry.* Spreads are typically entered in the new and old crop deliveries which will show the greatest separation. Increased supply from South America has affected the patterns during the winter months in the northern hemisphere, a time when demand and supply have historically been fragile.

- *Livestock* markets are noted for products that cannot be stored and redelivered; therefore, the prices for any one contract month are based on anticipated supply and demand at the time of delivery. Feedlots and farmers have been known to deliver early when prices were high or when production costs were rising; however, this will cause an irreplaceable shortage in the nearest deferred months (Figure 13.1).[1] Patterns in delivery months are a combination of the number of livestock on feed, expectations of marketing, and the price of grain.

Figure 13.1: Interdelivery price relationship and terminology. (a) Precious metals. (b) Industrial metals. (c) Foreign exchange. (d) Agricultural products. (e) Interest rates.

[1]Perry J. Kaufman, "Technical Analysis," in Nancy H. Rothstein (Ed.), *The Handbook of Financial Futures* (McGraw-Hill, New York, 1984).

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SPREADS IN STOCKS

In the stock market, spreads are actively traded in related companies.

- *Pairs trading*, which is buying one stock and selling short another in the same business, such as Verizon and Sprint, will profit from the competitive advantage of one firm over the other while removing the directional risk of the overall market.
- *Dividends versus Treasury yields* are an important benchmark for investors, who are always seeking the highest return. Most public utilities are in direct competition for low-risk investments targeting interest rate income. When Treasury yields become extremely low, as they did in early 2003, investors are willing to take greater risk to receive higher returns and begin looking for stable companies with high-dividend returns. When Treasury yields are very high they draw investments away from many other vehicles, including the stock market.
- *Cross-market spreads* will take one position in a stock that is highly dependent upon a physical commodity, such as a precious metal or oil, and the other in the futures market for that commodity.

Globalization

Globalization has increased the correlation in the financial markets of the world. Countries all compete for investment dollars (or euros, yen, and especially the Chinese yuan). Higher interest rates and a strong economy in the U.S. would put pressure on Europe to raise its rates or suffer a shift of funds away from the Euro into the dollar. A weak U.S. economy has a ripple effect on many of the world economies because the U.S. is an extremely large importer.

Technology facilitates globalization. Information about U.S., European, or Asian economic reports are disseminated instantly. When the U.S. government releases its reports, often at 8:30 A.M. Eastern Time, the world knows those statistics by 8:30:05. It is fair to say that the world reacts at the same time to these reports. Electronic trading, which allows 24-hour access in many markets, provides the means for price discovery and speculation.

Globalization has greatly increased the number of opportunities for spreading markets. We can expect the European interest rates to fall if the U.S. lowers its rates. We can expect the U.S.$/euro exchange rate to fall if the European economic growth is stronger than U.S. growth. The meetings of the *Group of 7* ("G7") further increases the chance of a unified policy by setting common expectations for interest rates and exchange rates among the largest economies. While there is a clear dependence of one market on the other, the effects are highly variable. Because these relationships are still relatively new and may be changing, there is great opportunity in spreads that span world markets.

Spreads are often unique to a specific market situation and cannot be generalized. The trader must first understand the basis of the spread relationship before any technical analysis can be applied. It is most important that a trader understand the conditions under which a spread, or even an arbitrage, will fail. This chapter presents many approaches to spreading that are very specific; examples are equally limited in scope and application.

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SPREAD AND ARBITRAGE RELATIONSHIPS

The relationship between two markets, or between various deliveries and trading vehicles within the same market, will determine the type of trading strategy that may be applied. The types of spreads and arbitrage situations that are most often watched are:

1. *Substitute products*, such as wheat and corn or cattle and hogs. Product substitution ranges from those markets that are nearly identical (e.g., 3-month T-bills and 3-month Eurodollars), to cotton and soybeans, which share the same land and growing season.

2. *Location spreads*, including gold in New York, Chicago, and London, cocoa and heating oil (gasoil) in New York and London. The price at one location should never be greater than the cost of moving the product from another location.

3. *Carrying charge spreads* and *cash and carry*, where one delivery month is out of line with others based on the cost of storing the physical product and redelivering it at a later date.

4. *Product relationships*, such as crude oil versus heating oil and gasoline, and soybeans versus soybean meal and oil. Costs for converting the raw material to its component products define relative prices.

5. *Usage spreads*, including the hog—corn ratio, feeder cattle—corn—fat cattle, cocoa—sugar, broilers—corn, and lumber—plywood. If the cost of corn increases, then the cost of livestock increases. If the market will not absorb the higher-end product cost, as determined by deferred futures prices, then livestock is brought to market early.

6. *Pure mispricing in financial markets*, such as different exchange rates offered by different banks around the world, and interest rates of the same maturity and the same grade, where there is no actual cost of delivery or carrying charges.

7. *Interest rate strips*, where pieces of varying interest rate maturities are put end-to-end and must be equivalent to the comparable rate offered on longer-term maturity.

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RISK REDUCTION IN SPREADS

As long as there is some fundamental relationship between the two markets being spread, *A* and *B*, the resulting spread return stream will be less volatile than the average volatility of the two spread components. In mathematical terms, the variance of the spread is

$$Std_{A,B}^2 = Std_A^2 + Std_B^2 - 2 \times Cov_{A,B}$$

where *Std* = the standard deviation
Cov = the covariance

When the two components of the spread are more closely related, they vary in the same way at the same time, and the covariance increases. This in turn reduces the variance of the spread. Covariance is calculated by first finding the differences between the corresponding prices and their average values, multiplying them, and finding the average over period *N*.

$$Cov_{A,B} = \frac{1}{N}\sum_{i=1}^{N}(A_i - avg_A)(B_i - avg_B)$$

It is easy to compare the risk of the spread with the risk of the individual markets using a spreadsheet. Put the prices of market *A* in column *A*, the prices of market *B* in column *B*, and the spread difference or ratio in column *C*. Calculate the standard deviations for all of the values in each of columns *A*, *B*, and *C*, and simply compare them. The stronger the relationship between *A* and *B*, the smaller the standard deviation of *C*.

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ARBITRAGE

When the two legs of a spread are highly correlated and therefore the opportunity for profit from price divergence is of short duration (less than 1 or 2 days), the trade is called an *arbitrage*. True arbitrage has, theoretically, no trading risk; however, it is offset by small profits and limited opportunity for volume. For example, a *spacial arbitrageur* using the Interbank market might call one bank in Tokyo and another in Frankfurt to find their rates on the Mexican peso. If they differ, the trader would buy the peso from one bank and sell the peso at another provided:

- The price difference was greater than the bid—asked spread, representing the cost of converting the currencies.
- The arbitrageur has proper credit established with both banks.
- The transaction can be performed *simultaneously* (by telephone). This requires one trader with a telephone in each ear or two traders working side by side.
- If banks make a market electronically, then arbitrage of rates between banks can also be done automatically.

Large-scale arbitrage has become the domain of major financial institutions that employ many traders, each provided with high-tech computer displays, sophisticated analytic software, and lots of telephones. These traders specialize in specific interest-rate markets, foreign exchange, individual stock selection, or less often, precious metals. They constantly scan quotes from across the world to find price differences, then act quickly using cash, forward, and futures markets. They trade large quantities to profit from small variations. For the interest rate markets, there are computer programs that compare the various types of coupons and maturities in order to identify an opportunity quickly. Such operations have become an integral part of the financial industry; they keep prices in-line around the world and generate steady profits.

Pricing of Futures Contracts

The relationship of one futures market delivery month to the spot price of that market is different according to the type of product, which has already been described in general terms. The mathematics of some of these relationships can become very complex, and the reader is referred to texts that deal specifically with these subjects.[2] The following sections describe the most important features of these relationships.

Storable Commodities

Storable commodities can be purchased in the cash market, stored, and sold at a later time. Storable commodities range from gold to grain, from crude oil to orange juice. They can be delivered at the maturity of a futures contract, held in storage, and redelivered against another deferred contract. This puts an upper limit on the amount of the carrying charges that can be implied in futures prices. The difference in cost between holding the physical commodity and buying it on the futures market are:

- The financing cost involved in the purchase of the physical commodity:

  $$\textit{Added interest cost} = \textit{Spot price} \times ([1 + \textit{Interest rate}]^{\text{Life of futures contract}} - 1)$$

  where *Life of futures contract* is expressed in years, and *Spot Price* is the nearest futures delivery price or the cash price.
- The cost of storage, if any.
- A convenience cost for not buying the physical product, and the ability to be able to sell it at any time.

These three costs are added to the futures spot price to get the fair value of the futures price at the time of delivery. The two strategies that create an arbitrage that keeps the cash and futures prices aligned are:

- Method 1: Buy the futures contract for F, taking delivery at expiration. The margin cost can be collateralized. The net cost is F.
- Method 2: Borrow the cost of the cash commodity S (the nearest futures delivery) and buy the cash product; pay the interest, $S([1 + r]^t - 1)$, storage net of convenience cost, $S \times k \times t$, until the corresponding futures market delivery at price F.

The two methods must have the same net cost, otherwise everyone would choose the cheaper alternative. Therefore the two strategies are equal, and form the basic arbitrage relationship between futures and spot prices:

$$F = S + S([1 + r]^t - 1) + Skt$$
$$= S([1 + r]^t + kt)$$

where F = the futures price
S = the spot (cash) price
r = the annualized interest rate

t = the life of the futures contract (in years) from today to the time of delivery

k = the net annual storage cost (expressed as a percentage of the spot price)

This relationship represents the ideal case. If you add more realistic features, including a separate borrowing and lending rates, r_b and r_a, where $r_b > r_a$, and assume that the short seller cannot recover the saved storage costs and must pay transaction costs, t_s, as well, you get a normal range in which futures prices can fluctuate:

$$(S - t_s)(1 + r_a)^t < F < S([1 + r_b]^t + kt)$$

When futures prices move outside this range, there is an opportunity for arbitrage.

Interest Rate Parity

One well-known, second-order arbitrage combines foreign exchange forward rates with interest rate parity. Consider a U.S. corporation that would like to invest $1 million for the next 6 months. The current U.S. T-bill return for the next 6 months is lower than the rate in Europe and the inflation rate is about the same. The corporation is faced with the decision of whether to convert U.S. dollars to euros and invest in European time deposits or accept the lower U.S. rates. The decision is made easier if the corporation purchases goods from Germany, since it must eventually convert U.S. dollars to euros to satisfy payments; the conversion cost will then exist with either choice.

What if the value of the euro loses 1% against the U.S. dollar during the 6-month investment period? A corporation whose payment is stated in euros suffers a 1% loss in the total interest received. If the 6-month return was 4%, interest received is now valued at $400 less than the $40,000 total, a small amount for the corporation making payment in euros. A speculator would face a different problem because the entire return of $1,040,000 would be reduced by 1% to $1,029,600 netting a return of only 2.96%, less the additional cost of conversion. For the speculator, shifts in exchange rates often overwhelm the relative improvement in interest rate return.

The *interest rate parity theorem* will normally explain the differences between the foreign exchange rates and the relative interest rates of countries. It states that *the forward rate of a currency is equal to its present value plus the interest earned in that country for the period of the forward rate.*[3] Using the futures or Interbank market for the forward rate (EUR_{1yr} is 1-year forward) and the spot rate for the current value (EUR_{spot}), the annual interest rate in the European Community (I_{EC}) is applied to obtain the relationship

$$EUR_{1yr} = EUR_{spot}\,(1 + I_{EC})$$

Because the forward value of the U.S. dollar can be expressed similarly as

$$USD_{1yr} = USD_{spot}\,(1 + I_{US})$$

Compute the *implied interest-rate/forward-rate parity* by dividing the first equation, EUR_{1yr}, by the second, USD_{1yr}:

$$USDEUR_{1yr} = USDEUR_{spot}\,\frac{1 + I_{EC}}{1 + I_{US}}$$

If you were using the EURUSD rate instead of USDEUR, you would divide the U.S. rate by the EC rate. For example, if U.S. interest rates are 4%, European rates are 6%, and the current exchange rate $USDEUR_{spot}$ is 1.165, the 1-year forward rate would be

$$USDEUR_{1yr} = 1.165 \times \frac{1.06}{1.04}$$

$$USDEUR_{1yr} = 1.187$$

The forward exchange rate of 1.187, higher than the current rate, is entirely based on the rationale that higher yields in the EC will attract more investment and further weaken the U.S. dollar. Any difference between this calculation and the actual forward exchange rate available in the market is based on anticipation of other factors.

Crossrate Matrix Evaluation

Given the large number of currency exchange rates that can be quoted in terms of any other currency, there are many combinations of rates that might provide an opportunity for arbitrage. The process for uncovering those inconsistencies that offer opportunity is easier if you put all of the rates into a table format often seen in the newspapers (see Table 13.1).

Table 13.1: Major Crossrates As of October 17, 2003

Open table as spreadsheet

	USD	GBP	JPY	EUR
U.S.	—	0.5972	109.55	0.8597
UK	1.6746	—	183.43	1.4397
Japan	0.009128	0.005452	—	0.007815
Euro	1.1632	0.6946	127.395	—

Reading down the first column of Table 13.1, *USD*, the numbers represent the amount of U.S. dollars needed to buy 1 British pound (1.6746), 1 Japanese yen (.009128), and 1 euro (1.1632).

If we call the table of crossrates *T*, then every crossrate in *T* is related to every other crossrate according to:

$$a_{ij} \times a_{jk} = a_{ik}, \text{ for all } i, j, k$$

where the first subscript is the row, the second is the column, and each value of *a* represents an element in the table, with a_{ji} representing currency *i* in terms of currency *j*. Therefore, values in the table are expressed as column-row rates, such as USDGBP column 1, row 2, or EURJPY in column 4, row 3. The top right triangle of the table is exactly the inverse of the lower left part, and can be calculated as:

$$a_{ij} = 1 / a_{ji}$$

Any two rates in table *T* can be multiplied together to get a third rate,

$$a_{ij} \times a_{mn} = a_{in}$$

As an example in Table *T*, multiply $a_{41} \times a_{12} = a_{12}$. Then a_{41} = 1.1632, a_{12} = .5972, and a_{12} = .6946, the product of 1.1632 × .5972, proving that the crossrates in table Tare correct.

The difference between the implied interest-rate/forward-rate parity and the current forward prices may offer arbitrage opportunities. Using the same crossrates in Table 13.1, we can find the forward rates for March 2004 delivery and the current three-month Libor rate, shown in Table 13.2. These periods do not correspond correctly but are convenient for an example.

Table 13.2: Current Libor Rates, Forward Rates, and Forward Rate Calculations

Open table as spreadsheet

	Current 3-Month Libor Rates	Mar-04 Forward Rate	Forward Calculated Rate	Opportunity Differential (in %)
U.S.	0.0117			
UK	0.0377	1.653	1.7176	3.91
Japan	0.0005	108.897	110.7763	1.73
Euro	0.0218	1.1604	1.1748	1.24

To get the forward rate for the *USDEUR* based only on the interest rate differentials, use the previous formula

$$USDEUR_{\text{forward}} = 1.1632 \times \frac{1 + .0218}{1 + .0117}$$

$$USDEUR_{\text{forward}} = 1.1748$$

This value appears in Table 13.2 under the column *Forward Calculated Rate.* The differential between the forward rate actually traded in the market, 1.1604, and the rate based solely on interest rate differences is 1.24%, with interest rates implying that the forward rate should be higher than it is currently priced. Then the market is anticipating lower prices not reflected in this calculation. In the three cases shown, all calculated values yield higher rates (a stronger GBP and EUR, and a weaker JPY relative to the USD) than the market price. Using accurate values for this calculation would indicate an arbitrage opportunity for buying the spot and selling the forward.

Class B Arbitrage

To facilitate the process of keeping prices aligned, there is *Class B arbitrage*, which takes advantage of the difference between the futures and the Interbank forward markets. *Class B* actually refers to the category of membership on the International Monetary Market of the Chicago Mercantile Exchange, which provides exclusively for this type of arbitrage.

Institutional Arbitrage

Arbitrage is most often associated with institutional trading. Because profits on individual positions are small, it is necessary to trade large numbers; hence, the capital requirements can be equally large. The most well-known of all arbitrages is called *program trading*, the process by which a stock index futures market and the cash index (the weighted average of the actual stock prices) are kept in the proper relationship to one another.

Program Trading

There is nothing secret about program trading. The premise is that cash and futures prices will come together (to within a small price difference) by the time the futures contract expires. At that time the buyers and sellers must settle in cash at the current cash market value. If the difference between the cash and futures price exceeds the cost of trading plus a profit, then the two markets can be arbitraged. A profit in the trade, *P*, is

$$P = |C - F| - C \times r \times t - E$$

where
- C = the cash price of the stocks
- F = the price of the futures index
- r = the annualized interest rate
- t = the time to maturity in years
- E = the execution cost

For a successful trade, P must be greater than some value that makes it worth trading.

Program trading may also be triggered when futures prices differ from fair value by a sufficient amount to be profitable. The *fair value* is the price at which cash and futures will converge at delivery based on today's values.

$$\textit{Fair value } (FV) = C \times [1 + (r - D) \times t]$$

where D = the annualized dividend payment

In addition to accepting a small differential between cash and futures at the time of delivery, you must know:

- The transaction costs of executing both the stock and futures side of the trade. This includes both commissions and an estimated slippage for each of the stock issues that must be bought.
- Because of the *up-tick rule*, the trade is much more practical when futures are above cash so that futures are sold and stocks are bought. The up-tick rule requires that stocks only be sold on an up-tick, which makes it impossible to guarantee that short positions can be entered in each stock, how much can be sold, or that the trade can be completed in a reasonable time. It can be done, but it is very difficult and may require some imaginative variations.

Program trading can work for any index traded as futures, which includes the 30 Dow Industrials, the S&P 500, the Russell 2000, small caps, and even sectors. Trading the larger index futures, such as the S&P 500, involves large cost for setting a position in all of the 500 stocks that comprise the Index. There is also competition from other institutions. This limits the profit potential of the trade to the smallest acceptable amount over the break-even level.

Program trading is separated into buying programs and selling programs. A *buying program*, the easier of the two, buys stock and sells futures when the difference is profitable. A *selling program* sells stocks and buys futures, a difficult implementation because of the up-tick rule for U.S. stocks. Adding more realistic assumptions of distinct borrowing and lending rates, r_b and r_s, made in the basic futures arbitrage discussed earlier, plus separate execution costs for buying stock E_b and selling short E_s, the *fair value at delivery* can vary within the band:

$$(C - E_s)[1 + (r_b - D) \times t] < FV < (C + E_b)\,[1 + (r_s - D) \times t]$$

Finding a Representative Subset of an Index

An arbitrage would be much easier and less costly if there were a smaller group of stocks or futures markets that performed the same as the entire index. If the index is weighted by capitalization, volatility, or some other characteristic, then sorting the components of the index in order of largest capitalization or highest volatility would allow you to find a reasonable subset. In the case of capitalization, it is likely that a smaller group of stocks would represent 90% of the index value; therefore that subset would perform in a way very similar to the index. While the S&P 500 is comprised of companies that all have relatively high capitalization, many of the index markets for countries with smaller economies will be dominated by a few large companies. Sector index markets will also show greater variation because they include companies of varying capitalization.

Another approach to finding a subset of markets that closely tracks the index value is by using step-wise regression, inputting all of the markets that compose the index, and examining the weighting factors assigned to each in the answer. Those markets with the highest weighting factors are the most significant in the movement of the overall index. By creating a smaller basket from those markets with the highest weighting factors, you can achieve a close approximation of the index with fewer components—at least temporarily. The influence of the components may change, causing the weighting factors to change; therefore, the regression would need to be rerun frequently, and the basket adjusted, to stay aligned with the index. Unless you are sure that the subset of the index that represents 90% of the total index will continue to reflect the index movement until expiration, you have added risk to an arbitrage that is intended to be nearly riskless.

Single Stock Futures and the Underlying Stock

Single stock futures allow you to buy or sell a stock for future delivery or cash settlement. The advantages of single stock futures is the lower cost of holding a position and the ability to go short without the restriction of the *up-tick rule*, which requires that all short sales (new short positions) be initiated on an uptick to avoid pressuring prices lower.

A natural arbitrage is created with single stock futures, and that arbitrage keeps the futures price from drifting away from the cash price, which is the current price of the stock being traded on the NYSE, Nasdaq, or any other exchange. The decision to enter this spread is the same as for program trading. The price discrepancy must be large enough to allow a profitable trade. For example, if the cash price of IBM is $120, interest rates are 3%, and IBM's dividend yield is 1%, it would cost the trader $120 × .03, or $3.60 in lost interest to purchase the stock.[4] The trader also expects to receive $1.20 from dividends over the life of the trade ($120 × .01). Ignoring interest on the dividend payment, the price of the futures contract should be

$$\textit{Single stock futures price} = \textit{Stock price} \times e^{rt} - \sum_{i=1}^{N} \textit{Dividend} \times e^{r_i t_i}$$

where r = the interest rate

r_i = the forward interest rate over the partial year t

The price of IBM futures should be $120 + $3.60 - $120 = $122.40; therefore, if the difference between the cash price of IBM and the single stock futures price varies because of strong selling concentrated in the cash market, you can buy the cash and sell futures until the fair value is restored. For example, if IBM is trading at $119 on the NYSE and the nearest futures is at $123, you can buy 100 shares and sell 1 futures contract (equal to 100 shares). If the markets settle at $120 and $122.40, respectively, you will have a gain of [($120.00 - 119.00) + ($123.00 - $122.40)] × 100 = (1 + .60) × 100 = $160, less commissions.

When trading in a foreign market, for example, a U.S. investor trading the Nikkei 225 Index, the theoretical value of the futures price in t years (where 3 months would be t = .25) would be

$$\textit{Futures price} = (1 + r_J - d_J)^t \times \textit{Cash price}$$

where r_J = the short-term interest rate in Japan

d_J = the average dividend yield on the Nikkei, in decimal format

Intermarket Index Spreads

The propagation of financial and stock index futures markets have expanded the number of markets that are interdependent upon one another. Prior to the influx of financial markets, product substitution (hogs and cattle, feedgrains) and location spreads were the most common activity; silver in New York, London, and Chicago, and gold in New York and Chicago received much attention. Now there are a large number of interest rate markets of all maturities in many countries, and stock index markets attempting to measure high cap, small cap, and sectors, as well as the old favorites, the S&P 500 and the DJIA. Every country seems to have introduced its equity index into the marketplace, all with the idea of competing for their share of hedgers and speculators.

Spreading two stock indices expresses a particular market opinion. If you consider four popular indices—the DJIA, S&P 500, NYSE Index, and the Russell 2000—we see that each represents a different picture of the business economy. The DJIA, limited to 30 very large companies, and weighted by price, is viewed as being the safe haven of stocks. When the economy is not robust, investors move to these very strong companies which traditionally pay competitive dividends. The S&P 500 is a broader view of high-cap stocks, offering more diversification but still viewed as safe. The NYSE Index is the average of all shares and expresses the broadest view of the economic health. If you believe that the economy is headed for a downturn, but do not want to be net short the entire market, then a spread which is long the Dow and short the NYSE Index would be a lower-risk approach to implementing that position. The Russell 2000 is a small-cap index, representing the weakest part of the market during a poor economy but often the first to recover as a bear market comes to an end.

Figure 13.2 shows the four index futures from August 2002 through September 2003, the end of the bear market that began in January 2000. It is very difficult to see the differences between the first three index markets, DJIA, SP, and NYSE without creating a ratio chart, shown in Figure 13.3. The Russell 2000, the bottom panel of Figure 13.2, does have some obvious differences, although it is difficult to identify the pattern simply from the price chart.

Figure 13.2: Major Index futures markets. From top to bottom—Dow Industrials (DJ), S&P 500 (SP), NYSE Index (YX), and Russell 2000 (RL).

Figure 13.3: (a) Ratio of S&P 500 to Dow Industrial. (b) Ratio of S&P 500 to Russell 2000.

Creating a Ratio Chart

To see the differences in two markets, a *ratio chart* can be created that divides the price of one index by another, giving the percentage change between the two. In Figure 13.3a the ratio of the S&P 500 and the DJIA varies from 104 to 110, with a midpoint of 107, a range of about 6%. Considering the very different ways that these index values are calculated, this is a narrow range. Of course, all of the Dow components are also in the S&P 500; therefore, there should be a similarity between the two. Because they represent the same set of stocks, the ratio would normally be traded as *mean reverting*, buying the lower and selling the higher, expecting prices to return to the midpoint.

The S&P 500 and the Russell 2000 each represent a different group of markets, the high caps and the small caps, and these stocks are attractive to investors at different times. In the bottom panel of Figure 13.3 the declining ratio of SP to RL shows that the Russell has been much stronger since April 2003. It is a sign that investors are comfortable with the market and will put their money in stocks that have higher risk. Because these markets represent a change of investor sentiment, the trend of ratio would normally be traded by selling the S&P and buying the Russell at a time when an economic recovery was expected, or when safety is not a concern.

Pairs Trading

Pairs trading uses the ratio technique just discussed applied to two closely related stocks. This is also called *statistical arbitrage (*stat arb*)*, mathematically-based trading that seeks to buy an undervalued but highly related stock, and sell another in anticipation of the two prices converging. Because of the similarity in the price movements, the ratio chart would normally be applied to intraday data and the trades expected to be held from 2 to 5 days. Short-term trading avoids the influence of a long-term trend in the stock that will cause prices to drift apart. Candidates for pairs trading would be competitive telephone services, such as Verizon, SBC, and BellSouth. All three are actively traded and react to the same news. Figure 13.4 shows the price series for Verizon (VZ) at the top, and prices for BellSouth (BLS) in the center. The bottom panel is the ratio of VZ to BLS.

Figure 13.4: Pairs trading using a ratio chart of Verizon and BellSouth.

This 4-year chart of the two telephone companies shows that the price of Verizon has traded at a premium of 30% to BellSouth (the horizontal line in the lower panel is at the ratio of 1.30). While prices have varied from that ratio, they have always come back to that point. Over time, one of the two companies will be more successful than the other, and the ratio will change; therefore, a shorter-term view of the ratio changes will have less risk. Over a period of only a few days, the ratio may swing between ±10% rather than ±30%.

To help find more flexible buy and sell points for the ratio, some traders will use the equivalent of a Bollinger band, 2 standard deviations on either size of a 20-bar moving average. This would work particularly well for an indicator that is fundamentally mean reverting. Another method uses a slow stochastic oscillator to identify relative overbought and oversold levels in the ratio. Either of these indicators adapts to volatility. Note that pairs trading is also limited by the size of the short position that can be entered and the up-tick rule. Shorts should be set first, then the long side should be entered to match the size of the short sale.

Stock and Futures Relationships

When a listed company has a highly focused business dependent upon one or more physical commodities, it can be helpful to view both the price of the stock and the price of the commodity at the same time. As an example, Figure 13.5 shows the price of gold futures along with the share price of Barrick Gold (ABX), a mining company.

Figure 13.5: Barrick Gold (ABX) compared to physical gold prices.

Through January 2000 both gold and ABX decline then rally at the same time. The price pattern begins to diverge in April 2000 as gold continues to decline, but the price of Barrick shares rallies to reach the previous high of $20. It is certainly possible that Barrick has improved its operating margins, developed a new, efficient processing method, or done something outside of the norm to bolster the stock price. However, by October 2000 the price of gold had dropped 17% from its highs and ABX had fallen 30%. The usefulness of the physical commodity-share price spread depends on the lack of diversification within the company.

Product Spreads

Product spreads take advantage of the relationship between the raw product and the results of processing that product. They are very actively traded. The *soybean crush* and the *energy crack* spreads are the most popular among futures traders and commercials, and have been used for decades. Product spreads usually involve three markets, which may be of different delivery months, depending on the processing time. The most common product spreads are:

Open table as spreadsheet

Raw Product(s)	Resulting Primary Product(s)
Soybeans	Soybean meal and soybean oil
Crude oil	Gasoline and #2 heating oil
Feeder cattle and grain	Fat cattle
Feeder pigs and corn	Live hogs
Live hogs	Pork bellies

Exchanges often allow reduced margins when these spreads are entered in the proper proportion at the same time.

The Soybean Crush

Typically, the product spread is viewed from the perspective of the processor. A. E. Staley or Archer, Daniels, Midland (ADM) will buy soybeans, crush them into meal and oil, then sell the products. You would expect the combined cost of the final products to be greater than the cost of the soybeans plus a margin of profit (the *Gross Processing Margin*). Due to processing time, the crush relationship should be reflected in the current soybean price and the deferred product prices. When the gross processing margin is applied to futures prices it is called the *Board Crush*.

Processing one bushel of soybeans weighing 60 pounds yields 11 pounds of soybean oil and 44 pounds of 48% protein soybean meal, 3 pounds of hulls, and 1 pound of waste. Then

$$GPM = .022 \times Soybean\ meal + 11 \times Soybean\ oil - Soybeans$$

where meal is expressed in dollars/ton, oil in dollars/pound, and soybeans in dollars/bushel, the same units as the futures contracts. The exact ratio for trading would be 10:11:9 (soybeans:meal:oil); however, most traders use 1:1:1. Applying this to the current prices of November soybeans and December meal and oil on October 22, 2003, the GPM becomes

$$GPM = .022 \times 240.30 + 11 \times .2669 - 7.625$$
$$= .5975$$

Therefore, the GPM is nearly 60¢/bushel.

When the combined return on soybean meal and oil is below the cost of crushing the soybeans, processors may execute a *reverse crush* spread, in which they sell the soybeans and buy the products. Even though this appears to be a clever way of keeping prices inline, it is not done until the crushing margin is very negative. Processors cannot readily reduce their level of operation and lay off employees; a reverse crush means that they are buying products as well as producing them—a position of significantly increased risk.

The Crack Spread

Crude oil is refined primarily into gasoline and heating oil. As with the soybean crush, where the processor buys soybeans and produces meal and oil, the refiner expects a profit from the business of buying crude oil and selling gasoline and heating oil. A speculator can theoretically participate in this process by buying crude oil and selling the products in the right proportion and in the correct delivery months. For example, if crude oil were trading at $20 per barrel, heating oil at 52.40¢ per gallon, and gasoline at 59.50¢ per gallon, then based on futures contracts of 1,000 barrels of crude and 42,000 gallons of heating oil and gasoline, we could calculate each contract value:

Gasoline component:	59.50 × 42,000	=	$24,990
Heating oil component:	52.40 × 42,000	=	$22,008
Total components:			$46,998
Crude oil component:	20.00 ×1,000	=	$20,000

Two other important facts are necessary in order to put this trade together:

1. It takes from four to six weeks to refine crude oil into its products; therefore, the prices used in the crack spread should always take the product prices quoted one month after the crude price.
2. While the refining ratios can vary during the year, based on the higher demand for gasoline in the summer and the higher demand for heating oil in the winter, the standard ratios are found in Table 13.3.

Table 13.3: Fuel Oil and Gas Production and Ratios, 1984–1992

Open table as spreadsheet

	Fuel Oil			Gases				Gas/Fuel Oil Ratio
	Distillate	Residual	Total	Gasoline	Jet Fuel	Kerosene	Total	
1984	981	326	1,307	2,371	414	42	2,827	2.16
1985	981	322	1,303	2,352	434	34	2,820	2.16
1986	1,021	324	1,345	2,476	472	33	2,981	2.22
1987	997	323	1,320	2,506	490	29	3,025	2.29
1988	1,046	339	1,355	2,555	501	29	3,085	2.28
1989	1,152	500	1,652	2,684	544	31	3,259	1.97
1990	1,067	347	1,414	2,650	556	16	3,222	2.28
1991	1,081	341	1,422	2,554	525	14	2,820	1.98
1992	1,088	326	1,414	2,591	512	15	3,118	2.20

Source: The CRB Commodity Yearbook, 1994, John Wiley & Sons, 1994.

Although there are many other byproducts of the refining process, the major components of fuel oil and gasoline are produced in a ratio of slightly more than 2 parts gasoline to one part fuel oil on average each year. This ratio then accounts for the 3-2-1 crack spread, where 3 contracts of crude oil are bought, and 2 contracts of gasoline and 1 contract of heating oil are sold. In the example above, we can complete the net transaction as follows:

Open table as spreadsheet

	Market	Price		Quantity		Unit Value		Units		Total Cost
Sell 2	Gasoline contracts	59.50	×	42,000	=	$24,990	×	2	=	$49,980
Sell 1	Heating oil contract	52.40	×	42,000	=	$22,008	×	1	=	$22,008
Buy 3	Crude oil contracts	20.00	×	1,000	=	$20,000	×	3	=	$60,000
Net transaction (without costs)										$11,998

Transaction costs will include execution slippage, buying crude oil higher and selling products lower than desired when the trade is entered, commissions, and the cost of holding the contracts until delivery (margin deposit).

Reverse Crack

Similar to the reverse crush, when the delivered price of the products total to less than the cost of crude oil, the refiner has no reason to process the crude oil, and can go to the market to buy the products and sell crude. This is called a *reverse crack*. In reality, processors can perform a reverse crack to some degree, but shutting down operations to accommodate a temporary market condition is not a good policy. The process of shutting down and restarting a large refinery is not simple, and labor problems make matters more complicated. When executing a reverse crack, the same delivery months are used for both crude and products.

Intercrop Spreads

A special case involving carrying charges is the *intercrop spread*, which can be highly volatile, even though there is an old crop inventory *carry-over* that ties the two seasonal markets together. Soybeans, for example, are harvested mainly in September and October. The August delivery is clearly the old crop, and November is the first new crop month; the September contract often reflects the shift from old to new.

Normally, the old crop trades at a premium to the new crop. Carrying charges, accumulating since the previous winter, are part of the August price; export demand may cause shortages in the old crop, which move prices further above the cost of carry. Figure 13.6a shows the anticipated price pattern resulting from carrying charges during a normal year. The minimum storage commitment for the 3 months immediately following harvest is shown as a larger increase in price. Normal carry adds equal amounts to the price until the following September, where old and new crop mix. Finally, any carry-over must assume the price of the new crop, which is in greater supply.

Figure 13.6: Intercrop spreads. (a) Normal carrying charge relationship. (b) New crop supply problems result in narrowing spreads. (c) Export affects the old crop more than new, resulting in a widening spread.

The theory behind an intercrop spread is that prices must come together when the old crop merges with the new crop. But can it be a profitable trade? Examine the two possible events which affect this trade:

1. Problems involving development of the new crop making supply uncertain. This causes prices in the new crop to rise faster than the old crop (Figure 13.6b).
2. Export demand in the old crop results in old crop prices rising faster than new crop prices (Figure 13.6c).

In Case 1, the spread between crops narrows and can only be traded as a spread that is *short the old crop, long the new crop*. This spread has limited potential since the November delivery cannot exceed the old crop by more than the normal carrying charge. At that point, processors will buy, store, and redeliver the old crop against the new crop. When prices in the new crop are nearing the old crop value, it makes sense to liquidate or even to reverse the spread. Once reversed, there is little risk that the spread can move adversely. A revised crop estimate that showed better yield than originally expected would cause the new crop to decline sharply and the spread to widen.

In Case 2, export demand in the old crop causes the intercrop spread to widen at first. A spread trader will typically wait until export commitments are complete, then sell the old crop and buy the new. When old crop prices rise to a large premium over the new crop, many processors will reduce

purchasing based on:

- Low or negative profit margins at the current price levels.
- Use of reserves or inventory to carry processing through until the lower new crop prices are available.

It is remarkable how demand is inversely related to price even when it is considered *inelastic.* When a delay in purchasing or processing will result in greater profits for the commercial, that delay is somehow achieved.

Butterfly Spreads

A *butterfly spread*, normally referred to as just a *butterfly*, is a low-risk technique for capturing short-term price distortions between delivery months in the same futures markets. It is best in highly volatile markets, where the concentration of trading in one or two delivery months causes those contract prices to move away from the normal delivery month relationship. These distortions occur often in the week before the nearby futures contract when large positions holders, such as fund managers, roll from the nearby month to the next delivery. Opportunities most often exist during the trading day; however, setting a butterfly is the same whether looking at intraday or closing prices.

For example, in April a combination of poor planting, declines in the U.S. dollar, and new export agreements changes the soybean prices as shown in Figure 13.7. Increased demand results in sharply higher July futures prices with a tapering-off of the effect in the more deferred contracts. The normal carrying charge relationship is shown as a straight line in the old crop, beginning again in the new crop. A butterfly entered in the old crop would mean selling two contracts of July soybeans and buying one contract each of May and August. This is the same as executing two spreads: long May, short July, and short July, long August.

Figure 13.7: Delivery month distortions in the old crop making a *butterfly spread* possible.

Each spread in the butterfly has a good chance of being profitable; the combination of the two is exceptionally good. The July contract cannot remain out of line with the deliveries on both sides because a trader could take delivery of the May contract and redeliver it in July at a profit exceeding the cost of carry. Under normal circumstances, commercial users of soybeans will defer their purchases to later months, depleting their reserves, to avoid paying a short-term premium and causing July prices to drop.

The butterfly spread guarantees that any adjustment in the three contracts back to a normal relationship will prove profitable. If the price of both May and August rise to be in-line with July or if May rises to form an inverted relationship, the spread will be profitable (Figure 13-8).

Figure 13.8: Corrections to interdelivery patterns.

The problem with such an ideal spread is the short window of opportunity and difficulty executing both legs at the right moment. Because profits are nearly riskless, opportunity is small. The beneficiaries of these trades are usually the floor traders who can act quickly. Once the position is entered, liquidation can be easily accomplished. Another common problem for those attempting butterfly trading from screen prices is that lack of trading in the deferred months may appear to be a distortion. Prices may be bid or asked at the correct level, but not traded. If the bid-asked prices do not show on your screen, then the last traded price that is out of line may be a false opportunity.

[2]See Aswath Damodaran, *Investment Valuation* (Wiley, New York, 1996, pp. 448–458), which provided the basis for these formulas; also see Marsha Stigum, *Money Market Calculations* (Dow Jones-Irwin, 1981).

[3]James E. Higgens and Allen M. Loosigian, "Foreign Exchange Futures," in Perry J. Kaufman (Ed.), *Handbook of Futures Markets* (Wiley, New York,

1984).

[4]Kenneth Kapner and Robert McDonough, "Doing Your Homework on Individual Equity Futures," *Futures* (March 2002).

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CARRYING CHARGES

The *carrying charge* structure of a market determines the underlying differences in the relative price of each contract and the price pattern of the delivery months. For metals and most storable commodities, these charges consist of interest, storage costs, and insurance. All else being equal, a market with *normal carry* can be expected to show steadily higher prices for deferred contracts based entirely on the cost of carry. Prices that move out of line, where the nearby is unusually inexpensive, may be corrected by taking delivery of the nearby and redelivering against the next contract.

It is always possible for changes in supply and demand to alter the relationship of futures contracts so that the carrying charge pattern no longer appears normal. Although this is not likely to occur in the metals, it often happens that an immediate demand for food can cause short-term increases in prices without substantial effect on more deferred months. This situation is called an *inverted market*, *negative carry*, or *backwardation*, even though the carrying charges are implicit in the price regardless of the pattern.

In the financial markets, a similar situation occurs when the demand for money increases dramatically in the short term. If the market expects that the demand will be short-lived, the rates on short-term maturities are significantly affected while the longer-term rates may show only a minor change.

In the metals markets, a normal carry is called *contango* (a term coined by the London Metals Exchange when referring to copper) and a negative carry is *backwardation.* Changes in supply and demand that lead to backwardation are most likely to occur in the industrial metals where the commodity is consumed at a greater rate. Gold, silver, and platinum, the *precious metals* markets, have traditionally had a uniform price relationship in the deferred delivery months. Any deferred delivery price can be calculated by adding the current rate of interest (plus storage and insurance) to the value in the cash market. If interest rates rise and the price of gold remains the same, the carrying charges and the spread will increase. If the price of gold rises but interest rates remain constant, the carrying charges and spread will also increase because the increased value of the contract results in higher interest costs. Similarly, lower carrying charges and a narrowing spread will occur if either or both the rate of interest or the price of gold declines. Precious metals are subject to *implied interest rate* spreading, discussed in the next section.

The terms used in referring to carrying charges in the financial markets are the same as those just mentioned, but the concepts are different. *Carry* is a term describing the yield-curve relationship. The concept of positive or normal carry is a curve that increases in yield with the time of maturity. The longer an investor is willing to commit money, the greater the yield. Negative carry can also exist for short periods of time. When economic conditions become unstable, the interest on short-term investments may increase sharply although longer-term rates will increase only slightly. Investors anticipate a correction in these short-term distortions, and do not often move money committed for longer periods for fear that rates will return to positive carry. The various relationships and terminology that exist in each market sector can be found in Figure 13.1.

Implied Interest Rates

A *pure carry* market is one in which the forward price is entirely comprised of the costs of holding the physical product until a predetermined delivery date. As previously mentioned, these costs are those of storage, insurance, and the loan rate. As an example, consider gold, which is a classic pure carry market.

Assume that spot gold is selling for $300 per ounce and the 6-month forward contract for $313.50, an increase of 4.5%. If interest rates are at 7%, there is a possibility of increasing the return on investment by purchasing gold at the current spot price of $300 per ounce and selling a futures contract 6- months deferred for $313.50. The gross profit is the difference between the futures price and the value of a comparable cash investment. Compare this with an initial investment of $30,000, which corresponds to the size of a 100-ounce futures contract of gold. That is,

6-month return on $30,000 cash at 7% = $1,050

6-month futures price	= 313.50
Less the spot price	-300.00
Gives the profit per oz.	= 13.50
Times the contract size of 100 oz.	= $1,350

The gross improvement over the cash investment is $300, or 1% over the 6-month investment period; however, there are costs involved in this *cash-and-carry trade* that do not exist in a straight time deposit. In addition to the storage and insurance of the physical gold, there are transaction costs involved in the trading of futures. Because these costs are relatively fixed, they are known in advance and the potential profit level of the cash-and-carry trade can be calculated.

The Limited-Risk Spread

If the nearby month of a storable commodity is at a discount to a deferred month by more than the cost of carry, a *limited-risk spread* may be entered by buying the nearby and selling the deferred. The trader then takes delivery of the nearby and redelivers it against the later contract. When trading commodities, which are significantly influenced by supply and demand, the outcome of this trade is never certain.

For example, the crude oil and copper markets are not affected by weather, as are crops, and their supply is readily available. Demand has caused both markets to become inverted for long periods of time. Anticipation of lower prices, reduced demand, a poor economy, or simply uncertainty of the near future may result in a hand-to-mouth purchasing policy. This causes a concentrated short-term demand in the spot market and little activity in the deferred months, resulting in higher prices in the nearby months. Carrying charges are still an integral part of the deferred price; if they were absent, the inversion would be more extreme. Even when they appear to have normal carry, these markets are not candidates for an implied interest rate or cash-and-carry spreads.

The limited-risk spread may be better termed a *limited-profit* spread. Although the carrying charges provide a theoretical limit to the premium that a deferred month may have over a nearby, there is no limit to the discount that a month may take on. An increase in the expected supply might change a normal carry market to an inverted one, resulting in a large loss.

The Carrying Charge Spread

The *carrying charge spread* is a popular trade based on anticipation of interest rate change and is therefore a lower risk than a net long or short position in any market. Consider gold again as an example.

In 1978, the price of gold was low (under $200 per ounce) as were interest rates (about 6%). An investor who had the foresight to expect both gold and interest rates to rise but who wanted to limit the risk of a speculative position, could have entered a *bull spread* by buying a deferred contract and selling a nearby contract of gold. The number of months between the contracts would determine the potential for both profit and risk; the further apart, the larger the carrying charges and the greater the expected spread movement.

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CHANGING SPREAD RELATIONSHIPS

Spread relationships can change over time due to structural changes in both the supply and demand, as well as changes in consumer habits. Considering the following:

1. Seasonality for crops, orange juice, and many other products has changed as countries in both hemispheres increase production and join world export markets. Grain and orange juice from South America and edible oils from the Far East have permanently altered the seasonality of supply. This competition puts pressure on carrying charges.

2. Large agricultural conglomerates are able to use futures markets to hedge their production or purchases, shifting the need to buy or sell away from typical harvest patterns. An increase in the storage facilities also decreases the need to sell at harvest.

3. Traditional ratios between gold, silver, and platinum are changed by new demand in the industrial use of those metals in the electronics and automotive industries.

4. Consumer tastes change, causing a shift away from red meat for some period, then back to red meat during another. Lean hogs have replaced the traditional hog futures contract. Health concerns about the use of nitrates in bacon will change processing or pricing; consequently, the ratio between hogs and pork bellies changes.

5. New products, such as high-fructose com sweeteners, have reduced demand for sugar.

Very little remains the same over time. Even though there may be anticipation of change, unexpected events relating to health or interruption of supply can produce a price shock which will affect many spreads.

In the stock market, the relationship between stocks in the same industrial group is affected by trading in index futures. If one stock belongs to the small caps and another to the large caps, their prices may be forced apart by buying in the Russell 2000 and selling in the S&P 500, moves that do not consider the individual stock relationships.

Gold/Silver and Platinum/Gold Ratios

A relationship that has always been followed with keen interest is the gold/silver ratio, traditionally considered normal at 33:1. It serves as a good example of the variability of many perceived spreads. When gold was $35 per ounce and silver about $1 per ounce, the relationship was never very stable. Between 1930 and 1945, silver prices dropped to about $.50 per ounce; from 1951 to 1962, they remained just under $1 per ounce and afterwards began its accelerating move to $38 per ounce in January 1980. Between 1944, when the International Monetary Fund (IMF) was formed, and 1971, the price of gold was fixed at $35 per ounce although in the few years before the cancellation of the agreement, the price varied above the designated value. From the late 1960s until the silver crisis of 1980, the gold/silver ratio ranged from about 20:1 to 45:1 in a slow cycle. During the crisis attributed to the Hunt brothers (September 1979 to September 1980), the ratio fluctuated around 33:1 in a highly volatile pattern moving only slightly above and below its historic pattern. Following the silver crisis, the value of silver declined faster than gold reaching a ratio of 56:1 in June 1982, with gold at $314 and silver at $5.57. A year later, the ratio touched 33:1 and rapidly widened to 66:1 in June 1986. Figure 13.9 shows the gold/silver ratio from 1990, most often trading around 70:1. Although the prices seem to follow a similar pattern, the disruption in 1999 shifted the ratio lower and took four years to recover.

Figure 13.9: The monthly gold/silver ratio has returned to about 70—1 with a fast but sustained movement to 50—1.

Traders will find that this long view of the gold/silver ratio is less practical than the shorter view. Figure 13.10 shows the same price series (nearest futures) on a daily basis. The ratio seems to hold at about 75:1 with variations from 70:1 to 80:1 that last up to three months. The risk is that an abrupt shift to 50:1, as seen in Figure 13.9, is always possible. Intraday traders will find the relationship between gold and silver even closer. Both markets will react in the same way to the same news, and any major shift in the ratio will appear to be gradual.

Figure 13.10: Cold/silver ratio (nearest futures) using daily data shows more consistency around a ratio of 75—1.

It is important to remember that the gold/silver ratio exists because these markets are used as a store of wealth and a safe haven in times of uncertainty. This perception can change, although investors have continually shown a need to fall back on tangible assets when nervous about the stability of their government or concerns about hyperinflation. The long-term shift in the gold/silver ratio may be a combination of new industrial uses for gold in electronics, and the general preference of gold over silver for safety.

The platinum/gold ratio (Figure 13.11) serves the same purpose as the gold/silver ratio, although both gold and platinum, both being precious metals, should have a more constant relationship than silver and gold. Structural shifts in the ratio are likely from time to time because of industrial uses. In addition to gold now used as an electronic conductor, platinum has been in demand for automobile catalytic converters. There is no fundamental reason for these prices remaining in the same ratio; however, the ratio remains very stable.

Figure 13.11: The platinum/gold spread, similar to gold/silver, shows periods where it might be successfully traded; however, markets such as 1980 always remain a possibility. *Source*—New York Mercantile Exchange.

Investors were hurt during the silver crisis of 1980 and not all of them have forgotten. Many people made their purchases during the latter part of 1979, when silver captured the front page of the newspapers, then lost heavily throughout 1980 and over the next few years. At the same time that the U.S. dollar was gaining incredible strength and interest rates were still high, gold and silver prices were dropping rapidly. Since 1980 gold has dropped from $800/ounce to $250/ounce and only started to move above these low levels in 2002. Nevertheless, many countries still hold gold as a store of value. But times change and there has been a shift to the U.S. dollar as an international standard, and to free-floating currencies. Investors feel safe with their money in countries with strong economies and they are willing to tolerate short-term currency swings in exchange for security and diversification. Recognition of the stability of the dollar can be seen in the price of oil, one of the largest traded commodities in the world, which is quoted in U.S. dollars rather than gold.

For a large part of the investing public, both in the United States and other countries, there is a natural preference for hard currency over dollars, euros, or yen when inflation or uncertainty is the main economic theme. Gold, platinum, silver, and precious gems are traded for currencies. That is unlikely to change in the foreseeable future.

Intramarket and Intermarket Financial Spreads

Spread relationships in financial markets represent anticipation of economic policy. The spread values themselves are well-defined by the interrelationship of all interest rate vehicles. They will vary, however, on the interpretation of the impact of government policy on benchmark interest rates with respect to money supply, balance of trade, unemployment, the federal deficit, economic growth, and the time period in which the action will occur. These factors affect the yield curve. The Federal Reserve will make periodic adjustments to the benchmark interest rate and, at the same meeting, state a bias as to how it perceives the economy, the purpose of its action, and how it may act in the near future based on the condition of the economy.

An *intramarket spread*, or *delivery month spread* in a single financial instrument, such as T-bills, is a conservative speculation in changing economic policy. A *bull spread*, long the nearby and short the deferred, captures profits when interest rates decline. A *bear spread* expects interest rates to rise.

An *intermarket* financial spread, involving different maturities, is a speculation in the changing yield curve. A *long bonds/short bills* position favors a flattening yield curve or *negative carry*, while *long bills/short bonds* expects a steepening of the yield curve, or a return to normal carry with respect to futures prices.

The TED Spread

The difference between 3-month U.S. Treasury bills and 3-month Eurodollars is traded as the *TED spread. Eurodollars* are U.S. dollars on deposit in banks not in the United States held by both non-U.S. banks and branches of U.S. financial institutions. While originally only European banks were included, Eurodollars can now be in any major bank in the world.

The TED spread is considered an indicator of credit risk and represents the shifting public confidence between the U.S. government and the highest quality non-U.S. domiciled banks. During times of crisis money flows back to the U.S. as a safe haven. The TED spread is traded in futures of the same delivery month. Typically Eurodollar rates are higher; therefore, if March T-bills are at 97.50 and March Eurodollars are quoted at 97.00 (discounted rates of 2.5% and 3.0%, respectively) the TED spread is .50, quoted simply as the whole number 50. The TED spread rises when there is greater economic uncertainty. Banks outside the U.S. offer higher rates to prevent money from flowing back to the U.S. Treasury. The U.S. T-bills will always trade higher, offering lower rates but more security.

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INTERMARKET SPREADS

There are many dependent relationships between futures markets. Because the bases for these intermarket relationships are fundamentally sound, spreads are an excellent way to profit from short-term divergence. The most comprehensive study of these relationships can be found John Murphy's *Intermarket Technical Analysis*,[5] in which he studies the leads and lags between markets and examines the interaction in their relationships.

The most alluring of the intermarket spreads is the relationship between bonds and the stock market, usually the S&P 500. The government manages economic growth and controls inflation using interest rates; therefore, it is natural to expect the stock market to react to changes in these rates orchestrated by the Federal Reserve. As interest rates decline, the S&P should rise. In economics, the reactive phenomenon is described as a *J-curve* because there is a delay between the lowering of interest rates and the response by the stock market. The lower part of the *J* pattern indicates that prices continue lower at first but at a slower rate before eventually responding to the stimulus. In most cases, such as the recovery that began in 2002, the Fed needs to lower rates a number of times before a sustained positive reaction can be seen in the stock market.

The relationship between interest rates, the stock market, and the U.S. dollar can be seen in the weekly data of Figure 13.12. The price of 30-year Treasury bonds in the top panel represents the forecast of longer-term interest rates, and should lead the market. The price of bonds reached a low in January 2000, equal to the highest yields since 1998, at the same time the stock market peaked. Higher interest rates serve to dampen growth and keep a rising stock market under control. As the stock market declines, seen in the center panel, the price of bonds rise (yields fall) to stimulate business activity. The J-curve can be seen beginning in the first quarter of 2002 when bond prices rise faster, finally resulting in a flattening of stock prices from the second quarter of 2002 through the first quarter of 2003. Bond prices then surged higher in the second quarter of 2003, causing the first upward move in the stock market.

Figure 13.12: Interest rates (top panel), causes response in the stock market (center panel) and the U.S. dollar (bottom panel).

All else being equal, such as inflation and government stability, the value currencies respond primarily to interest rates. Investors move funds to capture the highest real rate of return, the interest rate net of inflation. In the bottom panel of Figure 13.6 the value of the U.S. Dollar Index is seen rising (a stronger

dollar) during the period when bond prices were declining, then falling from the beginning of 2002 as interest rates decline. European rates remained relatively higher than U.S. rates during this period, giving institutions a more attractive place to park their funds. There is also a lag in the changing direction of the U.S. dollar based on the trend in yields.

These fundamental Intermarket relationships provide an opportunity for spreading in both a macro and a micro time frame. In Figure 13.13 we see U.S. bonds, the S&P, and the U.S. dollar/euro prices in 15-minute bars during mid-September 2003. First note that the euro prices in the lower panel are out of phase by 1 hour, 4 bars, because prices were quoted in New York while the bonds and S&P were recorded in Chicago time. Also note that (a) bonds open at 7:20 a.m. in Chicago and the S&P opens at 8:30 a.m. in Chicago, causing a gap and a delay in the S&P response to economic reports, and (b) U.S. government economic reports are released at 7:30 A.M., Chicago time, before the S&P opens. The sharp rise in bond prices on September 12 is in reaction to an unexpectedly bad economic report. At the same time, the U.S. dollar weakens against the euro (bottom panel, lagged 1 hour) and, when the S&P opens, it initially falls. For the remainder of that day the S&P prices slowly reverse direction, bonds temper their reaction, but the dollar remains weak against the euro. The euro will track U.S. interest rates rather than the U.S. stock market. Most traders will find more opportunity at less risk trading the intraday patterns of these highly interrelated markets.

Figure 13.13: A showing intraday patterns and reaction to economic reports.

One complication of intermarket spreads is the attempt to execute simultaneously in two or more markets trading on different exchanges. In the case of bonds, S&P, and euros, bonds futures are traded on the Chicago Board of Trade, the S&P on the Chicago Mercantile Exchange (CME), and the euro on either the International Monetary Market (a division of the CME) or in the Interbank market. Simultaneous execution cannot be guaranteed by either exchange. Each leg must be entered *at the market* with orders placed at *almost* the same time. There must be enough profit potential in the trade to absorb bad executions.

Increased Spread Risk

While any spread trading appears to limit risk because it reduces the net price move when the markets being spread are clearly related, it is not usually true. *Cross-margining* recognizes that buying one market and selling another related product has intrinsically lower risk than simply buying or selling short in a single market. The brokerage firm that you use will know that a long in S&P futures on the CME and a short in the Dow futures on the CBOT is a reduced-risk position; therefore, they will give you favorable margin consideration. Margin on these two trades will usually be reduced to the larger margin requirement of the two trades had they been taken as separate positions. Margin represents a measure of risk. When entering an intradelivery spread, for example, long March and short June 10-year Treasury notes, the margin can be remarkably small because the risk is perceived to be small. Lower margin equates to higher leverage and increases the risk for most traders who measure the returns on the trade as a percentage of the margin requirement. In some cases, the spread risk will be greater than the risk of an outright long or short position. When prices diverge the leverage can work against you.

Trending or Mean Reverting?

Spreads take advantage of diverging prices in related markets. In most cases we expect these markets to react in a similar same way to the same news; therefore, we would buy the market that lags a bullish report and sell the one that overreacts to the upside. That is a *mean-reverting strategy* and applies best to short-term trading. In the stock market we expect the shares of individual companies in the same, relatively narrow industrial group to respond in a similar way to news. Following a surprisingly good earnings report from Dell, and after waiting for Dell's price surge, we might buy Sun or Hewlett-Packard and sell Dell, looking for Dell's competitors to catch up. That is another mean-reverting trade.

Some longer-term spreads represent a change in public sentiment. For example, when the economy weakens there is a tradition shift from the more speculative stocks to the more conservative. This can be seen in an increase in the S&P relative to the Russell 2000. Small-cap stocks are thought to have greater risk than large caps. There may also be a gain in the 30 Dow stocks over the S&P 500, a sign of concentration in the most secure companies. In anticipation of market weakness, traders would buy S&P futures and sell Russell futures, looking for the spread to *increase* rather than *revert.* The trend of the spread produces profits.

It is safe to say that mean-reverting strategies are best applied to short-term trading, ranging from a few hours to a few days in length. Trending spreads can be held for weeks or months and take advantage of an economic shift in the market. Both enjoy high leverage but not necessarily lower risk.

[5]John J. Murphy, *Intermarket Technical Analysis* (John Wiley & Sons, New York, 1991).

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TECHNICAL ANALYSIS OF SPREADS

Once the spread components have been selected and there is full confidence in the underlying fundamental relationship (even if temporary), the extreme levels and trends may be found to determine which spread trades may be entered using a mean-reverting strategy.

Most technical analysis of intramarket spreads (e.g., March–December 10-year Treasury notes) is represented as variations or distortions from the normal price relationship. In this method of trading, the distortions are called *overbought* and *oversold* conditions and the strategic approach taken is to assume that the spread price will revert to the mean, that is, return to normal. By subtracting the deferred price from the nearby (e.g., December from March of the same year) over the life of the contract for many years, the investor can measure the historic patterns (see Figure 13.14). These spread relationships will vary in a manner that allows the trader to set objectives. When March is trading 1½ points over December, the spread can be sold; when March trades under December by 1¼ points, the spread can be bought.

Figure 13.14: Intramarket interest rate spread relationship. *Source*—Nancy Rothstein (Ed.), *Handbook of Financial Futures*, p. 359. © 1984 Nancy Rothstein. Reprinted by permission of McGraw-Hill Companies.

Historical Comparisons

Those spreads with a sound fundamental basis will show clear patterns in their price history. Analysis of longer historic periods will result in a better understanding of the consistency and risk involved in trading the spread. A long-term study will reveal seasonal and cyclic moves as well as periods of lower and higher volatility.

Many spread opportunities result from understanding changing spread patterns. For example, Figure 13.15 shows a longer spread history that has three distinct ranges, marked along the bottom as *a*, *b*, and *c*. During period *a*, spread traders would have identified +1 and -1 as the extreme levels and entered positions at those points; during period *a*, the risk varied but remained within a similar range. The higher volatility during period *b* would have caused large losses for those traders who are still expecting the period *a* patterns; unprecedented shifts in the spread relationship would prompt traders to liquidate spreads. As period *c* begins, traders have changed their objectives to wait for a spread opportunity at ±2, reacting to the patterns in period *b*. Although they did not profit from the original extreme moves in period *b* because spreads were entered too early, they are now prepared for the next large price swing. But instead of repeating itself, the spread narrows until it settles in a range of ±½. Traders will take some time to recognize the narrower range; a return to the more volatile ranges of either period *a* or period *b* will again produce higher risk and possibly losses.

Figure 13.15: Changing spread volatility.

This dilemma is common to spreading; spread prices shift from one range to another and change volatility at the same time. When volatility decreases, few spreads are taken, and when it unexpectedly increases, a large loss occurs. The following outlines possible solutions to this problem:

1. *Underlying price-volatility relationship.* Higher prices in most markets are associated with higher volatility and wider spread differences; lower prices force

most spreads to narrow. The spread between heating oil and gasoline must be greater when those products are trading at $1.00 per gallon than when they are at $.60. Figure 13.8 could easily be associated with changing price levels, where period *a* is a long-term bull market, peaking in period *b*, and followed by a decline to lower levels in period *c*.

2. *Normal seasonal patterns.* Seasonality causes spreads to narrow and widen in predictable ways. During harvest, the *basis spread* (the difference between the spot and cash markets) widens, reflecting the available supply. After harvest, the basis will continue to narrow if demand fails to materialize.

3. *Investor risk preference.* Investors shift to safer holdings during times of uncertainty, then return to markets with higher risk as the economy returns to normal. One familiar pattern is between the stock market and interest rates, but there is also a predictable shift between small- and large-capitalization stocks. During good periods investors are willing to risk the uncertainty of small caps; otherwise, they find safety in the larger companies. Figure 13.16 compares the history of the S&P 500 and Russell 2000, the large- and small-cap indices, from the beginning of 1998 through September 2003. When the ratio in the bottom panel is high, investors prefer the large caps, when the ratio is low they have shifted to the small caps. The lowest ratios were in the strong bull market that ended at the beginning of 2000. Investors started shifting away from small caps in mid-1998, perhaps believing that they were overpriced. In the 1st quarter of 2000, as the markets peaked there seems to have been a disconnection between the ratios. Investors may have viewed the first significant drop in share prices as an opportunity to buy the small caps because the Russell 2000 surged higher while the S&P 500 dropped. Towards the end of the chart there is a steady shift towards small caps showing greater investment confidence. The lower ratio is not the result of the S&P dropping faster than the Russell, but the Russell gaining steadily since March 2003.

4. *Specific events.*

   a. A freeze in coffee or orange juice that reduces supply and damages trees has a prolonged effect on prices and will make prices in the following crop year even more sensitive to a potential freeze.

   b. Events that cause seasonal price changes, such as exceptional demand for exported grain, will overwhelm the seasonal patterns for the remainder of the crop year and often into the next season.

   c. A combination of circumstances, such as low inventory, higher export demand in the previous year, and dry, hot weather midway in the growing season, will result in a nervous market, causing prices to rally for the smallest reasons in anticipation of potential problems becoming realities. By observing past similar situations, the extent of the rally can be seen as large enough to use a medium to fast trend-following method, with profit-taking either at the time the trend turns or 1 month before harvest begins, whichever comes first.

Figure 13.16: Shift in investor sentiment is seen in the ratio of the large cap and small cap stocks (third panel), and the relative change in the bottom panel.

Relative Spread Opportunities

An historic analysis of a spread relationship will show the extent of variability and include most patterns, expressed in terms of absolute price. When the historic spread range is wide due to shifts caused by inventory cycles, changing public opinion, and other factors, a *relative* measure is more useful than absolute prices. Figure 13.17*a* shows a simple example of a more complicated spread pattern where the spread widens and narrows within a broader range.

Figure 13.17: *Relative* spread opportunities. (a) Spread prices showing relative swings. (b) Prices adjusted to identify relative spread opportunities.

The safest spread trades are those taken at historic highs and lows (H_1, L_3, H_6), anticipating a return to normal levels; these trades do not occur often. Instead, there are many opportunities to sell a *relatively overbought* (H_2, H_3, H_4,...) or buy a *relatively oversold* level (L_1, L_2, L_4,...). There is less risk if the relative level is closer to the historic extreme.

The relative spread levels can be found by taking the difference between the spread price and a moving average. The number and magnitude of the relative tops and bottoms will vary with the speed of the trend; the faster the moving average (3 to 5 days), the more relative highs and lows will appear and the smaller the magnitude of those moves. Figure 13.17b shows an ideal detrended spread chart based on the patterns in Figure 13.17a The highs and lows are clear; however, it is not possible to distinguish those that have less risk from those with greater risk. When actually trading, selling H_3 is more likely to result in a loss than a profit because it sits in the middle of the larger range. It will be necessary to use both charts to select the proper trades—one to locate the relative highs and lows, the other to determine risk.

Relative Levels Using an Oscillator

An oscillator can be applied to the spread ratios as a practical solution for finding relative highs and lows. In the bottom panel of Figure 13.16 Ehlers' *Fisher Transform* is applied to the ratio of the weekly value of the S&P and the Russell using a calculation period of weeks. The indicator moves sharply between overbought and oversold levels, at levels of about +80 and -80. When the ratio peaks above 80 the S&P would be sold and the Russell bought. The trade would be closed out when the ratio is near zero, indicating a return to normal. Ehlers' Fisher Transform does a good job of reaching zero even when the indicator does not alternate between overbought and oversold.

Trend Analysis of Spreads

Moving averages, point-and-figure, and other trend-following methods are usually inappropriate for intramarket spreads, which tend to have very narrow ranges. The time needed to recognize a buy or sell signal using a trending approach often takes most of the potential profit from the trade. Trends are more likely to produce a series of losses than profits.

Trend following can be good choice for longer-term intermarket spreads. A prime example can be seen in Figure 13.16, where the ratio of the S&P 500/Russell 2000 declines steadily from April 2000 through September 2003. The most important qualities in the spread are the ability to show a trend and the longevity of that trend. Spread trends do not need to be as large as a move in a single market because lower margin requirements magnify the returns.

Using the 30-year Treasury bonds and 10-year Treasury notes as an example, the difference between the futures prices are shown in the third panel of Figure 13.18. An increase in the price of the 30-year bond relative to the 10-year note indicates a flattening of the yield curve (increasing prices indicate a declining yield). Shifts in the yield curve are based on the perception of interest rate policy; therefore, they can move in the same direction for a few weeks at a time. During June 2003 the yield curve was at its flattest point, then changed quickly over the next two months, returning to a normal level in August. A 10-day moving average of the spread difference, in the bottom panel, shows that the trend of the yield curve is relatively smooth. Buying when the trend turns up and selling when it turns down would have captured the most important moves.

Figure 13.18: The difference between the 30-year Treasury bonds (top) and 10-year Treasury notes (second panel) is shown in panel 3. A simple 10-day moving average trend is in the bottom panel.

Spreads that trend are those that have wide swings and continue for long time intervals. Traditionally, these include the differences or ratios between:

- Short- versus long-term interest rates (trading the yield curve).
- Interest rates of the same maturity of different countries.
- Index markets representing diverse market segments.
- Index markets of different countries.
- Hogs and cattle.
- Gold and silver, or platinum and gold.
- Currency crossrates.

Bull and Bear Spreads

A trending spread can be a low risk substitute for an outright long or short trend position. In grains and foods (*soft* commodities), a bull market will result in prices of the nearby delivery months rising faster than deferred months. A *bull spread* can be placed by entering a long position in the nearby and a short position in a deferred month. Both risk and reward are reduced; however, the greater the time between months, the more volatile the spread (Figure 13.19). As in an outright position, once the upwards price peaks, the spread must be reversed because the nearby delivery will decline faster than the deferred. By selling the nearby and buying the deferred contract, a *bear spread* is entered.

Figure 13.19: Interdelivery spread volatility. (a) Actual prices. (b) Relationship of interdelivery spreads.

The analysis that identifies the time to enter a bull or bear spread can be a standard trend-following approach based on the nearby contract only. Many traders believe that the spread itself must also confirm the trend before a position is taken; therefore, a moderate-speed moving average may be applied to the spread series. This would provide a signal based on the relative change in spread direction. A 1- or 3-day change might be enough for the fast trader. An bullish trend signal in the nearby delivery and a bearish signal in the spread is a conflicting message and no trade should be entered.

Legging In and Logging Out of a Spread

When both contracts, or *legs*, of a spread are not entered or closed out at the same moment, trading risk is increased. An unprotected leg of a spread is simply an outright long or short position and must be managed carefully. Consider a bull spread in a fast-moving market. Although both legs can be entered simultaneously using a spread order, the long position (the price moving in the trend direction) might be entered first, followed by the short leg within a few minutes or a few days. If the market is trending steadily, profits in the long position can be protected when the short leg is entered. Legging in is a rewarding philosophy when it works. When it doesn't work, there is a large loss on the outright position which will be difficult to offset with the lower profits from the spread. If the purpose of trading a spread is to reduce risk, legging in or legging out is not going to accomplish that goal.

When the trend turns from up to down, it is necessary to switch the spread from bull to bear. If large profits have been made in the bull move and both the trend and spread signal a downward turn, it could be tempting to lift the long leg, and hold the outright short using accrued profits to offset the increased risk. A more conservative trader might enter a bear spread in the two delivery months that represent lower volatility thereby reducing risk and profits even further—thereby conserving prior gains. The volatility of some futures markets such as energy are lower in deferred months while others, such as Eurodollars, are higher.

Creating a Spread to Protect an Outright Position

Protecting an existing trend position by spreading with the next deferred delivery is not as good as simply liquidating the initial position. If the market has been going up and indicates a temporary downturn, some traders will *hedge* by selling the next deferred contract. The result is a bull spread instead of an outright long. If the anticipation of a price reversal was correct, the trade risk is reduced but there is still a loss. If the decision was wrong, profits are reduced. Converting a potentially losing outright position into a potentially losing spread changes the size of the loss or profit. It is much simpler to close out the position rather than defer the decision.

Reverse Response to Trending Markets

Some intradelivery spreads respond in just the opposite way to trends. For precious metals, an upward trend results in the deferred contracts rising faster than the nearby. For example, consider the rising price of gold which results in a larger total contract value; consequently, there is higher interest due on the contract value, a component of the carrying charges.

Traders familiar with the potato market will know that higher prices, which reflect greater demand and product disappearance, will result in critical tightness in the last winter trading month. The perishable potato crop must last to early June when the first spring potatoes reach the market. Early demand on the stored crop will magnify the volatility as the end of spring approaches. For both metals and potatoes, a bull spread can be entered by selling the nearby and buying the deferred contracts, for the same crop year in potatoes.

Exceptions to the Rules

During a trending period, most markets exhibit a clear relationship between delivery months. However, this is not the case for nonstorable commodities, such as cattle, hogs, broilers, and eggs. These markets can show little relationship in the response of deferred contracts to the same bullish or bearish news.

During periods of exceptional demand, or if feed prices are very high, livestock may be sent to market early. This causes a drop in current prices and will force the price of hogs lower as well. The price of cattle and hogs in the next deferred month may rise to reflect the shortage of supply; however, even in the most extreme cases, this pattern cannot be carried very far into the future.

Volatility and Spread Ratios

Higher price levels result in increased volatility in the prices of individual markets and their related spreads. Fast price movements and large swings associated with high price levels will create spread opportunities that are more profitable than normal; markets with small movement are not attractive candidates for spreads. The combination of two low-volatility markets produces spreads with such small potential that execution costs often exceed the expected profits.

The two sides of a spread rarely have the same volatility. When badly mismatched, a spread will act the same as if you had taken an outright position in the more volatile side of the spread. The risk of the spread trade may even be higher than an outright long or short position. For example, Figure 13.20a shows the price movements of the nearby, the first deferred delivery, and a more deferred delivery. The nearby is the most volatile and the deferred are progressively less volatile, shown from top to bottom. This is often the case because news that affects the current price has less of an impact on future prices. A spread of the first and second deliveries, shown as the bottom line in Figure 13.20b, has reduced risk compared to an outright position in the nearby month. Both respond to news. A spread of the nearby and deferred delivery has very little risk reduction and greater leverage based on lower margin requirements. Because the deferred delivery moves only slightly, the leveraged spread becomes a much riskier trade than the outright long or short position.

Figure 13.20: Poor spread selection. (a) Spread price. (b) Spread components.

Spread Ratios

A similar risk exposure would occur if a gold-silver spread were created by subtracting the price of silver from that of gold rather than taking a ratio of the two. Equal moves of 10% in gold from $300 to $330 and silver from $6.00 to $6.60 would result in a spread price change from $294.00 to $323.40, effectively mirroring the gold change rather than maintaining an unchanged spread.

Markets that offer sound spread opportunities will vary in their absolute price range or volatility. For example, during 1984, the price of spot live hog futures varied from 43.80¢ to 58.00¢ per pound, at the same time pork bellies ranged from 54.70¢ to 74.10¢ per pound. Both appear to be consistent in volatility as seen from the ratios, yet more than a 50% difference occurred in the size of the price change. Had the ratio dropped to 1.15, a long bellies-short hogs spread would have been entered. If the ratio had moved to 1.35, a spread would have been entered to buy hogs and sell bellies. Assume that this distortion occurred at prices near the lows and prices then adjusted to 1.27 at the highs shown in Table 13.4. There are two possible trades that might have occurred:

Open table as spreadsheet

		Spread Price	High	P/L		Contract Size	Net P/L
Case 1:	Long bellies	50.00	74.10	$24.10	×	38,000	$9,158
	Short hogs	43.48	58.00	(14.52)	×	30,000	(4,356)
	Ratio	1.15	1.27				$4,802
Case 2:	Short bellies	54.70	74.10	(19.40)	×	38,000	($7,372)
	Long hogs	40.52	58.00	17.48	×	30,000	5,244
	Ratio 1	1.35	1.27				($2,128)

Table 13.4: Price Movement of Pork Bellies and Live Hogs in 1984

Open table as spreadsheet

	Low	High	Average	Range	Mean Volatility
Pork bellies	54.70	74.10	64.40	19.40	30%
Live hogs	43.80	58.00	50.90	14.20	28%
Ratio	1.25	1.27	1.27		
Spread	10.90	16.10	13.50		

In Case 1, the trade produces a profit while the relationship adjusts to normal; in Case 2, there is a loss even though the same adjustment occurs. The two factors that cause this are the different contract sizes and the absolute price range. If the contract sizes were adjusted to equal units, which can be done by trading four bellies and five hog contracts, the results would be:

Open table as spreadsheet

		P/L per Contract	Number of Contracts	Total P/L
Case 1:	Long bellies	$9,158	4	$36,632
	Short hogs	(4,356)	5	21,780
	Spread results			$14,852
Case 2:	Short bellies	($7,372)	4	($29,488)
	Long hogs	5,244	5	26,220
	Spread results			($3,268)

This is slightly closer to the correct results but not yet right. Adjusting the number of contracts based on price volatility will come closer to equalizing the relative risk on each side of the spread. The range of 14.20 in hogs and 19.40 in bellies combined with their contract size gives:

Open table as spreadsheet

	Range	Contract Size	Total	Ratio
Bellies	19.40	38,000	$737,200	
Hogs	14.20	30,000	$426,000	.5779:1

For convenience, the *spread ratio* will be taken as 1:2, which means trading two hog contracts for every one pork bellies contract. Then:

Open table as spreadsheet

		P/L per Contract	Number of Contracts	Net P/L
Case 1:	Long bellies	$9,158	1	$9,158
	Short hogs	(4,356)	2	(8,712)
	Spread results			$446
Case 2:	Short bellies	($7,372)	1	($7,372)
	Long hogs	5,244	2	10,488
	Spread results			$3,116

Using the relative volatility and contract size to produce a spread ratio gives the correct results.

Metal Ratios

Most metals markets showed extreme volatility in early 1980 as a result of the silver crisis. Gold moved from $150/oz in 1975, peaked at $850/oz at the beginning of 1980, then declined to $300/oz by 1985. Silver followed the same pattern, starting at $5/oz, peaking at $38/oz, and falling back to $6.50 in 1985. Even copper, which is not a precious metal, moved from $.60/lb to $1.35/lb and back to $.65/lb during the same period. At the beginning, the gold/silver ratio was 30:1, platinum/gold was 1.1:1, and silver/copper was 8.3:1. At their peak the ratios were 22:1, .5:1, and 28:1, respectively, a major change for all markets. High volatility and unprecedented price levels magnify the differences between these markets.

Although your target for a precious metals spread may be a price ratio—for example, 30:1 for gold/silver—the number of contracts traded on each side of the spread is determined by the risk of each market. Risk is most commonly a function of price volatility. If gold moved $50/oz over a 1-year period, while silver moved $.75 during the same period, we would multiply the price range by the size of the futures contract to get the volatility, or risk, expressed in dollars. A $50/oz move in a 100-ounce gold contract is equivalent to a risk of $5,000. A $.75 move in a 5,000-ounce contract of silver is a risk of $3,750. To maintain equal risk in both legs of the spread you would trade 4 contracts of silver for every 3 gold.

Table 13.5 shows the price ranges of the four major metals markets traded on COMEX for the year 2003. All of these markets had substantial volatility, shown as a percentage of the highest price and in the dollar value of the range. The far right column shows the trading ratios based on volatility. The platinum/gold ratio, currently at 1.9 based on price, requires that you trade 1.3 contracts of gold for one contract of platinum, a ratio of about 4:3. The gold/silver ratio can be traded with 3 silvers for 2 gold, and the silver/copper ratio requires 4 copper contracts for every 5 silver contracts.

Table 13.5: Metals Volatility Ratios, 2003

Open table as spreadsheet

		Price Range 2003						
	Contract Size	High	Low	% Rang	$ Range	Ratios	Price Ratio	volatility Ratio
Cold ($/oz)	100 oz	390	320	82.1	7,000			
Platinum ($/oz)	50 oz	760	580	76.3	9,000	Platinum/Gold	1.9	1.3
Silver ($/oz)	5,000 oz	5.35	4.4	82.2	4,750	Gold/Silver	72.9	1.5
Copper ($/lb)	25,000 lb	0.96	0.72	75.0	6,000	Silver/Copper	5.6	0.8

Volatile Spreads

Trading a high-priced spread or a high-volatility spread is always riskier than trading where both legs are at normal levels for the following reasons:

1. If only one leg is at a high price or high volatility, the profitability of the spread depends entirely on the profitable trading of the most volatile leg. Even if both legs react to the same news, you are increasing your risk by trading this spread because gains and losses depend only on the volatile leg, and the spread margins available can increase your leverage.
2. If both legs are volatile, specific events may cause them to move independently, creating unprecedented, high spread levels.
3. Highly volatile spreads in nearby months may not adjust to normal before the expiration of the contract. At expiration, extreme demand in the cash market may cause further unusual spread differences cause by a *short squeeze*, the inability to deliver the cash product at futures expiration.
4. A highly volatile spread may have greater risk than a single outright position in one leg. This is not the purpose of a spread trade.

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LEVERAGE IN SPREADS

Because a spread is the difference between two or more fundamentally related markets or delivery months of the same market, it is commonly accepted that the risk is less than that of an outright long or short position. Spreads between different delivery months in the same market are recognized as having the lowest risk. The result is that spread margins can be less than 20% of the margin required for an outright long or short position. Because margin on outright positions may be as low as 5% of the contract value (underlying asset), the spread margin can be as low as 2%.

The profit potential is also less for a spread than for a net long or short position. You would expect that if the margin requirement is 20% of the outright position, then both the risk and reward of the trade would be about 20% of an outright position. That is not necessarily the case. In agricultural products, the bull and bear spreads can be highly volatile; in contrast, the potential for an intramarket metals spread is equal to the change in interest caused by higher and lower contract values. Traders manage to compensate for the lower profits and risks by taking advantage of the smaller margins and entering more positions. With five contracts, the trader has managed to convert a conservative spread trade into the same risk and reward as an outright trade—perhaps with even higher risk—without added capital. The small trader, however, should not leverage spreads to their maximum.

Some trades that derive the benefit of spread margins are not always of proportionately less risk. For example, the International Monetary Market (IMM) has had a tradition of reducing margin for a spread of any two currencies. A short position in the U.S. dollar/euro against a long position in the U.S. dollar/Mexican peso is simply a euro/peso spread and not less risky than either of the individual legs. The trader must keep in mind that the decrease in margin, which accompanies spreads entered on the same exchange, will cause a substantial increase in leverage and may counteract the intrinsic risk reduction in a spread that was related to the smaller price movement. Spreads are not necessarily less speculative or safer than trading a single net long or short position; however, they offer unique opportunities.

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Chapter 14: Behavioral Techniques

OVERVIEW

There are some approaches to trading that are directly dependent on human behavior and cannot be represented by pure mathematical techniques. Short-term systems are more likely to target investor behavior than economic factors because, over a few hours of one day, the influence of macroeconomic policy and long-term trends is very small. The concepts presented in this chapter deal specifically with the interpretation of human reactions, although the interpretations are all systematic. The section "Measuring the News" covers an area that has always been important to a floor trader, yet has been greatly overlooked by technicians; it offers great opportunity for research. "Event Trading" the study of the market's reaction to price shocks, has become increasingly important for both proactive and reactive traders. "Contrary Opinion" takes the form of a poll or consensus of opinions of traders and market publications. It may help answer the question, "What is everyone else doing?"—or at least—"What are they thinking of doing?"

The principal works of Elliott and Gann are included in this chapter with a complete discussion of the Fibonacci series and its ratios. Fibonacci forms a singular part of their techniques, and has been applied to most other forms of charting. The way in which traders respond to market moves and the remarkable similarity that can be found in Nature give serious underlying substance to these methods. Because not all of the assumptions upon which these systems are based can be quantified, they can only be substantiated by the performance of the systems themselves. All of these behavioral methods are fascinating and open areas of creativity essential to broadening system development. They are grouped together with discussions of natural phenomena and the rapidly growing area of financial astrology, all of which should stimulate your grey matter.

Previous Next

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MEASURING THE NEWS

> *If you can keep your head when all about you are losing theirs, maybe you haven't heard the news.*
> —Rudyard Kipling[1]

The news is one of the greatest single elements affecting pricing of open markets. It broadcasts both statistics and interpretation, and can express information directly and by innuendo. It is indispensable to traders. If the news services are not objective, they could materially alter any opinion by including unverified or omitting relevant information. Occasionally, news services have released erroneous statements, such as "Bin Laden Killed," only to announce an hour or two later that it was an error, after leaving a trail of losses for many traders.

The impact of news is so great that a speculator holding a market position according to a purely technical system would do best not reading, listening to, watching, or in any sense being exposed to news that might be interpreted as being in conflict with the current market position. In a study commissioned by the *Wall Street Journal*, it was shown that 99% of the financial analysts polled read the paper regularly, and 92% considered it the *most valuable* publication they read.[2]

As an element of a trading program or as an indicator of its own, the news has exceptional value, but its interpretation can be very complex. We believe that, if we could measure the impact of unexpected news, the importance of the *Wall Street Journal* or other wire service articles, earnings releases, economic reports, the USDA crop reports, and the CFTC Commitment of Traders report,[3] we would be able to anticipation the direction of prices, or at least react profitably. But first we must be aware of the complications of analyzing the news. There is the problem of objectively selecting which items are relevant and which are most important. And then there is the difficulty of quantifying the news—how do you rank each item that is measured, and on what scale do you determine cumulative importance? Some news items clearly have a greater impact on the market—weather disasters, terrorist activity, economic reports, major trade agreements, changes in government policy, key crop reports—but these must be ranked as bullish (+) or bearish (-) in a way that produces a numerical system of analysis. On a single day, an address by the President about foreign trade may be ranked as a -3, a meeting of the Federal Reserve a +7, unemployment a -4, a bombing in the Middle East a -3, a continued lack of rain in the west as a +2, larger-than-expected retail inventories a -4, and a key article in the *Wall Street Journal* on the improved Russian crude oil production a +5, giving a net score of -5 to the overall economic picture. This would be interpreted as moderately bearish.

Klein and Prestbo attempted such a study by assigning values of 3, 2, and 1 to articles in the *Wall Street Journal* of decreasing importance. Their interest was the stock market, and their work was straightforward and some of the conclusions general in nature. They showed a direct correlation between the relevant positive and negative news articles and the direction of the stock market. As it was scored over 6-week intervals before and after major turning points in the Dow Jones Industrial Averages, the news would stay about 70% favoring the current market direction. Having eliminated the possibility of the market influencing the news, they could conclude that, in retrospect, the market reflected the nature of the news.

With the acceptance of world futures markets in fixed income and stock indices, there is a close tie between the movements of all financial markets in reaction to significant economic reports released anywhere in the world. Rising consumer confidence in Germany is interpreted as bullish in the United States because German spending will be representative of European spending and positive for American exporters. Similarly, surprisingly lower earnings or disappointing growth of a major microchip manufacturer reflects badly on the entire tech sector everywhere in the world.

There are exceptions when news is of limited scope and relevant to a specific commodity, such as a lack, of rain in the Corn Belt during prime growing season, or a winter freeze in Florida's orange orchards. The news is watched carefully during the last phase of a bull or bear move. Commodity traders will wait for a crop report to show the final numbers on

yield, in the same way the financial market traders will wait for initial claims to fall or the Fed to raise rates, signaling a final change in the economic trend. Chicago weather traders are notorious for watching the news. They begin during planting season when too much rain can slow the process and cause a shift from one crop to another. In June they begin monitoring rain as an indication of crop yield. Once there has been a sustained period with little rain they will set a long position. They will stay long while no rain is in sight and quickly sell if a thunderstorm develops over the Chicago Board of Trade building. They will also protect their positions going into the weekend, in the event of unexpected rain, then reset their longs on Monday. The news items that affect prices the most are:

- Release of economic statistics (PPI and CPI for inflation, retail sales, balance of trade, initial claims, consumer confidence, housing and refinancing).
- Action by the Federal Reserve or other central banks to change rates or change their *bias*.
- Changes in the money supply that indicate easing or tightening.
- Government reports on production and inventories.
- Unexpected news or price shocks, such as an assassination or terrorist attack.
- Trade negotiations, agreements, legislation, and occasionally rulings by the Supreme Court that affect business.
- Weather and natural disasters, such as earthquakes and hurricanes.
- In-depth studies by the *Wall Street Journal*.
- Front-page news articles and dominant television coverage of high prices, strikes, etc., and their potential effects on business.
- Market letters, research reports, and comments from accepted authorities, major brokerage houses, and influential organizations.

Ranking and Measuring

The problem of ranking and assigning numeric value to news items is that it requires knowledge of how others see the news. Klein and Prestbo studied this problem for the stock market and concluded that about 90% of the *Wall Street Journal* readers perceived news in the same way, when classified as bullish, bearish, or neutral. A reason for the consistent interpretation of the news articles is the published analysis. Within minutes of the release of an economic report or Fed action, the financial news services broadcast expert opinions. When this study was done, interpretations were supplied by the brokerage houses and transmitted to the media to be relayed to traders. *The professional analysis*, then and now, is assumed to be correct and is an overwhelming influence shaping public opinion.

News can also be measured empirically, by studying the immediate impact of an expected or surprise news item. For statistical reports, such as Initial Claims, Consumer Confidence, or the Producer Price Index, care must be taken to use the correct figures. Market reaction is a combination of expectations compared with actual figures and corrections to the previously released data. In some cases it is difficult to know whether a jump in prices was due to an upwards revision of the previous data or current values that are higher than expectations. You can find this week's list of economic reports on the Internet, along with the previous report data, expectations of the economists for the new data, and expectations of the market. Market expectations are reflected in the price before the reports are released and are the most important value. When testing reactions to these reports, the historic data must include the actual numbers released in the reports, and a separate value for the revision of the previous month. Some sources will give the corrected data rather than the numbers released at the time of the report. A history of market expectations may be difficult to find, but they can be determined from the market's reaction. Therefore, following the release of an economic report, we can expect the price change to be expressed as:

$$\textit{Price change} = f(a \times (\textit{Current value} - \textit{Expectations}) + b \times (\textit{Revision} - \textit{Previous value}))$$

where a and b are weighting factors, $a > b$ implying that the current value is more important than the previous one. The function f can be found using a regression analysis that relates the size of the price move to the net differences in expectations and actual data. It is necessary to make the assumption for this type of measurement that the effects of a news release are most important in the short term, and that their influence on the market is diluted daily. A starting point for representing the way in which the news decreases in importance is to use the relationship in physics:

$$I = \frac{1}{T^2}$$

where I = the net impact

T = the elapsed time since the release of the news

In science this relationship, which represents the physical impact declining with the square of the distance or time, applies directly to sound and light.

The impact of economic reports are significant, frequent, and worth studying. For futures markets, the CFTC releases its *Commitments of Traders* (COT) report each week. It tells the distribution of holdings among large and small speculators and hedgers as a percent of total open interest. This report is watched with the idea that the small speculators are usually holding the wrong positions and the positions of large hedgers are normally right. The COT report is covered in a later section of this chapter.

It is important to understand the difference between the analytic and empirical approach to news. In the *analytic* method, the value of specific events are determined in advance, and when they occur their preassigned values are compared with the effects. Using the *empirical* method, the historic effects of each event are tabulated and measured, then applied to subsequent news releases for the purpose of forecasting reactions.

The analytic approach has the advantage of working in an environment where multiple events are occurring simultaneously, and the cumulative effect of all news items is important. When testing the empirical approach, a single event of interest may not be distinguishable from other important news occurring at the same time. Finding situations that isolate a single news item so that you can measure its impact may be impossible. The primary disadvantage of the analytic approach is that it does not account for the discounting or anticipation of the news. An event of modest importance may become neutral or more significant relative to other concurrent or anticipated events; the empirical method would not be subject to that problem because it measures reactions and not expectations.

Trading on the News

Even without a sophisticated method of measurement, there are many professional speculators who trade on the news. When a bullish news item appears and the market fails to respond upwards, the experienced trader looks for a place to sell. It shows that expectations exceeded reality and prices had already anticipated the bullish interpretation of the news. Sometimes there are a large number of sell orders placed above the market in anticipation of one last rally after the report is released. An increasing number of traders watch the early morning price movement on 24-hour electronic exchanges, before the primary market opens. This replaces, the *opening calls*, which were early indications of market's opening direction in the pre-electronic era. In many cases a trader will sell a higher overnight move when there is little news to support the rise. If prices have been rising steadily in the pre-market session in anticipation of a bullish economic report, selling early may be the only opportunity. Prices frequently gap lower after a bullish report that did not meet market expectations. Most economic reports are released at 8:30 A.M., New York time, one hour before the U.S. stock markets open. The response to the report is actively traded on the electronic S&P, Nasdaq, and Dow markets. If you are trading individual stocks or ETFs then you will need to wait an hour until those markets open.

Agricultural *weather markets* function purely on news. When there is a potential for a drought, traders with long positions wait for the 5-day forecast hoping for no rain; they anticipate a loss of a specific number of bushels per acre for every dry day once rainfall is below a specific level. Weather markets are nervous, with prices often gapping higher and lower at the open, and are characterized by evening-up on weekends; they rely heavily on anticipation. It is said that a farmer loses his crop three times each year, once for drought, once for disease, and once for frost. In 1976, the news carried numerous articles on the desperate wheat crop in the western states, showing films of virtually barren fields, and yet the United States harvested one of their largest wheat crops on record. Weather markets have a history of volatile price movement but rarely materialize as the disaster that is anticipated.

The *discounting of news* is as important as the news itself. An old saying in the market, *buy the rumor*, *sell the fact*, implies that anticipation drives the price past the point where it would realistically account for the news. When the actual figures are released, there is invariably an adjustment back to their proper level. The pattern of anticipation for each economic report or news event should be watched closely. A later section in this chapter, "Trading the Reaction of Treasuries," shows that price reversals are more common than continued movement following a report.

Market Selectivity

The market seems to focus on one news item at a time and one remedy at a time. Although the same factors are always there to affect prices, they must reach a point of newsworthiness before they become the primary driving force. For heating oil, the combination of unexpected, sustained cold weather compared to inventories will activate a weather market. Although professionals may monitor thermals, published by the U.S. Weather Service, the market will react quickly to a weather report that anticipates a cold front over the next five days.

During 2003, when the economic recovery was the leading motivation driving stock prices, traders focused their attention on Initial Claims. The news broadcasts repeatedly stated that 400,000 claims was the balancing point between job growth and job loss. A sustained economic recovery needed job growth which would translate into consumer spending. The weekly Initial Claims data, released each Thursday at 8:30 A.M. in New York, was often followed by a sharp reaction in Treasuries and Index futures in U.S. and foreign markets. After months of terrorist activity in Iraq, continuous setbacks in the Israeli-Palistinian negotiations, and a backdrop of Al-Queda uncertainty, the market still responded to Initial Claims and ignored most other news. It is a classic case of crowd behavior.

Media Indicators

In a delightful article,[4] the author Grant Noble argues that the news recognizes events when they are cresting, and most often provides a countertrend trading opportunity. First, the American media should be viewed as providing trading signals in three major time frames:

1. *Long term*, as given by the large circulation news magazines such as *Time*, *Newsweek*, and the *Economist*. With the timeliness of a brontosaurus, they profile moves that last many years.
2. *Medium term*, represented by *Barron's*, *Forbes*, and *Business Week*, covering a period of about 3 months.
3. *Short term*, held captive by the *Wall Street Journal* and the *New York Times*, which provide intermediate predictions as well as medium-term outlook.

By reading these periodicals you find that the *Wall Street Journal* has run headlines on a "killing drought," "dust bowl," and the *New York Times* on "Drought… imperils crucial wheat crop" just as the wheat price makes its highs for the current move. In another case, *Barron's* cover article asked "Is the bull leaving you behind?" in August 1987 just ahead of the precipitous drop in October of that year. It is not surprising that the media would highlight events only after they have become a popular concern. We might say that the proportion of news coverage corresponds to a high public consensus, a topic addressed in the section "Contrary Opinion." It may be perfectly valid to construct a consensus indicator based on the number of square inches of news coverage given to an event in a combination of publications, each weighted by their circulation. Even with the increased access of electronic news, broad coverage and recognition of consensus remains a lagging indicator.

[1]Adam Smith, *The Money Game* (Random House, New York, 1967, p. 48). Also attributed to H. L. Menken.

[2]Frederick C. Klein and John A. Prestbo, *News and the Market* (Henry Regnery, Chicago, 1974, p. 3).

[3]A thorough analysis of the CFTC *Commitment of Traders* report can be found in Chapter 16. It should be noted that other government reports released on the same day may complicate the interpretation.

[4]Grant Noble, "The Best Trading Indicator—The Media," *Technical Analysis of Stocks & Commodities* (October 1989).

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EVENT TRADING

The largest price moves and the greatest volatility, called *price shocks*, are the result of reactions to unexpected news. These market events pose the greatest risks to all traders because they are unpredictable and of such great magnitude that they are out of proportion with normal trading risk. It may be possible to trade for a number of years without experiencing a large, adverse price shock; therefore, many traders do not plan properly for these situations. Yet surviving a price shock is often the difference between the end of a trading career and a long, successful one. Further discussion of price shock can be found in Chapters 21 and 22. This section presents a strategy for trading immediately after a price shock.

Not all price shocks are of such magnitude that they present an unmanageable problem. It may be that all price moves, big and small, are either the reaction to news or the anticipation of news. Larger price moves are the result of an act that affects the global economy, such as a terrorist attack, declaration of war, assassination, or natural disaster associated with weather or earthquakes. Smaller shocks come from the periodic release of economic reports by a government agency or monetary authority, financial commentary on television, radio or newspaper, earnings releases, unexpected bankruptcy, rulings by the Supreme Court, statements by the Department of Agriculture with respect to a new drug, and countless other sources. The U.S. government releases economic data on a pre-announced schedule, many of them at 7:30 A.M. Chicago time. These create regular disruptions to price movements in world financial markets.

The frequency and size of these price moves, triggered by unexpected news, make these events a natural candidate for a trading system.[5] The profit opportunity, however, does not lie in taking a position ahead of the report and anticipating the market reaction, but in studying the systematic patterns that come after the initial price reaction to the news. Because the news is unexpected, you cannot predict the results or the extent of the reaction; therefore, taking a market position in advance of a government report would have a 50% chance of success and often very high risk. Studies might show that there is a bias in the direction of the price shock due to the way the monetary authority plans economic growth and controls inflation; however, the risks would remain high. This section only looks at positions entered on the close of the *event day*, the day on which a sharp market reaction occurred.

Market Reactions to Reports

To determine whether there is ample opportunity to profit from the price move that follows an *event*, it is necessary to study the direction of the market reaction in combination with the subsequent prices changes that occur over the next few days. These lagged reactions are the results of market inefficiencies; it is unlikely that prices could immediately jump to the exact price that economic principles require, despite the premise proposed by the Efficient Market Hypothesis. With large price shocks there is often an over- or underreaction that is corrected during the next few days. Sometimes prices jump one direction and immediately begin to go the other way until they have completely discounted the price shock. The initial reaction to a price shock is not often the profitable direction for a trader.

Figure 14.1 illustrates the types of price movements that might follow an upwards price shock. When there is an underreaction, prices move higher over the next few days; when there is an overreaction, prices move lower. Patterns are not as orderly as shown in the Figure 14.1 because volatility is high and many traders react impulsively (or by financial necessity) to the move, covering their losses. In order to decide whether a market is a candidate for event trading, you must study the pattern of moves following the reaction to news and decide whether:

- The size of the move is enough to generate a profit in its reaction.
- The returns are worth the risk of loss associated with these volatile events.

Figure 14.1: Price reaction to unexpected news, including delayed response. The upwards price jump on the event day (0) may be followed by (a) a continuation move up or (b) a reverse move down over the next 3 days.

When studying these events, there may be a direct relationship between the size of the reaction and the type of pattern that follows. For example, a small reaction to news may be followed by a steady continuation of the direction of the price shock. Therefore, if Initial Claims or unemployment jumps by 0.2% in a month, then the market sees a reaction by the government to stimulate job growth by lowering interest rates. The same initial reaction would occur if unemployment jumped by 1 full percent, but the number would be so unexpectedly large that it may be considered an error, in which case it is not clear to what extent the government would respond. The market may overreact to a large shock but underreact to a small one. The only way to discover this is to study the reaction to events.

Fundamental to understanding price shocks is that the shock is based on the difference between the *expectations* and the *actual* reported data. The best assessment of expectations is the market price just ahead of an economic report. The market always discounts what it believes is its best guess at what the report will say; therefore, if bond prices rise in advance of an important unemployment report, we can say that the market expects unemployment to increase. If the futures price of short-term rates have moved up by the equivalent of ½% in yield in anticipation of a very bad report, and the report comes out neutral, then prices will drop sharply to offset the incorrect expectation. When studying market reactions from historic records of economic data, you must use price to represent expectations. A poll of the opinion of economists in advance of a report may differ substantially from the market expectations but will have value in deciding whether the final report numbers are good or bad news for the economy over time.

Measuring an Event

There are many economic statistics released each year, as well as special reports in the *Wall Street Journal* and other influential periodicals, Bloomberg, and financial broadcasting networks. To record the dates of each news items would be impractical for anyone; a simpler approach that might prove effective is to identify the importance of the event by the size of its reaction. This can be done by comparing the volatility of the current day with the average volatility of the recent past, using the *true range* calculation:

$$Volatility\ ratio = \frac{True\ range_{\text{today}}}{Average\ true\ range_{\text{previous } n\text{-days}}}$$

When the volatility ratio is below 1.0, current volatility is less than the average volatility over the past *n* days. When the ratio is greater than 3.0 we are likely to have identified a day in which a news event caused a significant price shock. The larger the ratio, the greater the surprise to the market. Note that the true range is used because the shock can occur overnight, causing an opening gap, in which case the best measurement of volatility includes the price move relative to

the previous close.

Volatility Pattern

During the declining stock market beginning in 2000 and subsequent rally, the key economic reports watched by traders were weekly Initial Claims and the monthly Unemployment. One study of volatility shows that price movement in the Treasury futures is greatest on the day of the report and lowest on the day after the report. There are cyclic variations in volatility that seem to occur in a weekly pattern between the monthly releases of these reports.

Key Government Reports

Even when there is public concern over the state of the economy, the market does not react in a similar way to all economic data. Some reports seem to be more important than others, and the market appears to focus on one report at a time. The most significant data seems to be unemployment and the Consumer Price Index (CPI). During a period of sustained low unemployment, as seen in 1997, even a modest increase will not cause much concern. A jump in the CPI, however, will always warn the market to expect a *preemptive strike* by the Fed, cutting off potential inflation by nudging rates up slightly. Other reports, such as the Balance of Trade, were particularly popular in the late 1980s when the deficit with Japan seemed to be at the root of the U.S. deficit. Sagging U.S. exports and overconsumption of foreign-made products by Americans looked as though the U.S. work force could not compete in the world market. During 2003 these same concerns surfaced with a slightly new interpretation. Manufacturing has moved out of the *industrialized* economic powers into the Third World nations in a trend that looks permanent. No one has yet presented a short-term solution to equalizing the balance of trade between countries such as China and the United States, when the Chinese people do not have the resources or the need to buy the service provided by the United States Computers and automobiles, some of the first major purchases by a growing affluent section of the Chinese population, are already manufactured locally.

Other reports can also attract the attention of traders, but may be as difficult to interpret as the Balance of Trade. Durable goods, retail sales, the budget and tax legislation all directly affect the economy and prices; however, it is not always clear how to relate the changes in durable goods orders with price change, or how the latest news on tax law will contribute to the economic well-being. More important, it is difficult to assess how the government will manipulate interest rates in reaction to these data.

Trading the Event Lag

Once you have studied the way prices move following an event day or a price shock, you can create trading rules. For example, you find that a monthly change in the Consumer Price Index of between 0 and 0.2% has no particular reaction, provided market expectations were similar to the data released. A change between +0.2 and +0.4 or -0.1 and -0.2 should provide enough surprise for a noticeable market reaction, when accompanied by lower or higher expectations. Data greater than a change of +0.4 should cause a price shock regardless of the anticipation. In addition, we might find that changes over +0.4 tended to react in the opposite direction to the normal government action because of overanticipation or disbelief.

Based on the results of studying these patterns, Warwick established the following trading rules:

1. Buy on the close if the market closes in the upper 20% of the trading range on an event day, and if prices have shown an historic continuation pattern.
2. Hold for a predetermined number of days, based on the lag pattern of the market.
3. Use a stop-loss to limit risk.

In an older study applied to the corn market, Arnold Larson[6] found that 81% of the price changes occurred on the event day. There was a typical price reversal of 8% over the next 4 days, and a net change in price of 27% in the original direction over 45 days. Although we should not expect those same numbers now, the pattern of a large move, a reaction, and a longer directional move may still be valid. Human behavior is not easily changed.

Results of Event Studies

In his book *Event Trading*, Warwick showed the test results of some of the major markets, allowing us to compare the effects of the systematic reaction of U.S. 30-year bonds with that of the S&P 500 and other financial markets. Unexpected news that causes bond prices to rally sharply (causing yields to decline) would result in a rise in the stock market, unless

the news was particularly bad for the long-term economy of the country. Therefore, a drop in the consumption of durable goods should be followed by lower interest rates and a slightly lagged upwards response in the stock market. This pattern is shown in Table 14.1 where the bond and S&P results are side by side.

Table 14.1: Results of Upwards Breakout of U.S. Bonds (left) and S&P 500 (right) for the Period 1989–1994

Open table as spreadsheet

	U.S. Bonds			S&P 500		
	Holding Period	Buy or Sell	Confidence Level	Holding Period	Buy or Sell	Confidence Level
Durable goods	0–1	B	97	0–4	B	> 99
Retail sales	0–1	B	90	0–2	B	96
Retail sales	1–5	S	95	2–4	S	96
CPI	Low confidence			0–3	B	92
PPI	0–5	S	95	0–1	B	97
NAPM	0–2	B	91	0–4	S	97
Industrial Production	0–1	S	94	Low confidence		
GDP	0–3	B	90	0–4	B	96
Employment	0–2	B	91	0–1	B	93

In general, we expect a price shock to impact interest rates first, then currency and equities markets. Typically, the interest rates react in a way to compensate for the economic effects and stabilize the other two markets; this preempts the action that would be expected from the Central Bank. The exception is when the news is much more extreme than usual and targets the stock market first. Investors, because of a lack of confidence, will shift their funds from equities to interest rates in an effort to find a safe haven during uncertainty. This will cause a decline in the stock market and a corresponding rise in the futures price of Treasuries, reflecting lower yields, although Warwick normally expects the two markets to move in the same direction. However, investors are cautioned that the time lag in the reaction of Treasuries and Index markets may vary considerably due to the state of the economy and current interpretation of economic policy by the government.

Table 14.1 shows the way the markets move after both the interest rates and stock market initially react with an upwards price breakout. When both markets continue in the same direction, such as following Retail Sales, GDP, and employment data, then the full impact of the data takes longer to be assessed by the market, or there is expectation of some continued response by the government. The PPI and National Association of Purchasing Managers (NAPM) reports do not show this consistency, indicating that the market takes this information differently. When the pattern of confidence is low, the market may do a good job of reaching the best price level in immediate response to the news; therefore there is no consistency in the price move that follows.

Table 14.2 shows the side-by-side test results of reactions that cause a drop in bond prices and a corresponding drop in the S&P 500. The frequency of low confidence results may represent the conflict between the normal upwards bias of the stock market or the unusually bullish trend during the test period. The GDP results which show the most confidence indicate that the stock market moves higher even when the interest rates rise in reaction to positive GDP data. Balance of Trade data, which is not always the primary focus of the market, has a very consistent pattern, but is not clearly related to the interest rate move as are most of the other statistics.

Table 14.2: Results of Downwards Breakout of U.S. Bonds (left) and S&P 500 (right) for the Period 1989–1994

Open table as spreadsheet

	U.S. Bonds			S&P 500		
	Holding Period	Buy or Sell	Confidence Level	Holding Period	Buy or Sell	Confidence Level
Durable goods	Low confidence			0–2	B	92
Retail sales	Low confidence			0–4	B	94
Retail sales	Low confidence			Low confidence		
CPI	0–4	S	97	Low confidence		

PPI	Low confidence			Low confidence		
NAPM	Low confidence			Low confidence		
Industrial Production	0–4	S	93	Low confidence		
GDP	0–3	S	91	0–3	B	>99
GDP	3–4	B	>99	0–3	B	>99
Employment	0–1	S	93	Low confidence		
Trade balance	0–3	S	93	0–3	S	>99

Although this work concentrates on the short-term daily reaction to unexpected news, the long-term trend should not be overlooked. Economic data can exhibit consistency over long time periods, and the response by the Fed is usually moderate but consistent. If the CPI or PPI show early signs of inflation, then the monetary authority will push rates up slightly; if this doesn't work, as seen in the next series of economic reports, they will move rates slightly higher again. This pattern allows for an underlying trend that can be used to filter the direction of trades and add confidence to the results.

Readers are cautioned that the Treasury-stock Index relationship can change for long periods due to the state of the economy. While the underlying economic relationship will eventually hold true, it is always important to study the market yourself and verify the patterns that you will use for trading. The process will build understanding and confidence in the method.

Reaction to Unemployment Reports

Markets treat unemployment data seriously because it is a direct reflection of how the population is faring. The government is sensitive to unexpected changes in the number of persons filing for unemployment benefits. Using Logical Information Machines (LIM), it was found that when the market underestimated its expectations of the monthly unemployment figure by at least 0.2%, there was an average return of 4.5% in the S&P 500 during the following 27 days from the close of the report day. Similarly, U.S. 30-year Treasury bonds showed an average return on a long position of 3.2% during the period from 3 to 28 days following the report.[7]

Trading the Reaction of Treasuries to Economic Reports

Treasury prices directly reflect the numbers released in economic reports. A good report implies that interest rates will rise and a poor report will cause them to fall; a reaction that accepts the position that the government will use interest rates to counterbalance economic growth, above or below its target level. As discussed in the previous sections, futures markets reflect the expectation of these reports. In a study by Ruggiero[8] that covered 175 report days, Treasuries were seen to overreact to the numbers released in the Producer Price Index (PPI), Unemployment, and Retail Sales on the day of the report, plus the days on which the results of the Treasury auctions are released.

To profit from the reaction of Treasuries, Ruggiero used a 1-day stochastic, (close—low)/(high—low). He then bought Treasuries when the value was below 0.50 and sold when it was above 0.50 on the next open following the report day. Positions were held for 3 days. Using bonds, the results of the PPI were best, Retail Sales next, and unemployment last, although still profitable. We can conclude that traders overreact to all three reports, but higher volatility will yield better returns.

Raschke Trades the News

In her popular book with Laurence Conners,[9] Linda Raschke trades only the reaction to the morning economic reports. Using 30-year U.S. bonds as an example, if a report such as the Producer Price Index or Gross Domestic Product causes bond prices to jump more than 1/32 above the high of the previous day, then place a sell stop 3/32 below the high of the previous day to enter a short sale on a reversal. After the new trade is entered, place a stop-loss 1/32 above the high of the current day and move that stop down as soon as possible to a break-even point.

Raschke's approach reflects a businesslike approach to trading, keeping risk as low as possible and the chances of success as high as possible, even during the unusually high price volatility that follows the release of morning reports. The same method is suggested for currencies, but there is no reason why it could not be used for any market that is directly

affected by the economic numbers, such as stock indices. European interest rate and index markets might be particularly interesting because they react to U.S. reports, yet the U.S. economy has only a secondary effect on their own; therefore, reaction should be moderated.

Presidential Election Cycle

Of all the events that move the market, the presidential elections have been the most consistent. The patterns stem from the motivation of the incumbent party to provide good economic news to the voters prior to the election year, and as far into the election year as possible. Stock market action during the election year is always more erratic, as parties battle over the value of each other's actions.

Studies of the 4-year patterns have all yielded very similar results to those shown in Table 14.3.[10] The year preceding the election (*year 3*) posts the strongest gains for the market, followed by a reasonably strong election year. The 2 years after the election show returns below average as the reality of politics reasserts itself and the immediate pressure to improve the economy is removed.

Table 14.3: The Presidential Election Cycle, 1912–1992, Based on the Percentage Returns of the Dow Jones Industrial Averages

Open table as spreadsheet

Pre-election year	11.0%
Election year	7.0
Post-election year	4.7
Mid-term year	2.3
Average year	6.3%
Source: Adam White.	

There is the additional possibility that there is an 8-year cycle that should be watched; however, the 8-year period should be most informative if it represented only those years in which the same president was in office. Actions by a president who cannot be reelected are likely to be different from one who seeks another term; therefore, we should expect a different pattern. This can be made more intricate by studying the patterns preceding and following a change of party, all of which have a fundamental basis in the behavior of the political parties and the voters.

More sophisticated computer software, such as that provided by Logical Information Machines, a Chicago firm, can produce a very interesting, closer view of how voters respond to election politics. Table 14.4 breaks the election year into seven periods between the key events for those years in which the stock market began the election year within 8% of its 2-year high price (*days* refer to business days):

1. The returns of the year preceding the election year.
2. The first 10 days of the new year, typically a strong period (days 0–10).
3. Through the State of the Union address and the primaries (days 10–83).
4. Waiting for the conventions (days 83–161).
5. Preelection blahs: the actual campaign (days 161–195).
6. The election to year-end reaction (days 195–253).
7. Combined periods (2) + (4) + (6).

Table 14.4: Election Year Analysis for Years in Which the Stock Market Began the Year within 8% of the Previous Two-Year Highs

Open table as spreadsheet

Year	1.	2. First 2	3.	4. Pre-	5. Pre-	6. Election to	7.

	Previous Year	weeks (1–10)	Primaries (10–83)	convention (83–161)	election (161–195)	year-end (195–253)	(2)+(4) +(6)
1936	41.82	2.76	4.64	11.91	-0.62	5.85	20.52
1944	19.45	1.63	-.84	9.27	-.86	3.14	14.04
1952	16.15	1.60	-2.82	8.02	-2.49	5.47	15.10
1956	27.25	-1.78	5.42	3.16	-6.65	2.38	3.76
1960	8.48	-2.49	-5.75	2.94	-7.13	8.49	8.95
1964	18.89	1.79	4.44	3.03	2.52	0.06	4.88
1968	20.03	0.26	-0.10	1.44	4.39	4.25	5.95
1972	10.82	1.41	3.39	5.30	-1.78	4.88	11.59
1980	12.31	2.26	-5.42	18.57	-0.20	7.66	28.49
1984	17.53	1.27	-5.01	4.27	0.41	0.63	6.17
1992	26.30	0.80	-2.72	2.14	-0.23	5.87	8.82
Average	19.91	0.86	-0.44	6.37	-1.15	4.43	11.66
Source: Michael Carr, Logical Information Machines.							

Combining the three periods (2), (4), and (6), which have strong upward biases, gives consistently positive results. Even if the newly elected party fails to deliver on their campaign promises, traders could have already converted those marketing gimmicks into stock market profits.

[5]Ben Warwick, *Event Trading* (Irwin, 1996).

[6]Arnold Larson, "Measurement of a Random Process in Futures Pricing" (Food Research Institute Studies 1, no. 3, November 1960), referenced in Warwick, *Event Trading*.

[7]Gibbons Burke, "Event-Based Analysis," *Futures* (April 1995).

[8]Murray A. Ruggiero, Jr., "Exploiting Report Day Tendencies in Treasuries," *Futures* (February 2001).

[9]Laurence A. Conners and Linda Bradford Raschke, *Street Smarts* (M. Gordon Publishing, Malibu, CA, 1995)

[10]Articles by Adam White, "The Eight-Year Presidential Election Pattern," *Technical Analysis of Stocks & Commodities* (November 1994); Arthur A. Merrill, "The Presidential Election Cycle," *Technical Analysis of Stocks & Commodities* (March 1992); and Michael J. Carr, "Get out the Vote and into Stocks," *Futures* (February 1996), all show very similar results for the 4-year election pattern.

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COMMITMENT OF TRADERS REPORT

Drawing from more than 20 years of experience in analyzing the CFTC's *Commitment of Traders Report*, William L. Jiler described an approach to identifying a major trend in his *1985 CRB Commodity Yearbook*.[11] With his usual thoroughness and clarity, Jiler presents material which had previously been unsuccessfully interpreted.

Originally released on the 11th day of each month, the publication of the COT report changed to twice each month in 1990, biweekly in 1992, and has been released every Friday since January 2000. The content of the report has remained the same. The *Commitment of Traders Report* summarizes the positions of *reporting* and *nonreporting* traders as of the close of trading on the Tuesday of the reporting week. *Reported positions* are those exceeding a minimum level determined for each futures market (e.g., 750,000 bushels for corn, 500,000 for soybeans, 500 contracts for 30-year Treasury bonds, and 300 contracts for the S&P 500). These levels are based on the total activity of the market and may change over time. As of January 2000, those traders with reportable positions must aggregate all smaller positions held in the same market into one number. Previously, only the individual orders in excess of the reporting limit needed to be identified. The report subdivides the open interest into positions held by hedgers, who are commercial users of the commodity, and speculators. By subtracting the reported positions from the total open interest, the total positions of small hedgers and speculators can be found. For grain reports, shown in Figure 14.2, positions are further divided into *old crop* and *other* positions, including new crop and intercrop spreads.

SOYBEANS - CHICAGO BOARD OF TRADE

COMMITMENTS OF TRADERS IN ALL FUTURES COMBINED AND INDICATED FUTURES. FEBRUARY 28. 1985

FUTURES	TOTAL OPEN INTEREST	REPORTABLE POSITIONS: NON-COMMERCIAL: LONG OR SHORT ONLY: LONG	LONG OR SHORT ONLY: SHORT	NON-COMMERCIAL: LONG AND SHORT (SPREADING): LONG	LONG AND SHORT (SPREADING): SHORT	COMMERCIAL: LONG	COMMERCIAL: SHORT	TOTAL: LONG	TOTAL: SHORT	NONREPORTABLE POSITIONS: LONG	NONREPORTABLE POSITIONS: SHORT
	(THOUSAND BUSHELS)										
ALL	359,190	15,810	32,400	41,060	41,060	117,420	140,380	174,290	213,840	184,900	145,350
OLD	302,170	16,275	35,075	27,620	27,620	105,685	128,700	149,580	191,395	152,590	110,775
OTHER	57,020	9,280	7,070	3,695	3,695	11,735	11,680	24,710	22,445	32,310	34,575
	CHANGES IN COMMITMENTS FROM JANUARY 31, 1985										
ALL	-330	-9,240	15,575	18,280	18,280	16,560	-44,770	25,600	-10,915	-25,930	10,585
	PERCENT OF OPEN INTEREST REPRESENTED BY EACH CATEGORY OF TRADERS										
ALL	100.0%	4.4	9.0	11.4	11.4	32.7	39.1	48.5	59.5	51.5	40.5
OLD	100.0%	5.4	11.6	9.1	9.1	35.0	42.6	49.5	63.3	50.5	36.7
OTHER	100.0%	16.3	12.4	6.5	6.5	20.6	20.5	43.3	39.4	56.7	60.6
	NUMBER OF TRADERS	NUMBER OF TRADERS IN EACH CATEGORY									
ALL	144	23	32	33	33	54	41	100	100		
OLD	134	23	32	23	23	51	39	88	90		
OTHER	32	8	8	5	5	9	6	21	17		

CONCENTRATION RATIOS

PERCENT OF OPEN INTEREST HELD BY THE INDICATED NUMBER OF LARGEST TRADERS

	BY GROSS POSITION: 4 OR LESS TRADERS: LONG	4 OR LESS TRADERS: SHORT	8 OR LESS TRADERS: LONG	8 OR LESS TRADERS: SHORT	BY NET POSITION: 4 OR LESS TRADERS: LONG	4 OR LESS TRADERS: SHORT	8 OR LESS TRADERS: LONG	8 OR LESS TRADERS: SHORT
ALL	13.0	23.4	18.1	28.6	10.5	21.3	14.6	25.3
OLD	13.9	25.0	19.6	30.4	11.9	23.6	16.1	28.2
OTHER	18.6	20.6	27.4	28.7	18.6	20.2	27.3	26.8

Figure 14.2: Commitment of Traders Report.

In order to analyze the shifts in position, Jiler has compiled tables of *normal patterns*, similar to a seasonal study (see Figure 14.3). When the open interest of one group is significantly greater than their normal holdings, they express a definite opinion on the direction of the market. By tracking these changes for many years and observing the corresponding price changes, Jiler concludes that the large traders have the best forecasting record, with the large hedger better than the large speculator. The small traders were notably worse. Guidelines were stated as:

Figure 14.3: Jiler's *normal* trader positions.

The most bullish configuration would show large hedgers heavily net long more than normal, large speculators clearly net long, small traders heavily net short more than seasonal. The shades of bullishness are varied all the way to the most bearish configuration which would have these groups in opposite positions—large hedgers heavily net short, etc. There are two caution flags when analyzing deviations from normal. Be wary of positions that are more than 40% from their long-term average and disregard deviations of less than 5%.

This result is confirmed by Curtis Arnold,[12] who compared positions of large and small speculators with commercials for 1-year periods spanning 1983–1984. Arnold shows in Figure 14.4 that the position of commercials and small speculators tend to be opposite, with the commercials positioned to profit from the subsequent price move.

Figure 14.4: Arnold's trader position study.

Over a wider group of 36 markets from 1983 to 1989, a study conducted by Bullish Review [13] showed that a large weighting of long or short positions held by commercial hedgers correctly forecast significant market moves 67% of the time. In retrospect, it seems likely that a large commercial trader, bank, investment house, or other institution would take a longer-term view of the market, setting positions to take advantage, (or avoid the risk) of a potential price move. Because of their size, institutions are not likely to change their positions on minor market variations. Analysts should be aware, however, that a qualified *hedger*, one that is registered with the CFTC in order to set large positions due to their ongoing risk of holding physicals, may also take large speculative positions under the same umbrella.

Creating an Oscillator for the COT Numbers

Briese uses a *COT Index*[14] as an oscillator to plot the results of the COT report.

$$COT\ Index = 100 \times (NL_t - Lowest(NL, n))/(Highest(NL, n) - Lowest(NL, n))$$

where NL = the net long positions of a given group of reporting traders
t = the current data
n = the lookback period, ranging from 1.5 to 4 years

This should be recognized as the formula for a stochastic, giving the bullish percentage.

In order to see the cycle of the three reporting groups, Ruggiero[15] plotted the stochastic of each group using a calculation period of 1 year. The positions of commercial and those of small-lot traders are completely out of phase. The stochastics show that the commercial traders reach an extreme level of bullishness (high stochastic values) just ahead of an upwards price move, and a low stochastic value just before prices drop. This implies that they are usually holding the right position. Ruggiero interprets the other values to mean that funds trading these markets become bullish or bearish when the commercials are beginning to exit their positions, about halfway through the move. Small-lot traders tend to become bullish, with a high stochastic reading, as prices peak.[16]

While this study supports the previous work, the use of a stochastic makes a strong visual impact, showing how the bullishness and bearishness of these different groups are remarkably out of phase. The best trading signals occur at just these times, when the positions of the commercials are strongest, well above 80, and the two other groups are weakest, under 20, or just the opposite. Extreme differences precede change in the positions of each group and the market price. The holding time for this trade corresponds to the time it takes for the stochastic to switch from high to low, and low to

high, for the different groups. On average this may take 3 to 6 months, depending on the market.

Trading Signals

An additional refinement was applied to the reported positions for the S&P 500. When the stochastic for the commercials crosses above 80 and the S&P closes lower than it did 4 weeks ago, we get a buy signal. The position is closed out when the stochastic touches 40, which is close to the neutral level. It is not safe to assume that stochastic values will move from overbought to oversold; it is much better to only expect them to return to neutral.

Ruggiero also used the COT Index for both commercials and small traders to create a basic timing model:

> If COT Index Commercials[lagged 1] > Ctrigger and COT Index Small < Strigger then buy
>
> If COT Index Commercials [lagged 1] < Ctrigger and COT Index Small > Strigger then sells[17]

The results are bullish when the COT Index for commercials is high and the COT Index for small traders is low. The results are bearish when the COT Index for commercials is low and the COT Index for small traders is high. The COT Index for commercials is lagged by one or more weeks because the actions of commercials are interpreted as leading the market. *Ctrigger* and *Strigger* are levels that are determined to be significant turning points. In Ruggiero's tests, this method was highly successful for Treasury bonds using *Ctrigger* = 30, *Strigger* = 50, and *lag* = 1 (one week).

The numbers in the COT report can be turned into a *Sentiment Index*, as shown in the next section of this chapter.

[11]William L. Jiler, "Analysis of the CFTC Commitments of Traders Reports Can Help You Forecast Futures Prices," *1985 CRB Commodity Year Book* (Commodity Research Bureau, Jersey City, NJ, 1985).

[12]Curtis Arnold, "Tracking 'Big Money' May Tip Off Trend Changes," *Futures* (February 1985).

[13]Steve Briese, "Tracking the Big Foot," *Futures* (March 1994).

[14]Murray A. Ruggiero, Jr., *Cybernetic Trading Strategies* (Wiley, 1997).

[15]Murray A. Ruggiero, Jr., "Seeking a Commitment," *Futures* (April 2002).

[16]The same conclusion is reached by Jon D. Andersen in "Analyze Net Positions," *Technical Analysis of Stocks & Commodities* (July 2002), although Andersen plotted the actual COT values—rather than convert to an indicator—and observed the diverging patterns.

[17]In Ruggiero, *Cybernetic Trading Strategies*, this is shown as a *buy* signal; however, it seems that it should have been a *sell* signal.

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OPINION AND CONTRARY OPINION

Market sentiment, the collective opinion of the investors, is a driving force in the market, yet it is very difficult to measure and even harder to deliver those results in a timely fashion. For that reason, analysts often substitute a combination of volume, open interest, and price for true sentiment, hoping that the recorded actions of traders closely relate to what they are thinking. Opinion, however, weighs on the marketplace and governs future actions in the same way the high volume may not move prices today, but provides a platform for a potentially large price move.

Public opinion is also fast to change. A prolonged bull market in stocks may show a gradual increase in bullish sentiment; however, the collapse of a bank, an increase in rates by the Central Bank, a sharp downturn in the economy of another region, or a single sharp drop in the stock index could quickly change the public's opinion. In reality, sentiment indicators are most popular for trading in the direction opposite to the unified public opinion.

Contrary Opinion[18]

The *contrarian* lies somewhere between the fundamentalist and the technician, basing actions on the behavior of crowds, in this case the market participants. The contrarian sees the end of a bull market occurring when everyone is bullish. Once all long positions have been set, there is diminishing influence by the bulls; moreover, the contrarian believes that opportunities always lie in the reverse direction from crowd thinking.

Contrary opinion alone is not meant to signal a new entry into a position; it only identifies situations that qualify. It lacks the timing. It is more of a filter than a trading system, a means of avoiding risk and finding an opportunity. Consider the patterns that appear in every prolonged bull or bear move. First, there is a place where the direction is generally accepted as the major trend. After that, traders wait for a pullback to enter in the direction of the trend at a more favorable price. These price *corrections* within a trend become smaller or even disappear when everyone wants to *buy a lower open* or *sell a higher open* until finally there is a *blow-off* and a reversal of a major bull or bear market. The dramatic end to a prolonged move is generally credited to the entrance of the public; when the masses are unanimously convinced that prices are going higher, who else is left to buy?

The other important ingredient for a contrarian is that all the facts cannot be known. The widely accepted belief that prices will go higher must be based on presumptions; if the final figures were out and the reality known, the market would adjust to the proper level. This idea is older than *The Art of Contrary Thinking*. In 1930, Schabacker discussed cashing out of a long position if the market rallied on news that was general rather than specific.

The practical application of the theory of contrary opinion is the *Bullish Consensus*[19] and the *Market Sentiment Index*, created from a poll of market letters prepared by the research departments of brokerage firms and professional advisors. In the *Bullish Consensus* (see Figure 14.5), these opinions are weighted according to the estimated circulation of these letters until a final index value is determined.

$$Bullish\ Consensus = \frac{Sum\ of(Each\ source \times Relative\ circulation \times Bullish\ opinion)}{Sum\ of(Each\ source \times Relative\ circulation \times 100)}$$

Figure 14.5: Interpretation of the Bullish Consensus. *Source*—R. Earl Hadady, *Contrary Opinion* (Pasadena, CA—Hadady, 1983).

The value of the bullish consensus ranges from 0 to 100%, indicating an increasingly bullish attitude. Because of the bullish tendency of the novice trader, and the long-term upwards bias of the stock market, the neutral consensus level is 55%. The normal range is considered from 30 to 80%, although each market must be individually evaluated.

Hadady also devised a simple mathematical way of displaying the bullishness of the market.[20] Using the formula below, he shows that when 80% of traders are bullish, then the average buyer will hold only ¼ the number of contracts as the

average seller. This leads to a precipitous drop in prices once a decline begins.

$$N_t = \frac{20\%T \times N_s}{80\%T} = \frac{1}{4} \times N_s$$

where T = the number of traders in the market

N_t = average number of contracts held by a single bullish trader

N_s = average number of contracts held by a single bearish trader

The principles of contrary opinion do not require that trades only be entered in the direction opposite to the current price movement. Within the normal range, the contrarian will take a position in the direction of the trend. Frequently, the Bullish Consensus will begin increasing prior to the price turning higher, indicating that the attitude of the trader is becoming bullish. It is considered significant when the index changes 10% in a 2-week period. Once the Bullish Consensus reaches 90% during an upward move, or 20% during a bear move, the market is considered overbought or oversold, and the contrarian looks for a convenient point to exit from the current trade. Positions are not reversed until prices show that they are changing direction. This could be identified using a moving average. Remembering Schabacker's advice, the occasion of a general news release that moves the market further in the direction of the general opinion would be an opportune moment to enter a contrary trade; specific news that fails to move prices would be a good indication of an exhausted trend when the consensus is overbought or oversold. A typical contrarian situation identified by Hadady is given in Figure 14.6.

Figure 14.6: Typical contrarian situation—wheat, 1978.

R. Earl Hadady said, "The principle of contrary opinion, by definition, works 100% of the time. The problem is getting an accurate consensus."[21] Timeliness is a problem with this index; if 60 to 70 market letters are reviewed, read, and weighted to form an index, the results may be outdated before they can be used. The theory of contrary opinion also

emphasized its use as a timing device for entering trades at an opportune moment and for filtering out the ambiguous trades; the theory is not readily applicable to exiting a position unless the reverse consensus occurs. Because a consensus does not have to switch uniformly from bullish to bearish, it is not always prudent to wait for an opposite confirmation before exiting a trade.

Commitment of Traders Sentiment Index[22]

The reported positions of traders, published in the CFTC's *Commitment of Traders Report*, may be considered a recording of market opinion into categories. By combining the idea behind the stochastic calculation with a method originally developed by Curtis Arnold, you can create a *Sentiment Index*:

$$\text{Commitment of Traders Sentiment Index} = \frac{\text{Current net} - \text{Minimum net}}{\text{Maximum net} - \text{Minimum net}}$$

where *Net* = Commercial net position (number of contracts) minus the total combined net position of large speculators and small traders

Maximum = Greatest net difference that occurred during the comparison period

Minimum = Smallest net difference that occurred during the comparison period

The intent of the Sentiment Index is to rank the current spread between the commercial and speculative positions within the context of the historic range, in a manner similar to a stochastic. There seems to be uniform agreement that the commercials are the group that determines the direction of prices. A shift in the position of the commercials should be closely watched.

A Lesson From Put-Call Ratios

The ratio of put option volume to call option volume, called the *put-call ratio*, is the major sentiment index for listed options. It too is used for its contrary value. The interpretation of extreme levels of the put-call ratios, in particular for the major index options, points out a problem that may reflect on the proper use of all contrary indicators.[23]

Prior to 1986, the market was considered ready for an upturn when the total put volume exceeded 65% of the total call volume. Similarly, when the put volume fell to 35% of the call volume it was a bearish indication. In the volatile markets of 1986 and 1987, these levels proved to be far too close and as McMillan said, "Not surprisingly, the put-call ratios fell into some disfavor at that point." This could easily happen with a contrary indicator, or any indicator which rarely reaches its extreme values (even a relative strength index that has no maximum and minimum bounds). Because contrary opinion is a valuable addition to analysis, the use of these indicators now focuses on relative highs and lows. This can be accomplished by smoothing the ratio using a standard moving average or momentum indicator, a simple difference over *n* days. When the ratio moves over 65% and turns down it is time to sell. This approach gives up a timing edge but greatly reduces risk and increases reliability.

Dogs of the Dow and the Small Dogs

One contrarian method that has captured the public's interest is the *Dogs of the Dow*, popularized by Michael O'Higgins in *Beating the Dow* (1991).[24] The method shows that, if, on January 1 of each year, you bought the 10 members of the Dow with the lowest stock dividend yields from 1973 through 1989, you would have beaten the average return of the Dow by 6.8% per annum. It assumes that good companies pull themselves up after a bad period. While not always profitable during the turn of the market between 2000 and 2002, it is reported to have done much better than the Dow Index.

For the small investor, O'Higgins proposed the *Small Dogs of the Dow*, also fondly called the *puppies*. Out of the 10 stocks selected as the Dogs of the Dow, buy the ones with the lowest stock value. In Robert Sheard's book, *The Unemotional Investor*, he presents the *Foolish Four*, a way of selecting 4 of the 10 Dogs.[25] As described on winninginvestments.com, Sheard sorts the 5 stocks of the Small Dogs, lowest price at the top, and places them alongside the 10 Dogs, lowest yields at the top. If the same stock appears at the top it is eliminated because it is trading at a low price for a good reason. If there is no match, he takes the top 4 stocks from the Small Dogs.

Watching the Big Block Transactions

Big block transactions are those that are equal to or greater than 100,000 shares or have a transaction value of $1 million or more. *Corporate insiders* are its officers, directors, and beneficial owners of more than 10% as specifically named in the 1934 Securities and Exchange Act, Section 16. Corporate insiders must register their holdings with the SEC and must

disclose any share transactions by filing a report within 30 days after the purchase or sale. Due to slowness in these filings, the Sarbanes-Oxley Act became effective in August 2003 to accelerate reporting (among other things), which now must be done within 2 days of the transaction. *Insider trading* is not the same as *trading on inside information*, which is illegally making a trade based on nonpublic or privileged information. Insider selling is a common occurrence, as executives who have accumulated stock options, and venture capitalists who see the appreciation in share value, convert their holdings into cash. Some of these transactions are done at regular intervals and have no relationship to market direction, while others are at opportune moments and may offer insight into the future direction of prices.

The combination of big block trades by corporate insiders is a special case that was studied by Bjorgen and Leuthold,[26] who concluded in 1998 that

- Since 1983, when net selling, measured in dollars, has reached historically high levels, the stock market performed poorly over the next 12 months. At the time this article was written, corporate insiders were selling at levels approaching historic extremes.
- When net selling reaches historic lows, the market has performed significantly above average over the next 12 months.

The authors also noted that the number of net buy or sell transactions, regardless of total dollars, may also follow the same relationship. The combination of these two items, large transaction size and privileged information, seems analogous to the positions of commercial traders in the *Commitment of Traders* report published weekly by the CFTC. Earlier in this chapter it was shown that commercials tend to be on the right side of the market while the small speculator is on the other side.

[18]For the most definitive works, see Humphrey Neill, *The Art of Contrary Thinking* (Caxton Printers, Caldwell, OH, 1960), who is credited with having first formulated the concept, and Earl R. Hadady, *Contrary Opinion* (Hadady, Pasadena CA, 1983).

[19]The *Bullish Consensus* is a product of Sibbett-Hadady, Pasadena, CA; a Market Sentiment Index is published in *Consensus*, Kansas City, MO.

[20]R. Earl Hadady, "Contrary Opinion," *Technical Analysis of Stocks & Commodities* (August 1988).

[21]George Angell, "Thinking Contrarily," *Commodities* (November 1976).

[22]Stephen E. Briese, "Commitment of Traders as a Sentiment Index," *Technical Analysis of Stocks & Commodities* (May 1990).

[23]Lawrence G. McMillan, "Put-Call Ratios," *Technical Analysis of Stocks & Commodities* (October 1995).

[24]See the website, "winninginvesting.com."

[25]See the website for the Motley Fool at "fool.com."

[26]Eric Bjorgen and Steve Leuthold, "Corporate Insiders' Big Block Trades," *Journal of Technical Analysis*, published by the Market Technicians Association (Winter—Spring 2002). This study was written in May 1998 and won the 1999 Charles Dow Award.

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FIBONACCI AND HUMAN BEHAVIOR

> *Even though we may not understand the cause underlying a particular phenomenon, we can, by observation, predict the phenomenon's recurrence*.
> —R. N. Elliott[27]

History is a record of great achievement in the face of disbelief, as exhibited by the explorations of Columbus, Magellan, and Marco Polo; the science of da Vinci, Galileo, and Copernicus; and the philosophy of Socrates, Aristotle, and Plato. We are more observant today and less apt to condemn those who delve into areas still unknown. Of these, astrology is the most popular, with a very large following, particularly in Asia. Its acceptance may be partly because of its strong basis in physical phenomena. It attempts to classify personality traits based on positions of planets and stars at the time of birth, and predict the actions of groups based on the relationships of planets, moons, and comets to one another. The science of physics confirms that the positions of our moon and planets, the energy given off, and the gravitational phenomenon are directly responsible for physical occurrences of tides and weather—it seems reasonable that they might have a measurable effect on behavior. This will be considered in the following sections.

Let us look first at the fascinating subject of symmetry in nature. Science is familiar with the symmetric shapes of crystalline substances, snowflakes, the spherical planets, and the human body. The periodicity of the universe—sun spots, eclipses, and other cyclic phenomena—is also understood, but its bearing on human behavior is not yet known. Work in biorhythms is only at the point of being a curiosity; the relationship of behavior to nonbiological functions, such as planetary positions, is too abstract.

In 1904, Arthur H. Church wrote about phyllotaxis, the leaf arrangement of plants,[28] showing its relationship to a mathematical series based on the works of Leonardo Pisano, commonly called *Fibonacci*.[29] This mathematical series of numbers has been attributed the quality of representing human behavior. Examples have been given which appear to be more than interesting coincidences to some, and significant to others. However, the resulting *Fibonacci ratios* have become an important part of price analysis.

It is not certain how Fibonacci conceived his summation series. His greatest work, *Liber Abaci*, written in the early part of the 13th century, was not published until 1857.[30] It contained a description of a situation involving the reproduction of rabbits in which the following two conditions hold: Every month each pair produces a new pair, which, from the second month on become productive; deaths do not occur. This becomes the famous *Fibonacci summation series*

> 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, …

(more accurately written as 1, 1, 2, 3, …, where the first two Is represent the original pair of rabbits). Each element of the series is the sum of the two previous entries.

Those who have studied the life of Fibonacci often attribute the series to his observations of the Great Pyramid of Gizeh. This pyramid, dating from a preliterary, prehiero-glyphic era, contains many features said to have been observed by Fibonacci. In the geometry of a pyramid there are 5 surfaces and 8 edges, for a total of 13 surfaces and edges; there are 3 edges visible from any one side. More specifically, the Great Pyramid of Gizeh is 5,813 inches high (5-8-13, and the inch is the standard Egyptian unit of measure); and the ratio of the elevation to the base is .618. [31] The coincidence of this ratio is that it is the same as the ratio that is approached by any two consecutive Fibonacci numbers; for example,

$$\frac{2}{3} = .667, \frac{3}{5} = .600, \frac{5}{8} = .625, \cdots, \frac{89}{144} = .618$$

It is also true that the ratio of one side to a diagonal of a regular pentagon is .618.

Another phenomenon of the Great Pyramid of Gizeh is that the total of the 4 edges of the base, measured in inches, is 36,524.22, which is exactly 100 times the length of the solar year. This permits interpretations of the Fibonacci summation series to be applied to time.

The Greeks showed a great fascination for the ratios of the Fibonacci series, noting that while F_n/F_{n+1} = .618, the reverse F_{n+1}/F_n = 1.618 was even more remarkable. They called these relationships *golden sections* and appear to have used them in the proportions of such works as the Parthenon, the sculpture of Phidias, and classic vases. Leonardo da Vinci consciously applied the ratio to his art. It has always been a curiosity that the great mathematician, Pythagoras, left behind a symbol of a triangle of Fibonacci proportions with the words "The Secret of the Universe" inscribed below.

Church, in his work in phyllotaxis, studied the sunflower, noting that one of normal size (5 to 6 inches) has a total of 89 curves, 55 in one direction and 34 in another, consecutive Fibonacci numbers. In observing sunflowers of other sizes, he found that the total curves are Fibonacci numbers (up to 144) with the two previous numbers in the series describing the distribution of curves. The chambered nautilus is considered a natural representation of a *golden spiral*, based on the proportions of the Fibonacci ratio (see Figure 14.7). Nature also shows that the genealogical pattern of a beehive, and the stem (growth) structure of the Sneezewort (*Achillea ptarmica*) are perfect duplicates of the Fibonacci series.

Figure 14.7: The *Golden Spiral*, also the logarithmic spiral, is a perfect representation of the chambered nautilus. *Source*—Robert Fischer, *Fibonacci Applications and Strategies for Traders* Gohn Wiley & Sons, 1993, p.9). Original source —H.E. Huntley, *The Divine Proportion* (Dover, New York, 1970, pp. iv, 101). Reprinted with permission.

Up to now, aspects of the Fibonacci series have been intriguing, but here it goes a step beyond. The numbers in the series have frequent or coincidental occurrences:

- The human body has five major projections; both arms and legs have three sections; there are five fingers and toes, each with three sections (except the thumb and great toe). There are also five senses.
- In music an octave means eight, represented on the piano by 8 white keys and 5 black, totaling 13.
- There are three primary colors.
- The United States had 13 original states and 13 is an unlucky number.
- The legal age is 21 and the highest salute in the army is a 21-gun salute.
- The human emotional cycle has been determined at 33–36 days by Dr. R. B. Hersey.[32]
- The wholesale price index of all commodities is shown to have peaks of 50 to 55 years according to the Kondratieff wave: in 1815 after the war of 1812, 1865 after the Civil War, 1920 after the World War I, and about 1975…[33]

These examples are not meant to prove anything in the strict sense, but to open an area that may not have previously been considered. Human behavior is not a pure science and probes of this sort may lead the way to further understanding. The following sections deal with ideas such as these—sometimes reasonable and other times seeming to stretch the imagination.

Application of Fibonacci Ratios

Fibonacci ratios have become an integral part of charting, used to measure advances and retracements. The most popular ratio is .618; therefore a price advance that measures $5 from start to peak will be expected to retrace by $3.09, before starting higher again, if it conforms to this pattern. Alternately, traders have used.382, the complement of .618, as a key retracement level; however, this is not a Fibonacci ratio. Advances of .618 or 1.618, based on the length of the previous upwards move, are measured from the end of a retracement to predict the extent of the next leg up. Therefore, a move that retraced .618 can be expected to test the previous highs, or move higher by an additional .618 of the first leg up. Examples of these ratios can be found throughout charting analysis and they are an essential part of Elliott's wave analysis, covered in the next section. Specific examples can also be found in Chapter 4, where *retracements* are discussed.

Fibonacci ratios have also been applied to the duration of price moves by projecting the distance between peaks and valleys. This is covered in the section "Time-Goal Days."

[27]R. N. Elliott, *Nature's Law: The Secret of the Universe* (Elliott, New York, 1946, p. 4).

[28]A. H. Church, *On the Relation of Phyllotaxis to Mechanical Laws* (Williams and Newgate, London, 1904).

[29]In the appendices to Jay Hambridge, *Dynamic Symmetry: The Greek Vase* (Yale University Press, New Haven, CN, 1931, pp. 141–161), there is a full discussion of the evolution of this number series within science and mathematics, together with further references.

[30]Leonardo Pisano, *Il Liber Abaci di Leonardo Pisano* (Baldassare Boncompagni, Rome, Italy, 1857).

[31]Jay Hambridge, *Dynamic Symmetry: The Greek Vase*, pp. 27–38.

[32]R. N. Elliott, *Nature's Law* (p. 55). Elliott quotes other human emotional relationships.

[33]*Cycles* (January 1976, p. 21); see also James B. Shuman and David Rosenau, *The Kondratieff Wave: The Future of America Until 1984 and Beyond* (Dell, New York, 1974), which is based on the theory developed by the Russian economist early in this century.

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ELLIOTT'S WAVE PRINCIPLE

R. N. Elliott was responsible for one of the more highly regarded and complex forms of market technical analysis. The *Elliott Wave Theory* is a sophisticated method of price motion analysis and has received careful study by A. H. Bolton (1960), and later by Charles Collins. His works are fully covered in two publications by Robert Prechter; brief summaries of the method appear in some of the comprehensive books on market analysis.[34] This presentation of Elliott's technique will include both the original principles and extensions with examples.

The Wave Theory is an analysis of behavioral patterns based on mathematics and implemented using price charts; its original application was for the stock index. It is credited with predictive ability with respect to the Dow Jones Industrial Averages that is second only to the occurrence of Haley's comet. It is understood that Elliott never intended to apply his principle to individual stocks, perhaps because the relatively low activity might distort those patterns that would have appeared as the result of mass behavior. If so, caution must be exercised when applying this method to individual stocks and futures markets that might not reflect macroeconomic patterns.

The successes of the Elliott Wave Theory are fascinating and serve to reinforce the use of the technique; most summaries of Elliott's work recount them and the reader is encouraged to read these. The *waves* referred to in the theory are price peaks and valleys, not the formal oscillations of sound waves or harmonics described in the science of physics. The waves of price motion are overreactions to both supply and demand factors within major bull moves developed in five waves and corrected in three. His broad concept was related to *tidal wave bull markets* that have such large upward thrusts that each wave could be divided into five subwaves satisfying the same principle. After each primary wave of the major bull trend there was a major corrective move of three waves, which could be further divided into three subwaves (see Figure 14.8).

Figure 14.8: Basic Elliott wave.

The types of waves could be classified into the broad categories of *triangles* and *ABCs*, representing a main trend and a correction, respectively. The term *triangle* was taken from the consolidating or broadening shape that the waves form within trend-lines, although in later works Elliott eliminated the expanding form of the triangle (see Figure 14.9).

Figure 14.9: Triangles and ABCs.

An interesting aspect of the theory is its compound-complex nature, by which each sequence of triangles can occur in subwaves within waves (Figure 14.10). More recent work suggests that in futures markets, a 3-wave development is more common than 5 waves. Prechter, a well-known interpreter of Elliott's principles, has shown many examples of major stock index moves that conform to the ratio of 1.618. The stock index, which has great participation, is most likely to represent the idealized patterns of human behavior.[35]

Figure 14.10: Compound correction waves.

Elliott's Sideways Markets

Occasionally, the market pauses during a major move; or, it may move sideways in a volatile pattern after completing the fifth leg of a wave. This has been described as "stock prices seen to be waiting for economic fundamentals to catch up with the market expectations."[36] These periods can be represented by a single *three*, a simple zigzag or flat formation, or by the more extended *double* or *triple three* (Figure 14.11).

Figure 14.11: Elliott's *threes*.

A small variation of the *single three* has been noted to occur following the third wave, when the zigzag forms a minor swing reversal with *b* lower than its preceding top, and *c* lower than *a.* Elliott also recognized this as a *descending zigzag* in an upward trend.[37]

Fitting the Market to the Patterns

One point to remember when applying an intricate set of rules is that an exact fit will not occur often. The best trading opportunities that will arise will be for those price patterns that fit best as the move is progressing; each successful step will serve as positive reinforcement for continuing. The critical period in the identification process is the fifth wave. The failure of the fifth wave to form indicates that the last correction of three waves will be retraced. In a bull market, an extension of the fifth wave is often followed by a corrective 3-wave pattern. In addition, the recognition of a 5-wave sequence should be followed by further analysis to determine whether that cycle was part of a more complex series. One of the difficulties in the method is the orientation of the current position to the wave formation; the multitude of primary and secondary waves makes some of the situations subjective until further price movement clarifies the pattern. Anyone interested in the further interpretation of wave formation should begin with Bolton's work.

Elliott's Use of the Fibonacci Series

The application of the Elliott wave theory was unique in its use of the Fibonacci series. Besides the natural phenomena mentioned earlier, the summation series has the mathematical properties that

- The ratio of any number to its successor (F_i/F_{i+1}) approaches .618.
- The ratio of any number to its previous element (F_{i+1}/F_i) approaches 1.618.
- The ratio of F_{i+2}/F_i is 2.618.
- The two ratios (F_i/F_{i+1}) × (F_{i+1}/F_i) =.618 × 1.618 = 1.

Elliott was also able to link certain measurements of the Great Pyramid to the Fibonacci series and connect the number of days in the year as well as the geometric figure of a circle to his theory. Both time and the circle will play a role in Elliott wave analysis.

While Elliott used the lower end of the Fibonacci series to describe the patterns in the stock index, it should be noted that there are increasingly larger gaps between successive entries as the series increases. To be consistent with the original principle, each gap could be subdivided into another Fibonacci series in the same manner that the waves take on a complex formation. Harahus offers an alternate approach to filling these spaces by use of Lucas numbers, formed in the same way as the Fibonacci summation beginning with (1, 3) and resulting in the series (1, 3, 4, 7, 11, 18, 29, 47, 76, 123, 199, …). The two sets are combined, eliminating common numbers, to form (**1, 2, 3,** 4, 5, 7, **8, 13,** 18, **21,** 29, **34,** 47, 55, 76, **89,** 123, **144,** 199, **233**, …). The Fibonacci numbers have been set in bold type since they will receive the most emphasis, while the Lucas numbers will serve as intermediate levels of less significance. The numbers themselves are applied to predict the length in days of a price move. A bull move that lasts for more than 34 days should meet major resistance or reverse on the 55th day or on the 89th day (considering Fibonacci numbers only). It is suggested that a penetration of the 89th day should permit the series to start again with the beginning of the series added to 89 (e.g.,…, **94,** 96, **97, 102,** 107, **110,** 118, **123,** 136, …), including the more important Lucas and Fibonacci numbers from the original series. This effect is similar to the complex wave-within-a-wave motion.

The same numbers are used to express key levels in a trend reversal. For example, a bull move that carries prices up for

47 days before a reversal should meet resistance at the price level on the 34th day. If that price does not stop the reversal, either the behavioral implications of the number series do not hold for this situation or prices are in a different part of the cycle.

With the introduction of Lucas numbers (L) there are some additional key ratios. In the combined Fibonacci-Lucas series (FL), denote an element with j if it is the first element of the other series following entry i; L_j is the first Lucas number entry following F_i that is a Fibonacci number. This results in the ratios F_i/L_j = .72, L_i/F_j = .854, and $F_i/F_{i+2} = L_i/L_{i+2}$ = .382.

The important ratio of a Fibonacci number to its following entry can be represented by the ratio of successive numbers $(1/2, 2/3, 3/5, 5/8, 8/13, 13/21, 21/144, \ldots)$. When expressed in decimal, these ratios approach the number.618 in a convergent oscillating series (1.000, .500, .667, .625, .615, .619, …). These ratios, the key Fibonacci-Lucas ratios and the alternate-entry ratios, represent the potential resistance levels, expressed as a percentage, for price adjustments within a well-defined move. For example, a price advance of 100 points in the Dow to 9,500 might correct 100%, 50%, or 62%, to 9,400, 9,450, or 9,438, respectively, according to the most important ratios.

Trading Elliott

Elliott also knew that there was great variability in the waves and ratios created by price movement. The appearance of the waves is not regular in either length or duration and should not be expected to continually increase as they develop, although the fifth wave is generally the longest. The waves must be identified by peaks only. Elliott introduced a channel into his theory in order to determine the direction of the wave being analyzed as well as to establish intermediate price objectives. Looking back at the diagram of the basic wave, note the channel that is drawn touching the peaks and bottoms of the bull move. For every two peaks, a channel can be drawn that will serve as a trendline for price objectives. This same technique is covered in detail in a later section of Chapter 3, where price objectives are covered. A break of the lower trendline in the bull move will serve to tell when a correction has begun.

The Elliott Wave Theory is very intricate, and a full understanding requires a careful study of the original material, but the following rules outline the essentials of the method:

1. Identify a main trend.
2. Determine the current status of the main trend by locating the major peaks and bottoms that will form the five key waves.
3. Look for 3 wave corrections and 5 wave subtrends or extensions.
4. Draw trendlines to determine the direction of the trend and reactions.
5. Measure the length of the waves in days to determine their adherence to the Fibonacci sequence, or alternatively, the Fibonacci-Lucas series; measure the size of reactions as compared to Fibonacci or Fibonacci-Lucas ratios.
6. Watch for reactions at points predicted by the Fibonacci sequence and corresponding to the patterns described by the 5-wave main trend and 3-wave correction.
7. Use the ratios, day counts, and trendlines as predictive devices to select price objectives.
8. Use the trendlines to determine changes of direction.

As complex as Elliott waves are, computer programs have been written that do a remarkably good job identifying them and showing them on a chart. To find these programs, you only need to type "Elliott wave" into an Internet search engine. The most well-known of these products is *Advanced GET*, which includes a sophisticated graphics package and technical analysis tools.

The Supercycle

In all interpretive analysis, the big picture of long-term economic movement forms the foundation, and shorter-term cycles and patterns are found within that larger structure. Elliott's wave theory is no exception. Shorter time periods include relatively more noise that make frequent, erratic patterns difficult to separate from the significant market movement. In 1996, Robert Prechter, well-known for his focus on Elliott, used a *Supercycle* to describe the 5th wave of the prolonged bull move that was still intact at that time (see Figure 14.12), applying Fibonacci ratios to forecast targets and explain the

past moves.

Figure 14.12: Price Relationships in Supercycle (V). *Source*—Robert Prechter, Jr., *Futures* (March 1996). Copyrighted 1996 by Robert Prechter, Jr. Reprinted with permission of *Futures*.

When using a charting technique, it is best to look for markets that, in some time frame, conform to the type of patterns you are seeking. This is also true with Elliott, which requires that prices advance in proportion to the Fibonacci ratios. In the DJIA Supercycle, shown in Figure 14.12,

- Wave 1 begins at the 1932 low of 41.22, peaking in 1937 at the high of 194.40, a gain of 371.61%, close to the Fibonacci ratio of 38.2%.
- A Wave 2 retracement follows, which is equal to 66% of Wave 1.
- Wave 3 starts in 1942 at the low of 92.29 and ends in 1966 at the high of 995.15, a gain of 970.975%. Note that when you divide the first gain by the second gain, 371.616/970.975, you get the classic Fibonacci ratio .3827. If Wave 1 is taken as equal to .618, then Wave 3 is 1.618.
- The Wave 4 retracement is another small move which may be interpreted as ending in 1976 at 577.60 or, preferably in 1883 at 776.92.
- The *ideal* 5th Wave should then follow the same pattern, and gain 600.692%. This target is found by finding the value of Wave 5 such that

  Wave 1 / *Wave* 5 = *Wave* 5 / *Wave* 3 = 0

  This gain of 600% is based on the low of 776.92, and gives a target price of 5444. Traders are cautioned that the high volatility and unusual extension of the current move is likely to cause very specific targets, such as this, to be violated by as much as 10%.

Automating Elliott's Wave Analysis

While analysts believe that there is substantial value in Elliott's method and accept its concepts, it is an added benefit to be able to assess its success in the past. Monitoring the formations using a program such as Advanced GET may satisfy

this problem; however, there are simple formations that can be tested automatically with a minimum of programming effort.[39] Murray Ruggiero has defined the four trading opportunities for a basic Elliott wave pattern to be:

1. Enter Wave 3 in the direction of the trend.
2. Stay out of the market during Wave 4 (a retracement).
3. Enter Wave 5 in the direction of the trend.
4. Take the countertrend trade at the top of Wave 5.

When a wave appears in two time frames, such as in both daily and weekly charts, the likelihood of the success of this formation increases. This concept is well accepted throughout technical analysis and can be found in many sections of this book, including Chapter 19. Without confirmation of a pattern or trade, the risk increases.

The key to automating Elliott's technique is the creation of the Elliott wave oscillator (*EWO*). A series of extensions and pullbacks can be found using the *EWO* and combined with a method of counting waves that locates the current price within the standard Elliott wave pattern. The following five steps present the bull move only, although the bear market is treated as just the reverse set of rules.

1. Calculate the Elliott wave oscillator (*EWO*) as the difference between a 5-period and a 35-period simple moving average, applied to the average of the high and low prices,

   ```
   mean= (high + low) / 2
   EWO= average(mean,5) -average(mean,35)
   ```

2. A new upwards trend begins when the *EWO* makes a new high for period *n*, where *n* is determined by the user. This allows, for example, Wave 3 to be identified when it goes above the high of Wave 1.

3. A new upwards trend also begins when the current value of *EWO* is below zero (the 5-day average is below the 35-day average), and the trend is down (Step 2), but the *EWO* has rallied by a predetermined percentage (called the *trigger*) of the lowest oscillator value of the past *n* periods (*lowest*(*EWO*,*n*)). Then the trend is up if EWO < 0, the previous trend value is down, and

   ```
   EWO > trigger*lowest(EWO,n)
   ```

   This rule allows the next wave to be found based on the retracement that comes between each wave.

4. To relate this to Elliott, we must know where prices are located in the five-wave sequence. For an uptrend, this is done in the following order:

   a. When the trend turns from down to up we assume it is the beginning of Wave 3; we save the current values of *EWO* and price.

   b. Continue to save the new high *EWO* value and new high price for Wave 3.

   c. Wave 4 begins when *EWO* falls to zero.

   d. If Wave 4 is currently active and the price is a 5-period high and *EWO* > 0, then Wave 5 begins. Save the highest *EWO* value and highest price of Wave 5 whenever they occur.

   e. If *EWO* in Wave 5 becomes higher than the highest EWO value in Wave 3, then we are still in Wave 3. Label the current Wave 5 values to indicate Wave 3, and continue as in Wave 3 with Step 4b.

   f. If the trend turns from up to down in Wave 5, then this is a *Wave 3 down.* Reset all values and look for a new *Wave 3 up* when Step 4a is satisfied.

5. The trading rules needed are based on the values of *n*, the number of periods, and *trigger*, the percentage retracement.

   a. Buy on open when Wave 3 is first identified, whether on a new n-period high or a retracement of the previous downturn (Step 4a).

   b. Buy on the open when Wave 5 is first identified (Step 4d).

c. Buy on the open when Wave 5 turns into Wave 3 (Step 4e).

d. Close out any long position when *EWO* falls below zero.

With these rules, a long position is taken during the strongest parts of Wave 3 and Wave 5. As a guideline for selecting both the period and the trigger values, a test of the Deutsche mark (now effectively the euro) for 20 years from 1976 through 1995 showed robust results using calculation periods from 50 to 140 and retracement *trigger* values of .70 or less.

```
{FUNCTION ELLIOTTWAVE}
{Find the current wave using EWTREND and EWO}
inputs: period(numeric), trigger(numeric)
vars: ET(0), mean(0), osc(0), wave(0), hiosc(-999), hiosc2(-999),hiprice
   (-999), hiprice2(-999);
osc = EWO;
mean = (high + low)/2;
{Is the current wave sequence up or down?}
ET = EWTREND(period,trigger);
{When the trend changes from down to up, label it wave 3 and save the
   current osc and price}
if ET = 1 and ET[1] = -1 and osc > 0 then begin
   hiosc = osc;
   hiprice = mean;
   wave = 3;
   end;
{If wave 3 and the oscillator make new highs then save those values}
if wave = 3 then begin
   if mean > hiprice then hiprice = mean;
   if osc > hiosc then hiosc = osc;
{Test for the beginning of wave 4}
   if osc <= 0 and ET = 1 then wave = 4;
   end;
{Test for the beginning of wave 5}
if wave = 4 and mean = highest(mean,5) and osc >= 0 then begin
   wave = 5;
   hiosc2 = osc;
   hiprice2 = mean;
   end;
if wave = 5 then begin
   if osc > hiosc2 then hiosc2 = osc;
   if mean > hiprice2 then hiprice2 = mean;
   end;
{Test for wave 5 becoming wave 3}
if wave = 5 and hiosc2 > hiosc and ET = 1 then begin
   wave = 3;
   hiosc = hiosc2;
   hiprice = hiprice2;
   hiosc2 = -999;
   hiprice2 = -999;
   end;

{Identify a wave 3 down while in wave 5)
if wave = 5 and ET = -1 then begin
   wave = 3;
   hiosc = -999;
   hiprice = -999;
   hiosc2 = -999;
   hiprice2 = -999;
   end;
{Return function value)
ELLIOTTWAVE = wave;

{ FUNCTION EWO }
{Find the Elliott Wave Oscillator (EWO)}
vars: mean(0);
mean = (high + low) / 2;
EWO = 0;
if average (mean,35) <> 0 then EWO = average (mean, 5) - average (mean, 35);

{ FUNCTION EWTREND }
{ Find the trend using EWO}
inputs: period(numeric), trigger(numeric);
vars:   trend(0), osc(0);
osc = EWO;
if osc = highest(osc,period) and trend = 0 then trend = 1;
if osc = lowest(osc, period) and trend = 0 then trend = -1;
if lowest(osc,period) < 0 and trend = -1 and
   osc > -1*trigger*lowest(osc,period) then trend = 1;
if highest(osc,period) > 0 and trend = 1 and
```

```
   osc < -1*trigger*highest(osc,period) then trend = -1;
EWTREND = trend;
```

Additional programs for the Elliott Wave count, including trading rules, can be found in Ruggiero.[40]

A Comment on Elliott Wave Theory

The Elliott Wave Theory is highly regarded, although it is an intricate combination of mathematics and chart interpretation based on assumptions about human behavior. Because it is primarily based on chart patterns it has been criticized as being too interpretive. The development of the 5th wave, the grand finale, receives the most attention—sometimes it never develops, and at other times it must be extended into another subset of waves. An analysis by Merrill shows that the median stock market bull move has 7 1egs and the bear move has 5 1egs, which may account for the frequent use of the compound form of the Elliott wave. Those analysts who find this study of interest should also read the works of W. D. Gann and Edson Gould, both of whom concentrated on mathematical approaches to charting.

[34]Robert R. Prechter, Jr., *The Major Works of R. N. Elliott* (New Classics Library, Chappaqua, NY, circa. 1980) and A. J. Frost and Robert R. Prechter, Jr., *Elliott Wave Principle* (New Classics Library, Chappaqua, NY, 1978); Merrill (1960) Appendices 5 and 6 contain one of the more thorough summaries and analyses of the basic Wave Theory, including performance.

[35]Robert R. Prechter, Jr., David Weiss, and David Allman, "Forecasting Prices with the Elliott Wave Principle," in Todd Lofton (Ed.), *Trading Tactics: A Livestock Futures Anthology* (Chicago Mercantile Exchange, 1986).

[36]See Robert R. Prechter, *Forecasting Prices* (1986).

[37]Robert R. Prechter, Jr., "Computerizing Elliott," *Technical Analysis of Stocks & Commodities* (July 1983), gives some general observations on how he would go about adapting Elliott's interpretations to a computer program.

[38]Robert R. Prechter, Jr., "Major Sea Change II," *Futures* (March 1996).

[39]The content of this section is based on Murray A. Ruggiero, Jr., "Building the Wave," *Futures* (April 1996). He credits Tom Joseph for the development of the computer software, which is the basis for the product Advanced GET.

[40]Murray A. Ruggiero, Jr., *Cybernetic Trading Strategies* (Wiley, 1997).

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PRICE TARGET CONSTRUCTIONS USING THE FIBONACCI RATIO

Harahus shows interesting constructions using Fibonacci ratios; these are referred to as the *golden rectangle, golden triangle*, and *golden spiral*. Although there is no doubt of their importance, their application to markets can be complicated. In using a method as sophisticated as the Elliott Wave Theory, it is necessary to select situations that are most representative of the phenomenon described by the Fibonacci series (and alternately by the Fibonacci-Lucas sequence). Experience will help you decide which waves and which formations are most important and should be applied to this geometric analysis.

Harahus introduced the *regular pentagon*, which has sides of equal length, as a tool for measuring corrections to the primary waves. This pentagon has the property that any diagonal is 1.618 times the length of a side, exactly a Fibonacci ratio. By constructing a regular pentagon so that the major price trend falls along one diagonal, or along one side, the other lines connecting the corners of the pentagon will serve as support of, or resistance to, future price moves. In addition, the circumscribed and inscribed circle will serve as a measurement of support and/or resistance (Figure 14.13). The use of a circle is similar to Gann's concept of *time and space*, which will be covered a little later in this section.

(a)

Figure 14.13: (a) Pentagon constructed from one diagonal, (b) Pentagon constructed from one side.

Harahus extends the charting techniques of the Elliott Wave Theory using circles and arcs, a method that has been applied to measuring retracements. A circle drawn from the top or bottom of a wave, representing the 38, 50, or 62% levels, serves as a convenient measurement of elapsed time combined with a price correction. Prices are expected to meet resistance at any attempt to penetrate the key circles formed using the center points *A* or *B* in Figure 14.14.

Figure 14.14: Using circles to find support and resistance.

Alternate Arc Measurement

In Chapter 4, there were alternate ways of measuring retracement levels. Tom DeMark[41] identified the extent of a price move differently from the classic definition. In his approach, if the market is currently at a low, rather than projecting the distance of this drop from the most recent swing high, he chose to look for the highest point that had occurred since the last time the market traded at this low level. He then applied his choice of ratios to find the key retracement levels. DeMark also uses this measurement from high to low to draw arcs identical to those shown in Figure 14.14 but limited to the Fibonacci ratio .618 and its complement .382.

[41]Thomas DeMark, "Retracing Your Steps," *Futures* (November 1995). Also see Chapter 2 of DeMark, *The New Science of Technical Analysis* (Wiley, 1994).

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FISCHER'S GOLDEN SECTION COMPASS SYSTEM

Although there are many systems that use the Fibonacci ratios, Fischer's *Golden Section Compass* (GSC) *System* is the only one that is based primarily on that concept and fully automated.[42] The system is founded on the premise that human behavior is reflected in the Fibonacci ratios; the human decision-making process unconsciously selects points to act that appear to be the right time or the right price level, but turn out to coincide with the same points determined by Fibonacci ratios. The behavior-based rules are combined with practical entry and stop-loss rules to eliminate those situations that do not properly develop.

Fischer is not alone in his observation of these patterns. Elliott, discussed in the previous sections, defined market cycles in 5-wave patterns with 3-wave corrections (Figure 14.15). In *Nature's Law*, Elliott shows the *complete market cycle*[43] as:

Figure 14.15: Elliott's complete wave cycle. *Source*—Fischer, *Golden Section Compass Seminar* (1984, p. 28).

Open table as spreadsheet

Number of	Bull Market	Bear Market	Total
Major waves	5	3	8 complete cycles
Intermediate waves	21	13	34 complete cycles
Minor waves	89	55	144 complete cycles

Time-Goal Days

The GSC System states that a new price direction will begin on, or shortly after, the day calculated as:

$$T_k = 1.618 \times (L_i - L_{i-1}) + L_i$$

or

$$T_{k+1} = 1.618 \times (H_i - H_{i-1}) + H_i$$

where L_i and H_i are the days on which lows and highs occurred, and L_i occurs before H_i.

For simplicity, an extreme may be used only twice for a calculation—once as the first point and once as the second. Figure 14.16 shows the order in which the calculations occur. Time-goal day T_5 was calculated from lows L_3 and L_4 before time-goal day T_7 occurred. When more than one time-goal day occurs at the same point, or when the highs or lows that formed the time-goal days are more significant, the likelihood of a major reversal increases.

Figure 14.16: Calculation of time-goal days.

Specific entry signals occur on a 5-day price reversal. A long signal is given following a time-goal day when the closing price is higher than the high of the past 5 days. This is sufficient to identify a trend change and allows the stop-loss to be the recent low or a fixed point below the entry price.

Price Goals

Price objectives are determined using the same highs and lows that were applied to time goals. Elliott's Wave Theory is refined by Fischer, as shown in Figure 14.17. Once the low has been found, followed by Wave 1, the price objectives for Waves 3 and 5 can be calculated as a function of Wave 1:

Wave 3 objective = .618 × (High of Wave 1 - low of Wave 1) + high of Wave 1

Wave 5 objective = 1.618 × (High of Wave 1 - low of Wave 1) + high of Wave 1

Figure 14.17: Price goals for standard 5-wave moves.

The pullbacks to points 2 and 4 in Figure 14.17 are not determined in this calculation, and the probability of the 5-wave target being successful is not confirmed unless the Wave 3 objective is satisfied. Price goals are used for profit-taking rather than new entry points. The GSC System, however, does not require that markets move in 5-wave patterns. Price objectives can be calculated from long-term lows and the high of the first move up by multiplying that move by the ratio 1.618. When price and time goals occur at the same point, there is greater confidence in the signal.[44]

In general, retracements from sustained moves can be expected to approximate or exceed 38.2% of the initial move (1 - .618, the complement of 61.8%). Once a high level objective has been reached and a reversal occurs, consistent profits may be taken using this goal. If prices fail to make new highs following the first retracement, objectives for the next lower levels down can be set according to the inverted Elliott wave patterns, or *1.618 × initial downward move.*

Filtering Highs and Lows

The GSC System can be made to identify more significant highs and lows by increasing the *selection filter.* For example, a sensitive system would select highs and lows in gold that are separated by a minimum swing of $10 per ounce. More significant points may be identified by swings of $20 per ounce. It can be demonstrated that a small filter will generate highs and lows that are produced by noise rather than significant behavioral actions. The system cannot be forced to produce more signals than the natural patterns allow. Readers will find this the same as the concept of a *swing filter.*

The *selection filter* should be adjusted for market volatility. At higher price levels the noise also increases and will obscure the more important high and low points. Although Fischer only briefly touches on this, traders who apply this method should be prepared to adjust the selection filter from time to time.

[42]Robert Fischer, *The Golden Section Compass Seminar* (Fibonacci Trading, Ltd., Hamilton 5, Bermuda). Also see Robert Fischer, *Fibonacci Applications and Strategies for Traders* (John Wiley & Sons, 1993).

[43]Robert Fischer, *The Golden Section Compass Seminar* (Fibonacci Trading, 1984).

[44]Examples of time and price objectives can be found in Tucker J. Emmett, "Fibonacci Cycles," *Technical Analysis of Stocks & Commodities* (May 1983 and March/April 1984).

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W. D. GANN—TIME AND SPACE

The works of W. D. Gann cannot be explained with any thoroughness in a few words, but some of his main ideas have been selected and presented in this section. Gann was a pure technician, using charts for all his analyses. His methods varied substantially from conventional charting techniques, but his philosophy was one of a professional trader: *Conserve capital and wait for the right time.* Gann traded primarily grains for many years, and in his writings he attempted to summarize his most important observations; some of them are reminiscent of other well-known market lore.

Price moves are never exact. Gann was a believer in support and resistance lines, but expected some violation of the objectives because of *lost motion*, his way of accounting for the momentum that carries prices higher or lower than their fair value. Nearly a cross between Elliott's *waves* and Angas' *cycles*, Gann classifies bull and bear moves into four *stages*, each one compared to a trending move and a subsequent reversal culminating in a major top or bottom. He observed that bull markets last longer than bear markets. He concluded that reversal patterns must decline in magnitude as the move develops and persists. A similar argument is expressed in the *theory of contrary thinking.* Much of Gann's work is based on the value of 1940 cents and requires an economic inflator close at hand to adjust prices to today's levels.

Gann's techniques combine mathematics and geometry with time and space; he finds duration as important as the size of the price change. One of his principles reflects the idea of a longer consolidation period resulting in a longer price move after a breakout. One popular approach to price objectives in bar charting is exactly this idea.

Time and Price

Gann proposed certain natural divisions for price swings, expressed as percentages. Zero and 100% are the most important of these. Using his understanding of human behavior, he considered a potential resistance level to be 100% of the original point of the move, or twice the starting price, or the highest or lowest price previously recorded for that market (based on cash prices, not futures). In a reversal, 100% was a full retracement of the original move back to its starting point. Part of the rationale for this theory is that most traders like whole numbers; for this reason orders in grains are most often placed at 5-and 10-cent levels rather than at odd values. Even now, traders will find more activity as prices attempt to cross whole number barriers, such as increments of 100 for the S&P, or each 1,000 for the DOW.

After the 100% level, decreased importance goes to increments of 50%, 25%, 12½%, and so on. For the grain markets, which were the most active at the time of Gann's trading, this would mean that major resistance could be expected at the even dollar levels with the next resistance at 50¢ intervals, then every 25¢, and so on; after a bull move of $1 per bushel, the major support would be $1 lower, then 50¢, 25¢, and 75¢, and so on. The use of successive halving of intervals was also extended to time. Considering a year to be a full cycle of 360°, a half year is equal to 26 weeks, a quarter year 13 weeks, an eighth year 45 days, and a sixteenth year 22½ days. In cases of conflict, time always took precedence over price. For grains, a 1-year cycle was significant because seasonality is implicit in their supply and demand, and their price. The combination of a key price level, expressed as a percentage move, occurring at a periodic time interval is the basis for much of Gann's work.

Geometric Angles

The most popular of Gann's methods is his use of geometric angles for relating price and time. By using square graph paper, it was not necessary to know the exact angle because the construction was based on the number of boxes up versus the number of boxes to the right. A 1 × 1 angle (45°) was drawn diagonally from the bottom of the lowest point of a price move through the intersection 1 box up and 1 box to the right. This is the *primary bullish support line.* The *primary bearish resistance line* is drawn down from left to right from the highest price using the same 1 × 1 angle. The next most important angles in order of significance are 2 × 1, 4 × 1, and 8 × 1, equivalent to about 63°, 76°, and 83°; for lower support areas there is also 1 × 2, 1 × 4, and 1 × 8, or 26°, 14°, and 7°. Places where the support and resistance lines cross are of special significance, indicating a major congestion area.

Figure 14.18 is taken from Gann's private papers and shows the use of geometric angles in an actual trading situation. Lines were first drawn where Gann expected a bottom, then redrawn as prices developed. The initial upward move followed the primary 45° line; the second important support line, 1 × 2, met the primary downward line at the point of wide congestion at the center of the chart. The highest point on this congestion phase became the pivot point for the next 45° downward angle defining the next breakout. Traders have found the primary 1 × 1, or 45° line, is an important tool for staying with the major trend. It is used to filter out small reversals in both standard charting techniques and the point-and-figure method.

Figure 14.18: Gann's soybean worksheet.

Gann combined this approach with a more remarkable technique, the *squaring of price and time.* It was fortunate to find a chart that complemented Figure 14.18, based on the lowest recorded cash price of soybeans, 44¢ per bushel. Figure 14.19 shows how Gann constructed this square, beginning with the lowest price at the center and moving one square to the right, circling counterclockwise and continuing the process. The basic geometric lines (horizontal, vertical, and diagonal) indicate the major support and resistance price levels; the most important one being 44 at the center, the junction of all lines.

Figure 14.19: May soybean square.

Relating the square to Figure 14.18, the price chart showing geometric lines, the first support level is seen to be exactly at 240 (upper left diagonal), the major resistance at 276 (right horizontal), the next minor support at 268 (lower right diagonal), congestion area support at 254 and 262 (1 box off), and back down to support at 240. Notice that the distance between the lines on the square become wider as prices increase, conforming to the notion of greater volatility at higher prices. It is also expected that soybeans at $10 will have some *lost motion* near these key support and resistance levels.

The Hexagon Chart

Gann extended his *squaring method* to include both geometric angles and the main cyclic divisions of 360°. By combining these different behavioral concepts, the strongest levels of support and resistance are found where all three coincide. The generalized construction for this purpose is the *Master Calculator*, based on aligning the chart at a point representing a multiple of the lowest historic price for that market; crisscrossing angles will then designate support and resistance for the specific market. Other time charts of importance are the *Square of Twelve* (one corner of the Master Calculator), the *Hexagon Chart,* and the *Master Chart of 360°*. The Hexagon Chart can be used as an example of the combined effect.

As shown in Figure 14.20, the inner ring begins with six divisions, giving Gann the basis for the chart name. Each circle gains six additional numbers as it proceeds outward, which relates to the overall continuity of the construction. In using the hexagon, the degrees represent time and the numbers in the circle are price; a major support or resistance point exists when both time and price occur simultaneously.

Figure 14.20: The Hexagon Chart.

For example, consider the 360° of the hexagon relating to the calendar year, or perhaps the crop year for grains. In his own work on grains, Gann equated 0° to March 20, near to the first day of spring, the *summer solstice*, when the sun crosses the equator going north. Then, the 45° line is on May 6, 90° on June 21 (the first day of summer), 180° on September 23 (the *winter solstice*), and 270° on December 21 (the first day of winter). These primary divisions also represent the most significant places for price support and resistance. The other lines represent secondary levels.

When looking at price and time together on the Hexagon Chart, the distance between the major degree lines becomes greater as prices increase, showing the importance of volatility. Using the price of November 77 soybeans, the chart shows that between 90° and 180°, or June 21 to September 23, 1977, the price of soybeans should have support at 567. Then it should move its major support level to 507 and its major resistance to 588, with the next higher and lower support and resistance at 432 and 675, respectively. As it turned out, this was a very accurate prediction.

On many of Gann's charts there is notation showing planetary movement, not related to the cycles of seasonality, but what is believed to be the Jupiter-Saturn cycle, discussed in the next section. These techniques make Gann's work more difficult to reproduce than most methods; his tools are less conventional than others. If Gann were asked for a word of advice, there is no doubt that he would caution to patience, stating: *When price meets time, a change is imminent.*[45]

[45]Computer software is available for calculating and plotting much of Gann's works. See "Gann-trader I," *Technical Analysis of Stocks & Commodities* (January/February 1984), or contact Gannsoft Publishing Co., 311 Benton St, Leavenworth, WA 98826, or Lambert-Gann, P.O. Box O, Pomeroy, WA 99347.

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FINANCIAL ASTROLOGY

Astrology seeks a common bond in human behavior, similar to the work in biological rhythms and cycles. The impact of astrology on civilization has been great; observations of the periodicity of the moon is traced back 32,000 years. Star charts were known to have been in Egypt about 4200 B.C., and the earliest written ephemerides were in the seventh century B.C.[46] The pyramids at Gizeh are said to have sloping corridors leading from the faces to the interior that were used as sighting tubes for Egyptian astrologers for making accurate forecasts. The acceptance of astrology throughout history is widespread, including virtually all civilizations.

Even sophisticated analysts have been found to confuse *astrology* with the daily horoscope found in a local newspaper. *Astrology*, the interpretation of the effects of planets and stars on human affairs, is an art followed by a large portion of the world population and should not simply be discarded as mystical or occult. Interpretation of these effects can be complex and involves special skills. Most forecasts begin with a birth chart, which describes the position of the stars at the time of the inception of an event, then look at the current positions to identify the transitions. Over time, planets have taken on an association with specific raw goods, and constellations are associated with certain types of business; these relationships can now be verified using computer programs which check the intricate position of the planets with the financial statistics of companies to find correlations. However, that task will be left for the more ambitious.

We must all agree that the positions of the planets and sun—those bodies with the largest gravitational pull on the Earth and each other—have clear physical effects that we can see around us. In the study of physics, this relationship is given as

$$\textit{Force of attraction} = \frac{\textit{Gravitational constant} \times \textit{Mass}}{\textit{Distance between the centers of the two masses}}$$

where the gravitational constant is 6.67×10^{-8}, the mass is found in Table 14.1, and the distance between the centers is calculated from Table 14.1.

Of the physical effects that obvious, the seasons and the tides are undeniable; is there are many more subtle phenomena when you study astronomy, the science of the motion of the stars and planets. In this section we will concentrate our attention on the physical phenomenon of planetary motion that can be identified and tested with the same confidence, and perhaps more, as other trading systems. Among these phenomena, eclipses and the lunar cycles are the most obvious, but there is one other combination that is important, the Jupiter-Saturn cycle.

The Jupiter-Saturn Cycle

Jupiter and Saturn combine to represent the overwhelmingly largest mass in our solar system other than the Sun (see Table 14.3). The two planets amount to about 95% of the total mass of all the planets, and are about .7% of the mass of the Sun. Because they are in adjacent orbits, they have a very large gravitational pull on other planets when they are near one another and a very different effect when they move apart. They are so large that they cause the Sun to shift periodically based on their positions around the true center of mass of the solar system, called the *barycenter.* When Jupiter and Saturn are on opposite sides of the Sun, the center of mass is near the center of the Sun, but when the two large planets are together, the Sun is pulled away from this center. This positioning also has significant effects on the Earth's climate, which in turn affects agricultural production, supply and demand, and ultimately the economy.[47] The Greeks called the Jupiter-Saturn cycle *The Great Maker of Time*, and it is said that every significant cycle in stocks, commodities, and interest rates is either a multiple or a harmonic of the Jupiter-Saturn cycle. The most well-known, the 59-year Kondratieff cycle, is 3 times the Jupiter-Saturn cycle (3 × 19.859 = 59.577). Gann, who used a combination of time and price, based time expectations on seasonality and cycles. His work referred to a *Master Time Factor* that was never defined, but experts believe that the Jupiter-Saturn cycle satisfies his technique.

Table 14.5: Size and Position of the Planets and Earth's Moon
Open table as spreadsheet

	Equatorial Diameter (km)	Mass[*] (kg)	Distance from Sun (mil km)	Duration of Orbit (Earth years)
Sun	1,392,000	1.99×10^{30}	0	0
Mercury	4,880	3.34×10^{23}	57.9	0.24
Venus	12,102	4.87×10^{24}	108.0	0.62
Earth	12,756	5.98×10^{24}	149.6	1.00
Mars	6,794	7.35×10^{22}	227.9	1.86
Jupiter	142,800	8.39×10^{27}	778.3	11.86

Saturn	120,000	5.00×10^{27}	1,427	29.5
Uranus	52,000	3.77×10^{26}	2,870	84.
Neptune	47,500	3.29×10^{26}	4,497	165.
Pluto	2,500	5.98×10^{22}	5,893	248.
Earth's moon	3,476	7.34×10^{22}	384,400 km	0.075
[*]Note that *mass* = *volume* × *density* and, except for the Earth and the Earth's moon, the density of the planets can only be estimated.				

Charting the Saturn Line

Having decided that the movement of the largest planets affect the way markets move, you can create a *planetary envelope* based on Saturn's path with respect to the Dow Jones Industrial Average and find frequent concurrence. This requires converting the position of the planets into price. [48] When completed, this envelope is treated as support and resistance lines in a manner similar to the standard charting interpretation, where penetration of a resistance line will become support; however, in appearance the Saturn lines are curved to represent its cycle (see Figure 14.21).

Figure 14.21: Saturn lines drawn on the Dow Industrial Average. *Source*—Jeanne Long, *A Traders Astrological Almanac* (1994). Reprinted with permission from PAS, Inc., e-mail— pas24@aug.com, website— www.galacticinvestor.com.

Converting Planet Position to Price

Long transforms planetary position to price using two separate *wheels*, combined to form a *Universal Clock*, in a manner similar to W. D. Gann. Each wheel is unique to a specific market. To create the Universal Clock for the DJIA, you begin above the right horizontal (at 3 o'clock) with the number 1 and move counterclockwise, placing 6 numbers per quarter, 24 for an entire cycle. You then move to the next outer circle and continue with the number 25 just outside the original number 1; therefore, each concentric circle contains the next 24 values, ending at 360° (a full cycle). The DJIA Clock is shown in Figure 14.22.

Figure 14.22: The DJIA Clock. *Source*—Jeanne Long, *A Traders Astrological Almanac* (1994). Reprinted with permission from PAS, Inc., e-mail— pas24@aug.com, website— www.galacticinvestor.com.

In the outer wheel of the clock, the DJIA is shown in increments of 10 points beginning in 1930 and continuing in circles of 24 values. Long does not explain the choice of the beginning price, but Gann uses a significant low and astrologers tend to use the price at a key starting time, such as the beginning of a new Dow calculation, birth of an exchange, or a transforming event.

To locate the planet on the time wheel, begin with the planet's position on a specific date. For example, on October 1, 1993 Saturn was at 24° 14' (with respect to Aquarius). Aquarius falls between 300° and 330°; therefore, the position of Saturn is 300° + 24° + 14', or approximately 324°. By locating 324 on the inner part of the wheel, you can refer to the prices on the outer part of the wheel and find the two prices (each in adjacent circles) that span the current DJIA price. These values are the current support and resistance lines. New values are found monthly.

Major Physical Events

Of the major physical phenomena used in financial astrology, the most important are:

- *Solar eclipse*, when the moon passes between the Earth and the Sun.
- *Lunar eclipse*, when the Earth passes between the moon and the Sun.

- *Conjunction*, when any two planets are on the same side of the Sun and form a straight line with the Sun.
- *Opposition*, when two planets are on opposite sides of the Sun and form a straight line with the Sun.

The physical significance of an eclipse is said to be that it disrupts the flow of energy between two bodies by the interference of a third mass. In actuality, the gravitational forces of the two bodies are maximized when they are both on one side the Earth, as in a solar eclipse, and minimized when they are on opposite sides, as in a lunar eclipse.

In astrology, the angles between planets are viewed from the position of the Earth; this is called a *geocentric system.* When a planet lies on the line between the Earth and Sun it is in a *geocentric conjunction*; when it is aligned behind the earth it is in *geocentric opposition.* When a planet is at 90° to the earth-sun line, it is said to be *square.*[49] The angles that the planets form with the Earth-Sun line are called *aspects.* For the purposes of trading, squares are considered bearish while conjunctions and oppositions are bullish; however, there are other interpretations. Conjunction and opposition may not always conform to the strict definition of forming a straight line with the Sun, but may refer instead to close proximity. Both solar and lunar eclipses are conjunctions.

Trading on Aspects

Although the clearest physical phenomena combine the sun, moon, and largest planets when they are in conjunction and opposition, there are many other combinations of planetary positions that are considered important. It may also be necessary to follow a planet from its 90° to 270° position so that you track its effect on prices through the most extreme 180° path. The calculations for lunar and solar eclipses appear at the end of this chapter, but automatically calculating the aspect of combinations of planets would be beyond the ability of even the most computer-literate traders; commercial software is available for this level of detail and can calculate the number of occurrences that an aspect corresponds to a price move or price peak of a minimum size. The simplest method is to select days that correspond to swing highs or swing lows and record the major aspects at that time. The larger the swing, the more significant the results. By creating a table of key reversal levels it may be possible to find those aspects that exert the greatest influence on the market. Once isolated, they may be used as a bias within a technical program.

Table 14.6: Jupiter and Saturn Planet RX and Stations, 1996–2001

Open table as spreadsheet

	Jupiter (Retrograde)	Jupiter (Direct)	Saturn (Retrograde)	Saturn (Direct)
1996	May 4	Sep 3	Jul 18	Dec 3
1997	Jun 9	Oct 8	Aug 1	Dec 16
1998	Jul 18	Nov 13	Aug 15	Dec 29
1999	Aug 25	Dec 20	Aug 30	
2000	Sep 29		Sep 12	Jan 12 (Jupiter not in sequence)
2001	Nov 2	Jan 25	Jan 24, Sep 26	(Saturn not in sequence)
2002		Mar 1		Feb 8

Source: Weingarten, *Investing by the Stars*.

Table 14.7: Eclipses, 1996–2001

Open table as spreadsheet

	Lunar Eclipse	Solar Eclipse	Lunar Eclipse	Solar Eclipse
1996	Apr 4	Apr 17	Sep 27	Oct 12
1997	Mar 24	Mar 9	Sep 16	Sep 2
1998	Mar 13	Feb 26	Aug 8	Aug 22
	Sep 6			
1999	Jan 31	Feb 16	Jul 28	Aug 11
2000	Jan 21	Feb 5	Jul 16	Jul 1
		Jul 31		Dec 25
2001	Jan 9	Jun 21	Jul 5	Dec 14
	Dec 30			

Source: Weingarten, *Investing by the Stars.*

Table 14.8: New and Full Moons, Eclipses 1996–2001

Open table as spreadsheet

	New	Full	New	Full	New	Full	New	Full	New	Full	New	Full
1996		Jan 5	Jan 20	Feb 4	Feb 18	Mar 5	Mar 19	Apr 4	Apr 17	May 3	May 17	Jun 1
	Jun 16	Jul 1	Jul 15	Jul 30	Aug 14	Aug 28	Sep 12	Sep 27	Oct 12	Oct 26	Nov 11	Nov 25
	Dec 10	Dec 24										
1997	Jan 9	Jan 23	Feb 7	Feb 22	Mar 9	Mar 24	Apr 7	Apr 22	May 6	May 22	Jun 5	Jun 20
	Jul 4	Jul 20	Aug 3	Aug 18	Sep 1	Sep 16	Oct 1	Oct 16	Nov 14	Nov 30	Dec 14	Dec 19
1998		Jan 12	Jan 28	Feb 11	Feb 26	Mar 13	Mar 28	Apr 11	Apr 26	May 11	May 25	Jun 10
	Jun 24	Jul 9	Jul 23	Aug 8	Aug 22	Sep 9	Sep 20	Oct 5	Oct 20	Nov 4	Nov 19	Dec 3

	Dec 18											
1999		Jan 2	Jan 17	Jan 31	Feb 16	Mar 2	Mar 17	Mar 31	Apr 16	Apr 30	May 15	May 30
	Jun 13	Jun 28	Jul 13	Jul 28	Aug 11	Aug 26	Sep 9	Sep 25	Oct 9	Oct 24	Nov 23	Dec 7
	Dec 22											
2000	Jan 6	Jan 21	Feb 5	Feb 19	Mar 6	Mar 20	Apr 4	Apr 18	May 4	May 18	Jun 2	Jun 16
	Jul 1	Jul 31	Aug 15	Aug 29	Sep 13	Sep 27	Oct 13	Oct 27	Nov 11	Nov 25	Dec 11	Dec 25
2001		Jan 9	Jan 24	Feb 8	Feb 23	Mar 9	Mar 25	Apr 8	Apr 24	May 7	May 23	Jun 6
	Jun 21	Jul 5	Jul 20	Aug 4	Aug 19	Sep 2	Sep 17	Oct 2	Oct 16	Nov 1	Nov 15	Nov 30
	Dec 14	Dec 30										
Source: Weingarten, *Investing by the Stars*.												

The Moon: *Buy Full, Sell New*

It is known that the moon's effect on our planet is great—it is vitally connected with the movement of all fluids. The mass of the moon is about 1/81 that of the Earth, and larger than the planet Pluto. It is remarkably large for a moon, with a diameter of 3,476 kilometers, 27% that of the Earth. Because of its large presence and close proximity to the Earth (about 230,000 miles), the moon is also believed to affect human behavior in strange ways, especially during a new or full moon.

In an experiment conducted on an arbitrary set of futures markets for the year 1972,[50] it was shown that short-term movements of prices react with some uniformity with respect to the phases of the moon. In fact, the markets chosen for observation—silver, wheat, cattle, cocoa, and sugar—showed an uncanny ability for prices to rise following a full moon and decline after a new moon.

To find the phases of the moon, you can refer to a number of books or many calendars that note the moon phases; however, to perform any lengthy study of the moon's effect on prices, the moon's phases will need to be computerized. An Easy Language function, called *Moonphase*, that gives the dates of the new and full moon, is given in Figure 14.23. The calculations require that dates be converted to Julian notation, the number of days since the calendar began. At the end of the program the Julian date must be converted back to our familiar notation. Figure 14.23 includes a function to perform the conversion. An explanation of these calculations is given in the next section.

```
{ TSM Moon Phases
Returns the mean phases of the moon, corrected for the sun's aberration
Copyright 1996-2003, P J Kaufman. All rights reserved.

There are no inputs to this program. It will automatically execute}

{ NOTE: Due to a decimal accuracy error in the transmission of a large
   decimal number from the function "TSMJulianEDtoDate, the date of the full
   moon or new moon may be off by one day. To avoid this problem, you may
   want to incorporate the function code directly into this program. }

vars: k(0), TT(0), n(0), ix(0), fullmoon(0), newmoon(0), nfm(130);
arrays: newdate[130](0), fulldate[130](0);

n = -nfm / 2;
if currentbar = 1 then begin
   print(file("c:\test\moon.txt"),," Event# Date Newmoon Fullmoon New date
      Full date");
   for ix = 1 to nfm begin
{ newmoons are relative to the year 2000 }
      k = n;
      TT = k / 1236.85; (time in Julian centuries }
      newmoon = 2451550.09765 + 29.530588853*k + 0.0001337*power(TT,2)
        - 0.000000150*power(TT,3) + 0.00000000073*power(TT,4);
{full moons relative to the year 2000 }
      k = n + .5;
      TT = k / 1236.85;
      fullmoon = 2451550.09765 + 29.530588853*k + 0.0001337*power(TT,2)
         - 0.000000150*power(TT,3) + 0.00000000073*power(TT,4);
      newdate[ix] = TSMJulianEDtoDate(fullmoon);
      fulldate[ix] = TSMJulianEDtoDate(newmoon);
      print (file("c:\test\moon.txt"),ix:5:0, k:8:0, newmoon:10:0,
         fullmoon:10:0,
         newdate[ix]:10:0, fulldate[ix]:10:0);
      n = n + 1;
      end;
   end;

{ TSMJulianEDtoDate : Convert Julian Ephemeris Date to Calendar Date
Copyright 1999-2003, P.J.Kaufman. All rights reserved.

This function converts the Julian Ephemeris Date, used to calculate the
moon and solar phases, and convert it to a standard calendar date
plus decimal days representing hours: YYYYMMDD.dd, where
   YYYY is the year (e.g., 1999)
   MM is the month
   DD.dd is the day of month and hours (in decimal days)
   (.50 means 12 o'clock noon) }

input: Jdate(numeric);
```

```
vars:  zz(0), fract(0), aa(0), alpha(0), bb(0), cc(0), dd(0),
       ee(0), daydec(0), mo(0), year(0), btemp(0), iday(0);

zz = intportion(Jdate + .5);
fract = Jdate + .5 - zz;
if zz < 2299161 then
      aa = zz
   else begin
      alpha = intportion((zz - 1867216.25) / 36524.25);
      aa - zz + 1 + alpha - intportion(alpha / 4);
   end;
bb = aa + 1524;
btemp = (bb - 122.1) / 365.25;
cc = intportion(btemp);
dd = intportion(365.25*cc);
ee = intportion((bb - dd) / 30.6001);
daydec = bb - dd - intportion(30.6001*ee) + fract;
if ee < 13.5 then
      mo = ee - 1
   else
      mo = ee - 13;
if mo > 2.5 then
      year = cc - 4716
   else
      year = cc - 4715;
print (file("c:\test\moon.txt"),"  year=",year:5:0,"  mo=",mo:2:0,"
day=",daydec:3:2);
{ Must round day due to TradeStation decimal accuracy }
iday = round(daydec,0);
TSMJulianEDtoDate = year * 10000 + mo * 100 + iday;
```

Figure 14.23: TradeStation functions to calculate the moon's phases.

Calculation of a New Moon, Full Moon, Solar and Lunar Eclipse

Although a highly accurate calculation of planetary positions and eclipses requires consideration of many minor items, a good approximation can be found with far less difficulty.[51] To calculate the exact time of the eclipses it is first necessary to find the time of the new and full moon. The resulting times are expressed in Julian Ephemeris Days (*JDE*), also called *dynamic time* (*DT*).

Lunar Phases

The new and full moons are simply two of the four lunar phases, measuring when the excess of the apparent longitude of the moon over the apparent longitude of the Sun is 0°, 90°, 180° and 270°. The time of these phases are given by the Julian date:

1. $JDE = 2451\,550.09765 + 29.530588\,853\,k + 0.0001337\,T^2 - 0.000000\,150\,T^3 + 0.000000000\,73\,T^4$

   where an integer value of k gives the new moon (i.e., 1, 2, 3, …) and an integer value increased by .25, .50, or .75 (e.g., 1.25, 1.50, 1.75) gives the three quarter positions of the moon, respectively. The value $k = 0$ corresponds to the new moon of January 6, 2000. Negative values indicate times prior to the year 2000. T is the time in Julian centuries since 2000, found by $T = k/1236.85$.

   In order to check your results, k is approximately equal to $(year - 2000) \times 12.3685$ and year is expressed in decimal (e.g., the end of March 1997 is 1997.25).

   Using this formula, we can get a list of dates for the full moon from about 1995 through the year 2000 (approximately 62) by creating an array called *JDE* and finding the 62 dates of the new and full moons ending at the year 2000 using the *TradeStation* code in Figure 14.23.

   For each value of k in the program *MoonPhases*, corrections must be made to find the exact time of maximum solar or lunar eclipse using the following values:

2. Eccentricity of the Earth's orbit around the Sun:

   $$E = 1 - 0.002516\,T - 0.0000074\,T^2$$

3. The Sun's mean anomaly at time *JDE*:

   $$M = 2.5534 + 29.10535669\,k - 0.0000218\,T^2 - 0.00000011\,T^3$$

4. The moon's mean anomaly:

   $$M' = 201.5643 + 385.816935\,28\,k + 0.0107438\,T^2 + 0.00001239\,T^3 - 0.000000058\,T^4$$

5. The moon's argument of latitude:

   $$F = 160.7108 + 390.67050274\,k - 0.0016341\,T^2 - 0.00000227\,T^3 + 0.000000011\,T^4$$

6. The ascending node of the lunar orbit:

Ω *(Omega)* = 124.7746 - 1.56375580k + 0.0020691T + 0.00000215T

7. The eccentricity of the Earth's orbit around the Sun:

   $E = 1 - 0.002516T - 0.000007T^2$

8. The following calculation, based on F and Ω, gives the basis for the solar or lunar eclipse. If F differs from 0°, 180° or 360° by less than 13.9°, then an eclipse is certain. If F is more than 21(from these phases, there is no eclipse. If F falls between these values then there is no eclipse if $|\sin F| > .36$.

   The next components needed for corrections are:

   $F_1 = F - 0°.02665 \sin \Omega$

   $A_1 = 299°.77 + 0°.107408\ k - 0.009173T^2$

9. Then to find the exact time of the full solar (or lunar) eclipse, the following corrections (in days) should be added to the time of the mean conjunction given by *JDE* in the first formula above (smaller quantities have been omitted):

   Time of maximum eclipse = JDE + (*lunar* or *solar* component below) + 0.0161 sin $2M'$ - 0.0097 sin $2F_1$ + 0.0073 × E × sin (M' - M) - 0.0050 × E × sin (M' + M) - 0.0023 sin (M' - $2F_1$) + 0.0021 × E × sin $2M$ + 0.0012 sin (M' - $2F_1$) + 0.0006 × E × sin ($2M'$ + M) - 0.0004 sin $3M'$ - 0.0003 × E × sin (M + $2F_1$) + 0.0003 sin A_1 - 0.0002 × E × sin (M - $2F_1$) - 0.0002 × E × sin ($2M'$ - M) - 0.0002 Ω

   solar component = - 0.4075 sin M' + 0.1721 × E × sin M

   lunar component = - 0.4065 sin M' + 0.1727 × E × sin M

10.

   P = 0.2070 × E × sin M + 0.0024 × E × sin $2M$ - 0.0392 sin M' + 0.0116 sin $2M'$ - 0.0073 × E × sin (M' + M) - 0.0067 × E × sin (M' - M) +0.0118 sin $2F_1$

11.

   Q = + 5.2207 - 0.0048 × E × cos M + 0.0020 × E × cos $2M$ - 0.3399 cos M' - 0.0060 × E × cos(M' + M) + 0.0041 × E × cos(M' - M)

12.

   $W = |\cos F_1|$

13.

   γ (gamma) = (P cos F_1 + Q sin F_1) × (1 - 0.0048W)

14.

   u = 0.0059 + 0.0046 cos M - 0.0182 cos M' + 0.0004 cos $2M'$ - 0.0005 cos (M + M')

Solar Eclipses

For a solar eclipse, γ (gamma), represents the shortest distance from the axis of the moon's shadow to the center of the Earth in units of the equatorial radius of the Earth (the distance from the center to the surface of the Earth at the equator). Its value is positive if the axis of the shadow is passing north of the Earth's center, and negative if it is passing south. When γ is less than +.9972 and greater than -.9972 the solar eclipse is *central*, that is, there is a line of central eclipse on the surface of the Earth (see Figure 14.24).

Figure 14.24: Geometry of a solar eclipse.

The value u gives the radius of the moon's *umbral cone* on the fundamental plane, which passes through the center of the Earth perpendicular to the axis of the moon's shadow (in units of Earth's equatorial radius). The radius of the *penumbral cone* in the fundamental plane is u + .5460. Based on these values, the following situations exist:

$\lvert\gamma\rvert$ is between 0.9972 and 1.5432 + u	The eclipse is not central
$\lvert\gamma\rvert$ is between 0.9972 and 1.0260	Part of the eclipse may touch the polar regions
$0.9972 < \lvert\gamma\rvert < 0.9972 + \lvert u\rvert$	The combination of a noncentral total or annular eclipse
$\lvert\gamma\rvert > 1.5432 + u$	No eclipse if visible from the Earth's surface
For a central eclipse,	
$u < 0$	The eclipse is total
$u > 0.0047$	The eclipse is annular
$0 < u < 0.0047$	The eclipse is either annular or annular-total.

To remove the ambiguity of this last situation, calculate

$$\omega = 0.00464 \cos W, \text{ where } \sin W = \gamma$$

If $u < \omega$ then the eclipse is annular-total; otherwise it is annular.

The greatest magnitude for a partial solar eclipse is reached at the point on the Earth's surface that comes closest to the axis of the shadow at

$$\textit{Greatest magnitude of a solar eclipse} = \frac{1.5433 + u - \lvert\gamma\rvert}{0.5461 + 2u}$$

Lunar Eclipses

For a lunar eclipse, γ is the least distance for the center of the moon to the Earth's shadow (see Figure 14.25). The value γ is positive if the moon's center is passing north of the axis of the shadow, and negative if it is passing south. At the distance of the moon, the penumbra radius $\rho = 1.2847 + u$ and the umbra radius $s = 0.7404 - u$. The magnitude of the lunar eclipse is

penumbral eclipses:	$(1.5572 + u - \lvert\gamma\rvert) / 0.5450$
umbral eclipses:	$(1.0129 - u - \lvert\gamma\rvert) / 0.5450$

Figure 14.25: Geometry of a lunar eclipse.

If the magnitude is less than zero, there is no eclipse. The *semidurations* of the partial and total phases in the *umbra* are calculated as

$$P = 1.0129 - u$$

$$T = 0.4679 - u$$

$$n = 0.5458 + 0.0400 \cos M'$$

and the semidurations in minutes are

$$\textit{Partial phase} = \frac{60}{n}\sqrt{P^2 - \gamma^2}$$

$$\textit{Total phase} = \frac{60}{n}\sqrt{T^2 - \gamma^2}$$

Example: Solar Eclipse of May 21, 1993

The following values can be used to verify your calculations:

May 21 is the 141st day of the year, therefore

k	= 1993 + 141/365 = 1993.38	
T	= 1993.38/1236.85 = 1.6116.	
JDE	= 2449128.5894	
M	= 135°.9142	P = 0.1842
M'	= 244°.5757	Q = 5.3589
F	= 165°.7296	γ = 1.1348
Ω	= 253°.002	u = 0.0097
$F,$	= 165°.7551	

Because 180° - F is between 13°.9 and 12°.0 the eclipse is uncertain, and because $|\gamma|$ is between 0.9972 and 1.5433 + u = 1.553, the eclipse is partial. By calculating the greatest magnitude of a solar eclipse, we get 0.740. Because F is near 180°, the eclipse occurs near the moon's descending node, and because γ is positive, the eclipse is visible in the northern hemisphere of the Earth. By adding the corrections to JDE, the final time of maximum eclipse is 2449129.0979, which corresponds to May 21, 1993, at 14h21m0s TD. This differs from the exact value of 14h20m14s TD by less than 1 minute.

[46]Derek Parker and Julia Paricor, *The Compleat Astrologer* (McGraw-Hill, New York, 1971, p. 12).

[47]For a complete discussion of this topic, see Henry Weingarten, *Investing by the Stars* (McGraw-Hill, 1996). A section written by Richard Mogey, "Long Cycles and the Master Time Factor," is the basis for the next section.

[48]Jeanne Long, "Planetary Support and Resistance on the DJIA," *A Traders Astrological Almanac 1994* (PAS Astro-Soft, Inc., 450-106 State Road 13 North, #206, Jacksonville, FL 32259-3863, email: pas24@aug.com).

[49]Hans Hannula, "Trading Planetary Eclipses," *Technical Analysis of Stocks & Commodities* (April 1992).

[50]Todd Lofton, "Moonlight Sonata," *Commodities* (July 1974).

[51]Jean Meeus, *Astronomical Algorithms* (Willmann-Bell, Inc., P.O. Box 35025, Richmond, VA 23235, Chapter 52). A shorter version appears in another volume, *Astronomical Formulae for Calculators*. For complete accuracy, the author refers readers to the *Astronomical Almanac*, or the *Canon* by Mucke and Meeus. The material in this section combines both versions of Meeus' work.

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Chapter 15 - Pattern Recognition
New Trading Systems and Methods, Fourth Edition
by Perry J. Kaufman
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Chapter 15: Pattern Recognition

OVERVIEW

Pattern recognition forms the basis for most trading systems. Patterns are most obvious in traditional charting, which is entirely the identification of common formations; even moving averages attempt to isolate, using mathematical methods, what has been visually determined to be a trend. Traders have always looked for patterns in price movement. Because the earliest technicians were not equipped with computers, their conclusions are considered market lore rather than fact, and are handed down from generation to generation as proverbs, such as "Up on Monday, down on Tuesday," "Locals even-up on Fridays," and "Watch for key reversals." Because these three sayings have endured, they are candidates for analysis later in this chapter. Readers should also note the early work of Arthur Merrill, whose well-known pattern studies are still quoted; these studies are referenced throughout this chapter.[1]

The earliest technical systems based on patterns were of the form: "If after a sharp rise the market fails to advance for 3 days, then sell." As computers became more powerful, more complex approaches could be taken. For example, by observing the closing prices starting on an arbitrary day, *all* patterns of higher and lower closes can be recorded to find their tendency to repeat. A computer is well-equipped to perform this task. First, the 2-day combinations of price changes —*up-up, up-down*, *down-up*, and *down-down*—are tallied to see if there is a greater chance of, for example, an up day following an up day and a down day following a down day. Next, the eight 3-day patterns are tested for the same possibility of a high-probability price move, then sixteen 4-day patterns, and so on. When you get to larger sequences, such as *up-up-down-up-down-up*, every six consecutive prices must be tested for that pattern. From the price moves that follow this pattern, we can conclude whether it has any predictive ability. This approach as well as the combination of events used to forecast profitable situations are discussed later in this chapter.

Pattern recognition may appear to be more of a game than a business, but it is a source of many valuable ideas as well as false paths. Figure 15.1, a graph of the New York Stock Exchange (1854–1959), shows a very simple way to visualize the price pattern throughout the year. Each box represents the net movement of consecutive 2-month intervals, and is either up or down. When viewing all the patterns for 104 years in one glance, it is difficult not to count the recurrences of the more obvious patterns and then look for the formations that precede them in order to see whether they could be predictive. For example, in 1922, 1924, and 1927, there were sharp advances in the market; the years preceding those showed identical *V* patterns. When we look for all other *V* patterns, we see that 3 of 5 were followed by the same bull moves. Another pattern that stands out is that of two consecutive years of sharp rise, 1862–1863, 1908–1909, 1918–1919, and 1927–1928; in no case was there a third consecutive year but neither the preceding nor following years seem consistent.

Figure 15.1: Graph of the New York Stock market.

Patterns frequently provide the foundation for a trading method or the motivation to begin the development of a method. They have been applied in many ways to price analysis, from the time of day to place an order to the compound relationship of price, volume, and open interest. Daily trading opportunities may be a function of patterns based on the strength or weakness of the daily opening price. These are discussed in the next section. Weekly and weekend price patterns are studied, as well as types of reversals and their effects. These techniques can be used sequentially by following a weekday pattern with a weekend pattern, or they can confirm the results of each other when used together. The end of this chapter discusses more general issues in pattern recognition.

[1]Arthur A. Merrill, *Behavior of Prices on Wall Street* (Analysis Press, Chappaqua, NY, 1966).

Previous Next

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PROJECTING DAILY HIGHS AND LOWS

Statisticians claim that the best forecast of tomorrow's price is today's price; they state that no one has been able to reliably account for the countless combinations of price moves that would be needed to accurately project the changes that result in the high and low prices for tomorrow. Nevertheless, many trader's project these values and seem to use them with success.

Pivot Technique

The simplest approach to projecting tomorrow's highs and lows is to base those figures on the average price of today plus or minus a value that somehow relates to the current trading range, or volatility. One technique, based on a *pivot point*,[2] projects two levels of support and resistance:

Pivot point	P	$= (H + L + C)/3$
Resistance 1	$R1$	$= 2 \times P - L$
Support 1	$S1$	$= 2 \times P - H$
Resistance 2	$R2$	$= (P - S1) + R1$
Support 2	$S2$	$= P - (R1 - S1)$

As an example, take the high, low, and close of the day to be 12.50, 11.50, and 11.75. Then

$P = (12.50 + 11.50 + 11.75)/3 = 11.916$
$R1 = 2 \times 11.916 - 11.50 = 12.332$
$S1 = 2 \times 11.916 - 12.50 = 11.332$
$R2 = (11.916 - 11.332) + 12.332 = 12.914$
$S2 = 11.916 - (12.332 - 11.332) = 10.918$

The projected support and resistance levels show a downward bias consistent with the close that was in the lower part of the trading range.

DeMark's Projected Ranges

Another author and trader, Tom DeMark,[3] has based his projections on the positioning of today's opening price relative to yesterday's closing price, which gives him added timely information. If today's open is higher than the previous close the projections are biased upwards; if lower than the close they are biased downwards.

If today's close is below today's open, then

Tomorrow's projected high = $(H + C + 2 \times L)/2 - L$

Tomorrow's projected low = $(H + C + 2 \times L)/2 - H$

If today's close is above today's open, then

Tomorrow's projected high = $(2 \times H + L + C)/2 - L$

Tomorrow's projected low = $(2 \times H + L + C)/2 - H$

If today's close is the same as today's open then

Tomorrow's projected high = $(H + L + 2 \times C)/2 - L$

Tomorrow's projected low = $(H + L + 2 \times C)/2 - H$

Once the basic formula is determined, which biases tomorrow's projection in the direction of today's close relative to today's open, the *projected high* is found by removing two units of the low price, and the *projected low* is found by removing two units of the high price from the formula. This effectively shifts the projection in the direction of the new high by one-half the difference of today's close and today's low, $(C - L)/2$, and the new low by one-half the difference of today's close and today's high, $(H - C)/2$.

Comparing the Two Ranges

Because the two methods of calculating the projected ranges use the same basic prices, combining them with slightly different arithmetic, it is not clear whether they give values that are the same or different. For example, if the Swiss franc had a high, low, and close of 6600, 6450, and 6500, respectively, the first pivot method would give a projected first resistance level (high) of 2 × (6600 + 6450 + 6500)/3 - 6450 = 6583. DeMark's projected high is different based on the way today's opening price relates to the previous close. If the open is lower than the previous close we get (6600 + 6500 + 2 × 6450)/2 - 6450 = 6550; if the open is higher, we have (2 × 6600 + 6450 + 6500)/2 - 6450 = 6625; and, if the open is about the same as the previous close then the projected high is (6600 + 6450 + 2 × 6500)/2 - 6450 = 6575. It seems reasonable that the pivot point method returns a value close to DeMark's neutral case, where the market opens unchanged from the previous close.

[2]Mark Etzkorn, "All in a Day's Work," *Futures* (January 1995). This technique is attributed to William Greenspan.

[3]Tom DeMark, *The New Science of Technical Analysis* (Wiley, New York, 1994).

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TIME OF DAY

Market participants, especially floor traders and day traders, are the cause of periodic movement during the day. Angas called these the "tides of the daily prices." Over the years, the great increase in participants has added liquidity to nearly all markets but has not altered the intraday time patterns. The classic pattern in both stocks and futures shows the greatest volume near the open, the next highest volume near the close, and the lowest volume at midday.

Trading Habits Form Lasting Patterns

There are a number of reasons for this normal pattern of trading. Many investors evaluate their positions and read market analysis in the evenings, then place their orders in the morning. Europe, which opens six hours earlier, waits for the U.S. open to enter orders reflecting news that has been driving their markets up or down. Although futures in all the major index markets are trading throughout the night, liquidity is erratic and prices often change direction. Liquidity in U.S. Index markets increases after the European equity markets open; however, this overnight trading has not changed the patterns that occur during the day sessions in the United States.

The closing of the day is a common time for trading because many investors believe that the closing price is the one that best represents the correct value. In the futures markets, a large part of the daily volume is the result of day trades by floor traders, or *locals.* Positions entered in the morning will be closed out by the end of the day to avoid depositing the margin required of positions held overnight. Accounts are settled using the closing price

Once the opening orders have been executed—the order flow that has accumulated from decisions made since the last close—volume declines. Scalpers and floor traders are active during the opening minutes but frequently have a mid-morning coffee break; this natural phenomenon causes liquidity to decline and may result in a temporary price reversal. All traders and investors develop habits of trading at particular times. Some prefer the opening, others 10 minutes after the open. Large funds and managed accounts have a specific procedure for entering the market, such as using close-only orders. Institutions with large orders must trade during times when the volume is heavy in order to keep slippage under control; therefore, they add to the already active early morning and late day trading, rather than enter orders during the middle of the trading session.

A day trader must watch certain key times. The opening moments of the trading session are normally used to assess the situation. The stock market will gap up or down to align itself with the futures market which has been trading continuously. Most other markets have electronic sessions in which the prices reflect current news. The day session opens with the bid-asked at the level already trading in the electronic session; therefore, there is little opportunity for profit in the first few seconds of trading. After a short delay, as the first burst of activity slows, floor trader will sell a strong open and buy a weak one; this means the trade must be *evened up* later, reinforcing the opening direction. On a strong open without a downward reaction, all local selling is absorbed by the market and later attempts of the locals to liquidate will hold prices up, preventing a reversal. Floor trades can normally be expected to take the opposite position to the opening direction, usually causing a reversal early in the session.

Tubbs' Intraday Patterns

Tubbs' *Stock Market Correspondence Lessons* (found in Chapter 13) explains the six dominant patterns in the stock market (based on a 10:00 A.M. to 3:00 P.M. session).

1. If a rally after the open has returned to the opening price by 1:00 P.M., the day is expected to close weaker.
2. If the market is strong from 11:00 A.M. to 12:00 P.M., it will continue from 12:00 P.M. to 1:00 P.M.
3. If a reversal from 1:00 P.M. to 1:30 P.M. finds support at 1:30 P.M., it will close strong.
4. If the market has been bullish until 2:00 P.M. it will probably continue until the close and into the next day.
5. A rally that continues for 2 or 3 days (as in Pattern 4) will most likely end on an 11:00 A.M. reversal.
6. In general, a late afternoon reaction down after a strong day shows a pending reversal.

Putting these together, the following two patterns (among others) can be expected:

1. A strong open with a reversal at 11:00 A.M. not reaching the opening price, then strength from 11:00 A.M. to 1:00 P.M., a short reversal until 1:30 P.M., and then a strong close; according to Pattern 5, there will be a strong open the following day.
2. A strong open that reverses by 11:00 A.M., continuing lower until 1:00 P.M., reverses again until 1:30 P.M., will close weak.

Merrill's Intraday Patterns

Merrill's work shows the hourly pattern of the stock market in Table 15.1, where a plus or minus sign indicates rising or falling prices during the preceding period. During the four years shown, the grid clearly indicates a strong opening and follow-through to 11:00 A.M. During 1963 the bullishness lasted all day, trailing off at the close. Except for 1963 we cannot say from this table that there was a bullish or bearish price move because there is no volatility, or average price move, associated with these hourly intervals.

Table 15.1: Merrill's Hourly Stock Market Patterns
Open table as spreadsheet

	Time during Trading Session					
	10:00	11:00	12:00	1:00	2:00	3:00
1962	-	+	-	-	+	-

1963	+	+	+	+	+	-
1964	+	+	-	-	+	-
1965	+	+	-	-	-	-

The pattern in Table 15.1 supports what we would expect as a normal intraday pattern. Prices begin strong and continue the first hour. Having exhausted the early orders, volume decreases and price reverses due to lack of buyers. By 2 P.M. the short sellers who faded the first-hour move cover their positions, causing a move back in the direction of the opening hour. The only inconsistency in the pattern is the weak close, which contradicts the strong open. Had there been both a strong open and a strong close we could declare these as bull years. Nevertheless, the pattern of a weaker close persisted for at least four years, offering an opportunity for day traders.

Updating Intraday Time Patterns, 1997–2003

The period from 1997 through 2003 represents a combination of extremes; first the end of one of the great bull markets in history, followed by a severe bear market which appears to have stopped, or slowed, by the end of the 3rd quarter 2003. If we could ever see a pattern in the way traders entered the market, it would be during these years. With the help of a computer program and intraday data, 30-minute intraday patterns were tabulated and summarized in Table 15.2.

Table 15.2: Intraday Patterns in Stocks and Interest Rates for the Two Periods, 1997–1999 and 2000-September 2003 (Chicago time)
Open table as spreadsheet

Years: 1997 through 1999															
S&P 500				Nasdaq 100				U.S. 10-Year Notes				Eurodollars			
End Time	% Up	% Dn	Net Direction	End Time	% Up	% Dn	Net Direction	End Time	% Up	% Dn	Net Direction	End Time	% Up	% Dn	Net Direction
900	54	46	100.0%	900	57	43	100.0%	900	49	51	100.0%	750	47	53	100.0%
930	48	52	-5.8%	930	50	50	-5.3%	930	55	45	-6.0%	820	54	46	-21.1%
1000	54	46	-1.8%	1000	56	44	4.6%	1000	53	47	-1.6%	850	48	52	-1.1%
1030	53	47	4.8%	1030	53	47	6.2%	1030	49	51	3.3%	920	54	46	-8.7%
1100	50	50	2.1%	1100	52	48	12.5%	1130	47	53	6.1%	950	47	53	-1.5%
1130	49	51	5.6%	1130	49	51	9.6%	1230	49	51	-3.7%	1020	58	42	6.2%
1200	53	47	-1.9%	1200	52	48	2.8%	1300	49	51	5.5%	1050	54	46	-2.2%
1230	50	50	1.9%	1230	51	49	-1.9%	1330	51	49	-5.7%	1 150	44	56	-0.5%
1300	50	50	-2.5%	1300	51	49	-4.4%	1400	53	47	6.5%	1220	57	43	-6.4%
1330	48	52	0.1%	1330	47	53	-0.1%	1200	50	50	8.0%	1250	46	54	-1.2%
1400	53	47	8.0%	1400	52	48	-0.8%	1100	53	47	4.6%	1320	49	51	2.5%
1430	55	45	0.1%	1430	52	48	7.4%	1430	49	51	-34.4%	1350	54	46	5.2%
1500	54	46	5.8%	1500	53	47	15.1%					1120	44	56	8.2%
1515	54	46	12.8%	1530	57	43	6.5%					1420	49	51	21.5%
				1600	0	100	-100.0%								

Open table as spreadsheet

Years: 2000 through 3rd Quarter 2003															
S&P 500				Nasdaq 100				U.S. 10-Year Notes				Eurodollars			
End Time	%Up	% Dn	Net Direction	End Time	%Up	% Dn	Net Direction	End Time	% Up	% Dn	Net Direction	End Time	% Up	% Dn	Net Direction
900	47	53	100.0%	900	50	50	100.0%	900	53	47	100.0%	750	52	48	100.0%
930	49	51	1.0%	930	48	52	3.2%	930	54	46	-5.2%	820	56	44	-10.5%
1000	51	49	1.1%	1000	49	51	1.9%	1000	53	47	-4.0%	850	51	49	-16.9%
1030	48	52	2.5%	1030	46	54	3.1%	1100	51	49	-2.9%	920	53	47	-8.7%
1100	52	48	6.8%	1100	50	50	5.4%	1130	52	48	3.4%	950	52	48	1.3%
1130	50	50	7.5%	1130	51	49	6.8%	1200	50	50	-6.0%	1020	56	44	-0.3%
1200	51	49	-1.5%	1200	53	47	0.7%	1230	52	48	0.4%	1050	48	52	10.6%
1230	54	46	0.4%	1230	53	47	1.9%	1300	52	48	-0.4%	1120	57	43	-2.0%
1300	48	52	-3.9%	1300	48	52	-1.8%	1330	55	45	4.8%	1150	46	54	-2.7%
1330	48	52	7.7%	1330	48	52	5.2%	1030	51	49	5.1%	1220	47	53	1.1%
1400	48	52	0.9%	1400	48	52	-6.0%	1400	55	45	3.1%	1250	51	49	-4.8%
1430	50	50	6.7%	1430	49	51	5.6%					1320	53	47	12.2%
1500	51	49	5.5%	1500	50	50	14.1%					1350	50	50	-5.7%
1515	55	45	-0.8%	1530	54	46	-14.0%					1420	45	55	14.5%

The top of the table shows the patterns for 1997 through 1999, three very bullish years for stocks while Eurodollar prices tried to rally (lower yields), then fell modestly while stock prices peaked. From the beginning of 2000, when stock prices began their steep decline, Eurodollars made an equally spectacular rally, moving to the lowest yields, and highest prices in 50 years.

S&P and Nasdaq Patterns

Let's look first at 1997–1999, the bullish years for stocks. The intraday time patterns for the S&P futures (Chicago time), shown in the top left corner of Table 15.2, show that prices ended the first 15 minutes of trading higher 54% of the time. The last 4 bars of the day, a span of 1 hour and 15 minutes from 1400 to 1515, also

showed 53–55% bullish net price moves. The far right column gives the persistence of the intraday pattern. The direction of the opening price relative to the previous day's closing price gives the *opening direction* for the day. Afterwards, all intervals are recorded as +1 if prices continue to move in the opening direction and -1 if prices move the other way. The first bar is always recorded as 100%. The second bar of the S&P shows a *Net % Direction* of -5.8%, meaning that the market tended to reverse from the opening direction a net of 5.8% over those days that it continued in the direction of the opening move. The S&P intraday pattern shows that prices reverse from the opening direction during the second and third bars of the day, but are very likely to move in the same direction of the open during the last hour of trading. Because there is an 8% bullish bias in the opening moves, we can conclude that the market closed strong as well.

In the bottom left of Table 15.2 is the S&P pattern from 2000 through September 2003. Here we can see a bearish bias of 6% in the open direction. Prices do not tend to reverse, but continue in the direction of the open throughout the morning, meander during midday, then have a modest move in the direction of the open between 1400 and 1500. The pattern shows consistency in the bearish direction, but not the strength of the bull market. It also shows that a different pattern may be associated with strongly trending markets.

Nasdaq patterns are not quite the same as the S&P, but are similar at the important times. There is a stronger 14% bullish bias in the early period, and stronger *Net% Direction* values. Prices tend to reverse from 1230 through 1400 before resuming the opening price direction. After the peak in 2000, Nasdaq shows less downwards bias on the open, the same consistency as the S&P during the first half of the day, but more severe reversals of direction in the afternoon.

Interest Rate Patterns

The interest rate markets did not have a strong trend during 1997 through 1999, but prices were very bullish from 2000 through mid-2003. During the first period there were an equal number of bullish and bearish 30-minute intervals during the day. The 10-year Treasury notes show a sharp tendency to reverse direction during the last bar, while Eurodollars were likely to confirm the opening direction. Both markets would reverse direction in the hour after the opening. From 2000 there is a noticeable bullish bias in the market opening, a consistent change of direction during the morning trading, then a confirmation of the opening direction at the end of the day. Treasury notes show greater consistency than Eurodollars.

Comparing the New and the Old

It is helpful to view the changing patterns of the S&P in the same way as Merrill's Table 15.1. Using futures in New York time instead of cash prices, the hourly changes for the individual years, 1997 through September 2003, are shown in Table 15.3. The opening hour tracks the general direction of prices. In 1997 and 1998, extremely bullish years, the first 2 hours and the last 2 hours posted gains. Although 1999 began with a lower open on average, it was followed by a very strong intraday pattern, with only one weak hour between 2:30 P.M. and 3:30 P.M.

Table 15.3: Yearly S&P Intraday Patterns Using Futures ➡ Open table as spreadsheet

(a) Direction of prices for each hour of trading							
	Time during Trading Session						
	10:30	11:30	12:30	1:30	2:30	3:30	4:15
1997	+	+	-	-	-	+	+
1998	+	+	+	+	-	+	+
1999	-	+	+	+	+	-	+
2000	+	-	+	+	-	-	-
2001	-	+	+	-	-	+	+
2002	-	-	-	+	-	-	+
2003	-	+	+	+	-	+	+

➡ Open table as spreadsheet

(b) Direction of prices, relative to the opening direction, for each hour of trading							
	Time during Trading Session						
	10:30	11:30	12:30	1:30	2:30	3:30	4:15
1997	open dir	-	+	+	+	+	+
1998	open dir	-	+	+	-	=	+
1999	open dir	+	+	-	+	-	+
2000	open dir	+	-	-	+	+	+
2001	open dir	=	+	+	-	+	-
2002	open dir	-	+	-	+	+	+
2003	open dir	-	+	-	+	+	-
Note: A "+" indicates the same direction as open.							

The year 2000, which marks the top of the bull market, shows strength during the first half of the day and weakness in the second half, and the year 2001 also shows mixed daily activity. This seems to indicate that bear markets are more complex than bull markets, or that traders were not yet convinced that they were in a bear market. By 2002 the tone was clearly negative, except for a closing rally, showing never-ending hope for a change of direction. As the prices bottom out in 2003 we see opening weakness followed by closing strength.

The second part of Table 15.3 shows the intraday patterns relative to the opening direction of the first hour. During all years except 1999 and 2000 we see the expected reversal during the second hour of trading. In most years the prices finished the last two hours in the same direction as the open. The last hour reversal during 2003 can be taken as a sign that the market was trying to change direction. Although not every year, and not every hour of trading, falls into a clear pattern, the overall picture helps to explain the intraday dynamics of the market. Figure 15.2 is a chart of the frequency that each bar closed in the direction of the first hour of trading. From this chart, it is clear that the most likely reversal comes during the second hour of trading, and that entering a trade during that reversal in favor of the opening direction is likely to see gains during the remaining trading day.

Figure 15.2: S&P 500, 1997–September 2003. Frequency of prices continuing in the same direction as the opening hour.

Patterns in Agricultural Futures

Many of the traders in agricultural commodities are likely to be a different group than those trading the S&P, interest rates, large-cap stocks, or foreign exchange. Therefore, we can expect patterns unique to those markets, yet with some similarity in the way human behavior is consistent.

Let's use soybeans from 1997 through September 2003 as an example, because it combines good volume with the largest price moves (in absolute dollar terms). First look at the price chart (Figure 15.3) to see that prices declined steadily for the first 5 years until the end of 2001, then rallied from that point until September 2003. The second part of Table 15.4 shows the pattern of trader reaction to the opening price direction. To make it clearer, the number of plus signs in each time bar is divided by the number of years to give the frequency of directional continuation in that bar. For example, the first bar recorded at 10:00 A.M. shows that in 3 of 7 years, or 43% of the years, the direction of prices reversed. The pattern of 15-minute frequencies is shown in Figure 15.4. Prices alternate between moving in the opening direction and reversing, but tend to move in the opening direction during the quiet midday hours, then are likely to close in the same direction as the open.

Table 15.4: Soybean Intraday Patterns, 1997–September 2003. Plus (+) indicates same direction as open. Open table as spreadsheet

	(a) Direction of prices for each 15 minutes of trading															
	Time during Trading Session															
	9:45	10:00	10:15	10:30	10:45	11:00	11:15	11:30	11:45	12:00	12:15	12:30	12:45	1:00	1:15	1:20
1997	+	-	+	+	-	+	-	0	-	-	-	-	-	+	+	+
1998	+	-	+	+	+	+	+	+	-	+	0	+	+	+	+	-
1999	0	+	+	-	+	-	-	+	-	+	+	+	-	+	+	+
2000	+	-	-	-	+	+	-	+	+	-	+	-	+	+	+	
2001	-	-	-	+	-	+	+	+	+	+	+	+	+	+	+	
2002	+	-	0	-	-	-	-	+	-	-	+	-	-	-	+	
2003	+	-	+	-	-	-	-	-	+	-	+	-	+	-	-	

Open table as spreadsheet

		(b) Direction of prices, relative to the opening direction, for each 15 minutes of trading														
		Time during Trading Session														
	9:45	10:00	10:15	10:30	10:45	11:00	11:15	11:30	11:45	12:00	12:15	12:30	12:45	1:00	1:15	1:20
1997	open dir	-	-	+	+	+	-	+	-	+	+	-	-	-	+	+
1998	open dir	-	+	+	+	-	-	-	+	+	-	+	+	-	-	-
1999	open dir	+	+	-	+	-	-	+	-	+	+	+	-	+	+	+
2000	open dir	-	-	-	+	-	0	-	+	-	+	-	-	+	-	
2001	open dir	+	+	+	+	+	-	+	+	+	+	-	-	+	+	
2002	open dir	-	+	-	+	+	+	+	+	+	+	+	-	+	+	
2003	open dir	+	-	+	-	-	-	+	+	+	+	+	-	-	-	

Note: A "+" indicates the same direction as open.

Figure 15.3: Soybean weekly prices, 1997–September 2003.

Figure 15.4: Soybean frequency of continuing in the opening direction, 1997–September 2003.

In terms of price direction, the top of Table 15.4 shows that soybean prices opened higher and closed higher during the years that prices were steadily declining. When they began to rally in 2002, there was a higher open but most other bars were lower. For prices to have moved higher during these years, there would have to be very large opening gaps and large but short bursts of upwards movement during the day. While there are day-trading opportunities due to price swings throughout the day, soybeans are clearly showing a different pattern than the S&P 500.

Refining the Patterns for Trading

When trying to find intraday market patterns, it might be best to observe only stronger or weaker openings. For example, if the first 30 minutes of S&P trading shows a gain greater than 5.00 points, we can expect the entire day to be more volatile than a day that posted a gain of only 1.00 point. Restricting trading to days of higher volatility will reduce the trading opportunities but should improve results. The same analysis shown in Figures 15.3 and 15.4 should be repeated with the smaller

opening bar price changes eliminated.

Figure 15.5 shows a comparison of S&P 500 futures frequency of continuation using no minimum restriction, a 3-point minimum, and a 5-point minimum. The test period was from January 2002 through September 2003. The thinnest line gives the frequency of all days without restriction, and the thickest line shows the same results using the largest restriction of 5 points. The thickest line shows the greatest extremes and more uniform pattern, although only 196 of 431, or 45%, of the days qualify using the 5-point filter. The picture shows that, during the 21 months of the test, the S&P price had a high tendency to continue in the direction indicated by the close of the first bar compared to the prior day's close. The middle of the day shows the greatest opportunity for setting a position in the opening direction; however, trades must be exited by 4:00 P.M. New York time because futures show a high likelihood to reverse during the last 15 minutes of trading. The *end-of-day reversal* could be attributed to the increasing number of day traders, who should have taken positions in the dominant direction, and liquidated by the close of the day.

Figure 15.5: S&P 500 futures, January 2002–September 2003. Frequency of continuation in the direction of the first 30-min bar using minimum moves of 0, 3.00, and 5.00 points.

Although the S&P showed a similar pattern with the three filters, other markets may have a tendency to be irregular, with peaks and valleys shifting based on the minimum filter. An oscillator based on shorter bar size may be used to find the relative price swings during the day. By selecting the overbought and oversold indications only during the periods corresponding to the highs and lows in Figure 15.5, you can gain flexibility. Further studies of *reversal patterns* and *gap analysis*, based on daily data, appear later in this chapter.

Programming Time Patterns

A TradeStation strategy called *TSM Time Patterns* is given in Figure 15.6. It allows you to input the minimum filter value and output a file named *timepatterns. txt,* placed in the directory named *c:\ test*, containing the information shown in Figure 15.6. The program will produce one line for each bar, regardless of the time interval of the bar. One word of caution is that the order of the bars printed in timepatterns.txt is based on the order seen by the program. Check that they are in time order. If not, simply move the line of data to its proper position.

```
{ TSM Time Patterns
   Copyright 2003, P.J.Kaufman. All rights reserved.
   Total intraday time patterns and print results }

{ "minpoints" is a filter so that no days are counted if the
   opening bar has a net change less than the value of "minpoints" }

inputs:   minpoints(0);
vars: n(0), ndays(0), opendir(0), ix(0), found(0), curdir(0),
   sum(0), minfilter(0);
arrays:   endtime[100](0), pattern[100](0), count[100](0),
   up[100](0), down[100](0);

{ identify new day }
if date <> date[1] then begin
   opendir = 0;
   minfilter = 0;
   if absvalue(close - close[1]) < minpoints then begin
      minfilter = 1;
      end
   else begin
      if close > close[1] then opendir = 1 else if close
         < close[1] then opendir = -1;
      ndays = ndays + 1;
      end;
   end;

if minfilter = 0 then begin
   curdir = 0;
   if close > close[1] then curdir = 1 else if close
      < close[1] then curdir = -1;
{ total values if open is not the same as prior close }
   found = 0;
```

```
   if opendir <> 0 and ndays <> 0 and curdir <> 0 then begin
{ record time of day on first calculation day }
   if n > 0 then begin
      for ix = 1 to n begin
         if endtime[ix] = time then begin
                        found = 1;
{ post a +1 if price move in the same direction as on the open }
                     if opendir <> 0 then begin
                        count[ix] = count[ix] + 1;
                        if curdir*opendir > 0 then
                            pattern[ix] = pattern[ix] + 1;

               if curdir > 0 then up[ix] = up[ix] + 1
                  else down[ix] = down[ix] + 1;
               end;
            end;
         end;
      end;
   end;

{ time not previously recorded }
   if found = 0 and opendir <> 0 and curdir <> 0 then begin
      n = n + 1;
      endtime[n] = time;
      count[n] = count[n] + 1;
      if curdir*opendir > 0 then pattern[n] = pattern[n] + 1;
      if curdir > 0 then up[n] = up[n] + 1 else down[n] = down[n] + 1;
      end;
   end;

if lastbaronchart then begin
   for ix = 1 to n begin
      sum = sum + count[ix];
      end;
   for ix = 1 to n begin
      print(file("c:\test\timepatterns.txt"),
         endtime[ix]:4:0,count[ix]:8:0,up[ix]*100/count[ix]:6:0,
         down[ix]*100/count[ix]:6:0,pattern[ix]*100/count[ix]:5:1,"%");
      end;
   end;
```

Figure 15.6: TSM Time Patterns.

Relating the Opening Direction to the Last Bar of the Prior Day

Holding a trade overnight has increased risk, but may offer substantial opportunity. Day traders are not usually willing to hold a position overnight; therefore, they may sacrifice profits for less risk. To test this, a short program was written, called *TSM EOD to Open Direction*, shown in Figure 15.7. The strategy was run on the S&P futures from January 2002 through September 2003 and the results printed in a file called *EODtimepatterns.txt* in the *c:\test* directory (Table 15.5).

Table 15.5: Output from PJK Time Patterns for S&P (Chicago time)

Open table as spreadsheet

		Price		
Time	**Cases**	**%Up**	**%Down**	**% In Open Direction**
900	196	44	56	100.0
930	190	48	52	50.5
1000	192	46	54	53.6
1030	188	54	46	50.5
1100	189	54	46	54.5
1130	187	52	48	59.9
1200	190	54	46	46.8
1230	192	54	46	47.4
1300	184	47	53	50.5
1330	193	48	52	53.9
1400	191	49	51	52.9
1430	190	54	46	55.8
1500	195	48	52	60.5
1530	187	56	44	40.1

```
{ TSM EOD to Open Direction
   Copyright 2003, P.J.Kaufman. All rights reserved.
   Total frequency of end-of-day moves (last bar) to first bar of
      next day }

{ "minpoints" is a filter so that no days are counted if the opening bar
   has a net change less than the value of "minpoints" }

inputs: minpoints(0);
vars: ndays(0), opendir(0), curdir(0), pattern(0), up(0), down(0),
   EODchange(0);

{ identify new day }
if date <> date[1] then begin
   if absvalue(EODchange) >= minpoints then begin
      opendir = 0;
      if close > close[1] then opendir = 1 else if close < close[1] then
         opendir = -1;
      ndays = ndays + 1;
```

```
{ add 1 if directio8f28last bar of day is the same as first bar of day }
      if opendir*curdir > 0 then pattern = pattern + 1;
      if opendir > 0 then up = up + 1 else if opendir < 0 then down =
         down + 1;
      end;
   end;

curdir = 0;
EODchange = close - close[1];
if close > close[1] then curdir = 1 else if close < close[1] then
   curdir = -1;

if lastbaronchart then begin
   print(file("c:\test\EODtimepatterns.txt"), ndays:6:0,up*100/ndays:6:0,
      down*100/ndays:6:0,pattern*100/ndays:5:1,"%");
   end;
```

Figure 15.7: TSM EOD to Open Direction.

Results in Table 15.6, ordered by the size of the price move during the last 15 minutes of trading, show a pattern that is generally accepted by traders. Unless you select those last bars (from 4:00 to 4:15 P.M., New York time) which had larger price moves, the chances of continuing in the same direction on the first bar of the next day were about 50%. However, when there was a modest move during the last 15 minutes of the day, from 2.00 to 4.00 points, the next morning tended to reverse direction. This corresponds to day traders resetting the positions that they liquidated near the close of the prior day. If they sold during the last 15 minutes, they buy back in the first 30-minute bar.

Table 15.6: Likelihood of S&P Movement in the Same Direction as the Previous Closing Bar

Open table as spreadsheet

Minimum Points	No. of Cases	Price Direction		
		% Up	% Down	% Continue
0	437	47	52	46.7
1	274	47	52	50.0
2	124	40	60	42.7
3	38	32	68	44.7
4	13	31	69	61.5

When there was a large price move, greater than 4.00 points, in the last 15 minutes of trading, prices continued 61.5% of the time in that direction during the first 30 minutes of the next day. We can speculate that a surprise earnings report that is released after the close of the New York Stock Exchange, but not before the close of the futures market, caused a sharp move that was carried over into the next day. The futures market reacts, but many investors who do not trade futures would need to wait for the open of the regular stock market session to react to the news. Only 13 of 437 days, or 3%, satisfied this condition, showing that better opportunities are far less frequent.

Intraday Highs and Lows

In selecting a place to enter the market for a single day trade, it would be a great advantage to know the time of day at which the highest or lowest price is likely to occur. To understand this, first look at Figure 15.8 which presents both the individual times at which intraday highs and lows occur as well as the cumulative percentage of occurrence throughout the trading day.

Figure 15.8: S&P futures, January 2002–September 2003, occurrence of intraday highs and lows using 30-minute bars.

S&P 500

The S&P futures pattern, shown in Figure 15.7, is interesting because of its similarity between the times that the highs and lows occur. The bar chart along the bottom shows the frequency of intraday highs and the frequency of intraday lows during each bar (highs are to the left). The intraday pattern forms a very uniform *U* shape, with a higher bar at the open, representing a 25% chance that a high will occur during the first bar of the day. On the far right, a high is likely to occur 15% of the time during the last bar. The middle of the day is the least likely time for the day's high or low to occur. This pattern is very similar to the intraday distribution of volume. The two curving lines represent the cumulative occurrence of the highs and lows up to that bar during the day; therefore, at the end of the day both cumulative highs and lows show 100%. The remarkable uniformity in the S&P high-low patterns could be attributed to the large participation in that market.

U.S. 30-Year Bonds

Bonds also have a U-shaped formation, but not as regular as the S&P. If we remember that yields have steadily declined until about May 2003, we would expect a bias in the occurrence of intraday highs and lows. Figure 15.9 shows that the cumulative lows (the thinner line) were more likely to occur earlier in the day. That pattern confirms an upwards trend in bond prices. Bond prices also show a greater likelihood to post their high or low (22% and 28%) during the first bar. This is likely to be caused by the economic reports, most of which are released 10 minutes after bond futures open.

Figure 15.9: 30-Year bonds, January 2002–September 2003, occurrence of intraday highs and lows using 30-minute bars.

Crude Oil and Soybeans

Crude oil and soybeans are grouped together because, more than other markets, they both tend to post highs and lows on the first and last bar of the day. Crude oil has posted open and closing highs of 28% and 33%, and opening and closing lows of 35% and 19% (see Figure 15.10). The bias towards opening lows of 35% implies that prices have been rising during the period from January 2002 through September 2003. The close shows the opposite, with highs of 33% versus lows of 19%. There is nearly a 2:1 chance that crude oil will make a high in the closing bar rather than a low.

Figure 15.10: Crude oil, January 2002–September 2003, occurrence of intraday highs and lows using 30-minute bars.

Soybeans (Figure 15.11) show a very similar pattern to crude oil, with the greatest chance of a low during the opening bar and a high on the closing bar. This can be interpreted as a likelihood to trend during the day.

Figure 15.11: Soybeans, January 2002–September 2003, occurrence of intraday highs and lows using 30-minute bars.

Euro/U.S. Dollar

Currency patterns are very different and more complex because they are traded throughout the 24 hours around the world. When the Japanese open for business it is still early evening in New York, and when Europeans start their day it is about 2 A.M. in New York. When London financiers end their day it is about noon in New York. One of the difficulties in finding intraday patterns for currencies is to decide what hours represent the *trading day*. In the results shown in Figure 15.12, the day started at 2:00 A.M. and ended at 4:00 P.M., New York, encompassing the open of European markets through the close of the U.S. stock market.

Figure 15.12: Euro/U.S. dollar, January 2002–September 2003, occurrence of intraday highs and lows using 30-minute bars.

While there is generally the same U-shaped pattern for the U.S. dollar/Euro seen in Figure 15.12, there is a hump that begins at 7:30 A.M. and peaks at 12:30 P.M., when most businesses close in Europe. Afterwards, the likelihood of a new high or low drops until the U.S. close.

Using the Intraday High and Low Patterns for Trading

There are few simple rules that come out of the intraday high-low patterns that could help trading. Because there is a high frequency of the high or low occurring during the first bar of the day, you become more confident that an early extreme is a high or low as the day progresses. For example, the S&P gaps up 3.00 points after a bullish employment report. It runs up to a high of 4.50 points at the end of the first 30 minutes, then falls back to trade up 2.50 points by the end of the second bar. Have we seen a high or a low? It may still be too early to tell. If prices continue lower and make new lows, then we are much more confident that the high was made during the first bar. If prices make a new high then we are equally confident that we have seen the low of the day. As each bar passes, we are more confident that we have seen the high or low. We can then trade in the direction of the high or low not yet seen, hoping that it will occur on the close. The sooner we make this decision, the more profit potential we can capture. A breakout of a high or low later in the day increases the chance of a close in that direction. Always place a stop-loss at the point where a new low would occur if you are long, or a new high if you have sold short.

Midday offers another trading opportunity because of the small chance of seeing a new high or low. If you have decided that the low occurred near the open, then buying on a test of the lows during the quiet midday session could provide good entry timing.

An Exception to Every Rule.

During the 1990s the stock market experienced one of the greatest bull markets in history. From 1995 through 1996 nearly everyone was talking about the 20% returns that were easily achieved in the stock market. This affected the intraday patterns. Investors would most often buy on the open of trading, but the would also buy on any pullback during the day. The result was that the U-shaped pattern that we clearly see in Figures 15.7 through 15.11 were replaced by a jump at the open and a straight line throughout the rest of the day.

Programming Intraday Highs and Lows

A program to print the distribution of intraday highs and lows is shown in Figure 15.13; sample output is shown in Table 15.7. The output is written to the file *IntradayHLdist.txt* and placed in directory *c:\test*. The program will work with any bar size and has no inputs.

Table 15.7: S&P Output from TSM Intraday High and Low Distribution

➡ Open table as spreadsheet

Time	High	Low	% High	% Low	c% High	c% Low

900	108	104	25	24	25	24
930	52	50	12	11	37	35
1000	25	31	6	7	43	43
1030	16	20	4	5	46	47
1100	18	15	4	3	50	51
1130	8	21	2	5	52	55
1200	11	9	3	2	55	57
1230	9	9	2	2	57	60
1300	10	6	2	1	59	61
1330	16	15	4	3	63	64
1400	23	17	5	4	68	68
1430	30	32	7	7	75	76
1500	44	52	10	12	85	88
1515	65	54	15	12	100	100

```
{ TSM Intraday High and Low Distribribution
   Copyright 1995-2003 P.J. Kaufman. All rights reserved.
   Produce a histrogram of frequency of high and low appearing
      at different times of day. }

   vars:    n(0), max(0), init(2), thigh(0), hightime(0), tlow(0),
      lowtime(0), k(0), tot(0), cumhigh(0), cumlow(0);
   array:   hdist[100](0), ldist[100](0), endtime[100](0);

{ Test for a new day )
   if date <> date[1] then begin
{ Finish processing yesterday }
   if init = o then begin
      if hightime <> 0 then hdist[hightime] = hdist[hightime] + 1;
      if lowtime <> 0 8n281dist[lowtime] = ldist[lowtime] + 1;
      end;
   if init > 0 then init = init - 1;
   n = 0;
   end;

{ Initialize new day }
   if n = 0 then begin
      thigh = high;
      hightime = 1;
      tlow = low;
      lowtime = 1;
      end;

   n = n + 1;
   if init = 1 then begin
      if n > max then max = n;
      endtime[n] = time;
      end;

{ Next interval in same day }
   if high > thigh then begin
      thigh = high;
      hightime = n;
      end;
   if high = thigh and n > max / 2 then begin
      thigh = high;
      hightime = n;
      end;
   if low < tlow then begin
      tlow = low;

      lowtime = n;
      end;
   if low = tlow and n > max / 2 then begin
      tlow = low;
      lowtime = n;
      end;

if lastbaronchart then begin
      thigh = 0;
      tlow = 0;
      for k = 1 to max begin
         thigh = thigh + hdist[k];
         tlow = tlow + ldist[k];
         end;
      print(file("c:\test\IntradayHLdist.txt"),"time high low %high %low
         c%high c%low");
      for k = 1 to max begin
         cumhigh = cumhigh + hdist[k];
         cumlow = cumlow + ldist[k];
      print (File("c:\test\IntradayHLdist.txt"), endtime[k]:4:0,
         hdist[k]:5:0, ldist[k]:4:0, hdist[k]*100/thigh:6:0,
         ldist[k]*100/tlow:6:0, cumhigh*100/thigh:7:0,
         cumlow*100/tlow:7:0);
      end;
  end;
```

Figure 15.13: Program to find Intraday High and Low Patterns.

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OPENING GAPS AND INTRADAY PATTERNS

The daily price fluctuations and intraday patterns of a market may be related to the strength or weakness of the daily opening. A large *gap opening* implies greater volatility for the day, positions prices for a greater reaction, and may show more consistency in the subsequent intraday patterns than a market that opens nearly unchanged. A gap analysis was performed to study the combination of patterns that could be traded profitably. A strong open followed by a stronger close would allow a trader to buy on a pullback after the open. A consistently weak close after a strong open would be an opportunity to sell short near the open. Specific entry timing can be improved by using the patterns discussed in the previous section.

The *gap analyses* for ten highly liquid markets in different sectors are shown in Table 15.8 through 15.17. Two time periods evaluated for each market are shown side by side, January 1990 through September 2003, and the most recent two years from October 2001 through September 2003. Price patterns during the longer period were unprecedented; therefore, we would want to compare a more recent period to see if these same patterns continue.

Table 15.8: Gap Analysis, S&P 500
Open table as spreadsheet

(a) S&P 500, 1990—September 2003									(b) S&P 500, September 2001—September 2003								
		Closing Prices			Trading Range						Closing Prices			Trading Range			
Gap	Cases	Cont Dir	Below Open	Rev Dir	CrossPrev Cls	Adj fr Open	Cont Only	Cont Next Day	Gap	Cases	Cont Dir	Below Open	Rev Dir	Cross Prev Cls	Adj fr Open	Cont Only	Cont Next Day
15.0	54	62	30	8	21	75	4	50	15.0	13	54	31	15	38	46	15	62
13.5	12	50	33	17	42	42	17	42	13.5	1	100	0	0	0	0	100	0
12.0	27	58	31	12	22	67	11	48	12.0	3	100	0	0	0	33	67	33
10.5	35	54	20	26	55	39	6	37	10.5	11	55	18	27	45	45	9	18
9.0	53	52	19	29	60	36	4	45	9.0	9	22	44	33	56	33	11	56
7.5	81	49	22	28	65	31	4	47	7.5	15	40	27	33	73	27	0	47
6.0	130	58	12	29	57	40	4	41	6.0	35	57	14	29	63	34	3	26
4.5	171	49	14	37	71	28	2	44	4.5	43	39	17	44	86	14	0	44
3.0	321	52	13	35	70	27	2	55	3.0	52	52	2	46	86	12	2	40
1.5	857	52	7	41	85	14	1	50	1.5	44	51	0	49	91	7	2	59
0.0	66	0	0	0	0	0	0	0	0.0	8	0	0	0	0	0	0	0
-1.5	809	48	8	45	86	13	0	45	-1.5	45	44	0	56	91	9	0	38
-3.0	277	45	20	35	70	27	3	46	-3.0	32	42	6	52	88	6	6	38
-4.5	147	50	15	35	66	33	1	44	-4.5	40	44	13	44	79	18	3	48
-6.0	114	52	15	33	63	32	4	47	-6.0	28	64	7	29	56	41	4	46
-7.5	72	56	21	24	67	32	1	46	-7.5	27	52	30	19	70	26	4	44
-9.0	47	46	26	28	51	49	0	38	-9.0	12	55	9	36	50	50	0	42
-10.5	39	59	21	21	38	59	3	36	-10.5	16	69	13	19	25	69	6	25
-12.0	31	48	32	19	35	58	6	48	-12.0	8	38	38	25	50	50	0	63
-13.5	20	60	30	10	35	65	0	55	-13.5	5	80	20	0	0	100	0	80
-15.0	56	43	41	17	45	55	0	43	-15.0	8	38	25	38	63	38	0	25

Each table is separated into two parts and values are expressed as percentages:

1. The position of the closing price following a gap opening.
   a. *Cont Dir.* The close continued (extended the move) in the direction of the gap.
   b. *Below Open.* The close was between the gap opening and the prior close.
   c. *Rev Dir.* The close reversed the direction of the opening gap, that is, if the open was higher, the close was lower.
2. The type of trading range pattern that occurred.
   a. *Cross Prev Cls.* Prices crossed the prior closing price at least once during the trading session.
   b. *Adjfr Open.* Prices reversed from the open but did not cross the prior close.
   c. *Cont Only.* Prices continued in the direction of the open and never reversed.

Table 15.9: Gap Analysis, Nasdaq 100
Open table as spreadsheet

(a) Nasdaq 100, 1990—September 2003									(b) Nasdaq 100, September 2001—September 2003								
		Closing Prices			Trading Range						Closing Prices			Trading Range			

Gap	Cases	Cont Dir	Below Open	Rev Dir	CrossPrev Cls	Adj fr Open	Cont Only	Cont Next Day	Gap	Cases	Cont Dir	Below Open	Rev Dir	Cross Prev Cls	Adj fr Open	Cont Only	Cont Next Day
50	78	52	23	25	43	55	1	54	50	3	67	33	0	0	100	0	100
45	17	35	41	24	53	41	6	53	45	0	0	0	0	0	0	0	0
40	21	65	20	15	38	62	0	48	40	2	50	50	0	50	50	0	0
35	34	52	24	24	55	45	0	53	35	2	0	100	0	0	100	0	50
30	42	55	26	19	49	46	5	50	30	10	70	30	0	11	78	11	60
25	50	46	18	36	62	36	2	44	25	9	33	11	56	67	22	11	44
20	81	53	21	26	68	31	1	48	20	22	45	25	30	55	41	5	36
15	149	47	18	36	76	21	3	47	15	43	42	21	37	73	23	5	40
10	224	49	12	38	75	24	2	53	10	60	51	7	42	84	16	0	42
5	300	52	4	44	85	10	5	58	5	73	57	4	38	86	10	4	44
0	39	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0
-5	239	48	5	47	90	8	2	36	-5	59	47	3	49	95	3	2	36
-10	171	49	11	41	77	21	2	40	-10	65	56	10	35	82	18	0	42
-15	113	50	16	34	68	30	2	44	-15	46	50	17	33	59	37	4	48
-20	67	43	21	36	70	27	3	43	-20	20	55	20	25	47	53	0	50
-25	50	56	22	22	60	40	0	36	-25	13	62	23	15	38	62	0	23
-30	33	45	18	36	55	45	0	48	-30	3	67	33	0	33	67	0	33
-35	23	48	26	26	39	57	4	52	-35	5	60	40	0	20	80	0	40
-40	22	48	19	33	68	32	0	45	-40	3	33	33	33	33	67	0	33
-45	14	64	7	29	43	43	14	71	-45	2	50	0	50	50	50	0	50
-50	66	56	22	22	48	49	3	39	-50	1	0	100	0	0	100	0	100

Table 15.10: Gap Analysis, German DAX

Open table as spreadsheet

(a) German DAX, 1990–September 2003									(b) German DAX, September 2001–September 2003								
		Closing Prices			Trading Range						Closing Prices			Trading Range			
Gap	Cases	Cont Dir	Below Open	Rev Dir	Cross Prev Cls	Adj fr Open	Cont Only	Cont Next Day	Gap	Cases	Cont Dir	Below Open	Rev Dir	Cross Prev Cls	Adj fr Open	Cont Only	Cont Next Day
50	221	51	27	22	39	59	2	49	50	36	53	25	22	36	56	8	44
45	38	39	21	39	63	32	5	55	45	10	30	20	50	90	10	0	70
40	50	56	14	30	53	45	2	56	40	10	60	20	20	56	33	11	50
35	82	52	13	34	62	35	2	51	35	24	50	25	25	71	21	8	46
30	81	54	19	27	56	41	3	49	30	22	55	18	27	55	41	5	59
25	74	50	9	41	78	19	3	55	25	20	30	10	60	85	10	5	40
20	83	46	12	42	77	22	1	54	20	21	42	16	42	81	19	0	57
15	80	48	8	45	85	14	1	46	15	22	45	9	45	86	14	0	45
10	95	48	1	51	91	8	1	56	10	28	39	4	57	86	11	4	61
5	82	52	2	46	94	5	1	54	5	33	55	3	42	94	6	0	33
0	25	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0
-5	80	58	1	41	94	4	3	39	-5	24	67	0	33	92	4	4	46
-10	81	53	3	44	90	4	6	44	-10	26	48	0	52	92	4	4	42
-15	70	51	3	46	84	13	3	44	-15	36	61	0	39	86	11	3	53
-20	71	51	9	40	79	21	0	41	-20	25	54	8	38	92	8	0	56
-25	74	42	25	33	73	27	0	36	-25	20	40	35	25	70	30	0	40
-30	64	53	9	38	72	28	0	47	-30	17	65	0	35	65	35	0	59
-35	47	49	21	30	69	29	2	47	-35	12	75	0	25	42	50	8	42
-40	39	54	10	36	67	31	3	38	-40	8	75	0	25	75	25	0	38
-45	36	36	33	31	64	36	0	47	-45	10	10	50	40	90	10	0	50
-50	181	53	32	15	34	65	1	43	-50	44	56	30	14	34	66	0	43

Table 15.11: Gap Analysis, Eurodollars

Open table as spreadsheet

(a) Eurodollars, 1990–September 2003									(b) Eurodollars, September 2001–September 2003								
		Closing Prices			Trading Range						Closing Prices			Trading Range			
Gap	Cases	Cont Dir	Below Open	Rev Dir	Cross Prev Cls	Adj fr Open	Cont Only	Cont Next Day	Gap	Cases	Cont Dir	Below Open	Rev Dir	Cross Prev Cls	Adj fr Open	Cont Only	Cont Next Day
0.10	13	31	69	0	0	100	0	62	0.10	1	0	100	0	0	100	0	100
0.09	5	20	80	0	0	75	25	60	0.09	0	0	0	0	0	0	0	0
0.08	5	80	20	0	25	75	0	40	0.08	1	0	100	0	0	0	0	0
0.07	21	44	44	13	14	81	5	38	0.07	1	100	0	0	0	100	0	0
0.06	47	47	39	13	30	58	12	62	0.06	4	0	67	33	25	75	0	50
0.05	84	51	30	19	28	64	8	54	0.05	13	56	33	11	25	67	8	69

0.04	37	65	24	12	22	75	3	41	0.04	6	40	60	0	0	100	0	17
0.03	286	51	24	25	45	41	14	54	0.03	32	64	27	9	36	36	27	38
0.02	606	56	6	37	70	9	20	50	0.02	73	63	8	29	58	18	25	42
0.01	188	51	0	49	82	0	18	52	0.01	24	50	0	50	71	0	29	42
0.00	890	0	0	0	0	0	0	0	0.00	122	0	0	0	0	0	0	0
-0.01	161	48	0	52	79	0	21	48	-0.01	26	40	0	60	81	0	19	46
-0.02	617	50	8	42	71	11	18	47	-0.02	86	51	2	47	70	9	21	48
-0.03	266	46	25	29	50	39	11	50	-0.03	35	45	21	34	50	42	8	57
-0.04	30	57	24	19	31	62	8	57	-0.04	4	-1	-1	-1	75	25	0	25
-0.05	80	35	49	15	29	67	4	49	-0.05	10	22	56	22	29	71	0	40
-0.06	33	50	38	12	17	76	7	67	-0.06	8	57	29	14	13	75	13	50
-0.07	26	43	52	5	21	63	17	62	-0.07	2	100	0	0	50	0	50	50
-0.08	2	100	0	0	0	100	0	50	-0.08	1	100	0	0	0	100	0	100
-0.09	11	40	60	0	0	100	0	36	-0.09	1	0	100	0	0	0	0	0
-0.10	4	0	50	50	50	50	0	0	-0.10	0	0	0	0	0	0	0	0

Table 15.12: Gap Analysis, U.S. 10-Year Notes

Open table as spreadsheet

(a) U.S. 10-Year Notes, 1990-September 2003									(b) U.S. 10-Year Notes, September 2001–September 2003								
		Closing Prices			Trading Range						Closing Prices			Trading Range			
Gap	Cases	Cont Dir	Below Open	Rev Dir	CrossPrev Cls	Adj fr Open	Cont Only	Cont Next Day	Gap	Cases	Cont Dir	Below Open	Rev Dir	Cross Prev Cls	Adj fr Open	Cont Only	Cont Next Day
0.625	20	39	50	11	20	80	0	60	0.625	5	60	40	0	0	100	0	60
0.563	14	57	36	7	21	71	7	64	0.563	1	0	100	0	0	100	0	100
0.5	31	38	45	17	40	60	0	48	0.5	11	40	40	20	36	64	0	36
0.438	30	54	29	18	29	71	0	53	0.438	8	25	50	25	43	57	0	63
0.375	67	56	32	12	28	70	1	55	0.375	22	64	23	14	27	73	0	59
0.313	160	50	34	17	35	61	4	50	0.313	30	59	34	7	37	63	0	50
0.25	205	60	17	23	46	51	3	52	0.25	34	74	12	15	41	56	3	47
0.188	296	48	18	34	64	31	5	55	0.188	36	42	31	28	72	22	6	50
0.125	397	49	13	38	72	22	6	51	0.125	30	60	3	37	69	17	14	33
0.063	475	54	2	44	91	5	4	56	0.063	42	43	2	55	93	5	2	38
0	209	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0
-0.063	426	48	2	51	92	4	4	48	-0.063	54	45	0	55	96	2	2	46
-0.125	339	47	11	43	75	19	6	52	-0.125	34	34	3	63	82	15	3	47
-0.188	281	45	18	37	63	31	6	43	-0.188	27	33	11	56	73	27	0	52
-0.25	165	48	21	31	51	46	3	41	-0.25	31	38	14	48	73	27	0	42
-0.313	138	44	33	23	41	56	3	44	-0.313	28	35	23	42	57	43	0	50
-0.375	43	35	40	26	55	43	2	53	-0.375	11	36	27	36	73	27	0	55
-0.438	34	45	39	15	27	73	0	50	-0.438	8	38	50	13	25	75	0	75
-0.5	21	74	26	0	29	67	5	48	-0.5	4	75	25	0	25	75	0	25
-0.563	17	63	25	13	18	82	0	53	-0.563	6	67	33	0	17	83	0	17
-0.625	27	54	38	8	15	85	0	48	-0.625	17	50	44	6	18	82	0	41

Table 15.13: Gap Analysis, Eurobund

Open table as spreadsheet

(a) Eurobund, 1990–September 2003									(b) Eurobund, September 2001–September 2003								
		Closing Prices			Trading Range						Closing Prices			Trading Range			
Gap	Cases	Cont Dir	Below Open	Rev Dir	CrossPrev Cls	Adj fr Open	Cont Only	Cont Next Day	Gap	Cases	Cont Dir	Below Open	Rev Dir	Cross Prev Cls	Adj fr Open	Cont Only	Cont Next Day
0.50	12	25	58	17	25	75	0	58	0.50	6	50	33	17	17	83	0	33

0.45	3	67	33	0	0	67	33	67	0.45	1	100	0	0	0	100	0	0
0.40	5	60	0	40	40	60	0	20	0.40	2	100	0	0	0	100	0	0
0.35	15	53	27	20	47	53	0	33	0.35	7	71	14	14	43	57	0	14
0.30	27	50	35	15	26	70	4	59	0.30	14	50	36	14	29	64	7	57
0.25	55	52	30	19	37	59	4	62	0.25	26	65	23	12	27	69	4	65
0.20	104	51	21	28	55	44	1	53	0.20	34	65	9	26	47	53	0	44
0.15	121	53	13	34	69	30	1	54	0.15	33	63	9	28	73	27	0	39
0.10	243	47	10	43	80	18	2	51	0.10	66	52	8	40	84	14	2	52
0.05	250	54	5	42	91	3	5	53	0.05	44	55	7	39	95	0	5	61
0.00	86	0	0	0	0	0	0	0	0.00	22	0	0	0	0	0	0	0
-0.05	239	43	3	54	93	5	2	45	-0.05	50	47	4	49	85	13	2	32
-0.10	224	51	6	43	80	16	3	44	-0.10	59	55	5	40	76	20	3	44
-0.15	104	41	10	50	72	28	0	51	-0.15	24	43	13	43	74	26	0	42
-0.20	89	53	10	36	61	36	2	47	-0.20	38	57	8	35	59	38	3	47
-0.25	30	57	18	25	45	55	0	50	-0.25	12	45	9	45	67	33	0	50
-0.30	20	30	40	30	45	50	5	50	-0.30	6	67	0	33	33	50	17	67
-0.35	9	67	33	0	11	78	11	44	-0.35	4	75	25	0	0	75	25	50
-0.40	4	50	25	25	75	25	0	50	-0.40	2	50	0	50	50	50	0	50
-0.45	7	57	29	14	71	29	0	29	-0.45	2	0	100	0	100	0	0	0
-0.50	8	13	88	0	13	88	0	50	-0.50	4	25	75	0	25	75	0	50

Table 15.14: Gap Analysis, Crude Oil

Open table as spreadsheet

(a) Crude Oil, 1990–September 2003									(b) Crude Oil, September 2001–September 2003								
		Closing Prices			Trading Range						Closing Prices			Trading Range			
Gap	Cases	Cont Dir	Below Open	Rev Dir	CrossPrev Cls	Adj fr Open	Cont Only	Cont Next Day	Gap	Cases	Cont Dir	Below Open	Rev Dir	Cross Prev Cls	Adj fr Open	Cont Only	Cont Next Day
1.0	36	59	34	6	12	88	0	67	1.0	2	100	0	0	0	100	0	50
0.9	5	60	20	20	20	80	0	60	0.9	0	0	0	0	0	0	0	0
0.8	15	53	33	13	21	71	7	67	0.8	3	0	67	33	33	67	0	67
0.7	23	45	36	18	23	73	5	52	0.7	5	40	20	40	40	60	0	60
0.6	36	51	34	14	39	58	3	50	0.6	14	62	23	15	21	79	0	43
0.5	67	52	27	21	42	57	1	60	0.5	17	65	18	18	24	76	0	41
0.4	112	50	23	27	42	52	6	61	0.4	27	48	26	26	38	54	8	56
0.3	208	53	24	22	46	49	5	55	0.3	50	53	30	17	53	43	4	52
0.2	487	48	17	35	63	33	3	50	0.2	47	63	9	28	64	34	2	47
0.1	693	51	6	43	85	11	4	50	0.1	54	44	8	48	92	4	4	50
0.0	148	0	0	0	0	0	0	0	0.0	12	0	0	0	0	0	0	0
-0.1	680	49	7	44	85	12	3	47	-0.1	44	57	5	38	80	9	11	50
-0.2	450	47	17	36	67	29	4	48	-0.2	58	44	9	47	75	19	5	41
-0.3	190	55	19	25	51	44	5	46	-0.3	47	33	29	38	67	28	4	45
-0.4	87	46	28	26	46	52	1	62	-0.4	25	42	25	33	46	50	4	72
-0.5	46	50	26	24	36	53	11	43	-0.5	16	44	25	31	38	44	19	31
-0.6	28	65	31	4	14	79	7	50	-0.6	10	70	30	0	0	100	0	80
-0.7	19	59	35	6	22	78	0	63	-0.7	4	25	75	0	0	100	0	25
-0.8	7	43	57	0	33	67	0	71	-0.8	3	0	100	0	50	50	0	67
-0.9	12	55	36	9	33	58	8	58	-0.9	5	50	50	0	20	60	20	100
-1.0	42	63	24	13	16	71	13	55	-1.0	5	67	33	0	0	40	60	40

Table 15.15: Gap Analysis, Gold

Open table as spreadsheet

(a) Gold, 1990–September 2003									(b) Gold, September 2001–September 2003								
		Closing Prices			Trading Range						Closing Prices			Trading Range			
Gap	Cases	Cont Dir	Below Open	Rev Dir	CrossPrev Cls	Adj fr Open	Cont Only	Cont Next Day	Gap	Cases	Cont Dir	Below Open	Rev Dir	Cross Prev Cls	Adj fr Open	Cont Only	Cont Next Day
10	7	33	50	17	29	57	14	100	10	0	0	0	0	0	0	0	0
9	1	0	100	0	0	100	0	0	9	0	0	0	0	0	0	0	0

8	3	33	33	33	33	67	0	33	8	0	0	0	0	0	0	0	0
7	7	43	29	29	29	71	0	71	7	1	100	0	0	0	100	0	0
6	15	33	47	20	40	53	7	60	6	1	0	100	0	100	0	0	0
5	31	46	36	18	26	74	0	55	5	9	25	38	38	33	67	0	44
4	43	60	33	7	19	77	5	58	4	14	64	21	14	21	71	7	64
3	129	46	34	20	32	67	2	50	3	32	50	41	9	34	59	6	44
2	370	47	30	23	48	50	3	50	2	63	63	15	22	42	58	0	46
1	1023	50	11	39	75	21	3	50	1	91	58	7	35	72	26	2	49
0	149	0	0	0	0	0	0	0	0	19	0	0	0	0	0	0	0
-1	939	52	11	37	74	22	4	50	-1	89	35	8	56	88	8	4	53
-2	431	51	31	18	36	60	3	48	-2	66	51	25	25	48	49	3	44
-3	153	50	38	11	23	74	3	54	-3	41	53	28	20	33	65	3	54
-4	44	41	50	9	25	73	2	59	-4	13	38	38	23	38	62	0	46
-5	28	36	54	11	19	78	4	46	-5	8	50	38	13	14	71	14	63
-6	2	0	100	0	0	100	0	100	-6	1	0	100	0	0	100	0	100
-7	10	40	60	0	0	100	0	80	-7	2	50	50	0	0	100	0	50
-8	1	0	100	0	0	100	0	0	-8	0	0	0	0	0	0	0	0
-9	1	0	100	0	0	100	0	0	-9	0	0	0	0	0	0	0	0
-10	7	43	57	0	0	100	0	29	-10	0	0	0	0	0	0	0	0

Table 15.16: Gap Analysis, Soybeans

Open table as spreadsheet

(a) Soybeans, 1990–September 2003									(b) Soybeans, September 2001–September 2003								
		Closing Prices			Trading Range						Closing Prices			Trading Range			
Gap	Cases	Cont Dir	Below Open	Rev Dir	CrossPrev Cls	Adj fr Open	Cont Only	Cont Next Day	Gap	Cases	Cont Dir	Below Open	Rev Dir	Cross Prev Cls	Adj fr Open	Cont Only	Cont Next Day
15.0	45	46	54	0	2	84	13	60	15.0	7	29	71	0	0	86	14	71
13.5	17	53	41	6	12	76	12	29	13.5	2	50	50	0	50	50	0	50
12.0	18	47	35	18	33	67	0	56	12.0	1	0	100	0	100	0	0	100
10.5	20	60	25	15	15	85	0	60	10.5	6	100	0	0	0	100	0	50
9.0	33	42	32	26	33	55	12	45	9.0	2	50	0	50	50	50	0	0
7.5	55	51	38	11	26	69	6	49	7.5	5	20	60	20	40	60	0	60
6.0	102	45	26	30	42	46	12	53	6.0	10	33	44	22	56	44	0	50
4.5	233	50	23	27	48	43	10	47	4.5	28	70	22	7	30	59	11	46
3.0	415	53	13	35	65	28	7	43	3.0	53	46	12	42	67	27	6	40
1.5	640	56	3	41	86	7	7	49	1.5	92	61	0	39	83	9	8	47
0.0	216	0	0	0	0	0	0	0	0.0	26	0	0	0	0	0	0	0
-1.5	645	56	4	40	88	6	7	52	-1.5	87	51	2	46	90	1	9	59
-3.0	450	50	13	38	67	25	8	48	-3.0	64	41	15	44	69	21	10	44
-4.5	246	50	20	30	57	35	8	45	-4.5	33	50	25	25	61	32	6	39
-6.0	99	54	23	22	45	49	6	51	-6.0	15	60	20	20	23	54	23	60
-7.5	51	45	37	18	39	57	4	33	-7.5	11	9	55	36	64	36	0	45
-9.0	36	42	42	17	26	69	6	50	-9.0	3	67	33	0	33	33	33	0
-10.5	25	56	32	12	16	68	16	32	-10.5	1	0	0	100	100	0	0	0
-12.0	14	46	38	15	21	64	14	57	-12.0	2	50	50	0	0	100	0	50
-13.5	9	56	33	11	11	78	11	56	-13.5	0	0	0	0	0	0	0	0
-15.0	41	50	47	3	10	83	7	51	-15.0	4	75	25	0	0	100	0	50

Table 15.17: Gap Analysis, Cotton

Open table as spreadsheet

(a) Cotton, 1990–September 2003									(b) Cotton, September 2001–September 2003								
		Closing Prices			Trading Range							Closing Prices		Trading Range			
Gap	Cases	Cont Dir	Below Open	Rev Dir	Cross Prev Cls	Adj fr Open	Cont Only	Cont Next Day	Gap	Cases	Cont Dir	Below Open	Rev Dir	Cross Prev Cls	Adj fr Open	Cont Only	Cont Next Day
2.0	37	38	52	10	17	60	23	73	2.0	1	100	0	0	0	100	0	100
1.8	4	75	25	0	0	100	0	25	1.8	0	0	0	0	0	0	0	0
1.6	9	44	33	22	44	56	0	56	1.6	2	100	0	0	0	100	0	50
1.4	5	20	40	40	80	20	0	40	1.4	0	0	0	0	0	0	0	0
1.2	19	47	37	16	21	68	11	58	1.2	2	50	50	0	0	50	50	50
1.0	46	47	29	24	49	42	9	57	1.0	3	100	0	0	0	67	33	67
0.8	78	51	21	29	48	45	6	53	0.8	11	55	9	36	36	55	9	55

0.6	226	50	25	25	47	44	9	54	0.6	21	47	16	37	48	43	10	62
0.4	455	49	16	35	62	30	8	53	0.4	65	59	14	28	52	33	16	52
0.2	734	48	5	47	84	8	8	49	0.2	91	52	7	41	78	12	10	46
0.0	162	0	0	0	0	0	0	0	0.0	16	0	0	0	0	0	0	0
-0.2	727	52	6	42	80	9	10	50	-0.2	82	51	6	43	80	10	10	56
-0.4	470	51	16	33	63	30	8	52	-0.4	90	47	17	36	67	25	8	57
-0.6	225	55	20	25	48	43	9	53	-0.6	39	53	17	31	45	42	13	67
-0.8	77	53	36	11	34	64	3	53	-0.8	14	50	50	0	14	86	0	71
-1.0	42	46	33	21	43	55	2	55	-1.0	7	29	71	0	29	71	0	57
-1.2	26	65	19	15	38	54	8	62	-1.2	2	100	0	0	0	100	0	50
-1.4	10	60	30	10	10	90	0	70	-1.4	0	0	0	0	0	0	0	0
-1.6	1	0	100	0	0	100	0	100	-1.6	0	0	0	0	0	0	0	0
-1.8	6	50	17	33	33	67	0	67	-1.8	0	0	0	0	0	0	0	0
-2.0	27	26	58	16	33	63	4	56	-2.0	0	0	0	0	0	0	0	0

In addition, a record is shown of the percentage of times that prices *continued on the following open* in the same direction as the current gap.

Using the Nasdaq 100 Index futures as an example (Table 15.9), we see that the gaps in the leftmost column ranged from +50 to -50 whole Index points. The second column shows the number of cases, or days, that satisfied each row value. All other columns are in percentages. The *number of cases* shows a typical price distribution, clustered near the smaller gaps, with an extended *tail* at the extremes. All gaps greater than +50 points were included in the top row; all gaps less than -50 are included in the bottom row. In the left chart (a) the number of cases drop by 25%, 33%, and 46% as gap values move from 5 to 10 to 15, but slow to 21%, 38%, and 29% as gaps move out into the tail at 35, 40, and 45 points. The three interesting patterns in the Nasdaq Index that also appear in many of the other markets:

1. *Closing Prices.* In the three columns under the heading closing prices, the period from 1990 shows that the greatest frequency of days closed higher than the opening gap. In the more recent two years that tendency was more pronounced, especially on days with larger gap openings. During both test periods, days with larger gaps down had a tendency to reverse direction *(Rev Dir)* rather than simply close between the open and the previous close *(Below Open*—note that for gaps down this should read *Above Open).*

2. *Trading Range.* As you would expect, days with large gaps have less chance of trading through the previous day's close; gaps up to 25 points have a great likelihood of trading through the previous close. It is important to note that there was very little bias towards higher or lower gaps, even though the longer test period included an extraordinary bull market. Very few days simply post the opening gap up as the low of the day. Further inspection of the numbers shows that during the past two years, a downward gap was less likely to cross back above the previous close than to trade between the open and the previous close.

3. *Cont Next Day.* Is there a tendency for prices to continue in the same direction as the gap the next day? Both periods show the upwards bias in the market because the downward gaps have a lower percentage of continuing than the upwards gaps.

The most extreme gaps, both higher and lower, are always interesting. Unfortunately, they represent a much smaller sample and are less reliable. The bottom two lines of the Nasdaq table for the period beginning 1990 shows that, with an opening gap of -45 points there was a 71% chance that the market would open lower the next day. However, as the gap increased, the tendency to continue reversed itself, with only 39% for the downside gaps of 50 points or more.

The following sections discuss some of the interesting features of the other markets in Table 15.6.

German DAX

The German DAX (Table 15.10), which was tested with smaller increments, shows a much greater tendency to trade through the previous close than do the S&P and Nasdaq. This could be attributed to its reaction to the U.S. economic news, which is released while the DAX is in the middle of its trading day. Similarly, the DAX has a higher frequency of reversing direction at all levels of gap openings.

Eurodollars

Perhaps the most actively trading futures market in the world, Eurodollars (Table 15.11), shows a tendency to continue in the same direction as the opening gap, except for very large gaps. When the gap opening is as small as 4 basis points, Eurodollars have a low frequency of trading across the previous close. It appears to be a market whose direction is determined at the open. During the shorter test period, the larger percentage values are all associated with a small number of cases.

10-Year Notes

As with Eurodollars, 10-Year Notes (Table 15.12), the U.S. benchmark interest rate, show a very orderly pattern. Although interest rates had declined steadily during most of the test period, there is reasonable symmetry for upwards and downwards gaps. As gaps were larger, there was a greater tendency to extend the close in that direction rather than reverse. During the 2-year test period, there was a clear bias to continue higher on the day following an upwards gap, but to reverse after a large downward gap.

Crude Oil

Crude oil (Table 15.14), the focus of a great deal of fundamental news, shows a very uniform pattern to continue in the direction of the gap—larger gaps do not seem to produce the typical overbought or oversold reaction. The tendency to continue in the same direction as the gap opening, and the decreasing frequency that prices will trade through the previous close, give a distinct clue to the intraday trading patterns.

Do Individual Stocks Show Unique Gap Patterns?

While we would expect different futures markets, such as crude oil and Eurobund, to show unique patterns, it is not clear that individual stocks will vary from the index that seems to drive those prices. Orders placing in Index futures make their way through arbitrage into the individual stocks, causing many to show similar patterns without fundamental justification.

For a comparison, IBM and Amazon.com were selected as representative of their respective broader markets. A gap analysis was run on the two stocks and on the S&P 500 and Nasdaq 100 for the same time interval. The scaling of the charts were kept at about the same levels by trying to get the number of cases at the extreme high and low gaps about the same. Therefore, IBM has 31 days when prices gapped higher by $2.50, while the S&P 500 had 33 days where the Index opened at least 15 points higher. The results, shown in Tables 15.18 and 15.19 have noticeable differences.

Table 15.18: IBM and Amazon.com, 1996–2000

Open table as spreadsheet

(a) IBM, 1996–2000									(b) Amazon.com, 1996–2000								
		Closing Prices			Trading Range						Closing Prices			Trading Range			

Gap	Cases	Cont Dir	Below Open	Rev Dir	Cross Prev Cls	Adj fr Open	Cont Only	Cont Next Day	Gap	Cases	ContDir	Below Open	Rev Dir	Cross Prev Cls	Adj fr Open	Cont Only	Cont Next Day
2.50	31	55	32	13	26	68	6	68	2.50	44	50	32	18	32	68	0	68
2.25	14	75	17	8	38	62	0	64	2.25	5	60	0	40	40	60	0	20
2.00	7	43	29	29	57	43	0	14	2.00	14	21	36	43	71	29	0	36
1.75	18	44	33	22	61	39	0	67	1.75	13	38	15	46	75	25	0	54
1.50	22	41	32	27	52	38	10	64	1.50	20	45	25	30	65	35	0	60
1.25	45	51	21	28	53	44	2	64	1.25	35	46	17	37	57	43	0	43
1.00	45	52	20	27	58	40	2	44	1.00	40	44	23	33	75	23	3	65
0.75	80	50	18	32	61	35	4	50	0.75	51	40	8	52	76	24	0	39
0.50	128	52	9	39	68	29	3	52	0.50	71	47	9	44	83	17	0	54
0.25	240	47	6	47	82	10	8	58	0.25	169	50	5	45	78	19	3	54
0.00	101	0	0	0	0	0	0	0	0.00	21	0	0	0	0	0	0	0
-0.25	208	54	4	41	86	8	6	41	-0.25	153	52	4	44	81	13	6	43
-0.50	85	44	15	41	79	19	2	41	-0.50	60	42	12	47	84	16	0	42
-0.75	56	55	16	29	73	18	9	48	-0.75	50	53	10	37	69	25	6	50
-1.00	38	55	13	32	61	39	0	42	-1.00	33	68	10	23	69	31	0	61
-1.25	28	41	15	44	61	29	11	46	-1.25	25	44	20	36	76	24	0	48
-1.50	21	67	19	14	38	62	0	43	-1.50	14	64	21	14	46	46	8	50
-1.75	17	47	35	18	41	59	0	41	-1.75	13	69	0	31	46	54	0	46
-2.00	8	50	38	13	13	75	13	75	-2.00	6	50	17	33	33	50	17	50
-2.25	6	50	0	50	50	50	0	17	-2.25	11	55	27	18	40	60	0	27
-2.50	20	70	20	10	11	79	11	35	-2.50	36	56	31	14	39	61	0	50

Table 15.19: S&P 500 and Nasdaq, 1996–2000

Open table as spreadsheet

(a) S&P 500, 1996–2000									(b) Nasdaq 100, 1996–2000								
		Closing Prices			Trading Range						Closing Prices			Trading Range			
Gap	Cases	Cont Dir	Below Open	Rev Dir	Cross Prev Cls	Adj fr Open	Cont Only	Cont Next Day	Gap	Cases	Cont Dir	Below Open	Rev Dir	Cross Prev Cls	Adj fr Open	Cont Only	Cont Next Day
15.0	33	66	28	6	15	85	0	48	50	64	56	19	25	47	52	2	52
13.5	7	43	29	29	43	43	14	57	45	14	43	29	29	50	43	7	57
12.0	21	55	30	15	24	71	5	48	40	16	63	19	19	38	63	0	56
10.5	23	57	22	22	57	38	5	43	35	23	45	27	27	57	43	0	48
9.0	35	56	18	26	60	37	3	43	30	21	57	24	19	57	38	5	48
7.5	53	47	23	30	65	29	6	49	25	32	41	25	34	66	34	0	50
6.0	76	59	12	29	55	43	3	47	20	51	57	20	22	74	26	0	51
4.5	100	56	11	33	64	34	2	47	15	89	48	17	35	78	20	2	54
3.0	149	51	10	39	76	22	2	58	10	147	49	16	35	68	29	3	56
1.5	193	49	3	48	91	7	2	62	5	218	50	4	46	85	10	5	63
0.0	17	0	0	0	0	0	0	0	0	22	0	0	0	0	0	0	0
-1.5	150	43	4	53	96	4	0	39	-5	166	48	6	47	87	10	2	34
-3.0	104	52	13	36	82	18	0	36	-10	82	46	11	43	69	28	4	33
-4.5	74	52	15	33	70	30	0	38	-15	53	46	15	38	73	27	0	38
-6.0	55	44	18	38	73	25	2	49	-20	30	33	23	43	80	20	0	33
-7.5	37	59	14	27	65	35	0	43	-25	22	50	23	27	73	27	0	50
-9.0	26	42	31	27	50	50	0	31	-30	26	50	15	35	54	46	0	50
-10.5	16	56	25	19	44	56	0	44	-35	15	33	27	40	53	40	7	53
-12.0	15	40	40	20	33	60	7	40	-40	14	62	23	15	71	29	0	43
-13.5	9	67	22	11	56	44	0	33	-45	9	56	11	33	56	44	0	78
-15.0	40	47	39	13	43	58	0	43	-50	50	56	17	27	52	46	2	32

On the upside, it appears that IBM showed a greater tendency to continue higher after a gap opening than the Index. It showed less of a tendency to continue the next day. But are these cases of the eye finding a pattern where no pattern exists? If the results of each column are averaged down, we are equally weighting each row. The extremes, with only

a few cases, will count as much as the middle rows which have the majority of cases. For IBM and the S&P, the results of the position of the closing price relative to the gap open gave 52%-20%-28%, *exactly* the same values. Therefore, although there may have been a shift between certain rows, the overall frequencies were the same. For the set of trading range numbers, the biggest variation was that IBM crossed the previous close 58% of the time, while the S&P crossed only 53%. The other values were much closer. While 5% may be a help, as a single statistic it is difficult to expect much from.

Amazon.com is a stock of extremes, and we would expect it to assert its personality over the Nasdaq-100 Index. For the set of closing price values, Amazon.com posted 50-16-34 compared to 49-19-32 for the Nasdaq Index, and for the trading range Amazon had 62-36-2 versus the Index of 64-34-2. These are very similar results and argue that the gap patterns of the major stocks in the Index markets can be tracked by studying the Index itself.

Gap Study Program

The TradeStation program in Figure 15.14 is easily converted to other programming languages. It can be used to evaluate the gap openings of any market based on daily prices. The results are printed to a text file named *gapanalysis. txt* stored in the *c:\test* directory. You need only provide a better heading if you choose.

```
{ Copyright 1978-2003. PJ Kaufman. All rights reserved. }
inputs:   gapincr(0), nbars(20);
vars:     ix(0), n(0), n2(0), min(0), gap(0), ngap(0), middle(0),
             tclose(0), trange(0);
arrays:   maxmin[50](0), ccont[50](0), cbelow[50](0), crev[50](0),
             trcross[50](0),tradj[50](0), trcont[50](0), ncont[50](0),
             nitems[50](0);

{ Initialize increments )
if currentbar <= 1 then begin
   n = nbars + 1;
   n2 = intportion(n/2);
   middle = n2 + 1;
   min = -n2*gapincr;
   for ix = 1 to n begin
      maxmin[ix] = min;
      min = min + gapincr;
      end;
   end;
{ Process gap }
if open <> close[1] then begin
   gap = (open - close[1]) / gapincr;
   if gap > 0 then begin
      ngap = intportion(gap) + middle + 1;
      if ngap > n then ngap = n;
      end;
   if gap < 0 then begin
      ngap = middle - 1 + intportion(gap); {gap is negative}
      if ngap < 1 then ngap = 1;
      end;
   nitems[ngap] = nitems[ngap] + 1;

{ Relative position of today's close }
   if (gap > 0 and close > open) or (gap < 0 and close < open) then
      ccont[ngap] = ccont[ngap] + 1;
   if (gap > 0 and close > close[1] and close < open) or
      (gap < 0 and close < close[1] and close > open) then
      cbelow[ngap] = cbelow[ngap] + 1;
   if (gap > 0 and close < close[1]) or (gap < 0 and close > close[1]) then
      crev[ngap] = crev[ngap] + 1;
{ Pattern of entire trading range }
   if (gap > 0 and low < close[1]) or (gap < 0 and high > close[1]) then
      trcross[ngap] = trcross[ngap] + 1;
   if (gap > 0 and low > close[1] and low < open) or
      (gap < 0 and high < close[1] and high > open) then
      tradj[ngap] = tradj[ngap] + 1;
   if (gap > 0 and low >= open) or (gap < 0 and high <= open) then
      trcont[ngap] = trcont[ngap] + 1;
{ Continue next day }
   if( gap[1] > 0 and open > close[1]) or
      (gap[1] < 0 and open < close[1]) then
      ncont[ngap] = ncont[ngap] + 1;
   end
else
   nitems[middle] = nitems[middle] + 1;


if lastbaronchart then begin
   print(file("c:\test\gapanalysis.txt"), "gap cases cont below rev cross
      adj cont nextday");
      for ix = n downto 1 begin
         tclose = ccont[ix] + cbelow[ix] + crev[ix];
         trange = trcross[ix] + tradj[ix] + trcont[ix];
         if absvalue(maxmin[ix]) - .00005 < 0 or nitems[ix] = 0 then
            print (file("c:\test\gapanalysis.txt"), maxmin[ix]:4:3,
               nitems[ix]:5:0, 0:5:0, 0:4:0, 0:4:0, 0:5:0,0:4:0, 0:
               4:0, 0:5:0)
         else
            print (file("c:\test\gapanalysis.txt"), maxmin[ix]:4:3,
               nitems[ix]:5:0, 100*ccont[ix]/tclose:5:0,
               100*cbelow[ix]/tclose:4:0, 100*crev[ix]/tclose:4:0,
               100*trcross[ix]/trange:5:0,100*tradj[ix]/trange:4:0,
               100*trcont[ix]/trange:4:0, 100*ncont[ix]/nitems[ix]:5:0);
         end;
end;
```

Figure 15.14: Gap study program.

A Simple Gap Trading Method for Stocks

A basic approach to trading gaps was taken by Reverre.[4] Beginning with a 1-year study of the distribution of opening gaps for General Electric, Reverre noted that the distribution was very narrow, with 85% of the days opening with less than a 1% gap, and only 5% of the days showing gaps greater than 2%. Apply the following rules:

Place limit orders to buy and sell if prices open more than 1% from the previous close.

Close out the trade at the close of the day.

Although there may be additional profits from holding the trade for more than one day, this simple method produced small but consistent profits when applied to the Dow stocks. Reverre makes two important observations:

1. Trading the medium-sized gap of 1% showed consistency because gaps often represented noise and were likely to correct.
2. Trading gaps greater than 2% gave much larger profits and losses. Larger gaps were more likely to be structural and may not correct.

Test results showed that a 1% gap yielded an average long profit of $.057 and average short profit of $.034, which makes the brokerage commissions an important factor. When optimizing the gap size, 1.25% showed the best results; however, this is likely to change with the overall volatility of the market.

Close-to-Close Gaps

Reverre also applied a similar approach to large 1-day moves, looking for a correction over the next one to three days. Using the largest 20% moves in General Electric, or about 1.28 standard deviations, during the period December 1995 to February 1999, a buy signal occurred when prices fell by more than 1.96% and a sell signal when prices rose by more than 2.24%. Although 70% of the corrections occurred by the close of the following day, best results came by holding the trade for two days. Entries could be placed as limit orders in advance of the close.

Tested over the 30 Dow stocks, maximum returns came from 1-day moves with gaps of 4% to 5%, holding for 1 day. A wider range of gaps, from 2.5% to 5% gave good results holding for 2 days. While less than half of the Dow stocks showed net profits, the overall profitability was good. Both long and short positions performed well even though the test period was near the end of a strong bull market.

[4]Stéphane Reverre, "Trading The Opening Gap," *Technical Analysis of Stocks & Commodities* (November 1999), and Stéphane Reverre, "Trading against the Gap," *Technical Analysis of Stocks & Commodities* (Bonus Issue 2003).

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THREE STUDIES IN MARKET MOVEMENT—WEEKDAY, WEEKEND, AND REVERSAL PATTERNS

The next three sections are concerned with day-to-day patterns, rather than those occurring within one day. The first, *weekday patterns*, looks only at the closing prices during a 5-day week from Monday through Friday in order to find recurring close-only patterns. A week is often considered to have integrity as a single unit of time, and participants are accused of acting in the same way each week. During a bull market, we are made to believe that new investors will enter on Monday; by Tuesday or Wednesday, the push given to prices by new business has waned, and prices fall back. This study attempts to isolate repeated patterns. For example, if Monday through Thursday were all higher, what is the possibility of Friday being higher? If prices have moved in the same direction from Monday through Thursday, should we expect a correction due to profit-taking on Friday? Because patterns represent human behavior, the results should be interesting.

Weekend patterns are considered independently in the second study. The opening direction on Monday could restore the trend of the prior week, if those traders who liquidate on Friday intend to reset their positions. The weekend is also an extended period for unexpected news or a build-up of public interest. The study will attempt to relate the direction of the Monday opening price to some pattern or trend of the preceding week.

Reversal patterns are not based on a day of the week but have often been discussed as a leading indicator. They may also be used as a filtering or timing device.

Weekday Patterns

During their constant exposure to the market, professional traders often observe patterns in weekly price movement; their acceptance of these patterns is as old as the market itself. In *Reminiscences of a Stock Operator*, the fictional character Larry Livingston (who we believe to be Jesse Livermore) begins his career recording prices on a chalk board above the floor of the New York Stock Exchange, eventually becoming aware of patterns in these sequences of prices. The most accepted pattern is the *Tuesday reversal*, which is taken as commonplace by close observers of the market. When questioned why a strong soybean market on the first of the week is followed by a weak day, a member of the Board of Trade would shrug his shoulders and quote: "Up on Monday, down on Tuesday." If this is true, there is a trading opportunity.

If a commonly accepted idea is not enough to be convincing, consider the additional idiosyncrasies of human behavior: The weekend allows a build-up of sentiment, which should result in greater activity on Monday. Coupled with adding back positions that were liquidated prior to the weekend, this may cause a disproportionate move on Monday, especially early in the session. This pattern may be further exaggerated when a clear trend exists. With this overbought or oversold condition on Monday, it is likely that Tuesday would show a correction. However, trying to explain why this might be how the market works is not as significant as collecting the numbers.

The first aspect of the test was to define the weekday pattern. This was done in terms of the Friday-to-Monday move (close-to-close). Monday always received the value X, regardless of whether its direction from Friday was up or down. For each day that closed in the same direction as the Friday-to-Monday move, another X is used; when the close reversed direction, an O is recorded. Therefore, XOXXO means that Tuesday and Friday, represented by O, closed in the opposite direction from the prior Friday-to-Monday move while Wednesday and Thursday were in the same direction. This could have meant either of the situations:

Open table as spreadsheet

		(1)	(2)
Monday	X	Up	Down

Tuesday	O	Down	Up
Wednesday	X	Up	Down
Thursday	X	Up	Down
Friday	O	Down	Up

It might be that there is a distinction between the weeks that begin with an upward move on Monday rather than a decline, but both cases were combined. This assumes that the pattern, rather than the direction, is most important. It would also be reasonable to have assumed that the upwards bias of the stock and interest rate markets during the past 10 years would justify a separation of patterns according to their initial direction.

Daily Sequences

Heating Oil

Figure 15.15 shows the weekly patterns of heating oil futures because they are the most extreme of all the examples. The first decision day, Tuesday, shows no bias. The American Petroleum Institute (API) reports on Wednesday; therefore, anxiety always lurks in the background. The most interesting path is XXOX, which indicates that prices were moving one direction before the API report on Wednesday, then closed in the opposite direction. Then there is a 70% chance that Thursday's move will reverse again, moving prices back in the direction of Monday and Tuesday. If prices do not reverse on Wednesday (XXX), there is a better-than-average change (54%) that prices will continue in the same direction on Thursday; therefore, there is a high frequency that Thursday will move in the Monday-Tuesday direction.

Figure 15.15: Weekly patterns in heating oil, June 1998–May 2003 (313 weeks).

If prices did not start the week with two days in the same direction, then a reversal of the Monday direction is expected on Thursday, and the direction following the API reports on Wednesday seems to dominate the pattern for the remainder of the week. For example, in the upper quarter of the chart, the Friday pattern was XOXXX and XOXOX. Both end with X and follow the X on Wednesday. In the quarter chart below that, XOOXO and XOOOO, the Friday pattern was a reversal but it also reflected the Wednesday direction. These four patterns at the top of the chart showed frequencies of 63%, 56%, 71%, and 65%, a high pattern. A market with a important weekly report is a good candidate for weekly patterns.

Nasdaq, Intel, and Amazon.com Patterns

The much larger volume in Index trading should prevent weekly patterns from being as clear as those seen in heating oil futures. In Figure 15.16, Nasdaq 100 for a 5-year period, the highest frequencies occur on Friday and only reach 63%. In the upper half of the chart, which have Tuesday reversal patterns, a Friday reversal is also more likely. In the lower half of the chart, where both Monday and Tuesday moved in the same direction, a Friday in the same direction as Monday is the overwhelming favorite. It is also interesting to see that Nasdaq has a 56% frequency of reversing on Tuesday, very different from heating oil which showed no preference.

Figure 15.16: Nasdaq 100 weekly patterns, June 1998–May 2003.

Because Intel Corporation is such a major influence on the Nasdaq-100, it is likely that the patterns of Intel would be very similar to those of the ND-100. Figure 15.17 shows that this is not really the case. While Tuesday and Wednesday patterns are nearly identical, the end-of-week has noticeable differences, with half the patterns favoring the reverse price move as those seen in the Index.

Figure 15.17: Intel Corporation weekly patterns, June 1998–May 2003.

Amazon.com, a maverick among stocks, may offer the best chance at patterns with high frequency. In Figure 15.18, the frequencies are nearly reversed from either the Nasdaq Index or from Intel. Where others tended to change direction, Amazon would prefer to continue; where others would continue, Amazon will reverse. Unfortunately, there are only three patterns that posted better than 60% historically; however, this may show that Amazon offers good diversification within a portfolio of stocks.

Figure 15.18: Amazon.com weekly patterns, June 1998–May 2003.

S&P, Microsoft, and GE Weekday Patterns

Most investors would think of the S&P as a more conservative group than the Nasdaq 100, and the frequencies in Figure 15.19 would support that premise. All the frequencies, except one range from 45% to 55%, provide no dramatic opportunities.

Figure 15.19: S&P weekday patterns, June 1998–May 2003.

Two of the major components of the S&P, Microsoft and General Electric, may be assumed to follow the pattern of the index, but we would be wrong. Shown in Figures 15.20 and 15.21, they have a large number of frequencies greater than 60%. In addition, Microsoft and General Electric show a greater likelihood to have a reverse pattern than a similar one. From these two samples we could conclude that there are many individual stock patterns, but collectively they offset one another, resulting in the featureless S&P profile.

Figure 15.20: Microsoft weekday patterns, June 1998–May 2003.

Figure 15.21: General Electric weekday patterns, June 1998–May 2003.

10-Year Notes, Euros, and Gold

To have a fair sampling of other markets, and to see if any weekly patterns dominate price movement, Figures 15.22 through 15.24 show the patterns of U.S. 10-year Treasury notes, the cash prices of the euro/U.S. dollar, and gold. These, just as the previous figures, seem to show their unique patterns. One theme seems to be common across all of the weekday patterns: As the patterns develop throughout the week, the frequency of investors reacting in a predictable way seems to increase. In other words, the range of frequencies that you see on Tuesday are generally smaller than those on Wednesday, which are smaller than those on Thursday. Friday shows the most extreme patterns and you have the greatest chance of anticipating Friday's price direction.

Figure 15.22: 10-year Treasury notes, June 1998–May 2003.

Figure 15.23: U.S. dollar/euro, June 1998–May 2003.

Figure 15.24: Gold weekly patterns, June 1998–May 2003.

Trading Weekday Patterns

The persistence of the weekday reversal over the past 5 years, and much longer in other studies, appears to be based on the nature of market participation. The patterns span nearly all markets with widespread opportunities. In order to trade these weekday patterns, positions must be entered on the close of the prior day. Therefore, if heating oil moved higher Monday and Tuesday, then reversed on Wednesday after the APIs announced higher inventories, we would buy on Wednesday's close looking for a 70% chance that prices will reverse again. If we are right, we cold hold that trade for a 58% chance of a continued move in the same direction. If Thursday's trade goes the wrong way, posting a XXOO pattern, then hold the trade looking for a 78% chance of a final pattern XXOOX.

Your trading success is improved if you can find situations such as heating oil, where one losing day has another good chance of turning into a profit simply by holding the same trade. This study could be taken further by looking at whether the open of the next day is a better point to enter a reversal trade than the previous close. Therefore, if Monday and Tuesday were both lower, a long entered on the open Wednesday may prove more profitable and less risky than a long entered on the close of Tuesday.

Weekday Pattern Program

Figure 15.25 gives the TradeStation program that calculates the weekday patterns. The output file is named *weekday.txt* and can be found in the *c:\test* directory. After each new market is run, it is necessary to rename the weekday.txt file as, for example, *weekdayND.txt* to avoid overwriting the file. The content of the file is grouped by day of the week, with 1 and

0 replacing X and O. Under each day name are the column entries in the order that you see in the previous weekday Figures. You will need to align them next to each other in order to get the same familiar format.

```
{ STRATEGY: Weekday Study )
{ Copyright 1985-2003. PJ Kaufman. All rights reserved. }

vars: dow(0), dir(0), ix(0),iy(0), error(0), Mon(0), day2(0), day3(0),
         day4(0), day5(0),div(0), pc(0);
arrays: Tues[2](0), Wed[4](0), Thurs[8](0), Fri[16](0), pattern[5](0),
           n2[2](0), n3[4](0), n4[8](0), n5[16](0);

{ create full pattern for week before entered values in case incomplete }
dow = dayofweek(date);

if currentbar = 1 then begin
   Tues[1] = 10; Tues[2] = 11;
   Wed[1] = 101;  Wed[2] = 100;  Wed[3] = 111;  Wed[4] = 110;
   Thurs[1] = 1011; Thurs[2] = 1010; Thurs[3] = 1001; Thurs[4] = 1000;
   Thurs[5] = 1111; Thurs[6] = 1110; Thurs[7] = 1101; Thurs[8] = 1100;
   Fri[1] = 10111; Fri[2] = 10110; Fri[3] = 101; Fri[4] = 10100;
   Fri[5] = 10011; Fri[6] = 10010; Fri[7] = 10001; Fri[8] = 10000;
   Fri[9] = 11111; Fri[10] = 11110; Fri[11] = 11101; Fri[12] = 11100;
   Fri[13] = 11011; Fri[14] = 11010; Fri[15] = 11001; Fri[16] = 11000;
   end;

{ Monday }
if dow = 1 then begin
   for ix = 1 to 5 begin
      pattern[ix] = 0;
      end;
   if close > close[1] then pattern[1] = 1 else pattern[1] = -1;
   end;
{ Tuesday }
if dow = 2 then begin
       if close > close[1] then pattern[2] = 1 else pattern[2] = -1;
       end;
{ Wednesday }

if dow = 3 then begin
   if close > close[1] then pattern[3] = 1 els8a28tern[3] = -1;
   end;
{ Thursday }
if dow = 4 then begin
   if close > close[1] then pattern[4] = 1 else pattern[4] = -1;
   end;
{ Friday }
if dow = 5 then begin
   if close > close[1] then pattern[5] = 1 else pattern[5] = -1;
   error = 0;
{ process pattern for entire week, convert to pattern beginning with 1 }
   for ix = 2 to 5 begin
      if pattern[ix] = 0 then error = 1;
      if error = 0 then begin
         if pattern[ix] * pattern[1] > 0 then pattern[ix] = 1 else
            pattern[ix] = 0;
         end;
      end;
   pattern[1] = 1;
   if error = 0 then begin
{ create a value for each day }
         Mon = Mon + 1;
         day2 = 10 + pattern[2];
         day3 = 100 + pattern[2]*10 + pattern[3];
         day4 = 1000 + pattern[2]*100 + pattern[3]*10 + pattern[4];
         day5 = 10000 + pattern[2]*1000 + pattern[3]* 100 +
            pattern[4]*10 + pattern[5];
{ match each pattern and add to number of cases }
         if day2 = Tues[1] then n2[1] = n2[1] + 1 else n2[2] = n2[2] + 1;
         for ix = 1 to 4 begin
            if day3 = Wed[ix] then n3[ix] = n3[ix] + 1;
            end;
         for ix = 1 to 8 begin
            if day4 = Thurs[ix] then n4[ix] = n4[ix] + 1;
            end;
         for ix = 1 to 16 begin
            if day5 = Fri[ix] then n5[ix] = n5[ix] + 1;
            end;
         end;
   end;
```

```
if lastcalcdate = date then begin
   print(file("c:\test\Weekday.txt"),"Monday = 1 100%, weeks =", mon:5:0);
   print(file("c:\test\Weekday.txt"),"Tuesday");

   for ix = 1 to 2 begin
      div = intportion((ix+1)/2);
      pc = n2[ix]*100/Mon;
      print(file("c:\test\Weekday.txt"), Tues[ix]:5:0, n2[ix]:4:0, pc:4:0);
     end;
   print(file("c:\test\Weekday.txt"), "Wednesday" );
   for ix = 1 to 4 begin
      div = intportion((ix+1)/2);
      pc = n3[ix]*100/n2[div];
      print(file("c:\test\Weekday.txt"), Wed[ix]:5:0, n3[ix]:4:0, pc:4:0);
      end;
   print(file("c:\test\Weekday.txt"),"Thursday");
   for ix = 1 to 8 begin
      div = intportion((ix+1)/2);
      pc = n4[ix]*100/n3[div];
      print(file("c:\test\Weekday.txt"),Thurs[ix]:5:0, n4[ix]:4:0, pc:4:0);
      end;
   print(file("c:\test\Weekday.txt"),"Friday");
   for ix = 1 to 16 begin
      div = intportion((ix+1)/2);
      pc = n5[ix]*100/n4[div];
      print(file("c:\test\Weekday.txt"), Fri[ix]:5:0, n5[ix]:4:0, pc:4:0);
      end;
   end;
```

Figure 15.25: Weekday pattern program.

Weekend Patterns

Of the three patterns studied, this one is the most intriguing. Three factors lead to the anticipation of strong weekend patterns:

1. *Friday liquidation.* The aversion of many short-term traders to hold a market position over the weekend.
2. *Resetting positions on Monday.* Those positions closed out on Friday are usually reset Monday, especially during a trending market or a weather market.
3. *New positions entering Monday.* After longer-term investors have digested the previous week's news and selected those stocks or commodities to buy.

If there are enough investors and traders on the same side of the market, the 2-day weekend delay should result in large Monday price jumps and good profits for those willing to take the weekend risk. Expecting that the best results would be found by combining the weekend patterns with a trend, or a high-frequency weekday pattern on Friday, a number of different conditions were tested. These were limited to closing price relationships.

Trend indicators:

Prior Thursday-to-Friday price direction.

Friday-to-Friday (1-week) price direction.

Most frequent price direction last week.

Following each of the trends or patterns, the prices on Monday were tabulated to determine the frequency and consistency of the opening price, closing price, and whether the high or low prices on Monday were able to reach extremes that confirmed the same direction as each of the trends or patterns. Table 15.20 lists the results for the same 10 markets used in the weekday patterns from June 1998 through May 2003. During this period, the stock market showed two years of bull market and more than three years of bear market.

Table 15.20: Weekend Pattern Based on Trend Scenarios during the Prior Week, June 1998–May 2003

Open table as spreadsheet

Market	Trend	Continued Direction Monday (%)		
		Open	Close	Extreme
S&P 500	Thursday to Friday direction	44	47	81
	Friday to Friday direction	44	43	81
	Most frequent direction	45	41	100
General Electric	Thursday to Friday direction	n/a	51	83
	Friday to Friday direction	n/a	52	81
	Most frequent direction	n/a	46	99
Microsoft	Thursday to Friday direction	n/a	54	82
	Friday to Friday direction	n/a	49	80
	Most frequent direction	n/a	50	99
Nasdaq 100	Thursday to Friday direction	51	52	85
	Friday to Friday direction	47	51	83
	Most frequent direction	48	50	99
Intel	Thursday to Friday direction	n/a	51	84
	Friday to Friday direction	n/a	49	81
	Most frequent direction	n/a	49	100
Amazon.com	Thursday to Friday direction	n/a	43	76
	Friday to Friday direction	n/a	47	81
	Most frequent direction	n/a	48	100
10-Year Notes	Thursday to Friday direction	47	47	76
	Friday to Friday direction	47	49	77
	Most frequent direction	48	49	97
USD/Euro	Thursday to Friday direction	42	46	95
	Friday to Friday direction	40	44	94
	Most frequent direction	44	51	98
Gold	Thursday to Friday direction	46	43	71
	Friday to Friday direction	45	47	72
	Most frequent direction	47	48	96
Heating Oil	Thursday to Friday direction	43	48	81
	Friday to Friday direction	45	50	79
	Most frequent direction	43	49	99

Trend Follow-Through to Monday

Even though the period 1998–2003 contained what we would see as very strong trends, the weekend moves tended to reverse the prior week's direction by the close of Monday. There was a very strong chance that the market would be trading higher if the previous week's trend were up, or lower if the trend were down, but the close on Monday showed that there was no follow-through. This consistency can be seen as a trading opportunity.

A high frequency of trading in the trend direction, and a low frequency of closing in that direction on Monday implies that a position could be taken against the trend of the previous week. If the USD/euro Friday-to-Friday trend is up, and the euro opens on Monday morning higher, or trades higher during the morning, then selling the euro has a good chance of being a successful trade by Monday's close. According to Table 15.20, the euro would have traded higher on Monday 94% of the time, but remained higher at the close only 44% of the time.

Over the years the weekend patterns have changed. Original studies in this book, begun in 1975, showed that the trend dominated price patterns. When the previous week had a clear uptrend, it was most likely that prices would trade higher, and remain higher, on Monday. The study in the 3rd edition of this book, using data from 1986 to 1996, showed that the

pattern had changed and there was no longer the same trend follow-through. Now, using data through the middle of 2003, the same mean-reverting patterns continue, even though there were clear price trends in many of these markets. The market is no longer handing you profits; you need to dig for them.

Combining Weekend and Weekday Patterns

The direction of Monday's prices are more interesting when viewed in terms of the previous weekday patterns. Seen side by side, the frequency of each pattern and the way the ten sample markets reacted on the close of the following Monday give insight into market behavior. Table 15.21 shows the percentage of total cases for each weekday pattern (based on about 227 weeks), and the percentage of days for which Monday's price closed in the X direction, continuing the direction of the previous Monday.

Table 15.21: Combining Weekend and Weekday Patterns, June 1998–May 2003 ➡ Open table as spreadsheet

For each market, the first column shows the percentage of total cases and the second column gives the percentage that Monday's close was in the X direction.

(a) S&P 500, Nasdaq 100, and Related Stocks

	S&P 500		GE		MSFT		ND 100		INTC		AMZN	
Patterns	% cases	% X	% cases	% X	% cases	% X	% cases	% X	% cases	% X	% cases	% X
XOXXX	6.2	43	3.5	75	7.5	65	7.0	56	7.5	41	6.2	50
XOXXO	5.7	62	4.8	9	8.4	47	8.4	42	5.7	38	4.4	60
XOXOX	7.0	56	5.3	33	7.5	47	5.3	75	7.9	56	7.0	50
XOXOO	6.6	33	7.9	56	5.3	25	7.5	53	7.0	31	5.7	46
XOOXX	6.2	43	3.5	50	3.1	57	4.8	45	7.5	53	7.9	28
XOOXO	7.5	59	5.7	38	7.5	59	7.9	44	7.0	50	5.3	42
XOOOX	6.2	50	7.9	56	6.2	57	5.7	62	6.2	71	8.4	47
XOOOO	6.2	86	5.7	54	6.6	53	4.8	45	4.4	60	6.2	57
XXXXX	6.2	43	3.1	29	3.1	43	4.4	40	4.4	40	5.3	42
XXXXO	3.5	25	4.4	50	3.5	38	4.4	50	4.8	45	3.1	43
XXXOX	3.1	29	7.5	47	4.4	40	6.6	60	6.6	60	6.6	27
XXXOO	4.4	30	6.6	53	7.0	19	4.4	50	4.8	64	3.5	75
XXOXX	5.7	46	9.3	48	7.5	47	4.8	36	7.0	38	7.5	41
XXOXO	6.6	33	3.5	50	8.4	58	4.8	45	4.0	33	4.4	50
XXOOX	7.0	50	4.0	56	4.0	56	7.0	38	3.5	50	5.3	58
XXOOO	6.6	67	10.6	54	3.5	13	5.7	54	5.7	31	7.0	75

➡ Open table as spreadsheet

(b) Other Futures Markets

	TY		EC		GC		HO	
Patterns	% cases	% X	% cases	% X	% cases	% X	% cases	% X
XOXXX	5	82	4.8	67	5.8	54	8.5	53
XOXXO	4.1	22	6	53	5.4	50	6.7	47
XOXOX	3.7	50	10.4	58	9.8	55	4	33
XOXOO	7.8	41	6	53	5.4	58	5.8	46
XOOXX	7.3	56	6	27	4	22	3.6	50
XOOXO	5.5	58	5.6	57	8.5	58	6.7	33
XOOOX	6.9	33	8	30	5.8	62	8	61
XOOOO	3.7	63	5.6	57	8.5	53	7.1	50

XXXXX	11.5	44	3.6	67	6.3	50	4.9	55
XXXXO	6	46	6.4	25	4.5	70	3.6	63
XXXOX	3.7	50	10	40	2.7	83	8	39
XXXOO	3.7	50	3.6	89	4.9	55	4.9	91
XXOXX	4.1	78	6	67	5.4	58	6.3	50
XXOXO	5	45	6.4	56	5.4	75	7.6	41
XXOOX	6	69	5.6	43	5.8	54	5.4	25
XXOOO	6.4	64	4	40	5.8	62	3.6	63

There are quite a few interesting combinations in Table 15.21, extremes that are over 65% or under 35%. In the first pattern of part (a), XOXXX, both GE and MSFT show a high frequency of continuing. In the last pattern, XXOOO, the S&P Index shows a 67% chance of continuing in the X direction on Monday, while MSFT shows only a 13% chance, and INTL a 31% frequency; AMZN shows a 75% likelihood of continuing. For all of the largest frequency values, MSFT and AMZN seem to be reacting in opposite direction.

For a small sample of other futures markets there are also a number of tradable extremes. The 10-Year Treasury notes (TY) show good continuation, 82%, following a pattern of XOXXX, and 22% after XOXXO, meaning that it usually wants to go back in the direction of the prior Monday after a pattern of XOXX, regardless of the Friday move.

The Euro/USD (EC) and heating oil (HO), unrelated markets, both show exception ally high frequencies of continuing on Monday after a previous pattern of XXXOO. Gold (GC) shows a collectively high frequency of continuing when the first two days of the week trade in the same direction, XX. The gold patterns XXXXO, XXXOX, and XXOXO, show frequencies of 70%, 83%, and 75%, respectively.

Specific market patterns, such as weekday and weekend frequencies, can provide an edge for traders in a very different and more complex environment. By finding patterns that are more likely, or even less likely, to occur within groups of similar markets, traders can vary their position size based on expectations, or even create or filter trades using these patterns. A combination of patterns that gives you a compounded opportunity for profit greatly increases your chances of success. Trading on a Monday-to-Wednesday frequency, look for situations where you can hold the same trade if it fails on Thursday, or even hold the trade over the weekend if it fails on Friday. If each combination has a reasonable chance of success, then two or three patterns in sequence will add safety. When creating these frequencies yourself, be sure that you use enough data so that the frequencies of the 16 weekday patterns each have enough cases to be sure the numbers are dependable.

Programming the Weekend Study

The following TradeStation program (Figure 15.26) prints the results used in the weekend study to a text file name *weekend.txt*, located in directory c:\test\. The content of the file is similar to Tables 15.20 and 15.21, however, the numbers 1 and 0 are used instead of X and O to show the patterns..

```
{ TSM Weekend Study }
{ Copyright 1985-2003. P.J. Kaufman. All rights reserved. }

vars:   dow(0), ix(0), nx(0), error(0), Mon(0), weekly(0), cases(0),
        div(0), pc(0), prevfri(0), savedir(0), start(0), change(0),
        TFopen(0), TFclose(0), TFext(0), FFopen(0), FFclose(0), FFext(0),
        Frgopen(0), Frgclose(0), Frgext(0), x(0), pcx(0);
arrays: week[16](0), oweek[16](0), xweek[16](0), pattern[5](0), cprice[5](0);

dow = dayofweek(date);
if currentbar = 1 then begin
   week[1] = 1o111; week[2] = 10110; week[3] = 10101; week[4] = 10100;
   week[5] = 10011; week[6] = 10010; week[7] = 10001; week[8] = 10000;
   week[9] = 11111; week[10] = 11110; week[11] = 11101; week[12] = 11100;
   week[13] = 11011; week[14] = 11010; week[15] = 11001; week[16] = 11000;
   end;

{ Monday }
if dow = 1 then begin
{ Process weekend pattern }
   if start = 1 then begin
      cases = cases + 1;
{ Thursday to Friday direction }
```

```
   change = close[1] - close[2];
      if (open - close[1]) * change > 0 then TFopen = TFopen + 1;
      if (close - close[1]) * change > 0 then TFclose = TFclose + 1;
      if (change > 0 and high > close[1]) or (change < 0 and low <
         close[1]) then TFext = TFext + 1;
{ Friday to Friday direction }
      change = close[1] - prevfri;
      if (open - close[1]) * change > 0 then FFopen = FFopen + 1;
      if (close - close[1]) * change > 0 then FFclose = FFclose + 1;
      if (change > 0 and high > close[1]) or (change < 0 and low <
         close[1]) then FFext = FFext + 1;
{ Most common direction }
      change = close - close[1];
      nx = 0;
      for ix = 1 to 5 begin
         if pattern[ix] = 1 then nx = nx + 1;
         end;
      if (nx >= 3 and (open - close[1])*savedir > 0) or (nx < 3 and (open -
         close[1])*savedir < 0) then
         Frqopen = Frqopen + 1;
      if (nx >= 3 and (close - close[1])*savedir > 0) or (nx < 3 and (close
         - close[1])*savedir < 0) then

         Frqclose = Frqclose + 1;
      if (nx >= 3 and ((change > 0 and high > close[1]) or (change < 0 and
         low < close[1]))) or
         (nx < 3 and ((change ;< 0 and low < close[1]) or
         (change > 0 and high > close[1]))) then Frqext = Frqext + 1;
{ Pattern match }
      for ix = 1 to 16 begin
         if weekly = week[ix] then begin
            if (close - close[1])*savedir > 0 ten xweek[ix] = xweek[ix] + 1;
            if (close - close[1])*savedir < 0 then oweek[ix] = oweek[ix] + 1;
            end;
          end;
        end;
        for ix = 1 to 5 begin
           pattern[ix] = 0;
           end;
        if close > close[1] then pattern[1] = 1 else pattern[1] = -1;
        cprice[1] = close;
        prevfri = close[1];
        savedir = pattern[1];
        end;
{ Tuesday }
if dow = 2 then begin
       if close > close[1] then pattern[2] = 1 else pattern[2] = -1;
       cprice[2] = close;
       end;
{ Wednesday }
if dow = 3 then begin
       if close > close[1] then pattern[3] = 1 else pattern[3] = -1;
       cprice[3] = close;
       end;
{ Thursday }
if dow = 4 then begin
      if close > close[1] then pattern[4] = 1 else pattern[4] = -1;
      cprice[4] = close;
      end;
{ weekday ]
if dow = 5 then begin
      if close > close[1] then pattern[5] = 1 else pattern[5] = -1;
      cprice[5] = close;
      error = 0;
{ process pattern for entire week, convert to pattern beginning with 1 }
      for ix = 2 to 5 begin

       if pattern[ix] = 0 then error = 1;
       if error = 0 then begin
          if pattern[ix] * pattern[1] > 0 then pattern[ix] = 1 else
             pattern[ix] = 0;
          end;
      end;
   pattern[1] = 1;
   weekly = 0;
   if error = 0 then begin
{ create a weekly pattern }
      weekly = 10000 + pattern[2]*1000 + pattern[3]*100 + pattern[4]*10 +
         pattern[5];
      end;
   start = 1;
```

```
      end;

   if lastcalcdate = date then begin
      print(file("c:\test\Weekend.txt"), "Trend period  Cases  Open  Close
         Extension  %Open %Close
         %Extension");
      print(file("c:\test\Weekend.txt"), "Thursday to Friday     ", cases:4:0,
         TFopen:4:0, TFclose:4:0,
         TFext:4:0, TFopen*100/cases:4:0,
         TFclose*100/cases:4:0, TFext*100/cases:4:0);
      print(file("c:\test\Weekend.txt"), "Friday to Friday       ", cases:4:0,
         FFopen:4:0, FFclose:4:0,
         FFext:4:0, FFopen*100/cases:4:0,
         FFclose*100/cases:4:0, FFext*100/cases:4:0);
      print(file("c:\test\Weekend.txt"), "Most frequent direction", cases:4:0,
         Frqopen:4:0, Frqclose:4:0,
         Frqext:4:0, Frqopen*100/cases:4:0,
         Frqclose*100/cases:4:0, Frqext*100/cases:4:0);
      print(file("c:\test\Weekend.txt"), "All patterns: cases %cases
         %MonXdirection");
      for ix = 1 to 16 begin
         x = xweek[ix] + Oweek[ix];
         pcx = 0;
         if x > 0 then x = xweek[ix]*100/x;
         print(file("c:\test\Weekend.txt"), week[ix]:6:0, xweek[ix] +
            oweek[ix]:4:0, (xweek[ix] + Oweek[ix])*100/cases:4:1,x:4:0);
         end;
      end;
```

Figure 15.26: Weekend study.

A Comment on Testing and Holidays

The weekday and weekend tests did not include any weeks in which there was a holiday, or long holiday weekends. It would have been perfectly reasonable to view the opening of the first day of the following week as a "Monday" even though it occurred on a Tuesday following a Monday holiday. In fact, those special cases may have proved very interesting. Similarly, a holiday on Friday could have been worked out to fit the weekday patterns and allow the Monday direction, compared to the previous Thursday direction, to be added into the total results. These tests only used complete 5-day trading weeks.

A well-known work that studies price movement prior to holidays is by Merrill and can be found in Chapter 10 under the section, "The Holiday Effect for Stocks."

Reversal Patterns

The last of the three studies looks at reversal patterns. The intention is to find a pattern in the open, high, low, and closing price of the day that will help predict the next day's pattern or direction. Three combinations are tabulated here:

1. *Intraday trend continued.* A continued upwards trend is set up when yesterday's high is greater than the previous high and yesterday's close is greater than the previous close. We then find the percentage of days that open higher or close higher than yesterday. Continued downtrends are the opposite pattern.

2. *Reversal day.* Beginning with yesterday's pattern of a higher high but a close below the prior close, a *reversal day* opens lower or closes lower than the previous close. An upwards reversal starts with a lower trend day.

3. *Extreme reversal.* Yesterday's high was greater than the prior high, but yesterday's close was below the prior low. The reversal from up to down is continued if today's open or close is lower than yesterday's close.

Results for these trend and reversal combinations are shown in Table 15.22 for the same 10 markets testing in the previous studies. These markets all show very similar results—a remarkable *lack of follow-through.* These studies show that, not only do the standard formations fail to respond in the manner expected, but they are extremely consistent in the negative reactions. These are shown in Table 15.22, where at most 3 of 10 markets performed in the manner consistent with traditional charting expectations.

Table 15.22: Reversal Analsysis for 10 Markets, June 1998–May 2003

Open table as spreadsheet

		Higher High		Lower Low		No. of Cases	
Market	**Pattern**	**Open**	**Close**	**Open**	**Close**	**Up**	**Down**
S&P 500	Trend	42	47	44	48	417	432
	Reversal	51	46	19	18	167	163
	Extreme	36	48	49	60	44	35
General Electric	Trend	na	47	na	50	417	432
	Reversal	na	58	na	14	146	126
	Extreme	na	64	na	47	25	32
Microsoft	Trend	na	49	na	50	412	438
	Reversal	na	45	na	17	181	178
	Extreme	na	37	na	49	41	35
Nasdaq 100	Trend	51	51	45	46	445	435
	Reversal	48	48	23	20	161	185
	Extreme	41	41	58	53	44	40
Intel	Trend	na	45	na	49	417	445
	Reversal	na	43	na	15	164	152
	Extreme	na	37	na	49	35	37
Amazon.com	Trend	na	47	na	47	413	421
	Reversal	na	50	na	17	135	147
	Extreme	na	36	na	52	22	33
U.S. 10-Year Notes	Trend	50	54	45	48	476	385
	Reversal	43	46	18	21	138	135
	Extreme	37	49	50	41	41	34
USD/EUR	Trend	34	46	38	45	404	394
	Reversal	35	43	15	21	206	192
	Extreme	37	40	41	34	35	44
Cold	Trend	48	45	47	49	393	412
	Reversal	45	47	13	8	120	105
	Extreme	36	39	26	19	33	27
Heating Oil	Trend	46	46	38	44	438	398
	Reversal	46	44	16	13	140	112
	Extreme	35	38	67	48	37	21

It could be significant that the most consistent result across all markets is the lower low on the close following a reversal day. The average result was 16.4%, which means that, after a bearish reversal day, prices were likely to turn back up 83.6% of the time. That is an unusually high frequency, and readers are encouraged to verify the program printed at the end of this section to be certain that there are no errors. Particularly good or bad results must be inspected closely and not accepted quickly. A lost opportunity is better than a careless trading loss. If valid, whenever today's high is above the prior high and today's close is less than yesterday's close, a buy should prove consistently profitable.

This pattern does not appear for the reversal to the upside, which had follow-through of about 47%. It does paint a picture that, during the 5-year test period, prices had a tendency to move higher; traders were willing to buy a lower close. They were not as willing to sell a higher close even after prices had made a lower low than the prior day.

Programming the Reversal Study

A TradeStation program for finding reversal patterns is given in Figure 15.27. The output is written to a text file named *reversal.txt* and placed into the *c:\test* directory. You can rename or eliminate the directory by changing the *print* statements. You will also want to rename the output file after each run to avoid overwriting it with other results.

```
{ TSM Reversal Study }
{ Copyright 1985-2003. PJ Kaufman. All rights reserved. }
{ Each of the following based on direction of current pattern:
1. Continued trend (higher high, higher close, then next open and close
2. Reversal: Higher high, lower close, then next open and close
3. Outside Reversal: Higher high, close below prior low, then next open and
   close }

vars:   trend(0), TUopen(0), TUclose(0), TDopen(O), TDclose(0),
        RUopen(0), RUclose(0), RDopen(0), RDclose(0),
        EUopen(0), EUclose(0), EDopen(0), EDclose(0),
        nTU(0), nTD(o), nRU(0), nRD(0), nEU(0), nED(0);

trend = close - close[5];

{ Continued trend }
if high[1] > high[2] and close[1] > close[2] then begin
   nTU = nTU + 1;
   if open > close[1] then TUopen = TUopen + 1;
   if close > close[1] then TUclose = TUclose + 1;
   end;
if low[1] < low[2] and close[1] < close[2] then begin
   nTD = nTD + 1;
   if open < close[1] then TDopen = TDopen + 1;
   if close < close[1] then TDclose = TDclose + 1;
   end;

{ Reversal }
if high[1] > high[2] and close[1] < close[2] then begin
   nRU = nRU + 1;
   if open < close[1] then RUopen = RUopen + 1;
   if close < close[1] then RUclose = RUclose + 1;
   end;
if low[1] < low[2] and close[1] > close[2] then begin
   nRD = nRD + 1;
   if open > close[1] then RDopen = RDopen + 1;
   if close > close[1] then RDclose = RDclose + 1;
   end;

{ Extreme Reversal }
if high[1] > high[2] and close[1] < low[2] then begin
   nEU = nEU + 1;
   if open < close[1] then EUopen = EUopen + 1;
   if close < close[1] then EUclose = EUclose + 1;
   end;

if low[1] < low[2] and close[1] > high[2] then begin
   nED = nED + 1;
   if open > close[1] then EDopen = EDopen + 1;
   if close > close[1] then EDclose = EDclose + 1;
   end;

if lastcalcdate = date then begin
   print(file("c:\test\Reversal.txt"), "Total cases: ", currentbar:5:0);
   print(file("c:\test\Reversal.txt"), " higher high lower low
      no. cases");
   print(file("c:\test\Reversal.txt"), " open close open
      close up down");
   print(file("c:\test\Reversal.txt"), "Trend ", TUopen*100/nTU:6:0,
      TUclose*100/nTU:6:0, TDopen*100/nTD:6:0, TDclose*100/nTD:6:0, "  (",
      nTU:6:0, nTD:6:0, ")" );
   print(file("c:\test\Reversal.txt"), "Reversal ", RUopen*100/nRU:6:0,
      RUclose*100/nRU:6:0, RDopen*100/nTD:6:0, RDclose*100/nTD:6:0, " (",
      nRU:6:0, nRD:6:0, ")" );
   print(file("c:\test\Reversal.txt"), "Extreme ", EUopen*100/nEU:6:0,
      EUclose*100/nEU:6:0, EDopen*100/nED:6:0, EDclose*100/nED:6:0, " (",
      nEU:6:0, nED:6:0, ")" );
   end;
```

Figure 15.27: Program to tabulate reversals.

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COMPUTER-BASED PATTERN RECOGNITION

The methods previously discussed were based on patterns familiar to traders. The weekly and weekend studies, as well as the intraday time patterns shown in the earlier sections, were verified by hand in the first edition of this book, but eventually succeeded in becoming one of the earliest computer studies. There is a type of pattern recognition, however, that would not be practical without the availability of a computer.

Rather than the conventional price patterns where recurring sequences of higher and lower days are found within certain qualified intervals, *computer-based pattern recognition* refers to *sets of descriptors* and *classes of interest.* For example, Aronson[5] describes the sets and values which must be satisfied by a professional jockey as:

Open table as spreadsheet

Descriptor	Value-Range
Height	Under 5' 5"
Weight	Under 120 lbs.
Age	16 to 35
Years riding horses	Over 10

The *set* of people who satisfy all four conditions are said to *contain* all professional jockeys. The converse, that all people satisfying these conditions *are* professional jockeys, is not true. It will be necessary to qualify this set further to create a set that contains *only* professional jockeys; however, these four conditions go a long way toward reducing the field.

How can this tool be applied toward the development of a trading strategy? If the system is defined in terms of the *trade profile,* it becomes obvious. Consider the following characteristics of a trade:

1. The price moves higher or lower by at least 3% of the starting price.
2. The price move occurs within 20 days.
3. There is no loss exceeding .5%.

Either a computer or an analyst can locate all price moves that satisfy these conditions within a price series. Each of the 5 days preceding an upwards move, which satisfies these conditions, can be marked as *buy* days, and the 5 days preceding a downwards movement can be designated *sell* days (see Figure 15.28).

Figure 15.28: Specific buying and selling days.

By keeping a table as they are located, the computer now contains the set of all buy and sell days; those days on which it would be good to get a buy or sell signal based on historic data. Next, some likely indicators must be specified to be used for identifying that these trades are about to begin. The following might be used:

- The moving average direction.
- An overbought/oversold indicator such as the *Relative Strength Indicator* (RSI) or *contrary opinion*.
- The direction of changes in trading volume.
- A 10-day momentum.

By entering a broad selection of indicators and trying to avoid duplication, the computer can find unique values for combinations of indicators that primarily occur during the days selected as buy and sell periods. Ideally, all buy signals should occur when one indicator, or the value of combined indicators, exceeds a specific threshold. For example, all buy signals occur when the average value of the RSI and the market sentiment (contrary opinion) is below the 10% level. However, having all buy signals occur here is not enough. Poor signals may appear at this level, which cause large losses. The perfect system will have *no losing signals* occur in this zone.

Unfortunately, in the real world there are no perfect solutions. The trades that are signaled by the combinations of indicators will have to be studied for net return, risk, and other performance criteria. However, the technique of setting up classes of indicators, and buy and sell days, is a new and valid approach to system development. It is analogous to the multiple regression method used by econometricians to find the relationship between statistics and prices. Although the econometricians use inflation, supply, interest rates, and so forth, pattern recognition can employ technical indicators and discrete patterns to forecast a buy or sell day.

Analysts interested in these techniques will find *neural networks* and *genetic algorithms* of particular importance. They are powerful search tools that find patterns in a large number of inputs with remarkable efficiency. Detailed discussion of these methods can be found in Chapters 20 and 24.

Repeated Patterns

A mindless task for a computer is to recognize repeated price patterns. Over many years, the chance of a higher close

following a higher close (or even a lower close) in the stock market is about 55%, due to investor bias and the *up-tick rule*. In most other financial and commodities markets there seems to be very close to a 50% chance of any day being higher or lower. If there were a 65% chance that a higher day followed a lower day, traders would jump on that opportunity and extract all possible profits until it was extinct.

What about two higher days in a row, or two lower days? We saw something similar in the Weekday Study, where various combinations that occurred during the week were posted with the frequency of a similar or reversal day following. There were some combinations that showed high or low frequencies and attracted our attention. In the Weekday Study we limited the analysis to repeated days of the week; however, these patterns could start at anytime.

When seeking repeated patterns, it is important to remember that the number of cases drops quickly as the length of the pattern is extended. For example, if you are testing 1,000 days of data looking for a 1-day pattern, you have 1,000 candidates. About one half will be higher days and the other lower days. If you now look for 2-day patterns, for example, *up-up*, then only 25% of the days are likely to qualify, because the other three combinations, *up-down, down-up,* and *down-down*, will normally share equal amounts. With 3-day patterns there are 9 combinations, each with about $1/9$ of the data, and so on. By the time you are looking for a sequence of 10, there are far more combinations than can be found in 1,000 data items and the number of examples that you can study will be very small.

But what if a specific sequence of 10 ups and downs can be found 10 times in a series of 1,000 prices? And what if an up day followed that sequence 70% of the time? Would you have a potential trading system? Unfortunately, there are just not enough cases to have confidence in the result.

One way to improve the sample is to look at the total count of up and down days within a long sequence, rather than the exact pattern of ups and downs. Therefore, if you found a sequence of 20 days with 15 ups and 5 downs, you would have a very bullish scenario for nearly all combinations, the least bullish being 5 five down days at the end. You have now greatly expanded the number of patterns that satisfy this condition, and you can give this sequence a quality—*bullishness*, which may improve the chances for predictive success.

Readers interested in this method should read the sections on "The Theory of Runs" and "Martingales" in Chapter 22.

[5]David R. Aronson, *Artificial Intelligence Methods* (privately published). Also see David R. Aronson, "Artificial Intelligence/Pattern Recognition Applied to Forecasting Financial Market Trends," *Market Technicians Association Journal* (May 1985, pp. 91–131).

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ARTIFICIAL INTELLIGENCE METHODS

Artificial intelligence refers to a computer process that performs an operation corresponding to or approaching human thinking. This is intended to distinguish it from simple pattern recognition, with which it is often confused. The state-of-the-art in artificial intelligence is the separation of two ideas. The collection of information that is stored in the brain has been termed the *knowledge base.* This is distinguished from reason, rules, and logic, called the *inference engine.* These ideas are not very different from the database and trading strategies that are discussed here.

The closest practical approach to artificial intelligence is *heuristic* programming. This refers to computer learning in very much the same way as finding its way out of a maze. The computer starts with rules relative to the problem, then records the successful and unsuccessful experiences. Eventually, it has a complete table of what to do for each situation or at least a table of probable solutions. This is a realistic, intelligent approach when the same events can be expected to recur in the same way. It does not help in new situations without the added complication of extrapolation, basic relationships (e.g., price level to volatility), and other forms of expectation.

The danger of the heuristic approach to pattern recognition is that it may continue to define longer combinations of patterns that have already produced inconsistent or poor results. Allowing the computer to identify a limitless collection of patterns is just another case of overfitting, but this time at a highly sophisticated level.

Heuristic programs have improved current technology in searching, optimization, and game-playing strategies; however, they are not readily available. There is no doubt that this technique will be quickly absorbed into trading strategies as it develops.[6] Those readers interested in these methods should learn about *expert systems, neural networks,* and *genetic algorithms,* which can be found in Chapters 20 and Chapter 24.

[6]Two books of interest that represent the state-of-the-art in heuristics and game-playing are Judea Pearl, *Heuristics* (Addison-Wesley, Reading, MA, 1984) and M. A. Bramer, *Computer Game-Playing: Theory and Practice* (Halsted Press, New York, 1983).

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Chapter 16: Day Trading

OVERVIEW

A *day trade* is a position entered and liquidated during the same trading day. Day trading reached a peak in popularity along with the top in the stock market at the beginning of 2000. High volatility and a clear bull market made day trading look easy, but that period did not last long. While trading for a living is always difficult, day trading puts more restrictions on the rules, requiring you to extract a profit during a limited time period. Price moves are smaller during one day than during the combined period of a few days or a few weeks. Intraday prices respond more to noise than to fundamental factors. They jump up and down following economic reports, large orders from funds, earnings statements, and the flow of gossip on the financial news networks. The fact that the economy is strong or weak, that creeping inflation requires raising interest rates, or that the budget deficit is steadily growing has little impact on a trade that targets a 1-hour period during the day. Day trading is highly focused on price patterns, noise, and volatility.

Gaps, time of day, and various daily patterns discussed in the previous chapter are easily applied to day trading. Day traders often look for extremes and a predictable pattern that follows. Day trading requires extreme discipline, excellent planning, anticipation, and concentration. The need for a fast response to changing situations tends to exaggerate any bad trading habits; as in other fields, the shorter the response time, the greater the chance for error. In this chapter we will extend the idea of day trading to systems and methods that may also be held overnight, but expect to limit the trade to about 24 hours.

In order to keep mistakes to a minimum, each day's strategy must be planned in advance. It should focus on the most likely situations that might occur based on the nature of the current price movement. There should also be a contingency plan for the extreme unexpected moves in either direction. Making spot decisions during market hours will cause more frequent errors.

Day trading has become more sophisticated as computers, electronic exchanges, direct access to live data feeds, better graphics, and more programmable strategies have descended on the industry. There is so much competition trading into Nasdaq that day traders target as little as 1¢ per share net profit on a trade. This is only possible because commission costs have dropped dramatically for electronic execution. The majority of exchanges in the world are now electronic, and more transition is expected. GLOBEX, the electronic offshoot of the Chicago Mercantile Exchange, allows side-by-side, 24-hour trading of a number of markets, most notably the S&P 500. Eurex, the largest European exchange, has been fully electronic since its inception; France's MATIF, London's LIFFE, and Sydney's SFE have all moved from pit trading to electronic markets. This is all good news for the traders. In addition to faster executions, the data streams have few errors and there is no question of a fair execution price. All of these tools have greatly increased competition among individual and commercial traders.

For the arbitrageur, computers have had an even stronger impact. Sophisticated systems at banks and large financial institutions consolidate data feeds that bring current transactions on every type of interest rate vehicle in every maturity and major currency. Analytic programs can find outliers and show which combinations (called *strips*) can produce a riskless profit. For the individual trader, few of these opportunities are available, although trading by these commercials adds liquidity to the market. Individuals, however, find it much easier to create spreads of different deliveries within the same market as well as spreads between two related products. Stock traders can create sector baskets or look for performance differences within a sector. Spread trading opportunities, based on formulated values such as the energy crack or soybean crush, can also be recognized and signaled automatically. Many of the opportunities that now seem so easy to see would previously have been missed. This faster, more systematic response to the market allows traders to improve profits and reduce risk in any day trading method.

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IMPACT OF TRANSACTION COSTS

Transaction costs are the greatest deterrent to day-trading profits. *Slippage*, the difference between your execution and your intended price plus the commission costs, can remove a large part of potential profitability and even turn expected profits into unexpected losses. An aspiring day trader has two ways of improving performance: paying lower commissions and carefully selecting opportunities.

Table 16.1 shows the average daily price moves in dollars or euros for a selection of futures markets and stocks. The table is sorted by greatest volatility in 2003, top to bottom, futures in the top section and stocks in the lower section. Note that the average volatility is based on the difference between the daily high and low, not the *true range*, which includes the previous day's closing price. In general, the index markets are the most volatile and offer the greatest opportunity for day trading. Energy markets are also volatile, but interest rates and agricultural products fall to the bottom of the list. If we look at the pattern during the seven years, we see that volatility for the index markets and stocks reached a peak in 2000, the top of the bull markets, and are much lower in 2003. It would have been easier to trade Amazon.com in 1999 when it moved an average of $6.10 each day; in 2002 it had fallen to $0.98 per day.

Table 16.1: Volatility and Volume of Selected Markets, 1997–2003 Open table as spreadsheet

	Value of 1 point ($)	Est. 2003 Volume	Currency	1997	1998	1999	2000	2001	2002	2003
S&P 500	250	300,000	U.S. dollars	3,828	4,758	5,533	6,964	5,619	5,363	3,619
Nasdaq 100	100	100,000	U.S. dollars	2,419	3,546	6,853	17,339	8,380	4,389	2,795
Natural gas	10,000	60,000	U.S. dollars	1,051	949	938	2,115	2,269	1,571	2,591
DAX Index	25	250,000	Euros	2,207	3,134	2,776	3,849	3,426	3,316	2,177
Unleaded gas	420	35,000	U.S. dollars	584	559	665	1,194	1,093	983	1,279
US 30-Year bonds	1,000	200,000	U.S. dollars	639	723	758	817	960	1,068	1,225
Heating oil	420	50,000	U.S. dollars	491	505	583	1,181	981	833	1,166
Crude oil	1,000	225,000	U.S. dollars	475	509	576	992	852	789	969
US 10-Year notes	1,000	460,000	U.S. dollars	416	484	499	528	652	715	796
Coffee	375	15,000	U.S. dollars	3,394	1,606	1,603	1,163	662	696	658
EuroBund	1,000	725,000	Euros	439	482	689	495	481	536	657
EuroStoxx 50	10	1,250,000	Euros		815	687	1,095	995	990	624
Corn	50	45,000	U.S. dollars	261	212	189	183	173	205	198

Eurodollars	2,500	700,000	U.S. dollars	159	177	174	167	271	277	189

Open table as spreadsheet

Stocks										
IBM	100	7,500,000	U.S. dollars	na	216	363	456	332	281	196
Amazon.com	100	10,000,000	U.S. dollars	na	218	610	423	112	97	98
Microsoft	100	75,000,000	U.S. dollars	na	102	149	171	120	98	74
General Electric	100	25,000,000	U.S. dollars	na	95	100	172	151	117	72
Intel Corp	100	55,000,000	U.S. dollars	na	91	139	296	163	115	64
AOL-Time warner	100	18,000,00	U.s. dollars	na	120	363	305	203	99	53

The cost of trading is different if you buy and sell in the direction of the price move (*trend trading*) or if you are trading against the direction of the move (*mean reverting*). Most day traders are trend traders, entering new long positions as prices move higher and selling short on new lows. For example, in trading the S&P 500, slippage should be expected to be at least 50 basis points, equal to $125, for each entry and exit. Commission costs can be as low as $4 per side, but we will use $15, making the total cost of trading $265, only 7.3% of the daily trading range. If you could capture half of the trading range, or even one-quarter of the range, there would still be sufficient net profits.

Costs have a very different impact on the less volatile markets. Moving lower on the list, 30-year bonds have a daily volatility of $1,225. A typical trend execution costs about 48/32 (1½ basis points); therefore, round-turn costs should be $93.75 plus $15 commission, or $108.75, 8.8% of the daily range. The exceptional liquidity of U.S. interest rate markets keeps the slippage small enough to allow day trading.

The energy markets and coffee, although very volatile, are much less liquid and result in higher slippage. When prices start to move in unleaded gas, you might find that your actual entry price is 25 or 50 basis points away from your planned price. At 50 points the cost would be $210 on each side, or a total of $435 for the trade, 34% of the total trading range of the day. Coffee might also cost 25 basis points, or $93.75 each side, for a total of $202.50, or 31% of the range. In order to successfully day trade markets with high slippage you must adopt the style of the floor trader and enter your order in the opposite direction of price movement, expecting prices to reverse direction. Slippage is then kept to a minimum on at least one side of the trade. If prices move against you, there may be no choice except exiting your trade in the trend direction.

The steady drop in volatility for individual stocks parallels the index markets; however, there is no leverage trading stocks. Commissions have fallen sharply over the past few years and you can trade 100 or 1,000 shares for a flat rate of $10 or $15 per side. For a trade of 100 shares, $10 per side costs $0.20 per share. If you assume slippage of $0.25 for IBM, you get a total cost of $0.70 or 35% for the stock with the largest daily range in Table 16.1. With slippage of only $0.10 for AOL, the total cost would be $0.40, or 75% of the range. These percentages are too large for a day trader. In 1999, when AOL had a range of $3.63 per day, day trading was viable.

Liquidity

It is no surprise that index markets are the venue of day traders. Volatility relative to costs is the largest of all markets, and the volume of trading makes slippage relatively small. Table 16.1 shows that the approximate total volume for S&P futures is 300,000 per day. The S&P daily volume for the full-size contract is about 200,000 and the electronic S&P e-mini is actually much larger at about 500,000 contracts. Table 16.1 converts the small S&P contract to the large contract equivalent, which is five times the size. The same conversion was done for the full-size Nasdaq-100 and the e-mini Nasdaq, which is 1/5 the size.

While the selection of day-trading candidates begins with those markets of greater volatility, volume is very important. Whether you are trading 1 contract or 1,000, a thinly traded market produces slippage that will cut sharply into profits. In choosing among index markets that usually offer the greatest volatility and profit potential, you are always safest with the markets that combine the highest volume and highest volatility. The markets shown in Table 16.1 have the highest volume of all index markets. The lower volume of coffee, only 15,000 per day, explains the larger slippage discussed in the previous section. During 1997 through 2000, the higher volatility of coffee could absorb the cost of slippage, but lower prices and lower activity make it a questionable candidate for day trading in 2003.

Markets with light volume can show larger price moves than similar markets traded on other exchanges. Traders will be

tempted to profit from these moves but will consistently find that the execution of an order at the posted price is elusive. The reality of trading these markets is that a Market Order or a Stop Order is not advisable due to the thinness of the trading. A Limit Order may not get filled, and a spread is not quoted at anything resembling the apparent price relationships that you see on a quote screen; there is no real way to take advantage of these perceived profits. If an execution succeeds, exiting the position still has the same problems plus some added urgency.

Mean-Reverting Strategies

Some strategies have less slippage than others. While trend following and momentum approaches buy and sell in the direction of the price move, mean-reverting strategies do just the opposite. They assume that relatively large price moves will not continue; therefore, a sharply higher move is *sold* and a sharply lower move is *bought.* Trading against the direction of the market with a small order should allow an entry at the intended price, reducing the slippage to zero. Exiting a mean-reverting method may not be as easy. If successful, prices reverse and you can exit at your leisure when prices return to a normal point, where they can remain for some minutes. However, if prices start higher and continue higher after you have sold, at some point you will want to cut your losses by buying back your shorts. This means buying when prices are moving higher and is subject to the same slippage as a directional strategy. The impact of slippage on a mean-reverting strategy depends on how often it achieves its profit targets, but assuming a conservative 50%, slippage is reduced to only 25% of the slippage seen in directional programs. As an added bonus, stock commissions may be significantly lower when a sell order is placed above the market, or a buy order below the market, because they serve the function of adding liquidity. The cost of slippage is a primary reason why many day traders choose mean-reverting strategies.

Missed Orders

With a systematic day trading program, your success depends on executing *all* of the signals reasonably close to your system price. During testing you should have accounted for reasonable slippage and commissions in the net results. In some cases that is not enough to ensure success. If you are buying and selling in the direction of the price move, there are days when the market jumps after a news release and you cannot get filled anywhere close to your intended price. With most of the potential profit gone before you enter the order, it would seem reasonable to simply skip that trade. These missed orders, called *unables*, can add up to a large part of your profits; at the same time they never reduce your losses.

Some markets are prone to more *unables.* Those that are open when the morning economic reports are released are most often a problem. The interest rate futures open 10 minutes before the regularly scheduled government releases and are often very quiet at the open while traders wait for the reports to be posted. European markets, both interest rates and equities, as well as all foreign exchange markets, are actively trading in advance of these reports and can change direction abruptly when the news is a surprise. On Wednesdays, the American Petroleum Institute (API) releases energy stocks at 10:30 A.M., Eastern Time, 30 minutes after the energy markets open for trading. On Thursday, natural gas stocks are reported at 10:30 A.M., also 30 minutes after its open. Other reports, such as the Chicago Purchasing Managers and Michigan Sentiment Index are typically released at 9:45 and 10:00 A.M., Eastern Time, after the stock market has opened. The Fed announces the results of the Fed Open Market Committee (FOMC) meeting at 2:15 P.M., Eastern Time. Add unexpected political and weather news to these regular announcements and you can easily form the opinion that prices are driven by a series of price shocks. The larger jumps make it difficult to execute a day trade in the direction of the price move, except at the worst price of the move.

For the energy complex, heated military or political activity in the Middle East have caused a prolonged period of very erratic price movement resulting in as much as 20% unexecuted trades during a one-month period using a directional strategy. If we consider the normal profile of a short-term trading system as having an average net profit of $250, an average loss of $150 and a 50% frequency of profits, we expect a profit of $5,000 for every 100 trades and a reasonable profit-to-loss ratio of 1.66. If, however, there are 10% *unables*, those missed opportunities must come from the profits; if the market was moving in the opposite way you would get all of your positions filled. Then 10% of the profitable trades means 5 trades missed out of every 100 for a total of $1,250. This reduces the total profits to $4,750 and the profit factor to 1.50. It may turn a marginal trading strategy, or one with small profits per trade, from a profit to a loss.

Markets with Trading Limits

Day traders may find that those markets with traditional daily trading limits present a problem during high volatility periods. Day trading does best in markets that have wide swings not deterred by limits; a single locked-limit move can generate a loss which offsets many profitable day trades. High volatility and locked-limit moves present a contradiction for day trading. Expanding limits have greatly helped reduce the frequency of locked-limit days; however, traders must always be on guard for this situation.

Estimating Slippage Costs

If you know the cost of slippage, you can do a much better job selecting the markets to trade and have a realistic appraisal of your trading expectations. The factors that make up slippage are volatility, overall market volume, specific market activity and the size of the order being placed. Of these items, the specific market activity is the most difficult to record, because it requires some estimation of volume as it accumulates throughout the day. Some Web sites post periodic volume for futures and stocks, and access to volume is likely to increase rapidly. While actual volume is not available, a reasonable approximation can be made using tick volume, the number of price changes during a fixed interval. In general, tick volume is directly proportional to actual trading volume. During periods of greater activity, both contract or share volume will increase along with the number of price changes.

If you have carefully recorded the order price, execution price, volatility (daily difference in the high and low), daily volume, time of day, and tick volume, you can find the importance of each factor and estimate the slippage for any trade by applying the formula:

> Actual slippage at time $T = a_0 + a_1 \times$ Volatility $+ a_2 \times$ Daily volume $+ a_3 \times$ Current activity at time $T + a_4 \times$ Size of order

By creating a spreadsheet of values for all trades, you can solve for a_0, a_1, a_2, a_3, and a_4, and then estimate future slippage at any time T during the day, given the current volume and order size. This approach was taken in 1992[1] for large Stop orders using a ratio of order size to current market activity. The results, shown in Table 16.2, show that slippage was very modest for most markets. The far right column gives the slippage likely at the 5% level, that is, there is only a 5% chance of having slippage greater than $135 per contract for sugar, combining both entry and exit. Commissions were not included. The unusually large *worst* loss in Treasury bills was confirmed as correct.

Table 16.2: Slippage (Loss) for Stop Orders (Slippage in Dollars per Contract)

Open table as spreadsheet

Market	Average	Best	Worst	St Dev	5% Chance of Worse than on Entire Trade
World sugar	13.63	-11.20	200.20	33.71	135
Coffee	48.13	-22.50	168.75	48.44	194
Pork bellies	38.49	-12.00	168.00	42.22	169
Soybean meal	14.34	0.00	60.00	21.46	86
Heating oil	37.35	-17.50	109.39	33.58	134
Japanese yen	18.53	-12.50	112.50	28.86	115
Deutschemark	18.06	0.00	162.50	33.67	135
Treasury bills	62.86	0.00	700.00	139.51	558
Copper	25.70	-11.36	62.50	24.15	97
Platinum	77.92	-17.86	280.00	85.68	343
Gold	65.80	0.00	410.00	91.72	367

Source: Thomas V. Greer, B. Wade Brorsen, and Shi-Miin Liu, "Slippage Costs of a Large Technical Trader," *Technical Analysis of Stocks & Commodities* (January 1992).

Sustained high volatility is most common in markets that are at abnormally high price levels. Bull markets are followed by bear markets, and the combination at the peak of the move creates sustained activity, as we saw in the stock market between 1998 and 2001. Prices that are volatile at low levels are most likely to be at the end of a decline and are likely to returning to previous, less volatile patterns. For agricultural markets and other commodities, when carryover stocks or inventories are increasing, volatility and prices decline. Many experts have theorized that the high interest rate yields seen in the 1980s, as well as the high precious metals prices, are a very unusual event not to be repeated often. They may have added the stock bubble of 2000 to that list.

Some markets do not have a high or low price in the normal sense of a physical commodity; therefore, they do not contain volatility patterns directly related to price level. While we expect gold and Microsoft to be more volatile at higher price levels, foreign exchange markets have low volatility when they are at levels perceived as the fair value or equilibrium. Prices then increase in volatility when they move either up or down from this level because any change away from the norm is considered unstable. Countries do not want their exchange rates to vary quickly and there is a lot of trading

activity when large, sudden changes occur.

Crude oil is a unique case because it is a controlled market. While currencies may become volatile as they move away from equilibrium, they will become quiet at a new price if that is perceived as reasonable by the market. This is not the case with oil because the producing countries continue to drive prices back to their target levels by controlling the supply. Therefore, the farther prices decline from the producers' desired price, the more of a struggle exists between fair value and controlled price, resulting in higher volatility. In the real world, even the United States, which is both the largest consumer of oil and a very large producer, does not want low oil prices. Prices below the U.S. cost of production, which is high compared to other countries, requires that the U.S. subsidize its oil industry, either directly or indirectly. Very high prices fall into the same pattern as high prices in any market—they are perceived as temporary and unsustainable. The day trader must always seek opportunities in potential volatility.

[1]Thomas V. Greer, B. Wade Brorsen, and Shi-Miin Liu, "Slippage Costs of a Large Technical Trader," *Technical Analysis of Stocks & Commodities* (January 1992).

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APPLICABILITY OF TRADING TECHNIQUES

Most traditional methods of technical analysis, in particular trend-following systems, are not used for trading when the holding period is less than 3 days; however, the price fluctuations during these shorter periods are nearly all *technical.* An economic analysis of supply and demand cannot be relevant over such a short time span, nor can the government's target of a 6% GDP, when the current level is 2%; that approach can only be used for establishing longer-term, *macro* trading policy. Price reaction to economic reports affects a day-trading strategy; however, no one has yet figured out how to anticipate those price jumps successfully. The day trader will *react* to large moves, not anticipate (this is covered in more detail in the section "Price Shocks" in Chapter 22. Techniques used for day trading can be applied to slightly longer periods of a few days. The number of data points, or the amount of price detail, used in a day-trading analysis are important to the results. You would not expect meaningful information using a 3-day moving average, which applies on three data points, compared to hourly data over the same period, which would have in excess of 24 data points in most markets.

Both day trading, which does not hold a position overnight, and short-term trading are most concerned with timing of entry and exit points. A common way to accomplish this is by a simple form of pattern recognition based on values relevant to the short time frame. From the floor trader's viewpoint, only the most obvious recent key levels are important. Today's price movements are compared to today's opening price; today's high and low, yesterday's closing price; yesterday's high and low, and less important, last week's high and low; very memorable older support and resistance points; and finally, the life of contract high and low. When the same price satisfies more than one condition, there is greater confidence in the importance of that point.

Noise takes on different roles for day trader and the trend follower. Noise, the underlying erratic movement of prices, is not a significant issue for the position trader looking to follow interest rates to high levels over the next year. But it is very important for the daytrader because the trend component of price movement is very small over a 24-hour period compared to the noise. That is, prices may move up and down by 2% during the trading day, while the average net change at the end of the day is only 0.25%. This makes it impossible, using the ordinary trend following tools, to decide whether a move up over 15 minutes will begin a trend or whether it is simply part of the more common market noise. During the short time frame, odds favor noise.

Time of Day Patterns

Time of day and *short-term patterns* are combined in the most popular forms of day trading; the types of patterns have already been discussed in Chapter 15. The nature of the trading day and its participants make certain times more important than others. The opening gap and the continuation of that direction usually take the first 15 to 20 minutes of the trading day, as does the reaction to the U.S. economic reports that are released at 8:30 A.M. in New York. After that, it is likely that price reversal follows and a trading range is established that lasts until the middle of the session. The midmorning period, which may marginally expand the initial trading range, tends to include low volume because many of the orders originating off the floor (called *paper*) are exhausted near the open; floor traders take this opportunity for a break, further reducing liquidity.

Following midday, activity steadily increases and the high or low of the existing daily range is tested. It is common for most day traders to buy the bottom of the range and sell the top. A break of either support or resistance after midday is considered a major directional change; traders quickly shift to the direction of the breakout with the expectation of holding that position for the balance of the day. A detailed analysis of these patterns is shown in Figure 16.1. This chart, created by Walt Bressert, uses the important recent highs and lows and is very specific about relationships between the developing range, the previous day's range, and the time of day.

Figure 16.1: Intraday timing of market movement. *Source*—Walt Bressart.

To clarify the way Figure 16.1 is to be read, we use line 1, column *A* as an example. Note that columns *A*—*D* are days where the open was higher than the previous close, and columns *E*—*H* are days where the open was lower than yesterday's close. The notation in the box with number 1 shows the preconditions of that row, explained at the upper right of the chart; therefore, $H_E < H_Y$ says that *the high of the entry is lower than yesterday's high.* This row shows the beginning of an *inside day*. Columns *A*—*D* give the trading signal as the day progresses. In the first box, 1*A*, the absence of broken lines marked *B* and *S* for buy and sell, indicate no trade occurs with this pattern for the first 30 minutes of the day.

The second box on row 1, 1*B*, shows that a buy and sell order can be placed 30 minutes after the open. The new long is entered on an upwards break of the previous day's highs, and a new short sale is entered on a drop through the previous day's low. By midday, box 1*C*, the buy and sell signals become closer by raising the short sale to a break of the current day's low, rather than the previous day's low. In box 1*D*, 35 minutes before the close, if prices are between the current open and the current high, the buy signal is lowered to the current high and the short sale to the opening price of the day. Bressert's chart is an extremely good example of the way a floor trader reacts to changing patterns in combination with the constantly moving clock.

Readers may want to compare Bressert's relationships with those found in Chapter 15; however, the tables in Chapter 15 represent only a small set of patterns that are covered in Figure 16.1. Intraday highs and lows that correspond to key levels found on charts such as channel support and resistance, and head-and-shoulders objectives, are also likely to have increased importance.

Trading in the Wrong Time Zone

Holding a position overnight involves margin and, above all else, greater risk. It also increases the opportunity for greater profits. In moderately active markets, the opening gap, the difference between the prior close and the next open, can be one-third to one-half the size of the normal trading range. Markets that are traded in one time zone, but reflect the business of a completely different geographic region, have larger systematic gap openings. For example, the Nikkei 225 is traded at the Chicago Mercantile Exchange but the Nikkei reflects the value of the Japanese stock market. While the day session in Chicago is open from about 7:00 A.M. to 3:00 P.M. local time, the time in Japan is 14 hours ahead, 9 P.M. to 5 A.M., during which there is no business activity in Asia. When Chicago opens, it must immediately reflect the price of the previous closing session in Japan, therefore it gaps to that level. This same situation happens to a lesser degree for European currencies, which are actively traded on Chicago's IMM. When those markets open at 7:20 A.M., Europe is coming back from lunch and all local economic news has already been absorbed into the market.

In Table 16.3 and Figure 16.2 we see that the currencies and metals, representing markets actively traded 24 hours, have the largest *overnight* gaps. This same pattern must continue when the futures market is out of phase with the cash market. Viewing world markets only during the U.S. business hours can put a trader at a disadvantage and force him or her to deal with unpredictable, uncontrollable risks. This has prompted many futures traders to watch the markets 24 hours, a daunting task.

Table 16.3: Percentage of Overnight Price Gap Compared with Subsequent Trading Range for Selected U.S. Markets

Open table as spreadsheet

	% Change Overnight	
Market	**1985–1989**	**1990–1995**

Cotton	29.6	27.5
Corn	26.3	26.5
Soybeans	25.5	23.8
Australian dollar	51.9	43.5
British pound	39.1	28.1
Canadian dollar	39.0	31.9
Deutschemark	37.9	30.9
Japanese yen	43.0	35.8
Swiss franc	38.4	25.5
Gold	28.7	31.5
High grade copper	na	30.9
Crude oil	32.4	26.6
Heating oil	33.8	29.0
S&P 500	19.3	16.3
NYSE Composite	22.0	19.9
Treasury bills	27.2	25.6
Treasury notes	26.6	13.6
Treasury bonds	22.6	11.6

Figure 16.2: Opening gap as a percentage of daily move.

The problem of trading in the wrong time zone can be corrected using the electronic, 24-hour markets offered on the CME's Globex platform and comparable systems on other exchanges; however, liquidity is not always enough to avoid large slippage. The 24-hour data stream will still be much better at generating trading signals using a computerized model than the truncated session in the wrong time zone.

Point-and-Figure for Short-Term Trading

Point-and-figure charting has been a primary tool of day traders for many years. Using the minimum price movement as the box size and a 3-box reversal, many traders will keep a continuous, although lengthy, chart of day-to-day price movement. Buy and sell signals can be taken in the standard manner, but day traders are most likely to use these charts for identifying countertrend support and resistance levels. Intraday point-and-figure, as well as moving averages, often show frequent changes of direction before a new buy or sell signal occurs, even when the minimum box size is used. Trend methods are best applied to short-term overnight positions where the size of the move is much larger. A primary advantage of point-and-figure is that directional signals occur concurrently with a price breakout. There is no lag when trading using point-and-figure.

Price reversals that occur during the day can be plotted using a smaller point-and-figure box size than is common for daily charting. The more frequent reversals due to the combination of more data and smaller box size will define the trend sooner or bring the protective stop closer. Remember, stop-loss levels advance only when there are reversals on the point-and-figure chart. Traders who use daily charts cannot see the different patterns that develop during the day.

In Chapter 5, where point-and-figure rules are given, there was a choice of plotting the reversal or trend continuation on an outside day. For daytrading, the reversal is preferable. This allows the chart to reflect the reversal sooner and bring the stop-loss closer—both will serve to reduce risk.

When day trading with point-and-figure, continue the chart from day to day rather than begin with a clean chart. When starting fresh each day you lose information that has been developed over the preceding days, and a new trading signal may not occur until a number of reversals have been plotted. This can limit profits if the pattern covers ⅓ to ½ of the trading range of the day. Point-and-figure is also subject to directional trading slippage.

Moving Averages

The intrinsic dependency on time, as well as its built-in lag, makes a moving average less adaptable to day trading. Traditionally, a moving average is recalculated at fixed intervals. Two "philosophic" questions must be answered with regard to intraday moving averages: Do trends exist in this short time interval? Does it make sense to apply a moving average to intraday prices unevenly spaced with respect to time?

In the introductory part of this section, "Applicability of Trading Techniques," the conflict between noise and trends was discussed. Markets with a large noise component require more time to identify a trend or simply a larger price move; therefore, it may not be possible to enter a trend trade and still have enough profit potential before the end of the trading session. It is likely that there will not be more than 25% of the daily range remaining after the trend has been identified, making the profit opportunity too small.

To be fair, there are analysts who believe a moving average is a fine tool for day trading. It has the same performance profile in the very short term as it does when applied to daily or weekly data, that is, it cuts losses short and lets profits run. However, no one calculation period seems to satisfy all markets because the difference between the slow moving 5-year Treasury notes and the explosive Nasdaq-100 require longer and shorter periods, respectively. Those planning to explore the use of a moving average should consider two issues: (1) Does the need to use different calculation periods constitute over-fitting or is it simply the necessary reflection of the individual market personalities? (2) Are the higher relative costs of day trading a serious obstacle to profitability, differentiating it from longer-term trend following for which transactions costs have little effect?

Uneven Price Bars

The issue of *uneven price bars* is more complex. Moving averages have been applied to daily data by convenience, although the development of all time series analysis was no doubt based on equal time intervals for the same reason. The versatility of computers now allows more choices. While equal 30-minute bars, or even 1-minute bars can be handled by a computer with no more effort than daily bars, more work has been done using *equal-tick bars.* For example, a price bar can be created from the high, low, and close of every 10, 50, or 100 price prints. Those bars can then be used to calculate a moving average. In a liquid market, prices might be posted every few seconds even though volume may vary. For practical purposes, prices might be considered equally spaced. But consider an extreme example. The price of a less liquid market changes every 15 seconds during more active times, then quiets to 5-minute intervals; at one time, there is a lull of 15 minutes followed by a jump in price. Is there a difference in the way we would interpret the following two patterns? Is there a difference in the way a moving average would calculate the trend?

Open table as spreadsheet

Pattern A		Pattern B
Time	Price	Time
10:00	5005	10:00
10:01	5010	10:05
10:02	5005	10:06
10:03	5015	10:16
10:04	5025	10:26
10:05	5020	10:28
10:06	5015	10:29
10:07	5025	10:44

Pattern *A* shows a gradual upwards movement over equal time intervals; pattern *B* shows slow rallies and fast drops. When interpreted by a trader, pattern *B* is often considered *toppy;* it is a market struggling to go higher with sellers waiting anxiously for their opportunity. Moving averages of pattern *A* taken as shown and pattern *B* interpolated to equal intervals will have the same trend direction at each point. There is not enough information to know which is best, but it is clear that the patterns can be interpreted differently.

One conceptual advantage of the equal-tick bar is that it deemphasizes the quiet periods of the day. By combining 50 price prints into one bar it may be possible to avoid trading during the middle of the day, when activity is low and many false signals occur due to a single trade of insignificant size. A fixed-interval moving average will give equal importance to these periods.

More on Choosing the Length of the Intraday Bar

While there is no *correct* bar length, traders often choose 5-, 10-, 15-, 30-minute, and 1-hour periods to chart. The older commercial software packages require that the interval be evenly divided into 1 hour; therefore, a 6½-minute interval is not allowed. When using longer bars, such as 1 hour, it is important to consider the length of the last bar of the day. In trading platforms or charting software that require that all bars begin at the start of the hour, a 1-hour bar will post its first price at the end of the first actual hour, rather than one hour after the open; the last bar will be the interval from the last whole hour to the close. In the case of the energy markets, this will be 30 minutes; for grains it could be 15 minutes. When bars are uneven in this way, the price ranges and corresponding volume are no longer comparable to one another.

More modern test platforms will allow intraday bars to begin at any time, and will also permit bars based on a fixed number of ticks, or price prints. For the large S&P, hourly bars will begin at 8:30 A.M. when the market opens in Chicago, and close at 4:15 P.M. The last bar will be only 45 minutes in length. By choosing odd bar sizes, it is possible to make the last bar of the day very small, perhaps only 5 minutes. It is best to plan ahead and choose a bar length that does not make the final bar of the day unreasonably short.

There is a difference in opinion between analysts over the choice of intraday intervals. One group prefers to pick a standard number because it conforms to the way others trade; for example, you can expect orders to flow more actively every hour. This approach may be particularly valuable if you plan to take the opposite position. Another group of traders are constantly seeking their own time interval, avoiding uneven order flow and price distortion caused by most other traders. If you are part of this group you may choose your interval by dividing the total number of minutes in the trading session by a value that gives you equal length bars. You may also want to find a bar length, such as 21 minutes, that represents a Fibonacci number and comes close to dividing the day equally. When using equal-tick bars, you have no control over the length of the last bar.

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TRADING USING PRICE PATTERNS

A trade that lasts from 1 to 3 days can be improved if short-term patterns or cycles can be found, such as those in Figure 16.1. For example, in a trending market there are outstanding weekly and weekend patterns. It is common to find that the price movements from Thursday to Friday (close-to-close) are in the direction of the major trend and that the movement on Monday is a continuation of that trend. By Tuesday (or sometimes Wednesday), the strength of new buyers or sellers has faded, and the market reverses due to lack of activity and some profit taking. It often stays in this state through Wednesday or early Thursday when it again resumes the trend. Friday afternoon may see a minor reversal of trend as some traders take profits and reduce risk for the weekend. In a sideways market, the Friday and Monday directions differ from the direction during the prior week and often differ from each other.

Support and Resistance

Support and resistance levels are important to the short-term trader. If prices start to move higher, slow down, and finally reverse, it is natural to consider the top price as a resistance point. Prices are thought to have been stretched to their extreme at that level. Any subsequent attempt to approach the previous high price will be met with professional selling in anticipation of prices stopping again at the same point or slightly lower. In addition, it is common for the same traders and others to place orders above the previous high prices in order to take new long positions or closeout shorts in the event of an upwards breakout through resistance.

This method, very popular among floor traders and active speculators, tends to create then emphasize the support and resistance price levels until they define a clear *trading range.* Within a 1- to 3-day period, these ranges can be narrow and yet effectively contain price movement. During the life of the trading range, it will continue to narrow as the levels become clear to more traders and the anticipation of a reversal at those levels becomes imminent. This is similar to a triangular charting pattern, where prices continue to narrow, only the time frame is much shorter than that of traditional charting.

To take advantage of the smaller ranges caused in this manner, it is necessary to enter positions during the middle of a trading session, frequently holding that trade until the middle of the next session. An example using the Chicago Board of Trade December 75 Silver contract during August 1975 will help to illustrate this. Prices on 4 consecutive days are seen in Table 16.4. The price levels and volatility of 1975 silver are remarkably similar to those in 2003. The opening and closing prices for the first 3 days do not indicate any opportunity for trading. Those prices were generally in the middle of the daily range; however, by using the high and low of the previous day, this situation can be traded either of two ways.

Table 16.4: December 75 CBT Silver
Open table as spreadsheet

	Open	High	Low	Close
August 21	500.50	505.00	493.00	498.20
August 22	501.00	504.00	494.50	500.00
August 25	501.00	594.50	496.00	503.80
August 26	502.50	504.00	483.80	483.80

Thursday, August 21, forms a range of 505 to 493, closing near the center of the range. After the next open, buy just above 493 and sell just below 505 in order to be certain of entering and exiting the position. For protection, a stop-loss can be entered at about 506 and 492 to reverse the position on a price breakout through those levels. Had this procedure been followed, entering 2¢ (200 points) before the bounds of the range, Table 16.5 shows how trades would have been executed.

Table 16.5: Trading December 75 Silver Using Support and Resistance
Open table as spreadsheet

		Profit/Loss
August 22	Sold at 503.00	
	Closed-out short and bought at 495.00	+8.00
August 25	Closed-out long and sold at 502.00	+7.00
	Closed-out short and bought at 496.50	+5.50
August 26	Closed-out long and sold at 502.00	+5.50
	Closed-out short and bought at 498.00	+4.00
	Closed-out long and sold at 495.00	-3.00
	Open position	+11.20

In each case, the entry was 200 points before the level where prices had reversed on the prior day. The Stop-Loss order was placed to limit losses to a 100-point penetration. Although this may not seem to be an ideal situation, professional traders frequently use this method. It can be seen that the support levels did actually rise from 493.00 to 494.50, and then to 496.00. When support was penetrated, prices rapidly broke to new lows of 483.80, down to the permissible trading limit at the time. Similarly, the resistance level remained intact, going from 505.00 to 504.00, 504.50, and finally 504.00. It is generally accepted that the resistance level represents a more volatile area that must be watched closely for false breakouts.

Support and resistance levels gain importance the more time they remain intact. The high and low of the prior day are not as significant as the weekly or the

monthly range. Each can be traded using the same technique. The major support and resistance levels are contract highs and lows, which rarely sustain breakouts on the first attempt. Longer-term price objectives can be identified using a continuation chart *that is not back-adjusted.* A proper continuation chart for identifying support and resistance plots only the nearest futures contract of a specific market, shifting into the new contract at the time traders traditionally roll their positions.

Before 1990 there were very few published day-trading systems. The more recent ones have had the benefit of sophisticated computer programs and large historical databases. The following method precedes this era and remains a unique and a valuable part of our literature.

The Taylor Trading Technique

In 1950, George Douglass Taylor published his *book method* of day trading which he had been using for many years in both the stock and grain markets.[2] The method is based on the experience of discipline and timing, but is carefully set down and can be implemented in either a sophisticated or simplified state. The system is intrinsically cyclic, anticipating 3-day movements in the grains. These 3 days can vary in pattern when they are within an uptrend or downtrend. Taylor's explanation of his method is thorough and includes many valuable thoughts for traders interested in working with the market full time. The summary and analysis presented here cannot replace a reading of the original material.

Taylor developed his approach to trading through experience and a belief that there is a basic rhythm in the market. The dominant pattern is seen to be a May repetition with occasional, although regular, intervals of 4- to 5-day patterns. Taylor's cycles are based on continuous trading days without regard to weekends and holidays. The 3-day cycle varies slightly if prices are in an uptrend or downtrend. The *uptrend* is defined as having higher tops and bottoms over some selected time period such as a week, month, or season. A *downtrend* is the reverse. During an uptrend the following sequence can be expected:

1. A *buying day objective*, where prices stop declining and a purchase can be made before a rally begins.
2. A *selling day objective*, at which the long position is closed out.
3. A *short sale day objective*, where prices meet resistance and can be sold prior to a reversal.

Following the third day, after a short position is entered, the cycle begins again with a *buying day objective.* Because an uptrend has been identified, Taylor has given extra latitude to the long position with part of the day between the liquidation of the long (2), and entering a new short (3) reserved to allow the upwards momentum to exhaust itself. Downtrends are the opposite, expecting some added time for the downwards move to finish before the rally begins.

The actual *objectives* are extremely short-term support and resistance levels, usually only the prior day's high and low prices or occasionally the high and low of the 3-day cycle, which may be the same prices. On a buying day, the objective is a test or penetration of the prior day's low price, but only if it occurs first, before a test of the prior highs. Taylor's method is then a short-term mean-reverting technique, which looks for prices to reverse direction continuously. His belief was that speculation caused these erratic, sometimes large, cyclic variations above and below the long-term trend.

Taylor placed great emphasis on the order of occurrence of the high and low on each day. In order to buy, the low must occur first. If this is a buying day in an uptrend, a long position is entered after any lower opening whether or not the prior low is reached. Taylor reasoned that because an uptrend is generally stronger toward the close, the first opportunity must be taken on a buying day. However, if a high occurs first and prices then decline, nearing the lows toward the end of the trading day, no long position is entered. This pattern indicates a lower open the following day that will provide a better opportunity to buy. During a downtrend, the violations of the lows, or penetrations towards the close, are more common. By waiting until the next day to purchase, the three-day cycle is shifted to favor the short sale.

Consider the same problem with regard to closing out a long and entering a new short during an uptrend. If on the same day that the long was entered prices rallied sharply, touching or penetrating prior highs, a higher opening would be expected the next day at which time the long position would be closed out. Because of the uptrend, a small setback and another test of the highs might be expected. It would then require another day to ensure that the strength was exhausted. If the highs of the *selling day* were tested on the open of the *short sale day*, a new short would be entered immediately. If the short sale day opened lower and finished higher, no position would be taken.

Shorter reactions to price moves are expected when a long position is entered on a buy day, or on the next open, during a downtrend. If prices rally sharply on the same day, the position is closed out at a profit. This is important to remember because trading against the trend does not offer the latitude of waiting for the best moment; time is working against the position.

Taylor called this technique his *book method* because he recorded all the information necessary for trading in a small 3" × 5" spiral notebook that he carried. The organization of the book is shown in Table 16.6, an example that uses the November 75 soybean contract. Of course in Taylor's book, there would be only one month per page due to the limitations of the page size. The first 5 columns contain the date and day (together), followed by the open, high, low, and closing prices. The first 10 days are used to determine where the cycle begins. Scanning the daily lows, circle the lowest of the first 10 days, in this case March 19. Then work backwards and forwards, circling every third low price. These are buying days. The sequences of 2 in-between days are circled in the *High* column and indicate the selling day and the short sale day, respectively. This example is especially simple because it assumes a consistent uptrend and shows no variation from the 3-day cycle.

Table 16.6: Taylor's Book, November 1975 Soybeans

1975		Open	High	Low	Close	D	R	BH	BU	Net
				March						
M	10	540	x542	535	540½					
T	11	435	560¼	x535	560¼	7		18¾	0	
W	12	560	x572	552	571½		37			
H	13	568	x577	559	560½					
F	14	553	559	✓549	549½	28		0	10	+2¾
M	17	548	✓560	548	548		11			
T	18	555	x558	538	538½					
W	19	530	546	x529	545¼	29		0	9	
H	20	543	✓555	540	547½		26			
F	21	547½	✓567½	547½	567½				−1½	
M	24	573	581	✓561	573	6½		13½	0	
T	25	573	x575	564	574		14			
W	26	577	✓594	574	594					
H	27	587	590	✓579	585	15		0	0	+31½
M	31	592	✓603½	589	595½	24½				
				April						
T	1	599	x599	584	591½					
W	2	589	591½	✓575	575¼	24		0	9	
H	3	570	✓573	565	566¼		0			
F	4	570	✓578	567	576¼				−12	
M	7	577	577	✓562	565¼	16		0	5	
T	8	566	✓579½	563	568¼		17½			
W	9	565	✓574	561½	573½					
H	10	571	575	✓556	561¾	18		1	5½	
F	11	560	x564½	558	563½		8½			−9
M	14	561	x568	555½	561½					
T	15	565	569½	✓560½	563½	7½		1½	0	
W	16	562	x566	553	559¼		5½			
H	17	560	✓565	558	563½					
F	18	563	563	✓557	559	8		0	1	−1

To judge the opportunities for buying and selling, the next columns, marked *D* and *R*, indicate the number of points in the *decline* from the short sale to the buying day and the number of points in the *rally* from the buying day to the selling day. In both columns, the differences are taken using the highs and lows only. These values represent the maximum number of points that could have been made in those trades, provided the highs and lows occurred in the proper order. An × or a ✓ in the circle next to the high or low means that the opportunity to buy or sell occurred first (if an ×) or last (if a ✓). In the case of the first, the trade would have been entered that day and in the other case, Taylor would have waited.

The next two columns, *BH* and *BU*, show the adversity and opportunity of that day's prices to the buying objective. *BH* means a *buying day high* and is entered with the number of points that the day traded above the prior day's high (the *short sale day*), and *BU* shows the opportunity to *buy under*, by recording the number of points by which the day sold under the low of the prior day—the area to buy if the low occurred first. If neither situation occurred, zeros were entered.

A wide column on the right was used to indicate the net weekly change in direction by taking the difference between the prior Friday's closing price and the current Friday's price. This should be used to compare with the trading performance.

By observing columns *D* and *R* in Table 16.6, it can be seen that there was ample opportunity for profits on both the long positions and short sales, with only one case of a zero entry on April 3. The trades that would have been entered or liquidated can be approximated using the *BH* and *BU* columns and the × and ✓ notations. For consistency, it might be assumed that the ✓ indicates that a position was taken on the next open. In either case, the results would have been good.

Taylor's daily method requires care in monitoring the market, which only a full-time trader can provide. The order of the highs and lows must be observed as well as whether the new low is going to penetrate or fail to penetrate the prior lows. The trades must be timed carefully for maximum profit. In addition, it would be helpful to combine this method with a good trend-identification technique as well as observe seasonal patterns to improve the choice of the overriding market direction.

Taylor's 3-Day Trading Method

For those who cannot watch the market constantly, Taylor offers a rigid *3-Day Trading Method*, which is a modification of his more comprehensive *book method.* The cycles remain the same, but the buying and selling objectives are entered into the market in advance. This method is expected to work on balance, as are other well-defined systems. What is primarily lost by this approach is the order of occurrence of the highs and lows; otherwise, the concept of the system remains intact.

It is interesting that this technique profits from *penetration* of support and resistance levels by assuming there will be no follow-through when the right patterns occur. Most other methods take the approach that trading in the direction of the breakout is the safer alternative, but Taylor views it as a better opportunity to do the opposite. It is one of the few examples of such an approach and could only succeed in the short term, where noise, rather than fundamentals, dominate price behavior.

A Practical Approach to Trading Taylor

In order to clarify the switching from a *buy day* to a sell *short day*, Raschke and Conners created their own indicator called *Momentum Pinball*,[3] using a 1-period rate of change or 1-day momentum. Called the LBR/RSI™, the indicator is a 3-day RSI of a 1-day rate of change; therefore, the rate of change reduces the lag in the indicator. For a *buy* signal,

- On the previous day, the indicator must have a value less than 30.
- On the current day, place a buy stop above the high of the first hour's trading range.
- Once filled, place a sell stop at the low of the first hour's trading range.
- If the trade gets stopped out, reenter if prices reverse and penetrate the original price.
- If the trade is profitable at the end of the day, carry it overnight.

Sell signals are the opposite of buy signals, with the indicator posting a value greater than 70 to set up the trade. Figure 16.3 shows an example of this method applied to daily Nasdaq-100 data from December 2002 through March 2003.

Figure 16.3: Using the LBR/RSI™ indicator to trade a modified Taylor approach.

Whenever the indicator values move above 70 or below 30 (the horizontal lines) in the lower part of Figure 16.4, orders can be placed to sell and buy, respectively. Penetration of the 70 and 30 bands are circled in the lower part of Figure 16.4 and the buy and sell days are indicated by *B* and *S*, along with the trade number, on the top price chart and the opening prices are circled.

Without studying the intraday price movement, which would be necessary to decide the success of this method conclusively, we can get a good idea of the

results simply by looking at the position of the opening price relative to the trading day on each of the signal days. For example, trade 1 is a buy signal in early December 2002. The day opens near the lows; therefore, a buy signal should have been taken as prices moved higher after the first hour. There would have been significant intraday profits; however, the day closed back near the open and the trade would have ended with a small loss for the day and not carried over into the next day.

Trade 2 was a sell but prices opened near the lows; therefore, no trade would have been entered. This is also true for trades 3, 7, and 11, where prices opened at one end of the daily range while the signal looked to trade in the other direction. In general, buy signals for trades 1 and 9 saw prices open low and move higher; sell signals for trades five, six, and eight saw prices open high and move lower. In total, there were 5 potentially good trades out of 10 signals, 3 cases where no trades would have been entered, leaving only 2 trades that were likely losses.

Intraday Breakout Systems

The 1990s were the crowning years for intraday breakout systems. With the advances in computer speed, user-friendly software, and the availability of electronic data feeds at a reasonable cost, the very popular *N-day breakout method* became the equally popular *N-bar breakout method*. Entry and exit signals could occur during the trading session based on the highs and lows of the previous 10 bars, rather than a new daily high or low. Traders also discovered that the risk could be shockingly large if there were more than one buy or sell during the day caused by wide price swings—new highs, followed by new lows, followed by new highs again. Trades were held overnight and the *N*-bar calculations continued across days.

Opening Range Breakout

A variation of the Intraday Breakout is the *Opening Range Breakout,*[4] which gives the underlying entry and exit signals based on how far prices move from the open of the day. The trader is then buying when prices move up from the open by, for example, 8/32 in bonds, or 25 basis points in cattle. If prices then declined to 8 ticks below the open, the long position would be reversed to a short. This approach uses the opening price as the *pivot point* for the day, claiming that price direction, relative to that point is important. Tests exited all trades on the close of the day.

It is also reasonable to use the close of the previous day as the pivot point. Most traders watch today's prices to see if they are higher or lower than the prior close, which connects today's price patterns to the previous day. In its basic form, the Opening Range Breakout treats one day as independent of all previous price movements. This seems unnecessarily restrictive. Crabel, in his extensive study of intraday patterns, has found that combinations of inside days, low volatility, bull and bear hooks, and other patterns that precede the current day, all contribute to a selection process that improves trading. Table 16.7 shows a comparison of an opening range breakout with and without a preceding inside day.[5] The improvement due to selection is significant.

Table 16.7: Opening Range Breakout, % Profitable Trades

Open table as spreadsheet

		Any Day (%)	Inside Day (%)
Bonds	Open plus 16 ticks	60	76
	Open plus 8 ticks	55	74
	Open minus 8 ticks	56	62
	Open minus 16 ticks	56	66
S&P 500	Open plus 160 points	68	61
	Open plus 80 points	55	57
	Open minus 80 points	49	48
	Open minus 160 points	49	45
Soybeans	Open plus 10 cents	60	70
	Open plus 5 cents	56	67
	Open minus 5 cents	58	69
	Open minus 10 cents	63	76
Cattle	Open plus 50 points	65	55
	Open plus 25 points	58	55
	Open minus 25 points	58	60
	Open minus 50 points	63	73

Source: Toby Crabel.

If you consider that intraday trading may give one new signal each day, any method that helps select the better trades is welcome. The intraday trading profile of many small profits and losses allows you to be more selective without fear of missing *the* one big trade of the year, which is a problem typical of a long-term trend-following system. If you had 250 trades per year, 2,500 in 10 years for each market, you could randomly skip 50% of the trades, or liquidate your positions and take a holiday, and not be concerned about lost opportunity. You should be able to stand aside at any time, then restart without concern about continuity.

Raschke Trades Crabel

Linda Raschke, one of the stars of intraday trading, working with Laurence Conners, put rules to Crabel's range contraction and expansion approach.[6] Raschke isolates Crabel's range contraction, focusing on a 4-day interval, NR4, where the 4th day has a smaller high to low range than the preceding 3 days. The trading rules are then:

1. On the day following the NR4 day, place a buy stop 1 tick above the high of the NR4 day and a sell stop 1 tick below the low of the NR4 day.
2. If a new signal occurs—for example, a buy—and prices reverse on the same day, moving through the level of the sell stop, close out the long and sell short.

3. Use a trailing stop to avoid giving back profits.

4. If not profitable in 2 days, then exit the trade on the close of the second day.

The trades of NR4 can be improved by filtering them with historic volatility, which is described as having more autocorrelation than price; that is, its cyclic properties are more predictable. To take advantage of the expansion and contraction of historic volatility, and to emphasize the consistency with Crabel's method, trades are only entered if the 6-day historic volatility is less than the 100-day historic volatility, where historic volatility over the past n days is measured as

$$HV_i = \ln\left(\frac{P_i}{P_{i-n}}\right)$$

Once the trade is qualified, all other rules are the same.

Breakout Ranges Based on Time

Instead of a breakout that occurs when prices move a fixed number of points away from the opening price, you can establish an opening range based on the first 60 minutes of trading.[7] After this time, a new high or low would be a signal to enter a long or short position. This is a trade-off between avoiding the erratic movements of early trading and missing the beginning of a price move that starts early and continues in the same direction.

Combined with the first-hour breakout is a calculation of the day's trading range to be used for reversing your position or taking profits. The projected range high is calculated as the average daily range added to today's low price after the first hour of trading; the low is that same range calculation subtracted from the high of the first hour. The *TradeStation* code for this system involves the use of multiple time frame data and can be found in Figure 16.4a; an indicator that shows the signal on a chart page is given in Figure 16.4b. In the practical application of this method, the first-hour range must be penetrated by at least 20 points for the S&P. If the first-hour range is nearly as large as the average 10-day range, which is used for the exit target, then substitute the anticipated high and low for buy and sell signals, rather than a breakout of the first-hour range. Other risk controls are also recommended, such as a trailing stop, a fixed stop, and reversal if prices reverse and the opposite signal is given.

```
{ System: 1st hour Breakout (adapted from M. McNutt, 1994)

   [10] MaxBorsBack
   [*] Generate Realtime Orders
   [*] Do not allow multiple entries in the same direction

System uses ten minute bars of S&P futues for data 1 and 60 minute bars
   for data 2 [daily data is held in data 3] }

vars: Sess1FirstBarDAte(9, data2), Sess1FirstBarHigh(0, data2),
      Sess1FirstBarLow(0, data2), avedayrange(0,data3);
input: RanLn(10);

avedayrange = average(high of data3 - low of data3, RanLn) of data3;

if (time of data2  = Sess1FirstBarTime of data2) or
   (date of data2 > date[1] of data2) then begin
      Sess1FirstBarDate = Date of data2;
      Sess1FirstBarHigh = high of data2;
      Sess1FirstBarLow - Low of data2;
      end;
If (Sess1FirstBarDate = Date of data2) and
   (time of data2 < Sess1EndTime of data2) then begin
      if close[1] < Sess1FirstBarHigh then buy at
         Sess1FirstBarHigh + 20 point stop;
      if close[1] > Sess1FirstBarLow then sell at
         Sess1FirstBarLow  -  20 point stop;
      end;

if low <= Sess1FirstBarHigh - avedayrange then exitshort at market;
if high >= Sess1FirstBarLow[1] + avedayrange then exitlong at market;
```

Figure 16.4a: TradeStation code for First Hour Breakout System.

```
{ Indicator: 1st Hour Breakout (adapted from M. McNutt, 1994) }

vars:  Sess1FirstBarDAte(9, data2), Sess1FirstBarHigh(0, data2),
       Sess1FirstBarLow(0, data2), avedayrange(0,data3);

avedayrange = @average(high of data3 - low of data3, 10) of data3;

if (time of data2 = Sess1FirstBarTime of data2) or
   (Date of data2 > date[1] of data2) then begin
   Sess1FirstBarDate = date of data2;
   Sess1FirstBarHigh = high of data2;
   Sess1FirstBarLow = low of data2;
   end;
if (Sess1FirstBarDate = date of data2) and
   (Time of data2 < Sess1EndTime of data2) then begin
   Plot1(Sess1FirstBarHigh, "1st Buy");
   Plot2(Sess1FirstBarLow,"1st Sell");
   Plot3(Sess1FirstBarLow + avedayrange,"Buy stop");
   Plot4(Sess1FirstBarHigh - avedayrange,"Sell stop");
   end;
```

Figure 16.4b: TradeStation code for First Hour Breakout Indicator.

Mark Fisher's Opening Range Breakout

In *The Logical Trader*,[8] Mark Fisher, an independent trader and founder of the largest clearing firm at the New York Mercantile Exchange, presents the most in-depth description of an intraday trading method yet published. The method itself, primarily an opening range breakout, is much more complex, with many additions developed over years of practical experience. And, while the techniques may be applicable to many day traders, some of the trades will target very small profits, satisfactory for a floor trader with very low costs and little slippage, but not practical for most screen traders. This summary only addresses the introductory concepts.

Fisher begins by defining the time interval to be used as the *opening range.* For stocks that interval is usually 20 minutes, and for futures somewhere between 5 and 30 minutes, depending on the market. At this point, the method is essentially an opening range breakout based on time. Because these are expected to be day trades, the time needed to recognize the opening range is kept as short as possible to allow the trade to capture as much of the daily price move as possible. It would be best to use no more than 5-minute bars for this approach. Fisher provides extensive tables that put actual values to the concepts, but it is always the best policy to find the best time period through testing or experience. Because the opening range time interval can be short, an additional requirement is that signals are confirmed by having prices remain above the breakout lines by ½ the time of the opening range.

We will call the high and low of the opening range *ORH* and *ORL*, and the time needed to establish the opening range as *OR.* Another range based on a percent of the opening range *ORH* — *ORL* (for example, 100%) is used to draw a line above *ORH* and below *ORL*, which we will call +*A* and -*A.* Another set of lines based on a different percentage of *ORH* — *ORL* (or example, 150%) are called +*C* and -*C*; therefore +*C* and -*C* are above and below +*A* and -*A.* Using these calculations, there are five initial trading scenarios for buying (they are opposite for selling):

1. *Buy* when prices move above +*A* and remain above +*A* for a time equal to ½ × *OR.*
2. Close out the long trade if prices fall one tick below *ORL.*
3. *Sell short* if prices fall below -*C* and remain below that value for ½ × *OR.*
4. Once reversed to short, a stop-loss is placed one tick above *ORH.*
5. If prices do not prove profitable within a time interval equal to 1 × *OR*, then exit the trade.

Figure 16.5 shows the sequence possible beginning with a buy signal. If +*A* is penetrated first, your trading bias is bullish; if prices reverse and fall through -*C*, then your bias becomes bearish. Although the time needed to confirm an anticipated trade is given as ½ × *OR*, and the time to confirm that an existing trade is 1 × *OR,* these times can be chosen by each trader. In the case of confirming a trade, the time might be 1.5 or 2.0 × *OR.*

Figure 16.5: Fisher's buy-and-reverse scenario.

Chosen carefully, prices will consistently find support and resistance at *ORH* and ORL once +*A*, -*A*, +*C*, or -*C* have been penetrated. The selection of *OR*, the time interval, is most important because the size of the opening range is the basis for the *As* and *Cs* and the confirmation of a trade.

Profit-Taking and Resets.

As with all day trading, profit-taking plays an important role. The erratic movement of intraday prices encourages profit-taking whenever there is an extended move; although not specifically discussed, profit targets can be also be set using a multiple of *ORH — ORL.* After a long position has been closed out by reaching a profit target, and prices fall back below *+A* for some time interval, a long can be reset when *+A* is broken again with a stop placed 1 tick below *ORL.*

Pivot Ranges.

In order to establish a bullish or bearish bias for the day, an additional *pivot range* is calculated based on the previous day's movement.

Daily pivot price (*DPP*) = ($High_{previous}$ + $Low_{previous}$ + $Close_{previous}$) / 3

Average high-low (*AHL*) = ($High_{previous}$ + $Low_{previous}$) / 2

Daily price differential (*DPD*) = *DPP — AHL*

Daily pivot high = DPP + DPD

Daily pivot low = DPP — DPD

The daily pivot range can be used as a bullish or bearish bias. If the previous close was above today's pivot range high then prices are considered bullish; if below the pivot low then it is bearish. To confirm a bullish bias, today's price movement must find support at the daily pivot low and not trade below that level. If prices break through the pivot low, they are expected to make a significant move lower; therefore, the pivot range acts a strong support and resistance. Prices movement that break the pivot range as well as other support and resistance levels are considered more significant.

Importance of Key Ranges.

Once you have found the best time to establish the opening range, then calculated the *A* and *C* levels, and finally the *pivot range, you* have a number of key levels that provide strong indication of support and resistance for the day. Penetration of those levels, and confirmation based on staying through those levels, are the primary buy and sell signals; however, well-chosen key levels are often a point of indecision. Prices can hesitate at the moment of penetration; it also common to move through those key levels and then retreat. Fisher's time confirmation recognizes this problem.

Another entire set of rules has been written to *fade* these support and resistance levels. That is, a downward penetration of a support level (*-A, -C*, or pivot low) that fails is likely to be followed by a minor rally, perhaps back to the bottom of the opening range, *ORL.* These trades can provide frequent opportunities to enhance trading returns; however, profits can be small on days with low volatility. Screen traders will need to assess for themselves whether their cost structure and execution ability allows them to take advantage of these opportunities.

Filtering the Opening Range Breakout

Larry Williams, in his day trading seminar,[9] offers improvements to the classic opening range breakout, applied to the S&P 500, using his own filters to select a better set of trades. He begins with a modification of his %R oscillator, which we interpret as

$$\%R\ Index = \frac{Close_{\text{today}} - Low_{10}}{High_{10} - Low_{10}}$$

This differs from the original %R (which can be found in Chapter 9) by substituting the difference between today's close and the lowest low of the previous 10 days in the numerator.

To set up a buy signal in the S&P,

- %R Index must be below 20% and today's close must be lower than the close 7 days ago.
- Today's close must be higher than the previous close or the previous two closes to avoid buying into falling prices.
- Today must not be an inside day.

When adapted to bonds, Williams wants more trend, therefore today's close must be higher than the close 4 days ago.

A second S&P method exploits a different set of patterns, capitalizing on the tendency to rally on Mondays and Tuesdays:

- The previous day must not be an inside day with a close greater than the low of the day before (2 days ago) or the day before that (3 days ago)
- Today's close must be less than the close 6 days ago.

For bonds, today's close must be greater than the close 15 days ago.

The actual buy signal comes when prices penetrate a band formed by adding 20% of the previous day's trading range to today's opening price. Williams also believes in the benefit of filtering trades using traditional seasonality. While they admittedly do not work all the time, they make the trader aware of the potential risk and provide a helpful edge.

Special Set-Up Patterns for Stocks

Both intraday patterns formed near the beginning of the day and daily price patterns that precede today's opening can be used to find the best intraday trading opportunities.[10] Rudd selects the highest-probability buy signals, always using 5-minute data. The patterns he describes are:

1. *Dip and rally.* Prices dip shortly after opening, lasting less than 1 hour, then rally back to reach the highs of the first few bars. They move sideways for some time, testing the highs without making new highs. Place an order to buy the breakout. The longer prices remain just under the high of the day, the more reliable the signals.
2. *Consolidation.* Prices move sideways for about 1 hour after establishing an opening range during the first few bars. Highs during the consolidation period tend to hug the highs of the day. Buy a breakout of the range. A narrow range is expected to give a more reliable signal.
3. *Delayed consolidation.* Prices open lower, then move higher during the first hour, settling at a resistance level. Prices test the highs but do not penetrate. Place an order to buy a breakout after resistance has held for at least ½ hour. Longer consolidations are better.
4. *Early breakout.* After a 15-minute narrow opening trading range, buy a breakout on the next bar. Prices may show a series of shorter consolidations and smaller breakouts.
5. *Reversing after a false breakout.* If, after buying a breakout of a narrow consolidation pattern (2), prices fall back into the original trading range, close out the long and sell a breakdown of support.

Day Trades Following a Wide-Ranging Bar

Days in which the ending pattern is a *wide-ranging bar* (a high-volatility outside bar) that closes near the high of the day offer two special buying opportunities for day trading (selling is simply the reverse pattern) on the following day.

1. *Breakout of a higher open.* If, during the first 15 minutes of the day, prices open above the high of the previous wide-ranging bar, trade lower to test the high of the wide-ranging bar, then begin to rally, buy the break-out of the current day high. Greater reliability should be expected if there is a well-defined upwards trend in daily prices.
2. *Selling a gap open.* A substantial gap open should be sold if price begin to fade during the first 5 minutes of trading.

Reversal Bar Set-Up

Rudd also looks for a reversal set-up in two preceding days, in order to take advantage of the completion of the actual reversal on the third day. The set-up must involve the following three events:

1. The *first daily bar* must close near its lows.
2. The high of the *second daily bar* must not be much higher than the low of the first daily bar, and must close near its high.
3. The high of the first daily bar should be at least 1 point above the high of the second daily bar, because the difference represents the profit potential for the following day trade.

Following a successful set-up, the day trade is entered on Day 3. The entry signals should be one of the original set-up patterns, such as a *dip and rally* or *consolidation*. A large range in Day 1 provides better opportunity.

[2] *The Taylor Trading Technique*, by George Douglass Taylor (1950), has been reprinted by Traders Press, P.O. Box 6206, Greenville, SC, 29606 in 1994.

[3] Laurence A. Conners amd Linda Bradford Raschke, *Street Smarts: High Probability Short-Term Trading Strategies* (M. Gordon Publishing Group, Malibu, CA, 1995).

[4] See Toby Crabel, *Day Trading with Short Term Price Patterns and Opening Range Breakout* (Traders Press, Greenville, SC 29606).

[5] Toby Crabel, "Opening Range Breakout, Part 4," *Technical Analysis of Stocks & Commodities* (February 1989).

[6] Laurence A. Conners and Linda Bradford Raschke, *Street Smarts: High Probability Short-Term Trading Strategies* (M. Gordon Publishing Group, Malibu, CA 1995).

[7] Malcolm McNutt, "First-Hour Breakout System," *Technical Analysis of Stocks & Commodities* (July 1994).

[8] Mark B. Fisher, *The Logical Trader* (John Wiley & Sons, 2002).

[9] James T. Holter, "Delivering the Day-Trading Experience," *Futures* (August 2001).

[10] Barry Rudd, *Stock Patterns for Day Trading and Swing Trading* (Traders Press, Greenville, SC, 1998).

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Chapter 17: Adaptive Techniques

An *adaptive* technique is one that changes with market conditions. It could be as simple as using a percentage stop-loss; however, technicians have begun to associate the idea of adaptive with a broader scope, although the purpose remains the same—to handle more subtle changing conditions without manual intervention. The trends and indicators that are discussed in this chapter are focused on automatically changing the calculation period that determines the trend or an indicator. Under some conditions, such as sideways markets, it may be best to use a slow trend or momentum, and during explosive volatility those same methods may work better if they respond quickly. This shift from slow to fast (and back) due to changing market conditions is solved by using adaptive techniques.

ADAPTIVE TREAD CALCULATIONS

We begin by looking at techniques that vary the length of the trend. These techniques are based on a common premise that it is better to use a longer-term trend, one that is slower to react to price change when the market is either in a sideways pattern, exhibits low volatility or, in the case of Kaufman, has high relative noise. This may seem a reasonable assumption, but identifying a sideways market is very difficult. A price may be unchanged from a week ago, yet during those 5 days it rose quickly for 3 days, then reversed sharply and, coincidently, was at the same level on the fifth day as it continued to plunge. In many ways these adaptive techniques improve the basic performance of standard trend calculations, but they cannot solve all of the problems.

Kaufman's *Adaptive Moving Average*

Kaufman's *Adaptive Moving Average* (KAMA),[1] which began taking form in 1972, is based on the concept that a noisy market requires a slower trend than one with less noise. *Noise* is the erratic price movement that can be seen on any chart as up-and-down price changes within a trend or during a sideways period. As we will show, noise is not just volatility. The assumption in the KAMA is that during a relatively noisy price move, the trendline must lag further behind being penetrated by the normal, erratic behavior of prices, which would cause an unwanted trend change. When prices move consistently in one direction with low noise, any trend speed may be used because there are no false changes of direction. Figure 17.1 shows a price move with low noise and the same move with higher noise. With low noise, the trendline can be positioned closer to the underlying price direction; with higher noise, the trend must lag farther behind.

Figure 17.1: Similar price moves with low and high noise.

The KAMA is intended to use the fastest trend possible based on the smallest calculation period for the existing market conditions. It varies the speed of the trend by using an exponential smoothing formula, changing the smoothing constant each period. The use of a smoothing constant was selected because it allows for a full range of trends, represented as percentages, compared to the simple moving average which uses integer values and is limited in its selection of the fast-end speeds (see the discussion of exponential smoothing in Chapter 7). KAMA is calculated as

$$KAMA_t = KAMA_{t-1} + sc_t \times (Price - KAMA_{t-1})$$

where $KAMA_t$ = the new adaptive moving average value

$KAMA_{t-1}$ = the previous adaptive moving average value

Price = the current price (for period *t*)

sc_t = the smoothing constant, calculated each period as follows:

$$sc_t = [ER_t \times (fastest - slowest) + slowest]^2$$

and

$$fastest = 2 / (fastest\ moving\ average\ period + 1)$$

$$slowest = 2 / (slowest\ moving\ average\ period + 1)$$

$$ER_t = \frac{|Price_t - Price_{t-n}|}{\sum_{i=1}^{t-n} |Price_i - Price_{i-1}|}$$

The *fastest* and *slowest* values represent the range of periods over which the KAMA can vary, each converted to its exponential smoothing constant equivalent. Nominally, these values are set to 2 and 30. By squaring the smoothing constant components, the slow end becomes 30 × 30, equal to an extremely unresponsive 900-period trend. The effect of this is to stop the movement of the trendline when the market becomes very noisy. On the other end, when the market goes up steadily, without a reversal for *n* days, the speed of the trend can reach a very fast 4-period equivalent.

The *efficiency ratio*, *ER*, has become known as *fractal efficiency.* It has the value of 1 when prices move in the same direction for the full *n* periods, and a value of 0 when prices are unchanged over the *n* periods. When prices move in wide swings within the interval, the sum of the denominator becomes very large compared to the numerator and *ER* approaches zero. Smaller values of *ER* result in a smaller smoothing constant and a slower trend. Both the KAMA and the smoothing constant are shown in Figure 17.2. The 10-day KAMA is plotted in the upper part of the chart along with Nasdaq 100 prices during September 2003. The trendline moves steadily higher, turns down quickly, then begins up again. It appears to move in steps caused by the acceleration of the trendline, followed by its slowing down. The trendline never retreats.

Figure 17.2: Kaufman's Adaptive Moving Average and the smoothing constant values on each day, Nasdaq 100, September 2003.

The lower part of Figure 17.2 shows the changing value of the smoothing constant, *sc*. In this example it reaches a high of .40, equivalent to a 5-day moving average, and a low near zero, which would cause the formula to assign the maximum 900-day average.

If you choose to use the default values for the KAMA, where *ER* is calculated over 10 periods, the smoothing constant ranges from 2^2 to 30^2, and *C* is the closing price, its calculation can be expressed in TradeStation code as

```
KAMA = KAMA[1] + ((absvalue(C-C[10])/
   summation(absvalue(C-C[1]),10)* .6022) + .0645)^2*(C - KAMA[1])
```

Time Period for ER

In Kaufman's Adaptive Moving Average, the time period only affects the calculation of the efficiency ratio. The purpose is to keep that period, n, as small as possible so that the evaluation of a few days will allow the speed of the trend to change from fast to slow and back again. Users may begin testing in the range of 8–10 days. It is not necessary to test calculation periods greater than the number of consecutive days that prices have moved in one direction. If prices rarely close more than 10 days in the same direction, then a 10-day *ER* is a good choice. Using more than 10 days will simply scale ER to a smaller number but not add any additional value to the calculation results.

Choice of Volatility

The use of the volatility function, *summation*(*absvalue*(*C*-*C*[1])) in TradeStation code adds all the individual price changes rather than looking only at the high-low range. Noise is considered more active when prices jump up and down, reversing direction frequently. It is not as important that the price moved from a low point to a high point, but the pattern of how it was done. A market in which prices moved from low to high then back to the low and high again is clearly more volatile and noisier than one which made a single move from low to high.

Small Moves in One Direction

Occasionally there is a series of price moves that progresses in very small increments in one direction without a reversal, causing *ER* = 1. Although this is theoretically correct, it may prove best to include a filter for those cases where the direction, $D = | Price_i - Price_{i-n} | < min$, or a scaling function that does not allow the smoothing constant to produce the usual fast trend as the direction *D* moves below *min.*

Trading the *KAMA*

The Adaptive Moving Average can be traded as any other trend-following method, and has similar characteristics of exponential smoothing. That is, when prices cross the trendline from up to down, the trendline *must* turn down. Although the KAMA may use a trend with the equivalent of 900 days, the value of the current KAMA will still turn down a very small amount. Trading rules that base signals on the direction of the trendline should include a small band around the KAMA to prevent price penetrations during a sideways market from causing a change in the trading signal. Without this band, the benefit of the KAMA during a sideways price move is virtually eliminated. These small changes of direction can be seen in Figure 17.2 whenever prices cross the trendline.

When applying the KAMA to a trading program, higher values of the efficiency ratio, *ER*, are rarely reached using a calculation period greater than 14. This would require an extremely directional move, where prices closed in the same direction every day for nearly 3 weeks. As longer periods are used, the pattern of *ER* becomes very uniform, based on the underlying level of noise in each market. Because peaks levels in the *ER* cannot be sustained, they are valuable candidates for profit-taking. In Figure 17.2, the peak over .40 was an excellent time to take profits. If that value was lowered to between .25 and .30 there would have been four additional opportunities; however, the first one would have cut short a much larger profit. This is the inevitable trade-off of profit-taking.

Programming the *KAMA*

The following TradeStation user function can be used by a system or indicator to calculate Kaufman's Adaptive Moving Average.

```
{ KAMA : Kaufman's Adaptive Moving Average
Copyright 1990-2003, PJ Kaufman. All rights reserved }

inputs:period(numericsimple);
vars:efratio(0), smooth(1), fastend(.666), slowend(.0645), AMA(0), diff(0),
   signal(0), noise(0);

{ calculate efficiency ratio }
efratio = 1;
diff = absvalue(close - close[1]);
if currentbar > period then begin
   signal = absvalue(close - close[period]);
   noise = summation(diff,period);
   if noise < > 0 then efratio = signal / noise;
   end;
if currentbar <= period then AMA = close;
smooth = power(efratio*(fastend - slowend) + slowend,2);
AMA = AMA[1] + smooth*(close - AMA[1]);
KAMA = AMA;
```

Chande's Variable Index Dynamic Average (VIDYA)[2]

Tushar Chande's *Variable Index Dynamic Average* (VIDYA) first appeared in *Technical Analysis of Stocks & Commodities* in March 1992. Both VIDYA and Kaufman's KAMA use an exponential smoothing as a base for varying the speed of the trend each day. VIDYA, however, uses a pivotal smoothing constant, which is fixed, and varies the speed by using a factor based on the relative volatility to increase or decrease the value of *s*.

$$VIDYA_t = k \times s \times C_t + (1 - k \times s) \times VIDYA_{t-1}$$

where s = a fixed smoothing constant, suggested as a 9-day equivalent (i.e., $s = 2/(9 + 1) = .20$)
C = the closing price
t = the current period
t-1 = the previous period
k = the relative volatility, calculated as

$$k = stdev(C,n) / stdev(C,m)$$

where *stdev* = the standard deviation function
n = the recent past n days and
m = a longer historic interval in days, $m > n$

Volatility

Chande uses a very practical relative volatility measure based on the standard deviation, or distribution of price moves over the past n days, compared to a longer historic pattern, taken over h days. When $k > 1$ the current volatility is greater than the historic volatility; when $k < 1$ the current volatility is lower. VIDYA can be written as an indicator in TradeStation code as

```
{ VIDYA :Variable Index Dynamic Average by Tuschar Chande
Copyright 1997-1998, PJ Kaufman. All rights reserved.
Period is suggested at 9, histper is suggested at >9 }

input:period(9), histper(30);
var:k(0), sc(0), VIDYA(0);

{ relative volatility }
k = stddev(close, period) / stddev(close,histper);
{ smoothing constant }
sc = 2 / (period + 1);
{ VIDYA calculation)
VIDYA = k*sc*close + (1 - k*sc)*VIDYA[l];
plot1 (VIDYA, "VIDYA");
```

MESA Adaptive Moving Average

Ehlers uses the phase rate of change to create the *MESA Adaptive Moving Average* (MAMA), also fondly called the *Mother of Adaptive Moving Averages*.[3] The phase rate of change is 360° per cycle; therefore, if the price cycle is 36 bars in length, then the phase rate of change is 10° per bar. If there are only 10 bars in the cycle, then the phase rate of change is 36° per bar. The phase rate of change is the number of degrees in the cycle that is captured by the time it takes to produce a single bar. To find the phase rate of change, a solution similar to the Hilbert Transform is used (an explanation and example of the Hilbert Transform can be found in Chapter 11).

The calculation of MAMA uses the same basic exponential formula as KAMA; however, the value of the smoothing constant, *sc*, must remain between the *fast limit* of 0.5 and the *slow limit* of 0.05. The smoothing constant is

$$sc = fast\ limit / phase\ rate\ of\ change$$

where if $sc < 0$ then $sc = fast\ limit$
if $sc > slow\ limit$ then $sc = slow\ limit$

Another indicator, the *Following Adaptive Moving Average* (FAMA), is created by applying the MAMA technique to the MAMA line, rather than to the price series, using a smoothing constant for FAMA that is ½ the value of the smoothing constant used for MAMA. The result is that FAMA is a smoother, less volatile version of MAMA. The crossover of MAMA and FAMA gives a reliable trend signal. Figure 17.3 shows the two adaptive trends (MAMA is the heavier line) applied to 60-minute bars of U.S. bonds during June 2003. On both the major up move and down move, both trendlines track price closely but do not cross until the first significant reversal day. A traditional 20-day moving average would have identified the same trends, but each entry and exit signal would have been 2 to 3 bars later.

Figure 17.3: Ehlers adaptive MAMA (faster line) and FAMA (slower line) used for crossover signals. U.S. bonds, calendar month of June 2003, 60-minute bars.

The TradeStation code for MAMA and FAMA is

```
{ TSM Ehlers MAMA
from John F. Ehlers, "Rocket Science for Traders"
(John Wiley & Sons, New York, 2001 }

inputs: price((H+L)/2), fastlimit(.5), slowlimit(.05);
vars: smooth(0), detrender(0), i1(0), q1(0), ji(0), jq(0), i2(0), q2(0),
   re(0), im(0), period(0), smoothperiod(0), phase(0), deltaphase(0),
   alpha(0), MAMA(0), FAMA(0);

if currentbar > 5 then begin
   smooth = (4*price + 3*price[1] + 2*price[2] + price[3])/10;
   detrender = (.962*smooth + .5769*smooth[2] - .5769*smooth[4] -
      .0962*smooth[6])*(.075*period[1] + .54);

{ computer InPhase and Quadrature components }
   q1 = (.0962*detrender + .5769*detrender[2] + .5769*detrender[4] -
      .0962*detrender[6])*(.075*period[1] + .54);
   i1 = detrender[3];

{ advance the phase of i1 and q1 by 90 degrees }
ji = (.0962*i1 + .5769*i1[2] - .5769*i1[4] - .0962*i1[6])*(.075*period[1]
   + .54);
jq = (.0962*q1 + .5769*q1[2] - .5769*q1[4] - .0962*q1[6])*(.075*period[1]
   + .54);

{ phase addition for 3 bar averaging }
   i2 = i1 - jq;
   q2 = q1 + ji;

{ smooth the i and q components before applying }
   i2 = .2*i2 + .8*i2[1];
   q2 = .2*q2 + .8*q2[1];

{ hymodyne discriminator }
   re = i2*i2[1] + q2*q2[1];
   im = i2*q2[1] - q2*i2[1];
   re = .2*re + .8*re[1];
   im = .2*im + .8*im[1];
   if im < > 0 and re < > 0 then period = 360/arctangent(im/re);

   if period > 1.5*period[1] then period = 1.5*period[1];
   if period < 6 then period = 6;
   if period > 50 then period = 50;
```

```
   period = .2*period + .8*period[1];
   smoothperiod = .33*period + .67*smoothperiod[1];
   if i1 < > 0 then phase = (arctangent(q1/i1));
   deltaphase = phase[1] - phase;
   if deltaphase < 1 then deltaphase = 1;
   alpha = fastlimit / deltaphase; {fastlimit was "speed"}
   if alpha < slowlimit then alpha = slowlimit;
   MAMA = alpha*price + (1 - alpha)*MAMA[1];
   FAMA = .5*alpha*MAMA + (1 - .5*alpha)*FAMA[1];

   plot1(MAMA,"MAMA");
   plot2(FAMA,"FAMA");
   end;
```

Alternate Choices for Varying the Trend Period

The use of an exponential formula, either the simplified one shown by Kaufman or the traditional one of Chande, allows the smoothing constant to vary according to the design of the user. There are indicators with which you are already familiar that might be substituted for the smoothing constant.

Correlation Coellicient, r^2

The most likely choice, suggested by Chande, is the correlation coefficient, r^2. This value is the result of measuring the residuals from a linear regression calculation. When the regression fit is very strong, the value of r^2 is close to 1; when there is no apparent market direction, r^2 is near 0. This fits neatly into the pattern of smoothing constants for KAMA and VIDYA.

When programming this technique, the calculation of the correlation of the residuals requires the use of arrays and it will be necessary to program the formula for the correlation coefficient directly. This can be done using the formulas found in Chapter 6. To avoid unnecessary complications, the following program calculates a similar technique (Method 1) by evaluating the correlation of the closing prices and a time series containing the sequential values 1, 2, 3, …. It then calculates the current value of the residual based on a linear regression of closing prices (Method 2) and finds the correlation coefficient of the series of current residuals. In the following programming code, Method 2 is plotted and the result of Method 1 appears in comment braces.

```
{ Adaptive R2 : Adaptive Correlation Coefficient Indicator
Copyright 1997-2003, PJ Kaufman. All rights reserved.
Plot smoothing function based on linear regression residuals and
on simple time series function }

input:period(9);
vars:R2(0), AR2(0), timeseries(0), resid(0), RR2(0), ARR2(0);

timeseries = currentbar;
{ Method 1: correlation of price and time series }
if currentbar <= period then AR2 = close else begin
   R2 = (correlation(close, timeseries, period) + 1) / 2;
   AR2 = AR2[1] + R2*(close - AR2[1]);
   end;
{plot1 (AR2,"R2"); }
{ Method 2: correlation with current regression residuals }
resid = close - linearregvalue(close,period,0);
RR2 = (correlation(resid, timeseries, period) + 1) / 2;
ARR2 = ARR2[1] + RR2*(close - ARR2[1]);
plot2 (ARR2,"ARR2");
```

Making Momentum Calculations Adaptive

There are many momentum calculations, such as *RSI*, that vary from 0 to 1, 0 to 100, or from -1 to +1. In order to use the RSI value as a smoothing constant in an adaptive indicator, it is necessary to change the values to range between 0 and 1, where 0 is less trend and 1 is more trend, which is the normal interpretation for the RSI and most other indicators. The momentum values, which could be an RSI, can be changed to fit the 0-to-I pattern of the smoothing constant by using the transformations

1. *M* varies from 0 to 1 `sc = M`
2. *M* varies from -1 to +1 `sc = absvalue(M)`
3. *M* varies from 0 to 100 `sc = M/100`
4. *M* varies from -100 to + 100 `sc = absvalue(M/100)`

where *sc* = the smoothing constant to be used for the current period
M = the current momentum value

Transformation (2) recognizes that when the momentum is at +1 and -1 there is a stronger positive and negative trend. By taking the absolute values, the negatives are reflected so that 0 to -1 take on the same pattern as the positive values from 0 to 1.

Programming the Adaptive RSI

The following TradeStation code adapts the RSI to be used as a smoothing constant. The transformation used is (4) in the previous section:

```
{ Adaptive RSI : Adaptive Relative Strength Indicator
Smoothing function based on RSI }

input:period(20);
vars:sc(0), ARSI(0);

if currentbar <= period then ARSI = close
```

```
else begin
   sc = (absvolue(RSI(close, period) / 100);
   ARSI = ARSI[1] + sc*(close - ARSI[1]);
   end;
plot1 (ARSI, "ARSI");
```

Comparison of Adaptive Trends

Figure 17.4 shows three of the adaptive trending methods compared to a moving average, all using a calculation period of 20. Kaufman's KAMA appears to be slightly closer to prices than Chande's VIDYA and flattens out faster during sideways periods; otherwise, they have similar characteristics because they both use the structure of exponential smoothing. The adaptive *RSI* (*ARSI*) used as a substitute for the smoothing constant is most responsive to price and appears as though it moves through the center of many of the sideways periods. Because the ARSI is much faster it tends to get caught with a false signal at the end of each sustained price move. The 20-period moving average is reasonably smooth during this market segment and shows typical characteristics of lag. When constructing trading rules for any of these methods, the buy and sell signals must be taken from the direction of the trend line and not from a price penetration of the trend line.

Figure 17.4: Comparison of moving average, KAMA, VIDYA, AR2 and ARSI. *Source*—Chart created with *TradeStation*® by Omega Research, Inc.

McGinley Dynamics[4]

Among the work produced by John McGinley is a list of popular adaptive methods. His own New McGinley Dynamics, expressed in TradeStation code, is

```
MD = MD[1] + (close - MD[1]) / (k*p*power((close/MD[1]),4))
```

where	*MD*	= the current McGinley Dynamic
	MD[1]	= the previous McGinley Dynamic
	k	= a constant = .60, 60% of a selected moving average period *p*
	p	= the moving average period
	close	= the closing price

The Parabolic Time/Price System

The first well-known adaptive technique was the Parabolic Time/Price System,[5] which attempts to reduce the lag intrinsic to a trend system as the trend develops. To do this, Wilder increased the speed of the trend by shortening the number of days in the calculation whenever prices reached new profit levels. The philosophy of the Parabolic System is that time is an enemy. Once a position is entered, it must continue to be profitable or it will be liquidated.

The Parabolic Time/Price System is always in the market; whenever a position is closed out, it is also reversed. The point at which this occurs is called the *Stop and Reverse* (SAR). When plotted, the Stop and Reverse point seems similar to a trendline although it has a decreasing lag. This is accomplished by making the SAR point, the distance between the current price and the trendline, closer to the current price of each bar, as shown in Figure 17.5. During periods of short, consistent trending, the Parabolic SAR converges on the price trend, extracting excellent profits.

Figure 17.5: Parabolic Time/Price System, Feb 96 S&P 500, 60-minute Chart. *Source*—Chart created with *TradeStation*® by Omega Research, Inc.

To calculate the SAR value, first assume a long or short position. If the market has recently moved lower and is now above the lows of that move, begin with a *long.* Call the lowest point of the previous trade the *SAR initial point* (SIP) because it will be the starting point for the SAR calculation (SARI = SIP). Calculate each following SAR as

$$SAR_{today} = SAR_{prior} + AF_{today} \times (High_{today} - SAR_{prior})$$

This is an exponential smoothing formula using the high price for a long position and the low price when a short is held. For this method the smoothing constant is called the *acceleration factor* (AF), and it is initially set to .02 at the beginning of each trade. After a day in which a new extreme occurs (a new high when long, or a new low when short) the AF is increased by .02. In terms of moving average days, the AF begins at 99 days and increases speed to a maximum of a 9-day moving average, but not in a linear fashion. The acceleration factor, AF, cannot be increased above the value .20.

In the SAR calculation, the highest high of the current move is used when a long position is held, and lowest low is used when a short is held. This feature keeps the SAR at its highest possible level during an upwards move. An additional rule compensates for this strength and prevents premature reversal by not allowing the SAR to get any closer than the price range of the most recent 2 days:

> *If long, the SAR may never be greater than the low of today or the prior day. If it is greater than this low, set the SAR to that low value. A reversal will occur on a new intraday low which penetrates the SAR.*
>
> *For short positions, the SAR is initialized as the high of the recent move, AF = .02, and the daily calculation uses the lowest low of the current price move. To allow some price ,fluctuation, the SAR may never be below the high of today or the prior day.*

Wilder's Parabolic Time/Price System was unique in varying the smoothing constant to satisfy the notion that time worked against the trade. The idea of increasing the speed of the trend as the trade becomes more profitable is still a concept that has validity and has not yet been adopted in other adaptive methods. One weak point may be that AF always begins at .02. Although this allows the trade latitude to develop without being stopped out, a market that is moving quickly through the buy or sell signal would be better traded with a faster trend. This method also requires fairly consistent price swings to produce profits.

A strong point is that the initial stop and reversal is the market extreme high or low rather than an arbitrary, computer-generated point. Also, the SAR does not get closer than the previous day's high or low, which prevents a reversal due to noise when the market is moving strongly in a profitable direction. For those readers interested in the further development of this method, the Parabolic Time/Price System is combined with Directional Movement (described in Chapter 23) to form the Directional Parabolic System discussed in Chapter 9.

The following TradeStation user function allows the user to specify the starting value of the smoothing constant AF_{min}, the increment AF_{inc}, and the maximum value AF_{max}. This provides for more flexible testing. Optimization of these values has been reported to produce good results.

```
{ Parabolic.VRT
This version of the Parabolic system was written by
Sam Tennis, VISTA Research and Trading, Inc.,
8103 Camino Real, South Miami, FL 33143, Email: skt@vista.com
and reformatted by PJ Kaufman }

{ Input values were formerly AFmin = AFactor, AFnic = AFactor, and
     AFmax = ALimit }
{ Sample usage: Plot1 (Parabolic.VRT (0.02, 0.02, 0.20)[1], "Parabolic");
Function returns SAR (stop & reverse) price objective }

input:AFmin(numericsimple), AFinc(numericsimple), AFmax(numericsimple);
vars:Position(1), AF(AFmin), SAR(low[0]), Hi(high[0]), Lo(Low[0]);

if currentbar <= 1 then Position = 1;
if currentbar > 1 then begin
   if High > Hi then Hi = High;
```

```
   if Low < Lo then Lo = Low;
if Position = 1 then begin
      if Low <= SAR[1] then begin
      Position = -1;
      SAR = Hi;
      AF = AFmin;
      Lo = Low;
      Hi = High;
      end; { Reverse position long to short }
    end
   else begin
      if High >= SAR[1] then begin
         Position = 1;
         SAR = Lo;
         AF = AFmin;

         Lo = Low;
         Hi = High;
         end; { Reverse position short to long }
      end;
   end;

if Position = 1 then begin
   if Position[1] = 1 then begin
      SAR = SAR[1] + AF * (High[1] - SAR[1]);
      if Hi > Hi[1] and AF < AFmax then AF = AF + AFinc;
      end; { we have been "long" for at least one bar }
   if SAR > Low then SAR = Low;
   if SAR > Low[1] then SAR = Low[1];
   end { long }
else begin
   if Position[1] = -1 then begin
      SAR = SAR[1] + AF * (Low[1] - SAR[1]);
         if Lo < Lo[1] and AF < AFmax then AF = AF + AFinc;
         end; { we have been "short" for at least one bar }
      if SAR < High then SAR = High;
      if SAR < High[1] then SAR = High[1];
      end; { short }

Parabolic.VRT = SAR;
```

The Master Trading Formula

Another landmark method of creating a variable speed approach is Mart's *Master Trading Formulas*[6] It is also based on an exponential smoothing formula where the smoothing constant and band formed around the trendline are calculated daily, based on market volatility. Mart's general technique is to combine the average *true range* (the maximum of yesterday's close and today's high or low) for the past 15 days with the net change over the same time period. Each of these volatility elements are ranked from 1 to 21 by defining a maximum value for each one and dividing that maximum into 20 equal zones (the 21st being anything higher). The two rankings are then averaged to get a *correlated volatility factor* (CVF). Another ranking of 21 zones is created by dividing the highest CVF into 20 equal parts. The CVF then relates linearly to a range of smoothing constants from .084 to .330, representing the approximate exponential equivalents of the moving average days from 5 to 23. The trendline value is then created daily using the formula

$$Trend_{today} = Trend_{prior} + CVF_{today} \times (HLC_{today} - Trend_{prior})$$

where HLC_{today} = the average of the high, low, and closing price As with the other adaptive methods, the speed of the trend increases as volatility increases.

A band is also placed around the trendline, based on an inverse relationship to the correlated volatility factor. The band is widest when there is low volatility and the smoothing constant produces a slow trend; it is narrowest in fast, highly volatile markets. Rules for trading Mart's Master Formula follow the basic band trading rules. The system is always in the market, taking long positions when the upper band is broken and short positions when the lower band is crossed.

[1]See Perry J. Kaufman, *Smarter Trading* (McGraw-Hill, New York, 1995, pp. 129–153), for a complete discussion of this method.

[2]Tushar S. Chande and Stanley Kroll, *The New Technical Trader* (John Wiley & Sons, New York, 1994).

[3]John F. Ehlers, *Rocket Science for Traders* (John Wiley & Sons, New York, 2001).

[4]John McGinley writes *Technical Trends*, P.O. Box 792, Wilton, CT 06897, and has compiled a selection of adaptive techniques as well as developed the ones discussed here.

[5]J. Welles Wilder, Jr., *New Concepts in Technical Trading Systems* (Trend Research, Greensboro, NC, 1978).

[6]Donald Mart, *The Master Trading Formula* (Winsor Books, Brightwaters, NY, 1981).

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ADAPTIVE MOMENTUM CALCULATIONS

Varying the period of calculation does not have to be limited to a trend formula. The period for any technique can also be adaptive. The following techniques apply the same concept to traditional indicators that are used to measure overbought and oversold price movement.

Variable-Length Stochastic

Written by Frank Key,[7] this adaptive technique uses Kaufman's *efficiency ratio*, *ER.* It changes the stochastic period within the default range 5 to 30, using only integer values. The effect is that, when prices are trending with respect to the stochastic, the stochastic period is lengthened to allow the trade to continue—to make the stochastic less sensitive to price changes. At turning points in the market, the stochastic period is shortened causing the reversal signal to be more responsive. Expressed in TradeStation code,

Stochastic period

```
NSP = IntPortion × ER ( (max period - min period) + min period)
```

Adaptive stochastic

```
ASTOK = slowK(high, low, close, NSP)
```

where	*ASTOK*	= the adaptive stochastic value today (based on *NSP* days)
	Max period	= the maximum period, suggested as 30
	Min period	= minimum period, suggested as 5
	ER	= Kaufman's efficiency ratio

The variable-length stochastic uses the efficiency ratio in a manner opposite to Kaufman's KAMA. While the KAMA increases in speed when the trend gets stronger, Key's variable- length stochastic decreases in speed. This technique gives prices more room to fluctuate during periods where a strong trend is also associated with high volatility.

Trend-Adjusted Oscillator

One problem that confronts many traders who use stochastics or other oscillators is that the oscillator values tend to cluster in the lower half of the chart when the trend is down, and in the upper half when the trend is up. For a countertrend trader, this causes many oversold conditions during a downtrend that can give false buy signals. A *trend-adjusted oscillator*[8] can correct this bias by modifying the value of the oscillator by the amount that the trend of the oscillator varies from its midpoint (usually 50%). Therefore, if a 10-day oscillator has been steadily declining and its 5-day moving average has a value of 40, then the current oscillator value is raised by 10% (the midpoint of 50 minus the oscillator moving average of 40). The calculations for this are:

$$n\text{-}Day\ \ oscillator\ (O_t) = \frac{\sum_{i=t-n+1}^{t} \frac{close_i - low_i}{high_i - low_i}}{n}$$

$$n\text{-}Day\ \ moving\ \ average\ \ of\ \ oscillator\ (MAO_t) = \frac{\sum_{i=t-n+1}^{t} O_i}{n}$$

$$Trend\text{-}adjusted\ \ oscillator = Midpoint - (MAO_t - O_t)$$

Dynamic Momentum Index

This approach to creating a dynamic, variable-length RSI, which changes the number of calculation days based on market volatility, can be used to change the period of any technique.[9] In the *Dynamic Momentum Index* (DMI), the length of the calculation period increases as the volatility declines. You may also select a pivotal period, around which the calculation period will vary; for the RSI this will be 14 days. When the volatility increases, the period will be less than 14 days and when volatility declines it will be greater. Based on this, the TradeStation code would be

$$DMI = IntPortion\left(\frac{14}{Volatility_t}\right)$$

$$Volatility_t = \frac{stdev(close, 5)}{Average(stdev(close, 5), 10)}$$

The DMI is 14, the pivotal value, when the volatility is *normal*; that is, when the current 5-day standard deviation is the same as the 10-day average of the 5-day standard deviation. When the current volatility increases, the ratio is greater than 1 and the value of the DMI becomes larger than 14. The function *IntPortion* takes the integer part of the calculation as the number of days in the RSI calculation.

A few alternatives in the DMI approach may improve results, and should be considered when generalizing this technique. First, the standard deviation should always be applied to the *changes* in price rather than the prices themselves. This removes the trend component. Additionally, the volatility ratio may be more robust if the sum of the absolute value of the price changes is simply compared against the average of that sum,

$$Volatility_t = \frac{Summation\,(Absvalue\,(Close_t - Close_{t-1}), 5)}{Average\,(Summation\,(Absvalue\,(Close_t - Close_{t-1}), 5), 10)}$$

[7]Frank Key, *Structured Software Systems* (Mt. Holly, NJ, copyright 1996).

[8]E. Marshall Wall, "Rolling with the Punches,"*Futures* (July 1996).

[9]Tushar Chande and Stanley Kroll, *The New Market Technician* (Wiley, 1994).

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ADAPTIVE INTRADAY BREAKOUT SYSTEM

An adaptive method developed for intraday stock trading, or stock index trading, has a number of unique features. The method is based on the idea that the expected value of the *n*-bar range is proportional to the square root of *n.* In a different approach, Meyers[10] first defines the high and low ranges as

$HR_t = H_t - L_{t-n}$ (today's high minus the low of *n* bars ago)

$LR_t = L_t - H_{t-n}$ (today's low minus the high of *n* bars ago)

Note that the high and low ranges *do not* use the highest high or lowest low of the past *n* bars, but the actual high and low of a single bar located *n* bars ago. Next, a range ratio is created from HR_t and LR_t by normalizing in ways, (1) dividing by $ATR(n)$ the average true range over period *n,* and (2) dividing by a power function, n^a, to correct for the characteristic that the *range ratio* gets larger as *n* gets larger. These calculations allow the different lookback periods to be compared. The normalized ranges are then

$NHR_t = HR_t / n^a / ATR(n)$

$NLR_t = LR_t / n^a / ATR(n)$

Finally, the maximum range for *NHR* and *NLR* can be found over the most recent *n* periods by using the function *maximum,*

$HR_{max} = maximum(NHR,n)$

$LR_{max} = maximum(NHR,n)$

The final elements are *high* and *low threshold values* which will be used to generate trading signals.

Buy when HR_{max} > *threshold high* and LR_{max} < *threshold low*

Sell when LR_{max} > *threshold low* and HR_{max} < *threshold high*

Close out all trades 5 minutes before the close of trading

Four key variables—*n*, the lookback period, *a*, the power function, and the two threshold values—are all found by optimization. It is suggested that the maximum lookback period *n*, should be no greater than 25. Tests performed on QQQ, the Nasdaq 100 ETF, yielded the values *n* = 6, *a* = .75, *threshold high* = .50, and *threshold low* = 1.05. If this method can be shown to be consistent over a reasonably long test period, producing about one trader per day, it is well worth pursuing.

[10]Dennis Meyers, "Range Roving," *Active Trader* (March 2003).

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AN ADAPTIVE PROCESS

An adaptive method can be a process as well as a formula. Rather than using an index or ratio to change the smoothing constant, which in turn alters the trend speed to be in tune with the current market, you can retest your system regularly using more recent data. The period being retested can always be a fixed number of days, or it can be selected visually, beginning when the market has changed its pattern, become more volatile, undergone a price shock, or moved to new highs or lows. The problem is having enough data to be satisfied that the results are dependable; the faster you react, the less data there is to make a decision. This approach, along with other testing methods, is covered in detail in the Chapter 21.

A Development Example

The size of price changes can also be used to vary the period of a moving average. When prices become more volatile, as measured by the standard deviation of the price changes, a shorter calculation period can be used to follow the market more closely. When there are smaller price changes, or stable volatility, the preference may be to slow the trend by increasing the calculation period.[11] The following steps can be used to build and personalize a variable-speed moving average with those characteristics:

1. Select the range over which the period of the moving average may fluctuate. For example, a medium to fast program might range from 5 to 30 days.

2. Calculate the mean and standard deviation of price changes over a separate, fixed time period, recommended as the length of the longest trend period (in this case 30 days), but no less than 10 days so that there are enough days to have a reasonable sample. Using a smaller period reduces the response time needed to switch from one moving average speed to another, but causes the results to be more erratic.

3. Select standard deviation threshold levels, which separate price changes in a way that is seen to be relatively more active or less active. For example, we will define a low volatility as falling inside the bounds created by the mean ±.25 standard deviations. This will be a less active area where the longest calculation period would be used. Outside the bounds of the mean ±1.75 standard deviations would be a highly active market requiring a fast trend.

4. Establish the rate at which the moving average period will change as volatility (price change) increases from the inside to outside boundary. This could be the linear relationship

$$n_t = (30 - 5) \times ((P_t - P_{t-1}) / stdev - .25) / (1.75 - .25) + 5,$$

$$\text{for } 1.75 > (P_t - P_{t-1}) / stdev > .25$$

when $(P_t - P_{t-1})/stdev$ is between 1.75 and .25. Otherwise it is the maximum and minimum values, 30 and 5, respectively. The general form is

today's moving average period = (*max MA period - min MA period*)
× (*today's changelstdev of changes*
- *min stdev boundary*) / (*max stdev boundary*
- *min stdev boundary*) + *min MA period*

[11]George R. Arrington, "Building a Variable-Length Moving Average," *Technical Analysis of Stocks & Commodities* (June 1991).

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CONSIDERING ADAPTIVE METHODS

At first glance, there appears to be a conflict between the sound statistical approach that encourages the choice of a simple set of rules applied to a long period of test data. The classic result is a statistically robust model, but one that might show considerable variation in performance over the test period. To stabilize returns we move away from fixed values in trading systems, such as a $500 stop-loss, or a 50-point breakout, and substitute risk and entry criteria that are based on volatility. The simplest of these methods uses a percentage of price; the most complex can be very intricate functions of volatility and cycles.

When a variable feature is incorporated into the strategy, the values smoothly adjust to the market patterns. However, at each price or volatility level, in particular extreme high or low volatility, there are few occurrences; therefore, we are not as certain that the sliding scale works at all levels. We can only judge the success of the technique by the improvement in the performance profile of the entire test period.

If we follow that logic further, we eventually come to the adaptive, or self-adjusting method, in which the most fundamental elements of a calculation can vary based on price level, volatility, or a broad choice of patterns. The methods in this chapter focused on two areas that have not been presented elsewhere in a collected manner. The first is the variation of the trend calculation period. The choice of a single trend does not serve us best for prolonged periods in the market. Slower trends are not reversed often, and give back much of their profits before ending; faster trends work only during periods when prices move quickly and uniformly. The obvious solution is that the calculation period should change, speeding up when there is a short-term, fast-moving price pattern. At other times it should align itself with the long-term direction. This concept is perfectly reasonable, although formulating the rules to vary the period has not been perfected. The methods shown here may work better than a static period, but represent only the beginning of a path that should lead to much better adaptive methods.

The other adaptive technique is the centering of an oscillator to avoid prolonged periods where the value of the indicator loses significance by pushing against the upper or lower limits. By recording the high and low values of a past time interval, the oscillator values can be continually readjusted to provide a more useful tool. Analysts are encouraged to look further into these methods as an excellent way to improve system robustness.

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Chapter 18: Price Distribution Systems

Price movement is usually seen as a chart in which each new time period is a new bar or point recorded to the right of the previous prices—the traditional *time series.* There are many applications that need to look at prices differently. In options, it is important to evaluate the current market volatility to decide the chances of prices remaining in a specific range for a specific amount of time. To get that value, we use the standard deviation calculation first introduced in Chapter 2. The standard deviation gives the most basic measure of price distribution. Although we apply the standard deviation to a time series, the dally price could be rearranged and the resulting standard deviation would still be the same. From the value of the standard deviation we can estimate the chances of a price remaining within a range over time. Because the standard deviation is the most commonly used measurement of price distribution, it is important to remember that a band formed by the average price change ±1 standard deviation contains 68% of the price movement (both up and down), ±2 standard deviations contain 95%, and ±3 standard deviations contain 99% of all price movement *based entirely on the sample of data used to calculate the standard deviation value.*

MEASURING DISTRIBUTION

The data used to determine the standard deviation is very important. Because we are seeking a statistical measure, it is most accurate when a large amount of data is applied. For example, you might find that 1 standard deviation of the crude oil daily price move is only $0.25 per barrel when measured over the past 10 years, but during the six months of the Gulf War the same measurement yielded $.50—a move twice as large.

Most trading applications using the standard deviation tend to apply short data intervals to its calculation, such as 20 days. This short period is not going to represent the same price distribution as a 10-year calculation; therefore, the probabilities given by the resulting standard deviation value must be interpreted differently. While it is less likely that the price will make a move of 3 standard deviations compared to 1 standard deviation, the chance of it doing so is far greater than 1% when the value was calculated on only 20 days, and even greater when those days happened to be biased towards a low volatility period.

The frequency distribution is another very practical approach to measuring price distributions. This was also described in Chapter 2. It has the advantage of having a much clearer visual interpretation. While the standard deviation gives us what appears to be a highly mathematical probability, the large error factor that is caused by small amounts of data may make its usefulness about the same as the frequency distribution. In the following sections, both techniques will be used.

Standard Deviation Bands

The use of *Bollinger bands*, discussed in Chapter 8, is a very popular application of basic price distributions. To create the standard Bollinger bonds, calculate the standard deviation of prices over a period of 20 days, and form bands of 2 standard deviations above and below the 20-day moving average, equivalent to the mean of the data. For those wanting bands that envelop more or fewer data points, the standard deviation factor can be larger or smaller. Once calculated, Bollinger bands can be displayed on any price chart and used to generate buy and sell signals, much the same as any other channel breakout system. Using a smaller Bollinger band—for example, 1 standard deviation—will give many more signals than using one of 3 standard deviations. At the same time, a band of 3 standard deviations translates into greater risk than 1 standard deviation. Signals produced with a larger band tend to be more reliable, but may have larger losses when prices turn the wrong way.

Bollinger bands also describe market volatility. A relatively narrow band translates into low volatility. By comparing a 21-period Bollinger band with a 65-period band you can see the relative difference between shorter-term and longer-term market volatility in Figure 18.1. The thicker lines, based on the 65-period calculation, cross the short-term band at points that show relatively overbought and oversold situations. If this were a daily rather than a 15-minute chart, the 21-period band would give monthly volatility and the 65-period band would be quarterly volatility, useful values for options traders.

Figure 18.1: Comparison of 21-period and 65-period Bollinger bands. *Source*—Chart created with *TradeStation*® by Omega Research, Inc.

Problems in Using Moving Standard Deviations

Applying any technique to a rolling time interval of the most recent *N* bars is a common method of keeping in tune with current market conditions. In the case of a simple moving average, we should be very familiar with the lag that is introduced when prices are trending—that is, when they are moving steadily higher, the lag causes the trendline to fall behind.

There is a similar lag when using the most recent *N* bars to calculate a standard deviation, even when the data has been detrended. If we are measuring the volatility of the market, and prices rally quickly, the volatility rises. This will be seen as a larger value of 1 standard deviation measured over a fixed number of days or bars. As volatility increases, the bands increase in width slowly. If we are using a 20-day calculation, then today's increased volatility will only be $\frac{1}{20}$ of the total. That will make the bands increase in width in an orderly, steady manner. At the two major price turns in Figure 18.2, in October and December 2002, the band width increases as the price move continues in the new direction.

Figure 18.2: Standard deviation bands, combined with a trendline, show significant lag.

The same lag occurs when volatility declines. The difference is that the bands remain wide and narrow slowly. This can be a problem if you want to measure another increase in volatility following shortly after the first. The bands are slow to correct. If the price move was upwards, as seen in the center of the chart, then the bulging bands that follow the peak make it more difficult for a short-term price drop to penetrate the lower band. Therefore, it is important to remember that price distributions are subject to the same lag as many other calculations.

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USE OF PRICE DISTRIBUTIONS AND PATTERNS TO ANTICIPATE MOVES

Prices often form patterns that can be evaluated using probability methods, or simply viewed in much the same way as a frequency distribution, or histogram. Because many concepts are sound, but the statistical analysis is often difficult due to limited amounts of data or changing conditions, analysts have taken a much more empirical approach towards studying price distributions. The following section looks at some innovative ways to look at price distributions and how they are interpreted into trading opportunities.

Analysis of Zones

Rather than using standard deviations to identify the chance of a price move above or below yesterday's closing level, Bruce Gould observed that historic prices could be divided into five zones, each 20% of the price range over the previous 3 years. Using this long-term approach, it is easy to see that selling in Zone 1 (the lowest price levels) would have less opportunity for profit than selling in Zone 2, just above it. Similarly, buying in Zone 5, the highest band, would carry both the greatest risk and the least opportunity of profit. This is likely to remain the case unless prices move to much higher levels and all zones need readjusting.

J. T. Jackson[1] has used this concept to define 5 short-term zones, based only on yesterday's prices, which can be associated with the strength or weakness of today's move. These daily zones, which are popular with floor traders, are calculated as:

Open table as spreadsheet

Calculation	Zone	If Price Is above Then
High2 = Average + High1 - Low1	6	Strong up
High1 = 2*Average +Low	5	Moderate up
Average = (High + Low + Close) / 3	4	Mildly up
Low1 = 2*Average - High	3	Mildly down
Low2 =Average + Low 1 - High1	2	Moderately down
	1	Strongly down

where the High, Low, and Close are yesterday's prices. Note that there are 5 calculations but 6 zones needed to separate them. A test of how the S&P 500 falls into these relative rankings gives:

Open table as spreadsheet

Zone	6	5	4	3	2	1
S&P Frequency	20%	44%	83%	79%	42%	20%

which shows the slightly upward bias expected of the overall equities market. These distributions may vary depending on the interval used in their calculation and whether there is a dominant trend during that period. A longer interval that includes bull, bear, and sideways markets would be safest; otherwise, there is the chance that the calculations will create a bull market profile, while some trading will occur during a bear market reaction. Although you can avoid trend bias by using longer intervals for the calculations, the zones tend to get very large.

The strategies for trading price zones focus on short-term trends and holding periods. For example, you can sell when prices move into Zone 4 (mildly up) with a stop in Zone 5. If you consider Zones 3, 4, and 5 as containing mostly market noise, then selling at the top of Zone 4 and closing out that trade at about the average, or buying near the bottom of Zone

3 and closing out at about the average, could capture the majority of price moves that have no direction.

Non-Random Patterns

In evaluating the zone approach, the markets that offer the greatest potential for this strategy are those that show an abnormal distribution of prices within the six zones. For example, if the six zones were all equal in size, and the frequency of prices declined by one-half as they moved from the center to the extremes, there would be a perfectly random distribution and no profit potential:

Open table as spreadsheet

Zone of Equal Size	6	5	4	3	2	1
Normal Distribution	7%	14%	28%	28%	14%	7%

If the distribution is normal, but Zones 3 and 4 are much wider than the outer zones, then the risk of selling at the top of Zone 4 with a stop at the top of zone 5 and a profit target at the average of Zones 3 and 4 would result in an equal number of profits and losses, but the profits would be larger. If the zones are of equal size, the opportunities come when the distribution is clustered in the center:

Open table as spreadsheet

Zone of Equal Size	6	5	4	3	2	1
Normal Distribution	2%	8%	40%	40%	8%	2%

In this case, selling at the top of Zone 4 would result in many more profits than losses, although profits and losses would be of equal size.

Applying a Moving Average Distribution

To extend the time frame and include a trend bias within the zone values, the same zones may be created by using the moving average values applied separately to the close, high, and low. For example, if three separate 21-day moving averages are calculated on the high, low, and closing prices, the moving average values can be substituted for yesterday's high, low, and close to give new zones. In using this approach, a strong upward trend would cause all the zones to lag below today's prices, making current values strongly overbought. Zones created from the history of these averages will reflect the relative overbought and oversold price levels within trends. In a strong upward market, prices can remain in Zone 6 while they are steadily moving higher, in much the same way that an oscillator can remain over 80% for a sustained period.

Using moving average values will change the way in which you trade these zones. For example, you might want to enter long positions only in Zone 5 and look to exit in Zone 6. You might find that, if prices end the day in Zone 6 (very strong), they are likely to open the next day in Zone 4 (slightly higher).

Zones for Forecasting Range and Risk Control

Statistics have proved that, barring a superior forecasting method, the best estimate for tomorrow's price is today's price. That is, under most conditions, we cannot predict with any certainty that prices will go up or down tomorrow, therefore the best estimate is to say that prices will be unchanged. However, if a trend system, such as a moving average, has been profitable, then its forecast for tomorrow is better than today's price. Market volatility, based on price changes, can be used with a directional forecast of tomorrow's price to create a set of zones used to control risk or project the probable trading range.[2]

Using a 10-day moving average of the daily prices changes,

```
A = Average(AbsValue(Close - Close[l]),10)
```

where *close*[1] = the previous close

Taken as positive numbers, zones are created that center around the current price and expand according to the average price change (volatility) using the following calculations:

```
H2 = Close[1] + 2 * A
```

```
H1 = Close[1] + A
L1 = Close[1] - A
L2 = Close[1] - 2 * A
```

Five zones are then created by the areas above *H2* and below *L2*, and the three ranges between *H2*, *H1*, *L1*, and *L2*, all of which change in proportion to the *n*-day volatility. These volatility levels, or bands, represent a very similar scenario to channel breakouts. The market often trades in a range defined by a normal or average level of volatility. When a new piece of information affects the price, it jumps to a new level, then trades with similar volatility (slightly higher at first) at the new level. Most often, the first breakout of an existing trading range puts prices in a zone just above the old range, making the pattern appear to be divided into equal zones. This same philosophy is the reason that standard profit targets for a price breakout are equal to the previous trading range. Readers can find additional trading range projections in Chapter 15.

[1]J. T. Jackson, *Detecting High-Profit Day Trades in the Futures Markets* (Windsor Books, 1994).

[2]Based on Tushar Chande and Stanley Kroll, *The New Technical Trader* (Wiley, 1994, p. 172).

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DISTRIBUTION OF PRICES

In the search to understand how prices move and what to expect, an analysis of price distributions can explain whether the market is trending, moving sideways, or simply unstable. Some of these patterns are clear and others need interpretation; in addition, the combination of patterns within patterns can become complex. The following is intended as a basic approach to interpreting price distributions, although each group of markets has special characteristics. Before engineering a systematic approach to trading, it is best to understand how prices are expected to distribute. This approach avoids surprises and the risk that goes with them.

Long-Term Price Distributions

A quick observation of price data for most commodities, such as soybeans or gold, shows that we should expect a skewed long-term price distribution, with prices clustering at lower levels and a long tail representing higher prices. In the case of gold, we should remember that prices peaked briefly at $675 per ounce (New York cash price) in 1980, but have remained below $400 most of the time before and after. If we consider $375 as the approximate normal price of gold, then the rise to $800 is a gain of $425 per ounce. If $375 was the average price, and price distributions were symmetric, then gold would be able to decline an equal amount, which would put the low price at negative $50 per ounce, which is not possible.

The reasons that cause prices to move result in a nonuniform, nonsymmetric pattern. The nonuniformity is sometimes called a *step process* because prices move up and down in steps rather than in gradual increments. If the price of soybean or heating oil gained a small percentage every year based on inflation, price forecasting would be very simple. Expectations, however, are based on inventories, exports, weather, the currency value, and government policy, all of which cause frequent sharp price adjustments. These shifts up and down appear as steps on a price chart. Once a new step is reached, prices will fluctuate in a range around the new *equilibrium level*, the current assessment of fair value. While prices are making their step up or down, they will normally form a short-lived peak or valley. Over time, when prices trade in a range, they normally trade at the lower end of the range. As some of the following methods will show, the actual distribution within the range will give you a good idea of what prices will do next.

Patterns of Market Groups

Markets in physical commodities, such as soybeans and coffee, have a cost of production that forms a practical lower bound to price movement. When there is ample supply or low demand, prices decline to those cost levels (or slightly lower), volatility drops, and there is little price activity. This also applies to the interest rate market viewed in terms of yield. At low yields, volatility is proportionally low and prices move sideways with an occasional spike (downwards for prices). Gold has a perceived low price based on the collective opinion of investors and the average price at which gold has been widely distributed as jewelry and bullion. A large number of small investors, having bought gold in various forms at prices between $300 and $500 per ounce, are simply not interested in selling at a lower price.

Currency markets are very different from physical commodities because they do not have a production cost, nor can you distinguish high from low. All currencies are quoted in terms of other currencies. If country *A* has a relatively strong exchange rate when measured in terms of country *B*, it might be relatively weak in comparison to country *C*. A stable political situation in a given country, consistently low inflation, and a controlled balance of trade (i.e., a stable economy), do not prevent that country's currency from having large price swings. Unexpected good economic news that affects country *B* will cause the value of *A*'s currency to decline relative to *B*, with volatility increasing. If the economy of *B* has no additional surprises, then the exchange rate between *A* and *B* will remain the same; however, volatility will decline as investors see the new level as normal. Once stabilized, prices will again distribute normally.

Frequency Distributions

If we remember the qualities of a standard deviation when measuring price distribution, it assumes a normal or symmetric pattern; therefore, a simpler *frequency distribution* can be used to allow a more realistic, visual representation of price distribution. The frequency distribution makes no assumptions about the shape of the curve, but records the amount of time that prices remain within a specified range. For example, if we look at the history of gold from 1976 through 1993 (see the bold line in Figure 18.3), prices have varied from $100 per ounce in 1976 to $675 per ounce in 1980. Because the first three years would lower the average, we will consider only the period from 1979 through 1993, which had a low of $228. Dividing the price range into 20 parts, we get bars of $23.60 per interval. Accumulating the history of monthly closing prices into the 20 slots from $227.60 to $251.20, $241.21 to $274.80, and so forth, we get a frequency distribution spanning the full range of gold prices, each bar indicating the number of months that the average monthly price fell within that bar. The distribution, seen in Figure 18.4, shows peak frequencies as gray bars from $392 to $445, significantly below the midpoint price.

Figure 18.3: Cash gold prices, CPI, and deflated gold prices.

Figure 18.4: Frequency distribution of gold. Gray bars show the distribution of cash prices. The dark bars show the distribution of deflated cash prices. The deflated prices are skewed much further to the left.

The total number of months from 1979 through 1993 is 228; therefore, we can find the approximate price that occurred at the 90% level by adding the frequency of the bars beginning at the highest price. Because 10% of 228 is 23, the bar that causes the cumulative frequency to exceed 23, beginning at the high end, will be the target price range for the 90% level. This works well for skewed distributions; the 90% level may be 3 bars from the top of distribution, while the 10% level may be the lowest bar of the distribution. For cash gold, the highest 10% of the prices includes the highest 9 bars, while the lowest 10% are in the bottom 2 bars. This shows an extremely skewed distribution.

Adjusting for Inflation

One way of correcting for the apparent bias in the long-term price movement is to adjust for inflation. That is, if we have a table of monthly Consumer Price Index values, all prices can be divided by the corresponding monthly percentage increase in the CPI. Therefore, if today's gold price is $400 per ounce, the price one year ago was $380, and inflation was 5%, today's price of $400 is divided by 1.05 to get $381. In Figure 18.3, the CPI appears as a steady increase which, when used to adjust the cash gold prices, shows that 1993 prices had returned to 1979 levels on an inflation-adjusted basis. The frequency distribution of the adjusted prices, seen in Figure 18.3, shows that the inflation-adjusted frequency (black bars) have a broad area of high occurrence at low

prices, with a small tail to the left and a longer tail to the right. The distribution of actual prices has its peak at about 369, with a much longer tail to the left caused by inflation. These patterns are fundamental to understanding and using price distributions. For practical purposes when applying the CPI for trading, the procedure is to *inflate* the older values. Instead of dividing prices by the cumulative CPI, we multiply the backwards cumulative effect. For example, if September is the most recent month, that remains unchanged, but August is multiplied by that month's rate of inflation. If the CPI gained 0.2%, then the actual price of gold ($375) is multiplied by 1.002 to give $375.75. An increase of 0.1% in July raises the actual July value by the compounded effect of 0.2% and 0.01%. This process is repeated going backwards for all the data. This can also be accomplished by creating an inflated CPI series, then multiplying the corresponding actual values by the inflated CPI values.

Structural Changes

Despite the need to correct for inflation, structural changes will affect the smooth pattern of the frequency distribution. For gold, cash prices below $100 per ounce are part of history that we can choose to ignore for now. By creating a new frequency distribution that reflects prices beginning in 1979, some of the price inconsistencies can be eliminated. In foreign exchange, the evolution of the European Community (EC), and eventually the conversion of many European currencies to the euro, permanently changed the pattern of crossrates for the countries that are now part of the EC. In commodities, changes in contract specifications, such as the shift from *live hogs* to *lean hogs*, makes the usefulness of historic data questionable. Unidentified structural changes cause an unexplained shift in the distributions that may lead to misinterpretation.

Medians and Means

Although the inflation-adjusted long-term distributions show that prices spend much more time at lower levels, there is a tendency to consider the average price as the midpoint between the highest and lowest prices. Using the gold example, the midpoint from 1979 to 1993 was $451; however, the best measure is the *median*, or middle value when all monthly prices are sorted from high to low. The median value for gold over the same period was $381. If we look back at Chapter 2 we find that skewness is measured as the difference between the mean and the median, as a percentage of the standard deviation. If we take the midpoint as a close approximation of the average, the difference of $70 is a very large value, indicating a distribution with a peak far to the left of center, a tendency towards lower prices. For price distributions, the median is a much more useful value than the average, although not as convenient to calculate. The median naturally adjusts for the skewness in the price patterns.

Short-Term Distributions

Unlike the predictable patterns of the long-term price distributions, the distribution patterns of short intervals can vary widely; they have been interpreted in many ways. Short-term distributions are not anchored to a base level because the entire period of analysis may be at price levels that are significantly above intrinsic value or production costs. Keeping in mind the normal shape of price distribution for each market group, a different configuration can be a strong indication of expected price change.

Three distribution patterns are shown in Figure 18.5 (b–d) along with the larger, long-term distribution (a). The normal distribution (a) is skewed towards lower prices and represents the dominant pattern at all levels. The first short-term distribution (b) mimics the normal pattern, with a long tail towards the higher prices and a large accumulation near lower price levels but with the extended tail much shorter. This is most likely to occur at low price levels, where most activity is near the bottom with occasional short excursions up. Distribution (b) can be a small segment of a normal pattern or a temporarily higher level that has relatively quiet, stable price movement. Figure 18.5c is a bell-shaped, symmetric curve that could indicate a congestion area or short-term equilibrium at a price level not near the lows but also not at exceptionally high prices. When prices trade equally within a range, they do not exhibit any likelihood of favoring an immediate breakout either up or down; however, in the big picture, declining prices are always more likely.

Figure 18.5: Three short-term distribution patterns. (a) A normal, long-term distribution. (b) A short-term normal distribution indicating stable prices at a

temporarily higher level, or a permanent change. (c) A bell-shaped curve representing congestion but not indicating future direction; the market is in suspension or temporary equilibrium. (d) The tail points to lower prices with most activity at higher prices; the market is unstable and has substantial downside potential.

The fourth distribution (see Figure 18.5d) is most interesting because it is skewed in the direction opposite to (a) and (b). For this pattern to have developed, it required a relatively fast move to a higher price level, then a congestion area formed at the higher level. If you had seen this distribution without knowing the actual prices, you could be certain from this pattern that prices are higher than normal. The pattern is top-heavy, and should be interpreted as unstable; prices are more likely to go down than up. This last conclusion does not require statistics, because prices at historically high levels may not decline immediately, but must eventually correct to normal levels. Buying into a market with this distribution assures high risk.

Identifying Potential Price Moves

From the patterns just described, a distribution that combines a long tail towards higher prices, with prices that are relatively low, offers no promise of a potential price move. When prices are closer to the frequency *mode*, the most common occurrence, they are less likely to move. Potential volatility increases as prices get farther from the mode. Three distributions that have greater chances for price moves are:

1. A broad, often erratic formation indicates volatile, current movement. Prices have not remained at one level, and have not yet established a well-defined pattern or trading range.
2. A skewed distribution (with the tail towards higher prices), the mode near the base level, with the current price at the high end of the tail indicates that prices are in the process of making an unusual, highly volatile move to the upside.
3. A skewed distribution (with the tail towards lower prices), the mode in the upper half of the distribution, and where the current price is in the tail (lower prices) indicates that prices have peaked after a significant move up and are ready to start down.

Any time prices form a distribution that is not the same as a long-term distribution and prices are not at low levels, there is potential for movement and volatility.

Using Skewness to Identify a Trend

It can be argued that the skewness of closing prices is a robust measurement because the closing price is the netting of many price changes during the day. The distribution of the intraday changes are reflected in the distribution of the closing prices.[3] Skewness can be used as a leading indicator of a trend change if it is calculated as a *moving skewness* and acted on when it shows early signs of change.

The calculation of moving skewness involves four steps:

1. *Double smoothing* of the closing prices, to get the *moving mean* (M), with $a = 0.1$,

   $S_t = a \times close_t + (1 - a) \times S_{t-1}$

   $D_t = a \times S_t + (1 \times a) \times D_{t-1}$

   $M_t = ((2 - a) \times S_t - D_t) / (1 - a)$

2. *Moving deviation* of the difference between the closing prices and the smoothed mean,

   $DEV_t = Close_t - M_t$

3. Moving standard deviation of the moving deviation, with $b = 0.05$,

   $SMD_t = b \times |DEV_t| + (1 - b) \times SMD_{t-1}$

   $DMD_t = b \times SMD_t + (1 - b) \times DMD_{t-1}$

   $MD_t = ((2 - b) \times SMD_t - DMD_t) / (1 - b)$

   $STD_t = 1.25 \times MD_t$

4. *Moving skewness,* with $c = 0.333$,

$$G_t = (c \times DEV_t^3 + (1 - c) \times G_{t-1}) / STD_t^3$$

The resulting value of G is shown in the lower part of Figure 18.6. The largest spike in the value of the moving skewness indicates the likely beginning of a trend move. For the S&P 500 futures, from May 2002 through July 2003, that seems to be the case. The larger spikes precede significant price moves.

Figure 18.6: Moving skewness, S&P 500 futures, June 2002-July 2003.

The TradeStation program to calculate the moving skewness follows. It has one important idiosyncrasy: Some of the calculation values get very small, resulting in an unmanageably large value of *G* (for the computer). To correct this problem, two of the intermediate results are tested for small values (less than 0.1). The effect is that some of the spikes may not appear on the chart. Using a smaller filter value will reduce the number of omissions, but the smallest filter must be found by testing.

```
{ TSM Moving Skewness
Copyright 2003, P.J.Kaufman. All rights reserved.
Based on the article by Dennis McNicholl,
"Old statistical methods for new tricks in analysis" (Futures, April 2002)
Also see the book, "Taming Complexity" by Dennis McNicholl }

inputs: MMper(0.1), MDper(.05), MSper(.333);
vars:   S(0), D(0), M(0), dev(0), SMD(0), DMD(0), MD(0), std(0), G1(0),
   t1(0), t2(0);

if currentbar <= 1 then begin
      S = close;
      D = close;
      SMD = 0;
      DMD = 0;
      G1 = 0;
      end
    else begin

{ calculate the moving mean using exponential smoothing }
   S = MMper*close + (1 - MMper)*S[1];
{ D is the double smoothing of closing prices }
   D = MMper*S + (1 - MMper)*D[1];
   M = ((2 - MMper)*S - D)/(1 - MMper);

{ calculate the moving deviation MD }
   DEV = close - M;
   SMD = MDper*absvalue(DEV) + (1 - MDper)*SMD[1];
   DMD = MDper*SMD + (1 - MDper)*DMD[1];
   MD = ((2 - MDper)*SMD - DMD)/(1 - MDper);
   std = 1.25*MD;

{ calculate moving skewness }
   t1 = MSper*power(DEV,3) + (1 - MSper)*G1[1];
   t2 = power(STD,3);
   if t2 > .1 and t1 > .1 then G1 = t1/t2;
```

```
plot1(G1,"skewness");
end;
```

A Trading System Based on Kurtosis and Skew

Two statistical ways of measuring price distribution are *kurtosis* and *skew,* both discussed in Chapter 2. Kurtosis is the peakedness of the distribution and skew is the position of the mode. When a price distribution is flat, we see the price movement as trending; when it has an unusually large number of occurrences near the same price, the peak of the distribution is larger and we associate the price pattern with a sideways move. If we use kurtosis in a trading strategy we would want to buy or sell in the direction of the trend when the kurtosis is decreasing, and we would want to fade (enter in the opposite direction) when the kurtosis is increasing.[4]

Skew can also indicate a developing price pattern. If the skew is towards higher prices, and we are trend following, we would buy; if it leans towards lower prices we sell. Volatility, measured as the average true range, can also help. Lower volatility is associated with lack of movement, while high volatility is often accompanied by large, fast price moves. The rules for a trend-following system that combines kurtosis, skew, and volatility are:

- *Buy* when kurtosis crosses below 0, skew > 0, and volatility > minimum level.
- *Sell* when kurtosis crosses below 0, skew < 0, and volatility > minimum level.

A mean-reverting (fading) strategy can be created by trading when the kurtosis crosses above zero, then trading the opposite way indicated by the skew. Volatility will also be important. The rules for mean reverting are:

- *Buy* when kurtosis crosses above 0, skew < 0, and volatility > minimum level.
- *Sell* when kurtosis crosses below 0, skew > 0, and volatility > minimum level.

The results of both the trending and fading strategies were very profitable when tested on Amazon.com from June 1998 through May 2003. Both methods used kurtosis and volatility periods of 20 days. The trending strategy differed by using a skew based on 5 days and a minimum volatility of .8, while the fading strategy did better with a skew of 7 days and a minimum volatility of 1.1. The fading strategy was twice as profitable as the trending one, but both had a high percentage of profitable trades, selected due to the minimum value. Except at the very low extreme, the trending strategy was not sensitive to volatility. Figure 18.7 shows the Amazon.com prices from April 2003 through May 2003 along with the trading signal. The center panel has the kurtosis and skew values, and the lower panel is the volatility. In the lower panel the bottom horizontal line at .8 is used to filter the trend trades, and the higher horizontal line at 1.1 filters the mean reversion trades.

Figure 18.7: Using kurtosis and skew in a fading strategy, Amazon.com, April 2002–May 2003. Kurtosis and skew in center panel, true range in lower

panel.

Additional Strategy Features

The rules for the Kurtosis-Skew strategy used only three variables: the period for kurtosis, the period for skew, and the minimum volatility. There are other features that should be considered:

- A *stop-loss* for long positions based on the lowest low, and for short positions based on the highest high of a recent period.
- A *maximum volatility.* Because mean-reverting trades performed better with higher volatility, trend trades may net better profits if they do not enter when volatility is high.
- *Exiting when kurtosis moves the wrong way.* The existing strategy will enter when kurtosis is moving the right way but not exit when it moves the wrong way. Results may be improved by exiting when the kurtosis crosses zero, or it may be even better to track the trend of kurtosis, rather than only its relationship to zero.

Program Code for Kurtosis-Skew Strategy

The Kurtosis-Skew Strategy, provided by TradeStation in its original form, appears below. It consists of the strategy *TSM Kurtosis-Skew*, and the functions *Kurtosis* and *Skew* used to calculate those values. The main strategy contains logic for a stop-loss and maximum volatility threshold. The last program is an indicator to display the kurtosis and skew in the center panel of Figure 18.7.

```
{TSM Kurtosis-Skew

Copyright 2003, P.J.Kaufman. All rights reserved.
This program is a modified version of "PriceDist_BO_FD" provided as part
   of the Omega Research System Trading and Development Club. For
   information on the club and other Omega Research educational services,
   please call 800-422-8587 or 305-551-9991.)

Inputs: TrdType(3), KurtLen(40), SkewLen(15), ExBars(10), StpPts(5),
   VolMin(.8),
   Vol1Max(1.1), ATRLen(10);
Vars: MP(0), StopPrice(0), Kurt(0), Skewv(0), Vol(0);

Kurt = Kurtosis(Close,KurtLen);
Skewv = Skew(Close,SkewLen);
Vol = Average(TrueRange,ATRlen);

{ENTRY RULES - BREAKOUT)
If (TrdType = 1 or TrdType = 3) and
   Vol > VolMin and Kurt crosses under 0 then Begin
{ test maximum volatility }
   if Vol < VolMax or VolMax = 0 then begin
      If Skewv > 0 then Buy ("BO-Long")this bar at close;
      If Skewv < 0 then Sell ("BO-Short") this bar at close;
      end
{ exit only if volatility exceeds maximum }
   else begin
      If Skewv > 0 then exitshort ("BO-XS")this bar at close;
      If Skewv < 0 then exitlong ("BO-XL") this bar at close;
      end;
   end;

   (ENTRY RULES - FADE)
   If (TrdType = 2 or TrdType = 3) and
      Vol > Vo1Min and Kurt crosses above 0 then Begin
      If Skewv < 0 then Buy ("FD-Long")this bar at close;
      If Skewv > 0 then Sell ("FD-Short") this bar at close;
      end;

   if exbars < > 0 then begin
   { long exit ]
      ExitLong ("LLStop") Lowest(Low,ExBars)[0] - StpPts Points Stop;
   { short exit }
      ExitShort ("HHStop") Highest(High,ExBars)[0] + StpPts Points Stop;
      end;
   ____________________________________________________________________________
   ***************************************************************
   Description : This Function returns Kurtosis
   Provided By : Omega Research, Inc. (c) Copyright 1999
   ***************************************************************}

   Inputs: Price(numericSeries), Length(numeric);
   Variables: P1(0), P2(0), P3(0), Avg(0), Std(0);

   P1 = Length * (Length + 1) / ((Length - 1) * (Length - 2) * (Length - 3));
   P2 = 0;
   P3 = 3 * Square(Length - 1)/((Length - 2)*(Length - 3));

   Avg = Average(Price, Length);
   Std = StdDevS(Price, Length);

   For value1 = 0 To Length - 1 Begin
         P2 = P2 + Power((Price[value1] - Avg) / Std, 4);
   End;

   Kurtosis = P1 * P2 - P3;
_____________________________________________________________________
   {***************************************************************
   Description : This Function returns Skew
   Provided By : Omega Research, Inc. (c) Copyright 1999
```

```
    ************************************************************}

    Inputs: Price(Numeric), Length(Numeric);
    Variables: Summ(0), Avg(0), Std(0), Y(0);

    Avg = Average(Price, Length);
    Std = StdDevS(Price, Length);
    Summ = 0;
    Y = Length / ((Length - 1) * (Length - 2));

    For values = 0 TO Length - 1 Begin
       Summ = Summ + Power((Price[value1] - Avg) / Std, 3);
    End;

    Skew = Y * Summ
    ____________________________________________________________________
```

```
{ TSM Kurtosis-Skew
Plot kurtosis and skew
Copyright 2003, P.J.Kaufman. All rights reserved. }

inputs:  kurtosisper(40), skewper(15);
vars:    k(0), s(0);

k = kurtosis(close,kurtosisper);
s = skew(close,skewper);
plot1(k,"kurtosis");
plot2(s,"skew");
```

[3]Dennis McNicholl, "Old Statistical Methods for New Tricks in Analysis," *Futures* (April 2002).

[4]The original TradeStation program for trading based on kurtosis and skew was provided as part of the Omega Research (now TradeStation) System Trading and Development Club. The program in this section is a modified version of that strategy. The functions have not been changed.

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STEIDLMAYER'S MARKET PROFILE

Market Profile, the effort of J. Peter Steidlmayer, appears to be a frequency distribution of intraday price movement but has used time, rather than volume, as its key element. Steidlmayer formalized this technique in 1985 while he was a director of the Chicago Board of Trade. The Board considered this such a unique insight that they copyrighted his work as *Market Profile* and *Liquidity Data Bank*. It was intended to provide detailed information to traders about how trading was facilitated. Market Profile offers much more than a count of how many times a price traded at one level. With proper studying, traders are able to separate participants by time frame and even identify their trading patterns. Figure 18.8 shows this technique as it originally appeared, with letters denoting sequential 30-minute time periods, and an analysis of who participated in the trade at each price.[5] Called a *customer trade indicator* (CTI), these categories are CTI 1, the local floor traders; CTI 2, the commercial clearing members; CTI 3, clearing members who fill orders for other members and nonclearing commercial traders; and CTI 4, clearing members who fill orders for the public or other customers not included in the previous groups (*outside paper*). The information, on whose behalf the trade was executed, is only available after the close of trading.

Open table as spreadsheet

Market Profile

Anylysis of a Trading Day

		%Volume by Type of Trader					Participation			%Count		%Volume		Ratio (1 + 2)/(3 + 4)	
Price	**Volume**	**Cti 1**	**Cti 2**	**Cti 3**	**Cti 4**		**Cnt**	**Cti 1 + 2**	**Cti 3 + 4**	**%1 + 2**	**%3 + 4**	**%1 + 2**	**%3 + 4**		
9609	736	54.6	8.8	0.0	36.5	LM	2	63.4	36.5	1.3	0.7	467	269	1.74	Buy 3 + 4
9608	8009	56.2	14.3	7.3	22.3	LM	2	70.5	29.6	1.4	0.6	5646	2371	2.38	
9607	7410	56.9	16.0	8.1	19.0	KLM	3	72.9	27.1	2.2	0.8	5402	2008	2.69	
9606	18142	62.1	13.0	3.5	21.4	KL	2	75.1	24.9	1.5	0.5	13625	4517	3.02	Sell 1 + 2
9605	31686	62.5	11.7	4.0	21.9	KL	2	74.2	25.9	1.5	0.5	23511	8207	2.86	
9604	13018	58.5	17.4	2.0	21.8	KL	2	75.9	23.8	1.5	0.5	9881	3098	3.19	
9603	14290	60.7	1 1.7	4.5	23.1	KL	2	72.4	27.6	1.4	0.6	10346	3944	2.62	
9602	5302	52.8	11.8	1.6	33.8	K	1	64.6	35.4	0.6	0.4	3425	1877	1.82	Buy 3 + 4
9601	3616	69.9	8.7	6.2	15.3	JK	2	78.6	21.5	1.6	0.4	2842	777	3.66	Sell 1 + 2
9600	4884	50.5	8.4	1.9	39.1	JK	2	58.9	41	1.2	0.8	2877	2002	1.44	Buy 3 + 4
9531	11828	60.4	12.5	1.2	25.8	J	1	72.9	27	0.7	0.3	8623	3194	2.70	
9530	13464	57.1	16.7	2.5	23.8	J	1	73.8	26.3	0.7	0.3	9936	3541	2.81	
9529	15878	59.7	12.7	3.5	24.1	J	1	72.4	27.6	0.7	0.3	11496	4382	2.62	
9528	4802	57.9	18.1	2.6	21.5	J	1	76	24.1	0.8	0.2	3650	1157	3.15	Buy 1 + 2
9527	4292	50.4	12.1	1.6	35.9	CIJ	3	62.5	37.5	1.9	1.1	2683	1610	1.67	Buy 3 + 4
9526	23594	63.1	11.0	4.8	21.1	FCHIJ	5	74.1	25.9	3.7	1.3	17483	6111	2.86	
9525	27090	58.5	15.6	2.7	23.2	FCHIJ	5	74.1	25.9	3.7	1.3	20074	7016	2.86	
9524	20004	59.7	15.3	2.5	22.4	CEFCH1J	7	75	24.9	5.3	1.7	15003	4981	3.01	

9523	13956	60.1	18.2	3.0	18.7	BCDEFGH	7	78.3	21.7	5.5	1.5	10928	3028	3.61	Sell 1 + 2
9522	11662	59.4	16.2	5.0	19.3	ABCDEF	6	75.6	24.3	4.5	1.5	8816	2834	3.11	
9521	23390	58.5	14.8	4.5	22.2	SABCDEF	7	73.3	26.7	5.1	1.9	17145	6245	2.75	
9520	46184	63.5	14.4	5.1	16.9	SABCD	5	77.9	22	3.9	1.1	35977	10160	3.54	
9519	16018	72.0	9.6	3.7	14.7	$ABC	4	81.6	18.4	3.3	0.7	13071	2947	4.43	Buy 1 + 2
9518	8750	59.4	12.8	2.3	25.5	$A	2	72.2	27.8	1.4	0.6	6318	2433	2.60	
9517	5912	64.6	12.3	3.9	19.2	Z$A	3	76.9	23.1	2.3	0.7	4546	1366	3.33	
9516	13896	62.9	15.7	4.9	16.5	Z$	2	78.6	21.4	1.6	0.4	10922	2974	3.67	Buy 1 + 2
9515	5234	62.0	10.1	1.8	26.1	Z$	2	72.1	27.9	1.4	0.6	3774	1460	2.58	
9514	1745	52.9	12.7	0.2	34.3	$	1	65.6	34.5	0.7	0.3	1145	602	1.90	Sell 3 + 4
Total 15%	374792	Total volume 9528-9518			199742										
		56219	15% of total			29961.3									
		value area (70%) from 9525 to 9520 (inclusive)													
R34-29	51555														
R7-10	34297														
R7-11	65983														

Figure 18.8: Original *Market Profile* for 30-year treasury bonds.

In order to understand what is described in Market Profile and the Liquidity Data Bank, you must know that the locals and commercial clearing members, CTI 1 and CTI 2, account for the largest part of volume (over 65%), and both have trading styles that are very different from the off-floor speculators who form groups 3 and 4. The locals take smaller positions, often counter to the current price moves and hold that trade for a period spanning seconds to a few hours. Most locals even up at the end of the day which avoids the need to finance their positions. A *commercial* might be a bank that is hedging an existing currency exposure or arbitraging a gap between two or more short-term rates in the cash market. These positions may move the market but can be insensitive to current price direction and flow into the market at arbitrary times.

Outside paper, a term that refers to customer accounts, ranges from individual speculators to major fund managers. Because they trade from off the floor, their style of trading favors holding positions for more than one day, and a large majority will be trend followers. The style of CTI 3 is similar to CTI 4, that is, both tend to be directional, and the two can be combined for the purposes of evaluation. Although they account for a smaller portion of the volume they are more influential in the short-term direction. Figure 18.8 combines CTI 1 with CTI 2 and CTI 3 with CTI 4 to simplify the patterns attributed to each group. During the period shown in the figure, the combined categories 3 and 4 caused the market to move when their participation was greater than 30%. Observation shows that these trading points occur as prices move out of a previous area of sustained trading.

Steidlmayer was said to have first developed this information for his own trading. He taught a course on how to apply his evaluation technique and there were a number of books written on the subject by himself and others.[6] He spent considerable time studying and classifying formations, and separating days into three primary categories: *normal*, *trending*, and *nontrending.* A normal day forms a standard bell-shaped curve with the widest point positioned near the center; this point is called the *value area.* On a trending day the value area is not as wide and appears closer to one end of the distribution. A nontrending day has neither of the two recognizable patterns.

There is an important philosophic basis for Steidlmayer's work. It is a very credible attempt to explain how the market functions. He says "the market probes high prices to attract sellers and low prices to attract buyers." This creates a *value area.* By observing the patterns of intraday price distribution you can know whether there are countertrend opportunities, when prices reach the extremes of perceived value on a normal day, or when trend opportunities exist in the direction of current price movement.

Construction of *Market Profile*

The *Market Profile* is created in a manner very similar to a point-and-figure chart. You can list every price on the left scale or create boxes that represent a price range. This latter technique will make the distribution look more uniform by clustering the price activity in exactly the same way as a frequency distribution.

The most common way of plotting intraday data for *Market Profile* is to begin by placing the letter "A" in the boxes alongside the price at which the market traded. If we use half-hour intervals, called *time/price opportunities* (TPOs), then all prices that were traded during the first half-hour are marked with the letter "A." The letter "B" is used for the second half-hour period, the letter "C" for the third period, and so on. At the end of the day we have a chart that looks similar to Figure 18.8.

Market Profile is also intended to be used over many days, identifying long-term patterns as congestion areas or trending markets. To the extent that it accomplishes this distinction it can be very valuable. The ability to determine whether a market is directional or not is the trader's greatest problem. In Figure 18.9 the Market Profile is constructed by using numbers instead of letters to represent the range of prices traded over each day. The entire chart covers a period of 9 days. Other than the substitution of days for half-hour periods, the chart is created in the same way.

Value Area Using Daily Data		
Price	**Day Traded**	
10228	1	
10224	12	
10220	120	
10216	120	
10212	120	
10208	245790	
10204	2456790	**36 day counts**
10200	245679	
10228	2345679	
10224	2345679	
10220	23589	
10216	589	
10212	58	

Figure 18.9: *Daily Market Profile*. *Source*—Jones, Figure 2, "Locating value with auction market data," *Technical Analysis of Stocks & Commodities* (July 1989).

Time/Price Opportunities

Time/Price Opportunities (TPOs) are the 30-minute blocks that are assigned letters on the *Market Profile* diagram. It is worth noting that the largest occurrence of TPOs at a single price does not necessarily correspond to the price at which the highest volume occurred, as seen by referring again to Figure 18.8. This distinction is at the root of *Market Profile* because it emphasizes the amount of time that traders accepted a price, rather than the volume traded at that price (which could have occurred during a single period). In the bond example given in Figure 18.8, the greatest volume was transacted at 9520 although the center of the value area—where there is the largest record of TPOs—is at 9523, 3 points higher. Clearly, the *Market Profile* analysis is seeking out a different way of observing the actions of traders. In the formation of a value area, if the market moves between two prices, such as 9520 and 9523, because those values bracket the current trading range, each traverse will cause the prices in between to be marked with the same TPO letter, regardless of whether any volume occurred at those prices.

TPOs allow us to judge the potential direction for a move out of the current value area. This can tell a trader to buy strength or sell weakness. The market is said to favor the direction indicated by the upper or lower part of the value area that has the highest TPO count. When performing the TPO count, you must have a well-defined value area and limit the count to within that range. Using Figure 18.8 with the mode at 9523, count the TPOs prior to the interval that begins *J.* There were 16 TPOs above 9523 and 21 below (not including 8$ and 3*Z*). During time interval *J*, the balance shifted to the upside when it touched 9529, at which point there was a large increase in volume. This could be attributed to CTI 1 and CTI 2 exiting shorts and to a lesser degree, going long. The locals were finally joined by groups 3 and 4 taking a long position at 9600. An imbalance in the TPO count expresses a willingness for the market to favor the direction given by the largest count, but this applies to a normally distributed value area only.

Typical Patterns

It is generally accepted that the market spends the greatest time in a sideways range, or congestion area, and a relatively small amount of time trending. The sideways period may be defined as an *extended time/price relationship* and the trending period as a *brief time/price relationship.* The extended period creates a value area where traders are willing to buy and sell, and this activity is reflected in higher volume. According to Market Profile,[7]

$$Value = Price \times Time = Volume$$

In this analysis, called *auction theory*, the value area is the place that the market is willing to trade, and is seen in the time value. The value area represents about 70% of the market volume. The center of this time value area is the price at which there are the most TPOs. Because market activity spends at least 80% of the time in this value area, prices tend to rotate about the center. *Rotation* is the term given to price action that moves back and forth above and below this central value, building the pattern of normal distribution similar to a bell-shaped curve.

What Are the Buyers and Sellers Doing?

The interpretation of the Market Profile is based on the concept that, under normal market conditions, prices rise to attract sellers and fall to attract buyers. There is a very active area of trading at a point called *equilibrium* where commercial buyers and sellers exchange freely because they consider the price *at value* (Figure 18.10a). If there are more buyers than sellers, the price rises to attract additional sellers who feel as though they are getting a price that is above value. However, as prices continue to rise there are fewer buyers because they perceive the market as overpriced. In Figure 18.10a, a buyer's curve and a seller's curve are drawn on the frequency distribution of a normal trading day.[8]

Figure 18.10: Buyer's and seller's curves for a sequence of days.

In this way the market is said to *facilitate* trade. When there are not enough buyers, the price falls; when the sellers are scarce, prices rise. Constructing the buyer's and seller's curves for a sequence of days can help understand the dynamics of trading in terms of both price expectations and volume. For convenience, the *curves* are shown as straight lines, similar to supply and demand lines, in the following examples.

In Figure 18.10b, Day 1 begins with the buyer's curve disappearing faster than the seller's; therefore, the buyer's curve is more horizontal and the seller's more vertical. On Day 2 (c), the sellers have held their position and the buyers are willing to move higher, retreating from their previous objective. This results in higher volume. Had the buyers moved lower and the sellers remained steady, the volume would be expected to decline. If on Day 2 (d) the volume increased while prices traded in the same range and at about the same peak price level (value level), the buyer's and seller's curves would have become more horizontal, indicating that both sides of the trade were holding firmly at the current level.

Quantifying the Value Area

The idea of a value area that is shaped as a bell curve, or an extended formation to represent a trending day, seems clear; unfortunately, actual price patterns are rarely as clear as these examples. To help this process, Jones has applied *overlays* to these patterns, measuring them using a standard deviation. In Chapter 2 we explained that, for a normal distribution, the value of one standard deviation represents a clustering of 68% of all values around the mean; therefore 34% are on either side. Similarly, two standard deviations contain 95% of all activity, 42.5% on either side of the average. In his analysis, Jones has defined a *value area* as one contained within two standard deviations of the center using the TPO count to isolate the range. For example, if the entire chart contains 100 filled boxes, the price range is from 6615 to 6655, the center is at 6635 and that row contains 10 filled boxes, then two standard deviations contain 90 × .425 = 38 boxes on each side of the center. This defines the value area.

Trending Markets

Trends spread volume over a wider price range and are relatively easy to see. In the previous discussions, there is an early warning of a trend when prices move out of the value area or when there are a larger number of TPOs on one side of the center of the value area. Trends develop when the market attempts to probe a new price level, causing the current price to diverge from the value area. The participants may reject this divergence and price returns to the previous area, causing a broadening formation; alternately, they may accept the new price as fair value and generate a new value area by attracting volume (see Figure 18.11). The initial trend that fails to find a new value area is called *price trend*; it usually begins and ends within a single time period (one TPO which could be a half-hour or a day). A move that attracts volume occurs over a longer time period and is called a *value trend*. Daily charts, or a sequence of intraday 30-minute charts, are easier to use than a single 30minute chart when looking for a trend.

Open table as spreadsheet

Beginning of a Trend		
Price	**Day Traded**	
10228	1	
10224	12	
10220	120A	
10216	120A	
10212	120AB	
10208	245790AB	
10204	2456790ABC	
10200	245679ABC	
10228	2345679ABC	
10224	2345679C	
10220	23589C	
10216	589C	
10212	58C	
10208	CD	**Breakout at 10208**
10204	CD	
10200	DEH	
10128	DEGH	**Consolidation or new**
10124	DEGHJ	**value area being formed**
10120	DEGIJ	**around center of 10124**
10116	DEFIJ	
10112	FI	
10108	F	

Figure 18.11: *Market Profile* for a trending market.

When comparing the *Market Profile* of successive days, it is helpful to watch the activity of the recent day compared to the value area of the previous day. When trading within the previous value area, both buyers and sellers are considered equal. A move above the value area is considered to be motivated by the buyer and reactive by the seller, and trading below the prior value is initiated by the seller and reactive by the buyer.

Trends do not move in a fast, straight line to their *correct* new level; instead they move in steps, pausing to test whether a new value area can be formed that facilitates price. The trend continues in this way until prices retrace to the previous consolidation area, where the TPO volume is expanded and the area is broadened, resulting in a value area.

Some Points to Remember about *Market Profile*

One great advantage of using the TPO count, rather than traditional volume, is that the *Market Profile* can be created at any time on any market. All the necessary information is available. The method is very different from traditional trending approaches and offers insight into the current status of price action, whether it is in a consolidation phase or trending. Although the evaluation of *Market Profile* has been very interpretive, there have been important steps towards defining value areas and trends in a more objective way. Using the overlay method proposed by Jones, a very simple trend filter could be constructed so that new trend trades, based on traditional moving averages, are not set until prices move out of the value area. During the past few years there seems to have been less interest in this technique; however, its underlying simplicity compared with other methods of analysis should keep its standing as a tool worth studying.

[5]F. M. "Doc" Haynie, "Stretching the 'Profile' to Cover 24-Hour Markets," *Futures* (February 1992).

[6]Three books on Market Profile appeared in 1989, J. Peter Steidlmayer, *Steidlmayer on Markets* (John Wiley), Kevin Koy, *Markets 101* (MLS Publishing, 401 S. LaSalle St., Chicago, IL 60605), and Donald Jones, *Applications of the Market Profile* (CISCO, 32 S. LaSalle St., Chicago, IL 60604); however, the most complete material comes from the original course taught by Steidlmayer, called the *Market Logic School*. Readers may also want to study the original publication, *CBOT Market Profile* (1984), available from the Chicago Board of Trade, also J. Peter Steidlmayer and Shera Buyer, *Taking the Data Forward* (Market Logic Inc., Chicago, IL, 1986), and J. Peter Steidlmayer and Kevin Koy, *Markets & Market Logic* (The Porcupine Press, Chicago, IL, 1986).

[7]Donald L. Jones, "Locating Value with Auction Market Data," *Technical Analysis of Stocks & Commodities* (July 1989).

[8]The following discussion is based on Robert Pisani, "How Market Structure Helps You Analyze Price Behavior," *Futures* (October 1987).

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Chapter 19: Multiple Time Frames

OVERVIEW

Although the use of multiple time periods for analyzing markets has been popular for decades, few professionals have talked about it. It is only since better quote equipment has allowed this technique to be accessed by a wider audience that this approach has seeped into the public domain. The combination of multiple time periods allows the trader to time entries into the market using very short-term data, such as 10-minute bars, while watching the longer term picture for the dally or weekly trend. Because it is agreed that most trends are best identified over a longer time period, while choosing the specific entry point requires a much faster response, the combination of two or even three time intervals is very sensible. If the trend can be identified profitably, then the trader can filter or select short-term trades that have a better-than-average chance of becoming winners.

For most traders, the use of any one time frame presents special problems. The very short term contains a high percentage of noise that obscures the market direction. The numerous individual patterns that can be found in a 5-minute bar chart can divert your efforts away from the big picture. The use of only weekly charts, although they clearly show the direction of prices, present higher risk and little opportunity for a good entry point. The obvious solution is to combine both time frames into a program that uses each to its best advantage.

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TUNING TWO TIME FRAMES TO WORK TOGETHER

Throughout most of this book the individual systems and methods have been discussed on their own merits. An analyst would look for the specific RSI or stochastic that generated the most profits by showing a timely trend change or an overbought/oversold condition. However, very few indicators work on their own as successful trading methods. They are combined with other indicators and their trading signals subject to selection using trend lines or divergence.

Once you have decided to combine two techniques, such as a moving average to identify the longer-term trend and an RSI or stochastic to provide improved entry timing, the two techniques must be tuned to work together. The best independent RSI signals are no longer the best entry timing points. Instead, you will want the time period for the indicator to be much shorter than the time period used to calculate the trend. For example, if your trend system has a typical holding period of one month (about 23 business days), you may want your timing oscillator to have a good chance of giving you a better entry point within the first 5 days (20%) of that trade.

To get an indicator to reach overbought and oversold levels an average of every 5 days, you will need to use less than 5 days to calculate the indicator value. It doesn't matter if the indicator returns a loss when all of its buys and sells are totaled because the profitable part of the program comes from the longer-term trend component. It is most likely that the oscillator will generate five overbought or oversold conditions during the typical holding period for the trend trade, but only one of them will be used—the first one after the new entry signal. It is only important to see how this selective timing helps to improve overall profits and risk of the combined strategy.

Figure 19.1 gives a TradeStation program that uses two time frames, a shorter one referred to as *data1* and a longer one, *data2.* These could be daily and weekly, hourly and daily, or any combination of shorter and longer time frames. The shorter one is used to calculate a fast stochastic (in this case, *%K-slow*) and the longer interval applied to the linear regression slope as the trend. Long positions are entered only when the trend is up (the slope is positive) and the stochastic is oversold, that is, below 20; shorts are entered when the slope is down and the stochastic is overbought, above 80. The trade is exited when the trend changes direction regardless of the value of the stochastic.

```
{Multiple time periods : Linear Regression Slope + Stochastic}
{period = length of exponential trend
 data1 = shorter time period of stochastic
 data2 = longer time period of linear regression slope}
       input:  fast(5), slow(50);
       vars:   slope(0), overbot(80), oversold(20), stoch(0);
{calculate stochastic over shorter data period}
       stoch = @slowk(fast) of data1;
{Linear regression slope}
       slope = LinearRegSlope(close of data2,slow);
       if slope > 0 then exitshort on close;
       if slope < 0 then exitlong on close;
{long signal : slope must be up and stochastic below low threshhold}
       if slope > 0 and stoch < oversold then buy on close;
{short signal : slope must be down and stochastic above upper threshhold}
       if slope < 0 and stoch > overbot then sell on close;
```

Figure 19.1: Program combining daily stochastic with weekly trend.

Using a longer data interval for the trend enhances the trending characteristics; at the same time, using a shorter time bar for the stochastics accentuates the noise and generates more overbought and oversold conditions. This use of multiple time frames, to emphasize the best of each system component, is at the root of the techniques in this chapter.

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ELDER'S TRIPLE-SCREEN TRADING SYSTEM[1]

The *Triple Screen* method combines three time frames in order to remove the disadvantages of each one. It combines indicators that are both trend-following and oscillators, where the oscillators are normally associated with a countertrend direction. Dr. Elder has observed that each time frame relates to the next by a factor of 5. That is, if you are using daily data as the middle time period, then the shorter interval will be divided into five parts, bars of 1 to 2 hours in length, and the longer period will be five days, or one week.

To be practical, it is not necessary to divide a 6-hour trading day into five intervals of 1 hour and 12 minutes. Rounding to 1 hour is close enough. If, for example, you want to focus on trading a 10-minute chart, then the middle interval is 10 minutes, the short-term is 2 minutes and the long-term is 1 hour (not 50 minutes).

In the following description, Screen 1 holds the longest time frame while Screen 3 shows the shortest one.

Screen 1: The Major Move

The long-term view is used to see the *market tide*, a clear perspective of the major market trend, or sometimes the lack of trend. Weekly data is used for this example, which is consistent with most experience that less frequent data (i.e., weekly or monthly) smoothes the price movement by eliminating interim noise. Although there are many other choices for a long-term trend, the Triple-Screen approach uses the slope of the weekly MACD, where the histogram that represents the MACD value is very smooth, equivalent to, for example, a 13-week exponential smoothing. The trend is up when the MACD bar, or 13-week exponential value, is higher than that of the previous week; the trend is down when this week's value is lower.

Screen 2: The Intermediate Move

Using an oscillator, Screen 2 identifies the time period in which we would trade. Again, the specific oscillator is not as important as the time frame and the ability to identify *market waves* in the major moves of Screen 1. Two oscillators are suggested, the *Force Index* and *Elder-ray*, both described below. A stochastic can also be used.

1. *Force Index*

   $$\textit{Force Index} = \textit{Volume}_{\text{today}} \times (\textit{Close}_{\text{today}} - \textit{Close}_{\text{yesterday}})$$

   The Force Index is then smoothed using a 2-day exponential smoothing, which has a smoothing constant of .333, and the resulting value is used to determine overbought and oversold levels.

   Entering a long position using the Force Index is not as clear as when using the Elder-ray; however, the following steps are necessary:

   1. The trend in Screen 1, the major move, is up.
   2. The 2-day exponential of the Force Index falls below its center line, and does not fall below the multiweek low. When using a stochastic instead of the Force Index, buy when the stochastic falls below 30.

2. *Elder-ray*

   Elder-ray is a technique for separating bullish and bearish movement.

   $$\textit{Bull Power} = \textit{High} - \textit{13-day exponential smoothing}$$

Bear Power= Low - 13-day exponential smoothing

To determine when to buy using the Elder-ray and Screen 1, the following two steps are necessary:

1. The trend in Screen 1, the major move, is up.
2. Bear power is negative but rising; bear power must not be positive.

   Two additional steps may be used to filter trades and improve performance, but are not required:

3. The last peak in bull power is higher than the previous peak (the most recent bull power should not be significantly lower than the previous peak).
4. Bear power is rising from a bullish divergence.

The opposite rules apply for sell signals.

Screen 3: Timing

The final screen is for fastest response, primarily for identifying *intraday breakouts* (see Chapter 16 for a full description of intraday breakouts). To improve the point of entry, Screen 3 can be used to set long positions when the current price moves above the previous day's high. There is no calculation involved, simply a Buy Stop order using the shortest time period. For example, where Screen 1 is weekly and Screen 2 is daily, Screen 3 would be hourly. Then to get a new buy signal, the high of the hourly bar must move above the highest high of the hourly bar of the previous day.

Stop-Loss

Every system needs risk control, and that most often comes as a stop-loss order. The Triple Screen approach positions the stop as a three-step process. For a long position,

1. First place the stop below the low of the day of entry, or the previous day's low, whichever is lower.
2. Move the stop to the break-even level as soon as possible. Naturally, there must be some room between the stop-loss level and the current price; otherwise the stop will always be hit.
3. Continue to change the stop to protect 50% of the highest profits. In addition, you may consider taking profits when the stochastic or Force Index moves above the 70% level.

[1]Dr. Alexander Elder, *Trading for a Living* (John Wiley & Sons, 1993).

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ROBERT KRAUSZ'S MULTIPLE TIME FRAMES

Although multiple time-frame techniques have become more visible, the most robust and fully automated approach has been taken by Robert Krausz. To understand the importance of first arriving at a sound theory before implementing and testing a trading program, we need to briefly review the characteristics of performance that indicate a robust method.

When testing a trend-following system, we should expect that a trend of 100 days, compared to a trend of 50 days, will produce larger profits per trade, greater reliability, and proportionally fewer trades. As you increase the calculation period, this pattern continues; when you reduce the calculation period this pattern reverses. You are prevented from using very short calculation intervals because relative market noise increases and slippage and commissions become too large; the longest periods are undesirable because of large equity swings. When viewing test results as a flowing picture, there must be a clear, profitable pattern when plotting returns per trade versus the average holding period.

The sophistication in Krausz's work lies in his understanding of this pattern, and its incorporation into the structure of his program, *The Fibonacci Trader*.[2] Kxausz worked in three time frames rather than two. Each time frame has a logical purpose, and are said to be modeled after Gann's concept that the markets are essentially geometric. The shortest time frame is the one in which you will trade; in addition, there are two longer time frames to put each one into proper perspective. The patterns common to time frames are easily compared to fractals; within each time frame is another time frame with very similar patterns, reacting in much the same way. You cannot have an hourly chart without a 15-minute chart, because the longer time period is composed of shorter periods; if the geometry holds, then characteristics that work in one time frame, such as support and resistance, should work in shorter and longer time frames. Within each time frame there are unique levels of support and resistance; when they converge across time frames then the chance of success is increased. In Krausz's work, the relationships between price levels and profit targets are woven with Fibonacci ratios and the principles of Gann.

One primary advantage of using multiple time frames is that you can see a pattern develop sooner. A trend that appears on a weekly chart could have been seen first on the daily chart. The same logic follows for other chart formations. Similarly, the application of patterns such as support and resistance is the same within each time frame. When a support line appears at about the same price level in hourly, daily, and weekly charts, it gains importance.

Laws of Multiple Time Frames[3]

As a well-known trader[4], Krausz brought more than just three time frames and some unique strategies to one display screen. He endowed the program with six rules:

1. Every time frame has its own structure.
2. The higher time frames overrule the lower time frames.
3. Prices in the lower time frame structure tend to respect the energy points of the higher time frame structure.
4. The energy points of support/resistance created by the higher time frame's vibration (prices) can be validated by the action of the lower time periods.
5. The trend created by the next time period enables us to define the tradable trend.
6. What appears to be chaos in one time period can be order in another time period.

Using three time frames of about the same ratio to one another (10-minute, 50-minute, and daily) with daily being the longest, Figure 19.2 shows the June 98 contract of U.S. bonds with a number of techniques applied over multiple time frames. Figure 19.2a uses only daily bars, while Figure 19.2b uses 10-minute bars; both charts are drawn on the same price scale to facilitate comparison.

Figure 19.2: Krausz's Multiple Time Frames, June 1998 U.S. Bonds. (a) Daily chart with Gann swings and a stepped moving average. (b) Multiple time frame structure for the corresponding four days. *Source*—Chart created using *The Fibonacci Trader*. Used with permission from Fibonacci Trader Corporation, 450–106 State Road 13 North, #206, Jacksonville, FL 32259-3863, www.fibonaccitrader.com.

To understand the application of these techniques, it is necessary to identify the following features:[5]

- The *Daily HiLo Activator* (in this case it is the moving average of the daily highs) is presented as a stepped line. The 4 days of interest are marked by the letters *A*, *B*, *C*, and *D* and appear on both (a) and (b) of Figure 19.2.
- The *50-minute HiLo Activator* (seen in Figure 19.2b), is the moving average of the 50-minute highs, used as a Buy Stop, or the moving average of the 50-minute lows used as a Sell Stop.
- The *10-minute Gann swings* are based on 10-minute bars (in Figure 19.2b). The solid line shows when the Gann swing represents an upwards trend, and the broken line when it shows a downtrend.

The interpretation of these techniques relies on the faster response provided by the 10-minute bars, combined with the direction given by the longer time frames.

- Based on the 10-minute Gann swings, the trend turned from up to down at about 121-00, while the daily Gann swings placed the trend change much later, near 120-00.

- The slope of the daily Gann swing, measured from point *X* to point *Y* on both charts, was down, defining the dominant trend. Short trades can be entered using the down trend of the 10-minute time frame. The process of coordinating the trend of the higher time period with that of the lower time period, and acting in only that direction, seems to be the most advantageous approach. The low of each 10-minute swing, marked *E*, *F*, *G*, *H*, and *I* on the 10-minute bar chart, provides opportunities to add to the original position.

- At the top left of the 10-minute chart, the 10-minute close falls below the Sell Stop of the 50-minute HiLo Activator at point *K* (about 120-06). The Buy Stop then applies and follows declining prices for 3 days. These changes occur in the same area where the Gann swing indicates a trend change from up to down.

- The 50-minute moving average of the highs, shown in a step formation on the 10-minute chart, tracks the highs of the market rallies on Days 1, 3, and 4. The daily moving average of the highs (the Daily HiLo Activator) remained level on Day 2 and turned down on Day 3. The trend can only change to up when the Daily HiLo Activator turns up again.

A Perspective on the 3 Time Frames

In thinking out the use of multiple time frames it is necessary to understand that you cannot substitute a 10-period moving average of 1-hour bars with a 40-period moving average of 15-minute bars. Similarly, you cannot substitute a 10-week average with a 50-day average. It seems natural to think that any two trends covering the same time span will give the same result, but that is not the case. Although we can average many data points, we cannot get rid of all the noise; fewer data points over the same time span will always yield a smoother result. Therefore, the use of hourly, daily, and weekly time periods—multiple time frames—gives a much different picture of the market than simply using three different moving averages based on the same data. It is much easier to see the major trend using weekly data, find the short-term direction based on daily data, and time your entry using hourly bars.

[2]Robert Krausz, *W. D. Gann Treasure Discovered* (Geometric Traders Institute, Fibonacci Trader Corp., 450-106 State Road 13 North, #206, Jacksonville, FL 32259-3863). Also see references in the section, "Fibonacci and Human Behavior," Chapter 14.

[3]Copyright, Robert Krausz.

[4]See Jack Schwager, *The New Market Wizards* (John Wiley & Sons, NY, 1992).

[5]The following chart analysis was provided by Robert Krausz. Further analysis of recent bond moves can be found in two articles, "*A Strategy for Trading Multiple Time Frames*," *Futures* (November 2001) and "*Intraday Strategies for Multiple Time Frames*," *Futures* (January 2002).

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MARTIN PRING'S *KST SYSTEM*

Martin Pring approaches multiple time frames using *rate-of-change* (ROC) indicators in his *KST System*.[6] Because each ROC applied to a specific calculation period has a unique cycle, the combination of three calculation periods will provide a valuable confirmation of a trading signal. Although Pring prefers to begin with a long-term view of the market, using 6-, 12-, and 24-*month* ROC calculation periods, Figure 19.3 shows the 6-, 12-, and 24-*week* ROC applied to the S&P 500 futures. Vertical lines show where the cycles of the three time frames align at major and intermediate tops and bottoms. These points will form the basis of the trading rules.

Figure 19.3: 6-, 12-, and 24-week ROC (top to bottom) applied to the S&P 500 continuous futures, January 2000–December 2003.

The cycles formed by the ROC are used in conjunction with a trend. The cycles not only confirm the trend change, but the size and frequency of the cycles will help to set objectives. The best trend moves occur when all three ROC indicators are moving in the same direction following a coordinated turning point.

The second stage in the process is to smooth the ROC indicators, making them more reliable. Using the 6-, 12-, and 24-month ROC preferred by Pring, the 6- and 12- month indicators are smoothed by a 6-period moving average, and the 24-month smoothed by a 9-month moving average. Because the ROC calculation actually speeds up the price movement, instead of introducing a lag, this small amount of smoothing shows very little lag in the smoothed values. Using the three smoothed ROC indicators, Pring selects trades using the following guidelines:

1. A trendline based on about ½ of the longest ROC period determines the direction of the trade.
2. The longer 24-period ROC identifies the major move.
3. The strongest price moves occur when all three ROC values are moving in the same direction.
4. If the 24-period ROC peaks while the other two indicators are rising, the sell-off is minor. Similarly, when the 12- and 6-period indicators peak but the 24-period is rising, the sell-off is also mild.

We can conclude that all three indicators need to peak at the same time, followed by all three values declining, to see a significant sell-off.

Creating a Composite Indicator

Pring observed that trading signals generated by combining the ROC indicators with a trend reversal could lag the major moves in the S&P by an unacceptable amount. To correct that problem, he created the *KST indicator*, a composite of four smoothed ROC calculation periods, each step-weighted in proportion to its period.

1. A 24-period ROC weighted 4.
2. An 18-period ROC weighted 3.
3. A 12-period ROC weighted 2.
4. A 9-period ROC weighted 1.

$$KST = (4 \times Average(ROC(price,24),9) + (3 \times Average\ (ROC(price,18),9)$$

$$+ (2 \times Average\ (ROC(price,12),\ 6) + (1 \times Average\ (ROC(price,6),6)$$

where *ROC(price*,24) is a function that returns the 24-period ROC of the *price* series, and *Average (series*,9*)* is a function that returns the 9-period average of *series.* In this formula, *series* is the result of the ROC calculation. In his description of KST, Pring does not give the weighting of 18-period ROC; the value 9 is used here.

To generate trading signals, Pring plots the 9-month ROC along with the KST indicator, plus the 12-period moving average trendline. In Figure 19.4 the bottom panel has an 18-period ROC smoothed using a 9-period average, one of the KST components. Using weekly data, the 18-period ROC seemed to track better. Trading signals are taken in the direction of the moving average trendline in the upper panel, but timed when the KST indicator crosses the ROC line after the first turn in the trendline. With the proper choice of ROC periods, the trade could be exited when the KST crosses the ROC in the other direction. If the ROC is too fast, then it will be difficult to take bigger profits from the trend moves; therefore, it seems preferable to use one of the slower ROC calculations.

Figure 19.4: KST combined with an 18-period ROC and a 12-period trendline can improve time and selection of major price moves. Prices are S&P 500 continuous futures, weekly data, January 2000–December 2003.

The major trends are clearer, and the signals more reliable, when applied to monthly data, although the method is generalized to work using any size data

bar. A faster version of KST can be constructed from daily data and used to filter trades, or improve their timing. It is a requirement, however, that the KST signals be used in combination with a trendline.

The KST is an exceptionally smooth indicator with very little lag, making its signals more timely than most other indicators. It can also be used in the same way as an RSI or stochastic, applying divergence and trendlines to generate additional, reliable trading signals. In Figure 19.4, a trendline has been drawn across the tops of the KST indicator beginning in April 2002, showing the breakout of a descending pattern in April 2003, a very timely entry into the stock market.

[6]Martin J. Pring, *Martin Pring on Market Momentum* (International Institute for Economic Research, Gloucester, VA, 1993).

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Chapter 20 - Advanced Techniques
New Trading Systems and Methods, Fourth Edition
by Perry J. Kaufman
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Chapter 20: Advanced Techniques

Volatility is an essential ingredient in many calculations, from Wilder's *RSI* to variable stop-loss points and point-and-figure box sizes. It can be an important filter for a trading system or it can be the main component of a strategy. Although a chart of volatility can look erratic, it is a more consistent and a more predictable component of a price series than the trend. Volatility is the main ingredient in risk; the more volatile the market, the greater the risk. As systematic programs mature, there seems to be a greater, justifiable concentration on how to include and manage volatility.

MEASURING VOLATILITY

In general, the volatility of most price series, whether stocks, financial markets, commodities, or the spread between two series, is directly proportional to the increase and decrease in the price level. Higher prices translate into higher volatility. This *price-volatility relationship* has been described as *lognormal* in the stock market, and is similar to a percentage-growth relationship. When you see a chart of the S&P 500 futures price series, the individual daily moves are clearly more volatile as prices peak in January 2000; however, if you plot prices on a semi-log scale, they appear to be very uniform. In Chapter 5's section on point-and-figure charting, it was shown that soybeans increased in volatility at an average rate of 2.38% relative to price, very much the same as a logarithmic increase.

$$(n\text{-day volatility})\ V(n)_{\text{today}} = c \times \ln\left(P_{\text{today}} - P_{\text{base}}\right)$$

where $V(n)_{\text{today}}$ = today's value of the n-day volatility
P_{today} = today's price
P_{base} = the base price of the commodity, somewhere below the cost of production
c = a scaling factor, near 1.0

This shows that, beginning at its base price, the volatility of a market increases in proportion to its price increase; it does not begin at the price of zero. To express this relationship for interest rate markets it is necessary to use yield rather than price. In addition, as we have discussed from time to time throughout this book, currency volatility cannot be expressed this way because currencies have no base price; instead, they have a point of equilibrium. Energy prices also do not conform because it is a controlled market. In both of these groups, prices become more volatile as they move away from equilibrium, or the artificially controlled price level, in either direction.

Transforming the Components Instead of the Price

It follows that prices are more volatile at higher levels and that most trading systems must cope with this change by adjusting their parameters. Some of this could be avoided by indexing all prices, expressing them as percentage changes; however, that is inconvenient for trading because it doesn't show the actual price. Most traders choose prices for their input, and these values can be automatically downloaded after the close of trading each day, or gathered as intraday bars during the trading session. Trading off a transformed, indexed series can add complications and introduce potential errors.

When we accept the policy of using actual prices as input, it is necessary to convert selected parts of the strategy calculation to compensate for changing volatility. For example, a stop-loss in gold might be $2 per ounce when the price is under $350 per ounce, $4 per ounce at about $400, and $10 per ounce at $500. A point-and-figure box size might vary in the same way as the stop-loss; as prices become higher, it requires a larger box size to maintain the same frequency of trend changes and signals. In the early development of trading systems, strategies such as MPTDI (see Chapter 8) used a step method, changing the stop-loss criteria each time prices, or volatility, passed through a series of threshold levels. Most strategies now apply a continuous function, such as a percentage of price or a multiple of volatility, to create a seamless flow.

Returning to the use of a stop-loss, many traders are willing to take a fixed amount of risk (for example, $500) regardless of whether this risk is too large or small for changing market conditions. In futures, a stop-loss that is based on margin offers some improvement because margins are set according to market risk and contract size; however, the lag in time needed for the exchange to change the margin is far too long to keep this relationship current. A percentage stop is a popular solution for analysts who realize that volatility increases with price, but it falls far behind during major bull and bear markets. A reasonable representation of long-term or underlying risk is the adjusted, lognormal *price-volatility relationship*. Although volatility may vary greatly at any price level, this relationship establishes a foundation for the *normal* level; it essentially compensates for not converting prices to an indexed value.

Determining the Base Price

The volatility relationship must begin with the price level at which volatility is essentially zero. Of course, we cannot find that level on a chart because no trading would have occurred. Although we do not yet know the price, we call the level where volatility is zero the *base price*. All interest rates, stock indices, and commodities have a base price. Certainly, if Treasury bills were to decline to a point where the yield was near zero, most investors would choose to place their money elsewhere, causing activity and consequently, volatility, to disappear. Similarly, when the price of corn falls to $1.75 per bushel, below the cost of production, farmers are not inclined to sell; they will wait until prices rise. This wait-and-see approach reduces volatility. At some theoretical point, not far below this very low area of activity, we can say that volatility goes to zero.

Figure 20.1a shows that the base price can be found by detrending the data and formulating the volatility using the detrended values. Gold, detrended using the CPI, turns out to be a good real-time example. Although Figure 20.1b does not indicate a time period, volatility only makes sense when measured over some interval. Once detrended, a scatter diagram of price versus volatility should show a relationship similar to Figure 20.1b. Figure 20.1c is a reminder that the magnitude of the volatility, and the price-volatility relationship, is directly proportional to the time interval over which the volatility is measured. Daily volatility appears on the far left, and volatility (highest high to lowest low) over 20, 40, and 60 days are shown to the right. Because prices do not continue to move up and down indefinitely, the figure does not show twice the volatility over twice the time interval as that interval becomes longer.

The price-volatility relationship of gold since 1976 can be used as an example of how to find the base price. Figure 20.2a is a scatter diagram of monthly gold prices versus the monthly change in price, taken as positive numbers. An alternate approach would look at the price range over the month, from high to low, rather than the net price change. The price range will approach zero a little slower than the price change. Note that there is a cluster of dots in the price interval from $100–$175 per ounce and then at $300–$450 per ounce. The lower values are the result of the pre-1980 price levels, while the higher grouping shows low volatility during periods of higher prices since 1980. Again, the use of monthly price changes can yield a value of zero even if there was significant volatility during the month, simply because prices ended at the same place as they began. Using a price range will show a smoother pattern of price versus volatility.

Detrending the price of gold using the Consumer Price Index, a technique shown in Chapter 6, improves the uniformity of the results, seen in Figure 20.2b. Instead of two separate clusters of dots at low volatility levels, there is only one cluster in the range from $110–$250 per ounce. A curved line has been drawn to represent the pattern of declining volatility in relationship to declining price. This line could be straight if prices were further adjusted using a log or power function. According to this curve, volatility approaches zero at a slower rate as prices drop below $200 per ounce.

The Time Interval

The time period over which volatility is measured is also a significant factor in the price-volatility relationship. A longer period means that the net changes over *n* days or *n* months are used instead of daily or monthly changes. Longer measurement periods give higher volatility values. Regardless of the number of days used to determine volatility, volatility will increase as prices increase and approaches zero at the same level. This direct relationship will be very uniform for highly liquid, exchange-traded markets except when prices are extreme. It should be recognized that some futures exchange have trading limits that prevent prices from moving more than a preset amount in a single day. Cattle reached its daily limits during December 2003 when mad-cow disease was discovered in one U.S. cattle feedlot. During these extreme periods, charts of the futures prices (not the cash market prices) will show that volatility stops expanding when it collides with these artificial constraints.

Figure 20.1: Measuring volatility from a relative base price. (a) Prices become less volatile relative to a long-term deflator (detrending line). (b) Volatility as a function of the detrended price. (c) Change in volatility relative to the interval over which it is measured.

Figure 20.2: Finding the base price where volatility is zero, gold 1976–1993. (a) Volatility versus price. (b) Volatility versus deflated prices.

The amount of price movement will also increase as the period of measurement gets longer. During a volatile interval, prices will move farther in one direction during 3 or 4 days than they will in 1 or 2 days. As this interval gets very long the volatility does not keep increasing at the same rate; it tends to slow, as shown in Figure 20.1c. The flattening of the curve occurs at the point equal to the duration of the maximum sustained price move.

An Example of a Lognormal Calculation

A lognormal relationship in prices can be shown using the math function *natural log*, *Ln*, in Excel. Over the long term and under average market conditions, the relationship between actual price changes and volatility is expected to be:

$$|Price_t - Price_{t-1}| \,/\, Ln(Price_t) \;\tilde{}\; |Price_s - Price_{s-1}| \,/\, Ln(Price_s)$$

This formula says that the absolute value of the change in price on day *T* divided by the natural log of the price on day *t* is approximately equal to (˜) the change in price on any other day, *s*, divided by the natural log of the price on day *s.*

For example, if the price on day *t* is 20 and the price on day *s* is 40, then the natural log of prices on those days are *Ln* (20) = 2.99 and *Ln* (40) = 3.99. If the volatility is $1.00 when *P* = 20, then the volatility is expected to be $1.23 when *P* = 40.

$$\frac{Volatility\ at\ price_t\ = 20}{Ln\ of\ price(20)} \approx \frac{Volatility\ at\ price_s\ = 40}{Ln\ of\ price(40)}$$

If the volatility at 20 is 1.00, then the volatility at 40 is 1.23. When using a spreadsheet for your calculations, note that the function *Ln* is not the same as the function *Log*.

Practical Volatility Measures

There are four practical measures of volatility that can be easily used to satisfy the need to show expanding and contracting volatility, but are not tied to an underlying price level. They simply measure volatility over the most recent *n* days, or *n* bars using prices differences or ranges. Using Figure 20.3 in conjunction with the formulas below, the four volatility measures for today, *Vt*, calculated using the past *n* days, are:

1. The *change in price* over *n* days (Figure 20.3*a*):

   $V_t = Close_t - Close_{t-n}$

2. The *maximum price fluctuation* during the *n* days (Figure 20.3*b*) :

   $V_t = Max(High_t, High_{t-n}) - Min(Low_t, Low_{t-n})$

   where *Max* and *Min* are the same as the *TradeStation* functions *highesthigh* and *lowestlow*.

3. The *average true range* over the past *n* days

   $V_t = Average(Truerange,n)$

   where *Truerange* is a function that returns the maximum range from the combination of today's high and low, and the previous close.

4. The *sum of the absolute price changes* over *n* days:

$$V_t = \sum_{i=t-n+1}^{t} \left| price_i - price_{i-1} \right|$$

Figure 20.3: Four volatility measure. *Source*—Perry J. Kaufman, *A Short Course in Technical Trading* (John Wiley & Sons, New York, 2003). Reprinted with permission.

In (1), the volatility is entirely dependent on the value of the two points P_t and $P_{t\text{-n}}$, regardless of the price activity that occurred during the days between them. If prices are very volatile but close where they began *n* days ago, this method would show zero volatility. Over many calculations, this method returns a reasonable measure of volatility; however, is it not as useful as the others.

The maximum range (2) corrects for the dependence on only two points and will produce a more meaningful measure of volatility, which may also be used as an estimate of risk. This method may be effective as the basis for a stop-loss or profit target if you know the average holding period of the trade, because it estimates the maximum move for that period.

The average true range (3) is the most popular measurement of volatility and gives a reasonable guideline for future volatility. Many strategies use a multiple of the average true range to place a stop-loss, or decide the current level of risk.

The sum of the absolute price changes (4) is the most descriptive measurement of volatility. It clearly shows that prices are more or less active in cases that are not apparent to the other three measurements. A price sequence that moves from highs to lows alternately each day is much more volatile than one in which prices move slowly to the highs and then back to the lows only once during the same time period. This measure is useful for indicating a change in market character-an increase or decrease in activity.

Ratio Measurements

Bookstaber[1] presents a volatility measurement *V*, in the traditional notation of a return series, that is, the ratio of successive closing prices. He adds alternate measures using the high and low, or a combination of the three as follows,

where C_t = the closing price on day *t*

H_t = the high price on day *t*

L_t = the low on day *t*

V_t = the volatility on day *t*

a. *Close-to-close volatility* (*the traditional return ratio, R*)

$$R_t = \frac{C_t}{C_{t-1}}$$

and

$$A = \frac{1}{n}\sum_{i=1}^{n} \ln R_{t-i}$$

then

$$V_t^2 = \frac{1}{n-1}\sum_{i=1}^{n} (\ln R_{t-1} - A)^2$$

and

$$V_t = \sqrt{V_t^2}$$

b. *High-low volatility*

$$V_t = \frac{.601}{n}\sum_{i=1}^{n} \ln\left(\frac{C_t}{C_{t-1}}\right)^2$$

c. *High-low-close volatility*

$$S_t^2 = .5\ln\left(\frac{H_t}{L_t}\right)^2 - .39\ln\left(\frac{C_t}{C_{t-1}}\right)^2$$

$$V_t^2 = \frac{1}{n}\sum_{i-1}^{n} S_{t-i}^2$$

$$V_t = \sqrt{V_t^2}$$

Note that t may be a time interval rather than a single day. Then C_t is the last price of the period, and H_t and L_t are the highest and lowest prices of the interval.

In the close-to-close estimation, the volatility V_t is the standard deviation of the closing price ratios. Bookstaber states that this measurement will follow a χ^2 distribution and that the actual volatility during the current period t can be set within the error bounds defined by the distribution.

Interpreting Volatility Using VIX

Even easier than calculating the volatility yourself is to have a good measurement accessible at all times. The CBOE's volatility index, *VIX*, is available on a real-time basis on most quote equipment. The VIX was introduced in 1993 and intended to be the basis of exchange-trading instruments; that is, you could buy or sell stock market volatility based on trading the VIX. VIX is actually the volatility of an options index, OEX, a weighted value of the implied volatilities of 8 puts and calls in the S&P 500, expressed as a percentage of the index price. Although the OEX is no longer quoted, it is possible to create your own basket of options using more sophisticated software. There is no doubt that another index will be published soon by the International Securities Exchange (ISE), now the largest options exchange.

Even without the OEX price, it is important to understand how the value of the VIX is calculated. If the VIX is 25%, and the OEX is 600, then VIX is forecasting 25% volatility for at-the-money options, relative to the price of the OEX for 30-day rolling expiration period.[2] Because the 30-day calendar period is equivalent to about 21 trading days, and there are 252 trading days in the year, 1 standard deviation of the volatility (equal to a 25% move in the OEX at 600) becomes

$$Implied\ range = 600 \times 25\% \times \sqrt{\frac{21}{252}} = 43.3$$

Then, an implied volatility of 25% when the OEX is at 600 is equal to a 68% (1 standard deviation) chance of a price change of ±43.3

within the next 30 calendar days.

The VIX is based on a very specific set of criteria that make it generic, rather than specific to any index or stock; however, its relative changes and extreme highs and low can make it very useful for trading. Figure 20.4 shows the VIX plotted below the cash S&P 500 index, SPX, from January 1, 1999, through January 1, 2004. The VIX peaks at the beginning of April 2000, and at each of the major lows in the SPX. The largest peaks correspond to September 11, 2001, and August 2002; the latter seemed to mark the end of the bear market. From May 2003 the VIX has moved to historic lows while the stock market has made a remarkably steady, low-volatility advance. The last extreme low in the VIX, during August 2000, marked the end of the greatest bull market of our time.

Figure 20.4: CBOE's VIX, the implied volatility index, with cash SPX, 1999–2003.

Another index, *iVIX*, is based on the implied volatility of 16 puts and calls rather than 8. While VIX weights the option volatility to approximate the strike price of an at-the-money option, iVIX is weighted so that strike prices that are farther out-of-the-money have less impact. This flexibility in iVIX makes it a more interesting measure of volatility.

Forecasting Tomorrow's Trading Range

Using the previous example, if a 25% volatility yielded an implied range of ±43.3 points for the next 30 calendar days, then the 1-day forecast would be ±9.45 points. This is found by replacing the 21 days in the *implied range* formula with 1 day. Then the *implied range* = 600 × .25 × .06299 = 9.448 and there is a 68% chance (1 standard deviation) that tomorrow's OEX would fall within the range 590.55 to 609.45. There is a 95% chance (2 standard deviations) that it would fall between 581.10 and 618.89. We can consider applying the VIX directly to the S&P futures price in the same way. If March SP is trading at 1100 and the volatility is 25%, then the implied range at 1 standard deviation = 1100 × .25 × .06299 = 17.32. However, in Figure 20.4 the VIX is at 18%, which makes the implied range 12.47. By substituting 12.47 for 25.00, the March S&P contract has a 68% chance of staying within 1087.50 and 1112.50 tomorrow.

Intraday Volatility and Volume

In Chapter 12, there is an intraday pattern of volume showing that volume is highest near the opening of the day, and again near the close of trading. Intraday volume forms a smooth *U*-shaped pattern for domestic markets, and a similar but extended pattern for markets that open in Europe but close in the United States.

Intraday volatility has a pattern that is identical to volume, highest at the open, then declines to its lowest point at mid-session, and rises again as the trading day ends. The closing volatility and volume are typically lower than the open activity.[3] For this purpose, volatility was calculated

$$V_t = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}\left(\ln\left(\frac{S_i}{S_{i-1}}\right) - \bar{S}^*\right)^2}$$

where n = the calculation period

i = the point in time

ln = the natural log

S_i = the price at time i

S^* = the arithmetic mean of the natural log of price differences:

$$\bar{S}^* = \frac{1}{n}\sum_{i=1}^{n}\ln\left(\frac{S_i}{S_{i-1}}\right)$$

To find the correlation between the intraday pattern of volatility and that of volume, a simple linear regression can be solved

$$Volatility_t = a_t + b_t \times Volume_t + e_t$$

where all values are calculated at time t. The resulting correlation, R = .595, is statistically significant for Nasdaq-100 volatility and volume. The correlation between volatility and volume are highest at the beginning and end of the day. Meissner and Cercioglu suggest that this volatility pattern, with the corresponding volume that provides liquidity, can be traded by being long options at the beginning and end of the day, profiting from the *gamma* (the rate of change of *delta*, which is the rate of change of the futures price with respect to the rate of change of the underlying asset). During the quiet mid-session period, a short options position may be used to profit from *theta*, the time decay.

VIX Trading System

The *VIX*, an index that measures implied volatility (see details in the previous section), can also be interpreted as the level of risk in the market. Conners has based a number of trading systems on the VIX. This strategy, called *Conners Vix Reversal 9*, CVR 9, is based on VIX range expansion, looking for higher prices in the S&P Index following a VIX expansion, and lower prices following a VIX contraction.[4] Conners treats volatility as mean-reverting. Entries are made based on a minor reversal in the VIX. The rules for buying (selling are the reverse) are:

Today's VIX high must be higher than the VIX high of the past 10 days.

Today's VIX must close below its open.

Yesterday's VIX must have closed above its open.

Today's VIX range must be greater than the ranges of the past 3 days.

If these 4 conditions are met then buy S&P futures on the close and exit in 3 days.

Conners is actually looking for turning points in the VIX. The specific pattern that precedes a buy signal in the S&P ends with a range expansion. This expansion is likely to mark the end of a short-term upwards move in the VIX. A decline in the VIX that follows eases the way for a short-term rally in the S&P. Traders are more comfortable buying when volatility is dropping, or at least not at noticeably high levels. As with many other systems, this requires protective stops and position size management.

Volatility System

Daily volatility can be used in a trading strategy, presented by Bookstaber,[5] as follows:

$$V_t(n) = \frac{1}{n}\sum_{i=1}^{n} D_{t-i+1}$$

where D_t is the maximum of:

a. $H_t - C_{t-1}$

b. H_t - L_t

c. L_t - C_{t-1}

and H_t = the high on day t

L_t = the low on day t

C_t = the close on day t

Note that D_t is the *true range* and V_t is the *average true range* over the n-day interval. The trading strategy presented with this is

- *Buy* if the next close, C_{t+1}, rises by more than $k \times V_t(n)$ from the current close C_t.
- *Sell* if the next close, C_{t+1}, falls by more than $k \times V_t(n)$ from the current close C_t.

The volatility constant k is given as approximately 3, but can be varied higher or lower to make the trading signals less or more frequent, respectively.

Trade Selection Using Volatility

High volatility is clearly related to greater risk, but low volatility may also mean that there is no chance of profits. This is especially true for trend-following systems. The following are reasonable expectations for selecting trades based on volatility:

Entering on very high volatility is exposure to very high risk. Returns from high volatility trades may range from large profits to large losses. Long-term performance may be best if these trades are avoided.

Entering on low volatility seems safe, but prices often have no direction and produce small, frequent losses. Waiting for an increase in activity before entering might improve returns.

Exiting a position when prices become very volatile should reduce both profits and risk, but may come after the fact. This is an issue best resolved by testing.

Filter or Delay?

Whenever a high or low volatility situation occurs at the time of an entry signal, there are two choices. The trade can be completely eliminated by *filtering*, or it can be delayed until the high volatility drops or the low volatility increases to an acceptable level. When a trade is filtered, it is necessary to track the trade that was not entered, to know when it was completed. Each new trade is subject to the volatility at the time of its entry. When a trade is delayed pending a change in volatility, and the trade ends during this waiting period, that event is over. Both of these cases have been studied and the results follow.

Constructing a Volatility Filter

Calculating the volatility is simple to program using any spreadsheet or strategy testing software. The following steps were used here:

1. Calculate a moving average trend.
2. Calculate the volatility, using any one of the methods described early in this chapter, but not including the volatility of the current day.
3. Enter a new trade if the volatility is (a) above the low filter threshold and (b) below the high filter threshold.
4. Exit a current position if the volatility is above the high filter threshold *and*, based on testing, (a) the current price change has moved in a profitable direction or (b) the current price change has moved in a losing direction.

To give the choices in (4) a chance to show which is robust, five different markets were tested: Eurodollars, Japanese yen, crude oil, IBM, and the S&P 500. Each was tested for more than 10 years ending in 1993. This test period is more interesting than the 1990s, which was highly biased by the bull market. Futures market prices were gap-adjusted and indexed, using the nearest delivery month. Results from these tests are shown as percentage changes; IBM was quoted in share price. The trend speed (a simple moving average) was the same as the period over which the volatility was calculated. Periods of 35 days and 10 days were tested; 35 days was arbitrarily chosen as about ⅛ of a trading year. The 10-day period (2 weeks) was included to represent a short interval.

Standard Deviation Measurement.

A standard deviation was used to determine the volatility threshold level. For example, for a high-volatility filter, a *1—standard deviation threshold* means that no trades were taken if the volatility was above the average volatility plus 1 standard deviation, the top 16% occurrences. A *2—standard deviation threshold* puts volatility in the top 2.5%, and 3 *standard deviations* means the top ½%. A zero

standard deviation would eliminate all trades above the average volatility. Because only 35 days are used, volatility can jump well beyond the normal 3—standard deviation maximum. Threshold values above 3 standard deviations (up to 7 standard deviations in these tests) must be used to isolate the most extreme volatile price movements because a sample of 35 days is too small to capture the true range of prices.

Entry Filter Results

Table 20.1 shows the results of a 35-day moving average system, buying when the trend turns up and selling when it turns down, using a volatility entry filter. Results are expressed as total returns for the periods based on maximum drawdown. Where the standard deviation value is zero indicates no filtering—all initial trade entries were taken. In part (a) the high volatility threshold causes a delay until volatility drops below the designated standard deviation threshold level; in part (b) the low volatility filter eliminates trades if they are below the threshold level at the time of the initial entry.

Table 20.1: High- and Low-Volatility Filter Results[*] Open table as spreadsheet

(a) High Volatility Entry Filter with Delayed Entry					
StDev	**ED**	**Yen**	**Crude**	**IBM**	**S&P**
none	835	340	218	13	-6
6.0	886	340	182	7	-4
5.0	876	340	183	9	-4
4.0	884	361	183	18	-4
3.0	932	399	176	19	-17
2.0	948	401	197	12	-17
1.0	988	410	198	20	-22
0	923	425	323	-35	-27

[*]35-day calculation period, rate of return based on maximum drawdown.

Open table as spreadsheet

(b) Low Volatility Entry Filter with Trade Elimination					
StDev	**ED**	**Yen**	**Crude**	**IBM**	**S&P**
6.0	109	266	139	3181	-40
4.0	457	47	94	308	-55
2.0	1172	85	-20	816	-85
0	491	340	83	214	-95
-1.0	860	337	156	-19	-67
-2.0	882	320	219	19	-36
none	835	320	84	13	-36

[*]35-day calculation period, rate of return based on maximum drawdown.

Results for the high volatility filter are not impressive. The Eurodollar (ED) improves for lower levels while the Japanese yen and crude oil do not. Both IBM and the S&P improve by waiting for volatility to decline, but both have underlying losing strategies; therefore, omitting trades are likely to improve results. Because these results are a function of both returns and risk, the elimination of high volatility does not clearly improve either component of performance.

The low-volatility filter is much clearer. In all cases, except the S&P, taking only those trades that occur when volatility is above the low threshold shows improvements for all markets. Because of the few cases that would have occurred with volatility greater than 6.0 standard deviations, the large return shown by IBM is not realistic. A standard deviation between -1.0 and +1.0, indicating the practical elimination of 16% to 84% of all trades, shows the most consistency.

High Volatility Exits: Distinguishing a Volatile Good Move from a Bad One

It seems natural to think that you may be able to reduce risk by exiting a trade when volatility becomes very high. It also may be too late because you may have already been exposed to the worst of the volatility. If prices jumped because of a price shock, then the highest volatility would have occurred at the moment of the shock. On the other hand, if prices have been moving higher for weeks, and are becoming very volatile at the top of a move, then exiting could save a lot of aggravation. If a market is noisy, then volatile price jumps are frequent and short-lived. In those situations, you should close out positions when a volatile move is profitable because profits will soon disappear. Or, if the volatile move is an immediate loss, then waiting before you exit should recover at least part of the loss. The opposite is true for a trending market. A good price move should be followed by more profits, and a bad move by further losses.

To study how to react to volatility would require classifying volatile moves into medium, high, and extreme (such as a price shock). In this

test we only distinguish high and low volatility, and positive (profitable) or negative direction. Tests of exit filters were separated into *positive* and *negative* price moves. When the positive option was elected, exits occurred when the high volatility level was reached *and* prices generated a profit for the current day. When the negative was used, prices must have produced a loss for the day.

For the Eurodollar, returns improve when volatile losing moves are liquidated and returns decline when profitable moves are closed out. We can conclude that the Eurodollar is a trending market, and cutting a trade short due to increased volatility is not a good strategy. That is not true with the S&P, which has a high degree of noise over short time periods. It was also not the case for the yen, which has erratic price behavior.

Because shorter-term analysis operates in an environment of greater noise, the exit filters will generally improve results as the calculation period becomes shorter. For markets with significant long-term trends, such as fixed income, and systems that are intended to capitalize on those trends, exiting a trade for almost any reason (other than a change of trend) is going to adversely affect the performance.

Creating Your Own Filters

A volatility filter is a simple calculation. Deciding which volatility filter to use is more difficult because it requires a number of different testing programs. The following TradeStation code and spreadsheet (Table 20.2) combine all of these features into one testing program. An option is used to select each feature.

Table 20.2: Spreadsheet Sample

Open table as spreadsheet

Col	Begin Description	Row	Calculations
L3	Low filter limit factor		[Constant]
M3	High filter limit factor		[Constant]
A	Date	5	[Input]
B–D	Open, High, Low prices	5	[Input]
E	Closing price	5	[Input]
F–G	Vol, OpInt data	5	[Input]
H	Positive value of price changes	6	=ABS(E6:E5)
I	35-Day moving average	39	=AVG(E5:E39)
J	Average volatility	39	=AVG(H5:H39)
K	Standard deviation of volatility	39	=STD(H5:H39)
L	Low filter limit	39	=J39-$L$3*K39
M	High filter limit	39	=J39+$M$3*K39
N	Position	40	=IF(I40<I39,-1 ,1)
O	Low volatility indicator	40	=IF(H40<L39, 1 ,0)
P	High volatility indicator	40	=IF(H40>M39, 1,0)
Q	Buy/sell with low filter	40	=IF(AND($N40=1 ,N39=-1),
			IF($H40>$L39,"buy","c/o"),
			IF(AND($N40=-1 ,N39=1),
			IF($H40>$L39,"sell","c/o")," "))
R	Buy/sell with low delay	40	=IF($N40=1 ,IF($H40>$L39,"buy",
			IF($N39=-1 ,"c/o"," ")),
			IF($H40>$L39,"sell",IF($N39=1 ,"c/o","")), " "))
S	Buy/sell with high filter	40	=IF(AND(N40=1,$N39=-1),
			IF($H40<$M39,"buy","c/o"),
			IF(AND($N40=-1 ,P39=1),
			IF($H40<$M39,"sell","c/o")," "))
T	Buy/sell with high delay	40	=IF($N40=1,IF($H40<$M39,"buy",

			IF($N39=-1,"c/o"," ")),IF($N40=-1,
			IF($H40<$M39,"sell",IF($N39=1 ,"c/o",")). " "))
U	Exit on high volatility	40	=IF($H40>$M39,"c/o"," ")

```
{ High and Low Volatility Filters
   Copyright 1994-1998, P. J. Kaufman. All rights reserved.

Do not enter trades on high volatility and price in trend direction.
      Exit on high volatility and price change of direction option.
   Option 0 = No entry or exit filter
   Option 1 = Entry filter only
   Option 2 = Exit filter only - no price direction
   Option 3 = Exit filter only - profitable move
   Option 4 = Exit filter only - contrary move
   Option 5 = Both entry and exit filters (options 1 and 2) }

input:   option(2), length(35), Efactor(1.0),ELfactor(1.0), Xfactor(1.0),
            prndate(0);
vars:   vavg(0), vsd(0), lowlimit(0), Euplimit(0), Xuplimit(0), mavg(0),
           aror(0), deltapl(0), totalpl(0), risk(0), ratio(0), position(0),
           variance(0), change(0), ELuplimit(0);

{ Volatility = average + standard deviation of price changes.
   Calculate average and sd before new prices }
   change = AbsValue(close - close[l]);
   vavg = Average(change[l],length);
   vsd = StdDev(change[l],length);

{ Extreme volatility limits }
   lowlimit = vavg - vsd;
   Euplimit = vavg + 2*Efactor*vsd;
   ELuplimit = vavg + 2*ELfactor*vsd;
   Xuplimit = vavg + 2*Xfactor*vsd;

{ System rules based on moving average trend }
   mavg = average(close,length);
   if mavg>mavg[1] and position = -1 then position = o;
   if mavg<mavg[l] and position = 1 then position = o;

{ Enter on new trend signals below high volatility:
   Efilter or new trend signals above low volatility: ELfilter }
   if option=l or option=5 then begin
{ High volatility delay }
{   if mavg>mavgfl] and position <> 1 and change<Euplimit then begin }
{ Low volatility filter }
{   if mavg>mavg[1] and mavg[1]<=mavg[2] and change<Euplimit and
change>ELuplimit then begin}
{ Low volatility delay }
    if mavg>mavg[1] and position <> 1 and change<Euplimit and
change>ELuplimit then begin
       buy on close;
         position = 1;
         end;
{ High volatility delay }
{   if mavg<mavg[1] and position <> -1 and change<Euplimit then begin }
{ Low volatiltiy filter }
{   if mavg<mavg[1] and mavg[1]>=mavg[2] and change<Euplimit and
change>ELuplimit then begin }

{ Low volatiltiy delay }

if mavg<mavg[1] and position <> -1 and change<Euplimit and
       change>ELuplimit then begin sell on close;
       position = -1;
       end;
      end;

{ Normal entry only once in the same direction }
   if option<>1 and option<>5 then begin
      if mavg>mavg[1] and position <> 1 then begin
         buy on close;
         position = 1;
         end;

      if mavg<mavg[1] and position <> -1 then begin
         sell on close;
         position = -1;
         end;
      end;

{ Don't reenter after high volatility exit }
   if option>1 then begin
      if mavg>mavg[1] and change<Xuplimit and position <>1 then begin
         buy on close;
         position = 1;
```

```
         end;
      if mavg<mavg[1] and change<Xuplimit and position <> -1 then begin
         sell on close;
         position = -1;
         end;
      end;

{ Exit without volatility }
   if option=o or option=1 then begin
      if mavg<mavg[1] then exitlong on close;
      if mavg>mavg[1] then exitshort on close;
      end;
{ Exit on high volatility and profitable direction}
   if option=2 or option=3 then begin
      if mavg<mavg[1] or (close>close[1] and change>Xuplimit) then
         exitlong on close;
      if mavg>mavg[1] or (close<close[1] and change>Xuplimit) then
         exitshort on close;
      end;
{ Exit on high volatility and not a profitable direction}
   if option=2 or option=4 or option=5 then begin
      if mavg<mavg[1] or (close<=close[1] and change>Xuplimit) then
         exitlong on close;
      if mavg>mavg[1] or (close>=close[1] and change>Xuplimit) then
         exitshort on close;
      end;

{ Replace high volatility days because they distort standard deviation }
{   if change > vavg+2*factor*vsd then change = vavg; }


NOTE THAT PARTS OF THE PROGRAM HAVE COMMENT BRACES AROUND ONE OR MORE LINES.
THESE REPRESENT OTHER OPTIONS THAT MAY BE TESTED. IT WILL BE NECESSARY TO
REMOVE THE COMMENT BRACES FROM ONE SECTION AND ADD THEM TO ANOTHER.
```

[1]Richard Bookstaber, *The Complete Investment Book* (Scott, Foresman, Glenview, IL, 1985, p. 349).

[2]Andrew Fisher, "Teaching the Old VIX New Tricks," *Futures* (August 2001). Fisher explains the VIX calculations in addition to proposed improvements in iVIX.

[3]Gunter Meissner and Sarp Cercioglu, "Trading Trends and Correlations," *Futures* (January 2003).

[4]Larry Conners, "Timing Your S&P Trades with the VIX," *Futures* (June 2002).

[5]Richard Bookstaber, *The Complete Investment Book* (Scott, Foresman, Glenview, IL, 1985, pp. 224–236).

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TRADE SELECTION

Once you have a basic system, the next step is to decide whether you can eliminate some of the losing trades without eliminating the profitable ones. In the extreme, we want to eliminate *all* of the losing trades, even if we reduce some of the profits; of course, that is impossible. Every system has a risk, even so-called "riskless" trades. Arbitrage, when done properly, has virtually no risk; however, it may be so competitive that the opportunities are rare and the margin of profit small. You might find, after months of trading a *guaranteed* arbitrage, that your returns are disappointing compared to the cost of doing business. Putting your money into U.S. bonds would have been nearly as good with a lot less work.

Nothing is free. Good trading is not a matter of hitting it rich on a single short position, it is grinding out a profit day by day and week by week. Occasionally, if you follow new markets, you might find an opportunity that others have not yet seen. If you act fast, you can capitalize on this for a short time, until others see the same situation. Then bigger players come in and push you out. In turn, they are followed by other investors who combine to remove all the profit opportunity, even for themselves. At the same time, other opportunities surface.

When selecting trades to eliminate, the easiest place to begin is by associating performance with volatility or price level. While some systems perform better in an environment of higher volatility, your strategy may show the best return relative to risk when there is less volatility. In general, markets with extremely low volatility do not perform well because they have less direction for trend following and less volatility for mean reversion. Under moderate volatility conditions, systems will return both lower profits and smaller losses; with high volatility we can expect large profits and high risk.

Predicting Volatility with Trading Ranges

William Brower, in his publication *The Inside Edge*,[6] performed a thorough study of trading ranges, looking for when there would be a higher range tomorrow. This is an advantage for day traders and systems with short holding periods, and breakout systems in general. A summary of his results is shown in Table 20-3 for the S&P from 12/23/87 through 12/15/95. *O*, *H*, *L*, and *C* are the opening, high, low, and closing prices, and the notation [1] and [2] represent the prices 1 and 2 bars back.

Thomas Bierovic—On-Balance True Range

To visualize the change in volatility, Thomas Bierovic has created an *On-Balance True Range* by following the same rules as On-Balance Volume, but substituting the true range calculation for volume. He then calculates a 9-day exponential smoothing of the On-Balance True Range and uses the crossovers of the oscillator and smoothed oscillator to confirm signals. Although the highs and lows may come at nearly the same time as other oscillators, the relative peaks and valleys may offer the trader new insights. For many traders, this simple interpretation can help separate high and low volatility conditions.

Table 20.3: Predicting the Trading Range of the S&P 500

Open table as spreadsheet

Rule	Conditions Tested	Conclusion
1	`0 < L[1] - x`	Very good predictor, but few cases (161 at *x* = -.10)
2	`0 > H[1] + x`	Modest predictor, but few cases (101 at *x* = .60)
3	`C[1] + x > 0 > C[1]`	Range got smaller when *x* = .35
4	`C[1] - x < 0 < C[1]`	Range got smaller when *x* = .30
5	`0 < C[1] - x`	Range tended to increase as *x* increased
	`H[2] <= H[1] and L[2] >=`	

6	`L[1]`	No significance
7	`H[2] > H[1] and L[2] < L[1]`	Modest predictor of lower volatility
8	`Day of week`	Mon had lowest volatility, Tues and Fri the highest
9	`Average(TrueRange,3) [1] > x`	Higher average true range for 3 days was a very good predictor of higher volatility
10	`RSI (close, 3) [1] < x`	When RSI < 40 good predictor of higher volatility
Source: William Brower, *The Inside Edge*.		

[6]William Brower, *Inside Edge* (Inside Edge Systems, 10 Fresenius Road, Westport, CT 06880, March/April 1996).

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PRICE-VOLUME DISTRIBUTION

Many systems that have excellent historic back tests fail when they are actually traded. These include models based on both intraday and daily data. One reason for this disappointing performance is the lack of understanding of market liquidity. Consider two systems:

> A *trend-following method*, which signals a buy or sell order when prices rise or fall relative to a specific price level or trendline during the day.
>
> A *countertrend system*, which sells and buys at relative intraday highs or lows.

Although each system intends to profit with their opposing philosophies, both act when prices make a relatively unusual move. Figure 20.5 shows the normal distribution of intraday volume and the profitability associated with this distribution.[7]

Figure 20.5: Daily price/volume distribution.

The solid line *bb'* is the actual volume on an ideally normal day. Volume is greatest at the median *M* and declines sharply to the high and low endpoints *H* and *L*, where only one trade may have occurred. As we know from previous sections, the time of highest volume will be near the open and close of trading; therefore, *M* will actually occur at the beginning or end of the day, while the end points of *bb'* will occur near midday.

The dotted line *cc'* represents the apparent profit for a countertrend system that makes the assumption of a straight-line volume distribution. The endpoints are shown to contribute the largest part of the profits when, in reality, no executions may have been possible near those levels. Assuming the ability to execute at all points on the actual distribution *bb'*, the approximate profit contribution is shown as *dd'*.

For trend-following systems, no profits should be expected when buy or sell orders are placed at the extremes of the day. The actual price distribution *bb'* is the maximum that could be expected from such a system; in reality, the first day is usually a loss.

[7]Gary Ginter and Joseph J. Ritchie, "Data Errors and Profit Distortions," in Perry J. Kaufman (Ed.), *Technical Analysis in Commodities* (Wiley, New York, 1980).

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TRENDS AND NOISE

Throughout this book there are techniques that try to find the underlying trend when the price direction is not clear. The trader who enters a new trend sooner will be more profitable, but the erratic behavior of prices makes a faster response less reliable. What makes a trend so difficult to identify is *noise.* Noise is the erratic movement of price; by definition it is unpredictable. In engineering, this type of behavior that shows no patterns is called *white noise*, yet the noise that we see in price movement has very definite statistical attributes.

Noise is the product of a large number of market participants buying and selling at different times for different purposes. Each has its own objectives and time frame. Noise can be the result of price shocks—unexpected events, in particular news or economic reports, that may or may not cause a lasting price change. Noise has most of the qualities of a sequence of random numbers. Nearly half of all price moves change direction on the next day; about 25% of all price moves continue in the same direction for two days, 12.5% for three days, and so on. These patterns should already be familiar to analysts. The size of a price move, or price shock, also appears to be random; that is, 50% are quite small, 25% are twice as large, 12.5% are four times as large, and a few are extremely large.

Then how can you tell if a price move up is an indication of a new direction or simply more noise? The answer is that you cannot know for sure until prices continue in the same direction. If you are a fundamental analyst, a structural change in the market is as close as you get to a definite change. For example, interest rates declined following the stock market peak in 2000 in order to stimulate economic growth and prevent a deep recession. By the end of 2003, equity prices had been rising for six months and interest rates were at a 50 year low. A move by the Fed that raises rates would be a structural change, a clear sign that it was more concerned with the prospects of inflation and convinced that that economic growth would continue without further stimulation. A trader would expect that a short position in long-term maturity, fixed income futures, would be sound.

A systematic trader, studying only the numbers, could identify this specific structural change by following the government's lending rate, the prime rate, or a combination of short-term rates, in combination with the price of market being traded. But at this point we are only concerned with how to recognize a trend change looking at a single price series.

We can improve our chances of entering a new trend, and not being fooled by noise, by waiting until the price changes direction by a larger amount. A small price change could easily be noise, but as the price change gets larger, the chance of being a true trend change increases quickly. This is the reason why a long-term trend is more reliable than a short-term one.

To see this clearly, Figure 20.6*a* shows an ideal, uniform amount of price noise along the bottom of the chart, representing about a 1% daily change. This is intended to show that a daily change of up to 1% falls into the category of noise. Trying to identify and enter a new trade because prices moved higher or lower by 0.5% would be a foolish strategy. The straight line in the figure shows, hypothetically, the amount of price change needed to trigger a trend change based on the calculation periods along the bottom axis. We read this as saying any trend using less than a 20-day calculation period will find that most trading signals are caused by noise; those using more than 20 days will be clear of most noise and are more likely to identify a true trend change. The shorter the calculation period, the more immersion in noise; the longer the period, the farther from noise.

A somewhat more realistic representation of noise is shown in Figure 20.6b. Noise is mostly below 1%, but spikes at odd times to 2%, less often to 3%, and occasionally to 5%. Even the large price shocks do not always indicate a change of direction and reverse within one or two days. The straight trend calculation line that cleared the noise in (a) is now fooled by two price shocks that caused short-term reversals of 4% and 5%. In an environment where most noise is below 1%, a move of 3% or more should have a high chance of indicating a true trend change; however, the size of a price shock follows a normal random distribution, and a few large shocks are inevitable. While the chances are good that you have entered a new trend, some false signals are unavoidable. If you wait until the price change is so large that the chance of it being caused by a price shock is negligible, you would never enter a new trade.

Each market has its own level of noise, and its own response to price shocks. It is the magnitude of the market noise that determines the calculation period needed for entering a trend. For a broadly traded market, such as equity indices and fixed income, the noise patterns are very predictable, while markets that have low volume will show more erratic behavior.

Noise can be measured using the same calculations as volatility, given at the beginning of this chapter, or preferably as Kaufman's *efficiency ratio* found in Chapter 17. Noise is not just volatility; it is price movement without direction. For the efficiency ratio, values below .20 show a high level of underlying noise, but these vary for each market. Short-term measurements of noise, that is, the level of noise during the past few weeks, are not as important as the longer underlying noise value that indicates the nature of price movement for each market.

Price change %
2.0
1.5
1.0
0.5
Trend calculation period
5
10
15
20
25
30
35
40
Trend calculation period, days

(a)

5
4
3
2
1
with same trend

(b)

Figure 20.6: (a) Idealized noise in price movement compared to the trend calculation period. (b) More realistic pattern of noise compared to the trend calculation period.

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EXPERT SYSTEMS

An *expert system* is one in which you draw conclusions based on an accumulated *knowledge base* that has been stored as data, facts, and relationships in the form of *if-then-else* rules. The person who collects this information is called a *knowledge engineer.* This process is often shown as a decision tree, where each "yes" or "no" answer leads down the binary path to the final conclusion; however, the actual process is more sophisticated and more interesting.

For a trading strategy, data used in the knowledge base should include price and economic data as well as the knowledge that, for example, *highly correlated markets move together*, and *high volatility means high risk.* When the first expert systems were developed, the core information was actually gathered by interviewing experts, which is how the name *expert system* was derived. The success of this method depends upon the quality and completeness of the knowledge base.

The knowledge base is used by an *inference engine*, which is able to draw conclusions from the facts stored in the knowledge base. Therefore, if we have the following information,

FACT 1: U.S. bonds are more volatile than Eurodollars.
FACT 2: The S&P 500 is more volatile than U.S. bonds.
FACT 3: Volatility is directly proportional to risk.

then the inference engine can create the new fact

FACT 4: The S&P is riskier than Eurodollars.

The inference engine provides a straightforward, logical process; however, there may be many relationships to resolve, not all of which may apply to the problem you would like to solve. For example, if we also have the following facts:

FACT 5: The S&P has a high degree of noise.
FACT 6: Eurodollars have a low degree of noise.
FACT 7: The S&P is currently trading below its 200-day moving average.
FACT 8: The S&P is currently trading above its 20-day moving average.
FACT 9: The S&P has been above its 200-day moving average for 80% of the past 20 years.
FACT 10: Eurodollar rates are driven by monetary bank policy.

FACT 11: Current monetary policy is dominated by concerns of inflation.
FACT 12: Inflation results in higher interest rates.
FACT 13: Net trading returns for the S&P have been 40% per annum.
FACT 14: Net trading returns for the Eurodollar have been 20% per annum.

then human logic might conclude that Eurodollar yields are likely to rise because of concerns over inflation. In addition, the S&P has greater risk, more erratic behavior, and is currently not as strong as it has been on average over the past 20 years, although it is now rising. Compared to Eurodollars, there is greater risk trading the S&P, but its returns have been higher.

How can this expert conclusion be duplicated by a computer? By adding a set of rules that parallels the thinking of experts, a computer can theoretically arrive at the same conclusions. For example,

RULE 1a: IF the Producer Price Index rises by more than the annualized rate of 4% THEN we have inflation.

RULE 2a: IF there is high noise THEN there is less chance of a trend

RULE 3a: IF there is high noise THEN there is greater risk.

RULE 4a: IF the faster trend is above the slower trend THEN prices are trending up.

For each positive rule 1 through 4, there should also be a negative rule:

RULE 1b: IF the Producer Price Index does not rise by more than 4% annualized THEN we do not have inflation.

RULE 2b: IF there is low noise THEN there is a greater chance of a trend.

RULE 3b: IF there is low noise THEN there is lower risk.

RULE 4b: IF the faster trend is below the slower trend THEN prices are trending down.

Even with the negative rules there are some ambiguous cases. For example, in Rule 4 two trends are in conflict. In other situations the positive rule might be true but the negative may not be as strong. In Rule 1b, we see that the effect is that "we do not have inflation" rather than "we have deflation."

Forward Chaining

The process of combining the rules and facts in order to yield an expert opinion is called *forward chaining.* For example, beginning with FACT 6, "Eurodollars have a low degree of noise" we find the relevant rule, RULE 3b: "IF there is low noise THEN there is lower risk" and create a new fact that "Eurodollars have (relatively) low risk." Note that in each case the terms *low*, *high*, and *faster*, are all relative.

Once we have this new fact, that Eurodollars have relatively low risk, and we similarly conclude that the S&P has "relatively high risk," we can also conclude that the Eurodollars have lower risk than the S&P. The process of following the path of each fact as it is handled by various rules is called *forward chaining.* It will lead to other rules and other facts; it may be that the expert opinion will be found along this route, or that the combination of new facts, such as the relative risk between the Eurodollars and the S&P, will provide the expert opinion.

This example shows only a few facts that can be easily summarized; however, there are thousands of pieces of information about performance characteristics, relationships to other markets, and fundamental factors that might alter expectations. If accumulated by asking experts, it is also likely that there will be conflicting information. While the human brain has a remarkable ability to sort through these items and select the information it considers most relevant, some important items can be overlooked when there is too much to consider. An expert system is expected to use all of the data and reduce it to a single decision. In doing this it must also select the most significant facts and resolve conflicts associated with the proper order of events and the time horizon of the investor.

A Technical Expert System

An expert system can treat indicator values as expert opinions and create systems without the fundamental relationships shown in the previous section. An example by Fish-man, Barr, and Loick[8] applied to the DJIA defines the *rules* as the relationships between the various indicators and calculations, and the *facts* as the values of those items. The purpose of this expert system is to inspect trending and nontrending characteristics of price movement to give the probability of a continued trend. The following example is adapted from their article:

Rule 1: IF ADX>18 AND ADX>=ADX[2]

AND nontrending is false or undefined

THEN there is a 95% chance the market is trending

Rule 2: IF ADX < 30 AND ADX <= ADX[2]

AND trending is false or undefined

THEN there is a 90% chance the market is nontrending

Rule 3: IF the market is trending

THEN MACD = probability of .8 AND SD = probability of .5 (85%)

Rule 4: IF the market is nontrending

THEN MACD = probability of .55 AND SD = probability of .75 (75%)

Rule 5: IF stochastic AND SK[1] < 30 AND SD[1] < 30 AND SK[1] < SD[1]

AND SK < SD THEN sell with 80% confidence

Rule 6: IF stochastic AND SK[1] > 70 AND SD[1] > 70 AND SK[1] > SD[1]

AND SK > SD THEN buy with 80% confidence

Rule 7: IF MACD AND MACD value > signal line value

THEN buy with 75% confidence

Rule 8: IF MACD AND MACD value < signal line value

THEN sell with 75% confidence

where ADX = the current 18-period ADX calculation
ADX[2] = the ADX value 2 periods ago
MACD = the Moving Average Convergence/Divergence with smoothing constants .15 and .075
SK = a 9-period, %K fast stochastic
SD = a 9-period, %D slow stochastic

and *undefined* means that there is no information about the values. The *facts* are the actual values to be used in the sample evaluation:

FACT 1: ADX = 19
FACT 2: ADX[2] = 19
FACT 3: SK = 90
FACT 4: SD = 80
FACT 5: SK[1] - SK = 68
FACT 6: SD[1] - SD = 92
FACT 7: signal line value = -70
FACT 8: MACD value = -68
FACT 9: the market is trending

The results, expressed as probabilities, offer greater insight into the likelihood of success using this method. Arriving at these probabilities, however, requires additional decisions. Without any further information, we can assume that there is only a 50% chance that the stochastic is a correct trend indicator. If we were to test the number of times the stochastic indicated an upwards move with the number of days that the subsequent price moved higher, we could get a much better indication of the chance of success.

[8]Mark B. Fishman, Dean S. Barr, and Walter J. Loick, "Artificial Intelligence and Market Analysis," *Technical Analysis of Stocks & Commodities* (Bonus Issue, 1993).

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FUZZY LOGIC[9]

In the second example of expert systems, the results were expressed as probabilities. Because trend and indicator calculations are estimations of market movement, very little is strictly true or false; therefore, probabilities are a more realistic way to view the results. The probability of being right can be represented by the *reliability* (percentage of profitable trades) of a system using these calculations. When right, the average payout is the *average profits per trade* and when wrong the loss is the *average loss per trade.* When you can assign a probability to results, the variable can be called *fuzzy.* But this way of looking at values is really a twist on basic probability analysis.

The idea of *fuzziness* is intended to describe the lack of precision in normal human conversation and thought. In its pure form, the use of fuzziness allows human uncertainty to be introduced into methods of artificial intelligence. For example, we often say:

> "There were a lot of people at the in line at the show."
>
> "I had to wait a long time."
>
> "It was really cold while I was waiting."
>
> "The stock market was strong yesterday."
>
> "Unemployment dropped sharply."

In all these cases we understand what is being said although there are no specific values associated with "a lot of people," "a long time," "cold," "strong," and "sharply." In fuzzy logic, all is not *true* or *false*, *0* or *1*, *there* or *not there.* True fuzzy logic will answer the question "If a half-eaten apple is still an apple, how much do you have to eat before it stops being an apple?"

The concept of fuzziness includes *fuzzy numbers*, such as "small," "about 8," (close to 5," and "much larger than 10," as well as *fuzzy quantifiers*, such as "almost," "several," and "most." Phrases such as "unexpected results of government reports cause big moves" is a common fuzzy expression.

Fuzzy Reasoning

Fuzzy events and fuzzy statistics are combined into *fuzzy reasoning.* It is a remarkable phenomenon that the answers to the following examples are clear to the human brain, but not to a machine (the answers can be found in the current footnote):[10]

Example 1:	X is a small price move.
	Y is much smaller than X.
	How small is Y?
Example 2:	Most price moves are small.
	Most small price moves are up.
	How many price moves are up?
Example 3:	It is not quite true that the quarterly earnings were very bad.
	It is not true that the quarterly earnings were good.

How bad were the quarterly earnings?

Common Approach to Fuzzy Solutions

In the terminology of fuzzy logic, there are three aspects of problem solving: *membership*, to show how the data are related to each other; *fuzzy rules*, to draw conclusions; and *defuzzifiers*, to turn the fuzzy answers back into usable results.[11]

For example, we would like to predict whether a price move will be big enough to capture the profit needed by our trading system. To have a robust system, we always use a 20-day trend but would like to predict which price moves will be above our minimum goal before we enter the trade. In general, we have found that, given commissions and slippage, we need to net $500 per trade. Because we are using a trend-following system that gives up profits before exiting, we would like to see an $800 peak profit in order to capture $500. Based on our needs, we can define our limits as:

Average peak move between $300 and $800 is acceptable.

Average peak move over $800 is desirable.

Average peak move under $300 is unacceptable.

To decide whether current price movement is likely to give us enough profit to enter a trade, we measure the average price move over every 20-day period for the past 1 year (long term) and for the past 1 month (short term). Based on this approach, we create the following rules:

1. If both the long-term and short-term profit potentials are unacceptable, then the current profit potential is unacceptable.
2. If both the long-term and short-term profit potentials are desirable, then the current profit potential is desirable.
3. If both the long-term and short-term profit potentials are acceptable, then the current profit potential is acceptable.

These three cases are very clear, but what if the long-term and short-term expectations are different? For example, if the long-term average peak profits are $250 and those for the short-term are $600, what can be expected from the current move? In the current application of fuzzy logic, this converts to a problem in probability for which we need more information about the history of these price moves. Through testing, we find that the 1-year average price move has a standard deviation of $75 and the past 1 month has a standard deviation of $200. We could then construct a diagram that shows the expected results from combining the two measurements (see Figure 20.7). The average returns are shown with descending lines based on their standard deviations. These cross at about $350 per trade, giving a reasonable answer to how to combine the two values.

Figure 20.7: Expectations of a price move using two time periods.

One additional measurement that cannot be overlooked is the potential error in each statistic. The longer-term measure used 250 trading days while the short-term used only about 20 days. The standard error for each calculation is 6.3% and 22.3%, respectively. In the final interpretation of results, we can say that the longer-term data is more important than the short-term values by about 3.5:1. Then we could write additional rules:

4. If the long-term potential is unacceptable and the short-term is acceptable, then the current potential is unacceptable.

5. If the long-term potential is unacceptable and the short-term is desirable, then the current potential is acceptable.

Using just the rules, we can claim that we are applying fuzzy logic to our trading; however, the state-of-the-art indicates that fuzzy logic is still hanging onto the coattails of simple probability. When it lets go, it is likely to be the most significant breakthrough in market analysis.

A Candlestick Example

Ruggiero[12] has created an example of fuzzy logic to identify the bullish engulfing, evening star, and dark cloud formations of candlestick charting. These patterns can be found in Chapter 3, and are defined as

Bullish engulfing pattern. A bullish outside day follows a down day, seen as a long white body larger than the entire previous day's dark formation.

Bearish evening star. Similar to an island reversal, it is a long white body followed by a gap higher white body, followed by a gap lower dark body.

Bearish dark cloud. A long dark body followed by a lower long white body, where the second day opens above the previous day's high but closes below the midpoint of the open to close range.

The process also requires the following program functions (which are not given here):

```
candlecolor(open,close)
fuzzylong(open,close,lookback,trigger1,trigger0)
fuzzysmall(open,close,lookback,trigger1,trigger0)
engulfing(open,close,refbar)
windowdown(open,high,low,close,lookback)
windowup(open,high,low,close,lookback)
```

The function *candlecolor* returns a 1 if white, -1 if dark. The *fuzzylong* and *fuzzysmall* functions confirm those formations, and the *windowup* and *windowdown* functions return a number greater than zero when there is a gap in the proper direction. The *lookback* parameter is the period used to calculate a moving average of the candle body size; the current candle body is considered large or small relative to the average body size. *Trigger1* is a factor that determines the current body is long when the *current body* > *average body* × *trigger1.* Similarly, the body is small when the *current body* < *average body* × *trigger0.* When using the *fuzzylong* function, *trigger1* > *trigger0.* The last parameter, *refbar*, identifies which bar is the one that is being engulfed.

The key programs that identify these patterns are

```
{ FuzzyLong function
   From Murray A. Ruggiero, Jr., "Cybernetic Trading Systems," (Wiley, 1997)
   Returns 1 if candlestick is long white
   Returns 0 if candlestick is long black }

   inputs: oprice(numericseries), cprice(numericseries), lback(numeric),
      onecof(numeric), zerocof(numeric);
   vars:   prevlong(0), crange(0), averange(0), ztrig(0), onetrig(0),
      tall(0), scale(0);

   crange = absvalue(oprice-cprice);   { calculate the range for the candle }
   ztrig = average(crange,lback)*zerocof;   { calculate what level
      represents a 0 }
   onetrig = average(crange,lback)*onecof;   { calculate what level
      represents a 1 }
   scale = onetrig - ztrig;   { calculate difference between zero and one
      levels }
   if scale = 0 then scale = 99.99;   { if difference is the same, set to a
      large bar }

   tall = maxlist(0,minlist(1,(crange-onetrig)/scale)); { fuzzy membership
```

```
      to tall }
{ if previous bar was tall, then relax requirements }
   if tall[1] = 1 and crange[1] - ztrig <> 0 then
      tall = maxlist(1,(crange - crange[1])/(crange[1] - ztrig));
   fuzzylong = tall;

{ FuzzyBullishEngulf function for bullish engulfing pattern
   From Murray A. Ruggiero, Jr., "Cybernetic Trading Systems" (Wiley, 1997)
   Returns 0 if not a bullish engulfing pattern, size if it is )

   inputs:   lookback(numeric), onecof(numeric), zerocof(numeric);
   vars:     color(0), sbody(0), lbody(0);

color = candlecolor(open,cclose);
   sbody = fuzzysmall(open,close,lookback,onecof*.3,zerocof*1.0);
   lbody = fuzzylong(open,close,lookback,onecof*2.0,zerocof*1.0);
   if engulfing(open,close,1) = 1 and color = 1 and color[1] = -1 then
         fuzzybullishengulf = minlist(sbody[1],lbody)
      else fuzzybullishengulf = 0;

{ FuzzyEveningStar function
   From Murray A. Ruggiero, Jr., "Cybernetic Trading Systems" (Wiley, 1997)
   Returns 0 if not an evening star, size if it is }

   inputs:   lookback(numeric), onecof(numeric), zerocof(numeric);
   vars:     color(0), sbody(0), fuzzyrange(0), return(0);

color = candlecolor(open,cclose);
   sbody = fuzzysmall(open,close,lookback,onecof*.3,zerocof*1.0);
   return = 0;
   fuzzyrange = close - (close[2] + open[2])/2;
   if color = -1 and color[2] = 1 and windowup(open,high,low,close,1)[1] > 0
         and open > open[1] and fuzzyrange < 0 then
      return = minlist(sbody[1],1-sbody[2]);
   fuzzyeveningstar = return;

{ FuzzyDarkCloud function
   From Murray A. Ruggiero, Jr., "Cybernetic Trading Systems" (Wiley, 1997)
   Returns 0 if not a dark cloud, and size if it is a dark cloud }

   inputs:   lookback(numeric), onecof(numeric), zerocof(numeric);
   vars:     color(0), sbody(0);

color = candlecolor(open,close);   { determines the candlestick color }
   { fuzzysmall has the arguments: lookback, onecof, zerocof

      but we reverse oneconf and zerocof to test for "not small" }
   sbody = fuzzysmall(open,close,lookback,zerocof*.3,onecof*1.0);
   return = 0;
   fuzzyrange = close - (open[1] + close[1])/2;
   if color = -1 and color[1] = 1 and open > high[1] and fuzzyrange < 0 then
      return = 1 - sbody[1];
   fuzzydarkcloud = return;
```

This is a clever and useful piece of code that satisfies our own definition of these candlestick formations. Although it is called *fuzzy*, the logic still relies on threshold values, *trigger1* and *trigger0*, to determine that a body is long or short. It may be *dynamic*, or *adaptive*, but it is not clear that it is *fuzzy*.

[9]Parts of this section are drawn from Perry Kaufman, *Smarter Trading* (McGraw-Hill, NY, 1995).

[10]The answers to the examples are: (1) very small, (2) most, and (3) bad.

[11]Murray A. Ruggiero, Jr., "Artificial Trader Jumps Candlesticks," *Futures* (February 1995), and "Lighting Candlesticks with Fuzzy Logic," *Futures* (March 1996).

[12]Murray A. Ruggiero, Jr., *Cybernetic Trading Systems* (Wiley, 1997).

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FRACTALS, CHAOS, AND ENTROPY

Another area that has captured the interest of market analysts is chaos. *Chaos theory* is a way to describe the behavior of nonlinear systems, those that cannot be described by a straight line. Chaotic systems are not without any form or method, as the expression is commonly used, but those phenomena that are not a simple variation of a linear relationship. Some examples of this behavior will be given later in this section.

One method of measuring chaotic systems is with various geometric shapes. This effort has resulted in an area of mathematics now called *fractal geometry*; its approach strikes a true note about how the real world of numbers actually works.[13] All of us have been taught Euclidean geometry in school; it is the world of straight lines and clean edges in which we can measure the length of a line or the area of a rectangle very easily. In the real world, however, there are no straight lines; if you look closely enough—using a microscope if necessary—they all have ragged edges and all may be described as chaotic.

Fractal Dimension

In fractal geometry we find that there is a way of representing the irregularity of numbers and the formations seen in nature. We first must accept the notion that there are no *whole* numbers in nature, that real-world objects are more likely to be described as fractional, or having a *fractal dimension.* The classic example of this is the algebra of coastline dimension. We will see that the questions "How long is the coastline?" and "How far did prices move?" are very similar.

The answer to both of these questions is "That depends on how it is measured." Consider the problem of measuring the coastline of Australia using a large wall map. If we take a 12-inch ruler, and placed each end on a part of the coastline, we might find that the coastline is about 10 feet (perhaps 10,000 miles according to the scale). Using a 12-inch ruler requires that we cross over parts of the coast that jut out into the water; in other cases we might span a large harbor in order to get both ends of the ruler to touch the coastline. Had we taken a slightly smaller ruler we would have been more accurate and perhaps have found the coastline to be 15,000 miles; even a smaller ruler would have followed the contours better and found 20,000 miles of coast. As the ruler gets smaller the coastline appears to get longer. If we had an infinitely smaller ruler, the coast would be infinitely long. There is really no correct answer to the question, "How long is the coastline?"

Fractal dimension is the degree of roughness or irregularity of a structure or system. In many chaotic systems there is a constant fractal dimension; that is, the interval used for measuring will have a predictable impact on the resulting values in a manner similar to a normal distribution. Therefore, if we used a 12-inch ruler to get 10,000 miles of coastline, we might expect a predictable relationship of coastline to ruler:

24-inch ruler	5,000-mile coastline
12-inch ruler	10,000-mile coastline
6-inch ruler	20,000-mile coastline

Note that the large 24-inch ruler returns a value that is actually smaller than what we believe is a reasonable answer. This is because, when you place a long ruler from one point to another on the map, it cuts across part of the land mass.

Using Fractal Efficiency

In Chapter 17, there is a discussion of Kaufman's efficiency ratio. This ratio is formed by dividing the net change in price movement over *n* periods by the sum of all component moves, taken as positive numbers, over the same *n* periods. If the ratio approaches the value 1.0 then the movement is smooth (not chaotic); if the ratio approaches 0 then there is great inefficiency or chaos. This same measurement has recently been called *fractal efficiency.*

Fractal efficiency measures the amount of chaotic movement in prices; this can also be considered similar to market noise. In Chapter 17, Kaufman related this to trending and nontrending patterns, when the ratio approached 1.0 and 0, respectively. While each market has its unique underlying level of noise, the measurement of fractal efficiency should be consistent over all markets. Markets may vary in volatility although their chaotic behavior is technically the same; therefore, theoretically, the characteristics of one market may be compared to others by matching both the fractal efficiency and volatility. In reality, there are small differences in fractal efficiency due to the various participation and liquidity of markets; however, once these differences have been considered, the treatment of price behavior can be the same.

The interpretation of fractal efficiency as noise allows trading rules to be developed. For example, a market with less noise should be entered quickly using a trending system, while it would be best to wait for a better price if the market has been determined to have high noise. A noisy market is one that continues to change direction, while an efficient market is smooth. When viewed in the long term, the level of market noise should determine the type of strategy that should be applied to each market. These characteristics are important in choosing trading rules and in turning a theoretical model into a profitable trading system.

Chaotic Patterns and Market Behavior

Chaotic patterns are easy to imagine in the behavior of prices, but very difficult to measure. There would be no problem in predicting price direction if every participant reacted in the same way to the same event, much the way a single planet would smoothly orbit a single sun. In the real world nothing is quite as simple. Consider the pattern of prices represented as nearby moons, *a* and *b*, that are each circling nearby planets of equal mass, *P1* and *P2.* Because the planets are larger than the moons, they are called *attractors.* We will get a wobbly pattern whenever the moon passes across the midpoint where one attractor is stronger than the other, shown as a straight line in Figure 20.8a. A moon at point *a* is most affected by the nearest attractor, *P1*, but as it circles it becomes closer to *P2* and tries to form an orbit around it. It might form a figure-8 pattern as it switches between P1 and P2, ending up in location *b* on the far side of *P2.* The possible patterns are too complex and they vary based on the distance between *P1* and *P2* and the size of *P2* compared to *P1.* If attractor *P2* is much larger than *P1*, as in Figure 20.8b, there will simply be a distortion in the orbit around *P2* at the location of the straight line, rather than a switching of orbits from one planet to another.

Figure 20.8: (a) Equal attractors cause a symmetric pattern, often a figure 8, that switches between P1 and P2. (b) Very unequal attractors show only a small disturbance in a regular orbit.

As complex as these patterns might get, they are simple when compared to reality. Each day brings events of various importance into the market, acting as attractors. Each attractor has an initial importance that loses value over time. To make matters worse, we cannot always predict when a new attractor, or news event, will appear. When we can predict the time, we cannot predict the impact. This makes the chaotic pattern very similar to raindrops falling on a pond. Each new drop, equivalent to a new event, hits at an unpredictable time and place, with variable size, and forms circular ripples. These ripples dissipate at they get further away from the point of contact in the same way that the importance of an event fades away over time. The interesting aspect of the raindrop analogy is that, while we cannot predict where the next raindrop will fall, once it has landed we can completely determine its effects—until the next drop hits. This analogy is remarkably similar to the market. The frequency and size of price shocks are like rain drops; occasionally there is a large one that overwhelms the smaller events, the market noise, for a short time.

Conditional Entropy—Predicting by Similar Situations

Forecasting the future by finding a similar combination of factors, *similar conditions*, that occurred in the past has always been a technique used by fundamental analysts. It is necessary to match the state of major economic indicators, with the less quantifiable government policy, then look at how the prices reacted to these similar setups. The entire area of charting, traditionally called *technical analysis*, is based on a predictable outcome following a specific chart pattern. These patterns can be simple or very complex, exist in a single time frame or be the composite of multiple time frames.

There is one mathematical method that comes closest to being able to identify similarities in price patterns. *Conditional entropy* can measure the probability that two patterns are similar. The higher the value of conditional entropy, the more likely the results of a past pattern will predict the results of a current pattern.[14]

Entropy

Entropy, the basis for this more advanced form, is a measurement of expectations. If the output of a system is known, and there is no uncertainty, the value of the entropy formula is zero. When entropy is low, the state of the system is easy to predict. As the output becomes less certain, the value approaches 1 and there is more disorder. Entropy, H, defined as a function of price, x,

$$H(x) = -\sum_{x=i}^{n} p_i(x) \log_2 p_i(x)$$

where x can have n different values, and $p_i(x)$ is the probability that the outcome will be the ith value of x. When the system has only one possible outcome, $n = 1$, then $H(x) = 0$. If all n possible outcomes have an equal probability, then uncertainty is maximized and $H(x) = \log(n)$. Therefore, if there are 16 possible outcomes, the maximum entropy is 4. It is convenient to normalize the value of the entry by dividing by the maximum value $\log(n)$.

As an example, consider the price moves that follow a particular chart pattern, where prices close in the upper 10% of the daily trading range and the stock is above its 200-day moving average. The hypothetical frequency of the next day's move is shown in Table 20.4. The calculations in the columns follow the formula $H(x)$ and show the result $H(pattern) = 2.20$. The maximum entropy for a 6-scale variable is $\log_2(6) = 2.58$; therefore, there is considerable uncertainty in the ability of this pattern to forecast 1 day ahead.

Table 20.4: Frequency of Price Moves Following a Known Pattern, plus Entropy Calculations

Open table as spreadsheet

Price Move in%	Frequency	Probability	$\log_2$(prob)	prob × $\log_2$(prob)
+3	33	.13	-2.98	-0.38
+2	87	.33	-1.58	-0.53
+1	84	.32	-1.64	-0.53
-1	35	.13	-2.90	-0.39
-2	14	.05	-4.22	-0.23
-3	8	.03	-5.03	-0.15
Sum	261	1.00	-18.35	-2.20

Conditional Entropy

Conditional entropy will give us the probability of the outcome based on the current price pattern being similar to a previous price pattern. But first we need to create a frequency distribution to use as a basis for the calculations. Table 20.5 gives the number of times that an upwards price change occurred given the completeness of a chart pattern while the current price was above the 200-day moving average. The value 1 on the left scale indicates that the pattern was complete; the value 6 is a minimum recognition of the pattern. The top scale shows the percentage change in price on the next day. The frequencies show that price changes of 1% and 2% were most common when the chart pattern was near completion but not yet fully completed.

Table 20.5: Frequency of Price Moves Following the Completeness of the Chart Pattern When Prices Are Above the 200-Day Moving Average. The value 1 represents the completed pattern and 5 is the beginning of the pattern.

Open table as spreadsheet

	Price Change Next Day in %					
Completeness of chart pattern	**+3**	**+2**	**+1**	**-1**	**-2**	**-3**
1	19	4				
2	11	63	64	3	1	
3	2	16	18	20	2	2
4	1	4	1	9	6	2
5			1	2	4	3
6				1	1	1

Conditional probabilities can be calculated from the frequency distribution in Table 20.5. These are shown in Table 20.6. To compute the conditional probability of state j of variable Y (the dependent variable) given state i of variable X (the independent variable, the past pattern), we write $p(Y = j|X - i)$. Then the conditional probability is computed by dividing the frequency of occurrence of the two states, n_{ij}, by the total frequency of state i, given as n_i. Then the probability of Y conditioned on X is

$$p_{j|i} = \frac{n_{ij}}{n_i}$$

Table 20.6: Conditional Probabilities of a Price Change Given the Completeness of a Pattern. Values correspond to Table 20.5.

Open table as spreadsheet

	Price Change Next Day in %					
Completeness of chart pattern	**+3**	**+2**	**+1**	**-1**	**-2**	**-3**
1	0.83	0.17				
2	0.08	0.44	0.45	0.02	0.01	
3	0.03	0.27	0.30	0.33	0.03	0.03
4	0.04	0.17	0.04	0.39	0.26	0.09
5			0.10	0.20	0.40	0.30
6				0.33	0.33	0.33

In this hypothetical example, the probability is highest, and the price moves the most, when the chart pattern is complete. In a test with real data we might expect the two values in row 2, columns +2 and +1 to show the greatest probabilities. The values in the lower right corner are high, but on a sample of only 1 value; therefore, they are not reliable.

The conditional probabilities can then be entered into the final formula for conditional entropy. The conditional entropy is the average sum of the entropies based on the conditional probability, H, of Y (the second event or price change) conditioned on X (the first event or completeness of pattern) is

$$H(y \mid x) = -\sum_{x=i}^{t_1} p_i(x) \sum_{y=j}^{t_2} p_{ij}(y \mid x) \log_2 p_{ij}(y \mid x)$$

The higher the value of *H,* the greater the predictive value.

[13]An excellent discussion of this topic can be found in Edgar Peters, *Chaos and Order in the Capital Markets* (John Wiley & Sons, NY, 1991). The coastline example is originally credited to Benoit Mandelbrot.

[14]The mathematics for conditional entropy, with excellent examples, is located on the website *http://tecfa.unige,ch* and was written by Phillippe Lemay. This section is adapted from his work.

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NEURAL NETWORKS[15]

An area of analysis that has continued to grow rapidly is *neural networks.* It is recognized as a powerful tool for uncovering market relationships. This technique offers exceptional power for discovering nonlinear relationships between any combination of fundamental information, technical indicators, and price data. Its disadvantage is that it is potentially so powerful that, without proper control, it will find relationships that exist only by chance.[16]

Although the idea and words for the computerized neural network are based on the biological functions of the human brain, an *artificial neural network* (ANN) is not a model of a brain, nor does it learn in the human sense. It is simply very good at finding patterns, whether they are continuous or discrete, appearing at different times.

The operation of an artificial neural network can be thought of as a *feedback process,* similar to the Pavlov approach to training a dog:

1. A bell rings.
2. The dog runs to 1 of 3 bowls.
3. If right, the dog gets a treat; if wrong, the dog gets a shock.
4. If trained, stop; if not trained, go back to Step 1.

Terminology of Neural Networks

The terminology used in the computerized neural network is drawn from the human biological counterpart, shown in Figure 20.9. The principal elements are:

- *Neurons,* the cells which compose the brain; they process and store information.
- *Networks* are groups of neurons.
- *Dendrites* are receivers of information, passing it directly to the neurons.
- *Axons* are pathways that come out of the neuron and allow information to pass from one neuron to another.
- *Synapses* exist on the path between neurons and may inhibit or enhance the flow of information between neurons. They can be considered *selectors.*

Figure 20.9: A biological neural network. Information is received through *dendrites* and passed to a *neuron* for storage. Data are shared by other cells by moving through the output connector, called an *axon*. A *synapse* may be located on the path between some individual neurons or neural networks; they select the relevant data by inhibiting or enhancing the flow. Source—Perry Kaufman, *Smarter Trading* (McGraw-Hill, 1995, p. 165).

Artificial Neural Networks[17]

Using essentially the same structure as a biological neural network, the computerized, or artificial neural network (ANN) can generate a decision on the direction of the stock market. It relies heavily on the synapses, which are interpreted as weighting factors in this process. To achieve its result it will also combine inputs that interact with one another into a single, more complex piece of data using layers of neurons, as shown in Figure 20.10, a classic 3-layer neural network.

Figure 20.10: A 3-layer artificial neural network to determine the direction of stock prices. *Source*—Perry Kaufman, *Smarter Trading* (McGraw-Hill, 1995, p. 166).

To be most efficient, the inputs to the ANN should be those factors considered most relevant to the direction of stock prices. The five items chosen here were the Gross Domestic Product (GDP), unemployment, manufacturing or inventories, interest rates, and the value of the U.S. dollar—all readily available data. Each of these items is input and stored in

separate Layer-1 neurons. Changing values in these neurons may have a positive or negative effect on the final output, which is the direction of stocks. An improved GDP, lower unemployment, lower inventories, and a lower U.S. dollar are all good signs for economic growth and result in the possibility of higher interest rates. Higher rates are a defensive action by the Federal Reserve to prevent inflation with the eventual consequence of a decline in stock prices. Interest rates themselves have a direct effect on stock prices, improving corporate profits as the cost of borrowing declines.

Each neuron in Layer 1, which receives the data from the dendrites, is connected to a second layer of neurons through a synapse. Each synapse can be used to restrict or enhance information by assigning a weighting factor. For example, if changes in unemployment have a greater ultimate impact on stock prices than changes in the GDP, then it may receive a weight of 1.5 compared to .9 for the GDP. If very small changes in any of the data are deemed unimportant to the result, then the synapse can act as a threshold and only allow data to pass if it exceeds a minimum value. If the data is irrelevant, it gets a weighting factor of zero; if it is contrary to the result, the weighting factor will be negative.

The second layer of neurons is used to combine initial data into significant subgroups by trial and error. To allow this to happen, every neuron in Layer 1 must be connected to every neuron in Layer 2 by its own axon containing a synapse. Figure 20.10 shows the significant groupings that might result, ignoring the other connecting axons which would clutter the illustration. GDP, unemployment, and inventories are combined into a single item called Domestic Economic Health (DEH). The synapses allow each element to be assigned a specific level of importance relative to DEH using weighting factors. Also note that the neuron DEH is altered by anticipated interest rates, which is the result of data flowing to another neuron in Layer 2. Finally, the three neurons in Layer 2 are combined according to importance, giving the net stock market reaction to the input data.

Layer 2 may be called a *hidden layer,* because you normally only see the input and output layers. Layer 2 has the complex interconnections that allow feedback to occur. It is possible to have more complex connections by adding another hidden layer. In general, the more hidden layers, the longer the solution time and the more finely tuned the answer.

The human brain works in a way very similar to the artificial neural network shown in Figure 20.10. It groups and weighs the data, combining them into subgroups and finally producing a decision. The human process of weighing the data is complex and not necessarily transparent; that is, we may never know the precise flow of data, how many layers exist, and how weights are assigned and reassigned before the final decision.

A computerized neural network is not as complex. Because it cannot know whether its answer is correct, you must tell it. This is done by giving the computer the historic data and the corresponding answers. By giving the artificial neural network a long history of information, it can determine, using *feedback,* the weighting factors that would have given the correct results most often. The more history that is given to the computer, the more likely it will find a robust answer. Figure 20-11 shows the results of using five different inputs to predict the direction of the stock market. Two of the inputs, the Academy Award Winners and the Number of NASA Launches are not likely to be useful in the long term, but *may appear* to provide valuable information about economic activity for short intervals. By using enough comparisons, the weighting factors are found to show that unemployment has a strong negative effect on prices, the GDP a strong positive effect, and inventories have a weak positive effect. The other items had no consistent predictive ability and received a weight of zero. This feedback process is called *training.*

Selecting and Preprocessing the Inputs

There is considerable debate over the inputs needed to find a successful solution using a neural network; however, everyone agrees that the selection of inputs is critical. These inputs must be presented in the most direct form because the neural network will not be able to change them. This step is called *preprocessing.* We must decide what are the most likely factors affecting the direction of stocks and the ability to anticipate that direction, then prepare data that contains information with these qualities. For example, we may want to know the short-term and long-term trends, the direction of interest rates, the Dow Jones Utility Index, the ratio of interest rates to gold, economic data such as the GDP and the Balance of Trade, technical indicators such as the RSI, stochastic, and ADX, and a 20-day moving correlation between the U.S. stock market and other major equity markets. There are countless factors that might influence the direction of stocks; the more you choose, the slower the solution and the greater the chance of a less robust model. If you choose too few, they may not contain enough information; therefore, the preprocessing problem requires practice. You may also construct a number of simple trading systems that show profits and include their basic components as inputs to the neural network. You might create a performance series for a specific system that has only values -1, 0, and 1, representing short, neutral, and long market positions. In that way the neural net may be used to enhance an existing trading strategy.

Selecting the Output

In a manner similar to evaluating any back-testing result, the training process requires that you select the success criteria (a full discussion of this can be found in Chapter 21). One possibility for the success criteria is a combination of frequency of trading, the size of the profits per trade, a reward/risk ratio, and a frequency of profitability.

According to Ruggiero,[18] neural networks can be used to predict price direction, such as the percentage change five days into the future; however, they are much better at predicting *forward-shifted technical indicators* because these tend to have smoother results. Most technical indicators, such as trend and momentum calculations, smooth the input data, which is most often the price. The longer the time period used in the calculation, the greater the smoothing. Ruggiero suggests an output function such as

```
Average((close[-5] - Lowest(Close[-5],5))/(Highest(close[-5],5) -
   Lowest(close[-5],5)),5)
```

which is similar to a smoothed 5-period stochastic shifted forward by 5 periods. In this notation, the bracketed value [-5] represents 5 periods into the future.

The Training Process

At the heart of the neural network approach is the feedback process used for training shown in Figure 20.11. This is the part of neural networks that many people refer to as the *learning process.* To observe sound statistical practice, it is advised that only about 70% of the data be used for training. As the neural net refines the weighting factors for each of the inputs and combinations of inputs (in the layers between the input and output), it will need more data to test these results. Of the remaining 30% of the data, 20% should be designated for testing. The success or failure of the method to find a solution is based on the performance of the test data. The remaining 10% is saved for out-of-sample validation.

Figure 20.11: Learning by feedback. *Source*—Perry Kaufman, *Smarter Trading* (McGraw-Hill, 1995, p. 166).

Weighting factors are found using a method called a *genetic algorithm,* discussed in the next section and extensively covered in Chapter 24. For now, we need to know that the training process begins with an arbitrary or random value assigned to the weighting factors of each input. As the training proceeds, these weighting factors are randomly *mutated,* or changed, until the best combination is found. The genetic algorithm changes and combines weighting factors in a manner referred to as *survival of the fittest,* giving preference to the best and discarding the worst.

Testing is completed when the results, as measured by the success criteria, cannot be improved. That is, after a number of feedback loops on the historic data (the oldest 70% of the data), the test data (the next 20%) is used with the new weighting factors. If the results are improving the process continues. If the results are improving at a very slow rate, or have stopped because a better combination cannot be found, the neural network process is completed. Sometimes the results get worse rather than better. This can be fixed by beginning again using new random weighting factors. If this fails to solve the problem, then it is most likely that there are too many inputs that are irrelevant. Starting with a smaller number of basic inputs should get the process back on track.

Because the genetic algorithm is a trial-and-error process, rather than an analytic approach, the best results could be found by chance, rather than by cause and effect. With enough data it is always possible that two series of events will appear related even when they are not. It is necessary to review the results to avoid obvious mistakes.

A Training Example

We would like to train an ANN to tell us whether we should buy or sell stocks. As inputs, we select what we believe to be the five most relevant fundamental factors: GNP, unemployment, inventories, the U.S. dollar index, and short-term interest rates. This test does not use any preprocessed data, such as trends or indicators. To simplify the process, the following approach is taken:

1. Each input is normalized so that it has values between +100 and -100, indicating strength to weakness, with 0 as neutral.
2. When the combined values of the five indicators exceeds +125 we will enter a long position; when the combined value is below -125 we will enter a short.
3. Values between +125 and -125 are considered neutral to the trading strategy.

To show how the training process works, two combinations of starting values are shown in Table 20.7 and Table 20.8 as Case 1 and Case 2. Table 20.7 is the initial state of the neural network, where we begin by arbitrarily setting all of the weighting factors to 1.0. In actual training, the network might require that the sum of all weights total 1.0. The actual values of the normalized inputs are shown in the columns marked "Relative Value," and the correct historic answers are at the bottom, marked as "Strong" and "Weak" stock market reactions to these values. For the neural network to return the correct answers it must produce a result greater than +125 for Case 1 and below -125 for Case 2. By assigning initial weights of 1.0 to all inputs, the value of Case 1 is +75 and the value of Case 2 is +40; both fail to produce the known historic answer and testing continues searching for better weighting factors.

Table 20.7: Two Training Cases (Initial State)

Open table as spreadsheet

	CASE 1				CASE 2			
Input	**Relative Value**		**Weight**	**Net**	**Relative Value**		**Weight**	**Net**
GNP	Strong	50	1.0	50	Weak	-60	1.0	-60
Unemployment	Low	-25	1.0	-25	High	40	1.0	40
Inventories	Low	-50	1.0	-50	Neutral	15	1.0	15
U.S. dollar	Very Strong	75	1.0	75	Neutral	0	1.0	0
Interest rates	Falling	-25	1.0	-25	Rising	45	1.0	45
Total value		75				40		
Threshold		±125				±125		
Current response		None				None		
Actual market reaction		Strong				Weak		

Source: Perry Kaufman, *Smarter Trading* (McGraw-Hill, 1 995).

Table 20.8: Two Training Cases (After Mutated Weighting Factors)

Open table as spreadsheet

	CASE 1				CASE 2			
Input	**Relative Value**		**Weight**	**Net**	**Relative Value**		**Weight**	**Net**
GNP	Strong	50	1.0	50	Weak	-60	1.0	-60

Unemployment	Low	-25	-1.0	25	High	40	-1.0	-40
Inventories	Low	-50	1.0	-50	Neutral	15	1.0	15
U.S. dollar	Very Strong	75	1.0	75	Neutral	0	1.0	0
Interest rates	Falling	-25	-1.0	25	Rising	45	-1.0	-45
Total value		125				-130		
Threshold		±125				±125		
Current response		None				None		
Actual market reaction		Strong				Weak		
Source: Perry Kaufman, *Smarter Trading* (McGraw-Hill, 1995).								

In Table 20.8 the weighting factors have undergone mutation using a genetic algorithm. This example attempts to use only weighting factors of +1.0, 0, and -1.0. By reversing the effect of unemployment and interest rates on the direction of the stock market, and by random selection of weighting factors, the results now match the historic pattern of stock movement. Using fractional values for weighting factors, and many more training cases, the ANN method should find the current underlying relationship between these inputs and stock market movement.

Reducing the Number of Decision Levels and Neurons

The robustness of a neural network solution is directly related to the number of decision levels, the number of neurons in each level, and the total number of inputs. Fewer elements produce more generalized and therefore more robust solutions. When there are many decision layers and many neurons the inputs can be combined and recombined in many different ways, allowing very specific patterns to be found. The more specific, the greater the chance that the final solution will be overfitted, that is, it will be fine-tuned to such specific patterns in the past that those patterns will not occur in the future.

Failure to converge to a solution can also occur if there are too many inputs and the genetic algorithm allows too much mutating (discussed in the next section). Neural networks can be highly complex and requires experience before they can be used efficiently.

The trade-offs using a neural network are the same as most other optimization methods. Too many inputs and combinations increase the time of testing and increase the chance of a solution that is overfit. Too few values can produce a result that is too general, has large risk, and is not practical. It is best to begin with the most general and proceed in clear steps towards a more specific solution. In this way you will understand the process better, ultimately save time, and be able to stop when you have reached the practical limitations of this method.

Modeling Human Behavior

Neural networks are considered a learning process similar to the parallel architecture of the human brain. It can be trained on a classification of data, then used to find new data of the same class, or it can be trained on a number of points in a function (for example, a logarithmic curve or more complicated cycle), then used to find other points on that function.

One application that is relevant to price forecasting is to make each of the Layer-1 neurons contain the results of the major economic indicators. The synapse between level 1 and level 2 would discard any indicator when its value was not significantly different from zero. This reflects the way the public views economic reports. During the scenario of economic recovery, such as early in 2003, corporate earnings and income growth were most important. Other reports were, for the most part, ignored. After earnings improved and the stock market had rallied, traders looked for employment to improve as a means for sustaining economic growth and the stock market rally. At that point, earnings were not as important as more jobs. A neural network can be constructed to reflect this selection process that makes one or two economic reports more important than others given the state of the economy. Using previous GDP, stock market trends, and the direction of Fed funds, we can limit the entire neural net solution to the relationship between one or two economic indicators and the future direction of stock prices, setting the synapse weighting factors to zero for the other reports in level-1 neurons. A similar method might have the synapses assume a weighting factor of 0 when the economic report has a change that is large enough to attract the attention of the public (at least a 1.5 standard deviation change) and a value of 0 at any other time. In that way a minor change in all indicators does not have a cumulative impact on the neural network while the public shrugs off the data.

A Final Comment about Neural Networks

When using neural networks and other powerful searching tools, every analyst must keep in mind an important philosophical problem about their use. Neural nets will nearly always find the correct solution in a closed system, one where the output is fully defined by all the inputs, or one where there is definitely a solution. An ANN is often used when it is too difficult to find a solution by other means. For example, in a chemical or manufacturing process, the formula may have too many variables. A neural network will not only solve the problem, but solve it quickly. The stock market, however, is different. No one is sure that there is a solution of the type we are trying to find using a neural network. Because of this uncertainty, a large number of inputs might be used in the program. The inputs will include everything that seems reasonable, such as economic data, moving averages, and even the performance of some mutual funds. The neural net program will digest this information, calculate for some time, and produce an answer. However, there is no guarantee that the answer is successful because there may not be a successful answer. The neural net will generate an answer, whether or not it is the right one. You will then need to test the results on out-of-sample data to verify the success.

[15]Parts of this section are based on Perry Kaufman, *Smarter Trading* (McGraw-Hill, 1995, pp. 164–171).

[16]Readers are referred to E. Michael Azoff, *Neural Network Time Series Forecasting of Financial Markets* (Wiley, 1994), for a thorough treatment of this subject, and Edward Gately, *Neural Networks for Financial Forecasting* (Wiley, 1996), for a more introductory approach.

[17]The Internet is a great resource for finding out more about neural networks, from a basic description to complex applications. The website *www.cs.stir.ac.uk* featuring a description by Professor Leslie Smith, Centre for Cognitive and Computational Neuroscience, University of Stirling, U.K., was found to have very useful information.

[18]Murray A. Ruggiero, Jr., "Build a Real Neural Net," *Futures* (June 1996), the first of a series of excellent articles on this subject.

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GENETIC ALGORITHMS

The concept of a genetic algorithm is based on Darwin's theory of survival of the fittest. In the real world, a mutation with traits that improve its ability to survive will continue to procreate. This has been applied to system development using a *genetic algorithm.* Although a genetic algorithm[19] is actually a sophisticated search method that replaces the standard optimization, it uses a technique that parallels the survival of the fittest. It is particularly valuable when the number of tests or combinations is so large that a test of all combinations is impractical. Instead of the typical sequential search, it is a process of random seeding, selection, and combination to find the best set of trading rules. Standard statistical criteria are used in the selection process to qualify the results. Searching for an optimal set of parameters or finding the best portfolio allocation (as covered in Chapter 24) takes minutes using a genetic algorithm; a standard sequential search may take years at the same computing speed.

Representation of a Genetic Algorithm

Using the words common to this methodology, the most basic component of a genetic algorithm is a *gene;* a number of genes will comprise an *individual,* and a combination of individuals (and therefore genes) is a *chromosome.* Each chromosome represents a potential solution, a set of trading rules or parameters where the genes are the specific values and calculations. These in turn form individuals that represent rules that ultimately form a trading strategy. For example, Chromosome 1 might be a rule to buy on strength:

> If a 10-day moving average is less than yesterday's close and a 5-day stochastic is greater than 50, then buy.

Chromosome 2 could be a rule that buys on weakness:

> If a 20-day exponential is less than yesterday's low and a 10-day RSI is less than 50, then buy.

If we rewrite these two chromosomes in a notational form, the genes and individuals in its structure become more apparent:

> Chromosome 1: MA, 10, <, C, [0], &, Stoch, 5, >, 50, 1
>
> Chromosome 2: Exp, 20, <, L, [1],&, RSI, 10, <, 50, 1

Each of these chromosomes has 11 genes, any one of which can be changed. In addition, each chromosome has two individuals, separated by an "&" operator. In Table 20.9 the description of the genes indicates other values that can replace the current ones.

Table 20.9: Functional Description of the Genes in Chromosomes 1 and 2

Open table as spreadsheet

Gene	Chr 1	Chr 2	Function
1	MA	Exp	Trend type (moving average, exponential smoothing, breakout)
2	10	20	Calculation period for gene 1
3	<	<	Relational operator (<, <=, >)
4	C	L	Price used in gene 1 calculation ((H+L+C)/3, indexed value)
5	0	1	Reference to past data ([0] = current day, [1] = previous day)
6	&	&	Method of combining individuals (and, or)
7	Stoch	RSI	Indicator type (RSI, stochastic, MACD)

8	5	10	Calculation period for gene 7
9	>	<	Relational operator (<, <=, >)
10	50	50	Comparison value for relational operator
11	1	1	Market action (1 =Buy, -1=Sell)

Table 20.9 is a way to represent the chromosomes and individuals in a general form. It is easy to see that each gene can be changed, and each change will represent a new trading rule. For example, the 10- and 20-day averages in gene 2 of chromosomes 1 and 2 could be changed to 5 and 15 days; or, the indicators *Stock* and *RSI* could be *MACD* and *Momentum.* A combination of trading rules, or chromosomes, will create a trading strategy. Before continuing, the following steps will be needed to use the genetic algorithm to find the best results:

1. A clear way of representing the chromosomes and their component individuals and genes.
2. A *fitness* criterion to decide that one chromosome is better than another.
3. A *propagation* procedure that determines which chromosomes will survive and in what manner.
4. A process for *mutation* (introducing new characteristics) and *mating* (combining genes) to give chromosomes with greater potential a better chance for survival.

Representation of the genes and chromosomes has been shown in Table 20.9. However, there is one additional step needed to get started: creating an initial chromosome pool.

Initial Chromosome Pool

To begin, an initial pool of chromosomes must be created. These will look just like those in Table 20.9; however, each gene will be chosen at random from a list of candidates that have been previously defined. Eleven lists are needed, one for each unique gene.

1. *Trend type,* 1 of 5 choices: a moving average, exponential smoothing, linear regression, breakout, or step-weighted average.
2. *Trend calculation period,* a number between 1 and 200.
3. *Trend relational operator,* 1 of 3 choices: <, <=, >.
4. *Price used in the trend calculation,* 1 of 4 choices: close, (H+L+C)/3, (H+L)/2, indexed value.
5. *Reference data or lag:* a number between 1 and 10.
6. *Method of combining individuals,* 1 of 2 choices: *and* or *or.*
7. *Indicator type,* 1 of 5 choices: RSI, stochastic, MACD, momentum, Fisher transform (all indicators must be transformed to return values between -100 and +100.
8. *Indicator calculation period,* a number between 1 and 50.
9. *Relational operator,* 1 of 2 choices: > or <.
10. *Comparison value for indicator and relational operator,* a number between -100 and +100.
11. *Market action,* 1 of 2 choices: *buy* or *sell.*

These 11 lists offer the possibility of 4.8×10^{10} combinations, or 48,000,000,000 possibilities. Regardless of the computer speed, trying each combination would be a daunting task. However, the genetic algorithm is likely to find the best solution, or a solution very nearly the best, in less than 100 passes through its process.

To assure a fast solution, it is necessary to start with a large chromosome pool. Each chromosome in the pool is created by selecting one item from each list randomly. This pool represents the *genetic population.*

Fitness

Having created a pool of chromosomes that look similar to those in Table 20.9, it is necessary to decide which are best. This is done by defining a *fitness* criterion, or *objective function,* which can be used to rank the chromosomes. Because fitness will lead to survival, it is very important to decide which chromosomes should be discarded and which should survive, or even flourish. A fitness criterion must combine the most important features associated with a successful trading strategy:

- Net profits, or profits per trade.
- The number of trades, or a sample error criterion.
- The smoothness of the results.

Ideally, preference is given to systems that have large profits, lots of trades, and very consistent performance. To measure that result, the following might be used:

$$Rank = PPT \times \left(1 - \frac{1}{\sqrt{NT}}\right) \times \frac{GP}{GL}$$

where *PPT* = the profits per trade
NT = the number of trades
GP = the gross profits
GL = the gross losses

This fitness criterion, *rank,* favors large profits per trade, a large number of trades, and a high ratio of gross profits to gross losses, which is a measure of smoothness of returns. These factors are not weighted, but they serve as a simple measurement for ranking the chromosomes. For example, a trading method that returned $500 per trade for 10 trades, with a gross profit/loss ratio of .5 would have a rank of 170.75. Another system that returned only $250 per trade over 100 trades with a profit/loss ratio of 1.4 would rank 315.00. Therefore the system with the smaller returns has a much more agreeable trading profile according to the fitness criteria based primarily on the gross profit—to—gross loss ratio. Each analyst must create a criterion that allows those strategies that are most desirable to survive.

Propagation

The process *of natural section* allows only the best individuals to survive. A strong *propagation* criterion is used to encourage the survival of chromosomes with the highest ranking, as determined by the fitness test. A weak criterion allows lower rankings to survive. The implementation of the selection process is also drawn from evolution. When an individual has a high fitness score, it is allowed to create more offspring; therefore, it becomes a larger part of the population. When it has a low score, it creates fewer offspring, or no offspring, and eventually disappears from the population.

The propagation step in a genetic algorithm determines how many offspring will be created from each existing chromosome based on its fitness score. For example, if there are only 10 chromosomes in the initial pool, with fitness scores from 1 to 5, they are sorted in descending order of fitness as follows

Chromosome rank	1	2	3	4	5	6	7	8	9	10
Fitness score	5	4	3	3	2	2	2	1	1	1

The propagation criterion states that the fitness score of each chromosome is multiplied by 3 and divided by 5 in order to get the number of new offspring when the chromosome is propagated. Then the number of offspring, in the same order, are

Chromosome rank	1	2	3	4	5	6	7	8	9	10
New offspring	3	2.4	1.8	1.8	1.2	1.2	1.2	.6	.6	.6

The fractional number of offspring can be rounded or truncated (the fractional part dropped off) to get whole numbers. If rounded, there will be 3 offspring for the highest ranking chromosome, 2 for the next, 2 for the next 2, and 1 for the next 6, for a total population of 15. But it is necessary to keep the population fixed at 10 because the pool size should represent the maximum space available in the computer[20]; therefore, the bottom 5 chromosomes do not survive. The new population, using the original chromosome ranking is 1, 1, 1, 2, 2, 3, 3, 4, 4, and 5. There are more offspring from the

fittest chromosome 1; therefore, it has a better chance of surviving. The next few in line have a reasonably good chance of survival, and the ones at the bottom have disappeared.

One popular way to calculate the number of offspring is to divide the fitness of one chromosome, *f*, by the average fitness of all chromosomes, *F.* Therefore,

Number of offspring = Current fitness / Average fitness

This method works best when there are a large number of choices rather than only 10 possibilities. However, if the fitness of the linear regression chromosome was 4, and the average of all chromosomes was 2, the linear regression would propagate 2 or 3 offspring. The more offspring, the better chance of survival during the evolutionary, and genetic algorithm, process.

Mating

The new pool of offspring now moves to the next Darwinian test, *mating.* Remembering that a genetic algorithm is a sophisticated search method, it needs a way to combine the genes of individuals that have passed the fitness criteria in different ways so that we might create a better chromosome. This is very similar to cross-pollination, where you continue to pollinate two species with certain desirable but different features, hoping to get a new species that has the best of both. This is done through *mating* (also called *crossover*).

When mating, we must be careful to combine, or switch, the entire individual, and not just one gene. All of the genes that form an individual make sense only as a set. If we separate the individual then the result could be an inferior offspring. Using chromosomes 1 and 2, we can switch the first individuals to get

Offspring 1: Exp, 20, <, L, [1],&, Stoch, 5, >, 50, 1

Offspring 2: MA, 10, <, C, [0], &, RSI, 10, <, 50, 1

In the actual genetic algorithm process, only a small percentage of offspring are mated, perhaps 10–15%. If all the offspring were mated, then we would lose the combination that had the highest fitness; there is no guarantee that any of the offspring will be better. The offspring that are chosen to be mated are randomly selected. Because there are more offspring for the fittest chromosomes, there is a greater chance that these will be used in the mating process.

Mutation

Mutation is the process of introducing new genes, or combinations of genes, from a gene pool. Up to this point, the genetic algorithm has propagated the fittest chromosomes, then created new chromosomes by combining parts of an existing one through mating. The last step is to randomly introduce new genes on the chance that an even better chromosome, or a better individual, will be formed.

A new gene can replace any one of the genes in the chromosome; however, it must be chosen from the corresponding list for that gene, as shown in the initial creation of the *gene pool.* For example, the first gene of the chromosome, which represents a trend-following calculation, can only be selected from the five choices designated. In mutating the gene, one of these five techniques is chosen randomly. Similarly, the calculation period and the way in which rules are combined are selected randomly from their corresponding lists. Typically, only one gene in one of the individuals in a chromosome is mutated; however, you could mutate all of the genes in an individual. In this later approach, for Chromosome 1,

Chromosome 1: MA, 10, <, C, [0], &, Stoch, 5, >, 50, 1

the genes in the second individual (Stoch, 5, >, 50,1) might be mutated to (RSI, 10, >, 40,1). Of all the chromosomes, only 10% are chosen at random for mutation. If too many eare mutated then there is a strong chance of losing the best chromosomes. If too few are mutated then there is little chance of introducing a new and better chromosome. This same balance was discussed during mating.

The two methods of mating and mutation provide the only tools needed to introduce new features into the optimization and to combine features in all ways. If you could continue this process indefinitely, you could study every possible mutation and combination.

Converging on a Solution

Each pass through the genetic algorithm process creates a new generation of chromosomes. Normally, the population remains the same but the average fitness of the pool keeps increasing through propagation, mating, and mutation. The solution is found when either

1. The average fitness of the entire pool does not increase after a few generations are created, or
2. There is no improvement over the chromosome with the best fitness.

Finding the best solution requires a fine balance of how many chromosomes are mated and how many of the new offspring are mutated. If only a small percentage (less than 5%) are changed, there is little chance of creating better offspring. In that case the results converge quickly because they are limited to choices and combinations within the initial pool. If a large percentage of the offspring (more than 25%) are changed, there is a significant possibility that the best of the pool will be lost and the process will fail to converge.

Putting It into Practice: Simulated Performance

The technique for a successful search using a genetic algorithm requires that good test procedures be followed. Data is separated into the testing and out-of-sample parts, where 70% to 80% of the data is tested. Once a solution is found, it is applied to the remaining 20% to 30% of the data not yet seen. The performance of the out-of-sample data should show similar returns and risk as the performance of the test set.

Step-forward testing can also be applied. In this process a smaller amount of data is used beginning with the oldest. The out-of-sample period will be about 10% of the test data size and immediately follow the test period. The performance of the out-of-sample period is then recorded and the test data is shifted forward by 10%. The process is repeated, recording the results of the out-of-sample data using the new parameters found from the genetic algorithm search. When all the data has been used, the sum of the out-of-sample performance is the measure of success.

A complete discussion and analysis of testing procedures can be found in Chapter 21.

[19]This technique is attributed to John H. Holland, *Adaptations in Natural Language and Artificial Systems* (University of Michigan Press, 1975).

[20]The need to create a pool of maximum size, and maintain that size, is discussed in Chapter 24.

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CONSIDERING GENETIC ALGORITHMS, NEURAL NETWORKS, AND FEEDBACK

The good fortune of stumbling onto a great trading system, or even a better system or improved parameters, is always a pleasant experience. Arriving at a good solution, by hard work or by chance, still requires talent; many discoveries that seem to have occurred by chance are really the product of hard work that provides the opportunities for discovery. Genetic algorithms, neural networks, and other powerful search engines will find a solution that may be a modest improvement or a brilliant new strategy—but not always. Unlike real-life genetic mutations in which the changes relate to environmental factors, these solutions may target a very specific situation that may never occur again in the same way. To follow the path of a mutation requires confirmation that this new rule is statistically and logically sound—that the buy and sell signal occur at sensible points and there are enough cases to avoid relying on the results of a small sample. In the end, you must give it the final approval.

Both the genetic algorithm and neural network are capable of finding a solution in much shorter time than a sequential search. In many cases the solution can be found in seconds instead of hours; however, it may not be the best solution, just a very good one. Because there are so many combinations, you will never know whether the solution is the best—that would require testing every combination. It is most likely that the solution is a local peak, rather than a global one. The analogy can easily be seen on a contour map. If you are dropped at random on one point of the map, and you proceed to walk uphill looking for a peak, you will find the local high point, but you may have missed a much higher mountain across the valley.

Because the propagation, mating, and mutation processes all seek higher fitness values, they essentially move uphill from the best combinations in the initial pool. It is possible that a combination of trends and indicators that produce the perfect system was never produced by the random initialization of the pool, and subsequent mutation did not introduce the right genes to allow the ultimate combination to be found. One solution is to run the genetic algorithm or neural network a number of times to see if it arrives at the same solution starting with different random values in the pool. While it is not a guarantee that you will cover all major combinations, especially when there are a massive number of variations, it is the simplest way of avoiding serious oversights. The search tools are so fast that running them 10 times is still a minute amount of time compared to a sequential search. If you think about the contour map, starting at 10 different points has a much higher chance of finding the highest peak than beginning at one point.

Feedback is the basis for successful solutions using advanced searching methods, but it also creates uncertainty. For example, a neural network may be trained on 70% of the data and tested on 20%. When the test data is used to evaluate the weighting factors found using the training data, it provides feedback that biases the selection of weighting factors in the training data. Although these data sets are separated, the constant feedback between the two creates a connecting tunnel that makes them into one data set. If you constantly change the parameters and retrain based on the out-of-sample data, then you no longer have out-of-sample data. Withhold another 10% of the data for truly one-time-only, out-of-sample testing when the final solution is found. If that 10% of data does not produce results consistent with the training and testing, then the inputs must be changed and the process begins again. There is now a dilemma as to whether there is any out-of-sample data at all because the 10% held aside has been used as feedback for the entire process.

This problem is not unique to neural networks and genetic algorithms, but to all testing processes beginning with basic sequential optimization. How do you test your results on current data without being guilty of feedback? There is really no answer. Statisticians claim that the best solutions use the most data; you can't overfit a solution when you test a large number of situations. The results are forced into being general. Holding a small amount of data aside for out-of-sample testing may not prove anything unless the results are exceptionally bad and out of character from anything in-sample. If the out-of-sample results are poor, they may still be representative of one or two small periods during a long historic test. The final decision rests with the trader and not the computer. If the results seem reasonable, there was sufficient test data, the inputs were relevant, and the performance was monitored before trading begins, then the solution is likely to be good.

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Chapter 21: System Testing

Numbers are like people; torture them enough and they will tell you anything.
—Anonymous (quoted by John Ehlers in *Rocket Science for Traders*)

OVERVIEW

System testing has become a fight between computer power and human reason. Before 1990, testing a trading system was a simpler concept. Conscientious traders and analysts applied their ideas to charts, marking the buy and sell signals manually and keeping a hand-written record of the trades. The process took a long time; therefore, they were careful not to begin unless they were reasonably sure that the method had a good chance of success. Ideas came from an understanding of the fundamentals or the awareness of market patterns, in addition to experience. The tabulation of results was verification that the idea was sound.

By the early 1990s, you were at the high end of technology if you had daily data that could be read by a computer, and a program such as TradeStation or MetaStock to give you charts and indicators that could be combined into a trading system. Best of all, these programs showed the historic profitability of the trading strategies and, in particular, the best strategy. Moving averages and the RSI were still sophisticated tools, but the ability to test for the best calculation period and combine indicators began a step down a path that has now become very complex and taken the industry farther from the simple solution.

That process has continued to advance, but not always for the better. Those who have applied diligence, selectivity, and most of all common sense to the automating systems are likely to have gotten better results, faster response, and more useful information than ever before. Those who have carelessly used the power of new computers and the convenience of trading strategy development software, are not having much success. Bigger and faster computers and high-tech software do not mean better results.

The tools alone do not result in a successful trading program. It is the thought process and creativity that is needed to be competitive, although thoroughness and focus are qualities that can never be underestimated. Computers allow us to solve problems of magnitude and complexity that we could never have considered before, and do it in a way that is easy to understand. We can manipulate massive amounts of data to find out not only whether our ideas are sound, but the risks associated with various events. But computers are still highly sophisticated calculators, even when you call your technique "artificial intelligence." Giving it a catchy name doesn't make it happen. Computers do not think, they compute.

One of the most misused techniques that has followed from computerization is *optimization*. This is not the mathematical process of finding a *local maximum* on a map of continuous contours; instead it is the iterative process of repeatedly testing data to find the single best moving average speed, point-and-figure box size, stop-loss size, a combination of multiple values that produce the highest trading profits, the lowest risk, or some other target result. That is not to say that optimization could not be more. Traders seem to have an irresistible urge to know the system parameter values that would have generated the highest profits. Experience shows that the best test results never live up to their expectations and are often a financial tragedy when traded. They are the result of *fine tuning* or *overfitting*. Everyone using a computer for testing a strategy is guilty of overfitting the result at some time.

Computers present a serious, often futile, dilemma for the analyst. If the objective is to use a trend-following strategy, and a smoothing technique is selected—a moving average, exponential smoothing, or linear regression slope—how do you decide the right calculation period? More than 20 years ago, the 5-, 10-, and 20-day moving averages were most popular because they represented a 1-week, 2-week, and 1-month time interval. They were also easy to calculate. In fact, the 10-day moving average was the most common because no division was necessary to arrive at the average. Unfortunately, competition is now keener and that simple approach no longer works.

Consider the process of creating a trading strategy. For a trend system, once the trend period has been logically selected (e.g., 10 days) and the trading rules determined (buy and sell when the trend changes direction and use a stop-loss), you will want to know the performance of that choice over past data for a selection of markets or stocks. If testing proves successful, you will trade using that method; however, if it does not meet expectations using the test data, what do you do? With a computer, the answer is easy: try another trend speed and see if the results are better. This follows a perfectly natural progression; after all, who would use a system today that has failed to be profitable in the past?

A trader who is computer-literate and has purchased TradeStation, MetaStock, or another software package for testing will take an organized approach to experimenting with a broad selection of trend speeds, box sizes, stop-loss points, and trading rules—all tested simultaneously—to arrive at a system with an excellent trading profile. If no satisfactory combination can be found for a specific market, that market will not be traded. This method of optimization has become the primary tool in the development of trading systems; it is entirely dependent on having a computer. Performed properly, testing can teach a great deal; done incorrectly, the process can be misleading and completely illogical. It is not always easy to know which case has just been satisfied. The following sections discuss various aspects of testing and optimization, how to take advantage of it, and how to control it. There is a comprehensive summary at the end of the chapter.

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EXPECTATIONS

Expectations are an essential part of system development. They force you to define a plan in advance that can achieve certain goals. You need to decide the rules, the time period over which the system should work, the relative risk and return of each trade, the proportion of profitable trades, and other characteristics. The importance of this comes when you see the test results.

Testing should be the process of validating your ideas. That first requires that you define those ideas in a clear plan and decide whether it should work for hourly, daily, or weekly intervals. If the test results confirm your ideas then you can have confidence in the strategy. If they differ, you know that something is wrong, either with your plan or the way it was entered into the computer. Without expectations, there can be no validation or confirmation; therefore, if you indiscriminately test all indicators combined together, you don't know whether you have found a good idea or have simply overfit the data. Testing should be used for validation and for deciding between various trade-offs of risk and reward, but not for discovery.

Setting Your Objective and Measuring Results

There are a number of steps that must be carefully performed before testing can begin. These steps are more important than the actual testing and will require you to decide what you are looking for and how you will use the results. Correctly defined, the final system will have realistic goals and predictive qualities. Incorrectly done, it will look successful but fail in actual trading.

First, define the *test objective*. What results should the test present so that you can determine its success? Is it the highest profits possible from the test strategy, the frequency of profitable trades, or the average profit-to-average loss ratio? Testing software gives you a choice, but doesn't allow a combination of these items; most likely, it will be a combination that you want. For example, if maximum profits are used as the performance criteria, which is most often the default case, the resulting system may have one or two large profits and an overwhelming number of small losses before and after it. This can be seen in most energy strategies during Iraq's invasion of Kuwait in 1989 and the U.S. retaliation in January 1991. In order to net a profit in energy, the strategy must have held a short position ahead of the U.S. action. If a long position was held, then the profits from the previous 10 years were gone in one day. When testing the stock market index from 1995 through 2004, most trading strategies would have most of their profits from the beginning of 1999 through the end of 2000, then very small profits or even losses after 2000. When seen as total performance, the exceptional profits during the peak of the stock markets will overwhelm the results of the whole test, making it look excellent; however, the profits were made in the past and not the current market. Trading that strategy now would not be profitable.

The same performance would also show a very impressive average profit—to—average loss ratio. The highest frequency of profitable trades can also be inadequate if there are very small profits and large losses.

A popular way to view results is to look for a test profile with high profits and low risk. By choosing the largest equity drop as a measure of risk and net profits as reward, a measurement function for best results could be

Test function 1 = *Total profits* × (1.0 - *Percentage equity drop*)

which will reduce profits according to the size of the equity drop. The larger the losses, the smaller the test function value. A higher test function value should yield a smoother performance. Another measurement that gives the smoothness of returns is

Test function 2 = *Total gross profits / Total gross losses*

A classic measure of performance is

Test function 3 = *Annualized Returns / Annualized standard deviation of returns*

The third function has the benefit of standardizing both risk and return so that better comparisons can be made between different tests. The number of trades in the test will also be important, and could be included in the test function in the form of a sample error. Then the reliability of a test that had 10 trades over 10 years will not be as high as a test that had 500 trades. This can be included by dividing the test function by the square root of the number of trades. Other risk and performance measurements, such as the Sharpe ratio, can be found in Chapter 23.

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IDENTIFYING THE PARAMETERS

Once the test strategy is known, the *parameters* to be tested must be identified. A parameter is a value within the strategy that can be changed in order to vary the speed or timing of the system. For example, parameters include:

- Moving average calculation period (number of days or bars).
- Exponential smoothing constant (a percentage).
- Band width around a moving average (number of standard deviations).
- RSI calculation period (number of days or bars).
- Stop-loss value (fixed number of points or a percentage).
- Size of a point-and-figure box (in points).

Suppose the strategy is a moving average to identify the trend, an RSI to decide the entry time, and a percentage stop-loss. The most basic test would be to fix the calculation period of the RSI at 14 days, fix the stop-loss at 3%, and test the calculation period for a moving average system. The test would then simulate the results of the trading strategy, stepping through the possible range of moving average days, for example, 1, 2, 3, …, 250. This is called a *1-dimensional* optimization.

Most systems have more than one important parameter. In the moving average system which is being used as an example, the moving average period, the RSI period, and the stop-loss value are all important. If the stop-loss is held constant at 3%, the moving average and RSI can be tested together. The optimization process does a sequential test, selecting the first moving average value, then testing all of the RSI values; the second moving average value is then set and all of the RSI values are retested. The process is repeated until all combinations of the moving average calculation periods and RSI calculation periods have been tested. This is a *2-dimensional* optimization.

Test Size

It doesn't take much effort to create an optimization with a very large number of tests; with that, the test time for the optimization will increase dramatically. For example, a test of 250 moving average values (1 to 250), 30 RSI calculation periods (5 to 34), and 30 stop-loss values combinations (0 to 3.0 in steps of. 1) gives 250 × 30 × 30 = 225,000 tests. Even with today's faster computers, with each test taking 1 second (much longer for intraday data, perhaps less for daily data), the total test time will be about 62 hours. Tests with more parameters will quickly get out of control. It will be necessary to select fewer values to test for each parameter and choose them more carefully. Limiting the test is actually an advantage because it forces a decision, in advance, about the range of parameters that are reasonable for the strategy. Without these restrictions, the test process moves farther away from validation and closer to indiscriminant exploration.

Distribution of Values to be Tested

It is not necessary to test all of the calculation periods for a moving average or any trend method; however, the values cannot be spaced evenly apart. For a moving average trend, it is best to use all of the smaller values for the number of days and then fewer values as the numbers become larger. For example,

1, 2, 3, 4, 5, 6, 8, 10, 12, 15, 20, 25, 30, 40, 50

would be a better choice of values than using all numbers between 1 and 50. Consider that the difference between a 49-

and 50-day period is only 2%, while the difference between the 2- and 3-period test is 50%; the tests at the two ends of the test series thus represent very different sensitivity. The results of testing each value from 1 to 50 will appear to change dramatically at the short end (near 1) and change very little at the long end. The difference in performance between a 1- and 2-day moving average will be significant, but the difference between a 49- and 50-day one will be negligible.

One way of judging the best system, for example, a moving average or linear regression trend, is to run the test using the same calculation periods (1 to 50), then compare the average results of all 50 tests. Using equal increments will weight this set of tests heavily towards the long end; therefore, the comparison is not very good. Creating test values that increase in percentage increments would solve this problem. If the starting test value is multiplied by 1.5 to get the second value, and that is multiplied by 1.5 to get the third value, the final test series is improved. Beginning at 1, the series becomes 1, 1.5, 2.2, 3.3, 5.0, 7.6, 11.4, 17.1, 25.6, 38.4, and 57.7. This needs to be rounded for amoving average test that only accepts whole numbers: 1, 2, 3, 5, 8, 11, 26, 38, 58. Using an exponential smoothing instead of a moving average would work with all values. While it is not necessary to be this precise, the test series should reflect larger increments as the values get larger. By reducing the tests using percentage increments you not only improve the test time but you improve the results. The need to distribute the set of test values so that they do not bias the results will be important for comparing two systems and finding a robust solution, topics discussed later in this chapter.

Ranking the Test Parameters

Testing one parameter at a time can give you a better understanding of the dynamics of a system. It is much more difficult, sometimes impossible, to see the way that test results vary when there are five parameters being tested simultaneously. For this type of sequential testing, the most important feature must be tested first—the one that combines the big picture with the greatest impact on the results. In the example of a system with a moving average, RSI, and stop, the moving average is the primary component. The success of the strategy will depend on selecting a profitable trend period; the other indicator and risk control should improve the results. The merits of the system would be questionable if the trend could not show profits on its own, but the combination of the RSI and stop turned a losing trend into a net profit. In the same way, the second test should be the RSI. Risk control, using the stop-loss, should improve the final picture, but it is not likely that simply cutting losses will generate net profits.

Types of Test Variables

Test variables can be of three forms: *continuous*, *discrete*, or *coded* (alphabetic). In order to interpret and display test results properly, these forms need to be identified in advance.

Continuous parameters refer to values, such as percentages, which can take on any fractional number within a well-defined range. If a stop-loss level is defined as a percentage, it may be tested beginning with the fractional value .02% and increasing in steps of .005% until 2.0% is reached.

Discrete parameters are whole numbers, or integer values, such as the number of days in a moving average.

Coded parameters represent a category of operations, also called a *regime.* For example, when the parameter value is *A*, a single moving average is used; when the value is *B*, a double moving average system is tested; and when the value is *C*, a linear regression is used.

The first two parameter types, continuous and discrete, should be distinguished from the last one, coded. The analyst can expect some pattern in the results when testing parameters that take on progressively larger or smaller values. For example, a moving average of 1 day may post the largest losses, and show smaller losses until 30 days is reached, where it becomes profitable; performance peaks at 80 days and then starts to decay. The coded parameter, however, shifts rules for each value. There is no reason why a change of rules, which causes the system to switch from one regime to another, would result in any performance pattern that continues across these regimes. The first rule may be profitable, the second losing, and the third profitable. The display of results, discussed later, is only valid for continuous and discrete parameters tested in an incrementally ascending or descending manner.

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SELECTING THE TEST DATA

Testing a trading strategy on a computer is different from verifying a charting technique or taking prices from the *Wall Street Journal* to check results manually. If a computer is to be used for testing, there must be a complete database of price history and if more ambitious, a history of economic statistics as well. Data is readily available from numerous vendors and includes daily high, low, and closing prices, plus volume and open interest (for futures) on U.S. and major european markets. Individual stock data for U.S. markets can be downloaded from the Internet at no cost. When you purchase software to test your strategies, a database of daily prices may be included. Intraday (tick) data can be purchased from a limited number of vendors, the most well-known being CQG Data Factory and Tick Data, Inc. A complete database is an important asset. It can be kept current by automatic downloading at the end of each day.

Some data vendors, aware that analysts will want to use the data for testing that spans many years, have created special *continuous test series* specifically for that purpose. While cash market data, such as currency prices, are always continuous, most other data need to be adjusted. Prices of individual stocks will be corrected for stock splits by dividing the data prior to the split by the split ratio; therefore, a 3:1 split will be adjusted by dividing the data before the split by 3. If there was a previous split of 2:1 the data prior to that is divided by 6.

Futures data present a problem due to their limited contract life, most of them maturing every three months. To facilitate testing, some vendors have combined the individual contracts into a single, continuous series. In some cases, the software allows the users to specify exactly how the data should be combined. This gives the user the following choices for testing:

1. *Individual full contracts*. The entire futures contract or a series of contracts are tested. Using full contracts is a tedious process and can result in overlapping test periods and duplication of results. Individual sets of results must be combined in a spreadsheet to be evaluated. Figure 21.1 gives an example of the test bias resulting from carelessly using all of the data for futures contracts from July 1993 through December 1996. The horizontal bars represent the life of the contract for a futures market with delivery in May, July, September, December, and January. Because of the 18-month duration, there was only 1 contract tested in the last half of 1991, compared to 6 contracts tested during the middle period, and falling off to 2 contracts at the end of 1996. Figure 21.1b shows the frequency of testing for each time period.

2. *Selected parts of contracts*. The last 30 to 90 days of each contract can be tested to avoid overlapping data. By limiting a test to the nearest active contract, the one you will actually trade, you have a good representation of expected performance, although there are still a lot of little pieces to evaluate. When operating this way, you must remember to allow a *windup* period for your trends and indicators prior to the beginning of trading signals.

3. *Backward- (or forward-) adjusted data*. The data segments in (2) are combined on a specific *roll date* by adjusting all the prices in the older contract by the difference between the prices of the new and old contract on the roll date. For example, if on the same date the new contract was trading at 80.00 and the old contract at 75.00, then all the data in the old contract would be increased by 5.00. Moving backwards to the previous contract, if that showed a price of 78.00 when the 3rd-oldest contract showed 74.00, the prices in the 3rd-oldest contract would be increased by 9.00, the sum of the two roll values. Had the 3rd-oldest contract been higher than the second on the roll date, 81.00 versus 78.00, then its prices would be increased by only 2.00, the sum of 5.00 minus 3.00. The adjustment in every older contract is the cumulative adjustment of all the more recent roll dates.

   This technique has become popular and works well for trend systems. The adjustments will cause large distortions in the oldest data, especially if that data goes back more than 10 years. In the extreme case, the adjusted price can even become negative!

   The *roll date* can be one of the following choices:

a. A fixed date, such as the last day of the month before the delivery month. This is standard for interest rates, agricultural products, and some other commodities because margin requirements change significantly for those who trade into the delivery month. Therefore, for Treasury notes and Eurodollars, the June contract is rolled on the last day of May, the September contract on the last day of August, and so on. For index markets, the expiration date is not fixed and the contract is actively traded until a few days before delivery. Some analysts choose to roll on the 14th of the delivery month although expiration of the contract can vary from the 15th to the 18th of the month.

b. The day on which volume and/or open interest switches from the nearest delivery to the next deferred. The roll-adjusted series should represent the contracts with the greatest liquidity; therefore, the day on which the volume of the nearby contract drops below the volume of the next deferred month is the best day to roll the continuation series. While this would be complicated if done manually, data vendors can construct this series automatically. It is the one that best represents the way in which you would trade a market such as the S&P Index.

4. *Indexed data series*. A continuous series is constructed to represent the daily percentage returns each day. This is essentially the way a stock index is constructed. If the price of copper moves 1.0% from $.9000 to $.9090 per pound, then the indexed value will be increased by 1.0%. When the contract rolls, the price change of the new contract is compared to its prior price. The conversion into an indexed series is useful for comparing two markets and for constructing portfolios.

5. *Constant forward series*. In the same manner as the London metals and cash forward markets are quoted (for example, delivery 30 days forward), an artificial 30-day forward series can be created for any futures market. The 30-day price is calculated by interpolating between the delivery months on both sides of the date 30 days ahead. This type of data series is called a *perpetual contract* and presents its own set of problems. Deferred contracts are not as volatile as the nearby contract, and formulated values create a series that is much smoother than the one you are likely to trade. Your test results may appear to have less risk, probably less profit, and greater reliability in identifying trends. Most important, testing would be done on a price series where none of the prices actually occurred.

Figure 21.1: Testing using all of the data for futures contracts July 1993 through December 1996. (a) Test intervals. (b) Distribution of testing.

The Problems with Adjusted Data Series

Back-adjusted data, split-adjusted data, and indexed data are ideal for testing trending methods, such as a moving average or linear regression. They have no problems with the RSI, stochastic, or any of the other normal indicators. They cannot be used if any of the calculations requires percentages. Futures markets, especially energy, have large price differentials on the roll dates. This causes older prices to be shifted down so that the prices at the beginning of the adjusted series can be negative. This makes no difference to a moving average calculation, but a percentage of a negative number is likely to play havoc with the strategy's trading decisions. This problem is more subtle for back-adjusted stock splits because the prices all appear to be scaled correctly and never go negative. For example, if IBM had split twice (each 2:1) during the past 10 years, then the price 10 years ago would have been adjusted lower by dividing by 4. If the real price in 1990 was $50 per share, the adjusted series would show it as $12.50. If the trading range was $2 at $50 per share it will be $0.50 when back-adjusted to $12.50. But the volatility at a truly lower price might be proportionally higher than at $50. The $12.50 stock will have all the characteristics of a $50 stock.

Comparing historic highs and lows cannot be done with a back-adjusted series. Analysts may normally recognize an important resistance level when prices test the highs of the previous year; however, the older price has been adjusted and may be higher or lower than its original price. To make this comparison it is necessary to have a second series that is rolled on the same dates but not back-adjusted. The second series can be accessed when the true historic price is needed.

An indexed series can be awkward when you trade because all the prices must be converted to indexed values in order to

be evaluated by the strategy. You cannot simply test using an index series, then trade using a price series.

Which Data Series Is Best?

If all back-adjusted series have problems, which is best? In theory, using individual contracts, winding up your indicators, and trading only the nearby portion of the contract would come close to the way you will actually trade. The benefits are not likely to be worth the extreme effort needed to do this. The most practical solution is the back-adjusted series rolled when volume shifts. If the true prices are needed then a second series should be used.

Indexed series are also very good, although more difficult to trade. The process of indexing comes very close to volatility-adjusting and may make the data easier to use and the parameter selection more consistent.

Synthetic Data

The ultimate answer to getting test data is to create it yourself. As the testing process is discussed, it will require that the data be separated into a larger part that is used for historic testing, and a smaller piece for out-of-sample validation. It would be ideal if *synthetic data* could be created that had the same characteristics as the data that will be traded, yet is different. A strategy could be developed and tested on one series of synthetic data, validated on a completely different series of synthetic data and, when everything seems in order, the final validation process would be tested on a long interval of real data. Limitless, good data would certainly make system development more reliable.

Over the years analysts and mathematicians have attempted to create synthetic data. One of the first methods used a Monte Carlo process that first scanned actual data looking for a way to divide the data into equal-length segments by finding the calculation period that resulted in the lowest autocorrelation (the dependence of one data segment on the previous). The real data could then be rearranged randomly and the new series would have the same underlying characteristics as the original, but it would be different. Unfortunately, mixing segments would separate a prolonged bull market from the inevitable decline that occurs at the peak. A system can suffer a large loss when prices peak only if it has accumulated larger profits during the previous upwards trend. Separating the data so that these two events do not follow one another is unrealistic. The Monte Carlo approach was abandoned.

A synthetic series created mathematically begins with random numbers. It has been shown that a simple series of random numbers will look very similar to most price movement, especially during a sideways period. But price movement is not normally distributed and has much longer runs, both up and down, than would be found in a random series. Real data may have seasonality, a long, underlying directional bias due to government policy, changing volatility, and a certain level of underlying noise. But mathematics is powerful, and an artificial series can be created that has 10% trend and 90% noise, reflects a seasonal bias, and has a lognormal distribution.

A recent and sophisticated attempt at creating synthetic data can be found in Wolberg's *Expert Trading Systems*. The technique uses a Gaussian distribution to represent the skewed price distribution, and a noise component that is a function of the price trend, yet variable around the trend. The trend component is itself nonlinear, created using kernel regression. One process used for verifying that the synthetic data has the same characteristics as real data is the Fraction Same Sign, which is the percentage of synthetic records in which the predicted and actual data have the same sign. Other statistics of variance, noise, and distribution should match.

Synthetic data is an ideal solution to a difficult problem. It also brings to mind two computers playing chess with one another. In this case, one computer creates a data series to fool the other computer into thinking that it is real. The second computer is creating a strategy that can take advantage of the fact that it knows the data series is not real, and is constructed from components that are built systematically. If the series were totally random, then it would not be a price series. If it is not random, then another computer should be able to identify the process used to create the series, then capitalize on it. The strategy computer should always win.

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SEARCHING FOR THE OPTIMAL RESULT

The *optimal result* of a strategy is the set of parameters that produces the *maximum value* of the test objective, covered in the previous section. The test objective can be net profits or a reward-to-risk ratio. Later, the concept of *robustness* will be discussed. The maximum value will not be the selection that represents the most robust strategy. Optimization, which may best be called *massive testing*, will be used as a means for finding a robust solution.

There are many complex techniques for finding the maximum value. Later in this chapter, genetic algorithms and Monte Carlo sampling will be applied to tests that are too large for most other solutions. This section will look at the most basic approach, *sequential testing*, calculating the results of every combination of parameters. A single moving average system with a stop-loss might have the following parameter test ranges:

1. Moving average calculation periods from 1 to 50.
2. Stop-loss values from 0 to $1,000 per share, or the equivalent, in steps of $10.

The total number of tests would then be 50 × 100 = 5,000. When three parameters are tested, the number of tests increases rapidly. Taking care to use the best parameter distribution, as discussed earlier, is a simple way to reduce the test time and improve the usefulness of the results. When there are too many tests, even with carefully chosen values, a wider spacing of values can be used to locate the general pattern of performance. Once the approximate range of parameter values is known, more detailed retesting can be done.

Calculate the number of tests you will run before beginning an optimization. Although the time may not be a problem, your test software may not be set up to hold the number of test results that you are creating. All computers have limits. If you generate as much as 1,000 combinations, remember that you will need to evaluate them using a spreadsheet. Large numbers of rows and columns, combined with numerous markets, can create an unmanageably large spreadsheet.

Mathematical Optimization

If you have created a system on a grand scale and the number of parameters combined with the number of tests for each parameter generates a test that is far too long, then *mathematical optimization* offers a testing solution. One caveat is that this method only applies to continuous test values. That is, test values must be increased incrementally, as in a moving average calculation period, and result in a corresponding continuous result, such as performance that increases and decreases somewhat smoothly based on parameter values. You cannot use this method to test coded variables that cause an abrupt shift in the methodology. In the simplest example, the procedure is:

1. Test one parameter, such as the moving average calculation period. Set the other parameters to a reasonable value.
2. Find the best result and fix that value for the remaining tests.
3. Select the next parameter to test.
4. Continue at Step 2.

This technique is called *sequential optimization*. It has the advantage of reducing a 3-parameter test case from $n_1 \times n_2 \times n_3$ total tests to $n_1 + n_2 + n_3$. It has the disadvantage, however, of not always finding the best combination of parameter values when the test is very large. Figure 21.2 shows a two-dimensional map of test results, a good way of visualizing the relationships between parameter sets. If Figure 21.2 shows all the tests, then the best choice is the 20-day moving average with a.30% stop-loss, netting a score of 400. Using sequential testing, beginning with the moving average days, and setting the stop-loss to its lowest value, the best result (in row 1) is 200, the 15-day calculation period. Fixing the first

parameter value at 15 and testing the stop-loss values, the results appear in the same column. The best result is a score of 300 when the stop-loss value was .30%. While this result is good, it is not the peak result (or even next best, 350). If the test began with the stop-loss value, it ends at the same point. For this set of tests, the best results cannot be found regardless of whether the test begins with rows or columns—when the lowest value for the other parameter was chosen. Even though the area of greatest profitability is clear, the best choices in the first row or first column do not peak at values consistent with the overall best result.

			Moving average days			
		5	10	15	20	25
Stop-loss (points)	10	100	150	200	150	150
	20	200	150	250	300	300
	30	250	200	300	400	350
	40	200	150	200	300	300
	50	100	100	150	250	250

Open table as spreadsheet

Figure 21.2: Visualizing the results of a 2-dimensional optimization.

There are two ways that traditionally avoid this problem. One method is to list the parameters in order of importance, that is, those that would have the greatest impact on profitability, although you might choose this by its fundamental importance to the strategy. This was discussed in the previous section "Ranking the Test Parameters." In this example, the moving average is the primary parameter; however, that choice does not work in Figure 21.2. Fortunately, mathematicians are prepared for this problem.

The final alternative is to choose a series of random starting values for each of the parameters, including the primary one, and search horizontally and vertically from that point. For example, two random values, 1 and 4, are chosen for parameter 2, the stop-loss. The test begins by scanning row 1 for all values of the moving average, which was done in the first example. The maximum score was 300. The test is repeated, scanning row 4 for all values of the moving average. This time the value 300 is found in column 4. The next scan of column 4 finds the maximum, 400. Instead of testing all combinations, $n_1 \times n_2$, the answer was found searching $2 \times (n_1 + n_2)$. This is much faster when n_1 and n_2 are large.

The object of any search is to find the best results with as few tests as possible. Although each 3-parameter test is only $n_1 + n_2 + n_3$ tests, the total number of tests will accumulate quickly. When you have performed a number of searches beginning with a random seed and found the same results, you can conclude with some certainty that you have located the peak. For example, if you begin searching in Figure 21.2 in any row other than row 1, or in any column at all, you will find the maximum value. For a test of this size, after 3 seeded values show the same result, you can conclude that the peak has been found. For larger tests, more seed values would be needed, yet the total number of searches will be relatively small.

More on Test Continuity

Any system can be tested using a computer, but automatic selection of the best results only makes sense when they are continuous. A moving average system with stops is continuous in all directions. Adding a third dimension, an entry or exit delay (0, 1, or 2 days) will produce continuous results in three directions. But not all tests satisfy this principle. It has been briefly mentioned that rule changes are the most likely cause of discontinuity. Consider a test where one variable is the trend calculation period and the other is a set of rules, coded as *L*, *S*, and *B*, where *L* only takes long positions, *S* only takes short positions, and *B* takes both long and short positions. Although there may be interesting patterns and relationships, averaging these results does not make sense.

If each parameter tested has values that result in a continuous return curve, there are mathematical techniques available to locate the point of maximum profit with the minimum steps. One method, *optimization by steepest descent*,[1] uses both the returns and the rate of change of returns to determine the size of the steps taken during the optimization process. This method can be suboptimal if there is more than one return peak.

[1]F. R. Ruckdeschel, *BASIC Scientific Subroutines*, Vol. II (Byte/McGraw-Hill, Peterborough, NH, 1983).

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VISUALIZING AND INTERPRETING TEST RESULTS

Test platforms, such as TradeStation and MetaStock,[2] are excellent alternatives for analysts who do not want to develop their own test platforms. TradeStation performs an optimization by sequentially processing every combination of parameters from a range specified by the analyst. The results are shown as a table, which can be exported to Excel, with one combination of parameters following another and the results of the test displayed on one line. Using a moving average with a percentage band as the system, an optimization was specified with

1. The moving average calculation period varying from 10 to 50 days in increments of 10 days.
2. The percentage band (based on the value of the moving average) varying from 1% to 4% in increments of 1%.

The system buys when the closing price penetrates the upper band and sells when it penetrates the lower band. The results of the optimization using Nasdaq 100 continuous futures from 1996 through 2003 are shown in Table 21.1. The user can choose the statistics that appear in the table. In this test, the columns (from left to right) are the moving average period (*MA Per*), the percent band (*% Band*), net profit (*Net Profit*), net profit for long positions (*Long NetPrf*), net profit for short positions (*Short NetPrf*), number of trades (*#Trds*), percentage of profitable trades (*%Prf Trds*), number of profitable trades (*#Prf Trds*), average win/loss ratio (*Avg W/L*), average profit per trade (*Avg Trade*), average number of bars in a winning trade (*Avg WBars*), average number of bars in a losing trade (*Avg LBars*), maximum drawdown (*MaxDD*), profit factor (*PFact*), and return on account (*ROA*). *Profit factor* is the ratio of gross profits to gross losses, and *return on account* is the ratio of net profits to the absolute value of the maximum drawdown.

Table 21.1: Optimization Report from TradeStation for a Moving Average—% Band System Applied to Nasdaq Continuous Futures

Open table as spreadsheet

MA Per	% Band	Net Profit	Long NetPrf	Short NetPrf	#Trds	Trds	#Pft Trds	Avg W/L	Avg Trade	Avg WBars	Avg LBars	MaxDD	PFact	ROA
10	3	-89895	-32540	-57355	89	30	27	2.03	-1010	42	12	-189510	0.884	-47.4
10	4	-243235	-127165	-116070	61	36	22	1.23	-3987	46	16	-421200	0.693	-57.7
10	2	-194545	-89410	-105135	136	32	44	1.66	-1430	25	8	-227740	0.792	-85.4
10	1	-108775	-48005	-60770	192	35	69	1.56	-567	18	5	-157850	0.876	-68.9
20	2	-158015	-72245	-85770	94	32	31	1.61	-1681	39	10	-338560	0.792	-46.7
20	4	93265	52115	41150	48	41	20	1.69	1943	62	21	-120550	1.209	77.4
20	3	118545	67580	50965	60	41	25	1.73	1976	53	15	-221180	1.238	53.6
20	1	-39195	-13215	-25980	134	31	42	2.07	-293	29	7	-153890	0.945	-25.5
30	3	89365	51445	37920	52	32	17	2.48	1719	69	19	-128395	1.202	69.6
30	4	-12345	-13990	1645	43	32	14	2.02	-287	73	23	-210745	0.974	-5.9
30	1	178315	95540	82775	96	33	32	2.70	1857	43	8	-164980	1.352	108.1
30	2	65770	39605	26165	68	32	22	2.37	967	55	15	-141660	1.131	46.4
40	3	198085	103005	95080	43	34	15	2.90	4607	79	21	-150670	1.555	131.5
40	2	285980	152810	133170	51	35	18	3.46	5607	74	16	-154510	1.885	185.1
40	1	200735	106750	93985	78	28	22	3.79	2574	58	11	-147845	1.489	135.8
40	4	176195	80480	95715	31	38	12	2.37	5684	91	31	-161050	1.496	109.4
50	2	197125	107520	89605	49	34	17	2.89	4023	78	17	-116830	1.537	168.7
50	1	267520	140480	127040	56	33	19	3.51	4777	75	12	-90680	1.805	295.0
50	4	225465	106965	118500	27	40	11	2.57	8351	111	29	-152850	1.764	147.5
50	3	247025	116200	130825	31	38	12	2.95	7969	98	27	-127050	1.865	194.4

The optimization report is shown in the order that it appears after testing is completed. The moving average period increases from 10 to 50; however, the % band is not always in ascending order. Nevertheless, there is a clear pattern that shows profits begin with a 30-day moving average using a 2% and 3% band, then become profitable for longer calculation periods with all bands. When the optimization is completed, a final report is available showing the returns for the best combination of parameters, the 40-day moving average with a 2% band.

Seeing Continuity in Test Results

Visualizing the test results properly can make interpretation far easier. Table 21.1 is easy to read for the short test example, but combinations of 2 parameters can produce hundreds of lines of statistics that are not easy to organize. Figure 21.2 has already given a preview of how results might be presented in 2 dimensions to show continuity, rather than as a list of one test result after the other, one line under the other. If a 1-parameter optimization is run for a system in which all parameters and rules are fixed, except for the moving average calculation period, there are three possible patterns that might result (Figure 21.3).

Figure 21.3: Possible resulting patterns from a test that varies only the moving average days.

In all three patterns, the test returns are shown on the left, and the moving average calculation period is shown along the bottom. Figure 21.3a is a simple curve, indicating that both fast and slow parameters generate losses, although the midrange is profitable. It is easy to select the number of moving average days that produced the highest profit because of good continuity around that point.

Figure 21.3b shows two possible areas of success. Because both are about equal in size, the choice between the two is based on frequency of trading and size of the profits per trade. The short calculation period has more trades, a shorter holding period, and smaller profits per trade. Another possibility is to trade the moving averages represented by the peaks. If you must choose one, then it is most likely that the larger calculation period will produce results that are more stable; it is considered a more conservative selection. A fast trading system can result in errors, poor execution prices, and large transaction costs. Unless these factors have been carefully incorporated into the trading strategy, a highly profitable simulation will result in large, real losses.

The pattern in (b) appears exaggerated in (c), but is actually more realistic. The fast system has much higher profits in a very narrow range while the long-term trend has a wide range of success. The spike in the area of the 3-day moving average is surrounded by losses, indicating that the high profits may have been caused by a short-lived price shock, or an actual window of opportunity for a fast trader. This pattern also occurs when there are no transaction costs. There are fast trading strategies that can be highly profitable without slippage or commission!

The three patterns in Figure 21.3 are all good results, showing a wide range of calculation periods that produce profits. An erratic pattern, one that does not have these smooth return relationships, shows that the underlying strategy is bad, or that the test program has errors.

Two-Parameter Tests

The most popular tests are those that have two or more parameters, a combination of one or two trends, an indicator for timing, a stop-loss for risk control, and sometimes profit targets. Table 21.1 showed the results of a moving average with a percent band. The results of a 2-parameter test, for example, a moving average and a stop-loss, can be shown as a *grid* (a 2-dimensional table) in the same form as Figure 21.2, with the moving average calculation period along the left (rows) and the stop-loss values at the top (columns). Figure 21.4 shows that the lowest number of days and the smallest stop-loss value will give the score in the top left corner box. The bottom right box will show the result of the slowest trend and largest stop-loss.

Figure 21.4: Standard configuration for a 2-dimensional optimization.

By presenting the results as shown in Figure 21.4, there is a continuity of performance in all directions. The upper left corner represents the fastest system—the one with the most trades; the bottom right corner shows the results of the slowest strategy. The patterns to the upper right may be similar to those of the lower left if the system displays some symmetry. A faster trend speed with a large stop (top right) and a slow trend with a small stop (bottom left) may enter and exit for different reasons, but are likely to have a similar pattern in the same number of trades and profitability.

Although the combination of markets, trading rules, and parameter values can produce an infinite combination of results, three patterns are most likely to appear in this 2-dimensional presentation. Figure 21.5a shows the simplest case, where a single area of successful performance appears as a broad peak and gradually tapers off. This is analogous to the single parameter test shown in Figure 21.3a. Selecting the parameters associated with the center of the best performance area seems the most logical since moderate shifts in price patterns are still likely to be profitable.

Figure 21.5: Patterns resulting from a 2-dimensional optimization. (a) Single profitable area. (b) Two distinct profitable areas. (c) No obvious pattern.

Two areas of profitability are usually the results of a highly volatile market (Figure 21.5b). Prices that are moving quickly and sustain a major trend can be traded using a fast or slow model. The fast model is often more profitable because it captures more of the rising trend; it then reacts faster to profits from the decline. The slower trend-following approach captures less of the price move but keeps clear of the sharp reactions that stop out the middle-speed trends. This pattern does not appear with very long test intervals; it is a product of a faster price movement that cannot be sustained over a longer period. The choice of parameters to use in actual trading follows the same reasoning applied to Figures 21.3b and 21.3c.

The third case, shown in Figure 21.5c, is one of erratic returns. The absence of a consistent pattern in the performance indicates that the trading strategy does not work with this data.

Alternate Ways of Visualizing Results

With software such as MathCad you can see the 2-parameter test as a *contour* or *topological relief map*. The patterns shown in Figure 21.5 can be seen in multiple colors, graded from one shade to another as returns increase and decrease. It is much easier to see the peaks and valleys of performance and get a sense of smoothness; it is highly recommended. Any spreadsheet program will allow a surface plot which will give you a rough look at the continuity of a 2-parameter test, as shown in Figure 21.6. This 3-dimensional graph gives the net profits of a moving average crossover system applied to the Swiss franc. The larger calculation periods representing the slower trend are shown along the front scale and the faster trend along the right scale. The returns that are floating inside the grid have a ridge running from the front to the back, indicating that a slow trend of about 50 to 60 days dominates the results. Other than the fastest trends of 3 days, it is easy to see that there are many combinations of fast and slow moving averages that are historically profitable.

Figure 21.6: Three-dimensional map of crossover model.

Visualizing with Scatter Diagrams

Unfortunately, technology does not yet allow us to chart more than 3 dimensions. If the system has three parameters, a moving average, RSI, and slop-loss, it will be necessary to have more than one chart in order to visualize the results. In Figure 21.7, there are only two parameters, a fast and a slow moving average. Each chart will show the results of only one parameter (see Figure 21.7). To accomplish this, the results of an optimization were exported for the test platform to a spreadsheet. Using a scatter diagram, also called an *XY plot*, each circle represents the results of an individual test where the moving average had the calculation period shown along the bottom.

(a)

(b)

Figure 21.7: Visualizing the performance of multiple parameters. (a) The slow moving average peaks at 50–60 days. (b) The fast average may be best at any value from 7 through 15.

In this Swiss franc example, look at the first column in Figure 21.7a. The slow moving average value is 20, seen along the bottom. There are 9 circles in the column, each representing the results of using the slow moving average of 20 days, with each of the faster moving average periods of 3, 5, 7, 9, 11, 13, 15, 17, and 19. The picture of results shows a range from a small loss to a gain of about $30,000. As the slow moving average period becomes larger, the range of returns increases, peaking at 50 and 60 days. Which is better? Although the highest test result came with a calculation period of 60, the variance of returns was much higher than period 50, while the average returns of all tests were about the same. That would indicate that the use of a 50-period average was more stable and the better choice. In this example we must be cautious that the small number of tests does not make the 50-day results look better simply by chance.

The individual test results are shown as circles above the slow or fast moving average in Figure 21.7. For the slow moving average it is clear that

profits are greatest when 50 and 60 days are used for the calculation period; however, it is not as clear which of those two values are the best choice. The 60-day moving average posted profits higher than the 50-day average, but also showed profits below the lowest 50-day returns. A closer look shows that the average returns of the moving averages over those periods are about the same, but the 60-day moving average has a higher variance. Normally the best choice is the result that is most stable (the 50-day calculation) although in this example we must be cautious that the small number of tests do not make the 50-day results look stable just by chance.

The results of the faster moving average, seen in Figure 21.7b, shows much greater variance. The returns above the 7-period calculation have a very wide range that includes the highest result; however the average of the results for the 7 through 15 periods are all very similar. With variance in mind, the 13-day calculation seems to be the best candidate. We can be confident that this method is robust because nearly all combinations of fast and slow moving averages gave profitable returns, net of a $50 cost for commissions and slippage.

Standardizing Test Results

When testing a single system, the results of one set of parameters can easily be compared to other sets because the test period, commissions, and other basic values are all the same. However, over time you will test many different systems and variations of those systems, and you will want to compare them to decide which strategy is best. This requires some advanced planning.

Standardizing test results is the best way to increase the usefulness of extensive testing. This should include:

1. *Annualizing all values.* Tests not performed at the same time (3 or 6 months apart), or tests on different futures markets, are likely to use data that starts and ends on different dates. Annualizing the results will not give a perfect comparison, but will make comparisons more relevant.

2. *Risk adjusting.* A profit of $10,000 with a drawdown of $5,000 is effectively the same as a profit of $20,000 and a drawdown of $10,000, given adequate reserves. Expressing the results as profits divided by risk is a useful way to view returns.

3. *Adjusting for standard error.* The important difference between two tests that yield the same results, one test with two trades and the other with 50 trades, is that the one with only two trades is a less reliable result. If both posted 50% profitable trades, another losing trade would make the reliability of the second test drop to 49% while the first case would drop to 33%). Instead, results should be presented at the same confidence level, which means subtracting the standard error from the current result.

Averaging the Results

Because the testing process is computer-dependent, it is desirable to make the selection of the best parameters automatic. This can usually be done effectively by averaging either the annualized returns or the return ratio displayed in the test map. In the case of a moving average system, the first task is to correct the results to eliminate distortions caused by spikes. For example, the results of a 3-, 4-, 5-, and 6-day test show profits of 1,000, 8,000, 3,000, and 4,000, respectively. The 4-day case is clearly a profit spike and could be minimized by replacing its value with the average of the three values or, preferably, by the interpolated value of the two adjacent points (Figure 21.8). In general, the substitution process in which every value is replaced by the average of its neighbors

$$\overline{PL_i} = \frac{PL_{i-1} + PL_i + PL_{i+1}}{3}$$

Figure 21.8: Replacing a spike with the average *A* or an interpolation *B*.

will smooth out the returns. The best parameter set is the highest value of PL_i once all averages have been substituted for the raw test results.

It is more likely a spike or erratic results will appear when shorter calculation periods are used or when the test interval is short. Results of longer calculation periods tend to be stable. Remember that the difference between the results of a 2- and 3-day moving average are greater than those of a 30- or 31-day average or even a 30- or 40-day test. A rough but representative sample of results could be achieved by increasing the test values by a factor of 1.5, then averaging the results. For example, the average returns from a set of test values, 2, 3, 4.5, 6.7, 10.1, 15.2, 22.8, 34.2, 51.2,… will give a good, evenly weighted representation of the broad range of performance.

Two-Parameter Averaging

The results of a two-parameter test may also be averaged to create a smoother set of values. Using a 2-dimensional grid shown in Figure 21.9, the original results of each test will be denoted as PL_{ij}, the net profit or loss associated with row *i* and column *j* of the display. The object is to replace each PL_{ij} with PL_{ij}, the average value of its neighbors. This is done, as seen in Figure 21.9a, by taking an average of the 8 test results adjacent to the *ij*th value as well as the center value. There are special cases when the *ij*th result is not fully surrounded but on the perimeter of the test grid. Figures 21.9b, 15.9c, and 21.9d show the averaging technique used when the *ij*th box is a top, side, or corner value. The 9-box average shown here is comparable to the 3-point average in the 1-parameter test. If the test has relatively small increments between tests and more test cases, an average of a larger area would be better.

Figure 21.9: Averaging of map output results. (a) Center average (9 box). (b) Top edge average (6 box). (c) Left edge average (6 box). (d) Upper left corner average (4 box).

[2]There are an increasing number of test platforms available for a wide range of costs. Many of these will advertise in, or have been reviewed by, *Futures* magazine, *Technical Analysis of Stocks & Commodities*, and *Active Trader*.

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STEP-FORWARD TESTING AND OUT-OF-SAMPLE DATA

The correct procedure for testing always includes reserving some data to be used afterwards to validate the results. The data used during testing is called *in-sample data* and the reserved portion for validation is *out-of-sample data*. This concept should be familiar to everyone involved in the design or development of a system.

Traditionally, analysts use as much data as possible to determine whether their proposed strategy is sound. The use of long test periods assures a good sample of markets, including long periods of sideways movement, bull and bear markets, and a good number of price shocks of various sizes. As more data is used, it is most likely that the results will show larger profits and larger losses. More data allows the possibility of larger price runs, larger price shocks, and more complex patterns.

When there is, for example, 10 years of data available for testing, a standard approach would be to test the oldest 9 years, find the best set of parameters, then test the system on the most recent year using the selected values. If the result of the out-of-sample period is similar to the in-sample performance, the system is considered validated.

Step-Forward Testing Procedure

The concept of choosing parameter values from tests of in-sample data, then applying the results to out-of-sample data, has been developed into a test process called *step-forward testing*[3] (also *walk-forward testing*). This process goes as follows:

1. Select the total test period—for example, 10 years of daily data from 1988 through 1997.
2. Select the size of the individual test intervals—for example, 2 years.
3. Begin testing with the first 2-year period, 1988 through 1989.
4. Select the best parameter values from those results.
5. Use the selected parameter values from Step 4 to find the performance of the next 6 months of data (the first half of 1990). Accumulate this out-of-sample performance throughout the test process.
6. If there is more data to test, move the test period forward by 6 months (the second test will be from the second half of 1988 through the first half of 1990), then test the data; otherwise, go to Step 8.
7. Repeat Step 4.
8. The result of the step-forward test is the accumulated results of the individual out-of-sample tests in Step 5.

This process clearly simulates the traditional approach to test design, using in-sample and out-of-sample data in its proper order.

Short-Term Bias

Step-forward testing can introduce a bias that favors faster trading models. Because the in-sample test used only 2 years of data in our example, a long-term trading model may only post a few trades during this period, and a longer trade may be interrupted, and discarded, because it is still open when the end of the data is reached. If the open profits are included, the next set of tests may start in the middle of this trend, rather than at its natural beginning, posting a loss rather than a profit. This makes the results of the longer-term models unreliable. This would not occur if a single, longer test period were used.

The problem of short-term bias can be identified by the optimum parameters values switching from short-term to long-term in successive test periods. For example, if you test moving averages from 5 to 50 days you will find that one period shows 10 days as the best, followed by a period in which 50 days is best, followed again by a period in which 15 days is best. This erratic behavior is a sign that the data intervals are too short. It can be corrected by increasing the test intervals from 2 years to 5 years and making the out-of-sample period 1 year. Longer test intervals go a long way towards eliminating the short-term bias, but they must be considered in context with the type of trend envisioned by the developer.

Feedback

One serious problem occurs when the result of out-of-sample testing fails to perform as expected. The performance profile and even the individual trades are inspected closely to find how this period differed from the past. If the review is successful, a rule change is incorporated into the program and the in-sample data is retested. When completed, the new parameters are applied to the out-of-sample data. This repeated use of out-of-sample data is called a *feedback process*. The out-of-sample data was used to respecify the system; therefore, it is no longer out-of-sample and there is no data that can be used for validation. Because the original problems were corrected using that data, the system should perform well during that period. The improved results are the product of fitting the data. There is no confidence that the strategy will be able to produce profits in the future. This is a problem that can only be resolved by a broad view of robust testing procedures discussed throughout this chapter.

[3]A thorough presentation of both step-forward testing and optimum search techniques can be found in Robert Pardo, *Design, Testing and Optimization of Trading Systems* (Wiley, 1992).

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MASSIVE TESTING

A strategy with many parameters, each with a range of values that could reasonably be applied to each parameter, can combine to be a *massive test*—an optimization of hundreds of thousands (or even millions) of tests. It would be impossible to apply any form of sequential testing to reduce the test time to something reasonable. Yet there are strategies in which each parameter is interrelated to each other and they should be tested together. Two techniques can satisfy this problem: *genetic algorithms* and *Monte Carlo* sampling.

Genetic Algorithms

The use of genetic algorithms for finding parameters was discussed in the previous chapter in the sections "Neural Networks" and "Genetic Algorithm." A genetic algorithm is a very practical and very powerful searching tool.[4] It will be necessary to read the sections in Chapter 21 before continuing here.

In the previous discussion, a trend and an oscillator were combined into a trading strategy and the rules for applying each component could be randomly changed. In this example, the rules will be fixed but the parameter values are unknown; only the range of parameter values can be specified. Define the strategy and the range of calculation values as:

1. A long-term moving average trend, 30 to 250 days, increments of 5.
2. A percentage band around the long-term moving average, .5% to 4%, increments of.25%.
3. A short-term moving average trend, 3 to 30 days, increments of 3.
4. A percentage band around the short-term moving average, .1% to 1.5%, increments of .1%.
5. An RSI for entry timing, 5 to 20 days, increments of 1.
6. RSI overbought and oversold thresholds, 40 to 95 for overbought, -40 to -95 for oversold (only one set is needed if these values are symmetric), increments of 5.
7. A percentage stop-loss, .25% to 3.0%, increments of .25%.
8. A moving average trend for equity, 5 to 50 days, increments of 5.

These 8 parameters seem innocent enough, but total 2,332,800,000 tests. At 10 tests per second, the processing time would be 64,800 hours, more than 7 years! Following the steps discussed in Chapter 20,

Initialization

1. A *string* of 8 cells is created to represent each of the parameters. A string is the general term given to a single set of parameter values, called a *chromosome* in Chapter 20.
2. Each cell in the string is assigned a random number that conforms to the predefined ranges.
3. A pool of 1,000 to 5,000 strings is created, each with random values.

Propagation

4. The objective function (ranking score) is calculated for each string.

5. The pool may be sorted in descending order by objective function.
6. Multiple copies are made of the highest-ranking strings and added to the pool.
7. The pool is sorted by highest objective function, all culled to the best 5,000 strings.

Mating

8. Two strings, not previously selected, are chosen at random from the pool.
9. A random number between 1 and 8 divides the cells of the strings into left and right parts.
10. The left part of the first string is switched with the left part of the second string, creating two new strings.
11. The mating process continues until 10% to 15% of the strings have been combined.

Mutating

12. One string is chosen at random from the pool.
13. One of the 8 cells is chosen at random.
14. Based on the range of values for the parameter assigned to this cell, a new value is chosen at random.
15. Mutation continues until one cell in 10% of the strings have been changed.

Converging

16. The best objective function, or score, is saved at the end of each pass, and the parameter values associated with this string are saved.
17. The genetic algorithm process continues at Step 4 until the objective function converges. That occurs when, after a number of passes, the objective function does not increase significantly.
18. The genetic algorithm process is repeated up to 5 times, beginning with the initialization.
19. After 5 passes, the string previously saved with the highest objective function is the solution.

For a trading strategy with 8 parameters and over 2 billion combinations, the genetic algorithm should converge within 50 passes. Repeating the process five times in order to seed the cells differently increases the number of passes to 250. It is likely that the elapsed computer time will be 15 minutes. It does not guarantee that the maximum combination will be found. The chances of finding a maximum can be increased with a larger pool and by reseeding more times. However, the parameter values chosen from this short search will be astoundingly good. We will never know how close the results come to finding the maximum because no one is going to run a sequential search that takes 7 years. A more detailed example of the use of a genetic algorithm, applied to portfolio allocation, can be found in Chapter 24.

Monte Carlo Sampling

The problem with the genetic algorithm solution is that it returns only the maximum results. There is no information on the depth of success that is needed to determine robustness. It is always a help to know the parameter values that are most successful, but it is not enough. *Monte Carlo* sampling is used to create a subset of tests when the total number of tests is too large. The results of this smaller set of tests can be analyzed as though it were the complete set.

Monte Carlo simulation (MCS) was created by the famous mathematicians Johann von Neumann and Stanislaw M. Ulam; they devised the method shortly after World War II to help them simulate the behavior of an atomic weapon. There is an interesting example of how the Monte Carlo process has been used to find the area of a lake with an extremely irregular shoreline. A picture of the lake is taken from above and the scale is determined (e.g. 1" = 100 feet). Think about the picture as 10" × 10", displayed in color on a computer screen, with the lake clearly blue. The picture is then superimposed with a fine grid, so that there are 100 (or even 1,000 if more accuracy is needed) pixels per inch, for a dimension of 1,000

× 1,000. Now pick two random numbers between 1 and 1,000 to represent the *x* and *y* coordinates, and say the first are 135 and 441. Remember that a random number has an *equal chance* of being any of the values between 1 and 1,000. The position (135,441) is marked on the display and the computer determines whether it falls in the lake or on the shore. This process is repeated for 1,000 pairs of random numbers. When completed, the computer has counted 520 pairs that were in the lake; therefore, 52% of the display area is lake, or 520,000 square feet. If more accuracy was needed, the grid would be divided into more pixels, and more random pairs would be generated. The process works because the probability of a pair of random numbers falling in the lake is equal to the ratio of the lake's area to the entire picture.[5]

Random numbers can also be used to generate parameter values in a test of a trading strategy. Using the same 8 parameters applied to the genetic algorithm solution, a value is picked at random for each parameter from the list of ranges specific to that parameter. This is the same step as the initialization of the pool of strings used in the genetic algorithm. Every time a value is picked a counter is incremented. Every parameter has a counter for every possible value used in the test. After the first string is created and saved in a table along with its performance statistics, the counter for each random value that was used is increased by 1. After 1,000 random strings the total count for the list of values in any parameter will total 1,000.

The first opportunity to end the test is when the distribution of all values within a parameter list is normal. For a truly random selection, each value should have approximately the same count. Because there were 10 values for parameter 8, after 1,000 strings each value should have a count of very close to 100. If there were 20 values, each would have a count of 50. Once the minimum distribution criterion is satisfied, the more strings that are generated, the better the sample. These strings can now be analyzed as though they were the entire test set, although academics will argue that the statistical quality of the sample data (e.g., variance) may vary significantly from the whole set.

As with the genetic algorithm solution, the Monte Carlo sampling can be performed a number of times. If the best results are similar, then you can be confident that you are near the maximum. The use of random values has the additional advantage of avoiding unfair targeting of values that may be known in advance to perform well.

[4]Readers are encouraged to read Murray A. Ruggiero, Jr., *Cybernetic Trading Strategies* (John Wiley & Sons, NY, 1997, Chapter 20, "Using Genetic Algorithms for Trading Applications").

[5]Adapted from an example in Wolf von Ronik, "System Testing via Monte Carlo," *Futures* (April 2001).

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CHANGING THE STRATEGY RULES

As testing progresses, it is inevitable that the analyst will want to modify a rule or add a new feature to the trading strategy. This usually follows from inspecting the results of tests and noting that a specific pattern was not treated properly (or profitably). After some work, the analyst introduces a carefully constructed rule, which turns a previous loss into a profit. Figure 21.10 shows two possible changes in the test performance pattern for 1 parameter based on this change.

Figure 21.10: Patterns resulting from changing rules. (a) A rule change that improves one situation at the cost of others. (b) A rule change resulting in general improvement.

If the rule change improves the specific situation that was intended, but loses money in other market situations, the complete test pattern will appear as shown in Figure 21.10a. Higher peak profits occur where the new rule works best, but other parameter values have been turned from profits to losses or to larger losses. The average returns may remain the same, but the results are more extreme. Because the new rule caused the fitting of a specific pattern at the cost of added losses in other patterns, it is not an improvement.

In Figure 21.10b, the new rule improves performance in all cases. This type of pattern is an ideal solution. It is possible, of course, that an improvement is defined in such a way that it corrects only that specific problem without affecting any other trades. That type of rule fitting, which affects only one or two cases, is unlikely to work in the future. If it falsely raises expectations of success, then it puts the investor at risk.

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ARRIVING AT VALID TEST RESULTS

It is not unusual for the results of an optimization, especially one with many parameters, to appear perfect. All the trades could be profitable, the equity drops might be small, and the strategy might perform in changing markets, and yet, the final system will consistently lose money when traded. Creating a system with predictive qualities (rather than one that is historically fitted) requires preparation in advance of testing.

Common Sense Versus Statistics

You can always find a particular moving average or indicator that gave a signal to sell the S&P just before the 1987 crash. It's not difficult when a computer can combine millions of combinations of trend speeds, filters, momentum indicators, divergence rules, and so on. It's also easy when you are willing to sacrifice performance at other times to capture the biggest profit in recent history. However, what works in a specific case, and often an unusual one, is not likely to work in general. Manipulating the rules is a wasted effort. Showing that a combination of technical indicators would have profited from the last market crash has no bearing how it will respond to the next drop.

The adage that "there are lies, half lies, and statistics" is true. Statistics can prove a point or prove just the opposite, depending on how the numbers are presented. A frequent contradiction in the news is when an anticrime group states that burglaries doubled in the past year while the police department states that burglaries rose by the slowest rate in 5 years. A market can be in an uptrend and a downtrend at the same time, based on the time interval over which you view it.

The most profitable test results may not be the ones you want. If you tested the S&P from 1990 through 2003, the results would be overwhelmed by the 10-year bull market. The parameter values may be biased towards longer-term trends that captured most of the market's upwards move; however, it would have lost money during the sideways prices moves of 2002–2003. The statistical profile will look good because the bull market profits were far greater than the recent losses; however, using a strategy that capitalized on an unusual bull market is not a good choice today. As Jack Schwager has stated, "The mistake is extrapolating probable future performance on the basis of an isolated and well-chosen example from the past."[6]

Omissions and Scenarios

One of the more difficult problems to overcome are the ones you cannot see, the price moves that are not part of your test data—the *omissions.* Every few years the market experiences a price shock, most recently the terrorist attack of September 11, 2001. Price history is full of small price shocks caused by economic reports, but the very large ones are years apart. If your test does not include data with a significant price shock then you cannot know if you will survive the next one. If you have tested a strategy using data that is highly skewed in one direction, as the equity markets were in the 1990s, then the resulting strategy will be biased. You must be constantly looking for potential problems.

You will need to question the ability of your strategy to perform under different scenarios. What is the chance of a big profit this year or this week? What is the worst-case scenario—under what conditions could the strategy lose more than it has in the past? Will the method survive a sharp change in market volatility? Is a shorter holding period for each trade safer than staying with the long-term trend? Is an 8-day moving average really better than a 10-day breakout?

The following guidelines were developed over many years and are intended to avoid the most basic and costly errors that occur in testing. You may be able to add your own experiences to this list.

Searching for Robustness

A *robust* system is one that performs consistently in a wide variety of situations, including patterns that are still unforeseen.

From a practical view, this translates into a method that has the fewest parameters and is tested over the most data. In tests by Futures Truth,[7] the best performing systems commonly have four or fewer optimized variables.[8] The characteristics of a system with forecasting ability are:

1. *It must be based on a sound premise.* Each rule and formula must capitalize on a real fundamental or price phenomenon. *Discovering* a price pattern or cycle through optimization may seem to be a revelation, but it is more likely to be an illusion. By testing enough patterns, it is statistically probable that one of them will seem to fit. Without a fundamental reason for the existence of that pattern, it is not safe to use it. For example, the use of a very long-term trend to trade interest rates is intended to mimic the direction of U.S. economic policy; a shorter 1-month trend may be best for capturing the seasonal moves in agricultural commodities. A short-term trader may hypothesize that a strong close on increasing intraday volatility will have follow-through on the next open. Observations based on experience and confirmed by testing are usually sound.

2. *It must adapt to changing market conditions.* A system that assumes that markets don't change or that everything has been seen in past data will suffer large equity swings. Self-adjusting features do not use absolute price levels or fixed dollar amounts. They might include an inflator or deflator, stop-loss values that adjust to volatility, rule shifts based on whether the current year shows a seasonal or nonsea-sonal pattern, and a variation in position size based on changing risk.

3. *It must be tested properly.* The principles of statistics say that the best tests use the most data. More data includes bull, bear, and sideways markets, large and small price shocks, and periods of instability and doldrums. There is no substitute for more data Proper test procedures also include omitting data from the historic tests so that you can validate the results on an out-of-sample period. Usually the out-of-sample data is the most recent period; however, for faster trading strategies alternate years of data can be omitted from the historic tests to be used for validation. Alternately, you can paper trade until there are enough trades to compare the out-of-sample profile with the expectations defined by your tests.

   Some analysts prefer a technique called *blind simulation*, commonly known as *step-forward testing* (discussed earlier in this chapter). In this procedure, a series of fixed-length tests are defined and the parameters found to be optimal are applied to the next period ahead. The process then steps forward by dropping off old data and adding an equal amount of new data. The results of this second test are again applied to the unseen forward data. The performance of the strategy is measured by the combined results of the unseen data.

From time to time each of the three characteristics above will seem to be the most important. In the long run they must all be included to create a robust program.

Performance Criteria

Assuming that the proper principles have been followed, are the test results good enough? Although the strategy shows steady profits with a low equity drop, could a naive system have done better? Could you have done just as well by picking a stock with your eyes closed, then flipping a coin to decide whether to buy or sell? It can be a rude awakening to be pleased with your system's 40% returns only to realize that the average stock return was 60%.

Benchmarks

It is necessary to have a *benchmark* that provides a way of measuring success. It is best if this is a well-documented indicator, such as the S&P Index, the Lehman Brothers Treasury Index, a class of funds, such as Fidelity, or the Commodity Trading Advisor (CTA) Index. Benchmarks add a note of reality to expectations. The reason for developing a trading strategy is to have more consistent profits, or less risk during volatile periods, than an investment program already offered by, say, Merrill Lynch. Historically, the S&P 500 has a return-to-risk ratio of about 1.0, meaning that there is a 16% chance that the risk during any one year will exceed the annualized returns.

The spectacular profits or losses of one manager that get spotlighted in the news are not a good measure of anything, but simply a rare event. The goal of a trading strategy is to beat the benchmark, not a manager with a lucky year. It may seem desirable or gratifying to have received recognition for having the largest gain during a single month, but the focus should be on having very good gains over each year. The largest gain can only come with high risk. You should not be surprised if those investment advisors posting remarkable returns have had very erratic performance in the past. It is all too common to see that the CTA with the largest monthly gains, up 20% in June, is still down 5% for the year.

Measuring Test Results

A number of performance criteria are needed to evaluate any trading strategy during the test phase and to compare those results to an out-of-sample period or to actual trading.

1. *Net profits or losses.* Although not the best criterion for picking a parameter value, net profits are the reason for trading. While no one would select a system that produces a net loss, it is the other statistics that will tell which are the best choices for parameter values.

2. *Number of trades.* This simple value indicates whether your test was long enough to generate dependable results. A few trades can appear very profitable, but small numbers are statistically unreliable. A system that has more trades with the same returns has a better chance of performing up to expectations.

3. *Percentage of profitable trades.* Also called *reliability*, a value above 60% can be interpreted as a method that captures profits regularly. A trend system will be working correctly if its reliability is between 30% and 40%.

4. *Average net return per trade.* The average return per trade gives you an indication of how difficult it will be to realize the system returns. An average return of $50 per trade for a currency is likely to be overwhelmed by the slippage, which typically exceeds 4 points for each side, a total of $100 for a round-turn futures contract. Many very fast trading systems look good until you apply realistic costs. Slippage per side on the S&P should be 50 basis points, fixed income 1 to 2/32 (about $45), and energy products up to 20–30 basis points (about $100). The slippage executing stocks vary with the liquidity and market volatility. Slippage should be as accurate as possible, determined from actual trading. While it is good to be conservative by using a larger slippage, it eliminates faster trading systems that may be highly profitable.

5. *Maximum drawdown.* The largest equity swing from peak to valley is the maximum drawdown. This measurement can be very erratic and is not likely to be the largest risk seen in the future; however, it gives a rough idea of the minimum capital needed to trade this market. A surprisingly small maximum drawdown is a sign of overfit-ting or a very small test period. It is safer to take the average maximum drawdown from a range of tests than the one from the best result. An investor will typically capitalize a trading account with 3 times the maximum drawdown.

6. *Annualized rate of return.* The rate of return requires that the size of the initial investment be known. The investment can be calculated after the fact from the risk-to-equity ratio based on the maximum drawdown or standard deviation of historic returns. These returns should be annualized in order to compare one test against others or against a benchmark.

7. *Smoothness of returns.* A smoother equity curve is always more desirable than one with high volatility. The gross profit—to—gross loss ratio is a simple way to compare the smoothness of the equity curve across a set of tests. As the ratio increases, the proportion of losses declines and the equity curve becomes smoother. Any value over 2.0 is very good. The Sharpe ratio, which uses the standard deviation of returns to measure risk, can be substituted, or the standard deviation of the residual based on a linear regression of the return stream. These and other risk measurements are covered in Chapter 23.

8. *Average time-to-recovery.* A large drawdown may be inevitable in a realistic system, but a shorter time to recovery is most desirable. *Time-to-recovery* is the time between two successive equity highs. A larger drawdown with a much faster recovery seems to be a better trade-off for most investors.

9. *Time in the market.* All else being equal—profitability and risk—a trading system that is in the market less than another system is preferable. If two systems have approximately the same performance profiles, then the one that is in the market less is exposed to less risk. It may be a good trade-off to sacrifice some potential profit in order to be out of the market more often. As discussed in Chapter 22, being out of the market is the only defense against a severe price shock.

10. *Slope of periodic returns.* If the annualized returns are saved and a linear regression line drawn through those returns, the slope of that line would indicate whether the performance of the strategy is constant over time. A declining slope should be interpreted as better performance in the past, perhaps a trend system that did exceptionally well in the equity market of the 1990s but is not doing well now. A rising slope means that the strategy does better under current price patterns than older ones. A horizontal slope is best, indicating consistent performance across all time periods.

Having decided the measurements needed to understand the results of an individual test, there are other rules that must be established, including how to assess the end results. This will help to avoid bending the rules to fit the results.

Defining the Test Range for Each Parameter.

An optimization should represent a broad sampling of tests over a wide but reasonable range of parameter values. This range should be established in advance based on what is reasonable for the strategy. For example, if a short-term moving average is being tested from 3 to 15 days, then an RSI used for timing would have a range of 3 to 10 days. You would not test the RSI from 3 to 50 days because the longer periods do not make sense in the context of the original plan. Even worse, if the 45-day RSI proved the best, the initial concept may be discarded in order to pursue a solution that is most likely to be an overfitted dead end. On the other hand, if the common-sense ranges are used and are not profitable, the concept or rules must be reviewed to understand why they failed to work. The rules may have been entered incorrectly, a rule may have been omitted, or there may have been simply a programming error.

Use the Average of All Test Results.

Specifying reasonable parameter ranges is important when evaluating the test results. Nearly all tests will show profits and losses, hopefully with some areas of very attractive profits. If you tested 1,000 cases and 30% of the tests showed returns of about 40% per year, 30% showed breakeven results, and the last 40% showed various losses, you might say that the 30% profitable tests are a broad area from which parameter values can be chosen. That assumes that the market will continue to perform in a way that allows those parameters to generate profits during the next year. It is better to assume that the price patterns change; you cannot tell which combination of parameters will be the best. Of course, it is still necessary to pick one set of values to trade; however, your expectations should be set at the average performance of all tests. In the case of the test results above, the average may be slightly positive.

It may seem ambitious to expect the average return to be very profitable without narrowing the test ranges to predictably good values; however, it is an important goal. When comparing systems, the best one has the highest average of all tests. If you accept the premise that actual trading performance is represented by the average of all trades, then the goal is to create a strategy in which the adjusted returns are profitable.

Adjusted returns = *Average of all tests* - 1 *Standard deviation of all test returns*

A system satisfying this requirement should have an 84% chance of being profitable in the future.

Set Aside Data for Final Validation.

To find out whether you have overfitted the data, reserve 10% of the data for out-of-sample final validation. Do not use all the data in your tests. Some form of validation is needed before trading begins. Out-of-sample data is usually the most recent; however, it could be older data, an interval extracted in the middle, or even every other year. If the results using the out-of-sample data are far below expectations, it is better to find out now.

Stability Over Time.

Be sure that the test data is long enough to include a substantial change in price, a major bull and bear market, and an extended sideways period at low volatility. Display the performance in a number of smaller time intervals, instead of only one final return. Looking at the quarterly returns can reveal that the method was very profitable in the past, but has not been successful for the past two years.

Elimination of Outlier Periods.

Realistically, a system should not base its profitability on a single major market move over the test interval. In particular, if the move that generated the profit was actually a price shock, the system had only a 50% chance of posting that profit and has an equal chance of a loss in the future. It may be practical to remove the profits generated on the first day or two of a move that began with a price shock, allowing for the possibility of holding the wrong position in the future. To be more

conscientious about handling a random event, the profit for a price shock could be treated as a loss. Had the market moved the other way that certainly would have been the case. By posting a windfall profit, the risk of the system is artificially reduced.

Concentrate on Large Profits and Large Losses.

The largest profits and losses are critical to the net performance of any system; therefore, you should make a special effort to study those trades. In doing that you may find that the largest profits were the results of price shocks, as discussed in the previous point, or that there is an erroneous piece of data which was not seen before. If there are a number of large profits and no large losses, you can be sure that you have overfit the data.

Sensitivity Testing

Once the parameter values have been selected, a sensitivity test should be performed. *Sensitivity testing* is simply a way of finding out how much performance changes when the value of each parameter is shifted up and down by small amounts and combinations of parameter values are changed. A robust solution should be modestly sensitive to changing values; in some cases the performance will improve while others will cause a decline. As larger changes in values are used, some decay is expected. Overall, small changes in parameters should not jeopardize the profitability of the strategy. If the performance declines for all alternate parameter values, then the current model is a peak solution, which usually means it was overfit. Overfit means that it will not meet expectations.

Reading between the Lines

It is easy to show specific examples of rules, indicators, and systems that produce large profits, while the overall performance is bad. Many books base intuitive proof or justification of a trading method using specific examples. These examples look reasonable in isolation. There is an inclination to accept these examples as part of a successful strategy if the concept is sound, when there is fundamental or economic substantiation, such as expecting a seasonal low in the U.S. crops at harvest. For chart patterns and most technical indicators, such as a stochastic, this is not the case. There are few indicators that can be used as a profitable system without being combined with other features. Proving a system is likely to be successful can only be done with a long-term test and disclosure of the statistical performance profile, not with a few exceptional examples.

Systems That Work in Only One Market

If a system is developed for the e-mini S&P futures, should it work on the electronic Nasdaq 100, or on the Dow? Seen on a quote machine, the charts of those markets are very similar. When an Initial Claims report is surprisingly high, they all drop together; and when Retail Sales are higher than expected, they all rally together. Each of the three markets represents a different set of stocks, and each has a different volatility profile, and while a disappointing earnings report by Dell will impact Nasdaq more than the S&P or Dow, there are implications in the Dell earnings that inevitably affect stocks in the other two index markets. It is unlikely that the S&P would rally when the Nasdaq drops sharply. That is not to say that the three markets don't move apart or together at different times; otherwise, they would be the same markets. But if the strategy adjusts to volatility, then some of the differences are removed.

Then the answer should be *yes*, a strategy that is profitable for one index market should be profitable for all. It may be less profitable for others; however, if it generates good profits for the S&P and losses for Nasdaq, then the parameter values are most likely overfit. The two other index markets serve nicely as out-of-sample data.

Advertised Systems for One Market

From time to time, all traders receive mail that offers a highly specialized system called "The Cattle Trader," the "The Gold Day-Trading System," or "Easy Profits through Stock Index Trading." It is most likely that each of these systems have been finely tuned with rules unique to one market. Optimization is a well-known process and can be used responsibly or easily abused. Because these mail offers are selling big profits with little risk, it seems reasonable that the performance was discovered using optimization. It is a clear case of "too good to be true." Because the program is offered in only one market, it can be assumed that it did not work in other markets, an indication that it is not robust. And, because the rules of the program are not revealed, it is impossible to test it yourself.

Student *t*-Test

Among tests that help determine whether the results are *significant*, the student *t*-test is one of the most useful. It tells you whether there is a systematic bias in the data by showing whether the mean of the data is significantly different from zero. This is a useful piece of information when you try to decide whether the results of only a few trades represent a good system, or whether a series of losing trades implies that a system has no value. For a series set of trades produced by computer testing or by actual trading, the *t*-test is:[9]

$$t = \frac{\textit{Average trade results}}{1\ \textit{Standard deviation of trade results}} \times \sqrt{\textit{Number of trades}}$$

The critical value of *t*, which can be found in Appendix *A*, depends on the number of trades in the sample. From the same information, we also get

Degrees of freedom (*df*) = *Number of trades* - 1

Using the table in Appendix A, if there were only 10 trades, the degree of freedom is 9, and the value of *t* must be greater than 1.833 to have 95% confidence in the results.

When you want to know if two systems are producing results that are significantly different from each other, the technique is more complicated. It requires comparing the mean, variance, and number of trades of the two systems; most important is the approximation for the degrees of freedom which allows you to determine the confidence level of the results:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

where x_1 = the average of method 1 trades

x_2 = the average of method 2 trades

s_1 = variance of method 1 trades

s_2 = variance of method 2 trades

n_1 = number of trades in method 1

n_2 = number of trades in method 2

The calculation of degrees of freedom uses Satterthwaite's approximation:

$$df = \frac{\left(\frac{s_1^2}{n_1}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{(n_1 - n_2)} + \frac{\left(\frac{s_2^2}{n_2}\right)^2}{(n_2 - n_1)}}$$

[6]Jack D. Schwager, *Schwager on Futures: Technical Analysis* (Wiley, 1996, p. 673).

[7]John Hill and George Pruitt, Futures Truth, Hendersonville, N.C., is an organization that validates and monitors trading systems. It publishes *Futures Truth Magazine*, *www.futurestruth.com*.

[8]John Hill, "Simple vs. Complex," *Futures* (March 1996, p. 57).

[9]Ben Warwick, *Event Trading* (Irwin 1996).

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POINT-AND-FIGURE TESTING

The point-and-figure system is representative of the group of swing systems. Buy and sell signals occur when prices move above or below previous highs and lows, respectively. The trend direction changes when a price reversal exceeds a specified cumulative price change, designated in points. Because it is a method charted on graph paper, the reversal is shown in terms of boxes; the reversal criteria traditionally is expressed as a "3-box reversal" (for a complete explanation, see Chapter 5).

The size of the box and the number of boxes that define a reversal are the two variables that make up the reversal criteria. If Microsoft or gold were the object of the test, the box size might start as low as $0.125 or $0.10, the minimum moves, and increase in increments of the minimum move; the number of boxes in a reversal would be the integer values 1, 2, 3,…. Figure 21.11a shows that the expected pattern of test results is symmetric, extending across the diagonal drawn from the top left to the bottom right corners. This example followed the convention of putting the fastest trend change in the upper left (smallest box size and a 1-box reversal) and the slowest in the lower right corners.

Figure 21.11: Point-and-figure mapping strategy. (a) Reversal number of boxes. (b) Reversal (box size x number boxes).

The symmetry is the result of very similar performance for equal reversal values, the product of the box size and the number of boxes in a reversal. For example, a trend change of $3 in Microsoft could have occurred using combinations of $3.00 × 1 box, $1.50 × 2 boxes, $0.75 × 4 boxes, $.30 × 10 boxes, or $.10 × 30 boxes, among others. The difference in profitability occurs because the selection with the smallest box size will satisfy the penetration criteria sooner, giving slightly faster signals and more trades. The average profitability of all combinations of reversal size will appear as in Figure 21.11b. This representation can be used with the 2-dimensional map to find the most consistent set of parameters.

When tested over long periods, most markets have increasingly wide price ranges, as clearly seen in the S&P. In 1987 the S&P traded at about 300 and by 2000 it had peaked at 1552. Testing for fixed combinations of box size and number of reversal boxes for the past 10 years would find the single parameter set that performed best over this period; however, the increasing volatility would result in much larger profits and losses in recent years. The optimized results will favor parameters that performed best in the last few years and might ignore the profits and losses of the earlier period which would be comparatively small. To put it in perspective, a 10% move in the S&P in 1987 would only be about 25 points, equal to $6,250 trading a full size futures contract. A 10% move in 2000 would be 150 points, or $37,500. If prices moved 1% per day (3.00 points) in 1987, a reasonable reversal combination would be from .45 points for fast trading to 3.00 for a slower trend (either a 0.15 point box with a 3-box reversal or a 1.00 box with a 3-box reversal). In 2000, a 3.00 move

would have produced a new trade every few hours, creating a very different performance profile than in 1987.

The alternative to a fixed box size or fixed reversal size, expressed in points, is to vary the box size as a percentage of price. Therefore, if the best reversal in 1987 was .45 for the S&P at a value of 300, it would be 2.32 in 2000 with a price of 1500. However, this may not have increased enough, and many market analysts treat volatility as an exponential function with respect to price. This can be approximated using a square root or log function, both readily available in a spreadsheet or strategy testing program:

$$Box\ size = p \times \sqrt{Price}$$

$$Box\ size = p \times \ln(Price)$$

where p = the percentage that is varied as a parameter in the optimization

This last method would be similar to plotting point-and-figure on a log chart.

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COMPARING THE RESULTS OF TWO SYSTEMS

The easiest way to understand the use of testing is by example. Using daily Nasdaq-100 data from January 1997 through December 2003, we compare the results of two trend systems, one based on a moving average and the other on the slope of a linear regression, in order to decide which of the two is best. These calculations can be found in Chapter 7. In both cases, the system generates a buy signal or a sell signal when the trend line or slope turns up or down, respectively. There are no other trading rules. Table 21.2 shows the results of varying the calculation interval from 10 to 250 days in steps of 10 days. Transaction costs of $125 per trade were used to cover commissions and slippage.

Table 21.2: Comparison of Nasdaq Trend Tests Open table as spreadsheet

(a) Moving Average with $125 Transaction Costs							
Period	**NetPrft**	**PFact**	**ROA**	**#Trds**	**%Prft**	**AvgTrd**	**MaxDD**
10	-338005	0.71	-83.3	229	28	-1476	-405770
20	-70065	0.91	-28.774	181	30	-387	-243500
30	104715	1.17	65.869	157	34	667	-158975
40	226065	1.61	215.044	89	37	2540	-105125
50	198930	1.50	177.205	74	29	2688	-112260
60	284610	1.91	377.217	80	37	3558	-75450
70	261670	1.97	434.668	72	36	3634	-60200
80	-21600	0.95	-9.606	86	26	-251	-224850
90	93940	1.25	60.016	78	34	1204	-156525
100	-9640	0.98	-3.802	74	24	-130	-253525
110	62100	1.15	31.128	74	24	839	-199500
120	273470	2.17	274.018	50	38	5469	-99800
130	312970	2.73	314.385	36	33	8694	-99550
140	325790	2.57	344.569	48	27	6787	-94550
150	469530	5.52	1128.678	32	40	14673	-41600
160	445130	5.23	975.627	38	34	11714	-45625
170	455190	8.58	1398.433	20	35	22760	-32550
180	434260	6.17	844.043	18	27	24126	-51450
190	515210	36.35	4025.078	10	50	51521	-12800
200	480260	76.04	5136.471	8	50	60033	-9350
210	401590	10.01	995.266	10	40	40159	-40350
220	409960	13.19	1406.381	8	62	51245	-29150
230	338160	5.29	477.627	18	55	18787	-70800
240	359210	9.18	1122.531	10	50	35921	-32000
250	346560	16.99	1566.373	8	37	43320	-22125
Average	254400						
StDev	208936						

Open table as spreadsheet

(b) Linear Regression Slope with $125 Transaction Costs							
Period	**NetPrft**	**PFact**	**ROA**	**#Trds**	**%Prft**	**AvgTrd**	**MaxDD**
10	-44455	0.95	-22.517	173	34	-257	-197425
20	49995	1.09	31.159	81	29	617	-160450
30	267190	1.77	240.831	50	38	5344	-110945
40	109005	1.32	70.967	37	37	2946	-153600
50	130605	1.39	67.487	27	40	4837	-193525
60	157965	1.61	106.769	23	34	6868	-147950
70	300015	2.94	331.783	19	36	15790	-90425
80	313145	3.39	503.651	15	40	20876	-62175
90	165265	1.85	182.613	15	33	11018	-90500
100	190660	1.97	138.662	16	37	11916	-137500
110	134610	1.55	55.855	12	33	11218	-241000
120	270560	3.17	219.343	12	41	22547	-123350
130	416630	6.96	577.25	8	62	52079	-72175
140	531740	16.53	1615.74	6	66	88623	-32910
150	468600	14.72	1042.492	6	66	78100	-44950
160	499400	10.11	923.532	6	66	83233	-54075
170	418800	9.63	710.433	6	66	69800	-58950
180	493850	27.05	996.67	4	75	123463	-49550
190	594060	100.00	3062.165	2	100	297030	-19400
200	524160	100.00	2961.356	2	100	262080	-17700
210	540260	100.00	10004.815	2	100	270130	-5400
220	463710	100.00	2880.186	2	100	231855	-16100
230	401260	100.00	925.629	2	100	200630	-43350
240	404310	100.00	1003.251	2	100	202155	-40300
250	417560	100.00	2420.638	2	100	208780	-17250
Average	328756						
StDev	176634						

Which System Is Better?

The first point to notice is that most test results are profitable. This is very important when choosing a trading technique because it justifies the underlying premise—that the market being tested has trends. The best performance for both methods comes at a calculation period of 190 days. The moving average shows net profits (*NetPrft*) of $515,210 and the linear regression slope $594,060. As an alternative to profits, either the profit factors (*PFact*) or the return on account (*ROA*) could be used. For those values, the moving average results peaked at the 200-day calculation period and the linear regression slope at 210 days.

The choice of method and calculation period could be as simple as picking the best performer from the two tables, but that would not be correct. To compare the two methods, it is first necessary to get a bigger picture of performance. This can be by first finding the average and standard deviation of the returns for all tests in each method. At the bottom of parts (a) and (b) of Table 21.2, the values for the moving average are $254,400 and $208,936, and for the linear regression slope, $328,756 and $176,634. Both results are excellent, but the linear regression slope has a noticeably higher average and smaller standard deviation, indicating more stability. That makes it the better choice.

Another way to see the big picture is to plot the performance of both methods on a single chart, shown in Figure 21.12. Both give you a pattern of success, but the moving average falls off from 80 to 110 days, while the linear regression is more consistent across the whole test period. Both methods have their worst performance at the short end and seem stable at the high end. Remember that tests of larger calculation periods are similar to each other because the difference between 240-

and 250-day moving averages is negligible. Tests for both methods flatten above calculation periods of 150 days because they all have very similar trades. In the linear regression tests, there are only 2 trades above 190-day periods and the difference in performance is a slight variation in entry and exit timing.

Figure 21.12: Comparison of Nasdaq trend following techniques.

The flattening out of performance on the right side of the chart might bias the comparison between the two methods, although both had similar results in that range. If the comparison in Table 21.2a and 21.2b included only the range from 10 through 190 days, the moving average would have an average of $211,803 with a standard deviation of $222,343, while the linear regression would have $287,771 and $182,101, respectively. The linear regression slope is still better.

Using Correct Transaction Costs

Transaction costs have a significant impact on short-term trading and can change the appearance of the multiple-test performance pattern. Faster trading has the advantages of smaller actual losses and more transactions. A system that performs well with more transactions will give more confidence of futures performance. A system that only had two trades during the past 10 years may show high historic profits but does not represent a good sample.

On the negative side, short-term trading is a fight against slippage and overall transaction costs. There may be times when prices are moving so fast that you miss the trade completely. Most profits from short-term trading occur at the beginning of the trade and require good entry timing. Using the linear regression slope method, tests were run for calculation periods 2 through 25, first with no transaction costs, then with a total round-turn cost of $125 per trade. The results are shown in Table 21.3 and the net PL plotted in Figure 21.13. The impact of transaction costs is all at the very short end and can be seen best in the chart where the difference in performance is wider under 5 days, and converges until there is little difference at 25 days. In Table 21.3, the 2- and 3-day performance drops about 50% and 30% while the 25-day performance only falls 4.5%. There are many trading strategies, especially mean-reverting stock programs, that show large profits from very short-term trading, but small profits per trade. Without using correct transaction costs, you can be fooled into thinking that you have a successful program instead of one that consistently returns profits that are less than the cost of doing business.

Table 21.3: Comparison of Linear Regression Slope Tests with and without Transaction Costs Open table as spreadsheet

(a) Linear Regression Slope with No Transaction Costs							
Period	**NetPrft**	**PFact**	**ROA**	**#Trds**	**%Prft**	**AvgTrd**	**MaxDD**
2	-220140	0.89	-72.6	854	34	-258	-303430
3	-367540	0.78	-91.4	547	34	-672	-401950
4	-190810	0.86	-76.9	417	39	-458	-247970
5	-277300	0.77	-61.7	315	39	-880	-449670
6	37270	1.04	15.9	267	42	140	-234000
7	-160150	0.85	-66.3	231	35	-693	-241500
8	-24360	0.97	-13.7	207	36	-118	-177190
9	-189170	0.80	-86.3	195	32	-970	-219240
10	-22830	0.97	-11.6	173	34	-132	-196550
11	-181010	0.80	-64.0	150	28	-1207	-282670
12	-256490	0.73	-77.4	136	31	-1886	-331420
13	-298840	0.67	-87.1	122	26	-2450	-343150
14	-334220	0.63	-86.3	115	27	-2906	-387150
15	-165980	0.79	-66.1	109	33	-1523	-251060
16	-4000	0.99	-2.4	109	33	-37	-164300
17	1940	1.00	0.9	101	34	19	-211350
18	7900	1.01	2.9	93	32	85	-269200
19	34920	1.06	13.7	87	27	401	-254850
20	60120	1.11	37.6	81	30	742	-159950
21	93880	1.19	73.6	83	34	1131	-127600
22	85990	1.17	81.1	81	35	1062	-106000
23	9090	1.02	7.1	76	31	120	-127850
24	67950	1.15	58.4	70	34	971	-116350
25	173500	1.44	172.0	62	38	2798	-100850
Average	-88345						
StDev	155551						

Open table as spreadsheet

(b) Linear Regression Slope with $ 125 Transaction Costs							
Period	**NetPrft**	**PFact**	**ROA**	**#Trds**	**%Prft**	**AvgTrd**	**MaxDD**
2	-326890	0.84	-91.4	854	33	-383	-357830
3	-435915	0.74	-97.2	547	34	-797	-448555
4	-242935	0.82	-85.5	417	38	-583	-284220
5	-316675	0.74	-68.4	315	39	-1005	-463295
6	3895	1.00	1.6	267	40	15	-238000
7	-189025	0.82	-74.6	231	35	-818	-253250
8	-50235	0.94	-27.6	207	36	-243	-181940
9	-213545	0.78	-91.7	195	32	-1095	-232990
10	-44455	0.95	-22.5	173	34	-257	-197425
11	-199760	0.78	-69.9	150	28	-1332	-285920
12	-273490	0.71	-81.4	136	30	-2011	-335795
13	-314090	0.66	-90.3	122	26	-2575	-347650

14	-348595	0.62	-89.5	115	26	-3031	-389400
15	-179605	0.78	-70.4	109	33	-1648	-255060
16	-17625	0.98	-10.6	109	33	-162	-166300
17	-10685	0.98	-5.0	101	32	-106	-212225
18	-3725	0.99	-1.4	93	32	-40	-270075
19	24045	1.04	9.4	87	27	276	-255725
20	49995	1.09	31.2	81	29	617	-160450
21	83505	1.17	65.3	83	34	1006	-127975
22	75865	1.15	71.3	81	33	937	-106375
23	-410	1.00	-0.3	76	31	-5	-128975
24	59200	1.13	50.6	70	34	846	-116975
25	165750	1.42	160.2	62	38	2673	-103475
Average	-112725						
StDev	168292						

Figure 21.13: Comparison of linear regression slope tests with zero and $125 transaction costs.

Choosing the Final Parameter Value

When choosing the final parameter value, it is important to remember that your choice is not likely to be the best one when looking backwards in 3 or 6 months from now. The advantage of finding a trend system that has a broad range of successful results is that almost any choice of parameter value should be profitable in the future, although the profits may vary over a wide range.

Based on previous review, the linear regression slope is a better choice than the moving average system. It had a higher average and lower standard deviation of all tests, and the elimination of the tests with only two trades still showed much better average returns. Before moving forward, check to see if the test process was done correctly:

1. A good sample of parameter values was tested. This will include those variables that cause frequent as well as slow trading. The distribution of fast and slow test results should be similar, which may involve scaling in different ways. One simple measure that shows if the tests are well distributed is the average number of trades per test.

2. The average results of all tests and the variance of results should be used. When comparing two methods, the one with a higher average return and smaller standard deviation shows more consistency. If the average minus one standard deviation of the returns is profitable, it is a strong argument for a fundamentally sound approach.

3. Results should be scored in some way to include profitability and risk. Other measurements can be used, but stability is of great importance. The profit factor, or return-to-risk ratio, is a better measure of performance than net profits.

4. Results, or scores, should be averaged to avoid spikes or unusual distortions.

5. Transaction costs, including commissions and slippage, must reflect the liquidity of the market in a realistic way. Transaction costs that are either too large or too small will skew the results the wrong way and impact your final choice. A system with entries and exits in the direction of the trend should have greater slippage than a countertrend entry method; for example, a trend-following system has larger slippage than a mean-reverting system.

6. Make mistakes in the conservative direction. If two systems have comparable returns, select the one with the lower risk. If they have similar returns and risk, choose the one with fewer trades.

Because there is a wide range of profitable test values in Table 21.2b, the final choice needs to be narrowed to a smaller range. The 10- and 20-day periods can be eliminated because they have either losses or very small returns due to low per trade results and transaction costs. On the high end, from 190 days, there are only 2 trades per test. Over the test period of 7 years, that means holding each position for 3½ years—not what most people would call "trading," and not a good sample for high confidence in future results.

In the linear regression method, it is easy to see that the periods from 190 days capture the two bull and bear market trends; however, the moving average results show alternating 8 and 10 trades in that same range. It is an idiosyncrasy of a moving average that it inevitably gets caught in a sideways price pattern and flips from long to short and back to long—typical *whipsaws.* While the number of trades in a linear regression system will keep declining as the calculation period increases, the moving average method will stop declining and show a minimum number of trades caused by whipsaws. For that reason, tests from 190 days and higher can be eliminated.

Having reduced the final range to 30 to 180 days, there are two areas of interest; these are easiest to see in Figure 21.12. The broadest area of success, and the one with the highest returns, are from 140 to 180 days. Another interesting area is a lower peak from 40 to 120 days. Because the range from 140 to 180 represents an increase in the calculation period of 28%, and the range from 30 to 120 is 400%, the lower values include a much greater span. They also show a range of trades from 37 to 12, while the longer calculation periods have only 6 or 4 trades. Personal preference now becomes a factor. The faster trader believes that the final parameter value should come from the lower range. It represents a broader test of the system, and with more trades comes more confidence. Within that range, the highest profit factor (provided the profit factors form an orderly curve) will be the choice. That value is 3.39 at 80 days. Realistically, the two profit factors at 70 and 80 days look as though they are outliers within their immediate range. It would be best to interpolate the values using the two adjacent profit factors, 1.61 and 1.85. Similarly, the net profits could be reasonably reduced to those posted by the 60- and 90-day tests. Although expectations are reduced, the 80-day period sits in the middle of the range of successful results and remains the best choice.

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PROFITING FROM THE WORST RESULTS

The worst results of an optimization or test sequence may hold valuable information. It is important to know what caused the largest drawdown. Although that drawdown may have only occurred in one test, it may represent a potential problem in the system. In actual trading it could appear in any calculation period. When it comes to the size of losses, it is not advisable to assume the average; it is best to use the largest drawdown for all tests.

If the area of poor results is broad and continuous, it shows areas that should be improved, possibly by entry and exit timing. If the poor test results are associated with transaction costs exceeding the per trade returns, then it simply shows that the method cannot be traded quickly.

Looked at from another angle, the worst results may show an alternate strategy. Table 21.3b lists the performance of the faster calculation periods for the linear regression method. The 3-day test shows the largest net losses, with individual trade losses of $797 after transaction costs of $125. If the system had bought instead of sold, and sold instead of bought, it would have netted $547 per trade on 547 trades (a coincidence), for a net profit of $299,209. The large number of trades and consistent results makes this a tempting possibility.

In another example, Figures 21.14a and 21.14b show the idealized, continuous results of 1- and 2-variable tests. The 1-variable test can be the same as the moving average or linear regression example just discussed, and the 2-variable test would be 2 moving averages, one slow and the other fast. Both identify faster trading areas as having the maximum loss and slower trends as having the best performance.

Figure 21.14: Dual use of test map. (a) Single-variable test. (b) Two-variable test.

If the test results are shown with a band of transaction costs, it can be seen that results must be negatively very large before they exceed the transaction costs by enough to be profitable when reversing the trading signals. The worst results are only useful if there is a net profit from taking the opposite position. In the previous example, the net loss of $797 was reduced to $547 by reversing the effect of the $125 transaction cost, adding $250 to the per trade returns and changing the negative return to a positive one.

In the 2-trend example, the worst score that has a near-zero return before transaction costs can be used profitably. Unprofitable results of a fast trend mean that the system timing was consistently wrong, buying near the top of the short-term trend move, then selling at the bottom. That bad performance can be turned into an advantage using the following rules:

1. Trade a system of two moving averages, a long-term, designated by the *best score D2*, and a short-term, selected as the *worst score D1*.

2. When prices cross the long-term moving average moving higher, a long position becomes eligible. A long position is entered when the short-term moving average turns down, normally signaling a short signal. Positions may be

entered on a 1-day delay.

3. Long positions *may* be closed out when prices cross below the long-term trendline; they *must* be closed out when a short position is entered.

4. Entering and exiting short positions are the opposite of (2) and (3).

Because the short-term signals are not good indicators of trends, they can be used as a countertrend entry. Trading opposite to the current price direction allows for better execution when trading larger positions or in less liquid markets. The choice of immediate exit or delayed exit is the trader's preference. Once a position is held, there is greater risk waiting to exit, yet most exits would be improved by better timing.

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RETESTING PROCEDURE

One optimization is never the end of the testing process. If the system development is completed, the parameter values selected, and the most recent data used out-of-sample verification, then one final test must be done on all of the data before beginning to trade the program. Using the out-of-sample data as part of the main-stream test will add additional robustness to the results. The final parameter choices may be slightly different from the previous values but should not change significantly. A large change is a warning of problems, either a test period that was too short, or a poor selection of parameter values.

As in step-forward testing, some analysts prefer to retest a system using a fixed amount of data, dropping off the oldest. This does not mean that the total test period is only 6 months or 1 year of data, and should be retested each month. Longer test intervals are always better, unless there is a reason to believe that the oldest data is no longer relevant. In some cases there are structural changes, such as the formation period preceding the emergence of the European Currency Unit, which put controls on the variance in exchange rates between the participating countries. A new market with low liquidity during its earlier years may be considered different from more active, current market conditions. Retesting remains an important way to adjust the system to characteristics of new data.

Retesting is necessary after 5% to 10% of new data is available, relative to the original test interval. Using the two-variable test as an example, a shift may be expected in the area of best performance as shown in Figure 21.15.

Figure 21.15: Consecutive tests.

Because only a small amount of data was added, the size of the shift in Figure 21.15 should be small. If a large shift actually occurs, then two possibilities should be considered:

1. The data was unusually volatile and introduced patterns not previously seen in the data. In this case the shift in parameters is justified.

2. The data period for the original tests was short and did not include enough patterns to make the parameter choice robust. With a small amount of test data there is a greater likelihood that a faster trading model will be selected. As the data shifts and that faster model is no longer good, the parameters may jump to a very slow model. This erratic pattern of shifting from fast to slow is indicative of too little test data.

Retesting after a Major Move

When your system fails to produce the right amount of profit from a major move, or when the stock market takes an uncomfortably large plunge, it is natural to question whether the system has the right parameters. Is the trend fast enough? Is the stop-loss too close? This is the same process as retesting. If you have used enough data for your original tests, then it is very likely that the new tests won't change anything. If you make up new rules to fix this one problem, you are overfitting and therefore accomplish nothing. If you have doubts about the test period, use more data rather than less. The new patterns will only give you a more realistic idea of the market risk than you had before.

Is the Model Broken?

Some trading systems, when based on an economic scenario, will have a limited life. A fully technical program, such as a moving average, should adapt to trends of varying lengths that occur over time, taking larger and smaller profits, and

cutting losses short. The way to judge if a model is performing as expected is by measuring the size and duration of drawdowns and comparing that to the tested profile. If a new system begins trading and posts steady losses until it reaches the maximum loss that was expected, chances are that something is wrong. Systems should not decay from the first day unless something is wrong.

The probability of a drawdown greater than *P* can be calculated[10]

$$Probability\ of\ a\ drawdown \geq P = \left(1 - \frac{P}{100}\right)^{2\mu/\sigma^2}$$

This formula assumes a normal distribution of returns (although trading returns should have a longer tail to the right). The value μ is the average fractional change in equity, and *s* is the standard deviation of the equity changes. To use this with daily data, the equation gives the probability that the daily drawdown from the peak equity will be greater than or equal to *P.* The same formula works for monthly data. For example, during the test, the annualized return was 30% with a daily return ratio of $s/\mu = 9$. Based on 250 trading days per year, the daily value of μ is calculated using $(R_y/R_0)^{1/y} - 1$, or $\mu = (1.3/1.0)^{1/250} - 1$, and $\mu = 0.00105$. Then $\mu = 0.00945$ and the value of the exponent $2\mu/s^2 = 23.51$. If we want the 95% confidence level, then the final step is $P = (1 - 95/100)^{1/23.51} = 0.880$. Then the probability of a drawdown of at least 12% from the equity can be expected 5% of the months.

Chapter 23 has other measures of risk, including the use of residuals to find the probability of a drawdown over a single time period, and the probability that equity will remain below a threshold level for a specified time interval.

[10] John R. Wolberg, *Expert Trading Systems* (John Wiley & Sons, NY, 2000, pp. 181–183).

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COMPREHENSIVE STUDIES

A comprehensive test that applies one or more trading strategies to a broad selection of markets is a basic step needed to evaluate *robustness.* When a system performs well in many markets over the same test period and calculation ranges, it is fair to assume that the method is sound. If a technique works in the Swiss franc but not the euro, in 10-year Treasury notes but not 5-year Notes, in Intel but not Microsoft, then the method is not robust but fine-tuned to each market. Markets have individual characteristics that might justify differences in performance; however, a strategy that can generate profits in a broad range of markets with the same rules and calculations is robust. In addition to the studies that follow, Chapter 8, includes a section, "Comparison of Major Trend Systems," that will be helpful in viewing the results of different trend-following techniques side by side.

Robert Colby, in *The Encyclopedia of Technical Market Indicators*,[11] has given an excellent comparison of market indicators by presenting each of their test results in a common form. Viewing the results of a set of indicators gives a much better idea of the success of that approach than testing any one of them. For example, if one volume indicator was successful during the past 10 years, but three others were inconsistent, then the use of any volume indicator becomes questionable. It is necessary to study the specific rules and performance of the successful indicator to decide if it is sound while the others are not, or whether it had a few unusually good signals to offset a longer period of mediocre returns. Robustness is found when a number of strategies, all applied to volume, show similar, profitable returns. This was the conclusion when a selection of trending methods was tested in Chapter 8. To a lesser degree, a single indicator is robust when it works across a broad selection of markets.

Classic Tests by Maxwell, Davis and Thiel, and Hochheimer

There are three previous, well-known comprehensive studies of moving average systems by Maxwell, Davis and Thiel, and Hochheimer. In addition, Lukac, Brorsen, and Irwin studied 12 different trading methods across 12 futures markets. Although they are now dated, these studies can be used to compare the results of more recent data, and provide a guideline for testing; they emphasize different features of trading that were important to the authors and provide extremely helpful insight. By virtue of hindsight we can see that, with completeness in one area, a deficiency in another often comes along.

Davis and Thiel

Davis and Thiel, the authors of the oldest of the studies,[12] completed before 1970, analyze the greatest variety of markets, covering virtually all of the U.S. crops as well as cattle, eggs, and the soybean complex. They include about 5 years of data and use relatively fast moving averages (up to 10 days); they introduce variations in lead-oriented plotting and in testing nonconsecutive days; the data used is close-only. The results are clearly presented in both detail and summary, and yield generally good returns.

The study of moving averages uses combinations of simple buy and sell signals, leading plots (moving the calculation forward), and skips (using every second or third price rather than every price). They test a total of 100 combinations of the three factors:

> A *skip* from 1 day (none) to 5 days (1 week).
>
> An *average* of 5, 6, 7, 8, or 10 days.
>
> A *leap* of 0 or 2 days.

Before 1970, markets showed more short-term trending, and the moving average was state-of-the-art technology. Using a computer to study the markets in 1970 was very unusual; Digital Equipment was still selling their most popular PDP-5 and IBM had just introduced its first mini-computer, the System 3. Traders were using point-and-figure charts on the exchange floors, and the 10-day moving average was the most popular calculation period. Lower volume and a larger percentage of commercial participation made trends more consistent than today's markets. It was possible to trade using a 3- to 5-day moving average and post consistent profits.

In retrospect, the technique that skipped 1 or 2 days of data is another way of smoothing, similar to a 3-day momentum that compares today's price with the price 3 days ago. The success of the variations in rules is proof that markets trended in the 1960s and that a trending method, such as a moving average, was a viable strategy. In current markets, higher volume and broader participation has introduced more noise into price movement and causes the faster trend periods to fail. Over time it has been necessary to increase the calculation period in order to avoid steadily increasing noise.

Maxwell

Maxwell's study is extremely comprehensive but applies only to the pork bellies futures market.[13] His idea was to study various trending methods and trading rules by performing a thorough test of the combinations. As with Davis and Thiel, the computer was still not available to the general public, and the ability to perform a broad study was a groundbreaking event.

The primary trend feature included the possibilities of a simple mean, or a moving average of 3, 5, or 10 days, of either a conventional, average-modified, or weighted type. The second feature was the delay factor, used to improve the timing of both entries and exits. Some of the options were: (1) act without delay; (2) act if the signal condition persists for one additional day; (3) enter if the signal condition persists for two additional days, but liquidate without delay; and others. Combinations of two types of moving averages and a delay factor were tested, with and without fixed or moving stops. With 10 types of averages, 6 delay factors, and different stops, Maxwell had a lot of combinations to examine.

The study is then expanded to 3-factor systems with a list of 18 combinations of rules to generate 324 systems of which the results of 285 are recorded, with 49% profitable and 51% losing systems. The largest *loss* was generated by a system with the rules:

1. Enter a new position when both the weighted 3-day and weighted 10-day moving averages cross the price-mean, as long as the signal condition persists for two additional days (buy if averages cross moving down, sell if they cross moving up).
2. Liquidate positions when the 3-day average reverses its direction through the price-mean as long as it continues for one additional day.
3. No fixed stops are used.

The best *profits* in the 3-factor system used the rules:

1. Enter a new position when both the 5-day average-modified and a 10-day weighted average move above the price-mean, provided the 5-day average lagged behind the 10-day (that is, the longer-term trend turned up first in order to get a buy signal).
2. Liquidate the position when the shorter-term average crossed the longer-term moving average in the direction opposite to the current position.
3. No fixed stops were used.

Maxwell's study represents a great amount of work and some simple and sound philosophy. The conclusion—that 2 trends, one twice the length of the other, will be profitable if the slow trend turns first—makes sense even with longer calculation periods in current markets. The slower trend finds the major move and the faster trend provides the timing. Identifying the major move comes first. In the rules that produced the worst results, the 2-day lag to confirm the signal is long with respect to the 3- and 10-day trends. When trading using fast signals, any delay usually reduces the net profits.

Unfortunately, Maxwell's studies only used a 50-day test period for May 1972 pork bellies, which is not an adequate data sample to statistically justify his conclusions. Maxwell does test four other selected 50-day periods, but the reader cannot know how these periods were chosen. Considering the effort in outlining a testing program and establishing rules, in addition to the analysis of results, the test period is a very weak point. Because the final test rules and values are reasonable, the market may have been successfully traded with a broad range of trending strategies.

Comparing Methods of Calculation

Hochheimer[14] performs two interesting studies: a comparison of three types of *moving average calculations* and a test of *channels* and *crossovers.* In the first analysis, Hochheimer compares *simple, exponentially smoothed,* and *linearly weighted* moving averages, tested on a good sampling of markets (without financials and currencies, which did not exist during the 1970–1976 test period). The calculations for simple moving average and exponential smoothing can be found in Chapter 8. The *linearly weighted average* is actually *step-weighting,* where integer values are used as weighting factors, each successive day is incremented by one, and the most recent day has the highest weighting factor.

The same trading rules applied to all trends, regardless of the calculation method:

1. The trend calculation used the closing price only.
2. A *buy* signal occurred on an upwards penetration of the moving average by the closing price; a *sell* signal occurred on a downward penetration of the moving average.
3. The model is always in the market.
4. A trade cannot be executed when the day's high and low price are the same. This assumes that there was no trading, caused by a *locked-limit day,* the consequence of a price shock.

The test covered 7 years of data from 1970 to 1976 and calculation periods [or the equivalent smoothing constant converted as *21* / (*days* +1)], which ranged from 2 to 70 days. The results shown in Table 21.4 are interesting and logical. The longer trends (larger calculation periods) were consistently better than shorter ones, regardless of which technique was used. This would imply that the longer trends are more reliable. With a few exceptions, the best selection of days ranged from 40 to 70. This may be the first sign of a shift to longer calculation periods than the ones found best by Davis and Thiel as well as Maxwell, or it could be that a more comprehensive test

covering a wider range of calculation periods would have come to the same solution, even using 1960 data. Remember that previous studies focused on calculation periods of 10 days and less.

Table 21.4: Results of a Simple Moving Average Model

Open table as spreadsheet

	Best Day	Best Range	Net P/L	Max. Run of Losses	Trades		
					Total	Profit	% Prof
Cocoa	54	53–59	$ 87,957	$-14,155	600	157	26
Corn	43	43–46	24,646	-6,537	565	126	22
Sugar	60	55–60	270,402	-15,563	492	99	20
Cotton	57	52–57	68,685	-11,330	641	121	19
Silver	19	—	42,920	-15,285	1,393	429	31
Copper	59	54–59	165,143	-7,687	432	158	37
Soybeans	55	55–60	222,195	-10,800	728	151	21
Soy meal	68	65–70	22,506	-20,900	704	148	21
Wheat	41	40–45	65,806	-12,550	480	124	26
Pork bellies	19	16–25	97,925	-9,498	774	281	36
Soy oil	69	65–70	89,920	-8,920	586	122	21
Plywood	68	65–70	1,622	-3,929	372	98	26
Hogs	16	16–20	35,595	-7,190	1,093	318	29

A more careful look at the results can find other valuable information. During the 7 years of test data, soybeans had 728 trades using a 55-day simple moving average. That is more than 100 trades each year, one every 2 or 3 days. Hogs had 1,093 trades during the same period, and other commodities were similarly high. That seems to be an unusually large number of trades for the time interval used, indicating that there must have been many false trends that resulted in small losses. This is confirmed by the very low percentage of profitable trades, only 21% for soybeans. Nothing is indicated about transaction costs, and 728 trades costing $50 per trade in commissions and slippage would generate $36,400 in costs, about 15% of the Net P/L shown in the table. The total soybean profit of $222,195 was equal to $305 per trade profit over the test period, a very good net return and one that might have been unusual because of the unusually high volatility of the agricultural markets during the early 1970s. The grain market, sugar, and other commodities were driven to record price levels after the U.S.-Soviet grain sale was followed by a poor crop year. Although exceptional, every decade is noted by unprecedented price movement in at least one major sector. *Exceptional* might be the rule.

Comparing the Hochheimer results to the same system applied to the 10 years from 1986 to 1996, there is a very different picture (see Table 21.5). Many of the markets that produced large profits now show losses. The currencies stand out as uniformly successful; however, the best calculation periods vary from 40 to 75 days. The appearance of large calculation periods in the "Best Day" column indicates either a very long trend, as in the T-bonds, or an attempt to minimizes the losses in markets without any uniform trends. The average of all calculation days increased from 48 to 57 in the original test.

Table 21.5: Results of a Simple Moving Average Model (1986–1996), $50 Transaction Costs

Open table as spreadsheet

Market	Best Day	Net P/L	Max Loss	Trades			Robustness
				Total	Prof	% Prof	
Corn	80	$ -937	$ -8,462	98	23	23	0/20
Cotton	60	62,060	-76,640	99	38	41	18/20
Soybeans	95	-1,825	-11,175	124	33	27	0/20
Silver[*]	40	-485	-12,720	112	24	21	0/20
Copper[*]	45	18,987	-9,000	89	34	38	9/20
Gold	45	-3,240	-16,500	146	44	30	0/20
Swiss franc	45	76,025	-15,000	125	54	43	18/20
German mark	75	46,462	-13,462	91	29	32	20/20
Japanese yen	60	85,475	-13,737	169	61	36	18/20
British pound	40	61,825	-33,237	158	54	34	14/20
S&P 500	35	-4,650	-75,750	200	68	34	0/20
NYSE Index[*]	90	-7,100	-21,350	88	29	33	0/20
T-Bills	30	8,350	-6,325	156	49	31	8/20

T-Notes	15	52,215	-9,235	267	102	38	16/20
T-Bonds	100	51,084	-14,036	74	33	45	15/20
[*]Test data began in 1987 or 1988.							

In general, short trends are unstable. Because consistent short-term trends are rare over test intervals longer than 10 years, profitable results for a 15-day moving average are usually caused by one or two very large profits, or a sustained move in one direction. The choice of a short-term trend rarely produces profits in the future.

The ease of new computerized testing platforms allows a convenient way to look at robustness. For the single moving average, 20 periods from 5 to 100 days were tested in steps of 5 days. The last column of Table 21.5 gives the number of profitable tests out of 20 total tests. Six of the fifteen markets tested had no profitable results using any calculation period. Overall, 45% of all tests were profitable. The interest rates show very erratic results with a wide range of best days even though 10-year Treasury notes and 30-year Treasury bonds had a large number of profitable combinations. Only the currencies appear to be robust within an overall framework of mediocre performance. This updated test shows that it is more difficult to profit from a simple trending system, and the successful trends are slower. It will be necessary to improve timing or risk management in order to be competitive.

Crossovers and Breakouts

This Hochheimer study consisted of two tests. The first is a *crossover of two simple moving averages.* The short-term average (the faster trend) ranged from 3 to 25 days and the longer one from 5 to 50 days. The objective was to eliminate the whipsaws that were evident in the first study. The rules for this system were:

1. Each moving average used closing prices only; the calculation period for the long-term trend was always greater than the period for the short-term trend.
2. *A buy* signal occurred when the short-term average moved above the long-term average; a *sell* signal occurred when the short-term average moved below the long term.
3. The model was always in the market.
4. If the high and low prices of the day were equal, a *locked-limit* day was assumed and no trading signals were generated.

The use of a longer and shorter trend introduces the ability to identify a trend bias in the market and trade only in that direction. Theoretically, this should apply best to those markets driven by strong fundamentals, such as government economic policy. Interest rates are the most obvious, but interest rates have a direct effect on exchange rates and on the equities markets. In the original tests, from 1970 through 1976, price movement would have been dominated by the seasonality of the agricultural markets. Seasonal patterns will also create a strong trend during some years, although these trends are not as long as major economic trends. Using two moving averages, the faster one can be considered a timing mechanism while the slower one tracks the underlying market direction. In Table 21.6, the number of trades are less than the simple moving average model, and the percentage of profitable trades was increased, the type of results that any analyst would like to see.

Table 21.6: Results of Two Simple Moving Average Crossovers

Open table as spreadsheet

	Best Days				Trades		
	Fast	Slow	Net P/L	Max. Run of Losses	Total	Profit	%Prof
Cocoa	7	25	$176,940	$ -4,436	468	199	43
Corn	11	47	69,275	-2,697	225	93	35
Sugar	5	50	335,843	-13,851	311	109	35
Cotton	16	25	304,485	-4,755	485	233	48
Silver	3	26	100,790	-8,610	661	262	40
Copper	17	33	212,939	-3,057	354	177	50
Soybeans	16	50	286,440	-15,665	311	148	48
Soybean meal	18	50	117,155	-8,155	272	118	43
Wheat	11	47	113,118	-2,660	209	87	42
Pork bellies	25	46	13,124	-21,538	226	100	42
Soybean oil	14	50	121,749	-6,585	327	128	39
Plywood	24	42	18,505	-3,184	219	100	46
Hogs	3	14	97,488	-7,805	793	321	40

You should always expect better results using a 2-moving average system than a single moving average, even though, philosophically, the 2-trend system is a better approach. By testing overlapping periods, for example 5–40 days for the fast and 15–80 for the slow, the test

can choose the same period in the range 15–40 if a single trend works best. Trading two trends will produce more reliable results. Once the major direction is found by the slower trend, the faster one will take a series of small profits. It will never fight with the underlying trend. Shorter holding periods for trades will cause smaller risk and less total time in the market, both desirable features.

Crossovers Retested

The testing performed to find the best set of parameters is never the last test. It is always important to monitor performance and compare the out-of-sample results with a new optimization to determine the success of the system rules and the testing process. A 1982 publication by Hochheimer,[15] provides a rare opportunity to see how the original tests fared and how parameter selection would have changed based on both additional data and changes in price patterns. Everyone should keep careful records of their original tests and conclusions, then retest using new data and compare the old and new results. By studying the differences in the performance using the old parameter values, or by finding patterns in the new parameter selections, we can visualize an overall change in which the market moves. It may be that noise has increased, causing a shift to longer trends, or that risk is much greater and the returns are proportionally smaller.

In the 1982 update of the Crossover System optimization using three addition years of data through 1979, 11 out of 17 markets performed best using two moving average speeds that were either identical (in six cases) or nearly identical to the previous test. Five of the remaining six tests selected calculation periods that were longer, resulting in slower trading than the previous test. Only gold resulted in a faster selection, but gold futures only began trading in 1975; therefore, the original test in 1976 may have had only one year of data.

Because the results of using the parameters selected in 1976 were not shown in the new study, their performance could not be assessed. Eleven cases, however, where the new parameters were either identical or had very small changes, can be used to draw a conclusion. Their out-of-sample performance is shown in Table 21.7. If the parameters are not identical, the 1979 test must show results that are higher than the actual out-of-sample would have been.

Table 21.7: Retesting of the Crossover System

Open table as spreadsheet

	Through 1976						Through 1979			
	Best Days		Net P/L	Trades Profitable/Total	%	Profits/Trade	Best Days		Net P/L	Trades Profitable/Total
	Fast	Slow					Fast	Slow		
Corn	11	47	$ 69,275	93/225	41	$ 308	12	48	$ 83,586	129/332
Sugar	5	50	335,843	109/311	35	1080	6	50	348,833	160/449
Cotton	16	25	304,485	223/485	46	628	16	25	378,440	329/697
Silver	3	26	100,790	262/661	40	152	3	26	96,995	385/1098
Copper	17	33	212,939	177/354	50	602	17	32	218,790	245/571
Wheat	11	47	133,118	87/209	42	637	12	48	151,871	130/305
Pork bellies	25	46	13,124	100/226	44	58	25	46	78,207	137/312
Soy oil	14	50	121,749	128/327	39	372	14	50	125,848	190/488
Plywood	24	42	18,505	100/219	46	84	20	46	2,667	132/351
Cattle	7	13	147,540	337/792	43	186	7	13	162,280	490/1186
T-Bills	6	18	39,710	69/148	47	268	6	18	28,210	148/388

The first reaction to the update of the 1976 crossover test should be very positive. Nearly identical parameter values were selected for 11 out of the 17 products originally tested. This means that the traders who used this system were using the *optimum* parameters during the 3-year period from 1977 to 1979. How did they do?

Table 21.8 shows the results of the out-of-sample period, 1977–1979. In the cases where the parameter selection was slightly different, it must be assumed that the total performance, 1970–1979, was better than the performance using the original parameters. Therefore, the out-of-sample period should be at least as good as the results actually achieved. Total profits were $201,649, trading one contract of each market.

Table 21.8: Out-of-Sample Results for the Crossover System

Open table as spreadsheet

	Net P/L	Trades Profitable/Total	%	Profits/Trade			1 -Way Slippage (5% Daily Range)		
Corn	$ 14,311	36/107	34	$ 133[*]	½¢	=	25 × 250	=	$ -5,350
Sugar	12,990	51/138	37	94[*]	10 pts	=	112	=	-34,500
Cotton	73,995	106/212	50	349	10 pts	=	50	=	-21,200

Silver	-3,795	123/437	28	-9	½¢	=	50	=	-43,700
Copper	5,851	68/217	31	27[*]	20 pts	=	50	=	-21,700
Wheat	18,753	43/96	45	195[*]	½¢	=	25	=	-2,400
Pork bellies	65,083	37/86	43	757	10¢	=	42	=	-7,224
Soy oil	4,099	62/161	39	25	5¢	=	30	=	-9,660
Plywood	-15,838	32/132	24	-120[*]	20 pts	=	15	=	-3,960
Cattle	14,740	153/394	39	37	10 pts	=	40	=	-31,520
T-Bills	-11,500	79/240	33	-48	2 pts	=	50	=	-24,000
Totals	$201,649								-$205,214

[*]Best case (could have been no better, possibly worse).

Two additional factors should be considered. Although only 3 of the 11 tests showed losses, the fast nature of this system results in very low profits per trade in 4 of the remaining 8 markets. This may not seem serious until the results are changed to show realistic transaction costs. A trend-following system, with orders entered as intraday stops, or even on the close, must always allow for slippage caused by lack of liquidity and are directly related to the size of the order being executed (see the discussion of liquidity in Chapter 16). In a fast market, this slippage can be large, often hundreds of dollars in contract value away from the intended price. Even Market on Close (MOC) orders are subject to slippage. A buyer using an MOC order should expect to get the high of the closing range; a seller will get the low.

In Table 21.8, the furthest right column assumes a conservative slippage, one that should be included in any test program. In some cases such as copper and pork bellies, the slippage is small and does not seem to impact on profits; even the large profits of cotton survive well. But in the fastest trading commodities, even the smallest slippage will severely reduce large profits, frequently turning them into losses. The final total shows that those small costs when applied to every product were greater than the profits. Instead of making a killing in the market, these traders netted a loss—that spread could be $50 to $250, depending on the market and the volatility that day.

Crossover System, 1996–2003

Bringing this technique forward to current markets, seen in Table 21.9, there are a very different set of markets and price patterns. The first important difference is the effects of volatility. Hochheimer's test period through 1976 reflected an exceptionally volatile period for the grains and sugar, and price levels that have not been seen since then. Sugar touched nearly 50¢ per pound, at a time when the normal price was 5¢. At the same time, grain prices tripled. The 1976 results, seen in Table 21.7, show 225 corn trades, each with an average return of $308; in the 2003 market, there is not enough volatility to trade corn profitably. The bull market in sugar can be seen as the highest returns in the 1976 test, with an average of $1,080 per trade.

Tests using 1996 through 2003 data reflect a very different period, one where index markets show high volatility with two dramatic bull and bear markets, and interest rates an unprecedented bull market. Traditional commodities, grains, livestock and soft goods, have shown much lower relative volatility. Compared to the early 1970s, grain and sugar prices have been very quiet.

The updated tests in Table 21.9 used a range of 3 to 25 days for the fast moving average, and 5 to 60 for the slow one. The moving average crossover might be improved by increasing the length of the slower trend's calculation period in order to capture the long-term economic trend; however, these results are directed to the short-term trader and reflect the same calculation periods in Hochheimer's original studies. Table 21.9 has been grouped by type of market.

The most interesting results are the remarkable differences between the best parameter values for the three index markets, the Nasdaq 100, the S&P 500, and the German DAX. Nasdaq and the DAX show exceptionally large profits, and every combination of the DAX was profitable, while the S&P had no combination of fast and slow moving averages that was profitable. The Nasdaq had 77% of all combinations profitable. It is commonly accepted that the S&P has an exceptionally high level of noise that interferes with the trend, causing false signals. This test justifies that assumption. Although both the Nasdaq and DAX are also noisy, they have relatively higher volatility; therefore, once a trade is entered there is enough follow-through in price movement to net a profit.

Energy markets are usually volatile, but price movements during this test period reflect the Iraqi war and the electricity crisis during 2001–2002. Natural gas has been explosive in its volatility, and that is reflected in the large profits and robustness of 86%. Unleaded gas is typically more volatile than heating oil, and shows 58% of all trades were profitable.

Table 21.9: Results of Two Simple Moving Average Crossovers (1996–2003), $100 Transaction Costs

Open table as spreadsheet

Market	Best MA Periods		Net P/L	Profit/Trade	Trades			Robustness
	Fast	Slow			Total	Prof	% Prof	

Nasdaq 100	13	60	$369,180	$6,257	59	22	37	93/120
SP 500	17	25	-37,300	-242	154	42	27	0/120
German DAX[*]	7	25	154,950	1,169	141	49	35	120/120
Eurodollars	3	45	77,000	77	99	26	26	32/120
US 5-yr note	11	35	11,070	105	105	34	32	49/120
US 10-yr note	11	40	19,775	217	91	30	33	69/120
US 30-yr bond	10	21	30,562	203	150	54	36	71/120
Swiss franc	7	55	24,412	301	81	21	26	82/120
Japanese yen	17	45	63,187	709	89	29	33	70/120
Heating oil	13	30	14,123	100	140	38	27	27/120
Unleaded gas	5	23	28,123	167	168	53	32	70/120
Natural gas	3	35	101,600	907	112	40	36	104/120
Cattle	9	45	644	5	119	27	23	2/120
Wheat	9	35	3,375	40	83	23	28	13/120
Cotton	15	40	11,520	101	113	25	22	31/120
Soybean meal	5	45	6,660	57	115	5	4	13/120
Coffee	10	13	45,800	520	88	23	26	59/120
Sugar	5	55	2,727	35	77	21	27	17/120
Cocoa	15	25	4,862	36	132	35	27	44/120

[*]Returns in euros.

Looking at the robustness, the percentage of profitable tests, is the first step to understanding the success of these tests. A good example are the interest rate futures markets, which are shown in ascending volatility, the Eurodollar being the least volatile. As price volatility increases, the percentage of successful tests increase. The best profits of the 5-, 10-, and 30-year Treasuries follow an orderly pattern, although Eurodollars outperform them with one parameter selection. It is still important to try to find the pattern in the results across markets. In this case, the increased volatility is reflected in the robustness of results.

The other confirmation of robustness related to volatility is in the grain markets and most soft commodities. Wheat, cotton, and soybean meal have a difficult time overcoming the transaction costs of $100. This can be seen in the profits per trade of $40, $101, and $57, respectively, and in the very low percentage of profitable tests.

Breakouts

The next model tested by Hochheimer relies on trends but is very different from the previous single and moving average crossover. Originally called a *price channel*, it is now more familiar as an *N-day breakout*, the penetration of the high and low of the past *N* days. The penetration, which causes a *buy or sell* signal, occurs if the daily price closes above or below the high or low, respectively, of the previous *N* days.

Table 21.10 shows the results of the original test, using data through 1979. A common variation of this method is to buy when the *intraday high* penetrates the upper band; however, this can cause ambiguities when both the high and low of the day exceed both bands; it is not possible to know which one occurred first. Intuitively, the closing price is expected to be a more reliable indicator of direction than the intraday high or low.

Table 21.10: Results of Interday Closing Price Channel

Open table as spreadsheet

	Best Day	Net P/L	Max. Run of Losses	Trades		
				Total	Profit	% Prof
Cocoa	53	$147,913	$ -6,248	110	60	55
Corn	49	39,533	-5,048	118	50	42
Sugar	40	296,027	-20,758	133	57	43
Cotton	62	206,575	-6,870	89	48	54
Silver	14	27,690	-12,365	552	212	38
Copper	27	151,671	-7,225	217	115	53
Soybeans	51	244,839	-11,325	120	68	57
Soybean meal	49	104,690	-7,000	166	71	43
Wheat	23	111,087	-6,900	205	80	39

Pork bellies	52	60,263	-9,892	94	51	54
Soybean oil	51	8,646	-3,622	109	48	44
Plywood	49	8,632	-4,432	120	57	48
Hogs	9	83,702	-9,854	606	253	42

In the original tests shown in Table 21.10, the breakout method has much lower profits and proportionally greater risk than the crossovers, and the results appear to be more erratic. This method is clearly better than the single moving average, with more consistent profits, fewer trades, greater reliability, and even smaller drawdowns. Sugar was again the best performer, the result of the extraordinary move to 50¢ per pound during 1974.

Updating the Breakout Method and Comparing the Crossover

An important consideration when evaluating the results of two trading methods is the robustness, shown in the last column of Table 21.9 for the crossover system. Robustness is a way of looking past the fact that a 2-parameter system, such as the moving average crossover, can fit the results better than a single parameter method. This can be seen in the retesting of the breakout system, shown in Table 21.11. Parameter values varied from 5 to 100 days in increments of 5 days, totaling 20 different possibilities, while the crossover model had 120 combinations. However, the average robustness of the crossover model was 42%, while the average robustness of the breakout method was 51% for the same test period (although the breakout tests have a broader selection of markets).

Table 21.11: Results of Retesting the Daily Breakout System (1997–2003), $100 Transaction Costs

Open table as spreadsheet

Market	Best Period	Net P/L	Profit/Trade	Trades			Robustness
				Total	Prof	% Prof	
Nasdaq 100	100	$338,625	$42,326	8	4	50	18/20
SP500	100	73,200	7,320	10	4	40	5/20
Dow	35	6,000	300	20	7	35	1/20
German DAX[*]	15	188,012	3,133	60	30	50	19/20
EuroStoxx[*]	90	41,570	20,785	2	2	100	5/18
Eurodollars	80	22,575	3,762	6	4	67	18/20
US 5-yr note	95	22,790	3,798	6	4	67	15/20
US 10-yr note	65	20,118	1,828	11	6	55	17/20
US 30-yr bond	65	21,510	1,955	11	4	36	8/20
Eurobund[*]	65	41,510	5,930	7	5	71	19/20
Swiss franc	25	35,562	834	39	21	54	12/20
Japanese yen	70	51,150	4,650	11	7	64	18/20
Heating oil	75	14,898	1,241	12	5	42	12/20
Unleaded gas	70	31,348	3,134	10	6	60	13/20
Natural gas	20	47,240	891	53	23	43	16/20
Cattle	45	8,604	374	23	10	43	12/20
Wheat	70	17,762	2,537	7	4	57	8/20
Corn	35	6,525	261	25	15	60	3/20
Soybeans	20	16,362	333	49	24	49	8/20
Cotton	10	23,315	233	100	37	37	9/20
Soybean meal	25	9,960	242	41	17	41	4/20
Coffee	5	42,943	211	203	68	33	1/20
Sugar	95	512	46	11	3	27	2/20
Cocoa	100	-190	-19	10	3	30	0/120

[*]Returns in euros.

Another characteristic of the models is the percentage of profitable trades. The crossover method, similar to a single moving average, keeps losses small and lets profits run. It also has the same idiosyncrasy of a single moving average—getting trapped in a sideways price pattern and generating a series of whipsaw losses. The breakout method naturally adjusts to volatility by expanding the highest high and lowest low, making it more difficult to get false signals but increasing the risk when they do occur. This one feature represents the greatest difference between a moving average and a breakout system. In Table 21.9, the average percentage of profitable trades was 28%, while

the breakout system shows an average of 51% for all markets. The combination of higher robustness and more profitable trades makes the breakout method more desirable, even with higher risk.

Modified 3-Crossover Model

The use of one or more slow moving averages may result in a buy or sell signal at a time when the prices are actually moving opposite to the position that is about to be entered. This may happen when:

1. The rules use the crossover of the moving average to generate a signal, rather than a penetration of the price through the moving average.
2. The change in a simple moving average value based on the new price is less than the change in the oldest price that was dropped.

For example, if a long signal occurs and the oldest price showed a decline of *50* points while today's price declined 40 points, the new moving average value will rise by the difference, +10, divided by the number of days in the moving average. This may also occur using exponential smoothing under the special conditions

$$E_{t-1} - P_t > P_{t-1} - E_{t-1}$$

where E = the exponentially smoothed trendline
P = the price

The slope of a third, faster moving average, $MA3_t - MA3_{t-1}$, can be used as a confirmation of direction to avoid entry into a trade that is going the wrong way. This filter can be added to any moving average or multiple moving average system with the following rule:

> Do not enter a new long (or short) position unless the slope of the confirming moving average (the change in the moving average value from the prior day to today) was up (or down).

The speed of this third, confirming moving average only makes sense if it is equal to or faster than the fastest of the trends used in the Crossover System.

Test Results for the Modified 3-Crossover Model

Fortunately, the results of both the Crossover System as well as the Modified 3-Crossover System were available for the same commodities and the same years. Because the crossovers used in the latter model are exactly those of the first system, the comparison will show whether the confirming feature improved overall results. From the 22 markets tested, plywood was removed because its poor results on both systems tended to distort the comparison. The important statistics are shown in Table 21.12.

Table 21.12: Comparison of Systems 1970–1979

Open table as spreadsheet

	Crossovers				Modified 3 Crossover				Change	
	P/L	No. Trades	% Drop	% Profitable Trades	P/L	No. Trades	% Drop	% Profitable Trades	% P/L	% Trades
Deutschemark	$ 96,510	259	7.6	54	$ 97,698	226	3.4	52	1.2	-12.7
Japanese yen	94,575	131	3.1	51	92,287	111	2.9	58	-2.4	-15.3
Canadian dollar	71,940	158	7.0	52	69,690	116	5.2	60	-3.1	-26.6
British pound	80,262	113	8.2	46	69,808	81	8.3	53	-13.0	-28.3
Swiss franc	120,674	121	4.8	48	100,891	91	4.6	46	-16.4	-24.8
Cocoa	408,262	353	2.4	46	282,453	291	7.6	43	-30.8	-17.6
Coffee	83,586	332	3.9	39	56,338	231	5.8	35	-32.6	-30.4
Sugar	348,833	449	3.8	36	331,526	322	4.1	41	-5.0	-28.3
Cotton	378,440	697	2.8	47	282,460	483	3.3	41	-25.4	-30.7
Silver	96,995	1098	13.9	35	89,165	990	15.7	37	-8.1	-9.8
Copper	218,790	571	2.7	43	217,689	408	2.9	43	-.5	-28.5

Soybeans	386,137	483	4.8	47	308,233	317	5.7	48	-20.2	-34.4
Soybean meal	165,294	429	5.3	43	135,643	316	5.9	39	-17.9	-26.3
Wheat	151,871	305	2.7	43	90,093	207	6.9	44	-40.7	-32.1
Pork bellies	78,207	312	27.5	44	76,363	246	14.2	43	-2.4	-21.2
Soybean oil	125,848	488	5.2	39	89,834	346	9.3	40	-28.6	-29.1
Hogs	88,097	853	9.2	39	94,634	647	7.9	41	7.4	-24.2
Cattle	162,280	1186	4.8	41	155,135	875	3.3	40	-4.4	-26.2
GNMAs	76,291	197	4.4	52	56,217	133	6.5	47	-26.3	-32.5
T-bills	28,210	388	27.0	38	20,436	284	3.4	37	-27.6	-26.8
Gold	131,325	275	1.6	53	98,030	158	2.2	57	-25.4	-42.5
Average			7.3	45			6.1	45	-15.3	-26.1

The differences using the Modified 3-Crossover System versus the simpler Crossover System are:

Average change in profits	-15.3%
Average change in equity drop	-15.5%
Average change in percentage of profitable trades	.9%
Average change in number of trades	-26.1%

A decline in profits equal to a decline in equity drop (or risk) is the same as using the original Crossover System with a 15.4% smaller investment. The percentage of profitable trades increased negligibly, indicating that the confirmation filter did not eliminate more losing trades as was expected. The larger decline in the total number of trades indicates that the profit per trade has increased, an important benefit, all else being equal. The new filter appears to enter at a better point, and eliminate some trades with smaller profits. This improvement in the profits per trade means that there is more latitude for trading error, such as slippage. Although the overall profile of the Modified 3-Crossover is not much better than the Crossover System, it would be the preferred choice based only on the increased profits per trade. The TradeStation code for this method is

```
{ TSM Mod 3MA cross : Modified 3 moving average crossover
   Copyright 1994-2004, P J Kaufman. All rights reserved. }

{ length1 = length of moving average 1
   length2 = length of moving average 2
   length3 = length of moving average 3
   Note: the length of 2 must be greater than 1 and
      the length of 3 must be greater than 2 }

input: length1(20), length2(5), length3(2);
vars: ma1(0), ma2(0), ma3(0);

ma1 = average(close, length1);
ma2 = average(close, length2);
ma3 = average(close, length3);

if ma2 > mal and ma3 > ma3[1] then buy at close;
if ma2 < mal and ma3 < ma3[1] then sell at close;
```

4-9-18 Crossover Model—Surprising Results

This model, using the same rules as the Modified 3-Crossover System, was well-known before Hochheimer's studies. It seems likely that the selection of 4, 9, and 18 days was a conscious effort to be slightly ahead of the 5, 10, and 20 days frequently used in moving average systems that dominated systems of the 1970s. It may have resulted from the earliest computerized testing. There are some very sound concepts in this approach:

1. Each moving average is twice the speed of the prior, enhancing their uniqueness for recognizing different trends. Increasing the period in this way keeps a constant percentage difference.

2. The calculation periods are slightly faster than the conventional 5-, 10-, and 20-day moving averages, which may prove to be a practical advantage.

3. The same calculation periods are used for all markets, adding robustness to the method.

It would not be possible for either the profits or the equity drops to be better in this model than an optimized strategy, which includes the results of the Crossover and Breakout methods, yet out of 17 markets tested during the 1970–1976 period, only two lost money. That is a very impressive record. The ability for a single model to produce profitable results across a broad selection of markets is a very strong indication of robustness, and should add greater confidence to any optimized program.

Retesting the 4-9-18 Crossover—the Importance of Failed Tests

When the period from 1996 through 2003 is tested, as seen in Table 21.13, there are lower profits in the index markets and consistent losses in the energy, agricultural, and soft products markets. Those markets that showed high robustness in the breakout model did not necessarily show profits here. Only 50% of the markets were profitable, and many of those had only small gains.

Table 21.13: Results of 4-9-1 8 Crossovers (1996–2003), $1 00 Transaction Cost

Open table as spreadsheet

Market	Net P/L	Profit/Trade		Trades			Net PL w/o Trans Cost
				Total	Prof	%Prof	
Nasdaq 100	$ 49,210	$	623	79	28	35	57,110
SP 500	52,012		619	84	36	43	60,412
Dow	1,440		25	58	23	40	7,240
German DAX[*]	117,825		1,683	70	28	40	124,825
EuroStoxx[*]	3,180		61	52	22	42	8,380
Eurodollars	6,800		101	67	22	33	13,500
US 5-yr note	-5,731		-66	87	27	31	2,969
US 10-yr note	-1,859		-22	85	20	24	6,641
US 30-yr bond	-8,510		-103	83	28	34	-210
Eurobund[*]	-1,720		-22	78	28	36	6,080
Swiss franc	4,500		53	85	31	36	13,000
Japanese yen	-8,075		-89	91	30	33	1,025
Heating oil	2,152		28	76	33	43	9,752
Unleaded gas	2,771		36	78	32	41	10,571
Natural gas	25,200		296	85	29	34	33,700
Cattle	-20,644		-202	102	24	24	-10,444
Wheat	-9,037		-105	86	27	31	-437
Corn	-7,825		-100	78	24	31	-25
Soybeans	3,375		38	88	30	34	12,175
Cotton	-4,455		-54	83	26	31	3,845
Soybean meal	-2,270		-26	88	29	33	6,530
Coffee	5,089		61	84	32	38	13,489
Sugar	-13,649		-155	88	26	30	-4,849
Cocoa	-14,750		-176	84	32	38	-6,350

[*]Returns in euros.

When transaction costs of $100 are removed from the results, many more of the markets showed profits. This may offer some rationale that the underlying strategy is viable, but the market volatility is too low to net profits greater than the transaction costs. Of the various methods tested in this section, the breakout looks much better than this crossover; however, the breakout results were the best of an optimization and these are entirely out-of-sample based on a technique developed in the 1960s. If the conclusion drawn from these tests is that the model no longer works, then we must question whether a rigid set of trends can survive over the long term, whether the length of the trends has changed, whether price patterns are no longer the same because of changing market participation, or if there is more noise in the market, making it too difficult to identify the trend in a timely fashion.

If this model no longer works, the conclusions drawn from the previous tests need to be reassessed. Because there is no longer confidence that the best calculation period of the past will be the best for the future, we need to depend more on the robustness of the tests. If a large percentage of all tests are profitable, then there is a much greater chance that any parameter selected will be profitable. Our goal is to find the most robust system. Robustness is strongest if it extends over many different markets or stocks.

In order to remove the dependence upon specific fixed parameters that might return variable performance over many years, it is necessary to generalize many of the features in a system. For example, instead of a fixed stop-loss at 10 points or $500, it will be necessary to allow

that stop to vary based on market volatility, such as a percentage of the price or a multiple of the average price change over a recent time period. Even the calculation period of the trend may change according to volatility, market noise, volume, or some other factors. This approach is discussed further in Chapter 17.

Using Realistic Transaction Costs

All of the strategies tested have great possibilities as the basis for a successful trading program, provided realistic transaction costs have been included. Tests with no transaction costs skew the results towards faster trading and shorter calculation periods, and are therefore deceiving. Costs that are too large will penalize the entire method so that only the parameters that yield the largest profits per trade will be successful. Both underestimating and overestimating the transaction costs make it more difficult to find a successful system. If uncertain, a larger cost is more conservative, and ultimately safer. Actual trading gives you an opportunity to know the exact costs of commissions plus slippage. These should replace the estimates used for further testing.

There are other costs that can be very large and not included during testing. These are missed trades. From time to time a shock causes prices to jump instantly to a new level, far above the buy signal generated by the system. If the trade is entered as soon as possible, regardless of the price, the gap will be counted as part of the average slippage when it is evaluated. However, some traders will not enter the trade when the signal if very far from the current price; they consider the risk too high. During the original Gulf War, energy prices jumped so often that more than 10% of the trades might have been *unable*—not entered because prices moved too fast. An occasional large shock, such as 9/11, can materially change performance. All of these need to be recorded as slippage in order to correctly evaluate test results. Keeping an accurate record of actual trades compared to all system trades is the easiest way of finding the per trade cost.

Getting the Big Picture through Testing

The key to robustness is to test more data, more markets, more of everything, and then to study the results looking for a common pattern of overall consistency. There is no better way to tell if a market has trends than to test it for a variety of trending methods. A market that performs well using a daily breakout, but fails with a dual-trend crossover, is not a good candidate for trending profits in the future.

A comprehensive look at 12 trading methods applied to 12 futures markets provides an opportunity to evaluation generalized performance.[16] The annualized percentage returns for a variety of U.S. markets are shown for 12 well-defined technical methods in Table 21.14. These trading systems are:

CHL	*Channel breakout*, using the closing price penetration of the *N*-day high and low.
PAR	Wilder's *Parabolic system*, in which the stop and reverse point (SAR) gets closer each day.
DRM	*Directional Movement*, a Wilder method that averages the up days and down days separately.
RNQ	*Range Quotient*, basing a breakout on a ratio of current change to past change.
DRP	*Directional Parabolic*, combining the DRM and PAR systems.
MII	*M*II *Price Channel*, a breakout system using only the oldest and most recent prices.
LSO	*L-S-O Price Channel*, using two parameters, including an interval of oldest prices, to decide a channel breakout.
REF	*Reference Deviation*, determines a volatility breakout based on a standard deviation of past closing price changes.
DMC	*Dual Moving Average Crossover*, holding a trend position when both moving averages are moving in the same direction.
DRI	*Directional Indicator*, a ratio of current price change to total past price change.
MAB	*Moving Average with % Price Band*, gives a signal when prices penetrate the band.
ALX	*Alexander's Filter Rule*, generates signals when prices reverse from a previous swing high or low by a percentage amount.

Table 21.14: Percentage Returns by System and Market, 1978–1984[*]

Open table as spreadsheet

	CHL	PAR	DRM	RNQ	DRP	MII	LSO	REF	DMC	DRI	MAB	ALX	Average
Corn	22.4	3.8	29.8	-6.2	30.1	43.3	10.7	4.6	37.9	-2.9	-4.7	22.9	16.0
Cocoa	10.0	-101.7	-121.9	-345.0	-112.1	-73.6	-256.9	-120.5	-72.9	-281.8	-219.2	-35.2	-144.2
Copper	-15.4	2.9	-46.1	-78.4	-4.2	-31.4	-83.0	-66.2	-39.8	-94.3	-118.4	-16.8	-49.3
Cattle	-12.2	-28.4	-12.4	-72.5	-16.5	-34.8	-44.9	-56.3	-11.4	-70.0	-58.9	-5.5	-35.3
Pork bellies	-30.8	22.0	-6.8	-134.4	4.8	20.6	-117.4	-145.3	-6.5	-127.6	-112.0	-12.1	-53.8
Lumber	38.7	-43.6	-0.4	-19.2	-40.6	31.3	-46.3	-18.4	36.6	-19.1	-47.1	24.6	-8.6
Soybeans	7.7	-19.1	25.8	-57.9	-10.0	13.3	-21.5	-45.6	2.6	-10.7	-22.5	13.1	-10.4
Silver	60.5	54.4	0.2	-15.9	82.3	-19.1	12.5	-72.4	34.2	-76.2	-18.0	55.9	8.2
Sugar	103.4	46.2	61.2	-42.1	63.4	72.6	-0.8	-47.3	82.3	17.6	15.2	71.6	36.9
British pound	-3.5	8.1	20.7	-36.1	30.3	1.9	-7.8	3.5	25.9	-10.2	-65.8	-39.8	-6.1

German mark	66.5	35.4	68.2	18.8	78.0	63.3	19.2	-17.8	46.3	24.6	6.6	-50.0	29.9
T-bills	108.7	48.5	132.7	-40.1	225.5	189.9	221.8	239.8	127.8	39.2	-12.0	32.9	109.6
Average	29.7	2.4	12.6	-69.1	27.6	23.1	-26.2	-28.5	21.9	-51.0	-54.7	5.1	-8.9

[*]Calculation of annual percent returns assumes that 30% of the initial investment is used for initial margin, in which margin is estimated as 10% of contract value.

To create the results in Table 21.14, each market was tested for 3 years and the best parameters used to generate the returns for the next years, in a step-forward approach. It is easy to see that some markets are not profitable for any strategy and that some strategies are generally poor. Unless you were creating a strategy for a specific group of markets, you would not want to trade a system that was not profitable in at least 50% of the markets, nor would you want to trade a market that failed in most of the trend strategies. For example, cattle lost in every system, and the RNQ, REF, and MAB systems were consistently unprofitable; therefore, none of those would be good candidates for trading. The most consistent systems were CHL, PAR, MII, and DMC, each posting 8 of 12 winning markets; however, each has a noticeably different technique. T-bills present an interesting choice because the highest profit, 239.8%, occurred in one of the least reliable systems, REF; DRP, MII, or CHL are likely to be better choices because of their overall consistency.

Displaying the system results by year for all markets is another way to look at robustness. In Table 21.15, RNQ and MAB had net losses over all markets in all years, while CHL, MII, and DMC stand out as very consistent. The combined presentation of results across all markets and systems is a clear way of avoiding overfitting by looking at the big picture.

Table 21.15: Percentage Returns by System and Year[*]

Open table as spreadsheet

System	1978	1979	1980	1981	1982	1983	1984
CHL	6.1	47.9	81.6	21.8	28.3	19.9	28.0
PAR	18.5	16.4	54.5	29.9	-31.7	-43.2	-19.4
DRM	29.3	21.7	92.2	-31.6	-22.7	7.8	-7.3
RNQ	-57.2	-69.0	-9.6	-152.1	-31.2	-135.5	-100.1
DRP	34.8	63.8	88.7	31.0	-13.4	-20.0	38.5
Mil	12.9	41.6	87.8	54.6	-30.7	3.1	7.1
LSO	-47.1	-4.0	39.1	-55.1	-55.1	-37.6	-59.5
REF	-13.5	23.3	53.2	-85.2	2.0	-109.6	-69.2
DMC	17.6	26.8	85.4	5.9	22.9	1.9	-1.6
DRI	-60.7	-15.4	46.3	-108.1	-114.4	-105.3	-34.0
MAB	-38.0	-44.3	-7.7	-114.4	-91.1	-81.8	-45.7
ALX	28.3	38.6	82.6	-34.4	-8.2	-2.0	-14.4
Average	-5.8	12.3	57.8	-36.5	-28.8	-41.9	-23.1

[*]Equal percentage amounts of margin are assumed to be invested in each market.

[11]Robert W. Colby, *The Encyclopedia of Technical Market Indicators* (McGraw-Hill, 2003).

[12]R. E. Davis and C. C. Thiel, Jr., *A Computer Analysis of the Moving Average Applied to Commodity Futures Trading* (Quiatenon Management, West Lafayette, IN, 1970).

[13]Joseph R. Maxwell, *Commodity Futures Trading with Moving Averages* (Speer, 1974).

[14]Frank Hochheimer, "Moving Averages," and "Channels and Crossovers" in Perry J. Kaufman (Ed.), *Technical Analysis in Commodities* (Wiley, New York, 1980).

[15]Frank L. Hochheimer and Richard Vaughan, *Computerized Trading Techniques 1982* (Merrill Lynch Commodities, NY, 1982).

[16]Louis P. Lukac, B. Wade Brorsen, and Scott H. Irwin, "How to Test Profitability of Technical Trading Systems," *Futures* (October 1987).

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PRICE SHOCKS

Ignoring or underestimating the significance of a price shock will result in catastrophic losses—if not now, then sometime in the future. Price shocks are large changes in price caused by unexpected, unpredictable events. The impact of price shocks on historic tests can change the results from profits to losses; it varies the risk from small to extremely large. Unfortunately, not enough thought is given to how these moves affect test results and future performance. A discussion of price shocks could easily fill an entire book, but the concepts that are most important can be explained briefly. When it comes to actual trading, the difference between the expected results and actual performance (not attributed to slippage) is entirely dependent on the number of price shocks.

By its very nature, a price shock must be unexpected. However, not all similar events cause shocks. An assassination, abduction, or political coup is likely to be a surprise, while a crop freeze can be anticipated as weather turns unusually cold. Some economic reports, such as a 0.5% increase in the Producer Price Index or a jump in the balance of trade, will come as a shock, but a low carryover supply of soybeans or a tightening of the money supply after steady economic growth can be anticipated. During times when good economic news is important to support a continued bull market in equities, any reporting surprise will cause a shock. Every word used by the Fed when stating its current policy on interest rates, following an FOMC meeting, is dissected by the traders, often resulting in large, sudden price changes. The market always tries to anticipate the results of a scheduled economic report. When it is right, prices remain calm; when it is wrong, prices react in proportion to how poorly it was anticipated.

Misinterpreting the Past

At the time of a price shock, such as 9/11, we know that the event could not have been anticipated; at best we might have been lucky and held a position on the right side of the price move. We would never attribute that profit to trading skill. The problem comes when testing a strategy with historic data that contains that price shock. The computer cannot know the difference between a bull market and a price shock; therefore, results only show the set of parameters that had the best performance based on the historic data. The best results from a large series of tests will always include profiting from the largest price shocks, a situation that would be impossible in actual trading. For example, if there were 10 major price shocks in 20 years of data, and your historic tests profited from 8 of those shocks, then you have overestimated your profits by profiting from at least 3 shocks that should have been losses. Even worse, you have *underestimated your risk* by accepting results that had fewer losses because the price shocks produced unrealistic profits. It is the erroneously low risk that is fatal to trading.

How can this problem be corrected? First, look at the pattern of profits and losses from a series of tests. If a 20-day and 30-day moving average each showed a maximum drawdown of $10,000, but the 25-day average only lost $5,000, assume that the 25-day results could have had the same drawdown as the nearby tests. By some quirk of timing one test was able to avoid a loss while the normal test was not. It would be risky to assume such good fortune in trading. It is safe to average the returns of a series of tests, but use the largest drawdown.

Create a list of major price shocks. This can be started by finding a price chart published by the exchanges that shows key events. The ones that caused large price jumps will be the price shocks. Other large price moves should be checked to see if they occurred on a single day. If they did, they should be added to the list. Verify how many of these events produced profits or losses in the final system. If the results profited from more than 50% of the shocks, then both profits and risk are wrong. Reverse some of the 1-day profits with the equivalent loss. Be sure only one day is changed because the system should adjust after the day of the price shock. Also check to see that there is an even distribution with regard to the size of the price shocks. Not only should there be an even number of profits and losses from price shocks, but they should be of comparable size. The system may show good results by taking losses on the minor price shocks and large profits on major ones.

Price shocks must be treated as a serious risk; otherwise, any trading account can be overleveraged and undercapitalized.

This is the most common cause of catastrophic loss. A price shock that causes a windfall profit could just as easily have produced a devastating loss. The example that follows, "Anatomy of an Optimization," shows how expectations and reality are often quite different. Further examples can be found in Chapter 22.

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ANATOMY OF AN OPTIMIZATION[17]

The Iraqi invasion of Kuwait on August 6, 1990, and the U.S. retaliation on January 17, 1991, create a price pattern that causes a series of bad optimization tests; this pattern car teach an important lesson. The strategy is a simple moving average applied to crude oil futures. The test period began January 2, 1990, but 100 days were needed to initialize the calculations; therefore, the first trade was entered May 24,1990 (see Tables 21.16 through 21.18). The first test could have used more data; however, the results of that test would have been similar.

In both Test 1 and Test 2 the moving average calculation periods selected were those that produced the highest profits. By accepting these choices the trader would have held a short position before the invasion of Kuwait, and a long position before the U.S. retaliation. In reality there would have been a large loss—the best past parameter values could not predict the price action on the next day. When a price shock is an important part of the data being tested, the best optimized result is the one that took the most profits out of that move, even at the cost of losing on most other trades. The system is not robust, it is finely tuned to one price move.

In Test 2, although there were large profits from the first price shock, the trader would have still held the wrong position when the second shock occurred. This method of testing hides the real trading risk, focuses on profits that cannot be predicted, and does it all at the expense of everyday trading profits.

Table 21.16: Test 1. Optimizing Crude Oil, January 2, 1 990, through August 3, 1990[*] Open table as spreadsheet

Period	Net Prft	ROA	MaxDD	Trds
5	2615	82.9	-3155	11
10	6765	959.6	-705	5
15	6975	989.4	-705	3
20	4975	705.7	-705	3
25	6975	989.4	-705	3
30	4635	657.5	-705	3
35	3635	313.4	-1160	3
40	3215	276.0	-1165	3
45	3255	187.6	-1735	3
50	255	10.6	-2415	3
55	-715	-21.1	-3385	5
60	2625	156.7	-1675	5
65	2785	239.1	-1165	5
70	-385	-12.6	-3055	7
75	1955	112.7	-1735	3
80	-5040	-100.0	-5040	2
85	-5040	-100.0	-5040	2
90	-5040	-100.0	-5040	2
95	-5040	-100.0	-5040	2
100	-5040	-100.0	-5040	2

[*]Testing stopped the day before the invasion of Kuwait.

Open table as spreadsheet

Trade Detail from Testing				
Trade Date	**B/S**	**Price**	**Profit/Loss**	**Cum P/L**
May 24, 90	Buy	23.58		
May 25, 90	Sell	23.55	-55	-55
Jul 11, 90	Buy	22.49	1035	980
Aug 3, 90	Sell	28.51	5995	6975
[*]Testing stopped the day before the invasion of Kuwait.				
Test selects 15-day moving average.				
Holding short on August 6, 1990, when Iraq invades Kuwait.				

Test 3 looks back at the best results when the data includes both price shocks, August 6, 1990, and January 17, 1991. Instead of calculation periods of 15 and 20 days, selected in the first two tests, this optimization shows best returns for a 35-day calculation period. A look at the sequence of results in the optimization places the peak returns in an uncertain position between two losses, indicating instability. The trading detail shows that the system would have shorted oil on the day before the invasion of Iraq, a likely case of overfitting. The most reasonable selection would be in the area of the 60-day period, although profits are far lower, and there is still no assurance that this choice would be profitable the next time.

Table 21.17: Test 2. Optimizing Crude Oil, January 2, 1990, through January 16, 1991[*] Open table as spreadsheet

Period	Net Prft	ROA	MaxDD	Trds
5	-6010	-32.3	-18610	32
10	3660	22.3	-16430	20
15	12350	103.8	-11895	14
20	19810	345.4	-5735	10
25	8410	105.5	-7970	10
30	8420	86.8	-9705	8
35	18075	1348.9	-1340	5
40	11150	308.9	-3610	6
45	9335	304.1	-3070	5
50	8265	246.7	-3350	3
55	2485	55.0	-4515	7
60	9075	184.8	-4910	5
65	7155	100.4	-7130	7
70	3815	53.3	-7160	7
75	7195	83.9	-8580	9
80	-8540	-82.6	-10340	12
85	-3860	-54.2	-7125	8
90	1960	35.7	-5485	4
95	440	9.5	-4615	4
100	-3950	-85.6	-4615	2
[*]Testing stopped the day before the U.S. retaliation.				

Open table as spreadsheet

Trade Detail from Testing				
Trade Date	**B/S**	**Price**	**Profit/Loss**	**Cum P/L**

May 24, 90	Buy	23.58		
May 25, 90	Sell	23.55	-55	-55
Jul 12, 90	Buy	23.49	35	-20
Oct 1 9, 90	Sell	40.10	16585	16565
Oct 30, 90	Buy	41.23	-1155	15410
Oct 31, 90	Sell	41.92	665	16075
Nov 19, 90	Buy	38.39	3505	19580
Nov 21, 90	Sell	37.30	-1115	18465
Nov 26, 90	Buy	40.62	-3345	15120
Nov 27, 90	Sell	40.53	-115	15005
Jan 7, 91	Buy	35.70	4805	19810
[*]Testing stopped the day before the U.S. retaliation.				
Test selects 20-day moving average.				
Total profits are $3,225 without price shock.				
Holding long when U.S. attacks Iraq.				

Table 21.18: Test 3. Optimizing Crude Oil, January 2, 1990, through March 28, 1991[*] Open table as spreadsheet

Period	Net Prft	ROA	MaxDD	Trds
5	-17255	64.0	-26975	45
10	-13195	-45.0	-29295	31
15	4480	26.6	-16840	20
20	8430	67.6	-12475	16
25	-4690	-22.6	-20725	20
30	-1395	-6.4	-21775	17
35	28335	2114.6	-1340	9
40	-360	-2.5	-14420	12
45	18245	594.3	-3070	7
50	8265	246.7	-3350	3
55	2485	55.0	-4515	7
60	9075	184.8	-4910	5
65	7155	100.4	-7130	7
70	3815	53.3	-7160	7
75	7195	83.9	-8580	9
80	-18225	-81.3	-22410	13
85	-12945	-70.4	-18390	9
90	-4065	-40.3	-10080	5
95	-8645	-56.0	-15430	5
100	-3485	-75.5	-4615	5
[*]Test period includes both price shocks.				

Open table as spreadsheet

Trade Detail from Testing				
Trade Date	**B/S**	**Price**	**Profit/Loss**	**Cum P/L**
May 24, 90	Buy	23.58		

May 25, 90	Sell	23.55	-55	-55
Jul 16, 90	Buy	24.16	-635	-690
Nov 9, 90	Sell	40.58	16395	15705
Jan 14, 91	Buy	38.76	1795	17500
Jan 16, 91	Sell	39.36	575	18075
Mar 8, 91	Buy	29.89	9445	27520
Mar 13, 90	Sell	30.89	975	28495
Mar 19, 90	Buy	30.75	115	28610
Mar 28, 90	Sell	30.50	-275	28335

[*]Test period includes both price shocks.

Test selects 35-day moving average.

Total profits are $2,495 without price shocks.

Optimization profits include both Iraqi invasion of Kuwait and the U.S. attack on Iraq.

[17]Perry Kaufman, "Price Shocks: Reevaluating Risk/Return Expectations," *Futures Industry* (June/July 1995).

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A PLAN FOR ROBUSTNESS

Advances in computing power and testing software have made it very easy to test trading strategies using historic data. It is only logical that a strategy should have worked in the past. It is also sensible to understand the amount of risk that must be taken to gain the reward. For some market analysts, a relationship may be found between fundamental factors, volatility, and risk. For econometricians, the expected price of oil is greatly dependent upon the crude inventories and forecasts of supply and demand; for equity traders, economic health and per capita disposable income is the key element in predicting revenues in the leisure industry; and, the anticipated volatility of soybeans is often found in the size of the carry-over stocks. Past prices and their relationships to economic data form the basis for price movement. In the right market environment, trader expectations can overwhelm all the sound economic conclusions.

The most important factor in the success of a trading program is a sound premise; that is, a successful strategy is based on a real-life relationship between the price movement and the reaction of investors and traders. For example, when the monetary authority of any country raises interest rates, the price of equities tends to fall. Or, when there is bad news for the economy, investors shift from equities to the safer interest rate vehicles, driving the stock market lower and the bond market higher (yields lower). Once these relationships have been identified, it is perfectly sensible to look through historic data to uncover the change in unemployment claims or GDP growth that would move interest rates much higher, or cause a sustained shift from fixed income back to the equities markets—moves large enough to yield a profitable trade.

When an economist looks for a relationship between inventories and price, he or she is confident that there is a solution. The economist can identify those elements of supply, demand, and economic factors that are most relevant. The process is one of careful reasoning and a small amount of testing or validation. However, when a set of trading rules is tested on historic data, we have no way of knowing that this method should or will yield a profitable result.

For example, take the simplest case of a trading system that only uses a moving average trendline. A long position is signaled when the trendline turns up, and a short is generated when the trendline turns down. Is this a sound premise for a strategy? Is the premise more reasonable if the calculation period is very long, attempting to simulate the direction of government policy? If instead the calculation period is short, what fundamental trend is the system trying to identify? The process for understanding this is not trivial.

Realistic Assumptions

After deciding on the underlying strategy, and before testing begins, there are a number of decisions to make. These must be made without the benefit of hindsight, but using common sense. They include:

1. The amount of data to be tested.
2. The commission cost per unit traded.
3. Slippage cost per unit traded.
4. The range of parameter values to be tested.

The last item, the range of values for each parameter, means that you must decide in advance which moving average periods will be tested. If this is to be a long-term program that tries to capitalize on the way governments manipulate interest rates or money supply, then choose periods from 50 to 300 days. If you believe that long holding periods are too risky and most trends are medium-term, then a range of 20 to 100 days might be best. The very fast day trader, looking to downplay the trend, would want to test periods from 5 minutes to 1 day. It is important that the periods chosen for testing correspond to how you perceive the price movement. The approach that the computer will find whatever does works—doesn't work. You must *own* your system by understanding why you are trading this strategy. In that way, when something

goes wrong, you can fix it.

Commissions and slippage are vital to the results, but they are more significant for the short-term trader. As a system focuses on shorter holding periods, the profits per trade must become smaller; therefore, the transaction costs can become the difference between profits and losses. Because a computer believes that orders can be executed perfectly at the signal price, even during a price shock, it takes some effort to decide on realistic transaction costs. Normally, it is safe to overestimate the cost of entering and exiting the market, but for a short-term trader, even a small overestimation could eliminate a potentially profitable trading technique. Accuracy, as near as possible, is the best approach.

By making clear assumptions in advance, you gain the advantage of *validating* your ideas. You thought that medium-speed trends were likely to be best, but test results show that only a narrow range of calculation periods are profitable. You must now rethink why this occurred. Using negative feedback to learn more about the market is a very healthy process.

Targeted Test Results

Most computer software that allows historic testing gives results in terms of the highest returns. Given a choice, most users want to see the highest returns. A single test result, however, should not be considered representative of the worth of the system being tested.

If 1,000 different parameter values, spread over a wide range, were tested on a 10-year period of historic data, the results might be considered successful if 50 of those test results were exceptionally profitable. Statistically, it might be said that those 50 are *significant at the 5% level.* But that is not true. In a well-distributed, or random set of results, 5% are expected to be statistically significant. If the trading strategy is truly sound, then we would like to see much more than 5% significant successes. Success is measured by how much better the results were from the norm.

When assessing the results of an optimization over a reasonable range of parameter values, the average returns of all tests should be positive after transaction costs. Ideally, the average return minus 1 standard deviation of the returns should be positive. The distribution of returns should have a longer tail to the right, representing profits. This means that the strategy controls losses and has a greater chance of a larger profit.

Robustness

Practically speaking, a *robust* trading strategy is one that produces consistently good results across a broad set of parameter values applied to many different markets tested for many years. *Robustness* is a term used to describe a system or method that works under many market conditions, one in which we have confidence. In the best scenario, a robust system is not sensitive to moderate changes in parameter values.

A strategy can also be robust if the underlying premise has a single set of rules with no parameter values and is successful across a specific set of markets during a specific time period, provided there is a large sample of trades.

For example, if a long-term moving average system is robust, then someone unfamiliar with the system should be able to choose a calculation period between 100 and 300 days, specify a market and a time interval, and expect the system to show net profits from trading. This would be most likely if a large percentage of all the parameter values were profitable.

The highest profit or the best risk ratio is not important when looking for robustness, and focusing on these values can be distracting. Instead, it is the average values of all tests that is important, that is, the average net profit, average number of trades, average drawdown, and average profit per trade. In addition, the standard deviation of profits for all tests will give a very good idea of the consistency of returns over the range of tests.

The following is a checklist and brief explanation that outlines the steps for testing, evaluating the test results, selecting parameter values, and monitoring actual trading, consistent with the purpose of finding a robust trading strategy:[18]

1. *Deciding what to test.* Testing should be used for validation of an existing idea, not for discovery.
    a. *Is the underlying premise sound?* It should be based on careful observation of the market, or an awareness of relationships between different factors that drive the market, or between different markets themselves. It may be implemented using trends, oscillators, and other techniques, but it is trying to capture a pattern in human behavior, or an economic or fundamental process.

b. *Can you program all the rules?* Programming a system guarantees that all of the contingencies have been thought out. Rules can even account for exceptional situations, such as crisis intervention following a dramatic price shock, where a different set of rules are applied.

c. *Does the strategy make sense only under certain conditions?* A strategy can apply to a smaller set of specific situations, provided there are enough cases and those patterns can be extracted from a varied set of test data. When there are fewer cases it is more important that the justification be explained in advance, based on a clear market phenomenon, and not discovered by testing.

d. *Take a guess as to the expected results.* Based on the rules of the strategy, a rough estimate of the number of trades, percentage of profitable trades, and even the net profits should be written down before testing begins. Testing then becomes a way of confirming these estimates.

e. *Be critical of good results.* Getting good test results in a pattern that is different from expectations may mean that the rules are specified incorrectly, or that you misunderstood the risk of the method. It is the best time to rethink the problem before moving forward. While we always try to understand and fix bad results, there is an inclination to accept good results without questioning whether they could be wrong. Good results for the wrong reason are still a problem.

2. *Deciding how to test.* There are a number of steps necessary before the test process begins:

a. *Choose the testing tools and methods.* Select a test platform, such as TradeStation or MetaStock, that can speed up the test process and keep it objective. Programming in these platforms prevents the strategy from looking ahead at the data before making a decision about today, an error that can easily happen when programming in BASIC, C, or even using a spreadsheet. Many perfect strategies have been created by accidentally looking at tomorrow's prices.

b. *Use as much of the right data as possible.* More data is best, but if there is less data available it should have a wide variety of price patterns, such as bull and bear markets, price shocks, and sustained sideways periods.

c. *Choose the range of parameter values that applies to the strategy.* The nature of the trading strategy, for example, a long-term or short-term breakout, will determine the parameter values that should be tested. Test only the range that makes sense for the strategy. This serves to validate the concept and avoids discovering an isolated profitable situation that can be distracting and misleading.

d. *Decide the order in which to test the parameters.* Not all parameters should be tested at the same time. A few of the most important parameters should be tested first to see if the basic structure is profitable. These parameters, such as the calculation period for the trend, will have a wide range of results. These results may show that faster trading cannot be profitable after transaction costs. Other parameters, such as a stop-loss, are used to refine the risk profile, and should not turn a losing method into a profitable one. They can be tested later.

e. *Be sure the parameter test values are distributed properly.* Testing equal increments of trend periods can be misleading. The difference between a 3- and 4-day moving average is 33%, while the difference between a 99- and-100 day average is only 1%. When testing periods from 1 to 100 days, in steps of 1, the average results are heavily weighted towards the long end, which has similar performance. Commercial testing platforms may not allow unequal test increments; therefore, it is necessary to weight the results in a way that compensates for the distribution.

f. *Define the success criteria.* Highest net profits are not the best measurement of success for individual tests. Risk-adjusted returns, high reliability, frequency of trading, and time in the market can be combined to give a very good objective criteria. The entire set of tests, the optimization, must be measured using a combination of average risk-adjusted returns and robustness.

g. *Presentation and visualization of the results.* A table of test results, in the order they are processed by the testing program, is a very difficult format for evaluation. The availability of charts using a spreadsheet allows a visual presentation of how the values of each parameter to interact with all other parameter values. It becomes clear which parameters are stable and which are not performing properly. Two- and 3-dimensional contour maps can give a better view of the interaction between parameters; they also show the sensitivity of each parameter value at the same time—in easy-to-read colors.

3. *Evaluating the results.* Careful review of the test results can avoid many hours of unnecessary work later on. Looking at a good sample of individual test results (one result for each combination of parameter values), and even the individual trades of a few selected parameter values, will give you insight into the good and bad aspects of a trading strategy. The statistics are not enough information to be sure that the program is performing correctly. An exceptionally large trading loss, and too many trades that ended with a stop-loss and not enough with profit-taking, will indicate a problem that cannot be seen without studying the detail.

    a. *Verify a reasonable sample of calculations.* Just because calculations were done by a computer doesn't mean they are correct. Someone had to tell the computer what to do, and people make mistakes. This is the time to remember the Carpenter's Rule: *measure twice*, *cut once*.

    b. *Were there enough trades to have reliable results?* Results that show excellent performance with only a few trades are a problem. When there is not enough data, there is no way to be sure that the results are robust. Returns should be reduced according to the standard error, but common sense is also needed. The system can only be used if you have complete confidence in the underlying premise, and that requires enough trades to confirm the logic.

    c. *Does the trading system produce profits for most combinations of parameters?* The best assurance of robustness is when most parameters produce profitable results, even though the returns and risk vary.

    d. *Did logic changes improve overall test performance?* When a special rule is added to improve performance or to correct a specific problem, the average statistics of all tests must improve, while the standard deviation remains unchanged. Or, the standard deviation of all tests must decline while the average returns remain unchanged. Both profiles indicate a change that is a global improvement; otherwise, the changes have targeted a single problem at the cost of introducing new problems, which is a sign of overfitting.

4. *Choosing the specific parameter values to trade.* Choosing the final values to be used in trading is another unique and difficult problem. There is no sure way of knowing if the final selection of values will perform in the future. The testing process tries to separate robust performance from success by luck or chance.

    a. *The final optimization must include all data.* Good test procedures call for setting aside some current data to be used for out-of-sample verification. Once that has been completed successfully, a final optimization must be run that includes the out-of-sample data. New parameter values should be chosen from this last set of tests. Staying as current as possible improves the chances for success.

    b. *Choose values from a broad area of success.* Parameters should be chosen from an area that showed consistent risk-adjusted returns, and should not be biased by the one test that had peak profits. Peak performance of any sort is an exception not likely to be repeated. Select the final parameter values that represent average returns in an area of consistency that is not sensitive to moderate changes in parameter values.

    c. *Profits must be distributed evenly throughout the test period.* The best parameter value choices are those that show consistency over time. The stock index futures have a tendency to be highly profitable for trending methods during the bull market of the 1990s, but have struggled to show any profits during 2002 and 2003. A summary of the test results may show a very attractive profile, yet many parameter selections would not survive these two years without a reserve of profits built up in the 1990s. Verify that the final selection was uniformly successful across the entire test period. In the difficult index markets, parameter values that were successful during the few years following the bull market would have been successful during the bull market —nearly any set of values would have been successful in the 1990s. A set of values that show a moderate increase in performance in recent years is more desirable that one that shows a decay in returns; however, uniformity across the entire period is best.

    d. *Verify whether a disproportionate amount of profits came from price shocks.* It is not possible to avoid large price shocks in real trading because you never know when they will come. Historic results that do not show large equity jumps due to price shocks are not realistic, and result from overfitting. The final values chosen may have produced conservative results by avoiding all of the price shocks. Even worse, those results that profited from more than 50% of the price shocks, or from the largest price shocks, have erroneously low risk. Correct the performance by removing some of the profits from price shocks and turning them into losses. In real trading you cannot avoid a price shock, and far fewer than 50% of the price shocks will become a windfall profit.

e. *Scale the risk-adjusted returns to a personally acceptable risk level.* Every return is associated with a comparable level of risk. For example, the final system performance shows a risk-adjusted annualized return of 50% with an associated annualized risk of 20%, measured as 1 standard deviation of the monthly returns. Then there is a 2.5% chance that the system can lose 40% in one year (one side of the curve using 2 standard deviations of the risk). A trader that will only accept a 2.5% chance of a 20% loss will need to reduce the leverage by one-half, reducing the expected returns to 25% per annum.

f. *When there is a choice between two sets of parameter values, choose the one that causes less time in the market.* When there is broad range of success in testing, there may be a choice in parameter values. The values that generate comparable returns and have less time in the market are best. Being out of the market is the only defense against price shocks. If a strategy holds a position only 60% of the time, then there is a 40% chance that a price shock can be avoided. Strategies that are out of the market most often do not exit and then enter a new trade at the same time. Separating exits and entries improves slippage; the smaller the size of the order, the less slippage.

g. *Out-of-sample performance must be consistent with the test profile.* Before beginning trading, an out-of-sample test should confirm that the system can perform on data never seen before. If there is no recent out-of-sample data available, a test of a similar market or older data can be used. For example, if a system was developed on the U.S. index markets, then a test of the DAX, EuroStoxx, or the Nikkei will help confirm its robustness. While this is not necessarily as good as more recent data in the tested markets, failure to work on a similar index would still be a strong sign that the model was overfitted.

5. *Trading and performance monitoring.* The development of a system is never complete. There is a continuous evolution in the markets, seen in the changing participation, volatility, interrelationships between markets, and the introduction of new markets. The only way to see how these changes affect a trading program is to carefully monitor the system signals and the corresponding execution prices. From this evaluation funds can be reallocated, the method of placing orders can be changed, and better rules can be introduced. Without monitoring the trading, and comparing the results to the test expectations, there is no basis for saying that a system is performing correctly.

a. *Trade using exactly the same rules that were tested.* It is often convenient to program a simple version of an idea, but trade a more complex set of rules. Or, a new rule may be added at the end without testing, because the test process tapes too long. What appears to be an inconsequential change can cause substantially different results. If the tested method and traded method are not identical, there is no basis for comparing the actual results with the test results.

b. *Trade the same data that was used in testing.* The use of an artificial, continuous contract for testing futures will not give you the same results as testing each contract, beginning at the time it becomes the most active delivery month. Some artificial continuous price series are smoother than real price and appear to perform better; back-adjusted futures data is generally safe unless the exact price level has been used in the logic. Forex data is a unique problem because test data may represent the quotes of one set of banks, while the data on any quote machine will be from an entirely different set of banks. These can vary dramatically. The best trading results come when the test data and trading data are from the same source.

c. *Monitoring the difference between the system and the actual entries and exits.* Slippage, the difference between the system price and the actual market execution, can change performance from theoretically profitable to a real trading loss. Monitoring this difference will tell you the realistic execution costs, the maximum volume that can be traded, and the best time of day to trade.

A Final Comment on Testing

Testing is the only way you can know if a strategy can be successful, but it provides no guarantee of profits. Testing can be done on many levels. It can be as simple as validating a single set of rules with no choice of parameter values, applied to past data. It can be as complex as a multidimensional analysis of results based on parameters that are so interdependent that they must all be tested simultaneously.

Testing that follows a sound procedure and a test evaluation that looks for robust solutions will improve the chances for success. Bad testing can be tragic. It is a waste of time and resources, and leads to a system that has little chance of success.

While testing should use data that includes a wide sample of prices patterns, bull and bear markets, and prolonged sideways intervals, there are times when the data in the test interval does not resemble the current market conditions.

Had a system been tested on S&P futures from 1990 through 1999, the parameter values selected would have been biased to favor long positions. Trading that model would have been a disaster in 2000 and 2001. It may be necessary to find test data that represents the type of market most likely to be seen in the near future, or extend the test data backwards to reduce the impact of the dominant bull market.

The extent of testing is a matter of judgment. Simple tests can outline the performance profile and provide an understanding of the risks and rewards. Complex tests may introduce subtle errors in the process, just as complex strategies may be flawed due to their intricacy. Begin simply, increase the complexity slowly, and stop as soon as possible.

Remember that, as hard as we try, real-time results will not be as good as historic results. Historic price patterns never repeat themselves exactly. The best system rules and the best parameter values are the simplest and the most general. They may show lower returns and greater risk than the ideal optimized results, but they are much more likely to represent the future returns.

Other areas of interest to readers actively testing and evaluating test performance are *genetic algorithms*, a new search technique, discussed primarily in Chapters 20 and 24, and most of Chapter 23, especially the section "Measuring Risk."

[18]A more detailed explanation of testing "robustness" can be found in Perry Kaufman, *Smarter Trading* (McGraw-Hill, 1995).

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Chapter 22: Practical Considerations

OVERVIEW

This chapter discusses areas of technical and mathematical analysis that are not systems by themselves yet are essential to the successful development of a system and to trading. The first part concerns the use—and the misuse—of the computer. Technical analysis and computers have become inseparable and, with the simple steps provided by development software such as *TradeStation*, *MetaStock*, and spreadsheets, it would be rare to trade a new technical system without first running it through a computer to simulate its past performance. Those who do not use a computer directly are strongly influenced by the computer systems of others.

The second section, "Price Shocks," is the most underestimated deterrent for finding the best system, generating realistic expectations, and the most common reason for catastrophic loss. Price shocks have been discussed earlier in this book (Chapter 21 in the section "Anatomy of an Optimization"), yet they cannot be underestimated. Unpredictable events, once they become part of price history, are often treated as though they could have been anticipated. This can inflate performance returns and minimize risk during strategy testing with serious consequences to actual trading. This section tries to explain how to close the gap between testing and reality.

The Theory of Runs, the third section, is actually an application of gambling techniques, primarily Martingales, to trading. What would seem more reasonable than assuming that the odds are against you in the stock or futures markets and treating it as a gambling scenario?

The fourth section is about combining systems that focus on different market characteristics, and the understanding of the trade-offs inherent in the basic types of strategies. There is also a short analysis of trading limits in futures markets to show some of the problems and flaws of moving from a test to an operating environment. The last section reviews the similarity of systems and the impact of technical systems on the markets.

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USE AND ABUSE OF THE COMPUTER

> *Make sure your present report system is reasonably clean and effective before you automate. Otherwise your new computer will just speed up the mess.*
> —Robert Townsend[1]

Computers are not a substitute for thinking. They excel in performing the same tedious task, over and over again, quickly and accurately—provided, of course, that correct information was entered. But even though technology has not yet reached the stage depicted in *Star Wars*, the computer is the only practical tool for evaluating trading ideas. This section will consider both good and bad ways to approach a computer problem, none of which can be credited to or blamed on the machine. As a powerful tool, a computer can't be beat; many of the systems, advancements, and refinements presented in this book would not be possible without it.

Computers come in many packages and can be purchased or leased. The basic model is not usually the one to buy because memory size has become the critical component for speed. The larger the memory, the easier it will be for the system to manipulate complex software and images that are downloaded from the Internet. Processing speed and communication speed are also important if you plan to do a lot of testing. Buying the high-end hardware configuration ensures some added longevity to your purchase. During the 1980s the average life of a computer *generation* was about 10 years; however, advances in technology have reduced that to about 3 years, if you don't mind one year when you feel obsolete. Each year, computers become faster and more sophisticated. It is said that the capacity and speed of the computer doubles every year and a half.

Because not everyone knows how to program a computer, software companies have developed *turn-key* packages, programs that are *user-friendly*, operated by a click of the mouse, and driven by menu selection. The combination of these two factors, cheap and powerful hardware, and sophisticated, user-friendly software, has made individual and institution investors dependent upon this technology.

One of the first and foremost organizations to provide convenient computer research tools for the trader was the Technical Analysis Group (TAG), which began as a New Orleans-based users' group in 1975. It provided menu-driven capabilities for analysis of daily price data and programming capability similar to a spreadsheet using its CompuTrac software. It provided automatic updates of daily data at a time when that luxury was the state-of-the-art. The company that breaks ground is not always the one that survives the race, and those analysts developing systems now expect much more. Generally, development software falls into two groups:

1. *Daily market analysis*, with price updates at the end of the day.
2. *Intraday trading platform*, providing users with on-line data feeds to execute their strategies.

Both types of software provide the ability to enter your trading strategies and test them on historic data. The software that operates on daily data, also called *end-of-day data*, is considered "off-line" and is used by traders who prefer to evaluate the market after it closes and prepare orders that can be executed the next day without having to constantly watch the market. The intraday trading platform, however, is much more complex and more expensive. It requires active data feeds and provides real-time graphics and generates trading signals that change as price patterns develop during the day. It can make decisions based on each price print or based on a bar size defined by the user, for example, every 30 minutes.

Acquiring Data

Daily historic data, essential to the development of trading systems, is readily available and most often comes with the purchase of the software development program. It is common to see 25 years of historic data on all U.S. equity and

futures markets, but not as common to have European and Asian data provided as well. Specialized data vendors, such as Dial Data and Commodity Systems Inc., provide an easy way to update data each day in a format readily used by most testing and trading platforms. A large selection of vendors can be found by typing "stock data" or "futures data" into an Internet search engine. If futures data is needed, check to see if the vendor provides a continuous, back-adjusted data series, which will be necessary for testing. The types of back-adjusting were discussed in Chapter 21.

Intraday data is available from a few major vendors, such as the CQG Data Factory and Tick Data Inc., and can be easily obtained for at least 15 years on U.S. markets; however, it is also more difficult to get on less active markets outside the United States. The Chicago Mercantile Exchange has made most of its tick data available on compact disk, but it is necessary to convert their form into one that can be read by your trading strategy software. Other exchanges may follow the policy of the CME, and distribute data in order to encourage more trading.

Of the non-U.S. firms, London's LIFFE has been providing tick data for the longest time and 10 to 15 years is available for their oldest markets. France's MATIF, the European Eurex, and Singapore's SIMEX are the three other most active exchanges, and each has a Web site that can be checked for the availability of data. The form of the data provided is very similar, but expect them to be incompatible with the trading strategy software. They also require what is called "data reduction." It may be more expensive to convert this data to a standard format than it is to buy it from a data vendor.

If you are using an Internet charting service, or a trading platform that has delivery of data via the Internet, that data can be downloaded to a text file and used for historic testing. Most charting services will provide an "export" feature in a drop-down menu or by right-clicking on the prices that appear on the screen.

Cleaning the Data

Occasionally an historic test of a strategy will be immensely profitable, or will lose much more than you expected. When testing 20 years of data, it is inconvenient to look at each trade, especially if you are a short-term trader and the strategy produced thousands of trades. If the logic was tested on a smaller data interval, then it is common to accept the results as correct and rationalize the unexpected outcome as an odd sequence of bad or good trades. You might be surprised to learn that there can be many erroneous prices in your data. It is an incredible waste of time to use data without first reviewing it to find errors. It is possible for stock or futures data to begin with a short interval of data that has nothing to do with the current price series, but was something left over from a previous data series during processing by the vendor. In other cases the data has shifted decimal places somewhere in the middle of the series; a price beginning as 135.50 is then shown as 13550.

Tick data is notorious for including bad data with the good, simply because of the magnitude of the problem. The easiest approach to checking intraday data is to display it as a chart and quickly scan through all of the data before it is used. Bad data points are obvious once seen on a screen. A low price of zero will show up as a vertical line going to the bottom of the chart; this will result in the correct data points being scaled down to look as though they are just a horizontal line. You can then find the date of this point and correct it.

If you are very conscientious about the integrity of the data, a cleaning program should be written that looks for:

1. *Outliers*, those data points that are more than 2% away from the previous data (or some preset percentage).
2. *Missing dates*, more than 4 days in sequence without data should be flagged as a potential problem.
3. *Open and closing prices outside the high-low range*, are not possible and the data should be corrected or removed.
4. *Frequency of data*, a histogram of how many days had data posted for each 5-minute interval. When one day shows an unusually high number of bars with no data compared to the normal pattern, it should be flagged.

The days that are flagged will need to be reviewed individually, and the overall picture will give you a good idea about the quality of the data. There will be other, more subtle tests; however, finding the big problems is most important. A missing piece of data, or a shift in the decimal notation can cause one large profit or loss that will distort all the test results. Cleaning the data is a tedious but very important task. Do not assume that the data is clean.

Combining Standard Techniques into a System

Strategy development programs provide a wide assortment of standard techniques in the form of indicators and systems. Choose a stochastic oscillator or an RSI, a moving average or an *N*-day breakout, and combine them in various ways with different calculation periods, such as a 10-day and 40-day smoothing, or even vary the frequency of data using 30-minute, 1-hour, and daily bars. Each day, more tools and indicators are added to these packages. Somewhere in the combination

of these techniques should be a trading strategy that matches the time frame and risk profile that you want. For example, a long-term trend can be found with a standard moving average, weighted average, exponential smoothing, *N*-day breakout, or linear regression. These techniques are all already available. They can be combined with a band to avoid whipsaws. That is also easily done. If timing is important, an oscillator can be used to enter trades in the direction of the trend but only when the oscillator has moved to an overbought or oversold zone, essentially buying on a pullback.

Before taking the path of specialized programming, there is a lot to be learned by using these standard tools. It is not at all clear that a new trend calculation is any better than the ones already provided in the test platform. In Chapter 8, there was a comparison of trending techniques with the conclusion that, if the price trended, then any trending method should be profitable. It may be that the choice of trend period is much more important than the trend technique.

Programming a New Idea

Computer programming talent is no longer rare, but in high demand and fairly expensive. In addition, understanding a trading strategy is a special talent that requires training. Fortunately, the data management, the complex bookkeeping, and order entry are already built in to the programmable section of trading development software, such as TradeStation. Functions such as *buy on the close* or *sell at 125 stop* allow orders to be entered as they would in actual trading. It is only necessary to code the actual strategy and the list of trades and performance summary will be produced automatically. Large-scale testing is also a well-used feature. Most important, the software prevents you from looking ahead at tomorrow's price in order to decide whether to buy or sell today.

The prevailing philosophy about software development is to try to use as much third-party software as possible. For example, after an optimization has been run (resulting in hundreds of lines of test results, one line for each combination of parameter values), save the results to a spreadsheet. This test detail can then be sorted, organized, analyzed, and charted with all the facilities in the spreadsheet program. If a series of tests are saved, they can be compared in the spreadsheet. Results can be averaged and the variance can be found in order to find the most robust strategy. For the more popular platforms, such as TradeStation and MetaStock, a number of users' groups, support groups, and newsletters can be of great help. Some companies provide alternate statistical measurements for your tests, while others have an add-in portfolio program. It is a good idea to check to see if these services satisfy your needs before attacking the programming yourself.

Selecting a Programmer

If you are not going to program the strategy yourself, find someone with experience in the system that is being used, specifically someone who already knows the programming language. Contacting the users' group for that product or asking the company for a recommended list of independent programmers will speed up the search. Training someone who has no knowledge of trading or does not know the programming language is going to make this a long, frustrating experience. Given a choice, find someone with scientific rather than business programming experience.

Getting programmers to say how much it will cost or how long it will take to solve a problem is going to be difficult—they just don't know when it comes to developing something new. Programmers are incurable optimists, always thinking that the problem will be done at any moment. Even competent managers of programmers have difficulty in scheduling a project, based on the uncertainty of the debugging, or checking-out, process. If it is necessary to contract the work or hire a programmer, try to do it on a fixed-price basis and avoid the problems that will occur later.

Define the Steps

To keep the work on schedule, it is necessary to have a specific plan in advance. Start by applying the rules to a list of prices or a printed chart, marking the places where the system will buy and sell. It is important, that there is an actual example of what is expected so that the final results of the program can be verified.

List all of the rules in outline form. Every step must be complete and precise. If there are a number of ways in which rules or indicators may be combined, list each of the options. The computer cannot deal with ambiguities. It is very likely that a programmer can work directly from your rules to create the final strategy. This is a good check to be sure that all combinations of situations have been covered. Using this list of rules, select a price series and mark the trading signals that will be used to verify the program output.

Looking into the Past

The advantages of using as much data as possible has been discussed thoroughly—it reflects a broader variety of market conditions; therefore, results based on this data are robust. There is often a concern that older data does not represent

current conditions. While there may be some truth in that, there is usually more to be gained with a system that can survive those years and still perform well in current markets. Unless there has been a structural change that makes the old data invalid, longer tests and more data should be favored. If the older years represent a period of low volatility that is not likely to be seen again, a strategy should, at the very least, not post losses for that period. Price patterns never seem to repeat themselves; however, there are characteristics of the past that continually reappear.

Paper Trading

With all good intentions, when a new strategy is developed, the plan is to hold the most recent data aside for out-of-sample testing. However, before testing is completed, that data has been used at least once, most often many times. No matter how careful you are, it is possible that the system has been overfitted to the data by fine-tuning the rules and parameters.

The safest alternative is a period of *paper trading*. Only by monitoring the program daily can its performance be seen under real market conditions. Before doing that, the performance expectations must be documented. For example, the frequency of trading, holding period, percentage of profitable trades, size of profits, and size of losses must all be estimated in advance and used to measure comparative results.

It is always a relief when the system posts its first profit, but it is the overall profile that is most important. When paper trading, assume that the execution is the worst price of the 5 minutes immediately following an intraday signal, or the highest price of the futures market closing range if trades are executed *on the close*. A touch of reality can point out problems before they happen and save a lot of money. Don't start trading a new system without monitoring its performance first.

It Should Work, But It Doesn't

It was hard work and all of the steps were followed as conscientiously as possible. The rules were logical, and well-defined, and the strategy was tested on enough data. Your effort has resulted in proving one of four things:

1. The strategy is profitable.
2. The strategy is not profitable.
3. The strategy cannot be implemented effectively.
4. The whole process takes too long or is too expensive.

Of course, a successful outcome is the best result, but it is not the most likely result from the first attempt. If you are convinced that the method should work but the results were not satisfactory, each step in the process will need to be reviewed. Trading strategies should be built slowly; each piece must be proved to be sound before going on to the next step. You should never have gotten to the end without knowing that the final product was going to be profitable. If the performance deteriorated as new rules and features were added, you should have stopped until the problems were resolved.

Vertical or Integrated Solutions

There are two philosophies for system development, *vertical*, using individual building blocks, one upon the other, and *fully-integrated*, similar to a puzzle box where all pieces fit together in just one special way. The fully-integrated method takes advantage of the interrelationship between features, such as the calculation speed of a trend and a filter that blocks entering a new trade and forces the liquidation of the current trade when volatility is too high. It is possible that, as the filter blocks more trades, the trend speed will change to be profitable in markets with less volatility. Therefore, the two parameters, trend speed and filter threshold, are interdependent and must be tested together.

Using the vertical method, the primary rule is tested first and must be profitable without any other features. In this case the trend is tested and found to be successful when the calculation period is above 100 days. Next, the volatility threshold is tested with the selected trend period. The volatility threshold is therefore dependent upon a specific trend. It becomes clear that the volatility feature works or does not work.

What happens when the vertical solution shows that volatility does not help, but there is a very successful integrated solution? This will happen when the trend period is not profitable on its own, but is profitable when selected trades are made based on the volatility filter. To some analysts, this is a more sophisticated solution; to others, it is overfit. The

answer can be found by tabulating the percentage of profitable test combinations. If the percentage of profitable tests of the combined parameters is greater than the percentage of successful tests using only the trend, then the volatility feature is an improvement.

Transparant or Complex Solutions

A *transparent strategy* is one that is easy to understand. If it was capitalizing on a chart pattern, it could be explained by showing that pattern, or combination of patterns, on a chart. If a trading signal was generated, another trader who knew the rules could look at the prices on a screen and confirm that a signal should have occurred at that point.

A complex system is not transparent. A chart pattern that is filtered by price volatility and volume, then confirmed by the pattern of other stocks in the same sector as well as the S&P 500 index, would be difficult to calculate manually. If the underlying premise is a trend based on a portion of a trigonometric curve, it is not clear that anyone could intuitively know that a trade should have occurred on any specific price bar.

Complex solutions may be wrong without anyone knowing. They are more difficult to create, especially difficult to debug, and cannot be visually confirmed by studying the signals on a chart. Acceptance is based on historic testing and profitability. A complex solution can be successful, but it is a very difficult road to follow.

Isolating the Problems

A few of the more common problems that cause disappointing test results are:

1. *The rules were too subjective or ambiguous*. When the rules were programmed, choices were made in order to satisfy a rule that was not definitive. For example, the rule could have been *buy only if confirmed by volume*. When that rule was programmed, it was interpreted as *buy only if today's volume is greater than yesterday's volume*. Because volume is erratic, the statement should have been *buy only if today's volume is greater than the average volume of the past 10 days*. Knowing that one rule was not clear is a valuable discovery. Many traders believe that they are very clinical about their methodology; they know exactly what will be done in every circumstance; therefore, they think that their approach can be perfectly documented. But computerization cannot be done successfully unless every combination of events is accounted for.

2. *The techniques did not work for the parameter value range that was tested*. The original concept was to find a medium-length trend to avoid very long holding periods that have high risk, or very short-term trading that is too intense. However, none of the parameter values in the range from 15 to 70 days worked and the stop-loss of 1% to 3% did not seem to be effective.

   Systems do not always work as expected. It turns out that medium-speed trends have highly variable holding periods; that is, sometimes the price move is sustained for 1 to 2 weeks, other times 2 months. The same trend period cannot capture both. Negative results are important feedback. They help create a better strategy before it is too late. After all, if the answers were known in advance, this would all be unnecessary.

   Instead of finding a single, medium-speed trend, combine a longer trend with the medium one. The longer one will find the fundamental direction, dictated by economic policy; the medium calculation period will capture shorter moves within that trend, avoiding the losing scenario of trading against the fundamental direction. Take the time to understand why two trends worked when one did not. This is an opportunity to increase your understanding of how the market works and find a successful strategy at the same time.

   Before testing a different range of values than originally planned, consider what changes in strategy the new range of values represents. Longer calculation periods cause the trades to be held longer, have higher individual trade risk, and depend on the long-term direction of prices. Shorter periods speed up trading and focus on trader and investor behavior rather than the fundamentals of price movement; timing becomes critical. If you are satisfied with one of these philosophies, then test those ranges.

3. *It worked in some markets but not in others*. Some markets have clearer trends than others, while some have more noise. Not all markets will work with the same strategy; however, all markets within a correlated sector should work. Don't expect Raytheon and IBM to trade the same way, or Intel and General Electric, but two wireless telephone companies should produce similar results. In futures, the fixed-income markets show the longest trends, while the equity index markets have the most noise. You can be concerned when similar markets perform differently, but expect different markets to require different parameter values using the same strategy. Look for patterns in the selection of parameter values.

Expectations

In some work, defining your expectations can bias the process and give poor results. For the development of a trading system you must first have a sound premise before you start. This idea must be associated with a time frame, that is, whether it works best trading faster or slower, the frequency of profitable trades, and even the relative size of the expected profits and losses. With clear expectations, rules and techniques can be added and changed consistent with the philosophy of the method. If you expect to trade once each day and capture about 50% of the trading range, but the programmed strategy only gives a trading signal once each week, you can immediately look for an error. If profits are too small or losses too big, then you can carefully study how the rules apply to a series of prices and understand whether you have omitted some rules, applied the rules incorrectly, or overlooked something in your reasoning. Without clear expectations, you have no benchmark to help you through the development process.

A Winner in Disguise

One important twist on performance should not be overlooked: A consistently bad performer can become a consistent winner by doing just the opposite. Finding a profitable trend system in the range of shorter time intervals may seem to be a hopeless effort. On the other hand, systematic losses means that the price movement fails to trend, and every buy signal and sell signal is actually an overbought and oversold condition, predictive of price change. This can happen in highly liquid markets with a large noise component, such as the major equity index futures. What appears at first to be a trend change is a temporary distortion due to massive buy and sell orders.

Consistent losses do not always mean that the reverse trade will work. The net losses may be less than the total transaction costs; therefore, the opposite action may show even larger losses. The successful reverse system is one where the systematic losses far exceed the transaction costs.

Simple or Complex?

It is not necessary to create or acquire a system that is exceptionally complex in order to be successful. Simple systems, such as a dual moving average crossover, can be profitable as well. The difference between the performance of a simple system and a well-developed complex method is the return-to-risk ratio and the magnitude of the equity swings.

Simple systems will catch the trends and take as much profit from the big moves as the more sophisticated approaches. It is the different markets that make distinctions. Added features should reduce the losses during nontrending periods. This may be accomplished by identifying a trading range, using positions of varying size, applying a volatility filter, or by including economic data in the analysis. If a more complex system does not improve the return-to-risk ratio, giving more profit for the same risk, then a simple system is a better choice. Setting aside larger reserves using the simple system will reduce exposure to absolute levels of risk.

Just Because It Doesn't Work in Practice Doesn't Mean It Won't Work in Theory

You think you followed robust procedures for developing and testing the strategy and yet, when trading started, the equity was nearly straight down. What happened? The most likely answer is that those procedures were not followed as carefully as you thought. The key steps were:

1. Begin with a sound premise.
2. Precisely define the rules and calculations.
3. Test with sufficient data to include a wide sample of patterns.
4. Fund the account with enough money to survive a drawdown greater than any seen during testing.
5. Create a diversified portfolio.
6. Trade every signal.

If these steps were followed carefully and correctly, then the current equity drawdown should not be greater than the historic profile. However, a drawdown should not test the maximum loss more than a few times during an interval equal to the test period. If 10 years were tested, then it would be reasonable to expect a large drawdown every 2 or 3 years. The chance of that drawdown occurring right at the beginning of trading is cause for concern. It is possible that the program is

fine; however, it's more likely that something is wrong. Stop trading, or scale back to a very small position, and find the problem.

When trying to find what went wrong, you must assume that one or more of the procedures was done incorrectly.

Did you make assumptions? When the initial premise was verified, was it done with selected data, representing markets that were most likely to be successful? It may work during a particular type of market, but fail during other times. These other times may outnumber the profitable patterns. The computer should be used to test a continuous period and to avoid selective testing. Shortcuts lead to incorrect answers.

Ignoring a few large losses. Long-Term Capital made the mistake of rationalizing a few large losses, convincing themselves that the combination of events that caused the largest equity drawdowns during historic testing would not occur again. If those losses were removed, then the expected risk was much lower, trading could be leveraged, and profits would be increased proportionally. They were right and wrong. The same events did not happen again, but different circumstances resulted in losses just as large. Because of their high leverage and massive positions, they shook the entire financial system when they fell. If anything, history does not show enough risk. The increased correlation between markets, and greater participation, will result in faster, larger, and more volatile price swings with less protection from diversification. Large historic losses should not be ignored, but accepted as a likely but infrequent event. There is more about this important problem in the next section, "Price Shocks."

Misjudging market volatility. If the year was 1996 and the equity markets were moving steadily higher, a newly developed system trading the S&P or Nasdaq 100 could be very profitable. As time advances towards 2000, the system continues to perform in the same bull market, but volatility increases significantly. If the system trades the same number of Nasdaq contracts in 2000 as it did in 1996, then it is exposed to 6 times the volatility as prices moved from 600 to 4,000. Individual trade risk must account for changing volatility by varying the stop-loss and even the position size. In a diversified portfolio that included soybeans and Nasdaq futures, soybeans remained within a narrow range of volatility, while Nasdaq volatility kept growing. Did the historic tests account for this dramatic imbalance over time?

Failing to recognize an evolving marketplace. Not only will volatility increase with price, but price patterns will change with growing market participation. Increased volume from a broad set of participants introduces more noise into short-term price movement. Economic policy still creates the major trends; however, theoretical market efficiency does not stop the increase in erratic price movement caused by large and small traders acting with similar or opposite strategies. The net effect is that a trend system will take longer to recognize a trend change. It will enter later and exit later, resulting in a reduction in net profits. Over a long test interval, this will show a noticeable decay in performance.

Start Slowly

After paper trading, begin trading with an exceptionally small portfolio, one that reflects the shape of the full portfolio, but at the minimum level. There must be a chance to see if the system performs the way it appeared in testing. This will be the first opportunity to find if the estimate of transaction costs is correct. Slippage may be the factor that separates profits from losses. One conclusion may be that during quiet periods, when the market is moving sideways, there is small slippage but no profits; during a fast market, when you expect the largest profits, the slippage also increases. The size and frequency of the losses should be checked as well as the equity cycle. When everything passes inspection, the investment can be increased slowly. Patience and thoroughness are important ingredients for success.

Once the system has been checked out, it is a good policy to turn the day-to-day executions over to someone else. It may be the only certain way to follow the rules precisely. Try to stay detached and objective but monitor the results carefully to be sure there are no suprises. Even a large profit may be an early warning of a problem. Large losses often follow large profits.

[1]Robert Townsend, *Up the Organization* (Knopf, NY, 1970, p. 36).

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PRICE SHOCKS

Price shocks are the most likely reason for catastrophic loss. Athough very large price shock are infrequent events, experiencing only one is enough. Price shocks cause the largest gap between expectations (formed by historic testing) and real trading results.

A *price shock* is an unexpected event and the largest price shocks are unpredictable. Exceptionally volatile price moves, smaller price shocks, are caused by actual news that differs from expectations, such as the Fed raising rates by ½% when only ¼% was anticipated, or unemployment rising when it was expected to fall. But the largest price shocks are unexpected events with global impact, such as the terrorist attack of 9/11/2001. A significant unexpected political event, such as the abduction of Gorbachev in 1991, caused havoc in the foreign exchange markets for 3 days. The key word to remember is "unexpected."

Money Moves the Markets, Not Fundamentals

As technology has made communication instantaneous, everyone seems to know of a price shock at the same time. The world watched while the second airplane flew into the World Trade Center. Markets plummeted until trading was halted in the United States. Drops in the S&P 500 were mirrored in the equity markets of every country.

During a price shock, diversification is ineffective. Markets all move together or all reverse together. While the equity markets dropped, fixed income prices skyrocketed in a *flight to safety*. Both of those price moves are easily explained. However, other markets, such as soybeans and cocoa, uniformly reverse direction because of large-scale liquidation. The fundamentals are no longer important, only cashing out of all positions. It is the money that moves the market during a price shock. Markets that are entirely unrelated to the events will become volatile in what appears to be a sympathetic move. This usually compounds the trading risk while it presents great opportunities for profits after the price shock has been fully absorbed.

Fooling Yourself with Hindsight

If an event was expected then it would not cause a price change; therefore, no one can profit from a price shock by clever planning, but only by luck. We can never assume that an open trade would be on the right side of a price shock in more than 50% of those events, and it may be far fewer. Unfortunately, back-testing a trading system using historic data does not attempt to identify price shocks, but treats them as normal, everyday events. The final selection is often the parameter values that produced the best returns or return ratio, without concern about specific profits that may have been the result of shocks. Regardless of the way the best performance was judged—higher profits, lower risk, least sensitive, or a combination of statistical values—you can be sure that selection has been the greatest beneficiary of these unpredictable price shocks.

While there are no other alternatives for validating a proposed trading strategy, back-testing is weakest because of its handling of price shocks. Four important prices shocks since 1990 were:

1. *The abduction of Gorbachev*. A particularly difficult price shock on August 16, 1991, was followed by an opposite shock two days later. Russian Premier Gorbachev was abducted and then surprisingly released (see Figure 22.1). European currencies dropped sharply against the dollar because of anticipated disruption of Russian trade. Most financial markets were affected at the same time, as were the energy markets. Many currency traders profited from this shock because they were holding short positions over the weekend when Gorbachev was abducted on a Sunday. They continued to hold shorts looking for a further decline, then gave back their profits when prices abruptly reversed on Wednesday.

2. *Labour's victory in the British election, January 1992*. Politics holds many surprises, but the victory of the Labour party in 1992 was unexpected (see Figure 22.2). After a 2-month uptrend, prices gapped lower and posted a daily range of nearly £10, close to 6%. The low was made on the fifth day after the election results and was followed by a 3-week recovery that retraced 90% of the fall. Unlike the Gorbachev abduction, this price shock had limited effect on other markets.

3. *The Gulf War, August 1991 through January 1992*. Oil prices are notorious for volatility, but the Gulf War marked a period of unprecedented price shocks driven by news (Figure 22.3). But not all news is a complete surprise. In the agricultural markets, a crop freeze in orange juice or coffee is often anticipated by a change in weather. Before a freeze can occur, the temperature must drop, and below freezing temperatures must be sustained in order to cause damage. This weather change causes processors to protect themselves by buying forward contracts or futures. In turn, prices move up in anticipation of problems.

   Because Iraq had been moving troops near the Kuwait border, their intentions were not a surprise. In Figure 22-3 prices were rising from the second week of July as news of Iraq's plans circulated in the marketplace. The threat of an oil supply disruption, and a failing diplomatic solution resulted in a rise of $4 higher, or 28%. Therefore, many systematic traders and commercials would have been long on August 7, 1990, when Iraq invaded Kuwait. During the next months, oil prices show a number of gaps and wide-ranging days, fueled by news and uncertainty. The most dramatic price shock was on the day of the U.S. invasion of Kuwait, January 17, 1991. Futures prices opened near their high of $30.80/bbl and by the close of trading had fallen to $20.50. The first cash trade in oil, after the invasion was know, traded hands at about $40/bbl. Preceding the U.S. invasion, oil prices were exceptionally volatile but showed an upwards trend. There are essentially no trend systems that would have been able to hold a short position ahead of the $10 drop in futures prices; therefore, the size of the position held in energy should have been very small due to the potential risk, measured either by volatility or price level.

4. *The terrorist attack on September 11, 2001*. This generation will remember where they were on 9/11, just as the last generation remembers where they were when John F. Kennedy was assassinated. In an unprecedented move by the exchanges, all trades done in the morning before the attack

were cancelled. After a close on September 10 of 1101.4, prices of futures opened 6 days later on September 17 at 1041.4, 5.4% lower, posting the low for the move of 939.0 on September 21, after 5 days of steady declines.

Figure 22.1: The Gorbachev abduction caused a double price shock, with most impact on the European currencies, such as the US$/German mark. *Source*—Chart created with TradeStation® by Omega Research, Inc.

Figure 22.2: Labour's victory in the British election of 1992 represent a more more common shock. *Source*—Chart created with TradeStation® by Omega Research, Inc.

Figure 22.3: Crude oil prices from Iraq's invasion of Kuwait through the beginning of the Gulf War, August 1990—February 1991. *Source*—Chart created with TradeStation® by Omega Research, Inc.

Figure 22.4: The price shock of 9/11/2001.

The price shock of 9/11 favored the trend. The two months prior to 9/11 show an increasing bearish move, with the last two weeks steadily declining. The shock itself, the difference between the close of 9/11 and the open of 9/17 was not as severe as the other examples. The surprising 42-point rally on September 28 may have produced more losses than the actual price shock for systematic traders. The steady rise that followed during the next few months is similar to the recovery after the October 1987 plunge. Traders see the extreme lows as the farthest prices can be pushed and most sentiment

turns to the other direction.

The common elements in the four examples are:

- *Some price shocks favor the trend trader and others do not*. The British election and the U.S. invasion of Kuwait caused prices to change direction. The Iraq invasion of Kuwait and 9/11 favored current trend positions. The Gorbachev abduction was good on one day and bad two days later, or just the opposite, depending on your position.

- *Prices change direction after the shock has been absorbed into the market*. A price shock pushes prices to an extreme, and after the market has absorbed that move it is most likely to move in the other direction for a longer period. If a trading account was capitalized adequately to absorb these shocks, a crisis management strategy may be able to recover much of the loss or even net profits from the price moves.

Identifying Price Shocks

If we can't predict price shocks, and they seriously impact our historic tests, then we must identify those shocks so that we can correct for their effects. It may be necessary to look at the individual trades and compare them against a list of price shocks, which was prepared in advance, deciding which of the profits were realistic. More important, some of the price shocks that produced profits must be treated as losses in order to show the correct risk of trading. Profits from price shocks always understate the risk of a strategy. There may not be a systematic way of selecting which price shocks should be profitable and which were losers; however, the combined results of all price shocks should favor net losses and slightly higher risk. It may always be necessary to manually review the results for credibility. It is comforting to know that the computer may not yet be able to do everything; there is still room for common sense.

The process of identifying price shocks can be accelerated with a small amount of automation. A price shock will be defined as a day in which the true range was greater than the average true range by a multiplier, called the *shock factor*. This would be coded in TradeStation as

```
shock = 0;
truerange = high - low;
if high - close[1] > truerange then truerange = high - close[1];
if close[1] - low > truerange then truerange = close[1] - low;
volatility = average(truerange[1],vperiod);
if truerange > volatility*shockfactor then shock = truerange;
```

Current volatility is defined as the true range calculated over period *vperiod*. The current day, which is being tested for a price shock, is not included in the volatility measurement.

Once the larger price shocks have been identified, they should be transferred to a list or log that includes the date they occurred and the size of the initial shock. It might also be useful to count the number of days until prices return to a relatively normal level of volatility. It may be unrealistic to assume that the volatility resulting from a price shock will completely disappear; therefore, the point where the market may be considered normal may be when volatility declines to one-half the level of the initial price shock. This would be found using the code

```
if truerange < shock/2 then shock = 0;
```

With this simple method of identifying both the beginning and end of a price shock, it, becomes easier to study the effects of price shocks on testing performance. It can also become an integral part of the trading strategy. A simple test was performed in which an optimized trend system was inspected for periods of price shocks, where a shock was defined as a price move of 3 times normal volatility. The profits and losses from these periods were removed from the net performance of a 10-year period, with the results shown in Table 22.1. The reduction in profits for most markets was more than 50% when price shocks were eliminated. This means that the selection of parameters heavily favored profits that were generated by large, probably unpredictable, price jumps.

Table 22.1: Results of Removing Price Shocks from 10-Year Historic Performance

Open table as spreadsheet

	Trend System	Adjusted for Shocks	Percent Change
Crude Oil	17.12	7.88	-52
U.S. Treasury bonds	9.85	4.21	-57
German mark	14.92	5.97	-60
British pound	20.56	10.85	-47
S&P 500	-3.50	-4.25	-21

How can these results be used if we cannot see the price shock until after it has happened? First, the parameter value selection and the profile of performance is correct. Selection of values based on which ones profited most from price shocks will not be a good choice. Altering the results to adjust for price shocks will provide a much more realistic view.

Crisis Management

One aspect of crisis management is having sufficient financial reserves to survive an extreme, correlated price reversal, if not a worst-case scenario. For most trading programs, holding enough reserves aside to weather a worst-case scenario will lower the annualized rate of returns to a level below the return on government bonds. Nevertheless, the potential for a large loss is real and must be taken into account.

In the previous examples of well-known price shocks, prices reversed direction within a few days and continued in that direction for some time. The strategy that evolves is

1. If there is a windfall profit from the price shock, exit the position.

2. If there is a large loss from the position, hold the position expecting a reversal. This may take a few days and may increase the risk.

3. If there are adequate reserves, the position can be increased on peak volume or when volatility declines at a later point.

Holding a position during a price shock seems very risky; however, the trade has already seen most of the risk by the time the first order to exit could be placed. The increased risk from holding the trade for a few days is small in proportion. During Gorbachev's abduction, a short position should have been liquidated, getting the low price, while a long position would have begun its recovery immediately, reaching new high profits 13 days later. The British election had two legs down and only recovered to unchanged after 3 weeks. During the U.S. invasion of Kuwait, a long position, liquidated immediately, would have been highly profitable; a short position held for only a few hours more would have been even more profitable. Shorts held on 9/11 should have been liquidated immediately, even though they would not have captured the full profits, but longs would have suffered additional losses for the next 5 days. All of these situations require careful monitoring, but all have the same characteristic that the shock of the news carries prices to extreme levels, followed by a substantial reversal.

System Disconnect During a Crisis

A large price shock can create a disconnect between a trading system and the market. This is particularly true for trending methods. During 1987, the stock market began an accelerated decline in mid-October, leading to a 2-day drop of large proportion on very high volatility and confirmed by a peak in volume. Figure 22.5 shows how a 50-, 100-, and 200-day moving average reacted to that move. All three moving averages turned down on the day of the largest drop, and following a trend signal to sell would have captured the lowest price of the move. Switching to crisis management rules, where shorts are liquidated and longs are held, would have been a far better strategy.

Figure 22.5: S&P 500 futures. Moving average trendlines become out-of-phase during a crisis.

Equally important is the direction of the price movement compared to the direction of the three trendlines after the low price. The fastest, 50-day moving average turned down, crossing the prices that were moving higher in mid-December, and finally turning up in late December. The 100-day moving average turned up in the following March, and the benchmark 200-day moving average turned up in August of 1998. It seems clear that these moving averages are out-of-phase with the price movement after the shock. The moving averages are not reflecting the market trend; they are catching up to an event long past. Dogmatically holding a short position from mid-October onwards because the trendline is down puts the trader out-of-phase with reality.

Crisis management must be invoked to correct unusual situations that are not handled by the main strategy. These events can be identified using a technical measure of a price shock. The new rules can be well-defined in advance or they can be handled by a team of competent managers. They must recognize that, as in the Crash of 1987, the trendlines are no longer useful. Once the extreme period has passed, which can be determined by a drop in volatility, the trends can be reinitialized at the new price levels and follow prices higher.

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GAMBLING TECHNIQUES—THE THEORY OF RUNS

The application of gambling theory to highly leveraged or short-term trading satisfies two important conditions. First, it presumes no statistical advantage in the occurrence of profits and losses but concerns itself instead with the probable patterns. Each up or down price move, and each trading profit or loss, could be treated as an occurrence of red or black in roulette. Second, gambling theory stresses money management under adverse conditions. A successful professional gambler and an active trader must be highly disciplined and conserve capital. This section will look at a gambler's approach to money management and risk, using the *Theory of Runs*.

If the assumption is made that the profit or loss of each trade is unrelated to the previous trade, or that each successive price has an equal chance of going up or down, the situation closely resembles roulette. In Monte Carlo, the roulette wheel has 37 compartments: 18 black, 18 red, and 1 white, assuring a loss of 2.7% in the same way that transaction costs are a handicap to trading. Continuously betting on only red or black will break even, less 2.7%, over long betting periods. The only way to change the odds is by money management—varying the size of the bets. Although the variables in trading are more complex, we will look at this first.

The most well-known method for winning in a gambling situation is based on the probability of successive wins, the Theory of Runs. On each spin of the wheel, the likelihood of the same color (red or black) reoccurring is 50%, or ½ (ignoring the white slot). In order to define a run of 3 reds, it is necessary to show a black on each side, that is,

Black—Red—Red—Red—Black

otherwise the run may not be complete. If each color has a 50% chance of occurring, the probability of a run of 3 is

$$\frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \left(\frac{1}{2}\right)^5$$

One run of 3 can be expected for every 32 spins of the wheel (called *coups*). Extending that to runs of *n* consecutive reds gives $(1/2)^{n+2}$. For 256 coups, which is both a power of two and the approximate number of trading days in a year (if you consider daily closing prices rather than intraday trades), there are the following possibilities for runs of red:

Open table as spreadsheet

Run of Length	Probability of Occurrence	Expected Number of Occurrences	Total Appearances of Red
1	⅛	32	32
2	1/16	16	32
3	1/32	8	24
4	1/64	4	16
5	1/128	2	10
6	1/256	1	6

			Total appearances: 120

A run of greater than 6 is not expected to occur. Notice, however, that the total appearances of red is only 120, short by 8. These 8 appearances could increase any of the runs from 1 through 6, or become a run of 7 or 8. The likelihood of a run greater than 6 is calculated using a geometric progression to get the sum of all probabilities greater than 6, or $(1/2)^{n+2}$, where $256 = n = 7$:

$$P = (1/2)^9 + (1/2)^{10} + \cdots + (1/2)^{256}$$
$$= \frac{(1/2)^9}{1-(1/2)} = \frac{1}{256}$$

There is a single chance that there will be a run greater than 6 in 256 tries. The average length of a run greater than 6 turns out to be 8, based on the decreasing probability of occurrences of longer runs. The average length of all runs greater than n will be $n + 2$. That makes the table of runs complete, with the number of occurrences of red equal to 128.

Martingales and Anti-Martingales

The classic application of the Theory of Runs is called *Martingales*. In the simple version of this approach an initial bet is doubled each time a loss occurs; whenever there is a win, the betting begins again at the initial size. To demonstrate how this works, it is necessary to use a table of uniform random numbers (which can be found in Appendix 1). These numbers vary from 0 through 9. Let all those numbers beginning with digits 0 through 4 be assigned to red and 5 through 9 to black. Figure 22.6, read left to right, where open squares are red and solid squares are black, shows the first 257 assignments according to the Appendix 1. Assuming that we bet on black, losses will depend on the longest run of red. We must decide the size of the initial bet in advance, which should be as large as possible and still withstand the longest run of red that is likely to occur. By using the results from the analysis of the length of runs, we find that for every 256 coups it is likely that only 1 run greater than 6 will occur, and that run would most probably be 8 in length. The probability of a run of 9 is $(1/2)^{11}$, or one in 1024. In 256 coups, the odds are about 3 to 1 against a run of 9 occurring.

Figure 22.6: Sequence of random numbers representing occurrences of red and black.

Having decided that capitalization must withstand a run of 8, we calculate that a bet of $1 doubled 8 times is $128. Divide the maximum amount of money to be risked by 128 and the result is the size of the initial bet. Each $1,000 divided by 128

gives $7.8125, which must be rounded down to $7; therefore, on the eighth consecutive occurrence of red, the bet will be $897. Counting the occurrences of runs on the simulated roulette table (Table 22.2), it is interesting to see that a run of 8 (but not 7) appears.

Table 22.2: Simulated Runs

Open table as spreadsheet

Red	Black
35 runs of 1	35 runs of 1
12 runs of 2	14 runs of 2
7 runs of 3	11 runs of 3
7 runs of 4	3 runs of 4
2 runs of 5	2 runs of 5
2 runs of 6	
1 run of 8	
138 total occurrences	118 total occurrences

The results are within expectations, and no runs greater than 8 occurred in either red or black. For the purposes of this example, the betting would then proceed as shown in Figure 22.7, using an initial bet of $1. The numbers in the squares represent winning bets. Every occurrence of black is a winner. Although $64 is actually won on a single black coup, each sequence of runs nets only the initial bet because of the accumulated losses during that sequence. For the 256 coups shown in Table 22.2, there were a total of 65 distinct runs resulting in a profit of $65 (or $455 based on a $7 initial bet), or about half of the initial capitalization ($128 or $1000, respectively). Instead of using Martingales, if we had used the benchmark strategy of betting equal amounts on black to win on every coup, we would have lost $20 on a $1 bet. The Martingales method therefore has a good chance of winning a moderate amount.[2] In a casino, the drawback is the occasional run of 9, where the size of the bet exceeds the maximum bet for the table.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1	2	4	8	16	1	1	1	2	1	2	4	8	16	32
2	1	2	1	2	1	1	2	1	2	4	8	1	1	1	2
3	4	8	16	32	64	1	2	1	2	4	8	1	1	1	2
4	4	8	1	2	4	1	1	1	2	1	2	1	2	4	8
5	16	1	2	1	1	2	4	1	1	1	1	1	2	1	2

Figure 22.7: Betting pattern.

Anti-Martingales

The *anti-Martingales* approach offers a smaller chance of winning a large amount; it is exactly the opposite of applying Martingales. Instead of doubling each losing bet, the winners are doubled until a goal is reached. Because there is an excellent chance of 1 run of 6 in 256 coups and a similar chance of a longer run, this method wins if the long run occurs in the first half of the number of coups to be played (256 in this case). Once a run of 6 occurs you must immediately stop playing.

We already know that a run of 6 returns $32 on a bet of $1, and a run of 8 nets $128. This method would have lost if it had been applied to black in the test sequence; because there were 138 red coups with no black runs greater than 5, there would have been a loss of $138. If the bet had been on red, looking for a run of 6, there would have been three wins, each for $94, and a loss of $118 for that many appearances of black. Waiting for a run of 8 would have won $128 and lost $117 on black by stopping right after the win. The success of anti-Martingales depends on how soon the long run appears. In 4,096 coups, a run of 11 will occur once, returning $1,024 on a bet of $1. In the same 4,096 spins, there will be 2,048 losses, showing that if the long run happens in the middle of play, the method breaks even; if it occurs sooner, you win.

The Theory of Runs Applied to Trading

Before applying either Martingales or anti-Martingales to the markets, it must be determined whether the movement of prices up or down is as uniform as in roulette. A simple test was performed on 21 diverse futures markets and the combined results of all up and down runs are shown in Table 22.3. The expected occurrences of both up and down were twice the probability of either a red or black coup occurring.

Table 22.3: Expected Occurrences of Ups and Downs for a Diverse Set of Markets

Open table as spreadsheet

Length of Run	Expected Probability of Occurrence	21 Markets Combined	
		Expected	Actual
1	½	1,225	1,214
2	¼	612	620
3	⅛	306	311
4	1/16	153	167
5	1/32	77	67
6	1/64	38	41
7	1/128	19	16
8	1/256	10	5
9	1/512	5	3
=10	1/1,024	4	5
Total tested			2,449

Some differences between the random pattern previously used and actual results can be seen in Table 22.3. The random pattern is shown in the column *Expected*. These futures markets show fewer runs of one and more frequent runs of two; their tendency to fluctuate in a narrowing pattern around the expected (random) length of a run (Figure 22.8) may be due to the smaller sample of longer runs. The probabilities found here might be used to decide the chances of the next trading day continuing in the direction of the prior day's trend, noting that a 3- to 4-day run is as long as might be expected. The most interesting applications are in the betting strategies of the Martingales and anti-Martingales methods, applied to futures markets. The following sections show two possibilities.

Figure 22.8: Actual futures movement compared to random movement.

Trading Daily Sequences

By combining the Theory of Runs with the direction of the trend, the chances of being on the correct side of the longest run are increased, and the size of the price move in the direction of the trend may also tend to be larger. Long-term trends will offer the best chance of identifying the direction of prices. Assuming that the trend is up, as determined from a chart or moving average, enter a long position on the close of a day in which the price moves lower.

If Martingales is used, double the position each day that prices move adversely. A single day in which prices move up should recoup all losses and net a reasonable profit, equal to the average daily price change. If the trend is sustained, there should be fewer days down and more days up, thereby yielding a better return ratio than expected by a random distribution. A variation on Martingales might include holding the trade for 2 consecutive days in the profitable direction, based on the bias shown in the distribution of runs. Another variation would take profits while prices are moving in a favorable direction and set new trend positions after 1 or even 2days of price reversal. Either variation might improve the return ratio compared to a random occurrence of runs.

For the anti-Martingales approach, double the position after each profitable day, take profits after runs of 3, and begin again after a reversal day. By trading with the trend, profit sequences may be increased to 4 days; it may also be expected that, on average, the price change will be smaller on days that move counter to the trend.

System Trading

A standard trend-following system can expect 30–40% successful trades (called its *reliability*) of varying profitability, which can be defined in terms of a profit/loss ratio. In considering the Martingales and anti-Martingales methods, it should be noted that the lower probability of profitable trades would make the wait for a long run of profits less attractive. If a system has a profile of 35% successful trades and a profit/loss ratio of 3:1, $750 each profit and $250 each loss, then trading equal amounts on each signal would result in the following:

Total trades	100 × $ 25 (commission) =	$ -2,500
Profitable trades	35 × $750 =	26,250
Losing trades	65 × $250 =	-16,250
Net ($75 per trade)		$ 7,500

Taking these same figures and applying Martingales to a uniform sequence of 2 losses and 1 profit gives $275 as the first loss ($250 plus a $25 commission), $550 for the second loss, then a $2,175 for the profit, netting $1,375 for three trades, which would return $229 per contract traded.

The disadvantage of applying Martingales to the irregular returns of high-leverage markets is that a long run of losing trades requires a large amount of capital. If it is necessary to keep a large reserve in the event of a long run of losses, why not simply trade a larger, equal-size position on each signal without using Martingales? A sound trading strategy should differ from a pure gambling situation because a specific system will win in the long term, while you will lose at roulette. The results show that trading the same larger position on each signal will return a higher profit than an application of Martingales using the same investment size; however, a less aggressive betting method that assumes favorable odds can improve the return on investment.

In another study of appying Martingales, an actual trading system based on Wilder's RSI was used to create buy and sell signals.[3] During the test, a total of 277 contracts was needed at one point, which is far beyond the realm of the normal speculator. That means an investment of 277 times the initial margin, plus any accumulated loss, just to recover one unit of your initial margin! It should not be surprising that the risk-to-reward ratio of this betting method was found to be unacceptably large.

Complex Martingales

The simple Martingales discussed do not present an attractive way of managing risk; however, a slightly more complex form is far more practical and has very different results. Instead of doubling the bet each time there is a loss, as in the case of simple Martingales, increase the bet by a smaller amount, for example 40%.[4] This slows down the accumulation process and avoids the risk of ruin, or table limits. You may even choose to divide one bet into more than one, so that a situation where you would trade 8 units may be traded at two places, each with 4 units. You must simply remember to stop the sequence and begin again when your profits have exceeded your losses. In the following example, each loss is followed by increasing the bet by an equal amount. When a profit occurs, the bet size is reduced by one unit and the sequence ends when there is a net profit. Profits and losses are equal to the bet size.

In Example 1, it was necessary to win twice in order to realize a profit the size of the original investment; however, that profit could be achieved with 40% winning trades and 60% losing trades.

Example 1: Equal Size Bets with Equal Payoff

Open table as spreadsheet

Bet	Amount	Result	Net Profit or Loss
# 1	$ 500	Loss	$ -500
# 2	1,000	Loss	-1,500
# 3	1,500	Loss	-3,000
# 4	2,000	Profit	-1,000
# 5	1,500	Profit	500

Applying this strategy to a more realistic trading profile, consider a system with an average loss of $1,000, an average profit of $2,000 and a win-to-loss ratio of 1 to 3. This means that there are 2 losses and 1 profit in every 3 trades, and a net system result of zero, equivalent to a gambling situation. Example 2 shows another sequence of trades. Even though there are 3 losses to start, a single win nets a profit for the sequence.

Example 2: Equal Size Bets with a Trading System Profile

Open table as spreadsheet

Bet	No. of Units Bet	Result	Net Profit or Loss
# 1	1	Loss	$-1,000
# 2	2	Loss	-3,000
# 3	3	Loss	-6,000
# 4	4	Profit	-2,000

When applying a more complex form to reverse Martingales, it is best to target sequences of profitable runs that are likely to occur with reasonable frequency. Instead of betting the entire accumulated profit on the next trade, bet a fixed percentage of those profits. Alternatively, if you are looking for profitable runs of 4 remove the amount of the initial bet from the total bet after the system has returned two profits in sequence. This tends to conserve capital but slows down the process.

Delayed Countertrend Entry into a Run

Rather than entering on the first down day in an uptrend, waiting until prices posted two or three lower closes should increase the chances of a move back in the trend direction. Although there are fewer opportunities because a run of 3 in a particular direction will only occur 12.5% of the time, the chances of a continued move in the same direction quickly become smaller.

There has always been conflicting interpretation about the chances of a continued price move following a series of moves in that direction. In a purely random event, there is always a 50% chance of prices moving in either direction; however, the market is not a random event, and behavioral finance advocates will argue that there is enough predictability to be profitable. This premise can be substantiated by measuring the distribution and size of the average up and down moves within a long-term trend.

Gustafson[5] studied the S&P from 1988 to 1995 and created a trading strategy that entered a long position after prices closed lower 4 days in a row, exited after an upwards run of 5 days, and always exited after 8 days. Admittedly, this takes advantage of the upwards bias in the stock market, which was particularly strong in the mid- and late-1990s. The results for the in-sample period was 78% reliable with $35,030 profit and a $5,847 maximum drawdown. Applying this to data from 1982 through mid-2001, the results showed 76% reliability, profits of $348,460, and a drawdown of $56,370, showing that this pattern was successful out-of-sample. The TradeStation code for this method is

```
If close > close[1] then closeup = closeup + 1 else closeup = 0;
If close < close[1] then closedown = closedown + 1 else closedown = 0;
If closedown = 4 then buy next bar at open;
If closeup = 5 then exitlong next bar at market;
If barssinceentry = 8 then exitlong next bar at market;
```

[2]The Martingales approach is likely to work if the player could withstand adverse runs of 11, but casinos tend to limit bets to amounts significantly less than 2^{10} times the minimum bet.

[3]Roger Altman, "Tactical Trading Revisited," *Technical Analysis of Stocks & Commodities* (September 1993).

[4]James William Furguson, "Martingales," *Technical Analsyis of Stocks & Commodities* (February 1990), and "Reverse Martingales," *Technical Analysis of Stocks & Commodities* (March 1990).

[5]Gordon Gustafson, "Price Persistency," *Technical Analysis of Stocks & Commodities* (January 2002).

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SELECTIVE TRADING

It may be unrealistic to think that you can always follow a technical, fully automatic system without manual intervention. Overriding system signals may occur for reasons of sound risk management during a crisis when you decide that the system is not programmed to deal with the current volatility, that a more conservative action is the best business policy, or that the market has temporarily disconnected from the strategy.

The beginning system trader often has concerns that the impersonal buy and sell orders will not react properly to the underlying forces that are driving prices. This can cause the trader to override the system signals. For example, if the program is geared to take profits after a move of 2%, the trader might judge that the current price move is going to continue; therefore, he will hold the trade rather than take profits. The application of this special *intuitive* filter generally favors holding a position through ups and downs until it shows a profit, rather than applying consistenly good risk management. Judgment tends to interpret all news in favor of the position being held until it shows a profit. A trader who will survive must learn not to take a loss personally, to keep losses small, to establish and stay with a trading plan, and to filter out unsupported opinions. Trading is a business, and business principles must take precedence over emotional reactions.

Filtering Out the Losing Trades

Technical systems can be taken to extremes in an effort to automatically select only profitable trades. Two approaches to this are most common. The use of more than one trend indicator, such as two moving averages, is one method of isolating a segment of price movement that may have better performance than a longer, more variable interval. Then a third trend can be applied to improve the timing of the first two, and a fourth trend to restrict trading to that small piece of price movement that is highly consistent. As you become more and more selective, the number of trading opportunities disappear, and the system becomes overfitted to the few remaining trades. There are many logical filters, such as avoiding extremely high or low volatility, that address issues of risk; however, there is no way to filter out all the losing trades and leave only the profitable ones.

There are many trading systems that can be bought that promise profits. Those that do not disclose their rules are called a *black box*. Trying to incorporate a black-box approach to improve the performance of your own program is not a good idea. Without knowing everything about the other system, there may be inadvertent duplication techniques—a fast trend, a three-day cycle, or a calculated increase in position size. Although a correlation analysis of the black-box approach and your system may show that the methods work well together, there are still too many uncertainties. The unknown system may have been overfitted and will not show its real risk, or it may have a particular weakness to a market pattern that has not occurred during your testing period. You must understand every method that you trade, know how the parameter values were selected, and verify its results. It's your risk.

Diverse Building Blocks

The best way to create a successful trading system is to look for unique elements, each with a sound basis, and combine them one at a time, testing each to be sure they successfully stand on their own. The selection of a trend speed will be more important than either the smoothing technique or the number of trends to be used. There may be an advantage to the double moving average approach, but a third, fourth, and so on, lose their significance. A momentum indicator bears a close resemblance to a moving average when its rules are to buy or sell in the direction of the price move, especially when it crosses the zero line, the point of inflection. Both have great similarities and will not offer much diversification when applied to the same data. Each system building block should be fundamentally different. A technique such as a breakout method that does not depend on time would be a sensible complement to an MACD oscillator, which is driven by time. The more complicated cycle and wave theories, contrary opinion, and other methods all view price movement in a completely different way than a moving average, even when applied to the same data. The same moving averages may make the most sense when you apply the same period to different types of data, such as volume and open interest, or

compare two related series, such as Swiss franc and euro exchange rates.

Filtering is a tool not restricted to price analysis, but applicable to money management, reliability, risk, portfolio selection, and other aspects of a trading program. Selecting which markets to trade and how much of the investment to allocate is as important as the buy and sell signals. If the system itself corrects for high volatility markets by decreasing the distance of the stop-loss point (keeping the risk constant), it would be a duplication to trade fewer positions of that market, thereby reducing the effects of profits or losses relative to other items in a portfolio.

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SYSTEM TRADE-OFFS

Although traders are continually searching for a system that has no losses, they are realistic enough to know that most profit, loss, and risk decisions are dependent on one another. Just as in gambling theory, a system can be structured to have frequent small losses and occasional large profits—or frequent small profits with some large losses. It is simply not possible to create a system with such small losses that these losses are essentially zero without increasing the frequency of the losses to the point where profits rarely occur. In short-term or high-leveraged trading, the *cost of doing business*, transaction costs, prevents such an approach from working.

The basic principles of systematic trading require that the trader choose between the frequency of profits to losses, the relative size of those profits and losses, and the number of opportunities that will be available to trade. These interrelationships will be different for various types of systems.

Trend-Following Systems

The relative risks and rewards of trend-following systems are based primarily on the selection of the calculation period. Using a simple moving average system applied to closing prices, the example in Figure 22.9 shows that a faster moving average (smaller number of days in the calculation period) will stay closer to the current price than a moving average that uses a calculation period. The maximum risk is equal to the largest lag, as measured from the current price to the corresponding moving average value. Using a 5- and 10-day moving average, applied to stock prices that have moved up $1 each day for 10 days, the lag for the 5-day average would be $2.50 and the lag for the 10-day average would be $5.00. Because there is no limit on the movement of stocks, it is only possible to show that, all else being equal, trends will lag in proportion to their calculation periods. For futures markets that have daily trading limits, the maximum lag is:

$$M = P - (L \times N) / 2$$

Figure 22.9: Relative risk of a moving average system.

where P = the current closing price

L = the maximum limit move

N = the number of days in the moving average

The smaller losses of the faster trend system are kept in proportion to the profits because of the relative system sensitivity. The price changes of smaller magnitude, which cause the moving average to change direction and hold losses to a minimum, also break the sustained trends into shorter intervals. The net results are more frequent trades with relatively small losses and modest profits. Longer-term trends have fewer trades because they are less sensitive to change and remain with the prevailing price direction for a longer time. This results in larger profits and correspondingly larger losses.

The risk of a single trade being small or large is an incomplete measure of trading risk. Because there are more losses than profits in normal trend-following systems, it is important to consider the sequence of losses as part of the ultimate risk of trading. It is the aggregation of these losses that provides a reasonable comparison in determining whether a slow or fast moving average system has the best profit-to-loss ratio.

The feature of a trend system that is most appealing is the small losses relative to large profits, a technique called *conservation of capital.* This feature also causes frequent small losses during sideways markets and the number of these false signals cannot be reduced simply by using a longer-term trend. Testing will show that there is always some sideways price movement that coincides with the trendline, resulting in a high percentage of whipsaw losses. It is unrealistic to expect a smoothing technique to produce more than 40–45% profitable trades.

Mean-Reverting Systems

Mean-reverting systems are those that take advantage of nondirectional price movement, selling when prices move higher and buying when they move lower. The belief is that prices will return to the mean. The risk and reward profile of a mean-reverting method is different from that of a trend-following approach. Although the size of the profits and losses relates to the holding period of the trade in a manner similar to trend following, positions must be set in advance of an expected price reversal. This clearly introduces more risk and makes the success of the method dependent upon good timing. When mean-reverting methods are discussed here, those techniques that require a confirmation—that is, they wait until prices reverse direction—are not included. Waiting until prices turn introduces a trend element.

Due to the greater risk of a mean-reverting system, its objectives are generally well-defined. In a trend system you let the profits run until prices reverse and the trend changes dierction; however, most mean-reverting methods rely on an overbought/oversold indicator, contrary opinion, or divergence, and set goals for exiting when that condition disappears or becomes neutral. This results in a performance profile that limits profits; therefore, those profits must be more frequent. To accomplish results with limited but more frequent profits, you cannot also limit the size of the losses.

Trade-Offs

The selection of a performance profile goes together with particular trading styles. Some combinations are entirely incompatible. Ideally, you would want very large profits, high reliability, and small losses. Unfortunately, these combinations are not possible. The trade-offs that are readily available are:

1. A few large profits and frequent small losses.
2. Many small profits and a few large losses.
3. More opportunities with greater risk.
4. Fewer opportunities with less risk.

It is easy to identify the first combination with trend following. A trend system keeps taking a new position and getting reversed quickly, until a trend finally develops and the trade is held for a relatively long time and for a large profit.

In order to have fewer losses you must allow greater risk. Keeping losses small means being stopped out because of market noise rather than an underlying trend; therefore, you can expect many more losses than profits. In the case of a mean-reverting system, each move up is an opportunity to sell; the move is treated as market noise rather than as a new trend. A noisy market is one that changes direction often, and a large percentage of price changes are simply noise. As

with a normal distribution of random price changes, there are more frequent small price changes, and less frequent large changes. To profit from noise you must enter the market while prices are going in the opposite direction, as in a mean-reverting technique. This creates more risk when prices continue in that direction, developing into a trend. The sooner you enter the trade, the more opportunities, and the more often prices will move against you before reversing and becoming profitable. This causes the second profile; many small profits and a few large losses.

The last two choices, whether applied to a trend or mean-reverting strategy, are directly related to a random distribution of price changes. If you look back at the study of *runs,* you will remember that price changes exhibit a pattern very similar to random movement. For every 100 days of prices there will be 50 days in which prices reversed after only one day of up or down movement, 25 days of price movement in the same direction for two consecutive days, 12.5 days for three consecutive days, and so on. Although real price patterns may vary slightly from that distribution, they are very close. For any fixed time period these patterns remain the same, that is, there are always more opportunities for smaller moves than for larger ones. With trend following, if you use a very small price move as an indication of a new trend, there will be many signals with a very low probability of being correct. As the trend signal becomes more selective, a greater percentage of larger price moves will develop into profitable trends. Large price changes are less likely to be noise.

Mean-reverting systems are best when they seek out smaller price moves. There are more opportunities and these have a greater chance of being noise, rather than the beginning of a trend. As mentioned in the previous paragraph, entering early means holding the trade until it becomes profitable or until it has clearly become a new trend. When the trend does develop, the loss is large.

An example of mean-reverting trade-offs are shown in Figure 22.10 using a typical price oscillator. Prices are shown as sideways movement, with no trend bias. Assuming that there is a normal distribution of prices, there is a clustering near the center and less frequent peaks and valleys as prices move further away from the middle. If high values of the oscillator are treated as overbought and low values as oversold, the area above and below the center line can be divided into three zones, *slightly* (S), *moderately* (M), or *extremely* (E) overbought or oversold.

Figure 22.10: Entry point alternatives for a mean reverting strategy.

In Figure 22.10 there are more opportunities to buy a *slightly oversold* market and sell a *slightly overbought* market, the points where prices cross the innermost set of horizontal lines. Profits are taken when prices return to the mean, the center horizontal line. All prices must pass through the area closest to the center before reaching a more overbought or oversold condition; therefore, the *opportunities* must decrease as profit goals increase.

But what about the risk? If trades were entered at the *S* lines, and the *M* lines were used as a stop-loss, then almost one-half the trades would be stopped out, and the size of the losses would equal the size of the profits. Because price changes are not normally distributed, there are actually few losses than profits using this method; however, the net returns would not be impressive. If the entry were at the *S* lines and the exit at the *Stop* lines, then most trades would be profitable, but the losing trades would be large. The net of profits and losses would be much better because relatively few trades reach the stop. If trades are entered at the *E* lines and exited at the *Stop* lines, then profits would be larger than losses, risk greatly reduced. However, there would be very few opportunities and a larger percentage of them would be stopped out. Theoretically, the minimum risk occurs if a trade can be entered at the absolute extreme points. Figure 22.11 shows the relationships that exist for a standard mean-reversion system.

Figure 22.11: Relationship of profits to risk per trade based on opportunities.

All systems have trade-offs. In order to reduce the risk there must be more small losses or fewer opportunities—whether a trending or mean-reverting strategy. A trend-follower looking for the big move must also take a big risk and many small losses. In the development of a system or trading philosophy, each person must settle on the combination of risk, reward, and opportunity that best suits him or her. There is no *best* combination.

The Commodex Method of Combining Elements

The *Commodex* system was first presented in 1959 and is still actively run by second-generation Philip Gotthelf.[6] Commodex combines the components most acceptable to the experienced trader in a unique weighting method. It includes moving averages, price momentum, and open interest to calculate a trend index.

The most interesting aspect of the Commodex system is its ranking process, intended to produce a relative strength value for each trend. Using a 10- and 20-day double moving average, the system scores the current market performance to establish the value of the trending component. Bullish and bearish values are calculated by looking at three situations independently: the simple moving average signals derived from both the long- and short-term trends, and the double moving average signal generated by combining the two trends. The two techniques of single and double moving averages are treated exactly as covered in Chapter 8. The most important of the three factors is the long-term trend, second is the short-term trend, and last the relative position of the fast to the slow moving average. The highest-ranking upward-moving trend occurs when current prices are above both the faster and slower moving averages and the faster average is below the slower. The opposite positions would result in the strongest downward-trending component. Trends are considered neutral if the most important element, the long-term moving average, conflicts with the other two factors.

The rate of change in open interest (for futures) is considered a secondary reinforcement of the trend. Using a concept different from the usual charting techniques, Commodex considers it a bullish sign if there is an increasing *growth momentum* in open interest combined with rising prices. The growth momentum is the difference between the rate of increase of the open interest and the 20-day moving average of the open interest. Confirming a bull move with rising prices and rising open interest is a classic concept of charting. The bear move is confirmed with rising open interest and falling prices. Commodex also considers a drop in open interest along with falling prices to be a bullish factor. The movement of volume is treated in the same manner as open interest and can confirm a bull or bear trend. An increasing volume momentum with rising prices is support of an upward move; other combinations indicate bear trends.

Added together, the signals are ranked from a *strong buy* to a *strong sell* with lesser degrees in between. The system must be given credit for the quantification and balancing of these elements, which are generally treated as highly interpretive charting techniques. The rules for applying the daily signals to trading combine both the individual strength of the signal with the movement of the Commodex trend index. The trend index itself acts as an overbought/oversold indicator, encouraging profits at specified levels and considering a position reversal in more extreme situations; stops are

placed using the 20-day moving average with predetermined band penetrations. Additional objectives are based on the profits accrued from a trade, with a 50% return justifying a protective stop on part of the positions, and a 100% profit requiring the liquidation of half the position. These money-management concepts are an important aspect of any system and tend to round out Commodex.

The Commodex system has been used as an example of combining techniques that have been studied individually in previous sections. Because it is fully systematic, applying the same elements in the same way to each market, it may have valuable application to ranking stocks. It is important to see that each element is simple to understand and avoids duplication; it has single and double moving averages (with and without bands), momentum indicators derived from volume and open interest, an overbought/oversold indicator formed from a combination of all elements, trailing stops and liquidation based on money management and inverse pyramiding.

Combining Trends and Trading Ranges

Trends and trading ranges account for most price movement; the small percentage remaining are larger price shocks and a few unidentifiable patterns. Most traders must decide whether they intend to profit from trend moves or sideways markets and then develop techniques that target that objective. A trend is concerned with the periodic tendency of prices to move in one direction without a limiting objective, and a trading range or sideways period is considered mean-reverting. Sideways markets tend to remain contained within certain price levels. The role of time is different for the two approaches. The trend is expected to advance with some regularity, as befitting a time series, while prices within a trading range can move either up or down with varying speed, provided the upper and lower bounds are not violated.

Trading ranges and trends take turns dominating price movement, with the trading range most common. Long-term trends are easy to see, as for example, the declining interest rates from 2000 to 2003, or the drop in the U.S. dollar/euro from $0.75 to $1.30. When there is no actual or anticipated change in fundamental factors, prices fluctuate in a narrow range, bounded by *support* and *resistance* levels. Relative to the average price, the top of a trading range is often higher than the bottom because of the inherently greater volatility at higher prices. Prices have broken out of their trading when they close above or below the established resistance and support lines.

It often happens that the two techniques of price trend and trading ranges are in conflict: The trend is up and a resistance level is encountered, or the downtrend is met by a support level. Established support and resistance levels cannot be ignored; neither can a major trend. It makes sense to combine both features. The simplest way is to use the trading range while prices are within that area and follow the trend when prices break out either above or below (Figure 22.12).

Figure 22.12: Combining trends and trading ranges.

The exact rules for combining the two techniques depend on the size of the trading range, the speed of the trend, and whether the support and resistance levels have been established over time. Recent range formations offer less of an

obstacle than those that have survived for some time. If the range is narrow, a moving average buy or sell signal invariably occurs at the resistance or support level and is met with an initial reversal. For a larger range, a medium-speed moving average signal may occur closer to the center of the range and allow some opportunity for trend profit before resistance is encountered. For very wide ranges, there may be ample latitude for a moving average to signal entry and close out without the interference of support and resistance levels. One method of combining the two techniques is to use whichever signal is generated, regardless of the system. The following combinations of short position entry and exit would be used for medium to wide ranges:

1. Enter a new short position when the moving average turns down.
2. Enter a new short position when prices enter the sell zone below the resistance level.
3. Enter a new short position when prices fall below the support area, then close out the short position when the moving average turns up.
4. Close out a short position when prices enter the buy zone above the support level.
5. Close out a short position when prices break through a resistance level moving up.

The same rules apply in reverse for long positions. The advantage of this filtering method is that new short trades are not entered at support levels, which causes immediate losses or prolonged trades of little result.

[6]More on Commodex can be found at their website, Commodex.com.

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TRADING LIMITS AND DISCONNECTED MARKETS

Trading limits are unique to futures markets; however, the same phenomenon exists when any exchange-traded market—which includes foreign exchange, fixed income, and agricultural products—is closed while the cash market is open. The two markets disconnect. It also applies to similar companies traded on the exchanges in two different countries, where one exchange is closed and the other is open because of the difference in time zones.

The purpose of limits in futures is to prevent an immediate reaction to unexpected news from moving prices to unjustifiable levels. The first reaction to bad news can be unrealistically extreme. When there is time for a proper assessment of the problem, the situation is rarely as bad as initially thought. Limits serve to give the trader, who is on the wrong side of the price move, some extra time to capitalize the position, or to meet a margin call, rather than be forced to liquidate.

When unexpected news is announced while one market is closed and the other is open, the traded market quickly moves to a higher or lower price. If you are holding the wrong position in the market that is closed, should you try to hedge that position in the open market? In other words, if a U.S. manufacturer exporting to France was long $1 million in March euros futures as of the close of trading on Friday, and the U.S. President announced on Saturday that there really was no government deficit, the dollar would turn instantly and become very strong. Although the trade had lost 10% by the time the manufacturer's Chief Financial Officer could reach the telephone, should she sell euros in the cash market or wait until the futures markets open on Monday? The following examples, compiled some years ago, still apply.

The existence of trading limits in some of the U.S. markets is always a concern of novice speculators who have nightmares about losing all their wealth by being caught on the wrong side of a locked-limit move. There is no doubt that many have suffered, but trading limits have tended to protect rather than harm them. The limits established by the exchanges were intended to allow free trading within the normal range of price fluctuation. Markets have now gone away from fixed-daily limits and have a system of suspending trading for a short period when the market locks at the current limit, then reopening with larger limits. This provides a very brief cooling-off period. Exchanges are not as concerned about the well-being of the investor as they are about their own risk. They may also follow this increased price volatility with an increase in margin.

Frequency of Limit Moves

Sugar prices, which had a spectacular rise in 1974, can serve as an extreme case of changing volatility. Beginning in 1969, Table 22.4 shows the remarkable price move in futures, seen in the frequency of limit moves. The contracts shown have no duplicate dates and do not include the actual delivery month.

Table 22.4: Frequency of Limit Moves in Sugar

Open table as spreadsheet

Futues Contract	Total Days Examined	Days Closing at Limit	Percentage of Limit Closes	Range of Closing Prices	Exchange Limits (¢/lb)
Sep 70	248	0	.0	2.91–4.01	.50
Sep 71	249	0	.0	2.74–5.08	.50
Sep 72	240	18	7.5	4.26–9.17	.50
Sep 73	239	9	3.8	5.44–10.50	.50
Sep 74	239	40	16.7	7.56–28.15	.50–2.00
Sep 75	239	54	22.6	11.51–50.82	1.00–2.00
Sep 76	238	3	1.3	12.07–18.65	1.00

The obvious conclusion to be drawn from the pattern of limit moves in the sugar market is that limits did not expand quickly enough at higher price levels. In 1975, 22.6% of all trading days closed at the limit; at low price levels, the limits were of no consequence. The 1974 price of sugar increased by 15 times its 1969 price while the limits only expanded from 50¢ to $2.00, a factor of four. Limits present a problem for a trading system because they artificially alter the volatility of the market. The consolation is that a trading system is useless in a market that is locked-limit for a week. You might find it enlightening to test your system on a market and period where limit moves were evident to see their affect on trading signals and performance.

One way of comparing the effects of limit moves against a limitless market is to compare the U.S. and London exchanges. Using the May 1977 Coffee contract during the month of February 1977, there are three separate examples of limit moves in the U.S. futures market. Figure 22.13 illustrates the closing prices of the U.S. and London markets on the same day. Two problems that must be considered are the conversion of sterling to U.S. dollars, which was fixed at $1.70 for the entire comparison, and the overlapping hours of the New York Coffee and Sugar Exchange and the London Sugar Exchange. The exchange hours may have some difference in the daily price but should not appreciably affect the comparison.

Figure 22.13: Comparing limit moves in U.S. and London coffee markets.

The first U.S. locked-limit day was on February 7, when the New York coffee prices for the May 1977 contract moved to 230.82 (up 300 points). On the same day, London prices for the May 1977 contract moved from 218.80 to 230.56 (actually

2,883 to 3,038 sterling). A trader who closed out his position on the open in the London market would have taken a fill of 2850 and a loss of 12.67 cents per pound relative to the U.S. market. Those traders locked into their New York position could have gotten out for the first time on the open of February 8 at 233.50, a loss of 568 points. Had both the U.S. and London traders waited for the closing prices as shown in Figure 22.13, the corresponding losses would have been reduced to 1,176 points in London and 318 points in New York.

The second case was on February 17 and 18 when the U.S. market stayed locked at the limit for two days. A trader entering the market in London on the prior day at 241.91 (3,187.50 sterling) could have gotten out on the next day at 247.07 (3,255.07) for a loss of 516 points. The corresponding New York trader would have entered at 246.00 and exited at 254.50 for a loss of 810 points.

Remarkably, the London coffee prices had moved to 252.04 by the time the New York market was trading again. London prices had gained 1013 points during the time that a locked-limit U.S. market gained only 850 points. In both cases, the volatility of the London market with no limits was much greater than the U.S. equivalent and the results do not show any disadvantage to trading limits.

The third case of locked-limit moves began on February 24. On the day prior to the first locked-limit day, the U.S. market traded actively even after the London Exchange moved up an equivalent of 698 points. There should have been ample time that day, or even the prior day, when the U.S. market traded at the limit but closed lower for any trader to exit an undesirable position. Figure 22.11 shows the larger moves of the London market peaking and starting down to meet the plodding U.S. prices. The market with no limits has overreacted to the bullish news by at least 1,000 points. Of course, for traders who didn't get out of New York coffee soon enough, the overreaction of the London market was not very gratifying.

Changing the Rules

Due to the frequency of locked-limit moves during the exceptional periods, and the need to keep changing them as inflation forced prices higher, most exchanges have changed the way daily trading limits are established. At one time, an exchange committee was convened to review limits; now, limits automatically expand to meet conditions. The S&P, along with some other financial markets, have *circuit breakers* that cause the market to halt when specific limits are reached. After a short pause they reopen and can trade to new levels before another circuit breaket is activated. At an extreme level, however, the S&P will also stop trading, putting it in the same situation as New York coffee versus London coffee. The years have changed but the problems remain the same.

The normal policy for agricultural markets is that, following a trading day in which prices closed at the limit, limits expand to 1½ times their initial value. They may remain at this level for 1 or 2 days, provided prices continue to close at either limit (higher or lower). Limits will then expand to twice the initial range; if a locked-limit move persists, limits are entirely removed for one day. After this, or after any day that prices do not close at the limit, the pattern begins again with the initial limit value. Occasionally, the initial value may be altered by the exchange.

Similar to Price Shocks

Limit moves are always the result of price shocks. If there is a comparable cash market open, then prices in that market should be expected to have the same pattern as coffee in Figure 22.13, or the examples shown in the section "Price Shocks," Figures 22.1 through 22.4. In most cases, prices moved quickly to their extremes, then started the slow, prolonged reversal. Given the two choices of selling the cash market to protect a long futures position following a price shock that caused a dramatic drop or buying the cash market, the best strategy is buying after a short delay. This also doubles the risk of a position that has already accumulated a large loss; therefore, the absolute size of the loss is of concern. If entered, one of the positions must be liquidated as soon as the two prices come together. In addition, there is no way of knowing how much of the loss can be recovered. The recovery is based on whether the price shock was temporary or structural. When structural, both positions should be closed out when prices meet; there is less chance of a significant rally.

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SILVER AND NASDAQ—TOO GOOD TO BE TRUE

This story of silver trading could have applied to the Nasdaq or S&P index during the late 1990s. The word "silver" could be replaced by "Intel." There is no doubt that the circumstances will reappear from time to time.

In 1974, public awareness of inflation caused an overwhelming interest in all forms of hedging, with large numbers of naive investors purchasing silver and gold as currency protection. Many sophisticated investors turned to the futures markets, which offered leverage on their purchases; some learned how to use the markets themselves and others relied on advice.

One investment system that was sold at this time was more of a leveraged substitute for the purchase of buillon than a trading strategy. At the time it was published, it had *always* worked—the sponsor of the system stood behind it with his reputation. The rules of the system were:

1. Trade silver futures because of their intrinsic value, historic performance, potential, and fundamental demand with short supply.
2. Use the futures contract between three and seven months from delivery to combine the advantages of liquidity and duration.
3. Always buy, never sell, because it is always successful.
4. Buy whenever you like. Although any sophisticated method can be used, it won't matter in the long run—any guess will do just as well. Follow the same method for adding to positions or reentering after closing out a trade.
5. Close out the position when there is a profit, not before.
6. Meet all margin calls—don't let the market beat you.
7. Invest $5,000 per contract (5,000 troy ounces). This will allow a $1 per ounce adverse move (silver was at $4.50 per ounce).
8. Whenever you need reinforcement, reread the reasoning behind this system.
9. Do not let anyone or anything interfere with following this system.

How did the investors do? It depended on when they started. Entering in the first half of 1975, shortly after the system was released, showed individual contract returns ranging from profits of 51¢ to losses of 18¢ per ounce. A drop in silver prices then produced losses of up to $1.02 per ounce for the next 9 months (slightly over 100%), followed by a 2-month rally, and losses again. This system would have worked from 1979 to February 1980 and then lost for the next 6 years. An investor following these rules, entering at a chance place, would have had more than a 10:1 likelihood of losing. Any profit made would have been given back if the investor persisted in following the method.

The same results would have followed trading Nasdaq. Buying anytime during the 1990s would have produced profits. No matter what trend method, indicators, filters, or dart board you use, if you buy and prices go higher, you always make money. If a trader continued to buy from 2000 through 2003, he would have faced the same total loss as the silver trader. The only true test of a strategy is the ability to make money in different types of markets.

In trying to understand how a system such as this can have a chance of reaching the public, remember the time in which it was introduced. With prices increasing drastically, food shortages, and publicity over the devaluing U.S. dollar, the rationale of the system seemed justifiable. There was serious talk about *leveraged inflation funds* using futures. We saw the same euphoria on the part of inexperienced traders who bought Nasdaq in the late 1990s. They had no expectation of losses. These systems fill an immediate need, without regard to long-term consequences. There is no doubt that, if high

inflation, or another major bull market returns, systems just like this one will reappear right near the top.

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SIMILARITY OF SYSTEMATIC TRADING SIGNALS

A primary concern of both the government regulatory agency (CFTC) and individual traders is the similarity of computer-based systems that are used to manage large positions. If technical trading systems have similar foundations and testing methods, it is possible that many of them will produce signals on nearly the same day or even within a few seconds of one another during the day. That is, these systems may appear different in their rules and parameters, but they could be essentially quite similar—a case of too many people looking at the same markets and using the same tools.

At the end of Chapter 3 there was discussion of how the S&P index has altered the price patterns of those stocks within the index. Traders enter orders to buy and sell the S&P based on S&P price support and resistance, or on trends applied to S&P prices. Trading the S&P causes an arbitrage between the index and the individual stocks comprising the index; therefore, those stocks stop rising at the S&P resistance levels, even though that price may not align with the stock's own resistance point.

Just the way new tools and new participants are causing changes in price patterns, systematic trading has its own unique effects. Consider the extreme case where two systems with a trend-following philosophy have the same profit over the same period of time. Will the signals occur on the same day? Are they on the same side of the market most of the time? Figure 22.14 shows one combination that has a relatively low correlation given this situation.

Figure 22.14: Two trend-following systems with relatively low correlation.

System *A* is a slow trend-following method, which avoids the choppy markets but nets only a small profit. System *B* jumps in and out, capturing profits quickly but with frequent losses. They both return the same profits. System *B* is on the same side of the market as A about 50% of the time because the overall trend was up; therefore, it cannot be negatively correlated but it could have a modest positive correlation. If system *B* were not as fast as in this illustration, the positive correlation would be greater. As the time periods used for calculation become closer, the correlation increases; as the calculation periods become farther apart, the correlation decreases.

If systematic trend-following systems with different calculation periods are not highly correlated, then it is possible to reduce portfolio risk by trading a variety of different techniques and time periods; however, the reality may be different from the theory. Lukac, Brorsen, and Irvin[7] performed a study that compared 12 popular trading techniques (mostly trend-following) over 12 varied futures markets for the years 1978–1984. Each system was optimized, using 3 years of data, and the best parameter values were used to trade the next year. The systems selected were:

- *Channel systems*
  - Closing price channel (CHL)
  - MII price channel (MII)
  - L-S-O price channel (LSO)
- *Momentum/oscillators*
  - Directional Indicator (DRI)
  - Directional Movement (DRM)
  - Range quotient (RNQ)
  - Reference deviation (REF)
- *Moving averages*
  - Moving average with percent band (MAB)
  - Dual moving average (DMC)
- *Systems with trailing stops*
  - Parabolic Time/Price System (PAR)
  - Alexander's Filter Rule (ALX)
  - Combined Directional Movement and Parabolic Time/Price System (DRP)

The study used three measures to test system similarity:

1. The percentage of the time that systems are on the same side of the market (long or short).
2. The percentage of buy or sell signals that occurred on the same day or within a few days of one another.
3. The correlation of aggregate monthly portfolio returns.

The results show a significant positive correlation in the system profitability (Table 22.5). However, there is no pattern that shows that one particular type of system is notably more correlated than others. The Parabolic and Directional Parabolic systems are most similar because one is based on the other.

Table 22.5: Correlations of Aggregate Monthly Returns from 12 Systems

Open table as spreadsheet

	Trading System										
System	**CHL**	**PAR**	**DRM**	**RNQ**	**DRP**	**MII**	**LSO**	**REF**	**DMC**	**DRI**	**MAB**
PAR	0.57										
DRM	0.72	0.61									
RNQ	0.70	0.41	0.70								
DRP	0.65	0.81	0.79	0.57							
MII	0.75	0.54	0.67	0.73	0.67						
LSO	0.59	0.43	0.53	0.68	0.54	0.70					
REF	0.55	0.37	0.57	0.66	0.52	0.54	0.60				
DMC	0.72	0.41	0.68	0.78	0.55	0.74	0.58	0.57			
DRI	0.71	0.42	0.69	0.77	0.55	0.70	0.59	0.66	0.64		
MAB	0.72	0.55	0.75	0.74	0.69	0.69	0.63	0.60	0.78	0.72	

ALX	0.58	0.55	0.62	0.55	0.57	0.57	0.58	0.51	0.52	0.56	0.57

All coefficients significant at the 0.01% level with the exception of REF and PAR coefficient, which is significant at the 0.05% level.

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Only four of the systems were significantly profitable: CHL, MII, DRP, and DMC. The correlations of those systems do not seem any more significant than others that were not profitable. In Table 22.6, the percentage of trades that occur on the same day is very low. A more informative comparison is seen in Table 22.7, which tallies the percentage of days that each system held the same position.

Table 22.6: Percent of Trades That Occur on the Same Day

Open table as spreadsheet

	Trading System										
System	**CHL**	**PAR**	**DRM**	**RNQ**	**DRP**	**MII**	**LSO**	**REF**	**DMC**	**DRI**	**MAB**
PAR	19*										
DRM	25**	21**									
RNQ	22**	9	15								
DRP	30**	93**	48**	10							
MII	20*	15	10	28**	17						
LSO	22**	13	17	27**	18	23**					
REF	12	7	7	11	9	12	14				
DMC	16	6	8	28**	6	12	18	19*			
DRI	18	9	14	38**	10	32**	22**	15	25**		
MAB	28**	18	23**	23**	27**	18	25**	11	19*	23**	
ALX	12	20*	12	19*	20*	9	17	10	10	16	17

Percent of trades that occur on the same day by each pair of systems. Significance assuming a binomial distribution with * denoting 95% confidence limits and ** denoting 99% confidence limits.

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Table 22.7: Percent of Trading Days Systems Hold the Same Positions

Open table as spreadsheet

	Trading System										
System	**CHL**	**PAR**	**DRM**	**RNQ**	**DRP**	**MII**	**LSO**	**REF**	**DMC**	**DRI**	**MAB**
PAR	70										
DRM	82	76									
RNQ	75	61	73								
DRP	68	83	75	59							
MII	82	69	80	75	65						
LSO	73	58	71	73	57	73					
REF	72	57	69	69	55	72	69				
DMC	81	62	77	79	61	79	76	78			
DRI	70	56	68	72	54	71	69	67	73		
MAB	65	54	66	62	53	63	61	57	65	59	
ALX	72	64	71	68	59	73	65	67	73	63	58

Percent of the trading days each pair of systems is on the same side of the market (long or short) at the same time. All coefficients are significant, assuming a binomial distribution with 99% confidence limits
Source: Reprinted with permission of *Futures Magazine* (250 S. Wacker Drive, #1150, Chicago, IL 60606, November 1987).

The study concludes that computer-based systems *trade on the same day significantly more often than would randomly be expected, but the actual percentage of trades that occur on the same day is small*. These systems have the potential to move market prices, but the trades do not often occur at the same time. One must be concerned, however, if trend-following systems are holding the same position 75% of the time; they must compete with each other when they exit, even if that occurs over a period of a few days. Trading signals that occur at the same time may not be necessary to push the market.

Correlation at the Worst Possible Time

There is often a theoretical answer and a practical one to the same question. There is no doubt that a variety of trend-following systems generate trading signals at different price levels, some nearer to each other and some farther away. During active, high-volume trading periods, a few of these systems can give buy signals without causing prices to move so much that they then cause other trending systems to be triggered. During sessions with light volume it is more likely that a system traded with a large position will cause piggy-backing by others, resulting in a price spike that disappears once all the systems have kicked in.

The worst case is a price shock. Although not caused by systems, all trend systems not holding a position in the direction of the shock will get signals to enter at the same time, the result of a large price jump. These rare cases may not cause correlation statistics to increase but may magnify the slippage of that trade. During a price shock, these correlations mean very little and all markets reverse direction at the same time. The only way to minimize losses is to diversify using different trading philosophies rather than time periods. Although relatively rare, price shocks can be fatal. When designing your trading strategy, keep the practical issues of diversification and risk management always in sight.

[7]Louis P. Lukac, B. Wade Brorsen, and Scott H. Irwin, *Similarity of Computer Guided Technical Trading Systems* (CSFM-124, Working Paper Series, Columbia Futures Center, Columbia University Business School, New York, March 1986). Also by the same authors, "Do Similar Signals from Trading Systems Move Prices?" *Futures* (November 1987).

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Chapter 23: Risk Control

OVERVIEW

Atrading system alone will not assure success without proper risk control, beginning with individual trades, extending to diversification of markets, and continuing until a portfolio of different trading strategies is created. Every trading style has losing streaks that will ruin an investor who begins trading at the wrong time without adequate capital; therefore, the size of the position, the markets to trade, and when to increase or decrease leverage become important for financial survival. Some risks, called *systematic risk*, can be controlled or reduced while other *market risk*, which can take the form of a price shock, can never be eliminated.

This chapter covers a broad range of topics related to risk, including individual trade risk, portfolio risk, leverage, and a continuation of the effects of price shocks and catastrophic risk. It is not possible to say that one is more important than another. In a specific situation, any one of the areas discussed may be the answer to preventing a substantial loss. The first part of this chapter discusses capitalization and shows why many traders are successful for months and then lose everything in only a few days. It explains the choices in dynamic leveraging and offers alternatives of less risk. The last section analyzes when a system is performing properly and when it is not living up to its expectations.

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MISTAKING LUCK FOR SKILL[1]

Understanding risk is more important than learning to measure risk. The daily market volatility gives a good approximation of short-term risk, and the profits and losses of a trading method provide added information that will give many traders a reasonable idea of how much risk must be absorbed to create profits. Price shocks are more difficult to put into context because they are extreme compared to normal price movement. The previous chapter continued a discussion of some practical aspects of price shocks, with examples of how to manage both profits and losses caused by these large moves. This review only serves as a reminder of a very important problem.

A price shock represents the greatest risk for most traders. That risk can be perpetuated if the price shock results in a windfall profit. A price shock, such as 9/11, cannot be anticipated, and any profit that might have been gained is the result of luck, not skill. Traders must realize that the profit could have been a loss; they should assess how their account would have survived a drop of the same magnitude. Mistaking luck for skill ignores the risk and exposes the trader to future risk for which he or she is now unprepared. Long Term Capital, a home for some of the smartest financial minds, believed they could engineer the risk out of each trade but failed to survive an exceptional price move that had a very low probability of occurrence. Without including these larger, infrequent losses in the performance profile, trading accounts are likely to be undercapitalized.

The only way to reduce the possibility of loss from a price shock is to be out of the market as much as possible. This translates into two practical trading rules:

1. *Do not hold a position longer than necessary.* Choose a strategy that has good entry timing and has many opportunities for exiting the trade. It is best to be in the market when prices are moving and out when volatility drops and prices are no longer active. A trading method that is in the market only 40% of the time has a 60% chance of avoiding a price shock. A strategy that is always in the market will be exposed to all price shocks.

2. *Try to make as much as possible by investing as little as possible.* The less you have invested, the less you have at risk. Fixtures and options offer an opportunity to leverage price moves by as much as 20:1; however, that works against you when a price shock causes a large loss. A fully leveraged trading program that has a theoretical return of 200% per annum will also be a total loss after an adverse price shock. A deleveraged program may return only 20% but is 10 times more likely to survive a price shock, a much better long-term alternative.

When a price shock occurs, the ones who survive are those who had the least exposure. By holding positions only 30% of the time, there is a 70% chance you will be out of the market when a price shock occurs. In addition, if you have only a small position, then a loss will not be a disaster. Less exposure is the only defense from a price shock. While price shocks are rare, random events, they occur every few years, they are violent, and they leave many exposed traders in ruin.

[1]A book entirely devoted to this subject is Nassim Nicholas Taleb's *Fooled by Randomness* (Texere, 2001).

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RISK AVERSION

Traders react differently to risk, and most are risk-averse. A primary reason for the popularity of trend systems is that they provide some degree of conservation of capital. This is accomplished by taking small losses when prices move the wrong way, and holding a trade for a much longer time when it shows profits. By taking small losses, the investor can wait until a sustained trend comes along. This gives the trending system its familiar profile of a large number of small losses offset by a few large profits. But all traders have a personal acceptance level for risk and not all of them find conservation of capital appealing.

Daniel Bernoulli, a famous mathematician, proposed a theory of utility in 1738 that distinguished between price and value, where price is the same for everyone but value (utility) depends on the individual making an estimate based on their individual circumstances.[2]

Bernoulli's approach defined a concept of *diminishing marginal utility*, shown in Figure 23.1, which indicates that as wealth becomes greater, the preference for more wealth diminishes. In the lower left part of the chart, where the investor has a small net worth, the likelihood of accepting risk is much higher, although the magnitude of the risk is still small. When risk becomes greater, even proportional to reward, all investors become cautious. Bernoulli's graph shows the curve beginning at zero and moving up and to the right in a perfect quarter-circle, ending horizontally where risk is no longer attractive. This implies that people are risk-averse. Most people are not interested in an even chance of gaining or losing an equal amount. Other theories that have been proposed are that the market maximizes the amount of money lost and the market maximizes the number of losing participants. All of these concepts appear to be true and are very significant in developing an understanding of how the market functions.

Figure 23.1: Changes in utility versus changes in wealth. *Source*—Bernstein, *The portable MBA in Investment* 1995, p 38, © 1995 peter Bernstein. Reprinted by permission of John Wiley & Sons, Inc.

Risk Preference

The Bernoulli theory of utility is general, but each investor has his or her unique objectives and attitudes toward risk. Some investors would like to keep risks low and returns steady; more speculative investors would risk a sizable amount of their capital for a chance at the "big move." This trait is called the investor's *risk preference.* The *risk preference*, *P*, or *utility* of an investor for a specific venture (in this case a trade) can be found by adding the expected value of the investor's utilities or preferences, p_i, for the various outcomes of that event,

$$P = w_1 p_1 + w_2 p_1 + \ldots + w_n p_n$$

where $\Sigma\, w_i = 1$

n = possible outcomes

The weighting factors may be the results of personal bias or may be the calculated probabilities of each outcome. For example, consider a gold trade that has a likely profit of $4,000 and a risk of $1,500. Adjust the reward values by dividing by 1,000. If the probability of success is 60%, the total utility of the trade is:

$$P(\text{trade}) = 0.60 \times 4 + 0.40 \times (-1.5) = 1.8$$

If the probability of success were increased, the utility *P* would increase linearly. But investors do not feel the same about different rewards. Given a scale of 0 to 100 (negative to positive reaction), an investor may rank a 60% chance of a $4,000 profit and a 40% chance of a $1,500 loss, both as a 65. If the reward is increased to $8,000 while the risk remains at $1,500, the investor might only raise the preference of the trade to 80, although the utility would be 4.2, more than twice as large.

The various curves drawn through the computed utilities represent the risk preference of the individual. Figure 23.2 shows these curves progressing from extreme risk aversion to extreme risk seeking. As the risk increases in (1), the trader is risk-averse and less likely to participate in the trade; in (3), there is equal chance of taking the trade at all risk levels; and in (5), the trader is risk seeking and is more likely to enter a trade that has higher risk.

Figure 23.2: Investor utility curves. *Source*—R. J. Teweles, C. V. Harlow, and H. L. Stone, *The Commodity Futures Game—Who Wins, Who Loses, Why?* (McGraw-Hill, New York, 1974, p. 133). © 1974. Reprinted with permission of The McGraw-Hill Companies.

The Efficient Frontier

There are a large number of performance profiles that result from different trading strategies, a diverse selection of stocks, futures, and index markets, and the amount of leverage employed. Each of these investments can be described in terms of its annualized rate of return and its annualized risk. Risk is most often the standard deviation of the annual returns; however, many other measurements will be discussed in the next sections.

The *efficient frontier* is a way of visualizing which choices would be made by any rational investor. Suppose there were 8 different investment programs, and each reported their the annualized rate of return and some measure of risk, normally the annualized standard deviation of returns. These could then be plotted in Figure 23.3. Let us also assume that these investments represented a good sample of all investment risk and return combinations.

Figure 23.3: The efficient frontier.

A rational investor is one who wants the highest return for the lowest risk. Therefore, given a choice between investment *D* and investment *C*, we would choose *C* because it had the same risk but a substantially higher return. Similarly, if we were given a choice between investment *D* and investment *A*, we would choose investment *A* because it has the same return with a much lower risk. Given a choice of any two investments, displayed on a chart of risk and return, a rational investor will always choose the one that is higher and to the left.

The efficient frontier is a curve plotted through those investment alternatives that have the highest returns for a given risk, or the lowest risk for a given return. An investor seeking greater returns with a higher tolerance for risk will choose an investment further to the right on the curve; one with a lower risk tolerance must select a program farther to the left, with less return.

The optimal point on the efficient frontier is where the return to risk ratio is a maximum. Nevertheless, not all investors choose this point because the absolute level of risk is too high, or the absolute returns are too low. Investors' risk preferences are personal and unique. The optimal portfolio selection is discussed in detail in Chapter 24.

Common Sense

Risk control is as much an issue of common sense as it is complex rules and mathematics. Most of this chapter shows how various rules, measurements, and leveraging techniques can reduce risk; however, successful traders have applied common sense, without complex formulas, for a long time. Some of these successful principles are:

1. *Only risk a small amount of total capital on any one trade.* The total amount risked should allow you to comfortably survive a number of losses in a row. No trade should ever risk more than 5% of the invested capital.

2. *Determine the maximum loss for the current trade in advance.* There should be a clear exit point for every trade, and that price determines the risk. If the risk is too high, then a smaller position should be taken. If that is still too risky, then the account should be larger.

3. *Exit a trade quickly.* Exiting a trade is more difficult than entering because the timing is not always yours. Exiting quickly is often safer than being clever. Many floor traders believe that the smartest trader is the first one out.

4. *Don't meet margin calls.* Experienced traders believe that a margin call is an objective statement of a trade that's gone wrong, or a system that is not meeting expections. It is a time to review trading performance rather than invest more.

5. *Liquidate your worst position first when lightening up.* The profitable trades have proved that they are trending or performing properly; the losing ones have proved they are not. Stay with the good positions and liquidate the worst.

6. *Be consistent with your trading philosophy.* If you are a trend follower, then keep losses small and let profits run. You cannot be a trend follower by taking profits whenever the appear.

7. *Be sure the trading profile is compatible with your risk preference.* You cannot follow a strategy that takes risks that

are uncomfortably large. Be sure that profile is agreeable to you.

8. *Plan for contingencies.* Nothing ever goes as planned, and you must be prepared for infrequent but important exceptions.

[2]Peter L. Bernstein (Ed.), *The Portable MBA in Investment* (Wiley, New York, 1995, p. 37).

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LIQUIDITY

The ability to implement any trading program is directly related to the liquidity of the market. Even though liquidity can have more than one meaning, lack of liquidity has only one trading result—poor execution. A *liquid* market does not necessarily mean good fills, but an *illiquid* market assures bad ones. Two types of illiquidity most often encountered in the markets are:

1. *Fast markets*, in which there are mostly buyers or sellers, and few traders willing to take the other side of the position.
2. *Inactive markets*, usually the smaller cap stocks or deferred futures contracts where there is less commercial or institutional interest.

The fast market is the result of developing news where everyone has the same opinion on the direction that prices should move. In futures this may be combined with a supply/demand imbalance or a perceived imbalance. Once a large number of buy orders floods the market, specialists, market makers, and locals all stand aside (or widen the bid-asked spread and offer very small quantity) rather than be run over. The few arbitrageurs, hedgers, and risk-seeking traders willing to take the opposite position do little to offset the vast number of orders that continue to push prices in one direction. In the inactive market, a large premium must be paid to attract another trader to take the opposite side. This only succeeds when the bid or offered price clearly appears to give the other trader a guaranteed short-term profit.

An illiquid market causes poor executions, which is the largest part of transaction costs and is sometimes too large to overcome. Ginter and Richie[3] have described this as a function of the order size, volume, and the speed of the market, in a single formula that applies to the futures markets, but could be adapted to individual equities:

$$C = K \times \frac{Q \times V}{L_c \times L_o}$$

where
- C = cost of execution due to liquidity
- Q = size of the order entered
- V = volatility of the market
- L_c = volume of the market (all contract months for futures or possibly the combined volume of highly correlated equities)
- L_o = volume of the specific delivery month or individual equity
- K = constant factor

The volatility V might be the daily price range or a multiple of the standard deviation of the range. This provides a way to measure how much volume would move the market a specified number of points. The total volume (liquidity) L_c is important because it implies liquidity due to interdelivery spreading in futures. If applied to stocks, added liquidity may come from activity in a closely correlated industrial group. Volume also serves as a measurement of the general interest in the product or in the related stock group. Increased trading in other futures contract months, or in similar stocks, should increase trading into the nearest deliveries or target stock market.

The constant factor K varies according to the type of the execution order being placed and the current direction of the price with regard to that order. If prices are moving higher and a buy order is placed, K will be large; if prices are moving higher and a sell order is placed, K will be smaller. The investor can see that transaction costs, including commissions and execution slippage, will have considerably greater impact on systems that trade more often, have smaller average profits,

and trade in the direction of the trend. Given a choice between systems of equal gross profits, the investor should favor the method of fewest trades in the most liquid markets.

[3]G. Ginter and J. Richie, "Data Errors and Price Distortions," in Perry J. Kaufman (Ed.), *Technical Analysis in Commodities* (Wiley, New York, 1980).

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MEASURING RETURN AND RISK

To decide which strategy or portfolio has the best return and risk profile, it is necessary to measure both of these attributes. Returns are the simpler of the two and can be calculated in either of two ways:

1. The average of the annualized rates of return.
2. The slope of the linear regression line drawn through the cumulative return stream.

The most common calculation of returns is the average of the individual annualized returns; therefore, if a trading program returned 24%, 18%, 20%, 15%, and 19% in 5 consecutive years, most investors would see this as an average return of 19.2%. Another equally valid method is to find the slope of a straight line through the cumulative returns, 24%, 42%, 62%, 77%, and 96%. This gives the annualized returns as 17.9% because it reflects the slight tendency for returns to decline.

Select a Trading Model

Before either risk or returns can be measured, it is necessary to have a strategy that has produced historic results, whether real or theoretical. The use of actual trading results is always preferable and the measurement of risk and returns applies to all methods of trading. Suppose there is a choice of systems to trade, and the daily equity of each is available. If only one can be selected, which should it be? There are some characteristics of performance that axe universal:[4]

1. Larger profits are better than smaller profits.
2. Small short-term fluctuations are better than large, short-term fluctuations.
3. Upwards equity surges (profits) are better than downward surges (losses).

Naive Performance Criteria

The use of a single performance statistic, such as *maximum profits* or *standard deviation of returns*, is not sufficient to satisfy the basic needs of a risk measurement. There might have been a run of losses greater than the investment before profitability was achieved. Similarly, the risk alone is not sensible. The system with the smallest risk is one that never trades. A valid performance measurement must include a comparison of risk and reward.

The Sharpe Ratio

The classic measurement of performance is the *Sharpe ratio* (SR), expressed as

$$SR = \frac{E - I}{\sigma}$$

where E = the expected return (the annualized rate of return)
I = the risk-free interest rate (usually the 3-month rate)
s = the standard deviation, or fluctuation, of the periodic returns (for example the annualized returns)

For practical purposes, E should be an annualized rate of return in percent, and I is often omitted. The risk-free return, I, cannot be omitted when there is a risk-free return on unused capital that has been imbedded in the performance. For futures trading, interest can be earned daily on nearly the entire market-to-market value of the account. For a comparison of different investments, it is necessary to specifically identify which returns include interest income. The denominator of the Sharpe ratio, the annualized standard deviation of the equity, is a standard measurement of risk.

The Sharpe ratio satisfies the first universal criterion of system selection, that all else being equal, higher profits are better. It does not satisfy either of the other criteria illustrated in Figure 23.4 because it cannot distinguish between:

1. Consecutive small losses (System *B*) and alternating small losses (System *A*), shown in Figure 23.4a.

2. Large surges of profits and large losses, shown in Figure 23.3b.

Figure 23.4: Two cases in which the Sharpe ratio falls short. (a) The order in which profits and losses occur. (b) Surges in profits versus evenly distributed losses.

Clearly, System *A* is best in both cases.

Average Maximum Retracement

Schwager[5] has presented a comprehensive study of risk and return evaluation techniques. Although each method may emphasize a particular equity trait, he seems to favor the *Average Maximum Retracement* (AMR). This method answers the question: "For each day, what would be the retracement if one had started trading the system on the worst possible trade entry date?" The AMR is the average of the daily maximum retracement values.

$$AMR = \frac{1}{N}\sum_{i=1}^{N} POS(MCE_i - TE_i)$$

$$\text{where} \quad POS(X) = \begin{cases} x \text{ if } x > 0 \\ 0 \text{ if } x < 0 \end{cases}$$

and MCE = closed-out equity (realized profits) on any trade entry date prior to i

TE_i = total equity on day i

N = total number of days of equity data

When $TE_i > MCE$, all traders will have a profit on day i, regardless of when they began. Schwager suggests that a much simpler computation would use only the low total equity day of each month; it would give a rough but good approximation.

Largest Loss

Measurements such as Schwager's AMR, and even the basic standard deviation, are good for comparing the long-term performance of one system against another; however, they lack a certain reality of simply looking at the largest loss seen over the test period. John Sweeney calls this the *maximum adverse excursion*,[6] claiming that traders should minimize the size of their largest loss.

Consider the standard deviation of equity changes, showing that in any month there is a 68% chance that your returns will be between 15% and -5% (a mean of 5% and a standard deviation of 10%). There is only a 2.5% chance that you will lose more than 15% in one month (2 standard deviations); therefore, there is a 50% chance you will lose that 15% in one of the first 20 months (20 ÷ 2.5). Yet probability shows that you should lose more, if you keep trading, or less if you stop sooner.

The largest historic loss, called the *maximum drawdown*, is a practical alternative. It simply states that the trading program *did* lose 15% during one month of a 3-year test. While it is possible, and even likely, that the program will have a larger loss in the future, you must be prepared for a 15% loss in a single month.

Ulcer Index

Investors have increased anxiety as current returns drop farther below the highest returns previously achieved. This can be measured by the *Ulcer Index*, UI, a form of semi-variance that produces a statistical measure of relative declines on all days that were not new high returns.

$$UI = \sqrt{\frac{\sum_{i=1}^{n} D^2}{n}}$$

where D = the difference between the highest equity as of day i and the actual equity on day i

n = the number of days in the equity stream

If the equity on day i is a new high equity, then $D_i = 0$. As UI increases, investors are more anxious about performance.

Potential Risk

Risk is never a single value; it is a probability, and the standard deviation is the best tool for finding that relationship. Even if a drawdown has occurred that is larger than the previous maximum drawdown, there is still a small chance that another, even larger drawdown will occur. It is unreasonable to think that all future losses will be smaller than the maximum already experienced. This *potential for loss* can be expressed as a probability with two different measurements over n days:

1. *Probability of a drawdown* (DP). Calculate the standard deviation of all daily drawdowns, D_i, measured from the most recent equity high to today's equity value. When the today's equity is also a new high equity, the value used is zero.

   $$DP = stdev(D_i)$$

   where $i = 1,n$

2. *Semi-variance (SV).* Calculate the linear regression of the equity stream, then find the standard deviation of all drawdowns, D_i, below the corresponding value of the straight line fit, p_i'. Semi-variance will produce a smaller value than (1) because the values on the straight line will be lower than the peak equity; therefore, the drawdowns will be smaller.

A more conservative version of (1) and (2) can be created by omitting those days on which the equity made a new high. By removing those days with the value zero, the standard deviation will be increased slightly. With either measure, DP and SV represent the value of 1 standard deviation. Therefore, there is a 16% chance that there will be a drawdown greater than DP or SV over the next n days. There is only a 2.5% chance of a drawdown of twice that amount over the next n days.

Either of these measurements can be used to form a ratio of return to risk, called a *drawdown ratio* (DR):

$$DR = R/DP$$

or

$$DR = R/SV$$

where R = the annualized return on investment

Although this is not far from Schwager's approach, it satisfies all three of the original criteria: Higher profits are favored because the rate of return is in the numerator, the order of profits and losses will result in larger and smaller net equity drops, and large gains are not penalized because only the drawdowns are used to measure risk.

The conservative investors may want to include some additional simple considerations of potential risk. All else being equal, systems will have greater risk if:

1. They are tested with smaller samples.
2. They have few historic equity drops.
3. They concentrate on fewer product groups (not well diversified).
4. They compound positions.

Value at Risk

Value at Risk (VaR) is used in most companies to assess whether the current market positions are likely to produce a loss that is unacceptably large over the next few days. This is done using standard statistical methods that result in a probability of loss over a predetermined time horizon given normal market movement. For example, Bank Two holds large short positions in fixed income futures to protect loan commitments at current levels. They also hold a wide variety of foreign currencies, of which 50% are hedged with forward contracts. If interest rates drop or the U.S. dollar strengthens, they could show large losses in their futures positions. According to bank policy, the loss allowed in a single day must be kept to under 0.5% of cash value of these commitments. If there is a potential risk exceeding that amount, the futures position must be immediately reduced.

VaR is a combination of cross-correlations between markets for which there is exposure, the position sizes, the volatility of those markets, the projected time period over which the risk will occur, and a confidence interval to determine the risk tolerance. Using the return series for the interest rate and FX exposure held by Bank Two, VaR can be calculated as[7]

$$VaR = \sqrt{\sigma_{IR}^2 + \sigma_{FX}^2 + \left(2 \times \rho_{IR,FX} \times \sigma_{IR} \times \sigma_{FX}\right)}$$

where s = the standard deviation of the return series for the individual markets

ρ = the cross-correlation between the two return series

In this example, the return series reflects the position size and volatility of the exposure. This formula implies a VaR projected period of 1 day.

For example, Bank Two holds $125 million in EUR/USD, which has a daily standard deviation of 0.565%. If the current EUR/USD rate is 1.25, then the market value of the position is $100 million. It also holds a EUR125 million position in 10-year Eurobunds, which show a standard deviation of 0.605% and a market value of $100 million. Using 1.65 standard deviations to represent the 95% confidence levels, and making the assumption that r_i/s_I is normally distributed, the EUR/USD exchange rate should not drop more than 0.565 × 1.65 = .932% (less than 1%) on a single day, 95% of the time. The Eurobunds should drop less than 0.605 × 1.65 = .998% on a single day. We could then expect the approximate risk of the FX position to be $100 million × .932 = $932,000 and the risk of the Eurobund position to be $100 million × .998 = $999,000 over the next 24 hours.

The total risk of the FX and Eurobund positions is not the sum of the two risks, because correlations between the two markets may show that price movement of one market is partially offset by opposite movement in the other market. In this example, the cross correlation of the returns of two markets is -0.27, showing that there is a noticeable offsetting effect. Applying these values to the previous formula gives

$$VaR = \sqrt{(0.999)^2 + (0.932)^2 + (2 \times -0.27 \times 0.999 \times 0.932)}$$
$$VaR = \$1.168\ million$$

The value at risk for the next 24 hours is far less than the sum of the two individual markets' risks because their price movements tend to offset each other.

A more general calculation of VaR uses separate values for the underlying prices, the position size, the time period, and the confidence interval. For three assets, this is

$$VaR_i = CI \times \sqrt{P} \times \sqrt{w_1^2 x_1^2 \sigma_1^2 + w_2^2 x_2 \sigma_2^2 + w_3^2 x_3^2 \sigma_3^2 + 2 w_1 w_2 x_1 x_2 \sigma_1 \sigma_2 r_{12} + 2 w_1 w_3 x_1 x_3 \sigma_1 \sigma_3 r_{13} + 2 w_2 w_3 x_2 x_3 \sigma_2 \sigma_3 r_{23}}$$

where CI = the confidence interval (expressed as 1.65 standard deviations for a 5% probability

P = the VaR calculation period (5 is a projected period of 5 days)

w_i = the weighting factor, or relative position size

x_i = the current value or price of the asset on the current day t

s_i = the annualize volatility, shown below

r_{ij} = the cross-correlation between market i and market j

Cross-correlations can be found using the spreadsheet function *correl*, or can be calculated directly from the formula in Chapter 6. The volatility, s_i, is calculated using the prices, x_i, over n days, as the standard deviation of the price changes, annualized:

$$\sigma_i = \sqrt{252} \times stdev(d_i)$$

$$d_i = \frac{x_t - x_{t-1}}{x_{t-1}} \text{ over the past } n \text{ days}$$

The square root of 252 is used to annualize the daily values.

In the practical implementation of risk control, VaR would be calculated before the close of trading and, if its value exceeds the threshold amount, action can be taken to reduce the exposure on the same day.

Generalized VaR Calculation

The probability of loss at the end of a forecast period, P_E, is calculated as the difference between the cumulative percentage loss over that period and the cumulative expected return, dividing this value by the cumulative standard deviation, and applying the standard deviation of a normal distribution to give a probability estimate.[8]

$$P_E = N\left[\frac{\ln(1+L) - \mu T}{\sigma\sqrt{T}}\right]$$

where $N[\,]$ = the cumulative normal distribution function

L = the cumulative percentage loss in periodic units

μ = the annualized expected return in continuous units

T = the number of years in the horizon, where 1 day is $1/252$

s = the standard deviation of continuous units

In this process, the compounding of periodic returns results in a lognormal distribution, while the continuous returns and standard deviation are normally distributed. To calculate VaR, this calculation is changed to specify the probability, Z, and solve for the size of the threshold loss.

$$VaR = -(e^{\mu T - Z\sigma\sqrt{T}} - 1)W$$

where e = the base of the natural logarithm (2.7128)

Z = the chosen probability deviate (for example, 5% is 1.65)

W = the initial value of the asset

The result of this calculation gives the probability of loss at the end of the period, T, and does not reflect any losses that might have occurred during the period (if T is greater than 1 day). Losses during the period will always be at least as large as the loss at the end of the period.

Price Shocks and Realistic Distributions

Value at risk is a good indication of risk under most market conditions, but is known to be a poor measurement during extreme, highly correlated price moves across market sectors. It has been said that VaR works *except* when you need it the most—when the risk is greatest. A *stress test* is used to find out how VaR performs under extreme cases. This isolates specific market periods, such as price shocks (discussed in the previous chapter), or can use simulated data in which all prices reverse direction and make a 2 to 3 standard deviation move with very high correlation.

The assumption of a normal distribution in either returns or price movement is not realistic, an opinion also held by Benoit Mandelbrot, who maintains that using the standard deviation of equity changes underestimates real risk of the financial markets.[9] Most return

distributions have a fat tail due to the application of conservation of capital and the unusually long, nonrandom distribution of runs. A log distribution could be substituted for a normal distribution, but this tends to be more extreme than necessary. The degree of fat tail present in the distribution can be measured using *kurtosis*,

$$k = \frac{\sum_{i}^{n} r_i^4}{n\sigma^4}$$

where r_i = the return on day i

s^2 = the variance

n = the number of days

A normal distribution has a kurtosis of 3, but the actual returns series might have a kurtosis as large as 25, indicating a significantly fat tail. Although the non-normal distribution can be identified, there does not seem to be a simple solution in the form of a distribution that can be applied to VaR. When extreme distributions exist, the practical solution is to perform stress tests to recognize the potential risk during extreme cases and treat these as exceptions in the same way that crisis management might be used during a price shock. Advanced work with VaR focuses primarily on alternative distributions and unexpected, extreme risk.

Risk Characteristics of Systems

The selection of a type of trading approach assumes a unique risk pattern for each trade and for the overall returns. The difference between trend and mean reverting systems was discussed in the section "System Trade-Offs" in Chapter 22. In general, a trend system has many smaller losses and fewer larger profits. A mean-reverting system has the opposite; many smaller profits and fewer larger losses. This is similar to the choices available with gambling strategies.

Even among trending systems there are enormous differences in trading risk. A typical moving average system, which qualifies under *conservation of capital*, keeps individual trade losses small compared to individual profits, but may have a series of losses that add up to one very large continuous loss. In addition, trend systems fail when they encounter a sideways period, and frequently reverse from long to short and back again until prices finally pick a direction. Tests show that the number of trend trades cannot be reduced below a threshold level, even if the trend calculation period is very long. All trends seem to get caught in a sideways price pattern that generates a series of small losses.

A breakout system, the other very popular trending technique, exchanges a much larger risk for much greater reliability than the moving average or exponential smoothing. When a new long position is entered at a new high price for a specific time period, the risk is defined as the price needed to make a new low for the same period. Therefore, the trade risk at the time of entry is the difference between the highest and lowest closing prices, or the highest high and lowest low for the period,

Trade risk = *Highest*(*High,Period*) - *Lowest*(*Low,Period*)

The advantage of the moving average or smoothing method is that individual losses are small. Using the breakout approach, the advantage is that the method does not demand as much of price movement; that is, prices may be very erratic, and may take as long as needed to move to a new level, as long as they do not make a new low. The logic of the breakout method is that a fundamental change has caused prices to move to a new, higher range. As long as this new information is correct, prices should not reverse to a new low, which would negate that information. Therefore, the maximum risk can be set at the current low price.

Risk-Adjusted Returns

The decision whether to choose one trading approach with higher returns and higher risk, or another with smaller returns and lower risk can be resolved by converting performance to an annualized, *risk-adjusted return*. Using any method for measuring risk, a standard deviation of monthly equity changes, average maximum retracement, or even largest drawdown, divide the annualized rate of return by the risk to get the risk-adjusted rate of return. The highest value is the better choice.

Time to Recovery

A trading program that recovers quickly from losses is more desirable than a program that lingers at its lowest level of loss. The fact that a program recovers quickly does not change its level of risk, only its practical appeal. Time to recovery is implicitly measured using a number of drawdown methods, including the Ulcer Index, discussed earlier.

How Much Bigger Could the Risk Really Be?

Many of the risk measurements described in this section attempt to express the probability of a future loss. Within reason, many of them succeed. An investor must distinguish between the calculated probability and the effects of a real loss. If there was only a 1% chance of a 50% loss in a single month, then by the 50th month there would have been a 50% chance of a 50% loss. There is also a

large error factor in most of these calculations because the amount of data used to find the statistics was too small. If 100 cases were used, there is a 10% chance of error in the results. The value of the measurement is also dependent upon the period in the market that was used to create these values; the risk in crude oil was exceptionally high during the Gulf War. If that period is not included, the risk of trading crude oil might not reflect future price movements correctly.

It's Not the Markets, It's the Money

A discussion of risk cannot be complete without recognizing that it is the flow of money that moves prices. On most days diversification is achieved by holding stocks in unrelated sectors or industrial groups, or a wide range of commodity markets. News will affect hese groups differently. Energy may be strong on concerns about instability in the Middle East, while Health Care is weaker due to pending political legislation that limits reimbursement.

However, *in a crisis*, such as 9/11, *all markets move together*. It is not the fundamentals or the valuation of the company, it is the people who own the shares who decide to get out at the same time. Money seeks a safer place during a price shock, and this is seen as stock prices drop on widespread selling and bond prices rise on widespread buying. No amount of correlation analysis or diversification will protect an investment from a price shock in which all markets move the same way based on a flight to safety.

[4]Norm Strahm, "Preference Space Evaluation of Trading System Performance," in Perry J. Kaufman (Ed.), *Handbook of Futures Markets* (Wiley, New York, 1984).

[5]Jack D. Schwager, *A Comptete Guide to the Futures Markets* (Wiley, New York, 1984).

[6]John Sweeney, "Maximum Adverse Excursions for Stops," *Technical Analysis of Stocks & Commodities* (April 1987).

[7]Jacques Longerstaey, *RiskMetrics™ Technical Document, Fourth Edition* (Morgan Guaranty Trust Company, riskmetrics@jpmorgan.com).

[8]Mark Kritzman and Don Rich, "The Mismeasurement of Risk," *Financial Analysts Journal* (May/June 2002). This entire section uses material from the Kritzman and Rich article.

[9]B. B. Mandelbrot, "A Multifractional Walk Down Wall Street," *Scientific American* (February 1999).

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LEVERAGE

The consequences of leverage are readily seen in a risk/reward analysis; however, leverage also plays a crucial role in the trading strategy itself. Futures and options markets offer exceptionally high leverage opportunities, and most traders and analysts act as though they are obligated to take advantage of the maximum allowable. Without leverage, many futures prices show less risk than stocks.

Consider the case of an investor with $50,000 allocated to futures trading. If the price of soybeans is $6.00 per bushel and silver is $7.00 per ounce, a 5,000 bushel contract of soybeans is worth $30,000 and a 5,000 ounce contract of silver is valued at $35,000. With no leverage, the investor could only purchase one contract; because it is fully funded in the same way as most stock purchases, the investor is certain that the investment can be held as long as necessary to achieve a profit. Let us assume that, because of fundamental reasons, the investor believes that soybean prices will move to $8 per bushel and silver to $11 per ounce within the next 6 months. If correct, the gross return on investment will be 33% for soybeans and 57% for silver, equivalent to a 20% and 40% return on $50,000, respectively. With no leverage and not enough money to invest in both, the choice must be silver which has the highest return; in neither case could there be any *risk of ruin*. In both cases there would be excess risk capital.

But 100% capitalization is hardly necessary. Even the most conservative investor would agree that the price of either commodity would not drop to 30% of the current value; therefore, there is no significant risk in funding the investment at 70%, rather than 100%, of the contract values. By reducing the individual commitments, the investor can then purchase both silver and soybeans, thus adding diversification and a much higher return on the investment. Table 23.1 shows that 30% leverage would increase the return on investment from 40 to 60%, no doubt reducing risk at the same time due o diversification.

Table 23.1: Varying the Leverage of an Investment

Open table as spreadsheet

	Soybeans			Silver			Total Return		
Leverage (%)	Qty	Needed ($)	Profit ($)	Qty	Needed ($)	Profit ($)	Profit ($)	Needed ($)	%P/L
0	0	30,000		1	35,000	20,000	20,000	35,000	40
10	0	27,000		1	31,500	20,000	31,500	31,500	40
20	0	24,000		1	28,000	20,000	28,000	28,000	40
30	1	21,000	10,000	1	24,500	20,000	30,000	45,500	60
40	1	18,000	10,000	1	21,000	20,000	30,000	39,000	60
50	1	15,000	10,000	2	17,500	40,000	50,000	50,000	100
60	1	12,000	10,000	2	14,000	40,000	50,000	40,000	100
70	2	9,000	20,000	3	10,500	60,000	80,000	49,500	160
80	3	6,000	30,000	4	7,000	80,000	110,000	46,000	220
90	7	3,000	70,000	8	3,500	160,000	230,000	49,000	460
95	15	1,500	150,000	15	1,750	300,000	450,000	48,750	900

As the investment is reduced and leverage increased, both risk and return get rapidly larger. In Table 23.1, there are certain levels which are more significant than others:

- *30% leverage*, the point where there is added diversification, an increase in return, and a negligible increase in risk

of total loss.

- *90% leverage*, the maximum leverage given to speculators with good credit, a level established by the exchanges as the minimum margin levels.[10] Minimum margin requirements range from 5% to 20%, depending on the volatility of the market.

- *95% leverage*, equivalent to the margin of 5%, given to commercial hedgers, who are using the market to the risk of their cash product, and spreaders, when the markets being spread have a direct relationship to each other and the spread volatility is much lower than the volatility of each of the legs.

At 90% leverage, the investor may use nearly all of the $50,000 to purchase $500,000 in futures cash value. Then, an investor choosing to buy equal amounts of soybeans and silver, fully leveraged, can buy 8 contracts of soybeans worth $240,000 and 7 contracts of silver worth $245,000, and have $1,500 remaining unused. In an ideal world, each of those contracts would achieve their targets. Soybeans would move to $8 per bushel and 8 contracts would be worth $320,000. Silver would reach $11 per ounce and 7 contracts would be valued at $605,000. The total of $925,000 would be an 1,850% return on the $50,000 investment.

However, leverage also has a downside. If prices moved the wrong way by 10%, the entire $50,000 investment would be lost, the futures contracts would be liquidated by the broker. Because $485,000 in value was purchased for $50,000, a 10% loss of value would be $48,500, just about the entire investment. In reality, it is much worse, because brokerage rules require that, when the invested margin ($48,500) drops to 75% of the initial level (a loss of $12,500), the investor must restore the value of the account to the full amount of the margin. Therefore, if prices were to drop only 2.5%, the investor would be required to deposit an additional $12,500 within 24 hours, sometimes sooner. Given the volatility of futures markets, a 2.5% price change could happen on the first day.

Reserves

Most professional money managers use *reserves* to reduce the leverage and risk, thereby improving returns without endangering their staying power. The size of the reserves usually averages about 60% of the capital; however, ranges of 10% to 90% have been known. The use of a 50% reserve effectively halves the returns and the risk (Figure 23.5).

Figure 23.5: Varying reserves, assuming a 50% return on $50,000 (with standard reserves = 1).

Looking again at Table 23.1, there is now only $25,000 of capital available for margin. If exchange minimum margin rates are used, there is 90% leverage available; this means each contract of soybeans requires a $3,000 deposit and each contract of silver $3,500. The 80% leverage line, with one-half the margin shown, would require a total margin commitment of $23,000, slightly under our limits. The net effect of 90% leverage on one-half the total investment is the same as 45%

leverage. Returns are:

3 contracts of soybeans × $10,000 profit	=	$30,000
4 contracts of silver × $20,000 profit	=	60,000
Total profit	=	$90,000
Net return on investement	=	180%

[10]In futures trading, *initial margin* is the minimum amount required on deposit when the position is entered.

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INDIVIDUAL TRADE RISK

The first line of defense in controlling risk is the individual trade, although sequences of trades are also an important consideration. Trades can be viewed as one continuous event for the purpose of assigning risk; alternately, a strategy may consider separating the trade into two or more parts, for example (1) from the time of entry until the trade becomes profitable, and (2) from the time it is profitable until the end of the trade.

Risk on Initial Positions

The entry point of a trade is considered the period of greatest uncertainty. Systematic strategies are often successful at identifying a critical point where the trend should change, but may revert to its previous levels. The trader is confident that something important will happen at the point of the entry signal, but it may not always be profitable. Depending on how quickly you anticipate the new trade, prices are either about to change direction or have just changed.

Each trading style has its own intrinsic risk associated with initial entries. The trend philosophy is known for its tenacity, entering a long position whenever prices turn up, taking a small loss if prices then turn down, and reentering the next time they turn up. The breakout technique will only limit losses to the size of the current trading range and any attempt to reduce this loss, which can be large in a volatility market, conflicts with the essence of the method. It is not clear that the accumulated sequential losses of the trend method are less than a single loss in the breakout approach; in exchange for these two distinct approaches, the profit profile is also different. A comparison is shown in Chapter 8.

Additional Risk Control

Most traders prefer specific risk controls added to the one that occurs naturally when the trading method reverses position. These are generally stop-loss orders because they are placed below the current price for a long position, and are executed immediately when that price is touched. The price level for the stop order, applied to an individual trade, can be established by one of the following three general approaches:

1. *An estimate based on initial margin*, for example, 50% to 70% of initial margin. This is loosely related to long-term volatility but lags considerably.[11] An estimate of long-term volatility may be a more satisfactory alternative.

2. *A percentage of the portfolio, for example*, 1.0% to 2.5%. This concept of equalized risk (and perhaps reward) across all markets is very popular; however, it is not sensitive to individual markets, and as with many stops, it imposes artificial overrides. If the volatility becomes very high, as seen in the S&P in the late 1990s, then this risk level would need to be adjusted; otherwise, it could be reached on every trade. It is therefore necessary to determine when a market with exceptional volatility should be removed from the portfolio.

3. *The maximum adverse excursion* determined by historic evaluation.[12] A stop is placed just beyond the maximum adverse excursion for each trade, or 2.5%, whichever is smaller.

Stops

Stops provide the ability to control risk most of the time. A *sell stop* is placed below the current price and becomes a *Market Order* to sell once that price is touched. Stops do not limit losses to the price indicated in the stop order because of opening gaps and market volatility. If the market gaps lower on the open well below your stop order to sell, the order gets filled in turn at a price much lower than expected. When stops are placed very close to the market, they are hit with a frequency resembling a random distribution; this is not particularly helpful to performance unless you only want to remain with a trade if it performs properly from the beginning. When stops are placed much farther from the current price levels

they can serve to protect you from extreme losses, but not always. When a price shock occurs, stops are often filled far from their intended level and can actually be filled at the worst point of the move. A system should not be profitable because of stops, but must work before stops are introduced.

If stops are to work, they must be based on values other than an arbitrary financial limit. Some worthwhile possibilities that change with market conditions are:[13]

1. Advance the stop by a percentage of the price change, as in Wilder's parabolic system.
2. Use a swing high or low point, based on a percentage minimum swing.
3. Use the highest high or lowest low of the recent *n* periods.
4. Apply a method such as Kaufman's Adaptive Moving Average (KAMA) as a stop.
5. Adjust the stop by the volatility, such as 3 times a 10-day average true range.

Trailing Stop

A *trailing stop* is one that captures an increasing part of the profits as prices move in a favorable direction. A trailing stop may lag a fixed percentage behind the current price or it may be designed to capture a percentage of the profits. A trailing stop advances, but never retreats. It is usually based on one of the following three calculations:

1. *Fixed percentage.* Although a long position was entered at $75 in IBM using a moving average, a trailing stop of 3% is placed each day below the level of the highest prior close. The trade is liquidated if either the trend changes or prices fall by 3%, whichever comes first. At the beginning of the trade, the trend will be closer to the price, but as the trade develops the trend lag will cause it to fall away and the 3% stop will be closer.
2. *Volatility.* Because price volatility changes, a trailing stop may be calculated as in (5) in the previous section, and placed below the highest high of the current price move. This method is more adaptable than the fixed percentage; however, when volatility increases, the non-retreating stop may be touched due to market noise rather than a change of direction.
3. *Percentage of profits.* Placing a stop at a point that captures 50% of the profits is a sensible technique except at the beginning of the trade. When there are only small profits, the stop would be too close; therefore, this method can only be used after the price move representing one-half the profits is larger than a 2- or 3-day average price move.

Standard Deviation Stop

As a sound statistical measurement of risk, the standard deviation can be used to determine stop-loss levels.[14] In a method called the *Dev-stop*, Cynthia Kase uses the following steps to create stop-loss levels for both long and short positions:

1. Calculate the *true range* (TR) of the past two trading days using the highest high and lowest low of the 2-day period. That is, use the highest high and the lowest low of the 2-day period, and extend the range by the close of the previous day if it represented a gap.
2. Calculate the rolling *average true range* (ATR) of *TR* (in Step 1), using 30 periods for intraday charts and 20 periods for daily charts.
3. Calculate the standard deviations (STDEV) of the true ranges in Step 1 using the same period as in Step 2.
4. The stop-loss values are $DDEV = ATR + (f \times STDEV)$, where f = 1, 2.06 to 2.25, and 3.20 to 3.50, where the larger values of the pairs correct for skew and the allow for greater risk.
5. The *dev-stop* for long positions is *trade high — DDEV*; the dev-stop for short positions is *trade low + DDEV.*

This method adjusts for volatility using a standard statistical measurement and is applied to the extreme profit of a trade, in the manner of a trailing stop, to prevents unnecessary loss of equity.

Kaufman on Stops

As with many techniques, stops have both good and bad features. The good aspects are summarized in the increased control of risk—in particular the unexpected, extremely large risk of a price shock. It is an added assurance that volatility will not cause losses that are out of proportion to system performance and expected returns.

Ideally, a stop order entered into the market is expected to automatically get you out of a position when prices move adversely. It has the advantage of forcing the trader to decide, in advance, the size of the maximum loss, so that risk is under control. It avoids last-minute decisions and the temptation to hold a losing position with the hope that prices will recover.

Stops are normally *resting orders*, that is, they are held by the floor broker to be executed when the price is reached. For the purposes of discussion, a stop will be any form of an order that is intended to limit losses to a fixed amount, whether or not the order is placed in advance.

Risk Protection or False Hope?

The use of stops, or the intent to limit losses to a predetermined fixed amount, may give a false sense of security. For example, a stop order that is reached during an illiquid or quiet market will result in large slippage; during a fast market, or a price jump, it will often result in the worst execution. Large orders cannot be entered as stops because, when hit, they move the market and guarantee substantial slippage.

Market Noise and the Frequency of Stops

The use of small stops, or the trading practice of exiting a trade with a small loss, causes the total performance of a trend strategy to be worse. Small losses occur frequently due to market noise and are not an indication that the trading strategy is wrong or that the trend direction has changed.

Larger stop-losses offer some benefit for longer-term trading, when high volatility has caused the reverse trading signal to be very far away. Large stops may help reduce the risk of a price shock, but not always. Stops may reduce the volatility of portfolio returns simply by being out of the market more often.

Theoretically, the purpose of using a stop-loss is to limit each loss to a controlled amount, and generate a performance profile with a reasonable ratio of average profits to average losses (for example, an average profit of 2.5 with an average loss of 1.0). In addition, a trader would like to have at least one-half of all trades profitable. Unfortunately, the market does not work this way. It is not possible to control both the reward/risk ratio and the percentage of profitable trades.

Noise is the term given to erratic and unpredictable price movements. It is most often associated with relatively small moves, but can actually be any size. A price shock causes the larger price moves, many of which change direction as soon as the information has been absorbed into the market. Everyday noise is caused by traders entering and exiting the market with different objectives and different time horizons. For example, an institutional investor adds positions because of new funds from its clients; Russia sells gold to pay for a wheat purchase; or, an auto company liquidates part of its stock portfolio to cover foreign exchange losses. Because each event is unrelated to the other and there are so many of them, the total picture created by this noise appears to be random. This pattern has many of the properties of a random distribution, in particular, *price changes* (*noise*) *that are twice as large occur half as often.*

Total Losses Are Constant

If noise is very similar to a random distribution, then the number of occurrences times the size of the move will be very close to a constant value. This has a direct impact on the placement of a stop-loss order when it is close to the current price level. For example, the following is a typical result of setting a stop loss at 5, 10, and 20 pips below the current price:

Open table as spreadsheet

Size of Stop	No. of Occurrences	Size of Loss
5 pips	20	100 pips + slippage
10 pips	10	100 pips + slippage
20 pips	5	100 pips + slippage

In reality, this pattern may vary slightly from market to market; however, the cost of slippage will usually be large enough to cause the net losses to be similar. In addition, more frequent trading must also have additional transaction costs, with a

chance of larger slippage from time to time; therefore, the strategy that uses smaller stop-losses should perform worse than the strategy with larger stops. Larger stops have a better percentage of saving a price move that will continue in its direction because, as price moves are sustained, the number of price moves that can be classified as noise will fall sharply compared to a true trend change.

A Stop-Loss Can Conflict with the Trading Strategy

Combining a small stop-loss with a trend-following system is very likely to conflict in purpose. If a trending system gives one new trend signal each month, but the stop-loss is so small that it would be reached once each week, it would be very difficult to stay with a system position. Once stopped out, if the market turns and moves in the direction of the trend, the system is proved right but you have no position. It is necessary to create a reentry strategy that can be unnecessarily complex.

If every time you are stopped out of a trade the price continues in the same direction until a reverse position is signaled, then it follows that the selection of the trend calculation period is too slow. Rather than exit the trade when the stop is reached, the system should reverse its position. By shortening the trend calculation period, the need for a stop is eliminated.

Testing Stops over Ten Years

Table 23.2 gives the pattern of performance for a simple moving average trading system with calculation periods from 5 to 300 days and stops from .02% to 10%. Four major markets were selected: two stocks and two futures markets. The smallest stop-loss of 2% appears on the left, and the largest (10%) and no stop ("NONE") appear on the far right. Overall, the performance of the trend program without a stop is most consistent for the range of trend periods, although specific stops can be better for some intervals. It may be noted that there is a pattern in Siemens, where the best performance runs diagonally from the upper left towards the bottom right. This indicates that the size of the optimum stop loss may be related to the speed of the trend, but this pattern is not the same for the other markets tested, therefore it may be the result of a single trade, such as the crash of 1987 and not a robust relationship. Table 23.3 shows the same results for the German mark (now the euro) and Eurodollars in terms of risk-adjusted returns, where the returns are divided by one standard deviation of the equity changes. In general, these results were the same as the unadjusted ones in Table 23.2.

Table 23.2: Results of Tests Comparing Trend Period and Size of Fixed Stops[*]

Open table as spreadsheet

Stop-Losses: Results of Longer-Term Tests Annualized Rate of Return (Adjusted for 25% Drawdown												
(a) Chrysley Motors: 2329 Days (1/05/84 to 3/18/93)												
Stop-Loss in Whole Percant												
	.02	.05	.10	.15	.25	.50	1.00	2.00	4.00	7.00	10.00	NONE
5	-2.8	-2.8	-2.7	-2.7	-2.7	-2.8	-2.8	-2.7	-2.8	-2.8	-2.8	-2.8
10	-2.8	-2.8	-2.8	-2.8	-2.8	-2.8	-2.8	-2.8	-2.8	-2.8	-2.8	-2.8
25	-2.8	-2.8	-2.8	-2.7	-2.8	-2.8	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6
50	-2.6	-2.6	-2.6	-2.6	-2.6	-2.6	-2.2	-2.3	-2.2	-2.2	-2.2	-2.2
75	-1.2	-1.2	-1.2	-1.4	-1.4	-1.5	-1.5	-1.6	-1.4	-1.5	-1.5	-1.5
100	-1.5	-1.5	-1.5	-1.6	-1.7	-1.9	-.6	-.7	-.5	-.6	-.6	-.6
150	5.8	5.7	5.7	5.3	5.4	4.9	4.5	4.0	3.6	3.5	3.5	3.5
200	2.2	2.2	2.2	1.9	1.7	1.6	1.4	2.8	2.7	2.7	2.7	2.7
250	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-2.5	-.4	-.1	2.0	2.0	2.0
300	3.6	3.6	3.4	3.4	3.2	3.1	3.0	2.5	2.4	2.4	2.4	2.4
(b) Siemens: 1452 Days (2/3/87 to 11/23/92)												
	.02	.05	.10	.15	.25	.50	1.00	2.00	4.00	7.00	10.00	NONE
5	1.5	1.5	2.1	1.6	.9	1.4	1.9	1.5	1.2	1.2	1.2	1.2
10	11.8	11.7	12.0	11.4	10.6	8.5	8.2	7.5	6.7	6.0	6.0	6.0

25	10.1	10.1	9.4	8.8	7.4	6.8	5.0	3.7	3.5	3.0	3.0	3.0
50	6.3	6.3	6.1	5.6	8.9	6.7	6.7	8.4	8.8	7.7	7.7	7.7
75	9.8	9.4	11.4	11.6	12.1	11.1	8.3	10.0	9.7	8.7	8.7	8.7
100	5.2	5.2	4.8	4.9	4.1	3.1	4.8	5.9	5.9	5.3	5.3	5.3
150	5.0	4.9	4.9	5.0	5.0	4.2	3.0	4.7	7.8	7.7	7.0	7.0
200	3.6	3.6	3.6	3.2	2.9	2.2	2.9	1.8	2.9	2.8	2.8	2.8
250	4.5	4.4	4.4	4.3	3.9	3.3	4.4	5.2	4.9	4.9	4.9	4.9
300	4.4	4.4	4.4	4.2	5.4	4.9	4.1	2.7	2.4	2.4	2.4	2.4
(c) German Mark (euro): 2570 Day (11/24/82 to 11/23/92)												
	.02	.05	.10	.15	.25	.50	1.00	2.00	4.00	7.00	10.00	NONE
5	-1.9	-1.9	-1.9	-1.9	-1.9	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8	-1.8
10	-1.4	-1.1	-1.0	-1.0	-1.1	-.7	-.6	-.6	-.6	-.6	-.6	-.6
25	1.7	2.6	3.6	2.9	3.8	3.8	5.5	5.7	5.3	5.2	4.9	5.4
50	5.2	6.9	6.8	6.4	3.7	12.8	11.0	11.5	10.8	10.8	10.8	10.8
75	3.4	4.8	6.1	5.6	8.5	13.4	10.0	8.7	7.8	7.6	7.6	7.6
100	5.3	7.2	8.5	8.3	4.5	10.8	11.5	7.4	9.1	7.5	7.5	7.5
150	.5	.3	.0	-.4	1.6	8.1	6.8	7.7	5.3	3.6	3.6	3.6
200	.7	2.0	1.7	1.1	10.1	11.7	7.7	9.6	6.9	7.6	7.0	7.0
250	8.0	9.1	8.1	8.1	6.5	5.5	7.2	8.8	5.4	11.0	9.1	10.4
300	.7	.4	.2	-.1	.5	5.1	5.1	5.6	4.3	12.3	10.7	10.4
(d) Eurodollars: 2556 Days (1/03/83 to 12/14/92)												
	.02	.05	.10	.15	.25	.50	1.00	2.00	4.00	7.00	10.00	NONE
5	1.2	1.3	1.4	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1
10	1.8	2.1	3.1	2.7	2.7	2.6	2.7	2.7	2.7	2.7	2.7	2.7
25	3.8	3.0	6.7	6.1	8.2	7.4	7.4	7.4	7.4	7.4	7.4	7.4
50	4.0	8.5	10.5	7.7	8.1	7.8	7.7	7.7	7.7	7.7	7.7	7.7
75	6.5	10.2	8.1	9.2	10.8	10.0	9.9	9.9	9.9	9.9	9.9	9.9
100	7.1	4.8	8.9	6.3	6.4	7.2	7.8	7.8	7.8	7.8	7.8	7.8
150	4.1	1.8	2.9	2.6	6.4	5.0	7.6	7.6	7.6	7.6	7.6	7.6
200	7.3	5.4	.8	.4	2.9	5.9	6.5	6.5	6.5	6.5	6.5	6.5
250	1.1	-.8	-.8	.1	4.1	3.8	6.9	5.6	5.6	5.6	5.6	5.6
300	.2	-.1	-.6	-.8	.3	6.7	5.6	5.4	5.4	5.4	5.4	5.4

[*]Exponential smoothing was used to create a trend with buy and sell signals given when the trendline turned up or down, respectively, Stops apply to absolute losses, all orders were executed at the close of the day and there were no commissions or slippage charged. Although stopa improve performance in specific cases, there does nor seem to be a consistent pattern. Smaller stops are especially erratic, as the trends increase in length, often showing alternating better and worse performance.

Table 23.3: Comparison of 4-Year Test Results[*]

Open table as spreadsheet

Stop-Losses: 4-Year Test Results												
Comparison of Cash Return Versus Risk-Adjusted Return												
German Mark (Euro): 1030 Days (11/22/88 to 11/23/92)												
Annualized Rate of Return (on Cash, in Percent)												
Stop-Loss in Whole Percent												

	.02	.05	.10	.15	.25	.50	1.00	2.00	4.00	7.00	10.00	NONE
5	-7.5	-7.1	-7.3	-8.3	-9.9	-8.5	-7.1	-7.1	-7.1	-7.1	-7.1	-7.1
10	-6.8	-5.0	-5.3	-6.2	-7.6	-7.0	-4.4	-4.3	-4.3	-4.3	-4.3	-4.3
25	2.8	5.5	5.4	5.4	5.4	4.2	6.5	7.4	7.4	7.4	7.4	7.4
50	5.6	10.2	9.9	10.1	9.6	8.3	8.3	8.7	8.0	8.0	8.0	8.0
75	2.8	2.2	1.6	1.6	5.0	7.0	5.1	5.0	3.6	3.4	3.4	3.4
100	1.3	4.2	3.6	3.5	7.4	5.4	8.7	8.6	9.3	9.1	9.1	9.1
150	1.2	.9	.7	.7	-1.1	7.6	9.3	11.2	8.8	7.5	7.2	7.2
200	5.3	9.1	8.9	8.7	8.2	6.4	7.9	9.7	7.0	5.2	4.6	4.6
250	5.9	8.3	8.1	8.0	7.7	6.7	6.1	7.9	5.2	5.6	4.9	4.7
3001	2.0	1.8	1.5	1.2	.9	4.5	6.4	8.1	5.4	6.6	5.9	5.5
Annualized ROR (Adjusted for 25% Drawdown)												
	.02	.05	.10	.15	.25	.50	1.00	2.00	4.00	7.00	10.00	NONE
5	-3.7	-3.6	-3.6	-3.8	-4.2	-4.0	-3.6	-3.6	-3.6	-3.6	-3.6	-3.6
10	-3.9	-2.8	-2.9	-3.2	-3.6	-3.5	-2.5	-2.4	-2.4	-2.4	-2.4	-2.4
25	2.7	4.8	4.6	4.6	4.6	3.3	7.1	10.9	10.9	10.9	10.9	10.9
50	12.7	23.3	22.5	25.2	21.7	17.3	16.0	16.8	15.5	15.5	15.5	15.5
75	4.4	3.6	2.2	2.2	7.8	14.5	7.5	6.6	4.4	4.2	4.2	4.2
1001	2.8	8.7	7.0	6.8	18.1	9.5	18.1	11.3	19.1	18.6	18.6	18.6
150	3.7	2.4	1.7	1.7	-1.7	12.1	12.0	14.6	10.8	8.3	8.0	8.0
200	14.0	22.0	19.3	19.2	17.1	13.4	13.2	15.1	9.1	5.9	5.3	5.3
250	14.7	18.8	17.6	16.7	16.0	12.8	9.9	12.9	7.4	8.2	7.2	6.9
300	5.7	4.5	3.4	2.8	1.9	8.3	9.8	12.8	7.0	10.3	9.2	8.7
Eurodollars: 1042 Days (11/22/88 to 12/14/92)												
Annualized Rate of Return (on Cash, in Percent)												
	.02	.05	.10	.15	.25	.50	1.00	2.00	4.00	7.00	10.00	NONE
5	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3
10	.9	.9	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
25	.3	.4	.9	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
50	.3	.5	1.0	1.3	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6
75	.7	.8	1.1	1.1	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
100	.9	.8	1.0	1.0	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0
150	.0	.1	.1	-.1	.6	.9	.9	.9	.9	.9	.9	.9
200	.l	.l	l	.1	.7	1.1	1.1	1.1	1.1	1.1	1.1	1.1
250	.2	.2	.2	.2	.9	1.2	1.2	1.2	1.2	1.2	1.2	1.2
300	.2	.3	.2	-.3	.4	.6	.6	.6	.6	.6	.6	.6
Annualized ROR (Adjusted for 25% Drawdown)												
	.02	.05	.10	.15	.25	.50	1.00	2.00	4.00	7.00	10.00	NONE
5	2.9	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
10	21.9	22.4	25.7	19.5	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9
25	2.9	4.6	11.3	28.6	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9
50	7.6	12.6	23.8	33.0	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8
75	18.5	20.7	27.4	27.1	32.6	32.0	32.0	32.0	32.0	32.0	32.0	32.0

100	22.1	18.3	25.9	25.6	28.5	25.6	25.6	25.6	25.6	25.6	25.6	25.6
150	.7	1.4	-1.3	-1.3	7.3	11.4	10.9	10.9	10.9	10.9	10.9	10.9
200	3.5	1.7	1.2	1.0	9.1	13.8	14.1	14.1	14.1	14.1	14.1	14.1
250	4.4	5.9	4.9	4.4	16.8	14.8	15.1	15.1	15.1	15.1	15.1	15.1
300	4.3	6.5	5.6	-3.4	4.1	5.2	5.4	5.4	5.4	5.4	5.4	5.4

[*]The pattern in the "NONE" column (no stops) shows that the risk-adjusted results, in general, are more consistent than unadjusted returns.

Managing Risk with and without Stops

Despite the conclusion that the placement of fixed level stops causes a trade to be stopped out arbitrarily, it is difficult to trade without a clear idea of risk. For longer-term positions, a fixed stop-loss may help in the case of catastrophic risk. Before a stop-loss is used, it should be tested and compared with system performance that does not use a stop. Careful selection of the trading strategy may provide adequate risk control without an added stop-loss.

While fixed stops do not seem to enhance a trading program, a stop based on support and resistance levels may be quite different. It is already known that a breakout system that enters on a new high and reverses on a new low assumes the risk of the range defined by the difference between the high and low. This is analogous to the size of a support-resistance range. Because this range varies with market volatility and offers a view of risk that contrasts with a trend system, the combination of the two may improve net performance.

The safest way to reduce risk is simply to reduce the size of your positions, especially as volatility increases. Trading a smaller portfolio, a lower margin-to-equity ratio (less leverage), is the simplest approach to risk reduction and does not conflict with the underlying trading strategy. When trading stocks, allocating an equal dollar amount to each trade (therefore trading fewer shares as price or volatility increases) is also a sound risk-management approach. In the final analysis, the one who can profit by trading the smallest amount will be hurt the least when a price shock hits the market.

[11]Tushar Chande and Stanley Kroll, *The New Technical Trader* (Wiley, New York, 1994)

[12]John Sweeney, *Campaign Trading* (Wiley, New York, 1997).

[13]Tushar Charade and Stanley Kroll, *The New Technical Trader* (Wiley, New York, 1994).

[14]Cynthia Kase, "Redefining Volatility and Position Risk," *Technical Analysis of Stocks & Commodities* (October 1993).

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RANKING OF MARKETS FOR SELECTION

Choosing the right market to trade at the right time would clearly improve performance. To accomplish this, there are a number of ways to measure the *trendiness* of a market, from standard statistical techniques to more complex rules. Each unique method will measure some special characteristic of price movement. To take advantage of this it is necessary to trade using a system that targets this type of price pattern. For example, if you use a correlation coefficient, r^2, to rank the trend over 20 days, then a linear regression is probably the best choice of a trend-following system, using a period no greater than 20 days.

It may be interesting to list a number of trend-ranking approaches, then keep track of their values in a table over various time periods.[15] For example, the five measurements below can be calculated for periods of 5, 10, 20, and 40 days.

1. Correlation coefficient, but only for values greater than .25.
2. Sum of the net $ movement over n, 2 × n, and 4 × n days.
3. Slope of an n-day regression converted to a 1-day $ change.
4. Wilder's ADX, but only for values greater than .20.
5. Average absolute value of price changes.

Each measurement will need to have threshold values that determine when they represent significant trends. For the correlation coefficient, anything below .25 is most likely to be a sideways market; similarly, Wilder's ADX would need to be above .20 to indicate a trend. If the results are erratic, it may be necessary to smooth the last 3 days of each value. In the case of item 5, higher volatility is often associated with greater profits and greater risk for a trend-following system; therefore, a careful look at how this ranking affects performance is warranted.

Commodity Selection Index

Among Wilder's trading tools is the *Commodity Selection Index* (CSI),[16] a calculation for determining which products are most likely to make the greatest move for each dollar invested. In this case, the movement measured is *directional* and, therefore, should apply directly to trending models. The CSI combines directional movement, volatility, margin requirements, and commission costs into an index that allows for comparison and selection.

Directional Movement

The trending quality of the market, as defined by Wilder, begins with *directional movement*, the greater of either:

1. Plus DM (PDM), today's high minus yesterday's high, $H_t - H_{t-1}$.
2. Minus DM (MDM), today's low minus yesterday's low, $L_t - L_{t-1}$.

Note that *plus DM* and *minus DM* are often written as *+DM* and *-DM*; however, to avoid confusion in the following calculations, they will be shown as *PDM* and *MDM.*

The directional movement is either up or down, whichever is larger. It is the largest part of today's range that is *outside* yesterday's range. The value that is not used is set to zero. When an inside day occurs, both *PDM* and *MDM* are zero, and the directional movement is zero (Figure 23.6).

Figure 23.6: Defining the DM.

DM is expressed relative to today's *true range* (TR1), the larger of the following:

1. Today's high minus today's low, H_t - L_t.
2. Today's high minus yesterday's close, H_t - C_{t-1}.
3. Yesterday's close minus today's low, C_t - L_{t-1}.

The true range is always positive.

The relationship of the price direction to the true range is called the *Directional Movement* (DM). Today's directional movement is calculated using either the PDM or the MDM, whichever is greater.

$$PDM14 = +\frac{DM14}{TR14} \quad or \quad MDM14 = -\frac{DM14}{TR14}$$

Once the first DM14 is calculated, using 14 days of price movement, an *average-off* technique is used to find each successive DM14 as follows:

$$PDM14_t = PDM14_{t-1} - \frac{PDM14_{t-1}}{14} + PDM14_t$$

$$MDM14_t = MDM14_{t-1} - \frac{MDM14_{t-1}}{14} + MDM14_t$$

The same procedure is followed for the true range:

$$TR14_t = TR14_{t-1} - \frac{TR14_{t-1}}{14} + TR14_t$$

These results can also be produced using a smoothing constant of .071, which is an approximation of the fraction $1/14$, as follows, where t is today's value:

$PDM14_t = .071 \times PSM14_{t-1} + PDM14_t$

$MDM14_t = .071 \times MDM14_{t-1} + MDM14_t$

$TR14_t = .071 \times TR14_{t-1} + TR14_t$

At this point, the Directional Movement components can be used as trading indicators; they are the subject of the section "Optimizing Directional Movement." However, Wilder's interest was to use this in a more complete concept.

Directional Indicator and True Directional Movement

Once the PDM14, MDM14, and the TR14 are calculated, the *directional indicators*, PDI14 and MDI14 follow,

$$PDI_t = \frac{PDM14_t}{TR14_t}$$

$$MDI_t = \frac{MDM14_t}{TR14_t}$$

and the *true directional movement* (DX) is the difference between PDI14 and MDI14. When an upward trend is sustained, the MDI current value is zero; therefore, the PDI14 becomes larger, the MDI14 becomes smaller, and DX becomes greater. This is then *normalized* in order to express the final value between 0 and 100.

$$DX_t = 100 \times \frac{\left|PDI14_t - MDI14_t\right|}{PDI14_t + MDI14_t}$$

where multiplying by 100 converts the percentage to a whole number, and the absolute value prevents DX from becoming negative. At the same time, the absolute value causes DX to lose the information about which direction prices are moving.

Average Directional Movement Index (ADX)

The DX is then smoothed using a 14-day average (or .133 smoothing constant), and is called the *Average Directional Movement Index* (ADX).

$$ADX_t = ADX_{t-1} + .133 \times (DX_t - ADX_{t-1})$$

The ADX, the PDM, and the MDM are shown for Nasdaq 100 continuous futures in Figure 23.7. The heavier ADX line moves higher as the price trend becomes clear. The individual components, the PDM (shown as the thinnest line) and the MDM (the mediumweight line) indicate the relative strength of the upwards and downwards moves within the trend. As Nasdaq prices decline, the MDM remains above the PDM, which is shown along the bottom of the lower panel.

Figure 23.7: The 14-day ADX, PDM, and MDM, applied to Nasdaq 100 continuous futures prices, February–August 2002.

One last adjustment is made to the extreme variance of the ADX by taking the average of the current value and the value of the ADX 14-days ago. This final rating is called the *Average Directional Movement Index Rating* (ADXR),

$$ADXR_t = \frac{ADX_t + ADX_{t-14}}{2}$$

The ADX and ADXR are shown plotted together in Figure 23.8. The ADX is seen to oscillate about the ADXR. Measuring the distance of the ADX from the zero line, a higher amplitude means higher directional movement and a stronger trend, whether up or down. The peaks are always the extremes. The distance between the ADX and ADXR is used *to* measure the overbought and oversold condition of the trend. The larger the value, the greater the reactions to the trend.

Figure 23.8: The ADX and ADXR.

Using the ADX as a Trending Indicator.

The ADX has become popular in many ways. Ruggiero[17] uses it to determine the trend with the following rules:

1. If ADX crosses above 25, the market is trending.
2. If ADX crosses below 20, the market is consolidating.
3. If ADX crosses below 45 after being higher, the market is consolidating.
4. If ADX rises above 10 on 3 of 4 days after being lower, the market will start to trend.
5. If a trend based on rule 4 remains in effect until the 5-day difference in the ADX is less than 0.

Commodity Selection Index

The creation of the Directional Movement Indicator, the different components, and finally the ADX leads to the *Commodity Selection Index* (CSI), which is calculated as:

$$CSI_t = ADXR_t \times ATR_t \times \left[100 \times \frac{V}{M} \times \frac{1}{150 + C}\right]$$

where ADXR = average directional movement index rating
ATR14 = 14-day average true range
V = conversion factor; value of a 1¢ move for a futures market (in dollars)
M = margin (in dollars)
C = commissions (in dollars)

The CSI can be applied to equities by setting $V = 1$ and M to the total share value of the investment. Note that for a particular futures market, or for equities, the value in the bracket does not change. By calculating it once and calling that value K, the CSI can be expressed as:

$$CSI_t = ADXR_t \times ATR14_t \times K$$

A portfolio allocation can be chosen by calculating the CSI daily or weekly for each market. Simply select those products to trade that have the highest CSI or allocate position size in proportion to their CSI value.

Optimizing Directional Movement[18]

When these indicators were published in 1978, they were all based on a 14-day calculation period, which is why all of the notations include the number 14. With the ability to test these indicators over different calculation periods, the "14" was dropped from the notation. The first study to use PDI and MDI, the directional indicators, in a trading strategy was by Hochheimer, known for his other studies of moving averages, crossovers, and channels. He defined the rules of a *Directional Movement System* in two ways.[19] The first set of rules is:

1.
    a. *Enter a new long position and close out any short sales.* If the PDI crosses above the MDI, enter a *buy stop* on the next day using today's high price. This order remains as long as it is not executed and PDI remains higher than MDI.
    b. *Enter a new short sale and close out any long positions.* If the MDI crosses below the PDI, enter a *sell stop* on the next day using today's low price. Maintain this order until it is executed and while MDI remains below PDI.

Hochheimer calls the first case "directional movement with delay." The second case is an immediate market entry following the crossing of the directional indicators:

2.
    a. *Enter a new long position and close out any short sales.* If the PDI crosses above the MDI, buy on the open of the next day.
    b. *Enter a new short sale and close out any long positions.* If the MDI crosses below the PDI, sell on the open of the next day.

In both cases the system is always in the market. Before seeing the actual results, it is possible to generalize the expected performance.

1. Rule 2 must have more trades than Rule 1 because it always takes a position when a crossing occurs, while the first set of rules requires a confirmation.
2. Because there is no commitment to the trade (for example, no price channel), there could be frequent whipsaws using Rule 2.
3. Because Rule 1 uses the high and low of the prior day, its entry prices will always be equal to or worse than those of Rule 2.
4. If the Directional Indicator gives a highly reliable signal, it would be better to enter immediately, as in Rule 2.

Parameters and Test Ranges Defined

The purpose of the optimization was to see if changes in the calculation period caused improvements in results. Hochheimer chose the following parameters to test:

1. The PDM was calculated from 7 to 20 days.
2. The MDM varied from 5 above to 5 below the PDM value.
3. Two *true ranges* (TR) were calculated, the first using the parameter value of the PDM, the other using the parameter value of the MDM.

The test data covered a wide range of those futures markets available from 1970 to 1981.

Results

Selected results are shown in Table 23.4. The patterns resulting from the two sets of rules are as expected. Rule 2 has more trades, with a higher percentage of losses and higher risk. The returns using Rule 1 are consistently higher than Rule 2, indicating that, even using the best parameter values, it is best to wait for a confirmation of the signal rather than take every signal.

Table 23.4: Comparative Performance of Directional Movement Systems

Open table as spreadsheet

	Rule 1					Rule 2			
	Calculation Periods	P/L		Equity Drop	No. of Trades	Calculation Periods	P/L	Equity Drop	No. of Trades
Cocoa	22 17	$	43,083	$-13,019	723	23 18	$-4,117	$-17,152	1238
Corn	21 20		26,456	-7,072	613	21 20	26,456	-7,072	613
Cotton	18 21		37,495	-21,740	1256	24 19	29,765	-18,340	1462
Copper	18 20		219,639	-10,230	633	12 14	88,561	-13,390	1549
Deutschemark	8 13		140,538	-6,335	277	14 14	101,476	-7,290	423
Gold	15 10		827,980	-10,740	504	1612	664,390	-13,810	1041
Cattle	22 19		-7,850	-11,710	474	20 20	-14,860	-27,920	808
Soybeans	16 20		254,495	-39,639	895	19 20	177,584	-29,759	1420
Silver	16 11		1,034,825	-82,870	788	22 17	351,360	-136,585	1161
T-Bills	3 7		37,840	-12,005	286	11 8	5,235	-17,545	369
T-Bonds	8 7		185,371	-11,326	436	9 8	118,256	-7,294	739

It can also be seen that those markets with only a small amount of available data T-bills, T-bonds, currencies, and gold—had shorter calculation periods chosen. By observing the tendency for the products with more data to use longer, very similar intervals, these faster choices should be viewed with

skepticism. A *standard set* of calculation periods, that is, the same periods for all markets, may be a robust solution, rather than allowing an apparent overfitting of some of the data.

The similarity of the best calculation periods for the PDM and MDM is a hint that the use of different periods for these indicators may not be the right approach. The tests seem to be telling us that the same periods should be used. Philosophically, a comparison between the PDM and MDM may only make sense if they use the same calculation periods. They are intended to show the relative strength of the market, or the trendiness of prices, during a fixed time interval. Independently varying the calculation periods of these two indicators may introduce a directional bias as well as an opportunity for overfitting.

Trading Rules Combining PDM, MDM, and ADX

Most often, the three indicators, PDM, MDM, and ADX, are used to complement a trending strategy by improving the entry or exit timing. However, Colby[20] has found that the following rules, using a 2-day calculation period, were profitable for the Dow Jones Industrial Averages for 72 years from 1928 to 2000:

> *Enter a new long position* when the 2-day PDI > the 2-day MDI *or* the 2-day ADX > the 2-day smoothing of the ADX.
>
> *Close out a long position* when the 2-day PDI < the 2-day MDI *or* the 2-day ADX < the 2-day smoothing of the ADX.

Entering a new short sale and exiting a short sale are the opposite rules. All orders are executed on the close. The results show that a $100 investment would have returned $9,988 after profits were reinvested, which was better than a buy-and-hold strategy by 118%. Because of the strong bull market of the 1990s, this strategy would have lost money on its short sales since 1987.

Kaufman's Strategy Selection Indicator

A market's *personality* is reflected in its price patterns. Some markets, such as the S&P 500 index, are very volatile with gradual upward moves and fast, sharp drops. In contrast, Eurodollars are very steady, often trading high volume at the same price. Qualifying markets by their underlying level of *noise* allows you to decide which trading strategy is most likely to be successful. Less noise favors trending systems and high noise makes meanreverting techniques more appropriate.

The concept of *noise* has been discussed in numerous sections throughout this book, and it is again of great value when choosing which system to apply to a market and identifying when a market is best treated as trending. In essence, noise is market movement that has no direction or price movement in which the amount of direction is overwhelmed by erratic up and down movement. It is an undercurrent of unpredictable movement caused by a broad range of participants acting for their own objectives.

The calculation for noise can be found with examples in Chapter 17. As a simple reminder, it is defined as the *efficiency ratio, ER,* the net price change divided by the sum of the individual price changes taken as positive values, over the same time interval.

$$ER_t = \frac{\left|Price_t - Price_{t-n}\right|}{\sum_{t}^{t-n} \left|Price_i - Price_{i-1}\right|}$$

Time Frame

There always appears to be more noise over short time periods. That is because noise remains at about the same level, but price trends are not clear until they have persevered for at least a few days (and often for weeks). When using the efficiency ratio to measure noise, the very short intervals should be avoided; therefore a 16-day exponential smoothing will be used in the following comparison. In order to be certain that the efficiency ratio is stable, it will be calculated over a 65-day period.

Results of Efficiency Ratio Selection

Figure 23.9 shows that, when the returns of a trend based on a 16-day smoothing are compared to the average value of the efficiency ratio, profits are clearly greater when the ER is high; losses are larger when the ER is low. There is a pattern that begins in the lower left of the chart and broadens as it moves towards the upper right. Losses are consistent when the 65-day ER is below. 15, and profits increase as the value of ER increases above .15. ER values will be larger when a shorter calculation period is used.

Figure 23.9: Efficiency ratio and trend performance. A clear pattern can be seen when a long-term efficiency ratio (market noise) is plotted against the trend performance of a broad sampling of markets using 16-day exponential smoothing.

These results seem very consistent for abroad set of markets. The greatest profits are in the upper right part of the diagram where there is less noise; the greatest losses are in the lower left corner where there is the most noise. The efficiency ratio can be used for strategy selection as follows:

> When the efficiency ratio is high, then a trend system is a better strategy.
>
> When the efficiency ratio is low, then a mean-reverting system is best.

In the second case, a mean-reverting approach does not mean that you must set a short position when the market is moving up. It can also mean taking profits on a long position when there is a trend sell signal, or building a long position when a trending buy signal occurs on a price drop. While the efficiency ratio is not specifically a directional indicator, it does have the ability to classify markets as trending or not trending.

[15]Based on an idea suggested in Chande and Kroll, *The New Technical Trader* (Wiley, 1994).

[16]J. Welles Wilder, "Selection and Direction" in Perry J. Kaufman (Ed.), *Technical Analysis in Commodities* (Wiley, New York, 1980).

[17]Murray A. Ruggiero, Jr., *Cybernetic Trading Strategies* (Wiley, 1997).

[18]For a general discussion of this topic, see Chapter 21.

[19]Frank L. Hochheimer, *Computerized Trading Techniques 1982* (Merrill Lynch Commodities, New York, 1982).

[20]Robert W. Colby, *The Encyclopedia of Technical Market Indicators*, Second Edition (McGraw-Hill, 2003).

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PROBABILITY OF SUCCESS AND RUIN

The relative size of trading profits and losses, the frequency of the losses, and the sequence in which they occur combine to form an equity profile. This can apply equally to the returns of individual discretionary traders or fully automated trading systems. This profile can be used to determine the capitalization necessary to maintain trading during the losing periods and allow the system to return to its full potential. In investment terminology and probability theory, the level at which there is no longer enough money to continue trading is called the *point of ruin,* and the likelihood of getting there is the *risk of ruin.* The probability of the *risk of ruin* is expressed as

$$R = \left[\frac{1-A}{1+A}\right]^c$$

where 0 = R = 1, 0 indicates no risk, and 1 is certain ruin
A = P - (1 - P), P is the proportion of winning trades, also called the *trader's advantage*
c = the beginning units of trading capital (subsequent units can be expressed in fractional increments)

A trading system that has 60% profitable trades and trading capital in $10,000 units will have a risk of ruin calculated as follows:

$$A = 0.60 - (1 - .060) = 0.20$$

$$R = \left(\frac{1-0.20}{1+0.20}\right)^c = \left(\frac{0.80}{1.20}\right)^c = \left(\frac{1}{3}\right)^c$$

When c = 1, and the initial investment is $10,000, the risk of ruin is R = 0.33, or 33%. When c = 2 and the initial investment is $20,000, R = 0.11, or 11%. Therefore, the greater the trader's advantage or the greater the capital, the smaller the risk of ruin (Figure 23.10).

Figure 23.10: Risk of ruin based on invested capital.

When using profit goals, the point at which trading would stop, the chance of ruin should decrease as the goal becomes closer. The relationship can be expressed as:

$$R = \frac{\left[(1+A)/(1-A)\right]^{G} - 1}{\left[(1+A)/(1-A)\right]^{c+G} - 1}, \; 0 \le R \le 1$$

where all terms are the same as above, and G is the goal in units of trading capital.

Wins Not Equal to Losses

The basic equations just presented are generally applied to gambling situations, where the size of profits and losses are the same. This requires that the percentage of winning events exceed the losing events in order to avoid ruin. Trading, however, often results in more losing trades than profitable ones and must therefore return much *larger* profits than losses. This pattern is common to all conservation-of-capital systems, such as trend following. The risk of ruin of unequal profits and loss, including an unequal chance of a profit or loss, can be found as follows:[21]

C_T = the total capital available for trading (in units)

C_R = the cutoff point, where level of ruin is reached ($C_R < C_T$)

C_A = $C_T - C_R$, capital available to be risked

E = the expected mean return per trade, the probability-weighted sum of values that a trade might take

$$E = \sum_{i=1}^{n} (PL_i p_i)$$

where PL_i = the possible profit or loss value

p_i = the probability of PL_i occurring ($0 < p_i < 1$)

E_2 is the expected squared mean return per trade, the probability-weighted sum of all the squared values of a trade,

$$E_2 = \sum_{i=1}^{n} (PL_i^2 p_i)$$

where PL_i and p_i are defined above.

$$D = C_A / \sqrt{E_2}$$

$$P = 0.5 + E / (2\sqrt{E_2})$$

and the risk of ruin is

$$R = \left(\frac{1-P}{P}\right)^D$$

Introducing an objective and a desired level of capital *L,* the risk of ruin *R* becomes

$$R = 1 - \frac{[(1-P)/P]^D - 1}{[(1-P)/P]^G - 1}$$

where

$$G = 1 / \sqrt{E_2}$$

As in the first situation, using equal profits and losses, the risk increases as the objective *L* increases.

Ralph Vince, in *Portfolio Management Formulas* (Wiley, New York, 1990) derived similar results from P. Griffin's work, *The Theory of Blackjack* (Gamblers Press, Las Vegas, 1981), which claims to provide a "fair approximation" of risk. Vince's approach has been modified here for convenience and given in a way that allows spreadsheet formulas:

```
Risk of Ruin = ((1 - P)/P)^(MaxRisk/A)
```

where the following terms are defined in the order needed for calculation:

AvgWin is the average winning trade (e.g., $400)

AvgLoss is the average losing trade (e.g., $200)

Investment is the amount invested (e.g., $10,000)

ProbWin is the probability (percentage) of a winning trade (e.g., .40)

ProbLoss is the probability (percentage) of a losing trade (e.g., .60)

MaxRisk is the maximum part of the investment that can be lost, in percent (e.g., .25)

AvgWin% is ABS(AvgWin/Investment)

AvgLoss% is ABS(AvgLoss/Investment)

Z is the sum of possible events, ProbWin*AvgWin% — ProbLoss*AvgLoss%

A is the square root of the sum of the squares of possible events, (ProbWin*AvgWin%^ 2 + ProbLoss*AvgLoss%^ 2) ^ (1/2)

P is.5*(1 + (Z/A))

This can be written as the following spreadsheet example:

Open table as spreadsheet

Row		Col A	Description of Value of Calculation in Column A
1	AvgWin	400.00	Enter average winning trade in $
2	AvgLoss	200.00	Enter average losing trade in $
3	Investment	10000.00	Enter initial capital invested in $
4	ProbWin	.40	Enter probability of a winning trade
5	ProbLoss	.60	(1 - A4)
6	MaxRisk	.25	Enter maximum part of investment that can be lost (in *%)*
7	AvgWin%	.040	abs(A1/A3)
8	AvgLoss%	.020	abs(A2/A3)
9	Z	.0040	A4*A7 + A5*A8
10	A	.0297	(A4*A7^2+A5*A8^2)^(1/2)
11	P	.5674	0.9444
12	Risk of Ruin	.1016	((1 - A11)/A11)^(A6/A10)

In the above example, the risk of ruin is slightly greater than 10% based on historic data. The change in risk can be seen by varying the investment amount. Note that in row 11, when *P* = 1 the risk of ruin is 100%; therefore, *P* cannot be greater than 1.

[21]Fred Gehm, *Quantitative Trading & Money Management*, Revised Edition (Irwin, 1995).

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COMPOUNDING A POSITION

At some point, all speculators find themselves adding to, or compounding, their position. Many traders view this as a means of concentrating their resources on those markets that have more potential. There are two lines of thinking among these traders. When a trade becomes more profitable, it is confirming its move and is thought to deserve more of a commitment than a trade that has not become profitable. Also, by adding positions to a trade at preset intervals, the effect of a single poor entry point is reduced and a better average entry price is created. This later technique is called *scaled-down buying,* or *averaging down,* in the securities industry.

The following sections assume that additional positions are entered as trading profits accumulate. Nothing is added if the trade is not profitable; therefore, it is treating profits as a confirmation that the market is performing according to the trading plan. There are a number of techniques used by experienced traders, but timing is very important. You would like to see additional profits soon after adding positions. There must be substantial remaining profit potential and the amount of risk must be clear. Ideally, the stock or futures market should have a sustained basing formation. No matter how well each entry is chosen, compounding will result in the largest holdings at the highest (or lowest) price; when the market reverses, losses occur on a larger base and profits will disappear quickly. A compounded position is very fragile and top-heavy; prices must be watched carefully for a change of direction. It is possible to compound a small investment into a large fortune in a few months, then lose it all in a few days. As in all investments, the opportunities are balanced by the risk.

Compounding is easier with stocks than futures. While each share of stock may be $10 to $50, the minimum purchase of a futures contract can require $1,000 to $25,000 in margin, and additional capital reserves. If we started with 100 shares of Dell at $25, a cost of $2,500, a 1¢ move would generate a profit of $25, enough to buy another share. In futures, if one contract of the mini-S&P required $5,000 in margin, it is likely that there would be equal reserves of $5,000 to hold the leverage to about 4 to 1. The S&P trade would need a profit of 200 points, at $50 per point, to generate a $10,000 profit, the minimum needed to add 1 contract. It would be necessary to start with a large number of S&P contracts in order to produce profits that would allow compounding quickly, if at all.

Compounding at a Slower Rate—The Upright Pyramid

The standard pyramid, or *upright pyramid,* refers to the pattern of size used for compounding, which has a larger base and a small top. The largest portion of profits are developed early and an adverse price move is not as likely to be disastrous. The total position still appears to be top-heavy, but the pattern is conservative. The profit-compounding effect of this technique is comparably reduced. A favorite scaling method of this type adds one-half of the prior position at each opportunity (Figure 23.11a), usually a pullback after a profitable move. The maximum number of contracts to be held must be planned in advance. The total position, if followed to completion, will be about twice the number of contracts as the initial entry. For example, starting with 20 lots, 10, 5, 2, and 1 would be added respectively, for a total of 38. A more conservative plan would add 25% of the previous entry each time there was compounding. An advantage of this or any other pyramiding method is that an initial loss will be based on the smallest position size.

Figure 23.11: Compounding structures. (a) Scaled-down size (upright pyramid) offers a small amount of compounding. (b) Adding equal amounts (inverted pyramid) gives maximum leverage. (c) Reflecting pyramid combines leverage and profit-taking.

Adding Equal Size

Adding equal position size at each compounding level creates an inverted pyramid in the total position size (Figure 23.11). After the first addition, profits and losses accumulate at twice the rate. Once three equal parts have been added, the position is four times the original size. A change of direction of 25% from the starting point would remove all profits. With this approach as well as the other inverted-pyramid methods, the trader should follow the rule that *no unsuccessful secondary purchase should offset the entire profits of the prior purchases.*

Adding Equal Amounts

To offset the effects of disproportionate risk, subsequent positions can be added based on the new value of the stock being traded. Comparing this to the previous method of equal size, this would reduce the size of the added positions in a rising market and increase them in a declining one. If price level and volatility are viewed as directly related, this method of adding equal amounts would add equal risk.

Maximum Compounding

As larger commitments are added, a more inverted pyramid is created in which the risk of an immediate loss due to a small reversal becomes greater. The greatest risk and the most potential is in adding positions using all profits accumulated to date. Whenever possible, new positions are added; profits are considered a confirmation of the trend. Being completely leveraged is a tenuous position, requiring constant monitoring of the market; there must be a well-defined stop-loss at all times in anticipation of a premature reversal. And because prices cannot move in one direction indefinitely, it is best to have a profit objective.

Reflecting Pyramid

One way to reduce the extreme risks of compounding is to remove positions once a specific profit level has been reached. For example, a long in IBM at $70 is seen to have a reasonable expectation of an $8 profit. Using a *reflecting pyramid* (Figure 23.11c) positions are added until the maximum commitment is reached at $4, one-half the expected profit. Above $74, positions are reduced until the trade is entirely closed out at $78. This technique can be modified to apply to any of the methods of adding positions by requiring that the full commitment be achieved at a level below the expected profit; full liquidation may be targeted for a point above the average profit.

Comparison of Compounding Methods

Table 23.5 and Figures 23.12a and 23.12b show the risks and rewards of three methods of compounding compared to the benchmark case of holding the initial position from trade entry to exit. All methods of compounding increase both profits and risk. Holding the initial position shows consistently lower returns with a mostly higher reward/risk ratio, especially at early return levels. Scaled-down additions show an improved return and less attractive ratio; equal additions show much higher returns with a much lower reward/risk profile. The reflecting pyramid has both higher returns than the constant position and an improved ratio. At one-half the expected return, it is clearly a better choice than the other methods. As expected profits are neared, the investor must choose between the extremely high risk and profits of adding equal positions, and the excellent reward/risk ratio of the reflecting pyramid.

Figure 23.12: Returns and risks from compounding. (a) Returns and liquidated value (10-point reversal= $1,000). (b) Reward-torisk ratio.

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EQUITY TRENDS

Every system has profit and loss patterns that can be seen clearly by plotting its daily or weekly returns. Long-term trending techniques show that once or twice each year, there are major increases in profits corresponding to a trending market; at other times, returns show a steady decline and a stabilizing pattern. To see these patterns it is necessary to create the return streams using constant position size.

Increasing positions as equity increases during a trending period always results in being fully invested at the top of the cycle, when losses begin. Losses will be on a larger base than profits, and equity will drop much faster than it increased. Decreasing size as profits increase will reduce risk but lose the advantage of the fat tail. Similar changes can occur at the bottom of an equity cycle after a nontrending market period. A sustained losing streak may cause a speculator to reduce the investment in proportion to dwindling capital. If this happens, the result will be entering into a profitable period with a smaller investment than the prior losing period. The system must have disproportionately larger profits to recover the losses and achieve a net gain. Whether the position size is increased or decreased at different times, the result is that the underlying trend in the system equity is altered.

Table 23.5: Comparison of Compounding Methods[*]

Open table as spreadsheet

							Scaled to 10		
Price	**Add**	**Total**	**Equity**	**Liq Val**	**Risk**	**Equity/Risk**	**Equity**	**Liq Val**	**Risk**
No Pyramiding									
0	10	10	0	-100	100	0.00			
10	0	10	100	0	100	1.00			
20	0	10	200	100	100	2.00			
30	0	10	300	200	100	3.00			
40	0	10	400	300	100	4.00			
50	0	10	500	400	100	5.00			
60	0	10	600	500	100	6.00			
Scaled-Down (Upright) Pyramid									
0	32	32	0	-320	320	0.00	0	-100	100
10	16	48	320	-160	480	.67	100	-50	150
20	8	56	800	240	560	1.42	250	75	175
30	4	60	1360	760	600	2.27	425	237	187
40	2	62	1960	1340	620	3.17	612	418	193
50	1	63	2580	1950	630	4.11	806	609	196
60	0	63	3210	2580			1003	806	
Equal Positions									
0	10	10	0	-100	100	0.00			
10	10	20	100	-100	200	.50			
20	10	30	300	0	300	1.00			
30	10	40	600	200	400	1.50			

40	10	50	1000	500	500	2.00			
50	10	60	1500	900	600	2.50			
60	0	60	2100	1500					
Reflecting Pyramid									
0	10	10	0	-100	100	0.00			
10	5	15	100	-50	150	.67			
20	2	17	250	80	170	1.47			
30	0	17	420	250	170	2.47			
40	-2	15	590	440	150	3.93			
50	-5	10	740	640	100	7.40			
60	-10	0	840	740					
[*]1 point move = $100.									

A classic example of a pattern in returns is one where there is a 100% gain for each profitable period, followed by an interval where there is a 50% loss. Assume this cycle is repeated twice each year; in one year, the following equity pattern will occur:

	Change in Equity	Total Equity	
Original margin		$10,000	
Gain of 100%	+10,000	20,000	First 6 months
Loss of 50%	−5,000	15,000	
Gain of 100%	+10,000	25,000	Second 6 months
Loss of 50%	−5,000	20,000	

This leaves a net gain of 100% for the year. Each 100% profit was $10,000, and each 50% loss was $5,000—the rate of return is always based on the original investment of $10,000. Had the cycle started with the losing phase, there would be a net profit of 50% for the first year and 100% for each subsequent year.

In futures trading, most profits are excess capital; that is, they sit as cash in the account as *reserves* until specifically reinvested. If you begin by buying 10 contracts of mini S&Ps, which cost $5,000 each in margin, and have a profit of $1,000 in each contract, the $10,000 total profit is available for purchasing of additional contracts. Given the ability to reinvest incremental profits, not all traders would capture the 100% returns each year from a system that performs as the one in the previous example. As profits increased, more positions would be added so that by the time the total equity reached $20,000, the investment would have also grown to $20,000. The 50% loss is then applied to the larger investment:

	Change in Equity	Total Equity	
Original investment		$10,000	
Gain of 100%	+10,000	20,000	First 6 months
Loss of 50%	−10,000	10,000	
Gain of 100%	+10,000	20,000	Second 6 months
Loss of 50%	−10,000	10,000	

Trading futures would be a great deal of effort for no return.

Holding the investment constant as shown can also be viewed by studying the growth and decline of the account excess, called the *account excess* or reserves. The size of the reserve relative to total equity is the key to successful management. Starting with margin and reserves equal, reserves increase during profitable periods and decrease during

losing ones. Proportionately more of the total equity is traded during losing phases. This pattern can be used to improve results safely, as follows:

Open table as spreadsheet

	Change in Equity	Margin	Reserves	Total Equity	Reserves/Equity
Original investment		10,000	10,000	20,000	50%
Gain of 100%	+ 10,000	10,000	20,000	30,000	67%
Loss of 50%	-5,000	10,000	15,000	25,000	60%
Gain of 100%	+10,000	10,000	25,000	35,000	71%
Loss of 50%	-5,000	10,000	20,000	30,000	67%

Using the natural pattern of trading returns, hold the number of positions the same and allow the reserve to increase during profitable periods; maintain the same position size through the beginning of the next losing period. When the drawdown has slowed or stabilized, the total account value can be redistributed into margin and excess according to the original 50% formula. In the next example, the total account value of $25,000 is distributed 40% to margin and 60% to reserve at the end of the first cycle. It is redistributed so that the next profit phase will be entered with a larger base than the previous losing cycle. The result is a gradual increase in profits:

Open table as spreadsheet

	Change in Equity	Margin	Reserves	Total Equity	Reserves/Equity
Original investment		10,000	10,000	20,000	50%
Gain of 100%	+10,000	10,000	20,000	30,000	67%
Loss of 50%	-5,000	10,000	15,000	25,000	60%
Redistribute		12,500	12,500	25,000	50%
Gain of 100%	+10,000	12,500	25,000	37,500	67%
Loss of 50%	-5,000	12,500	18,750	31,250	60%
Redistribute		15,625	15,625	31,250	50%

Trading on Equity Trends

If a moving average technique is traded, the account value resulting from this strategy will fluctuate with the trending nature of the market. That is, when the market is trending, profits will accumulate, and when prices are fluctuating in a sideways pattern, losses result. By applying a moving-average analysis to the returns, the trending and nontrending periods are identified by *buy* and *sell* signals just as though the equity series was a price series.

An equity *buy* signal means that returns are increasing because the market has begun trending; the length of this period depends on the calculation period of the trend. A *sell* signal means that the market is no longer trending and a series of losses has caused a downturn in equity. These signals can be interpreted as *buy the system* or *short the system,* that is, enter all positions that the system currently holds or liquidate the entire portfolio and hold cash. An equity *buy* could also be taken as the point to redistribute the account value into the original ratio of margin to reserves. If the normal profile of price movement is to spend a large proportion in a sideways pattern, then there should be sustained periods of downward equity trends; equity trends can be used to improve performance.

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INVESTING AND REINVESTING: *OPTIMAL f*

Optimal f is the optimal fixed fraction of an account that should be invested at any one time, or the size of the bet to place on any one trade. The amount to be risked is measured as a percentage of the portfolio size. The objective is to maximize the amount invested (put at risk) yet avoid the possibility of total loss. Trading a very small part of assets can be a poor use of capital, while trading too much guarantees bankruptcy or ruin. Optimal *f* is the ideal portion of an investment that should be placed at risk at any one time. If you risk less than the optimal *f* then you are not generating the peak profits; however, if you trade more than optimal *f* you assure eventual ruin.

Investing generally has a two-level optimal *f* (1) the part of the total portfolio put at risk compared to that part held in cash equivalents, and (2) the individual size of the commitment to each stock or futures within that portfolio. This is particularly important for futures, where the high leverage of individual markets makes it very easy to risk too much on each trade.

Risk Assessment

Then, how much should be invested? The optimal amount is difficult to pinpoint because you would have to know what risks lie ahead, and of course, that's not possible. However, based on a very small likelihood of losing 50% of the portfolio when 50% is invested, it might be said that a portion under a 50% investment is best. To account for greater uncertainties in the future and improve your confidence level, you could reduce the size of the investment to only 25% of the initial portfolio. This approach has negative effects, because a smaller relative investment reduces both risk and returns. When the investment becomes too small, the returns are no longer attractive.

The probability of catastrophic risk is important to any investor or portfolio manager. For practical purposes it is always figured on the historic profile of the data or trading results. This still leaves uncertainty in the final values. Nevertheless, the most extreme situation can be found by using the calculation for *risk of ruin* in a previous section of this chapter, most often applied to gambling situations in which the bet sizes, payout, and odds are well defined. When there are enough test data and trades, this technique has been applied to trading systems (see the section "Wins Not Equal to Losses").

Some analysts have tried to deal with the uncertainties of price movements by using a *Monte Carlo* technique in testing, which moves sequences of blocks of data, or profit and loss results, using a random process. This results in a distribution of possible risk combinations from which you can assign the probability of loss. Monte Carlo risk analysis is considered unusually severe because many of the worst combinations happen because the return series is blocked incorrectly. For example, a long-term trend-following technique expects to capture moves that are based on economic or government policy; therefore, sustained profits are most often followed by a reversal before the trade is ended. In fact, the size of the change of direction at the end of a trend is directly related to magnitude of the prior trend. To move this data around so that the loss at the end of the trend comes at a different time may create a large loss without the offsetting profit, which is a situation that is unfair to the trading strategy. Yet even an analysis of real performance is likely to understate the size of the future risk.

For an initial investment, the optimal *f* is simply the maximum part of that portfolio that can safely be traded without any significant risk of ruin. For those investors who withdraw profits as they occur and continue to trade based on the same assumed initial investment, nothing need be changed unless exceptionally high risk causes a reassessment and decrease in the amount of leverage. However, it is more common—and more complicated—for the investor to vary the amount committed to the market by either increasing or decreasing leverage. This involves (1) determining the right time to change the leverage, (2) calculating the amount to increase the investment when there are profits, and (3) figuring the size of the reduction when there are losses exceeding some designated amount. These are issues that are addressed by optimal *f*.

Finding Optimal *f*

Ralph Vince, in his popular book *Portfolio Management Formulas*,[22] focuses on optimal *f*, risk of ruin, and other practical items. The significance of this approach is the need to maximize the amount invested yet avoid the risk of ruin. Trading a small amount of capital is inefficient, while trading too much guarantees total loss. Optimal *f* is the ideal amount of an investment that should be put at risk at any one time. First, we need to know what percentage gain is required to recover a percentage loss.

$$Required\ gain = \frac{1}{1 - Percent\ \ loss} - 1$$

That is, a 50% loss requires a 100% gain to restore the original value. Because the amount risked on each trade depends on our expectations of loss, the results obtained from the optimal *f* calculation will be the size of the bet, the invested amount, or the number of futures contracts to be traded, as a percentage of the maximum loss. The value used as a maximum loss will be an estimate, because losses can always be greater than those already experienced in the market, or those found by historic testing. In addition, the optimal f will be different for each system, depending upon its performance profile.

The mathematics needed to determine optimal/is based on the Kelly Betting System.[23] Kelly states that the optimum bet is the one that maximizes the growth function $G(f)$:

$$G(f) = P \times \ln(1 + B \times f) + (1 - p) \times \ln(1 - f)$$

where f = the optimum fixed fraction
P = the probability of a winning bet or trade
B = the ratio of the average winning return to the average losing return
ln = the natural log function

The solution for finding the optimal fixed fraction to invest uses the geometric product and geometric mean, which represent the way in which profits and losses accrue.

$$Optimal\ f = \max\left(\prod_{i=1}^{n}\left(1 + \frac{f \times (-R_i)}{Largest\ loss}\right)\right)^{1/n}, \text{ for } f = .01 \text{ to } 1.0$$

where max = the function that returns the maximum value
Π = the product function
R_i = the series of individual trade returns
n = the number of trades

By testing values of *f* between .01 and 1.0, and finding the geometric mean of all trades (each percentage profit or loss applied to the account value before the current trade), the value of *f* is found that gives the best return. That *f*-value is the optimal *f*, the percentage of the total account that should be invested for each trade.

A simpler way of expressing optimal *f*, the percentage of the investment to be risked on a single trade, is given as[24]

$$f = [p \times (PLR + 1) - 1] / PLR$$

where PLR = the ratio of average profit to average loss
p = the probability of a winning trade

Therefore, if p = .50, there is an equal chance of a profit or a loss, and the average profit is $400 while the average loss is $200 (giving PLR = 2.0), then f= (.50(2 + 1) - I)/2 = .5/2 = .25 or 25% of the available capital. Given an equal chance of a profit or a loss, it is not likely that there would be 4 losses in a row, each of 25%; however, the theory of runs shows that, out of every 100 trades, there should be one run of 6. Eventually, there will be a run of 4 or 5 losses in a row. Optimal *f*, however, invests a fraction of the current equity; therefore, after a loss of 25%, the next investment is 25% of the balance, or 18.75% of the initial equity. If there are further losses, that amount drops to 14.06%. After three losses in a row, instead of having lost 75% of the initial equity, the investment has only dropped by 57.81%. Over time, with profits twice as large as losses, and winning trades alternating normally with losing trades, the losses will be recovered.

Observations of Optimal *f*

According to Alex Elder,[25] there are some difficulties in using optimal *f*. Because the value is based on every historic trade, the ideal amount to invest on the next trade will keep changing. In addition, if you trade a position larger than the optimal *f*, with average results, you can expect to go broke eventually because you are overinvesting. On the other hand, if you invest less than the optimal amount, then your risk decreases arithmetically, but your profits decrease geometrically, which is another bad scenario. Because this is too complicated for most investors, the simple solution is to keep trading the same amount, with a reserve sufficiently large to absorb most extreme, adverse price moves.

On the positive side, Dr. Elder concludes that the most useful results of optimal *f* is that it shows the trader to:

- Never average down.
- Never meet margin calls.
- Liquidate the worst position first.

Practically Speaking

Evaluating the risk and reward of a trading program, even using a number of years of actual performance, rarely gives results that are statistically accurate. Markets change and the performance profile of any trading system can vary significantly over long time periods. Determining the size of the investment to use for a single trade based on the average risk and average return of past performance can lead to a tragic end. When investing 25% in each trade, a loss that is twice what is expected, followed by a smaller profit and another large loss (in a more volatile period), could exhaust your capital, regardless of the statistics.

In general, the less you risk, the safer you are. From time to time there are price shocks that produce profits and losses far greater than shown in the averages. Although the theory of an optimal fixed fraction may be correct, there is still great uncertainty in the program returns.

[22]Ralph Vince, *Portfolio Management Formulas* (Wiley, 1990, pp. 79–86).

[23]John L. Kelly, Jr., "Kelly Betting System," *Bell System Technical Journal* (July 1956).

[24]Robert P. Rotella, *The Elements of Successful Trading* (The New York Institute of Finance, 1992, pp. 549–550).

[25]Dr. Alexander Elder, *Trading for a Living* (Wiley, 1995).

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COMPARING EXPECTED AND ACTUAL RESULTS

In the development of an economic model or trading system, the final selection, as well as the choices made along the way, are the result of a performance comparison of the completed models. Often the results are given in terms of profit/loss ratios, annualized percentage profits, expected reliability (percentage of profitable trades to total trades), and potential risk. Although these statistics are common, their predictive qualities and sometimes their accuracy are not known. On occasion, these results are generated by a sample that is too small; usually they are not the results of actual performance but an historic test. This does not mean that the model will be unsuccessful, but that the pattern of success might vary far from the expected profit/1oss ratio, reliability, and risk. In actual trading, everyone experiences a series of losses far exceeding the maximum level that was expected; at that point, it is best to know whether this situation could occur within the realm of the system's profile or whether the system has failed. For example, a moving-average system is expected to have profitable trades (reliability of 33%), with a profit/loss ratio of 4:1. But the first 10 trades of the system are losers. Should trading be stopped?[26]

Binomial Probability

Consider the application of a random-number sequence to the trading model. What is the probability of *l* losses in *n* trades when the probability of a loss is *p*? Most of the work in this area of probability is credited to Bernoulli, whose study of a random walk is called a *Bernoulli process.* A clear representation of a random walk is shown by the Pascal triangle (Figure 23.13), where each box represents the probability of being in a particular position at a specific time in a forward random walk. The result of this process is called a *binomial distribution.*

Figure 23.13: Pascal's triangle.

The forward random walk has an analogy to price movement, with the far edges of Pascal's triangle showing the probability of a continuous sequence of wins or losses using random numbers. The sequence ½, ¼, ⅛,…, $(½)^n$ is exactly the same as in the discussion of the Theory of Runs. The probability of successive losses can be calculated as the likelihood of a run of the same length, $(½)^{n+2}$.

A binomial distribution is useful in considering the total number of losses that can occur in any order within a sequence of trades; it is the probability of getting to a specific point at the base of Pascal's triangle when there is a high probability of moving to the left (losses) rather than the right (profits). The formula for the binomial probability is:

$$B(l{:}\,p,n) = \frac{n!}{l!\,(n-l)!}\,p^{l}(1-p)^{n-l}$$

where l = the number of losses
n = the total number of tries
p = the probability of a loss

and the symbol "!" is the factorial (e.g., 5! = 5 × 4 × 3 × 2 × 1).

Consider the first 5 trades of a system with a probability of success of 1/3. How many losses should be expected? To answer the question, it must be phrased differently. In this case, what is the probability of having 4 losses out of the first 5 trades? Let l = 4 and find the binomial probability B for all possibilities based on a normal distribution function. Then,

$$\begin{aligned} B(4{:}.667,5) &= \frac{5!}{4!\,1!} \times (.667)^4 \times (.333)^1 \\ &= \frac{120}{24} \times (.19792) \times (.333) \\ &= 5 \times 0.659 = .32954 \end{aligned}$$

The binomial probability of having 4 losses out of the first 5 trades is about 33%. Table 23.6 shows the probability of loss for the first 5, 10, and 15 trades of a system with a ⅓ predicted reliability. Results show the highest probability of loss is at the ⅔ point (mean) for each sequence, but the standard deviation gives the range of variance about the mean, so that from 2.3 to 4.4 losses are expected in every 5 trades, 5.2 to 8.2 in 10 trades, and 8.2 to 11.8 losses in 15 trades.

Table 23.6: The Probability of a Specific Number of Losses

Open table as spreadsheet

5 Trades		10 Trades		T 5 Trades	
Losses	**Probability (%)**	**Losses**	**Probability (%)**	**Losses**	**Probability (%)**
0	1	0	0	0	0
1	4	1	0	1	0
2	16	2	0	2	0
3	33	3	2	3	0
4	33	4	5	4	0
5	13	5	14	5	1
		6	23	6	2
		7	26	7	6
		8	19	8	11
		9	9	9	18
		10	2	10	21
				11	20
				12	13
				13	6
				14	2
				15	0
m = 3 ⅓		m = 6 ⅔		m = 10	
sd = 1.05		sd = 1.5		sd = 1.825	
m = Mean.					

sd = Standard deviation.

Note that in the 5-trade example, the chance of no loss is only 1% and there is a 13% chance of all losses. For the purpose of evaluation, it is easier to look at the maximum rather than the minimum number of losses. For 15 trades, there is an 8% chance of 13 or more losses; if the system has produced more than 12 losses in that period, there may be something wrong with the trading method.

Instead of the Pascal distribution, which is normal, the Poisson and various skewed distribution functions will be more appropriate for trading performance. It is well known that price changes and their returns have a skewed distribution with a fat tail.

X^2—Chi-Square Test

Once a system has been traded and there is enough data to give a performance profile, a simple correlation between these actual results and the expected results can be found using the *chi-square test.* First, there must be enough data for a relevant answer. From the section on sampling, the formula for error is $1/\sqrt{N}$, where *N* is the number of items sampled. If there are 25 trades, the expected error in the calculation is $1/\sqrt{25}$, or 20%; 100 trades would give results accurate to 10%.

Assume that the real trading results show a reliability of 20% (1 out of 5) as compared to the expected reliability of 35%. What are the chances of getting these results? The chi-square test is

$$\chi^2 = \frac{(O-E)^2}{E}$$

where *O* = the observed, or actual result
E = the expected or theoretical result.

Then,

$$\chi^2 = \frac{(20-35)^2}{35} + \frac{(80-65)^2}{65}$$

$$= \frac{(-15)^2}{35} + \frac{(-15)^2}{65}$$

$$= \frac{225}{35} + \frac{225}{65} = 6.428 + 3.46$$

$$= 9.89$$

The percentage of actual winning trades is compared with the anticipated winning trades and the losing trades with the expected losing trades. The answer must be found in the first row of Table 23.7, which gives the distribution of X^2.

Table 23.7: Distribution of X^2

Open table as spreadsheet

Cases Less	Probability of Occurring by Chance								
1	.70	.50	.30	.20	.10	.05	.02	.01	.001
1	.15	.46	1.07	1.64	2.71	3.84	5.41	6.64	10.83
2	.71	1.39	2.41	3.22	4.61	5.99	7.82	9.21	13.82
3	1.42	2.37	3.67	4.64	6.25	7.82	9.84	11.34	16.27

4	2.20	3.36	4.88	5.99	7.78	9.49	11.67	13.28	18.47
5	3.00	4.35	6.06	7.29	9.24	11.07	13.39	15.09	20.52
6	3.83	5.35	7.23	8.56	10.65	12.59	15.03	16.81	22.46
7	4.67	6.35	8.38	9.80	12.02	14.07	16.62	18.48	24.32
8	5.53	7.34	9.52	11.03	13.36	15.51	18.17	20.09	26.13
9	6.39	8.34	10.66	12.24	14.68	16.92	19.68	21.67	27.88
10	7.27	9.34	11.78	13.44	15.99	18.31	21.16	23.21	29.59

The probability is distributed unequally in the table because the results are only significant if the probability is small, showing less likelihood of the results occurring by chance. For this simple 2-element test, the result *P* is classified as

Highly significant	if $P = 10.83$ (.1% or 1/1000)
Significant	if $P = 6.64$ (1% or 1/100)
Probably significant	if $P = 3.84$ (5% or 1/20)

The answer $X^2 = 9.89$ is between 0.1% and 1.0%, which shows *significance.* For a large sample, the actual reliability should not have been 20% when 35% was expected.

The chi-square test can be used to compare actual price movement with random patterns to see whether there is appreciable variation. Based on the expected number of runs, discussed earlier in the section "Theory of Runs," Table 23.8 shows the difference between the expected runs of a random series compared to the actual runs of a price series.

Table 23.8: Results from Analysis of Runs

Open table as spreadsheet

Expected Length of Run	Actual Results (E)	Results (O)
1	1225	1214
2	612	620
3	306	311
4	153	167
5	77	67
6	38	41
7	19	16
8	10	5
9	5	3
=10	4	5
=8[*]	19	13

[*]The last groups were combined in order not to distort the results based on a small sample.

Applying the actual data for runs of 1 through 8 against a random distribution, based on Table 23.8,

$$\chi^2 = \sum_{i=1}^{8} \frac{(O_i - E_i)^2}{E_i}$$

$$= \frac{(1214-1225)^2}{1225} + \frac{(620-612)^2}{612} + \frac{(311-306)^2}{306} + \frac{(167-153)^2}{153}$$

$$+ \frac{(67-77)^2}{77} + \frac{(41-38)^2}{38} + \frac{(16-19)^2}{19} + \frac{(13-19)^2}{19}$$

$$= \overset{(1)}{.09877} + \overset{(2)}{.10457} + \overset{(3)}{.08169} + \overset{(4)}{1.2810} + \overset{(5)}{1.2987}$$

$$+ \overset{(6)}{.23684} + \overset{(7)}{.47368} + \overset{(8)}{1.8947}$$

$$= 5.470$$

From Table 23.7, the probability can be found in row 7 to be about 55% for 8 cases. These results are not significant; the Theory of Runs shows that all cases taken together give the same patterns as chance movement. Individual runs or sets of 2 or 3 adjacent runs can be inspected for distortion. In both cases, the results are further from normal but not mathematically significant. The two runs that differed the most were 4 to 5 days, which showed an 11% probability of occurring by chance.

Highly significant price runs can be found in the occurrence of extended runs, for example, 20 days, which is found occasionally in trending markets. By looking at the *asymmetry* of price movement, where a reverse run of 1 day is of negligible value, the significance of these runs will dramatically increase. Price movement is not a simple matter of random runs and equal payout.

[26]Another technique, the probability of a drawdown was discussed in Chapter 21, in the section "Is the Model Broken?"

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Chapter 24: Diversification and Portfolio Allocation

OVERVIEW

The risk of trading in specific stocks, an exchange-traded fund (ETF), or individual futures markets can be substantially reduced by diversification and portfolio allocation. The object of finding the right amount to invest in each trade is to ultimately receive the highest return for the lowest risk. When a trading program shows profits in a broad set of diverse markets, then allocating part of the investment to more than one market will always improve the return-to-risk ratio.

This chapter discusses the methods that can be used to achieve diversification. It begins with a simple, logical selection of markets, then shows how the Excel's Solver program can provide a classic portfolio allocation solution with little effort. However, combining the return streams from trading results is not the same as using continuous prices, as done in traditional portfolio analysis. The remainder of this chapter shows how a genetic algorithm approach will create a portfolio that has a better return-to-risk ratio than the traditional solutions, and is flexible in the way it handles the idiosyncrasies of active trading.

Some of the terms used in this chapter will be those used by analysts working in the field of portfolio allocation and risk reduction. It is important to be able to speak the same language. These terms are:

Assets, which can be different markets, commodities, or investment vehicles.

Investment class, a category of investment, a similar group of markets, such as utilities, technology, equities in general, interest rates, real estate, art, or foreign exchange.

Returns, or *returns series*, are the daily net returns of an investment and can be daily changes or cumulative, depending upon the application. Returns do not include the initial investment and are usually expressed as a percent.

Equity is the current value of an account, including the initial investment plus or minus the cumulative net returns from trading. It is usually expressed in terms of the original investment, such as U.S. dollars.

Information ratio, or *return ratio*, is the measurement used for expressing the relationship of returns to risk. Returns and risk may be calculated using different methods.

Objective function is the way of measuring success in a strategy. If the objective function is the return, then the method that yields the highest net profit is the best answer. If the objective function is the return ratio, then the highest return divided by risk is the best answer.

Passive investment is a buy-and-hold strategy and is used as a performance benchmark.

String, a single entry in a table, such as one possible allocation of assets. One string might assign 5% to each of 20 assets, while another string allocates 3% to each of 10 assets, and 7% to each of the remaining 10 assets.

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DIVERSIFICATION

Diversification means spreading risk; it is the well-established way of lowering *systematic risk*, and every investor is well-advised to diversify. For the purposes of risk reduction, it is necessary to distinguish between *systematic risk*, which can be reduced by diversification, and *market risk*, which cannot be eliminated. The benefits of diversification are greatest when the markets traded are very different and the methods of making decisions are unrelated. Typical investment portfolios contain a variety of fixed income, equities, real estate, and art, as well as different investment philosophies. These all combine to provide different rates of return with different patterns so they do not suffer losses all at the same time. Unfortunately, this is not always the case. Market risk, including price shocks and catastrophic risk, is not predictable, and can surprise even the best investors. Minimizing and avoiding market risk is the subject of this and other sections in this chapter.

Practical diversification can begin with a broad selection of markets and a single tactical approach, a selection of different trading strategies for one product, or a combination of multiple systems and many markets. The objectives of diversification are:

1. *Lower daily risk* due to the offsetting of losses in some markets and systems with profits in others.

2. *Ensure participation in major moves* by continuously trading those markets in sectors or industrial groups that are likely to reflect fundamental changes. This avoids the need to identify which market will perform the best.

3. *Offset unexpected losses* caused by a system failing to perform in the current market, or a single trade that generates a large loss. It may be only bad luck that one system sold Raytheon short and went long IBM before 9/11, but another strategy may have been long U.S. bonds, offsetting the loss in stocks because of the flight to safety into fixed income.

4. *Reduce exposure* in any one market or related group by having funds distributed over many groups. If there are 10 unique asset classes, then an equal allocation only risks one-tenth of the portfolio. The more groups, the less the risk of exposure to any one group.

Diversification is accomplished by applying as many of the following techniques as possible:

1. *Selecting individual markets from different groups.* Risk is reduced when trading is spread among those markets with as little relationship to one another as possible. This can be measured as a low *covariance* or low *correlation* as discussed in Chapter 6. Setting aside asset classes such as real estate and art, which are not traded in the sense covered in this book, the market groups can be roughly classified, in order of size, as equities and equity index, fixed income, currencies, energy, grains, livestock, industrial and precious metals, foods, and miscellaneous. The last group accounts for fiber, wood, oil, and other products.

   There is a larger category called *financials* that encompasses fixed income, currencies, and index markets. While these sectors can move independently over the short term, they are recognized as having strong fundamental interrelationships. When an economic report is released, there is a predictable pattern to the relative direction of all markets within the financials. For example, a better-than-expected announcement of U.S. GDP will first cause Treasury prices to drop (a strong economy eventually causes inflation), then the U.S. dollar to strengthen (people buying dollars to invest into the U.S.), and the stock market to rise (unless it is sensitive to higher interest rates, in which case it will fall). When the attack of 9/11 occurred, investors moved away from the stock market into fixed income, and away from the U.S. dollar, if possible. This underlying similarity in price movement must be considered when allocating assets within a portfolio.

   Aside from the financial markets themselves, other commodities react to changes in interest rates and the U.S. dollar. As the dollar gets weaker, the price of oil, gold, and grain increase. As actively traded world markets, these

products hold an international value. If the price of crude oil is $30/bbl when the dollar buys 4,000 rubles, then a barrel of similar Russian oil will sell for 120,000 rubles in Russia. When the dollar drops to 3,600 rubles, down 10%, the price of crude oil remains at 120,000 rubles in Russia, but the U.S. price rises to $33 on the world market to maintain the same competitive price. Therefore, if interest rates directly affect exchange rates, and exchange rates directly affect the price of oil, then the price of oil will move when there is a change in interest rates or the U.S. dollar.

Although most news coverage comes when prices are volatile and there is correlated movement between most groups, there are long intervals when prices of commodities are not driven by financials. During those periods, agricultural markets have little to do with metals and each moves according to its own fundamentals. Barring a price shock and its aftermath, there is considerable independent movement in most commodity prices each day, and in many stocks. However, a radical change in the value of the U.S. dollar or interest rates following a price shock causes all the largest markets to be highly correlated. Money moves the market, not fundamentals, and money seeks safety. There is no diversification during a crisis.

When selecting those markets to be used in a diversified portfolio, it is necessary to check the historical similarity of returns as well as consider the major forces that currently drive the market—both historic and predictive sides of the problem. When properly selected, diversification will reduce risk, although not necessarily on any one day, as shown in Figure 24.1. As diversification increases from 1 to 4, risk falls quickly; however, as the number of markets, or assets increases above 4 the reduction in risk decreases. With perfect diversification, where each investment is independent of one another, diversification into 2 assets would reduce risk to 50% of the initial risk, 3 would reduce risk to 33.3%, 4 to 25%, and so on. In the real world, a fully diversified portfolio might reduce the initial risk by 50%, while more assets still offer better diversification than fewer.

2. *Multiple strategies.* Using more than one strategy or trading system will reduce risk provided they are not similar. Techniques may appear different and yet be highly correlated. A moving average system, ARIMA model, and point-and-figure are very different methods, but all are trend-following. If the sensitivity of all three systems are similar, which can be measured by the number of trades per year, the return patterns will also be similar. If three trending strategies each identify two trends during the same year, it is most likely that they will hold the same long or short position at the same time. For system diversification, it is best to select strategies with different functional attributes, for example, the following list gives methods that are likely to be less correlated, and techniques within each approach that tend to be different.

    a. Trend-following (moving averages, point-and-figure, breakout).

    b. Countertrend or mean-reverting (stochastic, contrary opinion, Hilbert).

    c. Spreading (pairs trading, sector neutral, interdelivery, intercommodity, arbitrage, product).

    d. Fundamental (value, supply and demand, P/E ratio).

    All four techniques are very different. Fundamentals may cause prices to have a persistent direction, but should have a longer time perspective with a different risk profile than a technical trend-following method. The four types of spreads all offer excellent diversification because many are market neutral, that is, they are not dependent upon the direction of price but on the relative difference between two markets.

3. *Balanced risk.* Equalizing risk is necessary if the selection of different assets and systems is to offer the best possible diversification. In securities, risk is often balanced by investing equal amounts in each stock, and that philosophy can be extended to different assets.

    Price volatility or market value can be used to measure risk. This method has advantages during very active periods, when a few markets with exceptional volatility might overwhelm the returns of less volatile assets. It has disadvantages when one asset is very cheap and inactive—and less likely to be profitable. For example, if both corn and the S&P 500 index were included in the same portfolio, there would be a remarkable contrast. In 2004, corn traded at $3 per bushel and the full size S&P 500 at 1100, making their futures contract values $15,000 and $275,000, respectively. Equalizing contract values would mean trading 18 corn contracts to every 1 S&P, a problem in liquidity for large investors. Of more concern is when corn traded at $2.00/bushel, a depressed market, in which the likelihood of profiting in corn is far less than that of the S&P, yet the positions are much larger.

    Equalizing risk must account for the way the trading model performs in the selected markets. If a strategy does best during a volatile period, then equalizing risk among less volatile assets will reduce returns. A *dynamic capital*

allocation may be necessary as the volatility shifts between assets.

Figure 24.1: Effect of diversification on risk.

These three justifications for diversification have their negative side as well. *Diversification usually means lower profits.* If there are equal returns from trading all assets and all strategies, then diversified returns reduce risk and leave profits at the same level. However, this never happens. It is not likely that General Electric and Amazon.com, or gold and crude oil will be profitable at the same rate, nor is it possible that two different strategies will show parallel returns.

A classic example of diversification is the use of one strategy that has a zero net return (System *B* in Figure 24.2) but a negatively correlated performance to another asset (System *A*) with a high return. While the average return of the two assets is half the return of System *B*, the combined risk could drop by more than 50%. If the objective function is a return ratio, then the combined portfolio of two assets is better than either one of the assets.

Figure 24.2: Improving the return ratio using negatively correlated systems.

None of the three benefits of diversification has addressed the correlations between assets. Although spreading an investment across different markets will reduce risk, it will show the most improvement when those assets are not correlated. Diversifying 10 assets into five equity index futures markets and five fixed income markets is equivalent to diversification into only two assets. Risk reduction must consider the correlations between assets.

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Chapter 24 - Diversification and Portfolio Allocation
New Trading Systems and Methods, Fourth Edition
by Perry J. Kaufman
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CLASSIC PORTFOLIO ALLOCATION CALCULATIONS

Deciding which systems and markets should be traded at the same time, in an effort to reduce risk through diversification, is an entire field of expertise called *portfolio management* or *asset allocation.* While the price patterns of markets have always changed with structural changes in the economy and an equally important growth of participation and technology, globalization during the past 10 years has made portfolio management much more difficult. As more institutions in different countries trade international equities and futures markets as they do their own, they cause a higher correlation of price movements throughout the world. This increase in correlation has initiated considerable study of allocation rebalancing, a process that would change the allocation of a portfolio regularly based on price relationships during a shorter, more recent interval than the classic approach.

The primary principle of classic portfolio allocation remains sound even in a changing environment: *Diversification reduces risk.* Once the assets are selected that will be used in the portfolio, the expected return, $E(R)$, for the portfolio is the weighted average of the expected returns on the individual assets of the portfolio,[1]

$$E(R) = w_1E(R_1) + w_2E(R_2) + \cdots + w_nE(R$$
$$= \sum_{i=1}^{n} w_iE(R_i), \quad where \sum_{i=1}^{n} w_i = 1.0$$

The worth of a portfolio is not only its return, but its risk; therefore, the variance of the portfolio becomes an important criteria in deciding which combination of assets creates the best results:

$$\sigma_R^2 = \sum_{i=1}^{n} w_i^2\sigma_i^2 + \sum_{i=1}^{n}\sum_{j=1}^{n} w_iw_jC_{ij}$$

where σ_i^2 is the variance of the returns of market i, and C_{ij}; is the covariance between the returns of market i and the returns of market j. The covariance, C, between two markets is the product of their standard deviations times the *correlation coefficient* (the *corr* function in Excel) between the same two markets

$$C_{ij} = corr_{ij}s_is_j$$

Given two portfolios with the same returns, the one with the smaller variance is more desirable; when the variances are the same, the portfolio with the highest return is best. This is the same conclusion drawn in the discussion of the *efficient frontier.* For a portfolio of only two assets, the calculations needed for expected return and variance are:

$$E(R) = w_1E(R_1) + w_2E(R_2)$$

$$\sigma_R^2 = w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2C_{12}$$

It is important to compare portfolios using this basic measurement of return and risk; however, it is not the entire picture. When evaluating the relationship between long return series, there may only be one case where a very high correlation would have caused a fatal loss of equity. That one case can be lost in the statistics because the large number of normal cases overwhelms one extreme event. For safety, it is also necessary to look at the maximum portfolio loss. In addition, it

is safe to assume that the largest historic loss will be exceeded sometime in the future, if only by chance or the fact that the probability of a run increases as the amount of data increases. In today's more complex market environment, the worst case scenario becomes more likely. Globalization has increased the correlations, and the past patterns in returns are not likely to represent all of the patterns that will be seen in the near future.

Spreadsheet Approach

A practical way of evaluating a portfolio that does not require special mathematical knowledge or expensive software is to use a spreadsheet program. Using a classic stock and bond mix, Table 24.1 shows the monthly returns of the S&P 500 (S&P) and the Lehman Brothers Treasury Index (LBTI) combined into a portfolio of 60% stocks and 40% bonds. Columns *B* and *C* show the monthly percentage returns of these two series and columns *E* and *F* have the corresponding cumulative returns. At the bottom of columns *B* and *C* are some basic calculations that describe the performance. The S&P has an annualized return of 16.41% with a monthly standard deviation of 3.32%; bonds have a 7.65% annualized return with a 2.61% standard deviation. The return ratio of AROR to standard deviation shows that the stock market was a better investment during these four years.

Table 24.1: Portfolio Evaluation of Stocks and Bonds Using a Spreadsheet

Open table as spreadsheet

	Percentage Change			Cumulative Values		
(A)	(B) S&P	(C) LBTI	(D) Stk + Bnd	(E) S&P	(F) LBTI	(G) Stk + Bond
Jan 94	3.40	2.44	3.02	3.40	2.44	3.02
Feb 94	-2.71	-4.03	-3.24	0.69	-1.59	-0.22
Mar 94	-4.00	-4.22	-4.09	-3.31	-5.81	-4.31
Apr 94	1.28	-1.36	0.22	-2.03	-7.17	-4.09
May 94	1.64	-0.61	0.74	-0.39	-7.78	-3.35
Jun 94	-2.45	-0.09	-1.51	-2.84	-7.87	-4.85
Jul 94	3.60	3.03	3.37	0.76	-4.84	-1.48
Aug 94	4.10	-0.53	2.25	4.86	-5.37	0.77
Sep 94	-2.45	-3.09	-2.71	2.41	-8.46	-1.94
Oct 94	2.25	-0.43	1.18	4.66	-8.89	-0.76
Nov 94	-3.64	0.48	-1.99	1.02	-8.41	-2.75
Dec 94	1.48	2.42	1.86	2.50	-5.99	-0.90
Jan 95	2.59	2.68	2.63	5.09	-3.31	1.73
Feb 95	3.90	2.88	3.49	8.99	-0.43	5.22
Mar 95	2.95	0.64	2.03	11.94	0.21	7.25
Apr 95	2.94	1.78	2.48	14.88	1.99	9.72
May 95	4.00	7.90	5.56	18.88	9.89	15.28
Jun 95	2.32	1.06	1.82	21.20	10.95	17.10
Jul 95	3.32	-1.64	1.34	24.52	9.31	18.44
Aug 95	0.25	2.13	1.00	24.77	11.44	19.44
Sep 95	4.22	1.73	3.22	28.99	13.17	22.66
Oct 95	-0.36	2.93	0.96	28.63	16.10	23.62
Nov 95	4.39	2.57	3.66	33.02	18.67	27.28
Dec 95	1.93	2.67	2.23	34.95	21.34	29.51
Jan 96	3.26	-0.02	1.95	38.21	21.32	31.45
Feb 96	0.69	-4.82	-1.51	38.90	16.50	29.94
Mar 96	0.79	-1.85	-0.27	39.69	14.65	29.68
Apr 96	1.34	-1.72	0.12	41.03	12.93	29.79
May 96	2.28	-0.04	1.35	43.32	12.89	31.15

Jun 96	0.22	2.10	0.97	43.54	14.99	32.12
Jul 96	-4.57	0.00	-2.74	38.97	14.99	29.38
Aug 96	2.11	-1.34	0.73	41.08	13.65	30.11
Sep 96	5.63	2.74	4.47	46.71	16.39	34.58
Oct 96	2.76	3.94	3.23	49.47	20.33	37.81
Nov 96	7.56	3.32	5.86	57.03	23.65	43.68
Dec 96	-1.98	-2.34	-2.12	55.05	21.31	41.55
Jan 97	6.25	-0.84	3.41	61.30	20.47	44.97
Feb 97	0.78	-0.01	0.46	62.08	20.46	45.43
Mar 97	-4.10	-2.44	-3.44	57.98	18.02	42.00
Apr 97	5.97	2.34	4.52	63.95	20.36	46.51
May 97	6.09	1.14	4.11	70.04	21.50	50.62
Jun 97	4.48	1.94	3.46	74.52	23.44	54.09
Jul 97	7.96	5.89	7.13	82.48	29.33	61.22
Aug 97	-5.60	-2.87	-4.51	76.88	26.46	56.71
Sep 97	5.48	2.84	4.42	82.36	29.30	61.14
Oct 97	-3.34	3.34	-0.67	79.02	32.64	60.47
Cum	79.02	32.64	60.47			
AROR	16.41	7.65	13.13			
StDev	3.32	2.61	2.71			
Ratio	4.94	2.93	4.84			

Using the standard 60% stock and 40% bond portfolio mix, column *D* (row 5) becomes +B5*.6 + C5*.4 and column *G* becomes the cumulative return of the portfolio. When the same statistics are calculated for the portfolio, the AROR is 13.13% with a standard deviation of 2.71%. The return of 13.13% is 60% of the difference between the bond and S&P returns, the weighted average of the two assets; however, the standard deviation has increased only 14%, rather than 40%, of the difference between the two separate standard deviations. The ratio of 4.84 is very close to the S&P ratio, reflecting the sharp drop in risk due to combining these two assets. This easy method can then be used to find the maximum drawdown of the portfolio returns, plot the original assets and final portfolio, and even apply a strategy to the new return series.

[1]Peter L. Bernstein (Ed.) *The Portable MBA in Investment* (Wiley, New York, 1995, p. 252).

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PORTFOLIO ALLOCATION USING EXCEL'S SOLVER[2]

Excel's Solver is a remarkably simple tool for solving complex problems. If it cannot be found under Tools, then it will be necessary to select *add-ins* and follow the instructions for installing this software. It is part of the Excel package, but it is not set up during the initial installation.

Solver allows the user to solve equations, subject to various conditions. For this example, we are interested in the returns of a trading system applied to the S&P 500 futures, 30-year U.S. bonds, and Cinergy, a large producer of electricity. The process begins by

1. Pasting the three return series into columns *B*, *C*, and *D* of a spreadsheet, as shown in Table 24.2. Notice that there are cells with daily returns of zero on days when there were no open trades for an asset.

2. Setting the default weighting factors to equal values. With three assets, the weights are each initialized as 1.0/3 = .333.

3. Creating the net portfolio returns in column *E.* For example, cell E4 is E4 = $B$3*B4+$C$3*C4+$D$3*D4, and then E4 is copied down.

Table 24.2: Solver Set-up

Open table as spreadsheet

	A	B	C	D	E
1		**Portfolio Allocation**			
2		**S&P**	**Bonds**	**Cinergy**	**Net**
3		0.333	0.333	0.333	1
4	19990104	0	0	-0.241	-0.013
5	19990105	0	0	0.184	0.010
6	19990106	0	0	0.084	0.004
7	19990107	0	0.008	0.182	0.011
8	19990108	0	0.041	0.011	0.008
9	19990111	0	0.142	0.166	0.034
10	19990112	0	0	0	0.000
11	19990113	-0.029	0.028	0	-0.017
12	19990114	0.048	0.128	0	0.060
13	19990115	0.012	0.034	0	0.015
14	19990119	0.003	0	0	0.002
15	19990120	0.097	0.103	0	0.093
16	19990121	-0.179	-0.102	0	-0.156
17	19990122	-0.064	-0.107	0	-0.068
18	19990125	0	0.121	-0.008	0.021
19	19990126	-0.017	0.052	-0.011	-0.004

Once the basic set-up is completed, the objective function is calculated. The value of the objective function will be used by Solver to find the answer. The objective function could be simply the net return of the portfolio at the bottom of column *E*, or the return ratio, which will be used here. To get the return ratio of 1,000 days of performance,

1. Calculate the annualized rate of return,

   ```
   =sum(E4:E1003)  /(count(E:4:E1003)/252)
   ```

2. Calculate the annualized standard deviation,

   ```
   =stdev(E4:E1003)*sqrt(252)
   ```

3. The return ratio, (1) divided by (2)

The values can be placed to the right of the returns in columns *G* and *H*, rows 5, 6, and 7, as shown below:

	G	H
5	Net AROR	1.2547
6	Net Stdev	0.8529
7	Ratio	1.4710

Weighted equally, the portfolio shows an annualized return of 125% and a return ratio of 1.47, both very good values; however, they are not the best.

Solver Settings

By clicking on Tools/Solver, the Solver Parameter window appears. This has the following sections that must be filled in:

1. *Target cell*, a single value that will be maximized, minimized, or made equal to a constant. In this example, the target cell is H7, the return ratio.

2. *Equal to: max*, *min*, *value of*:_, the way in which the target cell achieves the answer. The best portfolio will be the *maximum* value of the return ratio.

3. *By changing cells*, tells Solver that the solution can be found by varying the values of the weighting factors in $B$5:$D$5.

4. *Subject to the constraints*, allows us to enter the requirement that the sum of the weighting factors must equal 1.0. This is done using a secondary window where the cells, mathematical operator (=, <, >, ≠), and a constant can be entered. This portfolio requires the cells $B$5:$D$5, the operator "=", and the constant 1. It also requires that each of the 3 cells, B5, C5, and D5, be set so that each cell is ">= 0". This will prevent negative weighting factors, which represent selling the asset rather than buying. If the *short sale solution* was desired, then each of the 3 cells would be constrained as, for example, B5 >= -1 and B5 <= 1. This would keep the weighting factors between -1 and +1; otherwise they can take on any values.

There are various options for the number of iterations to be performed, the technique used, the maximum time allowed, and a record of various calculated values. The defaults work well; therefore, none of these are necessary.

Solver Results

By clicking on the *solve* button, the program returns an instantaneous answer. The cells containing the returns, standard deviation, and return ratio appear as

	G	H
5	Net AROR	1.8449
6	Net Stdev	1.0176
7	Ratio	1.8129

and the weighting factors as

Open table as spreadsheet

Portfolio Allocation			

S&P	Bonds	Cinergy	Net
0.768	0.179	0.053	1.000

The best results—a return ratio of 1.81, compared to 1.47 using equal weighting—allocated 77% to the S&P, 18% to bonds, and a little over 5% to Cinergy. This is a considerable improvement, and can be found with a few minutes of work.

[2]The author would like to express his thanks to Evans Curtice, of Graham Capital Management, for his help in this section.

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KAUFMAN'S GENETIC ALGORITHM SOLUTION TO PORTFOLIO ALLOCATION

A portfolio allocation is a basic requirement for trading more than one market. Excel's Solver can be used to get an estimate of the proper allocations; however, it does not include the cross-correlations in the result, market liquidity, or a number of subtle measurements that are needed by the professional manager handling large portfolios. In addition, a portfolio of 50 assets has a limitless number of allocations possible, and Solver will become unacceptably slow calculating the best weights.

The portfolio allocation solution is most popular in the securities industry to create a passive, risk-adjusted portfolio of stocks. This can be done by entering prices (instead of the return series) into the spreadsheet. The process is called *portfolio optimization*, and many Wall Street firms will *rebalance* the portfolio quarterly, using as little as one year of historic prices, to find the allocation that maximizes the return ratio.

Whether the need is to find a portfolio of stocks that work well together, balance a diverse portfolio of futures markets, or any combination of these and other investments, the time needed to find the best allocation for a large number of assets requires a special computer program. This section discusses the major considerations and their solution in a complete approach to portfolio allocation. It is intended to solve the special problems associated with a set of return series, where each series represents trading results, and each has numerous, discrete periods when there is no position; therefore, the returns are zero. As we will see, this type of input presents a problem for the traditional mean-variance method for finding the best allocations, such as used by Markowitz; it is easily solved, however, using the *Genetic Algorithm Solution to Portfolios* (GASP) developed by Kaufman.

Modern Portfolio Theory

Chapter 20 gave a basic explanation of how to use a genetic algorithm to find the parameter values of a trading system. Here, the genetic algorithm is used to find the best allocation for each asset—stock, stock index, or futures market—in order to achieve the best objective function.

The problem of portfolio allocation is different for the active trader than for the passive investor. In Modern Portfolio Theory,[3] Markowitz shows how optimal diversification can be achieved by allocating a percentage of an investment to each stock using a mean-variance solution. Because of Markowitz and those that followed him, it is now generally accepted that a properly allocated, risk-adjusted portfolio of assets is needed to achieve the highest return for a given level of risk. However, Markowitz did not address the problem of using investment returns as a substitute for continuous prices because Modern Portfolio Theory has focused on the mix of stock ownership that represents the optimal return for the investor.

A Special Case for Active Trading

For those traders who use a systematic method of buying and selling, their returns reflect those decisions. For them, an optimum portfolio based on the prices of the markets traded makes no sense. The portfolio program may be treating two stocks that are rising at the same time as highly correlated, while the trading system shows one stock long and the other short. Instead of a strong positive correlation for that time period, there should be a strong negative correlation. Therefore, it is the daily returns of the trading for each market that reflect the positions, not the price. When two markets are profitable or losing at the same time, they are positively correlated; when one is profitable and the other is losing, they are negatively correlated.

In traditional portfolio analysis, called a *mean-variance solution*, the standard deviation of the daily returns is used to represent risk. The covariance of each market with respect to the other, taken as pairs, represents the correlation and relative volatility of one with respect to the other. This method is accurate for continuous price series, where the daily price changes represent returns. However, when using trading returns instead of continuous prices, the method fails.

For example, when trading the S&P and bonds, a systematic method that uses two moving averages has the following rules:

1. Hold longs when the fast average and the slow average are both moving higher.
2. Hold shorts when the fast average and the slow average are both moving lower.
3. Exit all positions and do not enter new ones when the fast and slow averages are moving in different directions.

Problems with the Standard Deviation Calculation

The previous trading rules result in a system that is only in the market 50% of the time. During the periods when there are no positions, the daily returns are zero. How does this affect the standard deviation and covariance? If the bond price series has a daily standard deviation of 1.0%, then a trading system that was always in the market with the same position size should also have a standard deviation of returns of about 1%, because it will show the same daily fluctuations as the price. However, using the rules above, the trading program is out of the market 50% of the time. In one year, instead of 252 days with an average of 1% price move, there are 126 days with a 1% change in returns and 126 days with a zero change in returns. The standard deviation for the full period will be .50%. Had the system been in the market only 25% of the time, the standard deviation would fall to .25%.

Because the standard deviation is used to represent risk, a trading method that is in the market less often will always appear to have less risk. Similarly, if one trading method was active 50% in a market with a standard deviation of 2%, and another was active 25% in a different market with a standard deviation of 4%, both return series would have the same 1% standard deviation. If they were both trading on the same day, one would show twice the risk of the other. Therefore, the standard deviation is giving a premium to the system that is not trading.

Statistically, the zero returns are an important part of the series. But these are not really zero returns because the price didn't change, or because the trading program netted a zero return from its positions. The value is zero because there was no trading. If we consider a measure of risk as how much is lost or gained when trading, then the standard deviation does not return the correct value and does not provide a valid comparison with other assets.

Problems with the Covariance Calculation

The same intermittent returns are a problem for the covariance calculation. Embedded in this measurement is the correlation between the two items. If the data are price and they move up and down together, then the covariance between the two will be small; if they move differently, the covariance will be greater. Suppose that the S&P and bonds systems were each in the market 50% of the total days, and that they were in at the same time only 25%. How do you measure the similarity of returns when, in 75% of the days, there were no returns for one of the two markets?

Consider a more extreme case, where two strategies, one trending and one mean-reverting, are applied to the same market. When the market is trending, the trend system is used, and when the market is sideways the mean-reverting system is used. The two strategies both hold positions on only 3% of the total days, yet a correlation coefficient, or a covariance, is calculated using the returns of every day.

While the standard deviation and covariance are technically correct when applied to trading returns, they miss the intent of the measurement, which is to represent the risk of the two assets when they are active at the same time. Modern Portfolio

Theory arrives at a definitive, *optimal* allocation for any portfolio of assets. If the standard deviation and covariance calculations are correctly applied to trading returns, then this method will find the portfolio with the highest return ratio. However, if by applying a different technique using a genetic algorithm, the solution gives a return ratio higher than the mean-variance solution, there must have been some problem in the calculations when applied to intermittent trading returns.

Other Problems with Infrequent Trading Activity

Some trading methods may be very selective, waiting for the right combination of patterns to enter a position. When trading activity is low, for example, positions are held only 10% to 20% of the time interval, the cumulative equity series appears to have alternating periods of sharp increases (when generating trading profits) and a horizontal line (when out of the market). The net result is that the annualized returns are quite low relative to the total portfolio, and the returns have a high standard deviation relative to the rate of return. However, these strategies have a high return when they are in the market and offer important diversification to the portfolio. When applying a traditional mean-variance portfolio solution, these strategies and returns are eliminated because they have low betas (returns relative to an index of all systems), even though they have the highest payout (returns per day) when they are in the market during high-volatility periods.

The Objective Function and Target Risk Level

Before the problem can be solved, it is necessary to decide how to measure success. The accepted approach is the return ratio, the annualized returns divided by the annualized risk; however, there are many ways to measure risk, some better than others.

Risk measured by the securities industry. Securities analysts have always measured risk as the standard deviation of daily, monthly, or annual returns (if there is enough data). When the return ratio uses the standard deviation of returns, the optimization seeks the best return with the smallest daily changes. It may allocate only a small portion of the investment to a trading method that has the most volatile performance, even though most of the volatile periods were highly profitable.

Using daily returns requires that it be converted to annualized returns by multiplying by $\sqrt{252}$. For monthly data we multiply by $\sqrt{12}$. Although this is a long-accepted method, there should be some concern that estimating annualized returns from daily returns can be inaccurate.

Risk measured by the residuals of a linear regression. Another popular measure of risk uses the residuals of a linear regression. This can be derived from the same calculation that gets the annualized rate of return of the portfolio based on the slope of the straight-line approximation. If there are 5 years of return history, then the residuals would give the standard deviation of the return swings above and below the straight-line fit for the 5 years. This results in a probability of loss relative to the 5-year history, a convenient and useful value, which does not need to be annualized as did the standard deviation.

The negative aspect of using residuals as a risk measurement is that the optimization process will find the best allocation that keeps returns as close to the straight line as possible. This may seem good when it prevents drawdowns, but it also prevents any prolonged gains that move returns far above the normal returns, represented by a straight line.

Semi-variance of daily drawdowns. One measure that stands out as not having the restrictive qualities of either the standard deviation or the residuals is the semi-variance of drawdowns. This measure uses the difference between the previous high cumulative return and the current cumulative return, always a positive number. Therefore, there is a value on every day that is not a new high return. There is no accounting for the pattern of profits, only the losses. Because this is similar to the residuals, that is, it represents the probability of a drawdown of a specific size over the full interval of returns, it is not necessary to annualize the results. The portfolio optimization process will try to limit the size of the drawdowns, but has no agenda with respect to the profit patterns—they do not have to be close to a straight line, nor do they need to be small.

The objective function (OF) used in GASP will then be

$$OF = ARO R/s_D$$

where s_D = the standard deviation of the daily drawdowns, or semi-variance,

$$s_D = s(E_H - E_i),\ i = 1, n$$

where E_H = the high equity as of day i
E_i = the current equity
$E_H \neq E_i$
n = the total days of equity

The total items used for the standard deviation will be less than n by the number of days on which there was a new high equity, $E_H = E_i$.

The *target risk level* is the probability of a specific loss, given as a standard deviation or a percentage of investment, over a specific period of time. You may specify that the portfolio must have a small chance, for example, .1% (one-tenth of 1%) of losing 10% during a 10-year period. The 10% loss is based on the measurement of risk, either the standard deviation of the returns, possibly the standard deviation of drawdowns (semi-variance), or possibly the Ulcer Index (see Chapter 23 for different risk measures). Both the maximum and minimum target risk level will need to be specified. The minimum is necessary because the program can always allocate a very small part of the investment in order to keep risk low. That will normally cause the rate of return to be unacceptably low. When searching for the optimal portfolio, a large number of unacceptable solutions can be avoided by creating a range of risk tolerance.

The Optimal Portfolio

The *optimal portfolio* is the same whether using the classic mean-variance solution or a genetic algorithm approach. It is always the allocation with the highest possible return for the lowest possible risk. It is also called the *maximum return ratio.* Targeting only returns does not tell you anything about your risk.

Without considering investor risk preference, where some investors will accept higher risk in exchange for a smaller marginal return, any rational investor will take:

- Higher returns for the same risk.
- Lower risk for the same returns.

The efficient frontier was introduced in Chapter 22, showing the curve that represented the best choices of portfolios that satisfied the objectives of the rational investor. Figure 24.3 shows the efficient frontier with the optimal portfolio marked as point *A*. If the risk-free rate of return (RF) is 5.0%, then the optimal portfolio is located at the point where a straight line, drawn from point *RF*, touches the efficient frontier. This will also be the point where the return ratio is largest. Portfolios on the efficient frontier that are higher and to the right of *A* have risk increasing faster than returns; those that are lower and to the left of *A* have returns declining faster than risk. Point *A* will move farther to the right as the risk-free rate of return increases.

Figure 24.3: The optimal portfolio located on the efficient frontier.

Portfolio Constraints

Portfolio constraints represent practical considerations and limitations that are imposed on the portfolio program. The most obvious of these constraints is liquidity. Some stocks or futures markets are more active than others. Portfolio optimizer cannot be allowed to allocate too much to a thinly traded stock. Placing an unreasonably large order in an inactive stock would result in slippage and a poor execution far in excess of those transaction costs considered in the testing of the strategy. A safe rule is not to exceed 1% of the average volume traded in one day. Trading less is always better.

It is practical to specify liquidity constraints as absolute numbers, such as 500,000 shares of Microsoft or 5,000 contracts of S&P minis. Restricting allocation to a percentage of the investment may not always translate into the right number of shares.

Constraining Diversification

Ideally, the portfolio allocation program should be allowed to mix and match any markets in any percentage to create the best portfolio. However, in a real world there are choices to be made. There is a practical reason for choosing between

1. Optimizing a portfolio of all stocks at one time
2. Optimizing the returns of stocks within a sector or industrial group, then optimizing the returns of the groups.

Although a genetic algorithm solution is fast, time is always a factor. Separating the assets into common groups, optimizing these smaller sets and creating subportfolio return series, then optimizing the results of those smaller portfolios is a much faster process than a single, large optimization. Because the time to calculate expands exponentially, 10 separate optimizations each with 10 assets is much faster than one optimization with 100 assets.

We may know more about the potential for correlated price movement than the portfolio program can measure using the return streams. Stocks that are within the same industrial group will be affected in a similar manner by government action. If the price history does not have enough occurrences of the type of events that cause common price movement, then the portfolio process will assign larger allocations to similar stocks. When finding a portfolio allocation using only a recent time interval, the correlations may not appear strong; however, infrequent events that move these stocks in the same direction are very important to risk. It will be necessary to first create a portfolio of these common stocks or futures markets, then combine the returns of the smaller portfolios into one complete allocation.

The Genetic Algorithm Solution

The GASP program uses a genetic algorithm solution because it is fast and can handle disjoint returns, common to trading performance. There are six steps in the genetic algorithm solution:

1. Initialization.
2. Calculation of the portfolio objective function.
3. Test for completion.
4. Propagation.
5. Mating.
6. Mutating.

After Step 6, the process returns to Step 2 and ends when Step 3 is satisfied.

Preparation

To begin the process of portfolio allocation, we first need the return series of each asset. In a tradition stock portfolio, these can be the price series themselves converted to an index by calculating the percentage change each day, $\%P_t = \%P_{t-1} \times P_t/P_{t-1}$, and accumulating the values. For traders, the return series are the daily profits or losses of each strategy applied to each market, converted to a percentage change and accumulated. Table 24.3 shows 5 assets representing the returns of

one strategy applied to 5 different markets, for example stocks, Spyders (the SPY ETF), fixed income futures, currency futures, and energy futures. Although this performance history begins before 8/23/2000, the portfolio evaluation will begin on that date.

Table 24.3: Return Series for 5 Markets, in $

Open table as spreadsheet

	A	B	C	D	E
8/23/2000	48,491	51,249	42,890	33,355	45,646
8/24/2000	48,491	50,859	42,500	32,965	45,256
8/25/2000	48,456	51,259	42,900	33,365	45,656
8/28/2000	49,296	52,099	43,740	34,205	46,496
8/29/2000	49,166	51,969	43,460	34,075	46,366
8/30/2000	48,661	52,549	43,425	34,655	46,946
8/31/2000	48,461	52,349	43,345	34,455	47,164
9/1/2000	48,721	52,059	43,345	34,165	47,164
9/5/2000	49,171	52,274	43,560	34,090	47,379
9/6/2000	49,678	53,344	44,528	35,160	48,047
9/7/2000	49,678	53,642	44,528	35,642	48,047
9/8/2000	49,678	53,642	44,528	33,822	48,047
9/11/2000	49,083	53,327	44,553	33,527	47,802
9/12/2000	48,223	52,467	44,553	32,667	46,942
9/13/2000	47,763	52,007	44,553	32,207	46,482
9/14/2000	48,013	51,587	44,553	31,887	46,062
9/15/2000	49,863	51,992	45,048	32,122	46,062
9/18/2000	50,661	52,822	45,735	33,120	46,062

Common Trading Units.

The final portfolio will assign a percentage of the investment to each asset based on the return series. Different trading units for each asset can make the interpretation of the portfolio allocation more difficult. For example, if the returns each of 5 assets were based on a $1 million investment and the final portfolio of $10 million allocated 20% to each asset, then each would trade twice the amount that was originally used, or $2 million. If one asset were stocks, then the share price would be divided into $2 million to get the number of shares. If the asset was a futures contract and 8 contracts were traded in the $1 million test, then 16 would now be traded.

If the returns of the assets were generated with different investments, the results may try to equalize the risk. For example, if the return series for asset A was based on a $2 million investment, and the other four assets, B through E, were each based on $1 million, then a final portfolio allocation would assign 11.1% to *A* and 22.2% to each of the other assets in order to create equal investment risk. It recognizes that the volatility of the returns of the $2 million asset is twice that of the other assets. Asset *A* will then be traded with half the amount as the other assets, which will make the net amounts equal for all assets.

To avoid confusion, it is easiest to assign equal, even-value investment amounts when creating the returns for each system or market.

Indexing the Returns.

Using the same method described to convert prices to an index, the dollar returns are converted in Table 24.4. The first value in each series is always set to 100. The following values increase and decrease by the percentage change relative to the previous equity value. When completed, the five dollar-return series show returns in percent.

Table 24.4: Converting Dollar Returns to an Index

Open table as spreadsheet

Step 1. Convert $ Returns to % Returns					
	A	B	C	D	E
8/23/2000	100.00	100.00	100.00	100.00	100.00
8/24/2000	100.00	99.24	99.09	98.83	99.15
8/25/2000	99.93	100.02	100.02	100.03	100.02
8/28/2000	101.66	101.66	101.98	102.55	101.86
8/29/2000	101.39	101.40	101.33	102.16	101.58
8/30/2000	100.35	102.54	101.25	103.90	102.85
8/31/2000	99.94	102.15	101.06	103.30	103.33
9/1/2000	100.47	101.58	101.06	102.43	103.33
9/5/2000	101.40	102.00	101.56	102.20	103.80
9/6/2000	102.45	104.09	103.82	105.41	105.26
9/7/2000	102.45	104.67	103.82	106.86	105.26
9/8/2000	102.45	104.67	103.82	101.40	105.26
9/11/2000	101.22	104.05	103.88	100.52	104.72

9/12/2000	99.45	102.38	103.88	97.94	102.84
9/13/2000	98.50	101.48	103.88	96.56	101.83
9/14/2000	99.01	100.66	103.88	95.60	100.91
9/15/2000	102.83	101.45	105.03	96.30	100.91
9/18/2000	104.48	103.07	106.63	99.30	100.91

Initializing the Pool

The search for the best portfolio allocation begins by creating a *pool* of random portfolios, commonly called *strings* in genetic algorithm terminology. The pool can also be thought of as a *gene pool*, because future portfolios will be created from it. The pool should be as large as possible in order to increase the speed of the search. For portfolios with fewer than 25 assets, a pool of 5,000 should be large enough. To understand the number of combinations in a complete, sequential search of all portfolios, consider the 5-asset example, which has 100^5, or 10 billion, combinations—and that's if the percentage allocations are in whole percent, not fractions of a percent.

Creating a Portfolio from Random Numbers

Using the 5-asset example, one portfolio, or string, is created by:

1. Finding a uniform random number between 0 and 1 for each of the 5 assets. In Table 24.5, the Excel function RAND( ) is used for each of the 5 columns under the assets *A–E*, and then for each of the portfolios, 1–18 in the pool.
2. Adding the 5 random numbers for each portfolio to get the total, *T*, shown in the right column of Table 24.5.
3. Dividing each random number for assets *A–E* by *T* to create a normalized percentage, where the total of all random numbers equals 1. These numbers represent the weighting factors, or allocations, for each asset, shown in Table 24.6.
4. *Applying constraints.* Not all portfolios will qualify. If the investment is large—$100 million, for example—and asset *A* is a stock that must be limited to purchases less than $10 million, then asset *A* cannot have a weighting factor greater than 10%. This can be resolved by rejecting any portfolio that shows a weighting factor greater than .10 under asset *A*. In Table 24.6 that would reject all but two portfolios, 7 and 16. Fortunately, the process of generating initial portfolios is very fast, and rejecting 90% of them will not slow the process significantly. It would seem more efficient to generate a random number for asset *A* using the Excel function *Randbetween*(0,.10) to produce a value between 0 and. 10; however, the rescaling after the other random numbers have been generated might result in a value for *A* greater than 10%.

   Group liquidity constraints must also be corrected. After each asset has been assigned an allocation, another random number is selected between zero and the maximum liquidity for the entire group. Then the assets within that group, are scaled to that value. Consider a group with liquidity set at 1,000 futures contracts. This group contains 3 assets that have been assigned maximum liquidity of 550, 100, and 300 contracts based on their individual system liquidity constraints; however, the total allocation for the group that contains this system may be less than the group maximum. A random number is then selected for the group liquidity. If, for example, the number .40 is selected and the maximum group liquidity is 1,000, then all allocations in that group will be rescaled to total 400. When rescaling, it is necessary to prevent the individual assets from exceeding their maximum liquidity.

   The *amount of risk* is another constraint. Although the objective function will be returns divided by risk, the amount of absolute risk will be important in the results. Some investors will not accept a portfolio in which the risk exceeds some predetermined value. In other cases, it is not possible to achieve returns greater than, for example, 20% per annum, without having annualized risk in the range 5% to 20%. Any random portfolio that produce risk less than 5% or greater than 20% will be rejected. The calculation for finding these values are in the next section.

Table 24.5: Generating Random Numbers to Create Weighting Factors

Open table as spreadsheet

Step 2. Generate Random Numbers between 0 and 1						
Portfolio	**A**	**B**	**C**	**D**	**E**	**Total A-E**
1	0.954	0.356	0.402	0.924	0.388	3.025
2	0.642	0.091	0.501	0.010	0.010	1.255
3	0.295	0.995	0.509	0.558	0.687	3.044
4	0.581	0.204	0.943	0.408	0.175	2.312
5	0.615	0.796	0.277	0.115	0.072	1.874
6	0.726	0.073	0.069	0.376	0.184	1.428
7	0.953	0.523	0.246	0.893	0.080	2.695
8	0.329	0.667	0.169	0.211	0.626	2.001
9	0.660	0.747	0.372	0.226	0.769	2.774
10	0.833	0.893	0.536	0.010	0.850	3.123
11	0.776	0.252	0.663	0.964	0.667	3.321
12	0.578	0.873	0.299	0.100	0.447	2.296
13	0.883	0.567	0.621	0.712	0.732	3.515
14	0.606	0.025	0.798	0.227	0.219	1.875
15	0.629	0.396	0.234	0.041	0.146	1.446
16	0.713	0.531	0.515	0.852	0.942	3.553
17	0.829	0.584	0.411	0.289	0.011	2.125
18	0.812	0.215	0.444	0.159	0.724	2.354

Table 24.6: Normalized Weighting Factors for Each Portfolio in the Pool

Open table as spreadsheet

Step 3. Normalize Random Values						
Portfolio	**A**	**B**	**C**	**D**	**E**	**Total A-E**

1	0.131	0.290	0.062	0.310	0.208	1.000
2	0.150	0.125	0.291	0.290	0.145	1.000
3	0.393	0.103	0.295	0.135	0.074	1.000
4	0.304	0.130	0.132	0.385	0.049	1.000
5	0.248	0.287	0.058	0.160	0.247	1.000
6	0.330	0.171	0.280	0.057	0.163	1.000
7	0.066	0.313	0.201	0.203	0.217	1.000
8	0.380	0.043	0.143	0.423	0.012	1.000
9	0.216	0.365	0.133	0.016	0.270	1.000
10	0.277	0.049	0.129	0.261	0.284	1.000
11	0.178	0.283	0.301	0.107	0.130	1.000
12	0.172	0.086	0.204	0.288	0.250	1.000
13	0.439	0.322	0.053	0.172	0.014	1.000
14	0.305	0.063	0.063	0.217	0.352	1.000
15	0.313	0.189	0.245	0.251	0.002	1.000
16	0.098	0.247	0.359	0.255	0.041	1.000
17	0.111	0.322	0.079	0.251	0.237	1.000
18	0.214	0.165	0.225	0.139	0.257	1.000

Evaluation

The evaluation process calculates the portfolio returns and analyzes the results in order to find the objective function. This is done immediately after the initial pool is created, and it is done at the beginning of each cycle throughout the genetic algorithm process. The objective function chosen for this test is the return ratio; therefore, it will only be necessary to find the annualized returns and annualized standard deviation of each portfolio in the pool. If the semi-variance is used for risk, then that must be evaluated for the return series of each of the portfolios.

The portfolio returns R on any day, i, are

$$R_i = w_1R_{1i} + w_2R_{2i} + w_3R_{3i} + w_4R_{4i} + w_5R_{5i}$$

where $w_1 + w_2 + w_3 + w_4 + w_5 = \Sigma\, w = 1$, and $0 = w_i = 1$

R_i = the portfolio return on day i

R_{ni} = the daily return of asset n on day i

This process is easily done on a spreadsheet, shown in Table 24.7. For the first row, on 8/23/2000, each of the original returns is multiplied by the weighting factor at the top of the column and is posted to the corresponding position in the right part of the table. Because the values in the first row are all 100, the resulting weighted returns are the value of the weighting factors. These 5 weighted returns are then added to get the portfolio returns shown to their right.

Table 24.7: Evaluating Portfolio Return and Risk (left part)

Open table as spreadsheet

Step 4. Evalulate the Returns of Portfolio 1					
Weighting Factors					
	0.131	0.290	0.062	0.310	0.208
	A	B	C	D	E
8/23/2000	100.00	100.00	100.00	100.00	100.00
8/24/2000	100.00	99.24	99.09	98.83	99.15
8/25/2000	99.93	100.02	100.02	100.03	100.02
8/28/2000	101.66	101.66	101.98	102.55	101.86
8/29/2000	101.39	101.40	101.33	102.16	101.58
8/30/2000	100.35	102.54	101.25	103.90	102.85
8/31/2000	99.94	102.15	101.06	103.30	103.33
9/1/2000	100.47	101.58	101.06	102.43	103.33
9/5/2000	101.40	102.00	101.56	102.20	103.80
9/6/2000	102.45	104.09	103.82	105.41	105.26
9/7/2000	102.45	104.67	103.82	106.86	105.26
9/8/2000	102.45	104.67	103.82	101.40	105.26
9/11/2000	101.22	104.05	103.88	100.52	104.72
9/12/2000	99.45	102.38	103.88	97.94	102.84
9/13/2000	98.50	101.48	103.88	96.56	101.83
9/14/2000	99.01	100.66	103.88	95.60	100.91

9/15/2000	102.83	101.45	105.03	96.30	100.91
9/18/2000	104.48	103.07	106.63	99.30	100.91

Once the daily returns are created for the first portfolio (or any of the 5,000 strings in the pool), the annualized returns and annualized standard deviation are calculated. At the bottom of the column, *Portfolio Returns*, is the value 1.85, the difference between the final return value, 101.85, and the starting value, 100.0. This return represents only 18 days, from 8/23 to 9/18; therefore, the annualized return for portfolio *p* is

$$AROR_p = (R_p / n) \times \sqrt{252}$$

where 252 = the number of business days in the year
n = the number of days in the return series

The standard deviation of the returns, or risk, is found at the bottom of the column *Change in Returns.* Although the standard deviation function, *stdev*, should remove the trend before calculating, this does not always seem to be the case. For consistent results, create a series of return changes, then calculate the standard deviation of those changes. For portfolio 1, the standard deviation is 1.2265. It can be annualized using the same technique applied to the returns. Because annualizing the returns and risk in this example will not change their relative values, the objective function, *return/risk*, OF_1 = 1.51.

To complete the process, the objective functions, OF_p, must be calculated for all *p* portfolios in the pool. It is best to annualize the results so that different portfolio allocations can be compared when they have been applied to returns over different time intervals.

Rescaling to a Targeted Value-at-Risk

When using unit allocations, such as the number of futures contracts rather than a percentage weighting factor, it is necessary to rescale each portfolio allocation to a targeted risk level. Trading too few contracts will yield a low risk and a low return. It is necessary to specify the risk as a probability of loss equal to a percentage of the investment. If the target risk is 15% of the investment, and the risk evaluated after the random allocation shows risk of only 5%, then all allocations should be multiplied by 3. Portfolio specifications will allow individual portfolio risk to vary from the targeted risk by ±5% (specified by the user). After rescaling, it will be necessary to see if any of the assets exceed its liquidity limits. If yes, the portfolio is discarded.

Test for Completion

Each portfolio in the pool has been evaluated for its objective function. The best objective function in the pool is now compared to the best objective function in the previous cycle to decide if the process has been completed. This step is skipped on the first iteration, following the initialization of the pool. Completion may be tested in two ways:

Table 24.7: Evaluating Portfolio Return and Risk (right part)
Open table as spreadsheet

A	B	C	D	E	Portfolio Returns	Change in Returns
13.05	28.95	6.19	31.01	20.79	100.00	
13.05	28.73	6.13	30.65	20.62	99.18	-0.82
13.04	28.96	6.19	31.02	20.80	100.01	0.83
13.27	29.43	6.31	31.80	21.18	102.00	1.99
13.24	29.36	6.27	31.68	21.12	101.67	-0.33
13.10	29.69	6.26	32.22	21.39	102.66	0.99
13.05	29.58	6.25	32.03	21.49	102.39	-0.27
13.12	29.41	6.25	31.76	21.49	102.03	-0.36
13.24	29.53	6.28	31.69	21.58	102.33	0.30
13.37	30.14	6.42	32.69	21.89	104.51	2.18
13.37	30.31	6.42	33.14	21.89	105.13	0.62
13.37	30.31	6.42	31.44	21.89	103.44	-1.69
13.21	30.13	6.43	31.17	21.78	102.72	-0.72
12.98	29.64	6.43	30.37	21.38	100.81	-1.91
12.86	29.38	6.43	29.94	21.18	99.79	-1.02
12.93	29.14	6.43	29.65	20.98	99.13	-0.66
13.42	29.37	6.50	29.86	20.98	100.14	1.02
13.64	29.84	6.60	30.79	20.98	101.85	1.71
				1.51	1.85	1.2265
				Ratio	Return	Risk

1. *Convergence.* The best objective function in the current pool is identical, or nearly identical, to the best objective function in the previous *n* iterations. It is best to allow the method 2 or 3 cycles without any appreciable improvement before ending the process.
2. *Number of iterations.* The process has completed a fixed number of iterations.

Although convergence is the normal completion criterion in search methods, a fixed number of iterations may serve you best in this method. The genetic algorithm technique rapidly approaches an optimal solution, but it may show very slow improvement afterwards. Because this level of accuracy is not necessary, it is more important to repeat the entire process 3 to 5 times beginning with a new pool of random strings. Similar results from these tests, either from actually weighting factors or the objective function, will confirm that the method has found a global maximum rather than a local maximum. This concept will be reviewed at the end of this section.

Propagation

Darwin observed that propagation of the species was improved by the *survival of the fittest*. This step in the genetic algorithm process replicates the survival of the fittest. The purpose of this propagation step is to allow strings with higher objective functions to survive the selection process while those with the lowest objective functions are discarded.

Ranking the Portfolios

Using the objective functions, the portfolios in the pool are sorted so that the ones with the highest objective functions are at the top. For implementation, it is faster to do an *index sort.* First, number the portfolios sequentially by creating a column of the portfolio numbers along side their respective objective functions, then sort only those two columns. This avoids shuffling large lists of assets which can be time-consuming, even for fast computers.

Another random process is used to propagate the best portfolios. If there are only 8 strings in the pool with the following objective functions

3.65, 2.50, 2.00, 1.65, 1.40, 1.20, 1.05, 1.00,

then the differences between these values will be used to encourage the reproduction of the portfolios with the best objective functions. The differences are

1.15, .50, .35, .25, .20, .15, .05,

representing a total span of 3.65 – 1.00 = 2.65. These differences, converted to percentages of the span, are

43.4, 18.9, 13.2, 7.5, 5.6, 1.9

From this it can be seen that there are much larger gaps between the higher objective functions than between the smaller ones. This is the feature used to facilitate propagation.

Propagation of the Best Results[4]

Propagation enables the best portfolios to survive and have added influence on the outcome. Propagation, just as most of the other steps in the genetic algorithm solution, uses random numbers. In this case, a *uniform random number* between 3.65 and 1.00, the highest and lowest objective values, is needed. It is important to generate a uniform random number, one that is equally distributed between the range of values. To do this, the Excel function *randbetween(lowest,highest)* will be used, where *lowest* = 100 and *highest* = 365 (the function only uses integers, therefore the values are multiplied by 100).

Before getting a random number, find the midpoint between each of the 8 objective functions:

Portfolio	1	2	3	4	5	6	7	8
Objective functions	3.65	2.50	2.00	1.65	1.40	1.20	1.05	1.00
Midpoints	3.075	2.25	1.825	1.525	1.30	1.125	1.025	

Open table as spreadsheet

Because there are 8 portfolios in the sample pool, 8 random numbers are generated. Those portfolios chosen to be propagated are placed into a new pool. Although the random numbers are between 100 and 365, they are divided by 100 to fit the scale of the objective functions. When the random number falls to the left of the midpoint of two objective functions, 1 copy of the portfolio *to the left* is placed in the new pool, as shown below:

Open table as spreadsheet

Random Number	Reason	No. of Copies
3.63	Closer to 1 than 2	1 copy of 1
3.49	Closer to 1 than 2	1 copy of 1
1.71	Closer to 4 than 3	1 copy of 4
1.51	Closer to 5 than 4	1 copy of 5
1.93	Closer to 3 than 4	1 copy of 3
1.44	Closer to 5 than 6	1 copy of 5
2.64	Closer to 2 than 1	1 copy of 2
3.48	Closer to 1 than 2	1 copy of 1

When completed, the method has created a new pool containing the following 8 portfolios (shown in order of highest objective function):

New portfolio	1	2	3	4	5	6	7	8
Original portfolio	1	1	1	2	3	4	5	5
Objective functions	3.65	3.65	3.65	2.50	2.00	1.65	1.40	1.40

Open table as spreadsheet

Because the original portfolio 1 was the fittest, with an objective function of 3.65, it has the greatest chance of surviving. Porfolios 6, 7, and 8 did not survive, and while portfolio 5 has more copies than the better results 2 through 4, it will eventually be eliminated unless it mutates into a better portfolio. When performing this process with a large pool of 5,000 or 100,000, many of the old portfolios will survive. The objective is to remove about 10% of the worst performers on each cycle while propagating the best.

The following steps define the propagation process for a large pool of *P* portfolios. As individual portfolios (*p*) are propagated, they are moved from the original pool 1 to a new pool 2:

1. Calculate the objective function for all *P* portfolios in the pool.
2. Sort the portfolios, putting the highest objective function in position 1.
3. Note the range of the objective functions from the highest OF_H in position 1 to the lowest OF_L in position *p*.
4. Get a uniform random number, *R*, between OF_L and OF_H.

5. Determine which portfolio, p, has the objective function closest to the random number R.
6. Make 1 copy of portfolio p and place it into the new pool 2.
7. If P portfolios have been propagated, then go to Step 8; otherwise, go to Step 4.
8. Erase the contents of pool 1 and copy the contents of pool 2 into pool 1.

Pool 1 now contains the propagated portfolios. Pool 2 is only used as temporary storage during the propagation process.

If the propagation process is too slow, it can be accelerated up by multiplying the number of copies by a factor, such as 2, or by using the integer value of the objective function as the number of copies. The danger is that the program will make too many copies of the same strings, reducing the diversity in the gene pool and increasing the chance that the final choice will come from the original pool. This is the equivalent of finding a local maximum rather than a global one.

Mating Parents to Create Offspring

Mating is the process of combining two *parent* strings in a way that creates two unique offspring. As in life, if two strings with excellent genes are combined, the offspring may have genes that are superior to either of the parents. As with the other genetic algorithm steps, this will also be implemented using random numbers.

The mating process will select two portfolios at random from the pool of P portfolios and combine part of one string with part of the other. The strings will first be divided at a random point, then the two left parts will be switched. The result is two unique portfolios. Mating follows the steps:

1. *Select portfolio* p_i using a random whole number between 1 and P, where P is the total number of portfolios. Mark portfolio i as processed so that it will not be selected again.
2. *Select portfolio* p_j using another random number between 1 and P. If the portfolio selected is marked as processed, then increase the random number by 1 until the next unused portfolio is found. If the value reaches P, then begin again at 1.
3. *Get a random number*, a, from 1 to the number of assets in the portfolio. Our example uses 5 assets; therefore the random number must be one of the integers from 1 to 5.
4. *Mate* the two portfolios by switching the weighting factors in p_i, assets 1 through a, with the weighting factors in p_j, assets 1 through a. For example, if a = 2, then the two leftmost assets of portfolios i and j are switched:

   Before mating (*parents*)

Portfolio i:	w_{i1}	w_{i2}	w_{i3}	w_{i4}	W_{i5}
Portfolio j:	w_{j1}	w_{j2}	w_{j3}	w_{j4}	w_{j5}

   After mating (*offspring*)

Portfolio i:	w_{j1}	w_{j2}	w_{i3}	w_{i4}	w_{i5}
Portfolio j:	w_{i1}	w_{i2}	W_{j3}	w_{j4}	w_{j5}

5. *Normalize the two offspring.* Because the sum of the weighting factors will no longer total 1 in each of the offspring portfolios, they must be normalized by dividing each weighting factor by the sum of all the weighting factors in the new portfolio.
6. *Correct for liquidity constraints.* Mating does not affect individual market liquidity constraints because the positions in the portfolio of those items being switched remain the same. Group liquidity, that is, a maximum volume that can be traded in a set of markets, can be affected if the split occurs within one of these groups. If the petroleum sector, crude oil, heating oil, and unleaded gasoline is considered a futures market group, then each market may be limited to 2,000 contracts, but the total group may also be limited to 4,000 contracts because of diversification. During the initial allocation of the pool, the allocations for the three energy markets are reduced to 4,000 if they exceed that amount. For example, if crude, heat, and gas have initial allocations of 2,100, 1,500, and 1,500, they could be scaled to 1,400, 1,000, and 1,000 to keep the total below the group maximum of 4,000. However, another portfolio allocation might have 800, 1,500, 1,500. If these two portfolios are mated and the split comes after the first market, one of the offspring will have allocations of 1,400, 1,500, 1,500, which exceeds the limit. Therefore, groups need to be rescaled to satisfy liquidity constraints after mating.
7. *Continue mating* until all the portfolios have been combined into offspring. It may seem as though the act of mating all the parents might lose the best combination; therefore only 20% or 40% should be mated. The propagation of duplicate strings and the large number of combinations that might yield excellent results favor the mating of all portfolios in the pool. Less than that will cause convergence to an early, sub-optimal solution.

The mating process creates new combinations of portfolio allocations. Because of the previous propagation step, there are more copies of portfolios that generated higher objective functions. By combining these portfolios randomly, the chance of finding a better combination is very high.

Mutating: Introducing New Genes into the Pool

The final step in Darwin's process is mutation, a random change that can improve the species or create an inferior member. The act of mutating prevents the gene pool from stagnating. In this application, introducing new genes prevents the selection process from converging too soon. Consistent with the other steps, mutation replaces one gene (one weighting factor) with a new, random value, in a random selection of about 10% of the current portfolios.

1. Get a random number between 1 and P to indicate the portfolio to be mutated. Mark that portfolio as *processed* so that it does not receive another mutation.
2. Get a random number between 1 and a, the number of assets. This will be the asset to be changed.
3. Get a random number between 0 and 1.0 to represent the new weighting factor.
4. Adjust the new weight to satisfy any individual market liquidity constraints and group constraints (as discussed in the previous section, "Mating," item 6).
5. Normalize the weighting factors of the mutated portfolio by dividing each weighting factor by the sum of the weighting factors.
6. Continue mutating portfolios until the targeted percentage, between 5% and 15%, is reached.

As in the other steps, too much mutation will result in losing the best results; too little mutation will cause the genetic algorithm to converge too quickly to one of the portfolios already in the pool.

Continue with Evaluation

The genetic algorithm process is complete. The pool has been created, propagated, mated, and mutated. The results can now be reevaluated by calculating the objective function of each of the portfolios to see if there has been an improvement. This is done in the previous section "Evaluation." The process continues until the completion criteria is satisfied.

Optimal Subsets

When solving the portfolio problem for a large number of assets, for example 50 to 100, it may be practical to find the best subset of only 15 assets. While the genetic algorithm process will reject systems that do not contribute to the solution, the best allocations may concentrate 90% of the allocations in 10% of the assets. The remaining assets provide only marginal improvement.

The portfolio solution will normally allocate some amount of the investment to all assets, unless those assets are nearly identical to another asset in the portfolio; therefore, any subset will be suboptimal. Using subsets is contrary to the goals of the Markowitz solution because it limits the diversification. The mean-variance solution will always seek the lowest variance, which comes with greater diversification. Nevertheless, a portfolio of the most important assets is practical for an investor.

One solution to identifying the best subset is to run the full program on all assets, then simply discard the ones with small allocations and redistribute the investment in proportion to the remaining allocations. This approach is unnecessarily time-consuming and may yield allocations that exceed liquidity constraints when the allocations are redistributed to the chosen subset.

Using the genetic algorithm, subsets can be established during the initialization of the pool and maintained throughout the rest of the process. For a subset of *s* assets out of a total of *S* assets,

1. When initializing the pool, choose only *s* assets at random. The remaining assets are given the weight of zero. Follow the same steps for choosing weighting factors, then normalize.
2. Propagation remains the same. Only the objective function is calculated; the number of assets is not relevant.
3. Mating requires an additional step. Select the first parent portfolio and decide where it is to be split. Count the number of assets on each side of the splitting point. Select another parent portfolio. Count the number of assets on each side of the same splitting point. If they are the same, those two portfolios can be mated by switching assets at the splitting point. If not, move to the next sequential portfolio and test whether there is a matched distribution. Continue until a match is found. Two parents cannot be mated if they have a different number of assets on each side of the split because the resulting offspring will have either more or less assets than the required subset amount *s*. Except for a few portfolios, the normal distribution of assigned assets due to random selection will allow most portfolios to be matched with others that have the same asset distribution relative to the split. The few portfolios that do not match can be discarded.
4. Mutating has a problem similar to mating, but it is easier to solve. After selecting a portfolio at random, choose an active asset at random and remove it. Then choose another asset (previously zero but not the one just removed) and generate the new weight using a random number, normalizing afterward. This keeps the total number of assets at *s*.

The subset solution is much faster than a full solution. It involves some compromise because it is a suboptimal solution, that is, the best ratio will always be found by using more assets. Without controlling the mating and mutating process, the program will try to introduce more assets in order to improve the results. Although the pool starts with portfolios that all have only *s* assets, the mating and mutating process will continue to combine, add, and propagate portfolios with more assets. You will be fighting nature, although the best solution using a large number of assets will be only slightly better than the optimal subset.

Is It the Best Portfolio?

For allocating a few assets, the result of GASP is the optimal portfolio. As the number of assets gets larger, the number of possible solutions quickly becomes too large to have included all combinations in the pool, but for 20 or even 50 assets the solution is very likely the optimal combination. For a much larger number of assets, the combinations created by the genetic algorithm in a few hours of computing time are a very small percentage of the total possible. Yet the answer may be close to optimal.

When allocating many assets, one way of estimating the answer is to limit the percentage increments assigned to each allocation. Using 100 assets as an example, a random generation of weighting factors could return values with 4 decimal places, such as .0523, representing a 5.23% allocation. Then each of the 100 assets would have 10,000 possible choices and the total combinations would be 10,000! (1 × 2 × 3 ×…× 10,000), an extraordinarily large number. However, if the problem was limited to whole percent, the number of combinations would only be 100!, still very large but of much less magnitude. When arriving at the optimal solution, the shape of the allocations based on 1% increments must be similar to that based on .001% increments. Except for a very large investment, an allocation of .001% of the investment is not significant.

Although there are many answers with near-optimal solutions, many of them differ in the second and third decimal place, which makes it unimportant to the trader. The GASP program will consistently return a near-optimal solution.

Verifying the Global Maximum

One way of verifying that the solution is a global maximum and not a local one is to run the solution more than once. Each new pass creates a completely new pool of random allocations and begins the genetic algorithm process again. If five passes were made on a portfolio problem with 50 assets, the allocations should be very similar. The one with the highest objective function is the best, and may represent the global maximum. There may also be many local maxima with peaks that are nearly the same. This can be seen if the objective functions are the same but the allocations are significantly different.

It is more efficient to run the portfolio solution 5 times, each with 50 to 100 cycles of the genetic algorithm, than to run it once with 500 cycles. The solution begins to converge after 50 cycles and is unlikely to change significantly afterwards. This is due to the percentage of mating and mutation specified in the program at 10% to 15%. If a larger percentage is used, then convergence would not be as fast, but the results could become unstable.

An Example of a GASP Solution

The best way to understand the full process of the genetic algorithm solution is to see the step-by-step results. This example uses 19 unique strategies for trading the Nasdaq-100 futures contract, each with three components that could be based on a trend (*T*), mean-reversion (*M*), or a combination of both *T* and *M* (*B*). These strategies are applied to only long positions (*L*) or only short sales (*S*). Therefore, a long-only strategy that combines trend, mean-reversion, and mean-reversion components will be labeled LTMM, and appears as the eighth strategy in the output, shown in Figure 24.4. Other features of this test are:

1. A total of 19 assets (in this case an *asset* is the return stream of one Nasdaq strategy).
2. The historic returns of each strategy cover the interval from May 4, 1995, through June 30, 2002, a span of 7.16 years.
3. A target optimal subset of 12 of 19 assets.
4. An investment of $10 million.
5. An initial pool size of 5,000.
6. A mutation rate of 10%.
7. A risk calculation based on semi-variance of drawdowns (*D*).
8. A target risk of 16.7% representing the confidence level of 99.74.

9. Each pass of the program will have 100 cycles.

10. There will be 3 passes.

Open table as spreadsheet

(a) Pass 1

GENETIC ALGORITHM foliondx — **20020705 9:06:57**

from 19950504 to 20020630, 7.16 years, 19 assets, investment $10 mil

passes 3, cases 100, subset 12, pool size 5000, cull 2.00, mutate 0.10 preset fixed

basis D, minliq 1, liq on, ratio on, riskeq off, maxsys 0, VAR on, %target 16.97 16.60 6.67, adjtarget 2.85, VARlimit 5%

PASS 1						ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Case	ObjF	Std	StdR	StdD	Mdd%	LTBB	LBBB	LTBM	LBBM	LTMB	LBMB	LMMB	LTMM	LBMM	LMMM	STBB	SBBB	STBM	SBBM	STMB	SBMB	STMM	SBMM	SMMM	Net
1	12.955	1.18	19.17	2.79	16.85	0	0	0	1	19	40	41	11	21	53	9	71	0	18	0	0	27	35	0	346
4	13.089	1.11	15.17	2.75	19.42	0	0	0	39	15	33	34	9	17	44	7	28	0	33	0	17	34	0	0	310
5	13.905	1.26	15.00	2.78	16.85	5	0	17	35	0	42	42	0	18	49	8	66	0	16	0	0	25	14	0	337
9	14.161	1.41	14.21	2.85	14.75	7	0	32	26	2	25	117	0	4	39	42	2	0	26	0	0	33	0	0	355
10	14.529	1.43	15.86	2.87	16.84	0	20	27	41	2	25	117	0	4	39	42	2	0	26	0	0	33	0	0	378
12	14.944	1.36	13.94	2.72	16.02	13	0	15	26	0	29	110	0	3	36	6	55	0	26	0	0	33	0	0	352
13	15.111	1.39	17.16	2.79	16.25	13	0	15	26	0	29	110	0	3	36	6	55	0	26	0	0	33	24	0	376
14	15.439	1.48	17.98	2.89	16.37	0	0	7	29	23	35	117	0	4	44	5	65	0	16	0	34	25	0	0	404
15	15.925	1.50	19.22	2.92	17.72	0	3	32	32	0	45	117	0	4	39	2	71	0	0	14	20	33	0	0	412
18	16.293	1.47	18.61	2.78	15.65	5	0	7	39	15	25	117	0	0	45	7	61	0	14	0	39	33	0	0	407
19	16.313	1.48	18.89	2.79	12.90	0	3	32	35	0	31	117	0	3	44	7	71	0	32	0	8	33	0	0	416
22	16.477	1.48	17.18	2.79	14.01	5	0	27	41	0	33	109	0	3	43	7	71	0	16	0	20	31	0	0	406
25	16.732	1.46	19.12	2.71	15.14	0	0	17	39	15	25	117	0	0	44	7	65	0	16	0	29	31	6	0	411
29	16.810	1.47	18.23	2.71	13.58	3	0	31	35	0	26	109	0	3	49	7	71	0	16	0	27	33	0	0	410
30	16.833	1.47	20.29	2.73	14.33	0	0	17	39	15	25	117	0	0	44	7	71	0	32	0	23	33	0	0	423
31	16.842	1.48	18.58	2.78	14.70	0	0	33	38	0	40	103	0	3	49	8	66	0	20	0	23	33	0	0	416
32	16.972	1.50	18.17	2.72	13.37	3	0	31	35	0	31	117	0	2	45	7	71	0	20	0	19	33	0	0	414
34	17.044	1.45	17.45	2.71	14.68	4	0	29	41	0	37	96	0	0	49	8	66	0	15	0	26	33	0	0	404
36	17.078	1.46	17.61	2.72	14.71	4	0	29	41	0	37	96	0	0	49	7	67	0	19	0	24	33	0	0	406
37	17.100	1.49	17.77	2.75	14.91	5	0	27	41	0	38	102	0	0	49	7	59	0	28	0	23	33	0	0	412
39	17.122	1.48	18.00	2.73	14.85	3	0	27	41	0	38	102	0	3	49	8	66	0	15	0	26	33	0	0	411
41	17.129	1.48	17.09	2.72	14.38	4	0	33	41	0	29	102	0	3	49	8	66	0	15	0	24	33	0	0	407
42	17.152	1.50	18.42	2.76	14.86	4	0	27	41	0	40	103	0	0	49	8	71	0	20	0	23	33	0	0	419
43	17.190	1.48	18.13	2.73	14.70	4	0	27	41	0	38	102	0	0	49	8	66	0	16	0	29	33	0	0	413
44	17.225	1.48	18.96	2.73	14.46	3	0	29	41	0	40	108	0	0	44	14	71	0	16	0	22	33	0	0	421
45	17.235	1.48	18.01	2.71	14.70	4	0	27	41	0	38	102	0	0	49	8	66	0	20	0	24	33	0	0	412
47	17.257	1.48	18.53	2.73	14.68	3	0	27	41	0	40	103	0	0	49	8	71	0	20	0	22	33	0	0	417
49	17.261	1.48	18.10	2.71	14.68	3	0	27	41	0	40	103	0	0	49	8	66	0	18	0	24	33	0	0	412
52	17.285	1.50	18.43	2.74	14.41	3	0	31	41	0	37	107	0	0	49	14	66	0	16	0	24	33	0	0	421
54	17.306	1.48	18.17	2.72	14.39	3	0	33	41	0	36	102	0	0	49	14	66	0	20	0	20	33	0	0	417
59	17.315	1.48	17.98	2.71	14.39	3	0	33	41	0	36	102	0	0	49	14	66	0	16	0	22	33	0	0	415

Open table as spreadsheet

						ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NO	ND	ND	ND	ND	ND	ND	ND	ND	
Case	ObjF	Std	StdR	StdD	Mdd%	LTBB	LBBB	LTBM	LBBM	LTMB	LBMB	LMMB	LTMM	LBMM	LMMM	STBB	SBBB	STBM	SBBM	STMM	SBMB	STMM	SBMM	SMMM	Net
objf	17.315	1.48	17.98	2.71	14.39	3	0	33	41	0	36	102	0	0	49	14	66	0	16	0	22	33	0	0	415
Rtio	17.315	1.48	17.98	2.71	14.39	3	0	33	41	0	36	102	0	0	49	14	66	0	16	0	22	33	0	0	415

Open table as spreadsheet

BEST RATIO SOLUTION						ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Norm	AROR	AStd	StdR	StdD	Mdd%	LTBB	LBBB	LTBM	LBBM	LTMB	LBMB	LMMB	LTMM	LBMM	LMMM	STBB	SBBB	STBM	SBBM	STMB	SBMB	STMM	SBMM	SMMM	Net
stdev	33.29	16.60	12.75	1.92	10.20	2	0	23	29	0	26	72	0	0	35	10	47	0	11	0	16	23	0	0	294
sdres	17.42	0.55	6.67	1.01	5.34	1	0	12	15	0	13	38	0	0	18	5	24	0	6	0	8	12	0	0	152
maxdd	65.26	2.05	24.98	3.77	20.00	4	0	46	57	0	50	142	0	0	68	19	92	0	22	0	31	46	0	0	577

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EXPONENTIAL DISTRIBUTION CONFIDENCE LEVEL 16.97% EQUAL TO MAXIMUM DRAWDOWN OF $ 1.7 million																									
						ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Conf	AROR	Std	StdR	StdD	Mdd%	LTBB	LBBB	LTBM	LBBM	LTMB	LBMB	LMMB	LTMM	LBMM	LMMM	STBB	SBBB	STBM	SBBM	STMB	SBMB	STMM	SBMM	SMMM	Net
95.40	95.38	3.00	36.54	5.51	29.28	6	0	67	83	0	73	207	0	0	100	28	134	0	33	0	45	67	0	0	843
99.74	49.46	1.55	18.97	2.87	15.19	3	0	35	43	0	38	107	0	0	52	15	69	0	17	0	23	3b	0	0	437
99.90	42.59	1.34	16.26	2.47	13.05	3	0	30	37	0	33	92	0	0	44	13	60	0	14	0	20	30	0	0	376

Best case has 11 of 19 assets.

Open table as spreadsheet

(b) Pass 2																									
PASS 2						ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Case	ObjF	Std	StdR	StdD	Mdd%	LTBB	LBBB	LTBM	LBBM	LTMB	LBMB	LMMB	LTMM	LBMM	LMMM	STBB	SBBB	STBM	SBBM	STMB	SBMB	STMM	SBMM	SMMM	Net
1	13.651	1.18	13.66	2.75	16.61	14	0	12	49	0	3	34	4	1	58	0	0	3	38	0	0	53	22	0	291
2	14.190	1.19	12.82	2.73	16.58	12	0	13	53	0	4	37	5	2	63	0	0	4	41	0	0	57	3	0	294
5	14.449	1.44	21.58	2.82	18.82	10	0	6	36	0	0	123	0	0	62	26	44	2	38	19	9	28	0	0	403
9	14.576	1.37	16.40	2.82	15.56	0	0	34	18	0	29	105	7	0	55	26	8	0	0	13	37	31	0	0	363
10	14.595	1.39	17.56	2.91	18.90	0	0	0	54	9	29	105	7	0	55	26	8	0	0	13	37	31	0	0	374
11	15.225	1.34	19.08	2.73	15.85	0	0	33	17	0	28	101	0	12	50	18	26	0	30	0	0	43	17	0	375
13	15.246	1.42	19.73	2.93	17.95	0	0	41	22	0	28	101	0	12	50	18	26	0	30	0	0	53	11	0	392
14	16.199	1.45	22.19	2.84	14.48	0	0	35	30	0	29	101	0	0	62	30	44	1	32	0	0	43	18	0	425
17	16.387	1.41	20.51	2.75	17.48	6	0	17	41	0	27	99	0	0	62	30	44	0	27	0	0	40	19	0	412
18	16.561	1.45	21.51	2.81	15.30	0	0	35	30	0	29	101	0	0	62	18	53	2	32	0	0	49	10	0	421
21	16.669	1.44	20.76	2.80	15.63	0	0	30	42	0	38	95	0	0	58	24	41	1	29	0	0	39	22	0	419
22	16.798	1.45	19.27	2.78	15.66	0	0	31	43	0	29	105	7	0	55	26	36	0	22	0	13	37	14	0	418
23	16.980	1.48	19.02	2.83	16.68	0	0	26	48	0	41	105	7	0	55	26	36	0	33	0	13	37	0	0	427
25	17.013	1.52	21.67	2.90	16.56	0	0	31	43	0	41	101	0	0	62	26	37	0	28	0	17	40	16	0	442
26	17.077	1.51	21.10	2.87	16.27	0	0	31	43	0	41	101	0	0	62	26	37	0	28	0	17	40	12	0	438
27	17.198	1.44	18.91	2.73	16.01	0	0	30	42	0	36	94	4	0	62	23	44	1	33	0	13	37	0	0	419
29	17.299	1.45	18.97	2.73	15.93	0	0	30	42	0	35	97	4	0	62	23	44	1	33	0	13	37	0	0	421
31	17.427	1.46	19.25	2.73	15.97	0	0	31	42	0	38	95	0	0	62	18	53	1	23	0	22	37	0	0	422
35	17.479	1.46	19.51	2.72	15.65	0	0	29	46	0	32	101	0	0	62	18	41	0	27	0	16	41	6	0	419
38	17.651	1.51	19.24	2.74	15.77	0	0	30	48	0	32	105	0	0	62	18	44	1	29	0	22	37	0	0	428
42	17.661	1.50	19.55	2.75	15.73	0	0	32	50	0	29	101	0	0	62	17	53	2	27	0	22	37	0	0	432
45	17.677	1.50	19.42	2.74	15.79	0	0	32	47	0	32	101	0	0	62	18	53	1	25	0	22	37	0	0	430
47	17.694	1.50	19.01	2.72	15.64	0	0	30	50	0	29	105	0	0	62	18	41	1	30	0	22	37	0	0	425
48	17.710	1.49	18.87	2.71	15.70	0	0	32	50	0	29	101	0	0	62	18	44	2	27	0	22	37	0	0	424
51	17.730	1.51	18.89	2.73	15.97	0	0	30	47	0	35	105	0	0	62	18	44	0	26	0	22	37	0	0	426
53	17.767	1.51	19.35	2.72	15.88	0	0	29	46	0	35	105	0	0	62	18	44	1	29	0	22	37	0	0	428
56	17.800	1.51	19.49	2.75	15.73	0	0	32	50	0	29	105	0	0	62	17	44	0	30	0	22	40	0	0	431
72	17.801	1.52	18.68	2.72	15.81	0	0	32	47	0	32	107	0	0	62	17	44	0	30	0	20	36	0	0	427

Open table as spreadsheet

						ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Case	ObjF	Std	StdR	StdD	Mdd%	LTBB	LBBB	LTBM	LBBM	LTMB	LBMB	LMMB	LTMM	LBMM	LMMM	STBB	SBBB	STBM	SBBM	STMB	SBMB	STMM	SBMM	SMMM	Net
objf	17.801	1.52	18.68	2.72	15.81	0	0	32	47	0	32	107	0	0	62	17	44	0	30	0	20	36	0	0	427
Rtio	17.801	1.52	18.68	2.72	15.81	0	0	32	47	0	32	107	0	0	62	17	44	0	30	0	20	36	0	0	427

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BEST RATIO SOLUTION						ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Norm	AROR	AStd	StdR	StdD	Mdd%	LTBB	LBBB	LTBM	LBBM	LTMB	LBMB	LMMB	LTMM	LBMM	LMMM	STBB	SBBB	STBM	SBBM	STMB	SBMB	STMM	SBMM	SMMM	Net
stdev	33.28	16.60	12.81	1.87	10.85	0	0	22	32	0	22	73	0	0	43	12	30	0	21	0	14	25	0	0	294
sdres	17.32	0.54	6.67	0.97	5.65	0	0	11	17	0	11	38	0	0	22	6	16	0	11	0	7	13	0	0	152
maxdd	61.35	1.93	23.62	3.45	20.00	0	0	40	59	0	40	135	0	0	78	22	56	0	38	0	25	46	0	0	539

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EXPONENTIAL DISTRIBUTION CONFIDENCE LEVEL 16.97% EQUAL TO MAXIMUM DRAWDOWN OF $ 1.7 million																									
						ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Conf	AROR	Std	StdR	StdD	Mdd%	LTBB	LBBB	LTBM	LBBM	LTMB	LBMB	LMMB	LTMM	LBMM	LMMM	STBB	SBBB	STBM	SBBM	STMB	SBMB	STMM	SBMM	SMMM	Net
95.40	98.10	3.08	37.74	5.51	31.96	0	0	65	95	0	65	216	0	0	125	34	89	0	61	0	40	73	0	0	863
99.74	50.60	1.59	19.60	2.94	16.49	0	0	33	49	0	33	112	0	0	65	18	46	0	31	0	21	38	0	0	446
99.90	43.65	1.37	16.72	2.46	14.28	0	0	29	42	0	29	96	0	0	56	15	40	0	27	0	18	32	0	0	384

Best case has 11 of 19 assets.

Open table as spreadsheet

(c) Pass 3																									
PASS	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND					
Case	ObjF	Std	StdR	StdD	Mdd%	LTBB	LBBB	LTBM	LBBM	LTMB	LBMB	LMMB	LTMM	LBMM	LMMM	STBB	SBBB	STBM	SBBM	STMB	SBMB	STMM	SBMM	SMMM	Net
1	13.662	1.20	17.41	2.73	13.02	0	0	38	30	0	12	47	0	18	48	0	40	0	40	14	26	27	0	0	340
3	13.691	1.24	17.36	2.82	13.64	0	6	38	34	0	12	47	0	18	48	0	40	0	40	14	26	27	0	0	350
4	13.802	1.24	19.10	2.80	14.51	0	0	31	42	0	12	47	0	18	48	0	40	0	40	14	23	28	10	0	353
5	13.936	1.22	18.54	2.83	17.35	0	0	0	66	17	17	36	10	0	48	0	40	0	40	14	23	28	10	0	349
7	14.292	1.18	17.14	2.72	16.43	0	0	0	66	17	17	36	10	0	48	0	40	0	40	14	23	28	0	0	339
9	14.731	1.45	16.53	2.89	15.25	0	0	34	41	0	18	110	0	28	41	30	59	3	21	0	0	19	0	0	404
10	15.308	1.38	17.13	2.74	12.94	0	18	34	34	0	16	102	0	0	44	0	37	0	37	13	23	25	0	0	383

12	15.484	1.40	18.65	2.76	13.53	0	18	34	34	0	16	102	0	0	44	0	40	0	40	14	26	27	0	0	395
13	15.776	1.36	18.85	2.72	16.68	0	0	22	23	9	38	100	0	3	48	0	40	0	40	10	0	35	12	0	380
15	16.432	1.40	20.95	2.72	15.11	0	0	18	31	11	38	96	0	0	55	12	45	0	40	14	26	27	0	0	413
18	16.621	1.47	18.55	2.79	15.45	0	0	23	58	6	25	106	0	0	51	9	35	0	37	13	24	25	0	0	412
20	16.941	1.48	18.99	2.76	14.30	0	0	27	58	6	18	115	0	0	48	22	42	0	28	0	25	33	0	0	422
22	17.063	1.49	21.29	2.80	16.56	0	0	23	49	0	38	107	0	0	55	12	45	0	30	10	27	35	0	0	431
24	17.147	1.47	19.75	2.72	13.52	0	0	25	58	6	18	114	0	0	48	22	54	0	28	0	21	33	0	0	427
25	17.225	1.50	18.93	2.81	16.44	0	0	20	60	17	18	107	0	0	51	11	42	0	37	4	26	33	0	0	426
26	17.370	1.49	18.42	2.71	14.19	0	0	27	58	6	16	106	0	0	55	10	39	0	37	4	26	32	0	0	416
27	17.459	1.54	19.59	2.80	15.34	0	0	25	58	6	20	115	0	0	55	12	45	0	32	0	27	38	0	0	433
30	17.554	1.52	19.40	2.77	14.68	0	0	27	58	6	25	107	0	0	55	20	54	0	30	0	23	32	0	0	437
33	17.587	1.52	19.98	2.78	15.34	0	0	27	58	6	22	110	0	0	54	12	45	0	36	5	25	35	0	0	435
34	17.600	1.55	20.44	2.81	14.93	0	0	27	62	6	20	115	0	0	51	11	54	0	36	5	25	33	0	0	445
35	17.736	1.52	20.17	2.73	14.33	0	0	27	58	6	18	109	0	0	55	11	54	0	36	5	25	33	0	0	437
40	17.737	1.53	19.53	2.74	14.85	0	0	25	58	6	20	115	0	0	55	12	54	0	26	5	25	33	0	0	434
41	17.758	1.54	19.80	2.77	14.94	0	0	27	58	6	20	115	0	0	55	12	54	0	26	5	25	35	0	0	438
42	17.760	1.51	19.90	2.72	14.33	0	0	27	58	6	18	107	0	0	55	11	54	0	37	3	22	35	0	0	433
43	17.848	1.52	19.85	2.72	14.81	0	0	25	58	6	20	113	0	0	55	12	54	0	26	5	25	35	0	0	434
51	17.848	1.53	20.03	2.72	14.93	0	0	23	58	6	21	115	0	0	55	12	54	0	26	5	25	35	0	0	435
52	17.859	1.53	19.90	2.73	14.86	0	0	25	58	6	20	115	0	0	55	12	54	0	26	5	25	0	0	0	436
55	17.861	1.53	20.01	2.74	14.89	0	0	25	58	6	20	115	0	0	55	12	54	0	26	5	26	35	0	0	437
57	17.864	1.53	19.90	2.73	14.97	0	0	25	58	6	20	115	0	0	54	11	54	0	26	5	26	35	0	0	435
59	17.870	1.52	19.83	2.71	14.66	0	0	25	58	6	19	113	0	0	55	12	54	0	26	5	25	35	0	0	433
62	17.894	1.52	19.88	2.71	14.82	0	0	25	58	6	19	115	0	0	54	11	54	0	26	5	26	35	0	0	434

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						ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Case	**ObjF**	**Std**	**StdR**	**StdD**	**Mdd%**	**LTBB**	**LBBB**	**LTBM**	**LBBM**	**LTMB**	**LBMB**	**LMMB**	**LTMM**	**LBMM**	**LMMM**	**STBB**	**SBBB**	**STBM**	**SBBM**	**STMB**	**SBMB**	**STMM**	**SBMM**	**SMMM**	**Net**
objf	17.894	1.52	19.88	2.71	14.82	0	0	25	58	6	19	115	0	0	54	11	54	0	26	5	26	35	0	0	434
Rtio	17.894	1.52	19.88	2.71	14.82	0	0	25	58	6	19	115	0	0	54	11	54	0	26	5	26	35	0	0	434

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BEST	**RATIO**	**SOLUTION**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**				
Norm	**AROR**	**AStd**	**StdR**	**StdD**	**Mdd%**	**LTBB**	**LBBB**	**LTBM**	**LBBM**	**LTMB**	**LBMB**	**LMMB**	**LTMM**	**LBMM**	**LMMM**	**STBB**	**SBBB**	**STBM**	**SBBM**	**STMB**	**SBMB**	**STMM**	**SBMM**	**SMMM**	**Net**
stdev	33.29	16.60	13.64	1.86	10.17	0	0	17	40	4	13	79	0	0	37	8	37	0	18	3	18	24	0	0	298
sdres	16.28	0.51	6.67	0.91	4.97	0	0	8	19	2	6	39	0	0	18	4	18	0	9	2	9	12	0	0	146
maxdd	65.49	2.06	26.83	3.66	20.00	0	0	34	78	8	26	155	0	0	73	15	73	0	35	7	35	47	0	0	586

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EXPONENTIAL DISTRIBUTION CONFIDENCE LEVEL 16.97% EQUAL TO MAXIMUM DRAWDOWN OF $1.7 million

						ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
Conf	**AROR**	**Std**	**StdR**	**StdD**	**Mdd%**	**LTBB**	**LBBB**	**LTBM**	**LBBM**	**LTMB**	**LBMB**	**LMMB**	**LTMM**	**LBMM**	**LMMM**	**STBB**	**SBBB**	**STBM**	**SBBM**	**STMB**	**SBMB**	**STMM**	**SBMM**	**SMMM**	**Net**
95.40	98.81	3.11	40.38	5.53	30.13	0	0	51	118	12	39	234	0	0	110	22	110	0	53	10	53	71	0	0	883
99.74	50.96	1.60	20.93	2.93	15.50	0	0	26	61	6	20	121	0	0	57	12	57	0	27	5	27	37	0	0	456
99.90	44.10	1.38	18.26	2.47	13.47	0	0	23	53	5	17	104	0	0	49	10	49	0	24	5	24	32	0	0	395

Best case has 11 of 19 assets.

Total run time 85 mins 6 secs.

Figure 24.4: GASP solution for 16 Nasdaq 100 futures strategies.

Allocations that appear in Figure 24.4 are in numbers of futures contracts. The program knows the margin needed to trade one contract and the margin-to-equity ratio required by the investor. The total number of contracts allocated by the GASP program is a function of the total investment and the margin-to-equity ratio.

Overview of the Process

The evolution of results in Figure 24.4 can be seen in the number of cases (*Case*) and the objective function (*ObjF*) in the first two columns, and in the 19 columns of contract allocations under the strategy names, representing the largest part of the printout. In Pass 1, Case 1, at the top of part *a*, the objective function is 12.955. The allocations represent the best objective function found in the initial pool of 5,000 that qualified as having a risk within 5% of the targeted risk level of 2.85 for the semi-variance of drawdowns. Note that all values in the column *StdD* are within 5% of 2.85. Allocations are always rescaled, if possible, to achieve a standard risk level in order to avoid low-risk solutions that also have low returns. The columns that follow *ObjF* are alternate risk measures:

Std is the standard deviation of the daily returns.

StdR is the standard deviation of the residuals, based on a linear regression of the return series.

StdD is the semi-variance, the standard deviation of the daily drawdowns.

Mdd% is the maximum drawdown as a percentage of the investment.

Column 1 shows that the best solution was found in 59 cycles through the program. The missing numbers occur when no improvement was found for a cycle or sequence of cycles. Allocations shift considerably in the first 15 cases, then stabilize

and improve gradually. The objective function gained 80% of its improvement in the first 15 cases, and the remaining 20% in the next 45 cases, and nothing afterwards.

The final solution, which appears in case 59, is rescaled at the bottom of part (a) to the targeted confidence level of 99.75 (less than a .25% chance of losing the targeted amount of 16.97% of the investment during the test interval of 7.16 years. The annualized rate of return is 49.46% for this solution.

The results of the three passes show that the best objective function increases in each pass from 17.315 to 17.801, and finally to 17.894. The rate of return (seen as *AROR* in column 2 in the last 3 lines of each pass), however, only improves from 49.46% to 50.95%, showing that returns are very similar. Comparing Pass 1 and Pass 3, the allocations might seem very different; however, the same strategies receive the allocations and the distribution of the allocations are similar. In Pass 1, the strategy LMMB receives 107 contracts (confidence level 99.74), and in Pass 3 it is given 121 contracts. At the same time, strategy SBBB drops from 69 to 57 contracts. There are clearly a range of allocations that will return similar results. In each of the three passes, the number of assets allocated differed from 10 to 12, although all were no higher than the requested level of 12.

The total elapsed time for the test of 3 passes, each with 100 cases (or cycles), was 85 minutes on a 1.7 mHz Pentium 4 processor. Considering the number of possible combinations, the time is not a deterrent.

Test Interval for Portfolio Allocation

Short test intervals are responsive to current market conditions but do not reflect the full balance of bull and bear markets. Statisticians always prefer more data to less data. Rolling a 6-month portfolio every month limits the view of each performance or market to a very narrow window. No one has yet shown that an allocation based on short intervals is better than one based on a longer period. In order to include a fair sample of bull and bear market periods it is necessary to begin with data from about 1997, capturing 3 years of bull market performance, followed by 2 years of a bear market, and another period of sideways and tentatively bull market.

The period over which a portfolio is allocated must also include the full seasonal pattern of the assets, otherwise there can be unequal risk in seasonal and nonseasonal assets that are included at the same time. This would be the case with the heating oil and unleaded gasoline futures, or resort stocks where one company benefited from winter business and the other from summer business. The market that is out of season will show lower risk. The two opposed markets may be shifting risk in a way that is always out-of-phase with portfolio allocations that are based on the past 6 months of data.

[3]Harry M. Markowitz, "Portfolio Selection," *Journal of Finance* (March 1952), also Harry M. Markowitz, *Portfolio Selection* (Yale, 1979). The Markowitz model allows for short sales represented by negative weighting factors, where the sum of all weighting factors is 1. In this genetic algorithm there will be only positive allocations, although negative and positive can be implemented by allowing a random number between -1 and +1 to represent the weights rather than a value between 0 and 1.

[4]Thanks to Lutz Borgiel of Ariad in Hamburg, Germany, for his help with this propagation method.

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Appendix 1: Statistical Tables

PROBABILITY DISTRIBUTIONS TABLES

Table A1.1: Normal Curve Areas

Open table as spreadsheet

z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2612	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3820
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916

2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990

Table A1.2: T-Distribution

Open table as spreadsheet

d.f	a	.10	.05	.025	.01	.005
	1	3.078	6.314	12.706	31.821	63.657
	2	1.886	2.920	4.303	6.965	9.925
	3	1.638	2.353	3.182	4.541	5.841
	4	1.533	2.132	2.776	3.747	4.604
	5	1.476	2.015	2.571	3.365	4.032
	6	1.440	1.943	2.447	3.143	3.707
	7	1.415	1.895	2.365	2.998	3.499
	8	1.397	1.860	2.306	2.896	3.355
	9	1.383	1.833	2.262	2.821	3.250
	10	1.372	1.812	2.228	2.764	3.169
	11	1.363	1.796	2.201	2.718	3.106
	12	1.356	1.782	2.179	2.681	3.055
	13	1.350	1.771	2.160	2.650	3.012
	14	1.345	1.761	2.145	2.624	2.977
	15	1.341	1.753	2.131	2.602	2.947
	16	1.337	1.746	2.120	2.583	2.921
	17	1.333	1.740	2.110	2.567	2.898
	18	1.330	1.734	2.101	2.552	2.878
	19	1.328	1.729	2.093	2.539	2.861
	20	1.325	1.725	2.086	2.528	2.845
	21	1.323	1.721	2.080	2.518	2.831
	22	1.321	1.717	2.074	2.508	2.819
	23	1.319	1.714	2.069	2.500	2.807
	24	1.318	1.711	2.064	2.492	2.797
	25	1.316	1.708	2.060	2.485	2.787
	26	1.315	1.706	2.056	2.479	2.779
	27	1.314	1.703	2.052	2.473	2.771
	28	1.313	1.701	2.048	2.467	2.763
	29	1.311	1.699	2.045	2.462	2.756

30	1.310	1.697	2.042	2.457	2.750
40	1.303	1.684	2.021	2.423	2.704
60	1.296	1.671	2.000	2.390	2.660
120	1.289	1.658	1.980	2.358	2.617
8	1.282	1.645	1.960	2.326	2.576

Source: Paul G. Hoel, *Elementary Statistics*, Third Ed. (John Wiley & Sons, New York, 1971).

Table A1.3: Uniform Random Numbers

Open table as spreadsheet

	1	2	3	4	5	6	7	8	9	10	11
1	10480	15011	01536	02011	81647	91646	69179	14194	62590	36207	20969
2	22368	46573	25595	85393	30995	89198	27982	53402	93965	34095	52666
3	24130	48360	22527	97265	76393	64809	15179	24830	49340	32081	30680
4	42167	93093	06243	61680	07856	16376	39440	53537	71341	57004	00849
5	37570	39975	81837	16656	06121	91782	60468	81305	49684	60672	14110
6	77921	06907	11008	42751	27756	53498	18602	70659	90655	15033	21916
7	99562	72905	56420	69994	98872	31016	71194	18738	44013	44840	63213
8	96301	91977	05463	07972	18876	20922	94595	56869	69014	60045	18425
9	89579	14342	63661	10281	17453	18103	57740	84378	25331	12566	58678
10	85475	36857	53342	53988	53060	59533	38867	62300	08158	17893	16439
11	28918	69578	88231	33276	70997	79936	56865	05859	90106	31595	91547
12	63553	40961	48235	03427	49626	69445	18663	72695	52180	20847	12234
13	09429	93969	52636	92737	88974	33488	36320	17617	30015	07272	84115
14	10365	61129	87529	85689	48237	52267	67689	93394	01511	26358	85104
15	07119	97336	71048	08178	77233	13916	47564	81056	97735	85977	29372
16	51085	12765	51821	51259	77452	16308	60756	92144	49442	53900	70960
17	02368	21382	52404	60268	89368	19885	55322	44819	01188	65255	64835
18	01011	54092	33362	94904	31273	04146	18594	29852	71585	85030	51132
19	52162	53916	46369	58586	23216	14513	83149	98736	23495	64350	94738
20	07056	97628	33787	09998	42698	06691	76988	13602	51851	46104	88916
21	48663	91245	85828	14346	09172	30168	90229	04734	59193	22178	30421
22	54164	58492	22421	74103	47070	25306	76468	26384	58151	06646	21524
23	32639	32363	05597	24200	13363	38005	94342	28728	35806	06912	17012
24	29334	27001	87637	87308	58731	00256	45834	15398	46557	41135	10367
25	02488	33062	28834	07351	19731	92420	60952	61280	50001	67658	32586
26	81525	72295	04839	96423	25878	82651	66566	14778	76797	14780	13300
27	29676	20591	68086	26432	46901	20849	80768	81536	86645	12659	92259
28	00742	57392	39064	66432	84673	40027	32832	61362	98947	96067	64760
29	05366	04213	25669	26422	44407	44048	37937	63904	45766	66134	75470
30	91921	26418	64117	94305	26766	25940	39972	22209	71500	64568	91402
31	00582	04711	87917	77341	42206	35126	74087	99547	81817	42607	43808
32	00725	69884	62797	56170	86324	88072	76222	36086	84637	93161	76038
33	69011	65795	95876	55293	18988	27354	26575	08625	40801	59920	29841
34	25976	57948	29888	88604	67917	48708	18912	82271	65424	69774	33611
35	09763	83473	73577	12908	30883	10317	28290	35797	05998	41688	34952

36	91567	42595	27958	30134	04024	86385	29880	99730	55536	84855	29080
37	17955	56349	90999	49127	20044	59931	06115	20542	18059	02008	73708
38	46503	18584	18845	49618	02304	51038	20655	58727	28168	15475	56942
39	92157	89634	94824	78171	84610	82834	09922	25417	44137	48413	25555
40	14577	62765	35605	81263	39667	47358	56873	56307	61607	49518	89565

Source: Francis F. Martin, *Computer Modeling and Simulation* (John Wiley & Sons, 1968, p. 288). Reprinted by permission.

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Appendix 2: Method of Least Squares

The following programs, written in Microsoft FORTRAN for the IBM PC,[1] solve the 2-variable regression analysis using the *method of least squares*. The program allows for the regression of two series against one another, and the regression of one series against time.

OPERATING INSTRUCTIONS

In the following example, the user's entries are underlined:

```
LSTSO
Enter data in sets of 2 (Y then X).
If second variable is omitted, sequential numbers will be used for x.
Extra <return> ends input.
Enter below:
YYYYYY XXXXXX
1.27   2.43
1.19   2.26
1.10   2.15
<RETURN>
Print data (Y/N)? Y
```

(Computer prints data and solutions)

```
Sample results (Y/N)?Y
Enter start, end and increments below
ssssss eeeeee iiiiii
1.00   7.00   .50
```

(Computer prints sample results)

```
Plot results (Y/N)?Y
Name for X-scale (9 chars)?
SOYBEANS
Name for Y-scale (9 chars)?
CORN
Which plot?
   1: Linear
   2: Logarithmic
   3: Exponential
   4: Curvilinear
Which number? 1
(Computer plots)
Another plot (Y/N)?Y
Which plot?
   1: Linear
```

(and so forth)

[1]BASIC programs for both plotting and least-squares regression can be found in F.R. Ruckdeschel, *BASIC Scientific Subroutines, Volume I* (Byte/McGraw-Hill, Peterborough, NH, 1981).

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COMPUTER PROGRAMS

```
$TITLE: 'LSTSQ: LEAST SQUARES'
$SUBTITLE: 'COPYRIGHT 1986 P J KAUFMAN'
$STORAGE:2
      PROGRAM LSTSQ
C---- Least Squares Regression Analysis for 2 variables

      CHARACTER*1 ANS
      DIMENSION X(100),Y(100)

      DATA MAX/100/

      OPEN(6,FILE='PRN')

C---- Read data in sets of 2 variables
      I = 1
      WRITE(*,7000)
 7000 FORMAT(' Enter data in sets of 2 (Y then X).'/
     +       ' If second variable is omitted, sequential numbers',
     +       ' will be used for X.'/' Extra <return> ends input.'//
     +       ' Enter below:'/
     +       ' YYYYYY XXXXXX')
   10 READ(*,5000)Y(I),X(I)
 5000 FORMAT(BN,F6.2,F7.2)
      IF(Y(I).EQ.O)GOTO 30
      IF(X(I).EQ.O)X(I)=I
      IF(I.EQ.MAX)THEN

        WRITE(*,7001)MAX
 7001   FORMAT(' Data input reached max of',15,'. Processing begins.')
        GOTO 30
        ENDIF
      I =I+1
      GOTO 10

   30 N = I-1
      WRITE(*,7002)
 7002 FORMAT(' Print data (Y/N)?'\)
      READ(*,5001)ANS
 5001 FORMAT(A1)
      IF(ANS.NE. 'Y')GOTO 50
      WRITE(6,6000)
 6000 FORMAT('1Least-Squares Regression Analysis',20X,'Data Input'\\
     +      '  Y (dep)   X (ind)'\)
      DO 40 J = 1,N
         WRITE(6,6001)Y(J),X(J)
 6001 FORMAT(2F8.2)
   40 CONTINUE

   50 CALL RA2V(Y,X,N)

      CALL EXIT
      END
```

```
$TITLE: 'RA2V: Regression for 2 Variables'
$SUBTITLE: 'Copypright 1986 PJ Kaufman'
$STORAGE:2
      SUBROUTINE RA2V(Y,X,N)

C---- Regression Analysis for 2 Variables
C----     With Linear, Power and Log Transformations

C---- Y = Dependent variable
C---- X = Independent variable
C---- N = Number of data entries
```

```
      CHARACTER*1 ANS
      CHARACTER*2 SIGN,SIGNC
      CHARACTER*9 YNAME,XNAME

      DIMENSION X(100),Y(100),ZA(4),ZB(4),ZR(4)

      DATA MAX/100/


C---- Perform linear regression
      ITYPE=1
      CALL BSTFIT(Y,X,N,ZA(1),ZB(1),ZR(1),SD,ITYPE)
      SIGN=' '
      IF(ZB(1).GE.0)SIGN=' +'

      WRITE(6,6000)ZA(1),SIGN,ZB(1),ZR(1),SD
 6000 FORMAT(/54X, 'r2 St dev'//
             + ' LINEAR Y=',F8.3,A2,F8.3,'*X',18X,F7.1,F9.3)

      CALL LSTSQ2(Y,X,N,ZA(4),ZB(4),C,S4)

      SIGN =' '
      IF(ZB(4).GE.0)SIGN =' +'
      SIGNC =' '
      IF(C.GE.0)SIGNC =' +'
      ITYPE = 4

      WRITE(6,6004)ZA(4),SIGN,ZB(4),SIGNC,C,S4
 6004 FORMAT(/' CURVI Y=',F8.3,A2,F8.3,'*X',A2,F8.3,'*X2',12X,F9.3)

      ITYPE=2
      CALL BSTFIT(Y,X,N,ZA(2),ZB(2),ZR(2),SD,ITYPE)
      SIGN=' '
      IF(ZB(2).GE.0)SIGN=' +'

      WRITE(6,6001)ZA(2),SIGN,ZB(2),ZR(2),SD
 6001 FORMAT(/' LOG Ln(Y)=',F8.3,A2,F8.3,'*Ln(X)',10X,F7.1,F9.3)

      ITYPE=3
      CALL BSTFIT(Y,X,N,ZA(3),ZB(3),ZR(3),SD,ITYPE)
      SIGN=' '
      IF(ZB(3).GE.0)SIGN=' +'

      WRITE(6,6002)ZA(3),SIGN,ZB(3),ZR(3),SD
 6002 FORMAT(/' EXPON Ln(Y)=',F10.3,A2,F10.3,'*X',10X,F7.1,F9.3)

      WRITE(*,7000)
 7000 FORMAT('Sample results (Y/N)?'\)
      READ(*,5000)ANS
 5000 FORMAT(A1)
      IF(ANS.NE.'N')THEN
         WRITE(*,7001)
 7001    FORMAT(/' Enter start, end and increments below'/
    +          'ssssss eeeeee iiiiii')
         READ(*,5001)P,END,STEPS

 5001    FORMAT(BN,F6.2,2F7.2)

         WRITE(6,6009)
 6009    FORMAT(//12X,  'X LINEAR  CURVI    LOG  EXPON'/)

C----  Calculate all four fits at the same time
  100     Y1 = ZA(1) + ZB(1)*P
          Y2 = ZA(4) + ZB(4)*P + C*P*P
          Y3 = ZA(2) + ZB(2)*ALOG(P)
          Y3 =  EXP(Y3)
          Y4 = ZA(3) + ZB(3)*P
          Y4 = EXP(Y4)

          WRITE(6,6010)P,Y1,Y2,Y3,Y4
 6010     FORMAT(5X,5F8.2)

          IF(P.LT.END)THEN
            P = P + STEPS
            GOTO 100
            ENDIF

          ENDIF

        WRITE(*,7002)
```

```
 7002 FORMAT(/' Plot results (Y/N)?'\)
      READ(*,5000)ANS
      IF(ANS.NE.'N')THEN
         WRITE(*,7003)
 7003    FORMAT(' Name for x-scale (9 chars)?')
         READ(*,5002)XNAME
 5002    FORMAT(A)
         WRITE(*,7004)
 7004    FORMAT(' Name for y-scale (9 chars)?')
         READ(*,5003)YNAME
 5003    FORMAT(A9)
 120     WRITE(*,7005)
 7005    FORMAT(/' Which plot?'/' 1: Linear'/' 2: Logarithmic'/
     +           '    3: Exponential'/' 4: Curvilinear'/
     +           ' Which number?'\)
         READ(*,5004)I
 5004    FORMAT(BN,I4)
         TC = C
         IF(I.NE.4)TC = 0
         CALL PLOTRA(N,X,Y,ZA(I),ZB(I),TC,I,XNAME,YNAME)
         WRITE(*,7006)
 7006    FORMAT(/' Another plot (Y/N)?'\)

         READ(*,5000)ANS
         IF(ANS.NE. 'N')GOTO 120
         ENDIF

      RETURN
      END
```

```
$TITLE: 'LSTSQ2: 2nd Order Least Squares'
$SUBTITLE: 'P.J. Kaufman'
$STORAGE:2
      SUBROUTINE LSTSQ2(Y,X,N,A,B,C,S)

C---- Second Order (Curvilinear) Regression for 2 variables

C---- Y = Dependent variable
C---- X = Independent variable
C---- N = Number of data entries
C---- A = Constant term
C---- B = Coefficient of X
C---- C = Coefficient of X**2
C---- S = Standard deviation of residuals

      DIMENSION X(2),Y(2)

      DOUBLE PRECISION SXX,SXY,SYY,SXX2,SX2X2,SYX2

C---- Find the mean of x and y
      AX = 0
      AY = 0
      DO 10 I = 1,N
         AX = AX + X(I)
   10    AY = AY + Y(I)
      AX = AX/N
      AY = AY/N

C---- Initialize for summations
      SXX = 0
      SXY = 0
      SYY = 0
      SXX2 = 0
      SX2X2 = 0
      SYX2 = 0

C---- Sums
      DO 20 I = 1,N

         XI = X(I)
         YI = Y(I)
         XM = XI - AX
         YM = YI - AY
         XM2 = XI*XI - AX*AX
         SXX = SXX + XM*XM
         SXY = SXY + XM*YM
         SYY = SYY + YM*YM
         SXX2 = SXX2 + XM*XM2
         SX2X2 = SX2X2 + XM2*XM2
   20    SYX2 = SYX2 + YM*XM2

```

```
      B = (SXY*SX2X2 - SYX2*SXX2) / (SXX*SX2X2 - SXX2*SXX2)
      C = (SXX*SYX2 - SXX2*SXY) / (SXX*SX2X2 - SXX2*SXX2)
      A = AY - B*AX - C*AX*AX

C---- Standard deviation of residuals
      S = 0
      DO 150 J = 1,N
         TY = Y(J)
         TX = X(J)
         RV = A + B*TX + C*TX*TX
         ERR = TY - RV
         AVGY=AVGY+TY
  150     S = S + ERR*ERR

      S = SQRT(S/(N-1))

      RETURN
      END
```

```
$TITLE: 'REGVAL: Get regression value'
$SUBTITLE: 'Copyright 1986 PJ Kaufman'
$STORAGE:2
      FUNCTION REGVAL(X,A,B,ITYPE)

C---- Transform data from log form to normal form based upon the
C----     type of regression fit (transmitted via ITYPE)

         GOTO (110,120,130),ITYPE

C----    Linear
  110    TY=A+B*X
         GOTO 140


C----    Log
  120    TY=A+B*ALOG(X)
         TY=EXP(TY)
         GOTO 140

C----    Exponential
  130    TY=A+B*X
         TY = EXP(TY)

  140    REGVAL=TY

         RETURN
         END

      SUBROUTINE BSTFIT(Y,X,N,A,B,R,SD,ITYPE)

C---- Basic linear regression
C---- N      Number of input items
C---- X      Independent variable
C---- Y      Dependent variable
C---- A      Y-intercept
C---- B      Slope
C---- R      Correlation coefficient
C---- SD     Standard deviation of residuals
C---
C---- If ITYPE = 1 then linear (no prior x,y conversion)
C----          = 2 then log (x=log x,y=log y)
C----          = 3 then exponential (x=log x)

      DIMENSION X(2), Y(2)

      DOUBLE PRECISION SUMX2,SUMY2,XY

      SUMX=0.
      SUMX2=0.
      SUMY=0.
      SUMY2=0.
      XY=0.

      DO 100 I=1,N
         TX=X(I)
         IF(ITYPE.EQ.2)TX=ALOG(TX)
         TY=Y(I)
         IF(ITYPE.NE.1)TY=ALOG(TY)
         SUMX=SUMX+TX
         SUMX2=SUMX2+TX*TX
```

```
          SUMY=SUMY+TY
          SUMY2=SUMY2+TY*TY
          XY=XY+TX*TY
  100   CONTINUE

      IF(N.LT.2)RETURN
      B=(N*XY-SUMX*SUMY)/(N*SUMX2-SUMX*SUMX)
      A=(SUMY-B*SUMX)/N

C---- Correlation coefficient
      R1=N*XY-SUMX*SUMY
      R2=(N*SUMX2-SUMX*SUMX)*(N*SUMY2-SUMY*SUMY)
      R = ((R1**2)/R2)*100

C---- Standard deviation around fitted function
      SD=0
      DO 150 J=1,N
         TY=Y(J)
         TX=X(J)
         RV=REGVAL(TX,A,B,ITYPE)
         T=TY-RV
150      SD=SD+T*T
      SD=SQRT(SD/(N-1))

      RETURN
      END
```


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LEAST-SQUARES SOLUTION FOR CORN VERSUS SOYBEANS

Least-Squares Regression Analysis Data Input

Y (dep)	X (ind)
1.27	2.43
1.19	2.26
1.10	2.15
1.10	2.07
1.05	2.03
1.00	2.45
.98	2.36
1.09	2.44
1.12	2.52
1.18	2.74
1.16	2.98
1.24	2.93
1.03	2.69
1.08	2.63
1.15	2.63
1.33	3.08
1.08	3.24
1.57	6.22
2.55	6.12
3.02	6.33
2.54	4.92
2.25	6.81
2.02	5.88
2.25	6.61
2.52	6.28
3.11	7.61
2.50	6.05

		r2	St dev
LINEAR	Y= .274 + .339*X	84.2	.278
CURVI	Y= .310 + .323*X + .002*X2		.278
LOG	Ln(Y)= -.616 + .799*Ln(X)	86.3	.282
EXPON	Ln(Y)= -.373 + .195*X	87.3	.283

X	LINEAR	CURVI	LOG	EXPON
1.00	.61	.63	.54	.84
1.50	.78	.80	.75	.92
2.00	.95	.96	.94	1.02
2.50	1.12	1.13	1.12	1.12
3.00	1.29	1.29	1.30	1.24
3.50	1.46	1.46	1.47	1.36
4.00	1.63	1.63	1.64	1.50
4.50	1.80	1.80	1.80	1.66
5.00	1.97	1.97	1.95	1.83
5.50	2.14	2.14	2.11	2.01
6.00	2.31	2.31	2.26	2.22
6.50	2.48	2.48	2.41	2.45
7.00	2.65	2.66	2.56	2.70

Plot of Regression Analysis

LINEAR A = .274, B = .339, C = .000

Plot of Regression Analysis

LOG A = -.616, B = .799, C = .000

Plot of Regression Analysis

Plot of Regression Analysis

Previous Next

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LEAST-SQUARES SOLUTION FOR SOYBEANS ONLY

Least Squares Regression Analysis Data Input

Y (dep)	X (ind)
2.43	1.00
2.26	2.00
2.15	3.00
2.07	4.00
2.03	5.00
2.45	6.00
2.36	7.00
2.44	8.00
2.52	9.00
2.74	10.00
2.98	11.00
2.93	12.00
2.69	13.00
2.63	14.00
2.63	15.00
3.08	16.00
3.24	17.00
6.22	18.00
6.12	19.00
6.33	20.00
4.92	21.00
6.81	22.00
5.88	23.00
6.61	24.00
6.28	25.00
7.61	26.00
6.05	27.00

		r2	St dev
LINEAR	Y= .987 + .211*X	78.3	.881
CURVI	Y= 1.684 + .112*X + .004*X2		.830
LOG	Ln(Y)= .271 + .416*Ln(X)	58.0	1.212
EXPON	Ln(Y)= .527 + .053*X	83.1	.806

X	LINEAR	CURVI	LOG	EXPON
1.00	1.20	1.80	1.31	1.79
2.00	1.41	1.92	1.75	1.88
3.00	1.62	2.05	2.07	1.99
4.00	1.83	2.19	2.34	2.09
5.00	2.04	2.33	2.56	2.21
6.00	2.25	2.48	2.77	2.33
7.00	2.47	2.64	2.95	2.45
8.00	2.68	2.80	3.12	2.59
9.00	2.89	2.98	3.27	2.73
10.00	3.10	3.16	3.42	2.87
11.00	3.31	3.34	3.56	3.03
12.00	3.52	3.53	3.69	3.19
13.00	3.73	3.74	3.82	3.37
14.00	3.94	3.94	3.93	3.55
15.00	4.15	4.16	4.05	3.74
16.00	4.37	4.38	4.16	3.94
17.00	4.58	4.61	4.27	4.16
18.00	4.79	4.84	4.37	4.38
19.00	5.00	5.09	4.47	4.62
20.00	5.21	5.34	4.56	4.87
21.00	5.42	5.59	4.66	5.14
22.00	5.63	5.86	4.75	5.41
23.00	5.84	6.13	4.84	5.71
24.00	6.05	6.41	4.92	6.02
25.00	6.27	6.70	5.01	6.34
26.00	6.48	6.99	5.09	6.69

27.00	6.69	7.29	5.17	7.05
28.00	6.90	7.60	5.25	7.43
29.00	7.11	7.91	5.33	7.83
30.00	7.32	8.23	5.40	8.26
31.00	7.53	8.56	5.48	8.71
32.00	7.74	8.89	5.55	9.18
33.00	7.95	9.24	5.62	9.68
34.00	8.17	9.59	5.69	10.20
35.00	8.38	9.94	5.76	10.75
36.00	8.59	10.31	5.83	11.34
37.00	8.80	10.68	5.90	11.95
38.00	9.01	11.06	5.96	12.60
39.00	9.22	11.44	6.03	13.28
40.00	9.43	11.83	6.09	14.00

Plot of Regression Analysis

LINEAR A = .987, B = .211, C = .000

Plot of Regression Analysis

LOG A = .271. B = .416. C = .000

Plot of Regression Analysis

EXPON A = .527. B = .053. C = .000

Plot of Regression Analysis

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Appendix 3: Matrix Solution to Linear Equations and Markov Chains

DIRECT SOLUTION AND CONVERGENCE METHOD

Before computer programs offered ready solutions, problems such as Markov chains were solved in a direct manner, by algebraically manipulating the equations. This direct solution requires an understanding of simple matrix arithmetic, and very careful attention to calculating the numbers correctly. The convergence method is now easier, although it requires many more calculations. Without the computer, we would never even consider using this approach—with a computer, it is the best choice.

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GENERAL MATRIX FORM

A matrix is a rectangular arrangement of elements into rows and columns. A matrix *A* is said to be *m* × *n* (pronounced "*m* by *n*") if there are *m* rows and *n* columns in *A*.

$$a_{m \times n} = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{pmatrix}$$

Certain properties of a matrix make it a valuable tool for solving simultaneous linear equations. These elementary matrix operations, called transformations, allow you to alter the rows (which will represent equations) without changing the solution. There are three basic row operations:

1. Multiplication or division of all elements of the row by any number.
2. Interchanging of any two rows (and consequently of all rows).
3. The addition or subtraction of the elements of one row with the corresponding elements of another.

To relate the matrix to simultaneous linear equations, consider a three-equation example, where only the coefficients, *a*, remain as unknowns:

(1) $a_{11}x_1 + a_{12}x_2 + a_{13}x_3 = a_{14}$

(2) $a_{21}x_1 + a_{22}x_2 + a_{23}x_3 = a_{24}$

(3) $a_{31}x_1 + a_{32}x_2 + a_{33}x_3 = a_{34}$

The three elementary row operations can now be interpreted in terms of simple operations on an equation:

1. When both sides of an equation are multiplied or divided by the same value, the results are equal.
2. Any two equations in a system of equations can be interchanged with no effect.
3. When two equals are added or subtracted, the results are equal.

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DIRECT SOLUTION

Putting these rules into use, write the coefficients of the three simultaneous linear equations as a 3 × 4 coefficient matrix,

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \end{pmatrix}$$

with the objective of reducing the matrix to the form

$$\begin{pmatrix} 1 & 0 & 0 & A_1 \\ 0 & 1 & 0 & A_2 \\ 0 & 0 & 1 & A_3 \end{pmatrix}$$

which would mean that $x_1 = A_1$, x_2, $= A_2$, and $x_3 = A_3$ since

$$1 \times x_1 + 0 \times x_2 + 0 \times x_3 = A_1$$

$$0 \times x_1 + 1 \times x_2 + 0 \times x_3 = A_2$$

$$0 \times x_1 + 0 \times x_2 + 1 \times x_3 = A_3$$

To achieve the results, divide the first equation by a_{11}, the first element, leaving

(1-1) $$\begin{pmatrix} 1 & \frac{a_{12}}{a_{11}} & \frac{a_{13}}{a_{11}} & \frac{a_{14}}{a_{11}} \end{pmatrix}$$

and then multiply by a_{21} to get the first elements in rows one and two the same:

(1-2) $$\begin{pmatrix} a_{21} & \frac{a_{12} \times a_{21}}{a_{11}} & \frac{a_{13} \times a_{21}}{a_{11}} & \frac{a_{14} \times a_{21}}{a_{11}} \end{pmatrix}$$

Now subtract (1–2) from (2) and get

(1-3) $$\begin{pmatrix} 0 & a_{22} - \frac{a_{12} \times a_{21}}{a_{11}} & a_{23} - \frac{a_{13} \times a_{21}}{a_{11}} & a_{24} - \frac{a_{14} \times a_{21}}{a_{11}} \end{pmatrix}$$

That successfully eliminates the first element a_{21} from the second equation. By going back and multiplying (1,1) by a_{31} and subtracting the resulting equation from (3), a_{31} can be eliminated from equation (3). Now column 1 looks like

$$\begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}$$

Column two or any column can be operated upon in the same manner as the first column:

1. Divide row n by the element in position n (for example, a_{nn}), thereby setting $a_{nn} = 1$.
2. Multiply row n by the corresponding element in row $i \neq n$, so that $a_{nn} \times a_{in} = a_{in}$.
3. Subtract row n from row i, resulting in $a_{in} = 0$, and all other elements reduced by the corresponding element in row n.

Continue this procedure for each row i until all elements

$a_{1n}, a_{2n}, \ldots, a_{i-in}, a_{1+1n}, \ldots, a_{mn} = 0$ and $a_{in} = 1$

For example, beginning with

$$\begin{pmatrix} 2 & 4 & 8 & 34 \\ 6 & 5 & 2 & 22 \\ 3 & 6 & 5 & 30 \end{pmatrix}$$

Divide row 1 by the value 2 (position a_{11}):

$$\begin{pmatrix} 1 & 2 & 4 & 17 \\ 6 & 5 & 2 & 22 \\ 3 & 6 & 5 & 30 \end{pmatrix}$$

Multiply row 1 by the value 6 to get (6 12 24 102) and subtract the new calculated row from row 2:

$$\begin{pmatrix} 1 & 2 & 4 & 17 \\ 0 & -7 & -22 & -80 \\ 3 & 6 & 5 & 30 \end{pmatrix}$$

Multiply row 1 by the number 3 to get (3 6 12 51), then subtract the calculated row from row 3:

$$\begin{pmatrix} 1 & 2 & 4 & 17 \\ 0 & -7 & -22 & -80 \\ 0 & 0 & -7 & -21 \end{pmatrix}$$

Column 1 is now completed. Divide row 2 by -7 and get:

$$\begin{pmatrix} 1 & 2 & 4 & 17 \\ 0 & 1 & +22/7 & +80/7 \\ 0 & 0 & -7 & -21 \end{pmatrix}$$

Multiply row 2 by 2 and subtract the result (0 2 44/7 160/7) from row 1 to eliminate position 2 in the first row:

$$\begin{pmatrix} 1 & 0 & -16/7 & -41/7 \\ 0 & 1 & +22/7 & +80/7 \\ 0 & 0 & -7 & -21 \end{pmatrix}$$

Because the element in row 3 and column 2 is already 0, move to row 3. Divide row 3 by -7 and get

$$\begin{pmatrix} 1 & 0 & -16/7 & -41/7 \\ 0 & 1 & +22/7 & +80/7 \\ 0 & 0 & 1 & 3 \end{pmatrix}$$

Multiply row 3 by -16/7 and subtract the result (0 0 -16/7 -48/7) from row 1:

$$\begin{pmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & +22/7 & +80/7 \\ 0 & 0 & 1 & 3 \end{pmatrix}$$

multiply row 3 by +22/7 and subtract (0 0 +22/7 +66/7) from row 2:

$$\begin{pmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 2 \\ 0 & 0 & 1 & 3 \end{pmatrix}$$

The results show that $x_1 = 1$, $x_2 = 2$, $x_3 = 3$.

There are other ways to reduce the matrix to the final representation, but this technique is well defined and lends itself to being programmed on a computer.

Solution to Weather Probabilities Expressed as a Markov Chain

Let $A = \mathrm{P(clear)}_{i+1} = P(\mathrm{clear})_i$

$B = P(\mathrm{cloudy})_{i+1}, = P(\mathrm{cloudy})_i$

$C = P(\mathrm{rainy})_{i+1} = P(\mathrm{rainy})_i$

because when they converge all ith elements will equal $(i + 1)$th elements. The equations are

(1) $A = .7A + .2B + .2C$

(2) $B = .25A + .6B + .4C$

(3) $C = .05A + .2B + .4C$

In addition

(4) $A + B + C = 1$

To solve this system of equations using matrices, convert and add equation (3) to (4),

(1') $-.3A + .2B + .2C = 0$
(2') $.25A - .4B + .4C = 0$
(3') $1.05A + 1.2B + .4C = 1$

which becomes the matrix

$$\begin{pmatrix} -.3 & .2 & .2 & 0 \\ .25 & -.4 & .4 & 0 \\ 1.05 & 1.2 & .4 & 1 \end{pmatrix}$$

The following are key steps in the solution:

1. Reduce the first row,

$$\begin{pmatrix} 1 & -.6667 & -.6667 & 0 \\ .25 & -.4 & .4 & 0 \\ 1.05 & 1.2 & .4 & 1 \end{pmatrix}$$

and make the leading entries of rows 2 and 3 zero:

$$\begin{pmatrix} 1 & -.6667 & -.6667 & 0 \\ 0 & -.2333 & .5667 & 0 \\ 0 & 1.9000 & 1.1000 & 1 \end{pmatrix}$$

2. Reduce the second row,

$$\begin{pmatrix} 1 & -.6667 & -.6667 & 0 \\ 0 & 1 & -2.4291 & 0 \\ 0 & 1.9000 & 1.1000 & 1 \end{pmatrix}$$

and make the second entries of rows 1 and 3 zero

$$\begin{pmatrix} 1 & 0 & 2.2857 & 0 \\ 0 & 1 & -2.4291 & 0 \\ 0 & 0 & 5.7143 & 1 \end{pmatrix}$$

3. Reduce the third row,

$$\begin{pmatrix} 1 & 0 & 2.2862 & 0 \\ 0 & 1 & -2.4291 & 0 \\ 0 & 0 & 1 & .1750 \end{pmatrix}$$

and make the third entry of rows 1 and 2 zero:

$$\begin{pmatrix} 1 & 0 & 0 & .4000 \\ 0 & 1 & 0 & .4250 \\ 0 & 0 & 1 & .1750 \end{pmatrix}$$

Then A = .4000, B = .4250, and C = .1750.

Computer Program Direct Solution

The following FORTRAN program accepts a system of 10 equations in 10 variables (unknowns) and applies the matrix method of solution. This is done using the method of Gaussian elimination, discussed in the previous section.

```
       PROGRAM MATRIX
C----  Matrix solution to simultaneous linear equations
C----  Copyright 1986 PJ Kaufman
       DIMENSION A(10,10), C(10)
       OPEN(6,FILE='PRN')
       WRITE(*,7000)
 7000  FORMAT(' Enter matrix size (n)>'\)
       READ(*,5000)N
 5000  FORMAT(BN,14)

       IF(N.GT.10)STOP 'Matrix limited to 10 x 10¢
       WRITE(*,7001) (1,1=1,N)
 7001  FORMAT(' Enter matrix elements row by row under headings
      +       ' do not include constant to right of
      +       7X,10(12,'-xxxxx'))
       DO 20 I = 1,N
          WRITE(*,7003)1
 7003     FORMATC Row',12,':'\)
          READ(*,5003) (A(I,J), J=1,N)
 5003     FORMAT(BN,10F8.0)
   20     CONTINUE
       WRITE(*,7004) (J,J=1,N)
       WRITE(6,7004) (J,J=1,N)
 7004  FORMAT(/' Input matrix is:'//9X,10(12,'-col '))
       DO 30 I = 1,N
          WRITE(6,7005)I,(A(I,J),J=1,N)
   30     WRITE(*,7005)I,(A(I,J),J=1,N)
 7005    FORMAT(/' Row',12,':',10F8.3)
       WRITE(*,7008)(I,I=1,N)
 7008  FORMAT(/' Enter constant vector under headings...'/
      +        1X,10(11,'xxxxxx '))
        READ(*,5008)(C(I),I=1,N)
 5008   FORMAT(BN,10F8.0)
        WRITE(*,7009)(C(I),I=1,N)
        WRITE(6,7009)(C(I),I=1,N)
 7009   FORMAT(/' Constant vector is:'/10F8.3)
C-----  Process row by row (Gaussian Elimination)
        DO 100 I = 1,N
           DIV = A(I,I)
           DO 40 J = 1,N
   40         A(I,J) = A(I,J)/DIV
           C(I) = C(I)/DIV
C----- Zero out column I for each row
          DO 60 J = 1,N
             IF(J,EQ.I)GOTO 60
             FACTOR = A(J,I)
```

```
            DO 50 K = 1,N
   50            A(J,K) = A(J,K) - A(I,K)*FACTOR
            C(J) = C(J) - C(I)*FACTOR
   60       CONTINUE
  100       CONTINUE
        WRITE(*,7007)(C(I),I = 1,N)
        WRITE(6,7007)(C(I),I = 1,N)
 7007   FORMAT(/' Solution vector is: '/I0F8.3)
        CALL EXIT
        END
```

Sample Computer Printout

```
MATRIX
Enter matrix size (N)>3
Enter matrix elements row by row under headings…
do not include constant to right of =
        1-xxxxx 2-xxxxx 3-xxxxx
Row 1:  2       4       8
Row 2:  6       5       2
Row 3:  3       6       5
Input matrix is:
        1-col       2-col       3-col
Row 1:  2.000       4.000       8.000
Row 2:  6.000       5.000       2.000
Row 3:  3.000       6.000       5.000
Enter constant vector under headings…
1xxxxxx 2xxxxxx 3xxxxxx
34      22      30
Constant vector is:
  34.000  22.000  30.000
Solution vector is:
   1.000   2.000   3.000
```


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CONVERGENCE METHOD

This method performs a series of matrix multiplications until the difference between the new and previous matrix is very small.[1] Following the procedure in Chapter 2, "Basic Concepts," we can create a 3 × 3 frequency matrix by counting the number of up, down, and neutral days that follow other up, down, and neutral days. We use the term *neutral* to allow very small price changes to be considered in this group, rather than limit it to only those days with zero changes. For this example we will look at the number of up, down, and neutral days that follow a 5-day trend that was considered up, down, or neutral on the previous day. Suppose the results were those shown in the *frequency matrix F:*

Open table as spreadsheet

	Next Day Price Change				
		Up	Neutral	Down	Total
Previous day trend	Up	70	40	30	140
	Neutral	50	30	45	125
	Down	35	45	65	145

Divide each item in *F* by the total given at the end of that row, and get the probability of each occurrence in a *transition matrix T.*

Open table as spreadsheet

	Next Day Price Change			
		Up	Neutral	Down
Previous day trend	Up	.500	.285	.214
	Neutral	.400	.240	.360
	Down	.241	.310	.448

Now it is necessary to perform matrix multiplication. To multiply matrix *A* by matrix *B*, we multiply the corresponding items in row *i* of *A* by the corresponding item in column *j* of *B*, add those products together to get the item in row *i*, column *j* of the new matrix *C.* If we have two 3 × 3 matrices *A* and *B*, and we wanted to find the element in row 2, column 1 of the new product matrix *C* we would multiply and add

$$C_{21} = a_{21} \times b_{11} + a_{22} \times b_{21} + a_{23} \times b_{31}$$

The general formula for this is

$$c_{ij} = \sum_{k=1}^{N} (a_{ik} \times b_{kj})$$

For spreadsheet users, there is no general formula to copy from one cell to another. For matrix *A* of 3 columns and 3 rows located in columns *A*, *B*, *C* rows 1, 2, 3; matrix *B* in columns *D*, *E*, *F*, rows 1, 2, 3; and matrix *C* in rows *G*, *H*, *I*, columns 1, 2, 3, we enter the formula for c_{11} in cell *G*1 as

cell *G*1 = *A*1**D*1 + *B*1**D*2 + *C*1**D*3

While this is clearly tedious, at least the arithmetic will be correct.

Iterative Matrix

We can now find the solution to the Markov chain, the long-term probabilities, by performing a series of matrix multiplications beginning with the transition matrix.

1. Multiply the transition matrix T by itself to get the first iterative matrix I_1,

   $$I_1 = T \times T$$

2. Multiply the iterative matrix by the transition matrix to get the next iterative matrix,

   $$I_2 = I_1 \times T$$

3. Continue to multiply the last iterative matrix by the transition matrix until the new iterative matrix is unchanged (or very close) to the previous iterative matrix,

   $$I_n = I_{n-1} \times T$$

   When each element satisfies the condition

   $$\text{abs}(I_{ij}(n) - I_{ij}(n - 1)) < .001$$

   then the iterative matrix holds the final long-term probabilities of the Markov chain.

[1]George R. Arrington, "Markov Chains," *Technical Analysis of Stocks & Commodities* (December 1993).

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Appendix 4: Trigonometric Regression for Finding Cycles

The following computer programs and examples solve the cycle problems in Chapter 11.

SINGLE-FREQUENCY TRIGONOMETRIC REGRESSION

The FORTRAN program *TRIG1* and the subroutine *LINREG* are used to find the single-frequency representation of the copper cycle. The program output is clearly separated into the following information:

1. Input data, where each time period is the average cash price for a calendar quarter.
2. The solution to the linear regression, giving the detrending line. With b = .267, there is an inflationary bias of +.267¢ per quarter.
3. The detrended data resulting from subtracting the line values (2) from the original data (1).
4. Intermediate values for a, ω, and T.
5. The constant values a and b for the normal equations solving the single-frequency problem.
6. The cycle resulting from the detrended data.
7. The final cycle with the trend added back.

The results show a copper cycle of approximately 8.4 quarters, or slightly more than 2½ years.

An additional test was run on monthly cash corn prices from 1964 through 1983 to see if the seasonal cycle dominated the detrended pattern. The linear regression equation used for detrending was calculated as:

$$y = .939 + .01x$$

showing only a 1¢ per bushel per month rate of inflation, despite the bull markets in 1973 and 1980 through 1981. The cycle showed a period of 21.4 months, with the last highs in the cycle in August 1983 and the last lows in September 1982. Because this is clearly not a seasonal pattern, it must be either:

1. Dominated by other supply-demand characteristics, such as stocks, or,
2. Distorted by the nonseasonal rallies of 1973 and 1980, which each took three years to return to the traditional seasonal pattern.

```
      PROGRAM TRIG1
C---- Single Frequency Trigonometric Regression
C---- Copyright 1986 PJ Kaufman
      DIMENSION X(250), Y(250), D(250), R(250)
      DOUBLE PRECISION SC2,SCD
      DATA MAX/250/
      OPEN(6,FILE='PRN')
C---- Read data, set X to incremental time
      I = 1
      WRITE(*,7000)
  7000 FORMAT(' SINGLE FREQUENCY TRIGONOMETRIC REGRESSION'/
     +       ' Enter data 1 per line'/' Extra <return> ends input'//
     +       ' Enter below:')
```

```
   10 WRITE(*,7001)I
 7001 FORMAT(14,'>'\)
      READ(*,5000)Y(I)
 5000 FORMAT(BN,F8.2)
      X(I) = I
      IF(Y(I).NE.O)THEN
        IF(I.GT.MAX)STOP 'Maximum data exceeded'
        I = I+1
        GOTO 10
        ENDIF
      N = I-1
      WRITE(6,6000)
 6000 FORMAT('1Single Frequency Trigonometric Regression',20X,
     +       'Data Input'//' Time',16X,'Prices')
      DO 40 J = 1,N,4
   40    WRITE(6,6001)J,(Y(I),I=J,J+3)
 6001    FORMAT(14,4F8.2)

C---- Linear regression analysis for detrending
      CALL LINREG(N,Y,A,B,SD)
      WRITE(6,6002)A,B
 6002 FORMAT(/'Linear regression results: A =',F8.3,', B =',F8.3)

C---- Detrend data into D and computer sums for equation (4)
      DO 60 I = 1,N
   60    D(I) = Y(I) - (A+B*I)
C---- Print detrended data
      WRITE(6,6003)
 6003 FORMAT(/' Detrended data'/)
      DO 65 I = 1,N,4
   65    WRITE(6,6001)I,(D(J),J=I,I+3)
      SC2 = 0
      SCD = 0
C---- Solve equation (4) using detrended data
      DO 70 I = 2,N-1
         DI = D(I)
         SC2 = SC2 + DI*DI
   70    SCD = SCD + DI*(D(I-1)+D(I+1))

      ALPHA = SCD/SC2
      WRITE(6,6004)SC2,SCD,ALPHA
 6004 FORMAT(/'Sum C-squared =',F8.1,', Sum C x D =',F8.1,', Alpha =',
     +       F8.3)
C---- Solve for omega
      W = ACOS(ALPHA/2)
      T = 360/W
      WRITE(6,6014)W,T
 6014 FORMAT(/'Omega (W) =',F5.1,' degrees, Period (T) =',F6.2,
     +        'time units')

C---- Sums for normal equations
      COS2 = 0
      COSSIN = 0
      YCOS = 0
      SINCOS = 0
      SIN2 = 0
      YSIN = 0
      DO 80 I = 1,N
         C = COS(W*I)
         S = SIN(W*I)
         COS2 = COS2 + C*C
         COSSIN = COSSIN + C*S
         YCOS = YCOS + Y(I)*C
         SINCOS = SINCOS + S*C
         SIN2 = SIN2 + S*S
   80    YSIN = YSIN + Y(I)*S

C---- Solve normal equations
      TB = (YSIN*COS2 - YCOS)/(SIN2*COS2 - COSSIN)
      TA = (YCOS - B*COSSIN)/COS2
      WRITE(6,6005)TA,TB
 6005 FORMAT(/' Solution to normal equations: A =',F8.3,', B =',F8.3)

C---- Values of fitted curve using detrended data
      DO 90 I = 1,N
   90    R(I) = TA*COS(W*I) + TB*SIN(W*I)
      WRITE(6,6006)
 6006 FORMAT(/' Trigonometric regression results using detrended data',
     +       /)
      DO 100 I = 1,N,4
  100    WRITE(6,6001)I,(R(J),J=I,I+3)
```

```
C---- Add trend back to result
      DO 110 I = 1,N
  110    R(I) = R(I) + A + B*I

      WRITE(6,6007)
 6007 FORMAT(/' Final regression results with trend added back'/)
      DO 120 I = 1,N,4
  120    WRITE(6,6001)I, (R(J),J=I,I+3)
      CALL EXIT
      END

      SUBROUTINE LINREG(N,DATA,A,B,SD)
C---- Generalized simple linear regression
      DIMENSION DATA(2)

C---- Initialize sums
      SX=0.
      SY=0.
      SXY=0.
      SX2=0.
      A=0.
      B=0.
      SD=0.
      IF(N.LE.2)RETURN

      DO 100 I=2,N
         X = I
         Y = DATA(I)
         SX=SX+X
         SY=SY+Y
         SXY=SXY+Y*X
         SX2=SX2+X*X

   100    CONTINUE
       M=N-1
       B=(M*SXY-SX*SY) / (M*SX2-SX*SX)
       A=(SY-B*SX) / M

C----- Residuals
       SSR=0
       DO 200 I=2,N
          Y=DATA(I)
          R=Y-(A+B*I)
          SSR=SSR+R*R
   200    CONTINUE
       SD=SQRT(SSR/M)
       RETURN
       END
```

Single Frequency Trigonometric Regression

Time	Prices			
1	22.12	22.46	22.17	22.00
5	23.18	24.56	25.57	30.59
9	28.23	33.77	35.90	40.05
13	46.22	51.48	40.76	40.16
17	36.51	29.30	30.36	36.42
21	39.75	30.07	29.08	32.13
25	38.94	42.95	43.38	46.23
29	47.70	46.98	35.78	27.35
33	25.40	29.45	27.15	28.48
37	32.74	33.53	30.01	29.25
41	36.82	45.07	55.13	65.51
45	66.56	70.06	27.30	35.62
49	32.06	31.46	35.75	36.46
53	38.22	43.24	45.46	38.96
57	37.08	38.72	34.01	33.00
61	35.07	40.23	41.63	44.95
65	51.12	63.71	59.56	63.38

Linear regression results: A = 28.889, B = .267

Detrended data

1	-7.04	-6.96	-7.52	-7.96
5	-7.05	-5.93	-5.19	-.44
9	-3.06	2.21	4.07	7.95
13	13.86	18.85	7.86	7.00
17	3.08	-4.40	-3.61	2.19
21	5.25	-4.70	-5.96	-3.17
25	3.37	7.11	7.28	9.86
29	11.06	10.07	-1.39	-10.09
33	-12.31	-8.52	-11.09	-10.03

```
37    -6.04   -5.51   -9.30  -10.33
41    -3.02    4.96   14.75   24.86
45    25.65   28.88  -14.15   -6.10
49    -9.92  -10.79   -6.77   -6.32
53    -4.83    -.08    1.87   -4.89
57    -7.04   -5.67  -10.64  -11.92
61   -10.12   -5.23   -4.09   -1.04
65     4.86   17.19   12.77   16.32

Sum C-squared = 6338.4, Sum C x D = 9282.2, Alpha = 1.464
Omega (W) = .7 degrees, Period (T) =480.50 time units
Solution to normal equations: A = -.603, B = 1.831
Trigonometric regression results using detrended data
 1      .81    1.78   1.80     .86
 5     -.54   -1.66  -1.88   -1.10
 9      .27    1.50   1.92    1.32
13      .01   -1.31  -1.92   -1.51
17     -.28    1.09   1.88    1.66
21      .56    -.85  -1.80   -1.79
25     -.82     .59   1.68    1.87
29     1.06    -.32  -1.53   -1.92
33    -1.28     .04   1.34    1.92
37     1.47     .23  -1.13   -1.89
41    -1.64    -.51    .89    1.82
45     1.77     .77   -.64   -1.71
49    -1.86   -1.02    .37    1.56
53     1.91    1.24   -.09   -1.38
57    -1.93   -1.44   -.19    1.17
61     1.90    1.61    .46    -.94
65    -1.83   -1.75   -.72     .69

Final regression results with trend added back
 1    29.96   31.21   31.50  30.82
 5    29.68   28.83   28.88  29.93
 9    31.57   33.06   33.75  33.41
13    32.37   31.32   30.98  31.66
17    33.15   34.79   35.85  35.90
21    35.06   33.92   33.23  33.52
25    34.75   36.43   37.79  38.24
29    37.70   36.58   35.64  35.52
33    36.43   38.02   39.59  40.43
37    40.25   39.28   38.18  37.69
41    38.21   39.60   41.27  42.46
45    42.68   41.95   40.81  40.01
49    40.12   41.23   42.89  44.34
53    44.96   44.56   43.49  42.47
57    42.19   42.95   44.47  46.09
61    47.09   47.07   46.18  45.05
65    44.42   44.78   46.07  47.74
```


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TWO-FREQUENCY TRIGONOMETRIC REGRESSION

The FORTRAN program *TRIG2* and its subroutines *LINREG* (found in Appendix 4) and *MTX* are used to find the two-frequency representation of the copper cycle. The program output is clearly separated into the following steps.

1. Input data, where each time period is the average cash price for a calendar quarter.
2. The solution to the linear regression, giving the detrending line.
3. The detrended data resulting from subtracting the line values (2) from the original data (1).
4. Intermediate values for a_1, a_2, ω_1, and ω_2.
5. Resulting values a_1, b_1, a_2, and b_2, which are derived from the matrix solution using Gaussian elimination.
6. The cycle resulting from the detrended data.
7. The final cycle with the trend added back.

```
       PROGRAM TRIG2
C---- 2-Frequency Trigonometric Regression
C---- Copyright 1986 PJ Kaufman
      DIMENSION X(250), Y(250), D(250), R(250), A(4,4), B(4)
      EQUIVALENCE (A(1,1),C2W1),(A(1,2),CW1SW1),(A(1,3),CW1CW2),
      +            (A(1,4),CW1SW2),(A(2,1),DUP1),(A(2,2),S2W1),
      +            (A(2,3),SW1CW2),(A(2,4),SW1SW2),(A(3,1),DUP2),

      +            (A(3,2),DUP3),(A(3,3),C2W2),(A(3,4),CW2SW2),
      +            (A(4,1),DUP4),(A(4,2),DUP5),(A(4,3),DUP6),
      +            (A(4,4),S2W2),(B(1),YCW1),(B(2),YSW1),(B(3),YCW2),
      +            (B(4),YSW2),(B(1),A1),(B(2),B1),(B(3),A2),(B(4),B2)
       DATA MAX/250/,NDIM/4/
       OPEN(6,FILE='PRN')

C---- Read data, set X to incremental time
      I = 1
      WRITE(*,7000)
 7000 FORMAT(' 2-FREQUENCY TRIGONOMETRIC REGRESSION'/
     +       ' Enter data 1 per line'/'Extra <return> end input'//
     +       ' Enter below:')

   10 WRITE(*,7001)1
 7001 FORMAT(14,'>'\)
      READ(*,5000)Y(I)
 5000 FORMAT(BN,F8.2)
      X(I) = I
      IF(Y(I).NE.0)THEN
         IF(I.GT.MAX)STOP 'Maximum data exceeded'
         I = 1 + 1
         GOTO 10
         ENDIF
      N = I-1
      WRITE(6,6000)
 6000 FORMAT('12-Frequency Trigonometric Regression'//
     +       'Time',16X,'Prices')
      DO 40 J = 1,N,4
   40    WRITE(6,6001)J,(Y(I),I=J,J+3)
 6001    FORMAT(14,4F8.2)

C---- Linear regression analysis for detrending
      CALL LINREG(N,Y,ALIN,BLIN,SD)
      WRITE(6,6002)ALIN,BLIN
```

```
 6002 FORMAT(/' Linear regression results: A =',F8.3,', B =',F8.3)

C---- Detrend data into D and computer sums for equation (4)
      DO 60 I = 1,N
   60    D(I) = Y(I) - (ALIN+BLIN*I)
C---- Print detrended data
      WRITE(6,6003)
 6003 FORMAT(/' Detrended data'/)
      DO 65 I = 1,N,4
   65    WRITE(6,6001)I,(D(J),J=I,I+3)
      SC2 = 0

      SCD = 0
      SCP = 0
      SD2 = 0
      SDP = 0
C---- Solve for alphal and alpha2 using detrended data
      DO 70 I = 2,N-3
         C = D(I) + D(I+2)
         T = D(I+1)
         P = D(I-1) + D(I+3)
         SC2 = SC2 + C*C
         SCD = SCD + C*T
         SCP = SCP + C*P
         SD2 = SD2 + T*T
   70    SDP = SDP + T*P
      ALPHA2 = (SDP*SC2-SCP)/(SD2*SC2-SCD)
      ALPHA1 = (SCP-ALPHA2*SCD)/SC2
      T = SQRT(ALPHA1*ALPHAI+8*(I+ALPHA2/2))
      W1 = ACOS((ALPHAI+T)/4)
      W2 = ACOS((ALPHAI-T)/4)
      WRITE(6,6004)SC2,SCD,SCP,SD2,SDP,ALPHAI,ALPHA2,W1,W2
 6004 FORMAT(/' Intermediate values:'//
     +        ' SUMS C2 = , F8.1,', C*D =',F8.1,', C*P =',F8.1/
     +        '      D2 = , F8.1,', D*P =',F8.1//' Alphal = ',F8.3,
     +        '  Alpha2 = , F8.3,' Omegal =',F5.2,', Omega2 =',F5.2)
C---- Sums for normal equations. . .to be used for matrix solution
      C2W1 = 0
      CW1sw1 = 0
      CW1CW2 = 0
      CW1SW2 = 0
      YCW1 = 0
      S2W1 = 0
      SW1CW2 = 0
      SW1SW2 = 0
      YSW1 = 0
      C2W2 = 0
      CW2SW2 = 0
      YCW2 = 0
      S2W2 = 0
      YSW2 = 0

      DO 100 I = 1,N
         DI = D(I)
         SW1 = SIN(W1*I)
         CW1 = COS(Wl*I)
         SW2 = SIN(W2*I)
         CW2 = COS(W2*I)

         C2W1 = C2W1 + CW1*SW1
         CW1SW1 = CW1SW1 + CW1*SW1
         CWICW2 = CW1CW2 + CW1*CW2
         CWISW2 = CWISW2 + CW1*SW2
         YCW1 = YCW1 + DI*CW1
         S2W1 = S2W1 + SW1*SW1
         SW1CW2 = SW1SW2 + SW1*CW2
         SWISW2 = SW1SW2 + SW1*SW2
         YSW1 = YSW + DI
         C2W2 = C2W2 + CW2*CW2
         CW2SW2 = CW2SW2 + CW2*SW2
         YCW2 = YCW2 + DI*CW2
         S2W2 = S2W2 + SW2*SW2
  100    YSW2 = YSW2 + DI*SW2
C---- Duplicate calculations for matrix
      DUP1 = CW1SW1
      DUP2 = CW1CW2
      DUP3 = SW1CW2
      DUP4 = CW1SW2
      DUP5 = SWISW2
      DUP6 = CW2SW2
```

```
      WRITE(6,6009)
 6009 FORMAT(/' Coefficient matrix:'/)
      DO 110 I = 1,NDIM
  110    WRITE(6,6010)(A(I,J),J=1,4),B(I)
 6010    FORMAT(5F8.3)
C---- Solve using matrix Gaussian Elimination
      CALL MTX(A,B,NDIM)

C---- Solution vector
      WRITE(6,6011)(B(I),I=1,NDIM)
 6011 FORMAT(/' Solution vector:'/4FB.3)
C---- Values of fitted curve using detrended data
      DO 90 I = 1,N
   90    R(I) = A1*COS(W1*I) + B1*SIN(W1*I) + A2*COS(W2*I) +
                B2*SIN(W2*I)
WRITE(6,6006)
 6006 FORMAT(/' Trigonometric regression results using detrended data',
      +       /)
       DO 105 I = 1,N,4
  105     WRITE(6,6001)I,(R(J),J=I,I+3)
C---- Add trend back to result
      DO 115 I = 1,N
  115    R(I) = R(I) + ALIN + BLIN*I

      WRITE(6,6007)
 6007 FORMAT(/' Final results with trend added back'/)
      DO 120 I = 1,N,4
  120   WRITE(6,6001)I,(R(J),J=I,I+3)

      CALL EXIT
      END

      SUBROUTINE MTX(A,C,N)
C---- Matrix solution to simultaneous linear equations
C---- Copyright 1986 PJ Kaufman

      DIMENSION A(4,4), C(4), A1(4,4), C1(4)

C---- Process row by row (Gaussian Elimination)
      DO 100 I = 1,N
         DIV = A(I,I)

         DO 40 J = 1,N
   40       A(I,J) = A(I,J)/DIV
         C(I) = C(I)/DIV

C---- Zero out column I for each row
         DO 60J= 1,N
            IF(J.EQ.I)GOTO 60
            FACTOR = A(J,I)
            DO 50 K = I,N
   50          A(J,K) = A(J,K) = A(I,K)*FACTOR
            C(J) = C(J) - C(I)*FACTOR
   60       CONTINUE

  100    CONTINUE

      RETURN
      END
```

2-Frequency Trigonometric Regression

Time	Prices			
1	22.12	22.46	22.17	22.00
5	23.18	24.56	25.57	30.59
9	28.23	33.77	35.90	40.05
13	46.22	51.48	40.76	40.16
17	36.51	29.30	30.36	36.42
21	39.75	30.07	29.08	32.13
25	38.94	42.95	43.38	46.23
29	47.70	46.98	35.78	27.35
33	25.40	29.45	27.15	28.48
37	32.74	33.53	30.01	29.25
41	36.82	45.07	55.13	65.51
45	66.56	70.06	27.30	35.62
49	32.06	31.46	35.75	36.46
53	38.22	43.24	45.46	38.96
57	37.08	38.72	34.01	33.00
61	35.07	40.23	41.63	44.95
65	51.12	63.71	59.56	63.38

```
Linear regression results: A = 28.889, B = .267

Detrended data
 1     -7.04    -6.96    -7.52    -7.96
 5     -7.05    -5.93    -5.19     -.44
 9     -3.06     2.21     4.07     7.95
13     13.86    18.85     7.86     7.00
17      3.08    -4.40    -3.61     2.19
21      5.25    -4.70    -5.96    -3.17
25      3.37     7.11     7.28     9.86
29     11.06    10.07    -1.39   -10.09
33    -12.31    -8.52   -11.09   -10.03
37     -6.04    -5.51    -9.30   -10.33
41     -3.02     4.96    14.75    24.86
45     25.65    28.88   -14.15    -6.10
49     -9.92   -10.79    -6.77    -6.32
53     -4.83     -.08     1.87    -4.89
57     -7.04    -5.67   -10.64   -11.92
61    -10.12    -5.23    -4.09    -1.04
65      4.86    17.19    12.77    16.32

Intermediate values:

SUMS C2 = 17396.7, C*D = 8753.0, C*P = 10475.1
     D2 =  6126.9, D*P = 5499.2

Alpha1 = .151, Alpha2 = .898, Omega1 = .47, Omega2 = 2.52

Coefficient matrix:

34.206      .790      -.461      .426      124.829
  .790    33.794      -.454      .479       -7.036
 -.461     -.454     33.742     -.781      -33.500
  .426      .479      -.781    34.258       28.219

Solution vector:
 3.635     -.317      -.930      .762

Trigonometric regression results using detrended data
 1      4.29      .84      .69   -1.20
 5     -3.72    -2.38    -4.57   -2.18
 9     -1.06     -.43     3.23    2.12
13      4.21     3.45     1.39    1.82
17     -2.17    -1.93    -3.36   -4.39
21     -1.80    -2.78      .67    1.72
25      2.23     4.76     2.31    3.24
29      1.05    -1.35    -1.09   -4.45
33     -2.90    -3.25    -2.67     .70
37       .12     3.49     3.41    2.97
41      3.91      .27      .59   -2.04
45     -3.65    -2.57    -4.56   -1.50
49     -1.06      .38     3.44    2.19
53      4.54     2.79     1.38    1.20
57     -2.70    -1.91    -3.91   -3.91
61     -1.68    -2.44     1.44    1.69
65      2.86     4.60     2.08    3.19

Final results with trend added back
 1     33.44    30.26    30.38   28.75
 5     26.50    28.12    26.19   28.85
 9     30.23    31.13    35.05   34.21
13     36.58    36.08    34.29   34.98
17     31.26    31.77    30.61   29.85
21     32.71    31.99    35.70   37.02
25     37.80    40.60    38.42   39.61
29     37.69    35.56    36.08   32.99
33     34.81    34.72    35.57   39.21
37     38.89    42.54    42.72   42.54
41     43.76    40.38    40.97   38.60
45     37.26    38.61    36.89   40.22
49     40.93    42.63    45.96   44.98
53     47.59    46.11    44.96   45.06
57     41.42    42.47    40.75   41.01
61     43.50    43.01    47.16   47.68
65     49.12    51.13    48.87   50.25
```


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Appendix 5: Fourier Transformation

OVERVIEW

The original computer program that solves the Fourier transformation as described by Jack Hutson and Anthony Warren (*Technical Analysis of Stocks & Commodities*) is based on the Cooley-Tukey Fast Fourier Transform Algorithm (1965), developed at the IBM Thomas J. Watson Research Center. A full explanation of this program and its interpretation can be found in the two articles that appeared in the January 1983 edition of *Technical Analysis of Stocks & Commodities*, then reprinted in the September 1986 issue.

The following program appeared in the September 1986 issue of *Technical Analysis of Stocks & Commodities*. It was written by John Ehlers and appended to the article "A Comparison of the Fourier and Maximum Entropy Methods."

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FAST FOURIER TRANSFORM PROGRAM

```
 10 REM "FAST FOURIER TRANSFORM"
 20 REM FOR APPLE ][ WITH 2 DISKS USING
 30 REM DATA IN CSI OR COMPU-TRAC FORMAT
 40 REM BY JOHN F. EHLERS
 45 REM COPYRIGHT (C) 1986 BY TECHNICAL ANALYSIS, INC.
 50 HOME
 60 DIM DF$(20)
 70 HTAB 5: INVERSE : PRINT "* FAST FOURIER TRANSFORM *" :
    NORMAL
 71 HTAB 19: PRINT "BY"
 72 HTAB 14: PRINT "JOHN EHLERS"
 73 HTAB 16: PRINT "BOX 1801"
 74 HTAB 12: PRINT "GOLETA, CA 93116": PRINT
 80 LET D$ = CHR$(4)
 90 PRINT D$ + "OPEN MASTER,L40,D2"
100 FOR I = 1 TO 20

110     PRINT D$ + "READ MASTER,R";I
120     INPUT DF$(I)
130     IF LEFT$ (DF$(I),5) = "99999" GOTO 150
140     NEXT I
150 PRINT D$ + "CLOSE"
160 FOR J = 1 TO I-1
170     PRINT "<"; CHR$ (J + 64); ">"; MID$ (DF$(J),4,16)
180     NEXT J
190 PRINT "<V> VIEW NEW DATA DISK"
200 PRINT "<X> EXIT TO MENU": PRINT
210 PRINT "    SELECT <>": CHR$(8); CHR$(8);
220 POKE - 16368,0: GET X$: PRINT X$; ">"; CHR$(8); CHR$(8);
230 IF X$ = "V" THEN
        HOME : VTAB 10:
        PRINT "INSERT NEW DATA DISK IN DRIVE 2":
        PRINT: PRINT "PRESS";: INVERSE: PRINT "RETURN";:
        NORMAL: PRINT "TO CONTINUE": VTAB 22:
        POKE - 16368,0: GET S$: GOTO 30
240 IF X$ = "X" THEN HOME
250 LET SF = ASC (X$) - 64
260 IF SF > 1 AND SF <= J - 1 THEN 290
270 HTAB 13: PRINT "": CHR$(8);: GOTO 220
280 IF K < 120 OR K > LR THEN
         PRINT "OOPS - RUN AGAIN": END
290 HOME : VTAB 10: INVERSE: PRINT MID$ (DF$(SF),4,16):
    NORMAL: PRINT: PRINT
300 PRINT: PRINT D$ + "OPEN" + MID$ (DF$(SF),4,16) + ",L40":
    PRINT D$ + "READ" + MID$ (DF$(SF),4,16) +",RO":
    INPUT X$: LET LR = VAL (X$)
310 PRINT D$ + "CLOSE"
320 IF LR < 32 THEN 370
330 IF LR < 1024 THEN 410
340 PRINT "CONTAINS"; LR; " RECORDS"
350 PRINT "A MAXIMUM 1024 RECORDS ARE ALLOWED": PRINT
360 PRINT "PRESS";: INVERSE: PRINT "RETURN";: NORMAL:
    PRINT " TO CONTINUE": VTAB 22
370 PRINT "CONTAINS ONLY"; LR; "RECORDS"
380 PRINT "AT LEAST 32 RECORDS ARE REQUIRED": PRINT
390 PRINT "PRESS";: INVERSE: PRINT "RETURN";: NORMAL:
    PRINT "TO CONTINUE": VTAB 22
400 POKE - 16368,0: GET S$: HOME: CLEAR: GOTO 20
410 PRINT "CONTAINS "; LR; " RECORDS": PRINT
420 PRINT "ENTER ONLY 32, 64, 128, OR 256"
430 PRINT "FOR ANALYSIS. THIS NUMBER MUST BE"
440 PRINT "LESS THAN THE FILE LENGTH.": PRINT
450 INPUT "RECORDS FOR ANALYSIS? "; N
```

```
 460 IF (N = 32 OR N = 64 OR N = 128 OR N = 256 OR N = 512)
        AND N < LR THEN 480
 470 PRINT: PRINT "OOPS -- RUN PROGRAM AGAIN": END
 480 DIM DA$(1024), F(1024), A(257,8)
 490 PRINT: PRINT D$ + "OPEN" + MID$ (DF$(SF),4,16) + ",L40"
 500 FOR I = 1 TO N:
         PRINT D$ + "READ " + MID$ (DF$(SF),4,16) + ",R";
         (LR - N + I): INPUT DA$(I):
         NEXT I
 510 PRINT D$ + "CLOSE"
 520 REM *** DATA CONVERTER ***
 530 IF MID$ (DA$(1),23,5) <> "99999" THEN 550
 540 LET DA$(1) = DA$(2)
 550 FOR I = 1 TO N
 560     LET F(I) = VAL (MID$ (DA$(I),23,5))
 570     IF MID$ (DA$(I),23,5) = "99999" THEN
             LET F(I) = F(I - 1)
 580     NEXT I
 590 REM *** SPECTRUM ANALYSIS ***
 600 LET PI = 3.1415926
 610 LET PO = INT (N / 4): LET SO = 8
 620 FOR I = 1 TO RO + 1:
         FOR J = 1 TO 8: LET A(I,J) = 0: NEXT J:
         NEXT I
 630 FOR I = 1 TO RO
 640     FOR J = 1 TO SO STEP 2
 650         LET K = 4 * (I - 1) + .5 * (J + 1)
 660         LET A(I,J) = F(K)
 670         LET A(I,J + 1) = 0
 680         NEXT J
 690     NEXT I
 700 LET M = LOG (N) / LOG (2): LET N2 = N / 2:
     LET N 1 = N - 1 : LET J = 1
 710 FOR I = 1 TO N1
 720     IF I >= J THEN 850
 730     LET R = INT ((J - 1) / 4)
 740     LET S = 2 * J - 8 * R
 750     LET R1 = INT ((I - 1) / 4)
 760     LET S1 = 2 * I - 8 * R1
 770     LET R1 = R1 + 1
 780     LET R = R + 1
 790     LET T = A(R,S)
 800     LET A(R,S) = A(R1,S1)
 810     LET A(R1,S1) = T
 820     LET T = A(R,S - 1)
 830     LET A(R,S - 1) = A(R1,S1 - 1)

 840     LET A(R1,S1 - 1) = T
 850     LET K = N2
 860     IF K >= J THEN 910
 870     LET J =J - K
 880     LET K = K / 2
 890     GOTO 860
 910 LET J = J + K
 920 NEXT I
 930 LET L0 = 1
 940 FOR L = 1 TO M
 950     LET L1 = L0
 960     LET L0 = 2 * L0
 970     LET V =1
 980     LET W = 0
 990     LET Z = PI / L1
1000    LET W1 = COS (Z)
1010    LET W2 = SIN (Z)
1020    FOR J = 1 TO L1
1030        FOR I = J TO N STEP L0
1040            LET K = I + L1
1050            LET R1 = INT ((K - 1) / 4)
1060            LET S1 = 2 * K - 8 * R1
1070            LET R1 = R1 + 1
1080            LET A1 = A(R1,S1 - 1)
1090            LET B1 = A(R1,S1)
1100            LET T  = A1 * V-B1 * W
1110            LET U  = A1 * W + B1 * V
1120            LET R  = INT ((I - 1)/ 4)
1130            LET S  = 2 * I - 8 * R
1140            LET R  = R + 1
1150            LET A(R1,S1 - 1) = A(R,S - 1) - T
1160            LET A(R1,S1)     = A(R,S) - U
1170            LET A(R,S - 1)   = A(R,S - 1) + T
1180            LET A(R,S)       = A(R,S) + U
```

```
1190            NEXT I
1200        LET U = V * W1 - W * W2
1210        LET W = V * W2 + W * W1
1220        LET V = U
1230        NEXT J
1240     NEXT L
1250 LET Z = - 1E6
1260 FOR I = 1 TO RO / 2
1270     FOR J = 1 TO SO STEP 2
1280         IF I = 1 AND J = 1 THEN 1310
1290         LET A(I,J) = SQR (A(I,J) * A(I,J) + A(I,J + 1) *
                 A(I,J + 1))

1300         IF A(I,J) , Z THEN LET Z = A(I,J)
1310         NEXT J
1320     NEXT I
1330 HOME: PRINT "SPECTRUM FOR" + MID$ (DF$(SF),4,16)
1340 PRINT
1350 PRINT "PERIOD RELATIVE AMPLITUDE'
1360 PRINT "(DAYS)     (DB)": PRINT
1370 LET K = 0
1380 FOR I = 1 TO RO / 2
1400     FOR J = 1 TO SO STEP 2
1410         IF I = 1 AND J = 1 THEN 1460
1420         LET L = INT (N / K + .25)
1430         IF L + 1 , P THEN 1460
1440         LET P = L
1450         PRINT TAB( 2): L; TAB( 16);
                   INT (1000 * LOG (A(I,J) / Z) / LOG (10)) / 100
1460         LET K = K + 1
1470         NEXT J
1480     NEXT I
PROGRAM LENGTH: 152 LINES/3304 BYTES
```


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Appendix 6: Construction of Pentagon

CONSTRUCTION OF A PENTAGON FROM ONE FIXED DIAGONAL

Establish the diagonal *D* by connecting the top and bottom of a major price move by a straight line. This diagonal will be toward the left and top of the pentagon to be constructed (see Figure A6.1).

1. Measure the length of the diagonal *D*. This diagonal connects two points of the pentagon.
2. With the point of a compass at one end of the diagonal and the tip on the other, draw a long arc to the right; placing the point on the other end of the diagonal, draw another are to the right. These arcs should not cross to avoid confusion.
3. The length of a side of a regular pentagon is calculated from the diagonal by the formula

   $$S = .618 \times D$$

   Using a ruler, set the compass to the length of a side and place the point at one end of the diagonal. Draw an arc on both sides, crossing the arc on the right; do the same for the other end of the diagonal. The two new arcs will cross on the left. The three new crossings are the missing points of the pentagon.
4. The center of the pentagon can be found by bisecting any two sides. The point at which the two bisecting lines cross is the center. Use this point to circumscribe a circle around the pentagon.

Figure A6.1: Construction of a pentagon from one diagonal.

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CONSTRUCTION OF A PENTAGON FROM ONE SIDE

Establish the side *S* by connecting the top and bottom of a major price move with a straight line. As in the previous example, this side will be toward the top and left of the pentagon, which will extend down and to the right (see Figure A6.2).

1. Calculate the length of the diagonal *D* by applying the formula *D* = S/.618. This will require a ruler to determine the length of *S*.
2. Using a ruler again, set your compass to the length of the diagonal calculated in the first step. Draw wide arcs of radius *D* from the endpoints of *S* crossing to the lower right of *S*. The place of crossing will be the third point of the pentagon P_4, opposite side *S*.
3. Set the compass back to length *S* and place the point at P_4. Cross the inner arcs drawn in step 2 with a small arc drawn on either side of *P*. The place of crossing will be the two remaining points of the pentagon.
4. The perpendicular bisectors of any two sides will cross at the center of the pentagon and allow you to circumscribe a circle around the pentagon.

Figure A6.2: Construction of a pentagon from one side.

The perpendicular bisector of any side is constructed by setting the compass to any length greater than half of the line being bisected, then placing the point at one end of the line. Draw an arc on both sides of the line in the area above the center of the line. Do the same by placing the point of the compass at the other end and crossing the arcs already drawn. A line through the two crosses will be the perpendicular bisector of the original line.

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Bibliography

W. Peter Aan,"How RSI Behaves." *Futures* (January 1985).

Bovas, and Abraham, Johannes Ledolter.*Statistical Methods for Forecasting*. Wiley, New York, 1983.

Ralph, and Acampora, Rosemarie Pavlick."A Dow Theory Update." Originally published in the *MTA Journal* (January 1978), reprinted in the MTA Journal (Fall—Winter 2001).

B. Steven Achelis,*Technical Analysis from A to Z*. Probus, 1995.

M. Ralph Ainsworth,*Profitable Grain Trading*. Traders Press, Greensville, SC, 1980.

D. Jon Andersen,"Analyze Net Positions." *Technical Analysis of Stocks & Commodities* (July 2002).

S. W. Andrews,*Magic Squares and Cubes*. Dover, New York, 1960.

B. L. L. Angas,*Investment for Appreciation*. Somerset, New York, 1936.

George. Angell,"Thinking Contrarily." *Commodities Magazine* (November 1976). An interview with R. Earl Hadady.

George. Angell,*Winning in the Commodities Markets*. Doubleday, New York, 1979.

J. Louis Anon,"Catch Short-Term Profits with ARIMA." *Commodities Magazine* (December 1981).

Gerald. Appel,*Winning Market Systems: 83 Ways to Beat the Market*. Signalert, Great Neck, NY, 1974.

Gerald, and Appel, Martin E. Zweig.*New Directions in Technical Analysis*. Signalert, Great Neck, NY, 1976.

W., Richard Arms, Jr."Equivolume—A New Method of Charting." *Commodities Magazine* (April 1973).

M. Curtis Arnold,*The Personal Computer Can Make You Rich in Stocks and Commodities*. Weiss Research, West Palm Beach, FL, 1980.

_____. "Tracking 'Big Money' May Tip Off Trend Changes." *Futures* (February 1985).

———. "Your Computer Can Take You Beyond Charting." *Futures* (May 1984).

R. David Aronson,"An Introduction to Computer-Based Pattern Recognition." *Financial and Investment Software Review* (January/February 1984).

_____. "Artificial Intelligence/Pattern Recognition Applied to Forecasting Financial Market Trends." *Market Technicians Association Journal* (May 1985).

R. George Arrington,"Building a Variable-Length Moving Average." *Technical Analysis of Stocks & Commodities* (June 1991).

Thomas. Aspray,"Fine-Tuning the Demand Index." *Technical Analysis of Stocks & Commodities* (June 1986).

_____. "Demand Oscillator Momentum." *Technical Analysis of Stocks & Commodities* (September 1989).

Michael. E. Azoff,*Neural Network Time Series Forecasting of Financial Markets*. Wiley, 1994.

H. Eugene Barnett,*Programming Time—Shared Computers in BASIC*. Wiley-Interscience, New York, 1972.

D. John Becker,"Value of Oscillators in Determining Price Action." *Futures* (May 1994).

Jacob. Bernstein,"Cyclic and Seasonal Price Tendencies in Meat and Livestock Markets." In Todd Lofton, ed. *Trading Tactics: A Livestock Futures Anthology*. Chicago Mercantile Exchange, 1986.

Jacob. Bernstein,*The Handbook of Commodity Cycles*. Wiley, New York, 1982.

Jacob. Bernstein,*Seasonal Concepts in Futures Trading*. Wiley, New York, 1986.

L. Peter Bernstein,*The Portable MBA in Investment*. Wiley, New York, 1995.

Beyer, William H., ed. *Standard Mathematical Tables*, 24th ed. CRC Press, Cleveland, OH, 1976.

Eric, and Bjorgen, Steve Leuthold."Corporate Insiders' Big Block Trades." *Journal of Technical Analysis* (Market Technicians Association, Winter—Spring 2002).

William. Blau,*Momentum, Direction, and Divergence*. John Wiley & Sons, New York, 1995.

John. Bollinger,*Bollinger on Bollinger Bands*. McGraw-Hill, 2002.

A. John Bollinger,Bollinger Capital Management, Inc. P.O. Box 3358, Manhattan Beach, CA 90266, www.bollingerbands.com.

Hamilton. A. Bolton,*The Elliott Wave Principle: A Critical Appraisal*. Bolton, Tremblay & Co., Montreal, 1960.

Richard. Bookstaber,*The Complete Investment Book*. Scott, Foresman, Glenview, IL, 1985.

P., and G. E. Box, G. M. Jenkins.*Time Series Analysis: Forecasting and Control*, 2nd ed., Holden-Day, San Francisco, 1976.

Steve. Briese,"Commitment of Traders as a Sentiment Index." *Technical Analysis of Stocks & Commodities* (May 1990).

_____. "Tracking the Big Foot." *Futures* (March 1994).

William. Brower,*Inside Edge*. Inside Edge Systems, 10 Fresenius Road, Westport, CT 06880, March/April 1996.

J., and Stephen Brown, Mark P. Kritzman.*Quantitative Methods for Financial Analysis*, 2nd edition. Dow Jones-Irwin, 1990.

S. William G. Brown,"Logarithmic Point & Figure Charting." *Technical Analysis of Stocks & Commodities* (July 1995).

Gibbons. Burke,"Event-Based Analysis." *Futures* (April 1995).

J. Michael Carr,"Get out the Vote and into Stocks." *Futures* (February 1996).

David. Cassidy,*Trading on Volume*. McGraw-Hill, 2001.

S., and Tushar Chande, Stanley Kroll.*The New Technical Trader*. John Wiley & Sons, 1994.

C. Chatfleld,*The Analysis of a Time Series: Theory and Practice*. Chapman and Hall, London, 1975.

Chicago Board of Trade. *CBOT Market Profile*. 1984.

H. A. Church,*On the Relation of Phyllotaxis to Mechanical Laws*. Williams and Newgate, London, 1904.

Claude. Cleeton,*The Art of Independent Investing*. Prentice-Hall, Englewood Cliffs, NJ, 1976.

W. A. Cohen,*How to Use the Three-Point Reversal Method of Point and Figure Stock Market Trading*. Chartcraft, Larchmont, NY, 1972.

W. Robert Colby,*The Encyclopedia of Technical Market Indicators*. McGraw-Hill, 2003.

W., and Robert Colby, Thomas A. Meyers.*The Encyclopedia of Technical Market Indicators*. Dow Jones-Irwin, 1988.

Commodity Trading Manual. Chicago Board of Trade.

Commodity Traders Club. *Comparative Performances*. Messena, NY, 1969. (A reprint).

Commodity Yearbook 1975. Commodity Research Bureau, New York, 1975.

Commodity Yearbook 1987. Commodity Research Bureau, New York, 1987.

Commodity Yearbook 1992. Commodity Research Bureau, New York, 1992.

Commodity Yearbook 1994. Knight-Ridder, New York, 1994.

CompuTrac Manual. Telerate, 1990.

A., and Laurence Conners, Blake E. Hayward.*Investment Secrets of a Hedge Fund Manager*. Probus, 1995.

A., and Laurence Conners, Linda Bradford Raschke.*Street Smarts: High Probability Short-Term Trading Strategies* (M. Gordon Publishing Group, Malibu, CA 1995).

Conners, Larry."Timing Your S&P Trades with the Vix." *Futures* (June 2002).

ContiCommodity. *Seasonality in Agricultural Futures Markets*. ContiCommodity Services, Chicago, 1983.

Control Data Corporation. *Control Data 6000 Series Computer Systems Statistical Subroutines Reference Manual*. St. Paul, 1966.

Cootner, Paul, ed. *The Random Character of Stock Market Prices*, MIT Press, Cambridge, MA, 1964.

_____. "Speculation and Hedging." *Food Research Institute Studies, Vol. VII: 1967 Supplement*. Stanford University Press, Stanford, 1967.

Toby. Crabel,*Day Trading with Short-Term Price Patterns and Opening Range Breakout*. Traders Press, Greenville, SC 29603.

———. "Opening Range Breakout, Part 4." *Technical Analysis of Stocks & Commodities* (February 1989).

Elias. Crim,"Are You Watching the 'Right' Signals?" *Futures* (June 1985).

CSI Technical Journal. Commodity Systems Inc., Boca Raton, FL (May 1995).

Cycles. Foundation for the Study of Cycles, Pittsburgh, January 1976.

Aswath. Damodaran,*Investment Valuation*. Wiley, New York, 1996.

Jon. Davis,*Weather Sensitivity in the Markets*. Smith Barney, October 1994.

Earl. Robert Davis, *Profit and Profitability*. R. E. Davis,West LaFayette, IN, 1969.

E., and R. Davis, C. C. Thiel, Jr.*A Computer Analysis of the Moving Average Applied to Commodity Futures Trading*. Ouiatenon Management Co., West Lafayette, IN, 1970. (A research report.)

R. Thomas DeMark,"Retracing Your Steps." *Futures* (November 1995).

_____. *The New Science of Technical Analysis*. Wiley, New York, 1994.

Victor. De Villiers,*The Point and Figure Method of Anticipating Stock Price Movements*. Trader Press, NY, 1966.

R., and Edward Dewey, Og Mandino.*Cycles*. Hawthorn Books, New York, 1971.

D. Richard Donchian,"Donchian's 5- and 20-Day Moving Averages." *Commodities Magazine* (December 1974).

Thomas. Dorsey,*Point & Figure Charting*, 2nd edition. Wiley, 2001.

M., and N. Downie, R. W. Heath.*Basic Statistical Method*, 3rd edition. Harper & Row, New York, 1970.

Dunn & Hargitt Financial Services, Inc., West Lafayette, IN.

Dennis. Dunn,*Consistent Profits in June Live Beef Cattle*. Dunn & Hargitt, West Lafayette, IN, 1972.

William. Dunnigan,*One Way Formula*. Dunnigan, Palo Alto, CA, 1955.

———. *Select Studies in Speculation*. Dunnigan, San Francisco 1954. (Includes "Gain in Grains" and "The Thrust Method in Stocks.")

———. *117 Barometers for Forecasting Stock Price*. Dunnigan, San Francisco, 1954.

B. Richard Earp,"Correlating Taylor and Polous." *Commodities Magazine* (September 1973).

D., and Robert Edwards, John Magee.*Technical Analysis of Stock Trends*. John Magee, Springfield, MA, 1948.

D., Robert Edwards, John Magee, and W. H. Charles Bassetti.*Technical Analysis of Stock Trends*, 8th edition. Original edition published by John Magee.

F. John Ehlers,*Cybernetic Analysis for Stocks & Commodities*. John Wiley & Sons, New York, 2004.

F. John Ehlers,*MESA and Trading Market Cycles*, 2nd edition. John Wiley & Sons, 2001.

F. John Ehlers,"Relative Vigor Index." *Technical Analysis of Stocks & Commodities* (January 2002).

F. John Ehlers,*Rocket Science for Traders*. John Wiley & Sons, New York, 2001.

F. John Ehlers,"How to Use Maximum Entropy." *Technical Analysis of Stocks & Commodities* (November 1987).

_____. *MESA and Trading Market Cycles*. Wiley, New York, 1992.

_____. "Moving Averages, Part 1." *Technical Analysis of Stocks & Commodities* (1988).

_____. "Moving Averages, Part 2." *Technical Analysis of Stocks & Commodities* (1988).

_____. "Optimizing RSI with Cycles." *Technical Analysis of Stocks & Commodities* (February 1986).

_____. "Trading Channels." *Technical Analysis of Stocks & Commodities* (April 1986).

Alexander. Elder,*Trading for a Living*. John Wiley, New York, 1993.

N. R. Elliott,*Nature's Law, The Secret of the Universe*. Elliott, New York, 1946.

_____. *The Wave Principle*. Elliot, New York, 1938.

J. Tucker Emmett,"Fibonacci Cycles." *Technical Analysis of Stocks & Commodities* (May 1983 and March/April 1984).

F. William Eng,"A Mechanical Trading System." *Technical Analysis of Stocks & Commodities* (July 1986).

_____. *The Technical Analysis of Stocks, Options & Futures*. Probus, 1988.

Christina. Ericsson,*Forecasting Success*. Kaufman, Westport, 1987.

Mark. Etzkorn,"All in a Day's Work." *Futures* (January 1995).

Eric. Evans,"Why You Can't Rely on 'Key Reversal Days,' " *Futures* (March 1985).

Andrew. Fisher,"Teaching the Old Vix New Tricks." *Futures* (August 2001).

B. Mark Fisher,*The Logical Trader*. John Wiley & Sons, 2002.

Robert. Fischer,*The Golden Section Compass Seminar*. Fibonacci Trading, P.O. Box HM 1653, Hamilton 5, Bermuda.

B., Mark Fishman, Dean S. Barr, and Walter J. Loick."Artificial Intelligence and Market Analysis." *Technical Analysis of*

Stocks & Commodities (Bonus Issue 1993).

William. Carl Floss,*Market Rhythm*. Investors Publishing Co., New York, 1955.

G. Norman Fosback,*Stock Market Logic*. Dearborn Financial, 1998.

_____. *Stock Market Logic*. The Institute for Economic Research, 1985.

F. Nelson Freeburg,*Formula Reseach*. Formula Research, Inc., 4745 Poplar Ave., Suite 307, Memphis, TN 38117-4408, Vol VI, nos. 10–11, December 2000 and August 2001.

P. Christian Fries,"Elastic Moving Averages." *Technical Analysis of Stocks & Commodities* (June 2001).

J., and A. Frost, Robert R. Prechter, Jr.*Elliott Wave Principle*. New Classics Library, Chappaqua, NY, 1978.

A. Wayne Fuller,*Introduction to Statistical Time Series*. Wiley, New York, 1976.

Fults, John Lee. *Magic Squares*. Open Court, La Salle, IL, 1974.

Futures Truth Magazine. Futures Truth, Hendersonville, NC, www.futurestruth.com.

D. William Gann,*The Basis of My Forecasting Method for Grain*, Lambert-Gann, Pomeroy, WA, 1976.

_____. *Forecasting Grains by Time Cycles*. Lambert-Gann, Pomeroy, WA, 1976.

_____. *Forecasting Rules for Cotton*. Lambert-Gann, Pomeroy, WA, 1976.

_____. *Forecasting Rules for Grain-Geometric Angles*. Lambert-Gann, Pomeroy, WA, 1976.

_____. *How to Make Profits in Commodities*. Lambert-Gann, Pomeroy, WA, 1976.

_____. *Master Calculator for Weekly Time Periods to Determine the Trend of Stocks and Commodities*. Lambert-Gann, Pomeroy, WA, 1976.

_____. *Master Charts*. Lambert-Gann, Pomeroy, WA, 1976.

_____. *Mechanical Method and Trend Indicator for Trading in Wheat, Corn, Rye, or Oats*. Lambert-Gann, Pomeroy, WA, 1976.

_____. *Rules for Trading in Soybeans, Corn, Wheat, Oats and Rye*. Lambert-Gann, Pomeroy, WA, 1976.

_____. *Speculation: A Profitable Profession (A Course of Instruction in Grains)*. Lambert-Gann, Pomeroy, WA, 1976.

_____. *45 Years in Wall Street*. Lambert-Gann, Pomeroy, WA, 1949.

Gannsoft Publishing. "Ganntrader I." *Technical Analysis of Stocks & Commodities* (January/February 1984).

Edward. Gately,*Neural Networks for Financial Forecasting*. Wiley, 1996.

Fred. Gehm,"Does Pyramiding Make Sense?" *Technical Analysis of Stocks & Commodities* (February 1986).

_____. *Commodity Market Money Management*. Wiley, New York, 1983.

_____. *Quantitative Trading & Money Management*, revised edition. Irwin, 1995.

Joseph, and Gies, Frances Gies.*Leonard of Pisa and the New Mathematics of the Middle Ages*. Thomas M. Crowell, New York, 1969.

Warren. Gilchrist,*Statistical Forecasting*. Wiley, London, 1976.

Ginter G., and J. Richie."Data Errors and Price Distortions." In Perry J. Kaufman, ed. *Technical Analysis in Commodities*. Wiley, New York, 1980.

B. Edward Gotthelf,*The Commodex System*. Commodity Futures Forecast, New York, 1970.

Philip, and Gotthelf, Carl Gropper."Systems Do Work… But You Need a Plan." *Commodities Magazine* (April 1977).

G. Bruce Gould,*Dow Jones-Irwin Guide to Commodities Trading*. Dow Jones-Irwin, Homewood, IL, 1973.

B. Thomas V., Greer, Wade Brorsen, and Shi-Miin Liu."Slippage Costs of a Large Technical Trader." *Technical Analysis of Stocks & Commodities* (January 1992).

J., and Grushcow, C. Smith.*Profits Through Seasonal Trading*. Wiley, New York, 1980.

Gordon. Gustafson,"Price Persistency." *Technical Analysis of Stocks & Commodities* (January 2002).

Earl. R. Hadady,*Contrary Opinion*. Hadady, Pasadena CA, 1983.

_____. "Contrary Opinion." *Technical Analysis of Stocks & Commodities* (August 1988).

C., and M. Hallberg, V. I. West.*Patterns of Seasonal Price Variations for Illinois Farm Products*. Circular 861, University of Illinois College of Agriculture, Urbana, 1967.

Jay. Hambridge,*Dynamic Symmetry: The Greek Vase*. Yale University Press, New Haven, 1931.

_____. *Practical Applications of Dynamic Symmetry*. Yale University Press, New Haven, 1938.

David. Handmaker,"Low-Frequency Filters for Seasonal Analysis." In Perry J. Kaufman. *Handbook of Futures Markets*. Wiley, New York, 1984.

David. Handmaker,"Picking Software to Trade Technically." *Commodities* (August 1982).

Hans. Hannula,"Trading Planetary Eclipses." *Technical Analysis of Stocks & Commodities* (April 1992).

David. Harahus," *…on Market Speculation…*" Harahus Analysis, Ferndale, MI, 1977.

F.M. Haynie,"Doc." "Stretching the 'profile' to cover 24-hour markets." *Futures* (February 1992).

Van Court, Haze, Jr.*Systems Analysis: A Diagnostic Approach*. Harcourt, Brace & World, New York, 1967.

Adam. Hewison,"The Will Rogers Theory of Point & Figure Trading." *Technical Analysis of Stocks & Commodities* (August 1991).

A. Thomas Hieronymus,*Economics of Futures Trading*. Commodity Research Bureau, New York, 1971.

_____. *When to Sell Corn-Soybeans-Oats-Wheat*. University of Illinois College of Agriculture, Urbana, 1967.

E., and James Higgens, Allan M. Loosigian."Foreign Exchange Futures." In Perry J. Kaufman, ed. *Handbook of Futures Markets*. Wiley, New York, 1984.

B. F. Hildebrand,*Introduction to Numerical Analysis*, McGraw-Hill, New York, 1956.

Holliston. Hill,"Using Congestion Area Analysis to Set Up for Big Moves." *Futures* (April 1985).

John. Hill,"Simple vs. complex." *Futures* (March 1996).

L., and Frank Hochheimer, Richard J. Vaughn.*Computerized Trading Techniques 1982*, Merrill Lynch Commodities, New York, 1982.

H. John Holland,*Adaptations in Natural Language and Artificial Systems*. University of Michigan Press, 1975.

T. James Holter,"Delivering the Day-Trading Experience." *Futures* (August 2001).

Hoyle, *The Game in Wall Street*. Hoyle,originally published 1898, reprinted 1997.

K. Jack Hutson,"Filter Price Data: Moving Averages vs. Exponential Moving Averages." *Technical Analysis of Stocks & Commodities* (May/June 1984).

M. J. Hurst,*The Profit Magic of Stock Transaction Timing*. Prentice-Hall, Englewood Cliffs, NJ, 1970.

K. Jack Hutson,"Elements of Charting." *Technical Analysis of Stocks & Commodities* (March 1986).

_____. "Good TRIX." *Technical Analysis of Stocks & Commodities* (July 1983).

_____. "Elements of Charting." *Technical Analysis of Stocks & Commodities* (March 1986).

_____. "Filter Price Data: Moving Averages Versus Exponential Moving Averages." *Technical Analysis of Stocks & Commodities* (May/June 1984).

_____. "Using Fourier." *Technical Analysis of Stocks & Commodities* (January 1983).

K., and Jack Hutson, Anthony Warren."Forecasting with Maximum Entropy." *Technical Analysis of Stocks & Commodities* (December 1984).

K. Jack Hutson,"Good Trix." *Technical Analysis of Stocks & Commodities* (Vol 1:5).

T. J. Jackson,*Detecting High-Profit Day Trades in the Futures Markets*. Windsor Books, 1994.

L. William Jiler,*Forecasting Commodity Prices with Vertical Line Charts*. Commodity Research Bureau, New York, 1966.

_____. *How Charts Are Used in Commodity Price Forecasting*. Commodity Research Publications, New York, 1977.

_____. *Volume and Open Interest: A Key to Commodity Price Forecasting*. Commodity Research Bureau, New York, 1967.

Bruce. A. Johnson,"Finding Cycles in Time Series Data." *Technical Analysis of Stocks & Commodities* (August 1990).

F. Charles Johnson,"Stochastic Oscillator Program for the HP-41C(V)." *Technical Analysis of Stocks & Commodities* (September/October 1984).

Donald. Jones,*Applications of the Market Profile*. CISCO, 32 S. LaSalle St., Chicago, IL 60604.

_____. "Locating Value with Auction Market Data." *Technical Analysis of Stocks & Commodities* (July 1989).

Jay. Kaeppel,"The January Barometer: Myth and Reality." *Technical Analysis of Stocks & Commodities* (July 1990).

E. R. Kalman,"A New Approach to Linear Filtering and Predecting Problems." *Journal of Basic Engineering* (March 1960).

Kenneth, and Kapner, Robert McDonough."Doing Your Homework on Individual Equity Futures." *Futures* (March 2002).

Cynthia. Kase,"Redefining Volatility and Position Risk." *Technical Analysis of Stocks & Commodities* (October 1993).

J. Perry Kaufman,*Handbook of Futures Markets*. Wiley, New York, 1984.

_____. "High-Tech Trading." *Futures and Options World* (London, September 1985).

_____. "Market Momentum Re-Examined." Unpublished Article, November 1975.

_____. "Moving Averages and Trends." In Todd Lofton, ed. *Trading Tactics: A Livestock Futures Anthology*. Chicago Mercantile Exchange, 1986.

_____. "Price Shocks: Reevaluating Risk/Return Expectations." *Futures Industry* (June/July 1995).

_____. "Safety-Adjusted Performance Evaluation." *Journal of Futures Markets*, Vol. 1 (1981).

_____. *Smarter Trading*. McGraw-Hill, New York, 1996.

_____. "Technical Analysis." In Nancy H. Rothstein, ed. *The Handbook of Financial Futures*. McGraw-Hill, New York, 1984.

_____. *Technical Analysis in Commodities*. Wiley, New York, 1980.

J., Perry Kaufman, Dennis C. Koutras, and Peter Psycharis."Positioning the Greek Equities Market in International Portfolios." *Nonlinear Analysis, Theory, Methods & Applications*, Vol. 30, no. 4, *Proceedings of the 2nd World*

Congress of Nonlinear Analysts, Elsevier Science Ltd., Great Britain 1997.

Perry, and Kaufman, Alberto Vivanti.*Global Equity Investing*. McGraw-Hill, New York, 1997.

J. Perry Kaufman,*A Short Course in Technical Trading*. Wiley, 2003.

J., and Perry Kaufman, Kermit C. Zieg, Jr."Measuring Market Movement." *Commodities Magazine* (May 1974).

L., John Kelly, Jr."Kelly Betting System." *Bell System Technical Journal* (July 1956).

W. Chester Keltner,*How to Make Money in Commodities*. The Keltner Statistical Service, Kansas City, 1960.

G., and John Kemeny, J. Laurie Snell.*Finite Markov Chains*. Springer-Verlag, New York, 1976.

G., and John Kemeny, Thomas E. Kurtz.*Basic Programming*, 2nd edition. John Wiley & Sons, New York, 1971.

F. John Kepka,"Trading with ARIMA Forecasts." *Technical Analysis of Stocks & Commodities* (August 1985).

C., and Frederick Klein, John A. Presbo.*News and the Market*. Henry Regnery Co., Chicago, 1974.

E. Donald Knuth,*The Art of Computer Programming, Vol. 2: Seminumeric Algorithms*. Addison-Wesley, Reading, MA, 1971.

Kevin. Koy,*Markets 101*. MLS Publishing, 401 S. LaSalle St., Chicago, IL 60605.

Don. Kraska,"Letters to S&C." *Technical Analysis of Stocks & Commodities* (February 1996).

Robert. Krausz,"A Strategy for Trading Multiple Time Frames." *Futures* (November 2001).

Robert. Krausz,"Intraday Strategies for Multiple Time Frames." *Futures* (January 2002).

Robert. Krausz,*W.D. Gann Treasure Discovered*. Geometric Traders Institute, Fibonacci Trader Corp, 450–106 State Road 13 North, #206, Jacksonville, FL 32259-3863.

Robert. Krausz,Fibonacci Trader, *Tutorial & Educational Supplement*. Fibonacci Trader Corporation, 757 S.E. 17th Street, Suite 272, Ft. Lauderdale, FL 33316.

Mark, and Kritzman, Don Rich."The Mismeasurement of Risk." *Financial Analysts Journal* (May/June 2002).

Stanley. Kroll,*The Professional Commodity Trader*. Harper & Row, New York, 1974.

Stanley, and Kroll, Irwin Shishko,*The Commodity Futures Market Guide*, Harper & Row, New York, 1973.

S. Kaiser Kunz,*Numerical Analysis*, McGraw-Hill, New York, 1957.

C. Walter Labys,*Dynamic Commodity Models: Specification, Estimation, and Simulation*. Lexington Books, Lexington, MA, 1973.

E. Patrick Lafferty,"End-Point Moving Average." *Technical Analyisis of Stocks & Commodities* (October 1995).

R. Donald Lambert,"Commodity Channel Index: Tool for Trading Cyclic Trends." *Commodities* (1980). Reprinted in *Technical Analysis of Stocks & Commodities* (July 1983).

_____. "Exponentially Smoothed Moving Averages." *Technical Analysis of Stocks & Commodities* (September/October 1984).

_____. "The Market Directional Indicator." *Technical Analysis of Stocks & Commodities* (November/December 1983).

C. George Lane,"Lane's Stochastics." *Technical Analysis of Stocks & Commodities* (May/June 1984).

Arnold. Larson,"Measurement of a Random Process in Futures Pricing." *Food Research Institute Studies 1*, no. 3 (November 1960).

H. Robert T. Lee,*Power Tools for Traders*. Mega Capital Limited, Hong Kong, 1997.

Edwin. Lefevre,*Reminiscences of a Stock Operator*. Books of Wall Street, Burlington, VT, 1980. Originally published in 1923 by George H. Doran Co., New York.

Phillippe. Lemay,http://tecfa.unige.ch

H. Thomas Lincoln,"Time Series Forecasting: ARMAX." *Technical Analysis of Stocks & Commodities* (September 1991).

B., and Jeffrey Little, Lucien Rhodes.*Understanding Wall Street*, 3rd edition. McGraw-Hill, 1991.

W., Andrew Lo, Harry Mamaysky, and Jiang Wang."Foundations of Technical Analysis: Computational Algorithms, Statistical Inference, and Empirical Implementation." *The Journal of Finance* (August 2000).

Todd. Lofton,"Chartists Corner." *Commodities Magazine* (December 1974). Two series of articles.

Todd. Lofton,*Getting Started in Futures*, 4th edition. Wiley, 2001.

_____. "Moonlight Sonata." *Commodities Magazine* (July 1974).

_____. *Trading Tactics: A Livestock Futures Anthology*. Chicago Mercantile Exchange, 1986.

Jeanne. Long,"Planetary Support and Resistance on the DJIA." *A Traders Astrological Almanac 1994*. Professional Astrology Service, 757 S.E. 17th St., Ft. Lauderdale, FL 33316.

Jacques. Longerstaey,*RiskMetrics' Technical Document*, 4th edition. Morgan Guaranty Trust Company, *riskmetrics@jpmorgan.com.*

Ballesca. Luis Loyo,"Price Projections on Point and Figure Charts." *Technical Analysis of Stocks & Commodities* (July 1989).

Duncan, and R. Luce, Howard Raiffa.*Games and Decisions*. John Wiley & Sons, New York, 1957.

B. Louis P., Lukac, Wade Brorsen, and Scott H. Irwin."How to Test Profitability of Technical Trading Systems." *Futures* (October 1987).

B. Louis P., Lukac, Wade Brorsen, and Scott H. Irwin.*Similarity of Computer Guided Technical Trading Systems*. CSFM-124, Working Paper Series, Columbia Futures Center, Columbia University Business School, New York, March 1986.

Charles. MacKay,*Extraordinary Popular Delusions and the Madness of Crowds*. Noonday Press (Farrar, Straus, and Giroux), New York, 1932.

Nathaniel. Macon,*Numerical Analysis*, John Wiley & Sons, New York, 1963.

Peter. Madlem,*Power Investing with Sector Funds*. St. Lucie Press/American Management Association, 1999.

B. B. Mandelbrot,"A Multifractional Walk Down Wall Street." *Scientific American* (February 1999).

M. Harry Markowitz,"Portfolio Selection." *Journal of Finance* (March 1952).

M. Harry Markowitz,*Portfolio Selection*. Yale, 1979.

S. Donald Mart,*The Master Trading Formula*. Winsor Books, Brightwaters, NY, 1981.

F. Francis Martin,*Computer Modeling and Simulation*. John Wiley & Sons, New York, 1968.

R., Joseph Maxwell,St. *Commodity Futures Trading with Moving Averages*. Speer, Santa Clara, CA, 1974.

John. McGinley,*Technical Trends*. P.O. Box 792, Wilton, CT 06897.

Curtis, McKallip, Jr."Fundamentals Behind Technical Analysis." *Technical Analysis of Stocks & Commodities* (November 1989).

C. J. C. McKinsey,*Introduction to the Theory of Games*. McGraw-Hill, New York, 1952.

G. Lawrence McMillan,"Put-Call Ratios." *Technical Analysis of Stocks & Commodities* (October 1995).

Dennis. McNicholl,"Old Statistical Methods for New Tricks in Analysis." *Futures* (April 2002).

Malcolm. McNutt,"First-Hour Breakout System." *Technical Analysis of Stocks & Commodities* (July 1994).

Jean. Meeus,*Astronomical Algorithms*. Willman-Bell, Inc., P.O. Box 35025, Richmond, VA 23235.

———. *Astronomical Formulae for Calculators*. Willman-Bell, Inc., P.O. Box 35025, Richmond, VA 23235.

Gunter, and Meissner, Sarp Cercioglu."Trading Trends and Correlations." *Futures* (January 2003).

William, and Mendenhall, James E. Reinmuth.*Statistics for Management and Economics*, 2nd edition. Duxbury Press, North Scituate, MA, 1974.

A. Arthur Merrill,*Behavior of Prices on Wall Street*. The Analysis Press, Chappaqua, NY, 1966.

———. "The Presidential Election Cycle." *Technical Analysis of Stocks & Commodities* (March 1992).

Dennis. Meyers,"Range Roving." *Active Trader* (March 2003).

Cecil. Frederick Mills,*Statistical Methods*. Henry Holt & Co., New York, 1924.

C., and Douglas Montgomery, Lynwood A. Johnson.*Forecasting and Time Series*. McGraw-Hill, New York, 1976.

Steve. Moore,"Playing the Seasonals." *Active Trader*, Vol. 1, no. 8 (November 2000).

J. M. Morney,"On the Average and Scatter." In *The World of Mathematics*, Vol. 3 (James R. Newman, ed.), Simon & Schuster, New York, 1956.

John. Murphy,*Technical Analysis of the Futures Markets*, 2nd edition. New York Institute of Finance, 2001.

J. John Murphy,*Intermarket Technical Analysis*, Wiley, New York, 1991.

Christopher. Narcouzi,"Winning with Failures." *Technical Analysis of Stocks & Commodities* (November 2001).

Humphrey. Neill,*The Art of Contrary Thinking*. The Caxton Printers, Caldwell, OH, 1960.

Grant. Noble,"The Best Trading Indicator—the Media." *Technical Analysis of Stocks & Commodities* (October 1989).

Omega TradeStation. *Easy Language Manual*. Omega Research, Boca Raton, FL 1995.

J. Merrill Oster,"How the Young Millionaires Trade Commodities." *Commodities Magazine* (March and April 1976).

J., Merrill, Oster,et al. *How to Multiply Your Money*. Investors Publications, Cedar Falls, IA, 1979.

Robert. Pardo,*Design, Testing and Optimization of Trading Systems*. Wiley, New York, 1992.

Derek, and Parker, Julia Paricor.*The Compleat Astrologer*. McGraw-Hill, New York, 1971.

J. J. Payne,"A Better Way to Smooth Data." *Technical Analysis of Stocks & Commodities* (October 1989).

Jack. Perrine,"Taurus the Bullish." *Commodities Magazine* (September 1974).

L. John Person,"Pivot Points and Candles." *Futures* (February 2003).

Edgar. Peters,*Chaos and Order in the Capital Markets*. John Wiley & Sons, NY, 1991.

D. Dennis Peterson,"Positive Volume Index." *Technical Analysis of Stocks & Commodities* (April 2003).

Robert. Pisani,"How Market Structure Helps You Analyze Price Behavior." *Futures* (October 1987).

Michael. E. Polous,"The Moving Average as a Trading Tool." *Commodities Magazine* (September 1973).

J. Mark Powers,*Getting Started in Commodity Futures Trading*. Investors Publications, Waterloo, Iowa, 1975.

R., Robert Prechter, Jr."Computerizing Elliott." *Technical Analysis of Stocks & Commodities* (July 1983).

_____. "Major Sea Change II." *Futures* (March 1996).

_____. *The Major Works of R. N. Elliott*, New Classics Library, Chappaqua, NY, 1980.

R., Robert Prechter, Weiss, and David Jr., David Allman."Forecasting with the Elliott Wave Principle." In Todd Lofton, ed. *Trading Tactics: A Livestock Futures Anthology*. Chicago Mercantile Exchange, 1986.

J. Martin Pring,*Technical Analysis Explained*. McGraw-Hill, New York, 1991.

Martin. Pring,"Twice as Nice: The Two-Bar Reversal Pattern." *Active Trader* (March 2003).

J. Martin Pring,*Martin Pring on Market Momentum*. International Institute for Economic Research, Gloucester, VA, 1993.

Ray. Reiman,"Handicapping the Grains." *Commodities Magazine* (April 1975).

Stéphane. Reverre,"Trading Against the Gap." *Technical Analysis of Stocks & Commodities* (Bonus Issue 2003).

_____. "Trading the Opening Gap." *Technical Analysis of Stocks & Commodities* (November 1999).

S. Charles Rockwell,"Normal Backwardation, Forecasting, and the Returns to Commodity Futures Traders." *Food Research Institute Studies, Vol. VII: 1967 Supplement*, Stanford University Press, Stanford, 1967.

P. Robert Rotella,*The Elements of Successful Trading*. The New York Institute of Finance, 1992.

H. Nancy Rothstein,*The Handbook of Financial Futures*. McGraw-Hill, New York, 1984.

R. F. Ruckdeschel,*BASIC Scientific Subroutines*, Vol. 1. Byte/McGraw-Hill, Peterborough, NH, 1981.

_____. *BASIC Scientific Subroutines*, Vol. 2. Byte/McGraw-Hill, Petterborough, NH, 1983.

Barry. Rudd,*Stock Patterns for Day Trading and Swing Trading*. Traders Press, Greenville, SC 1998.

A., Murray Ruggiero, Jr."Seeking a Commitment." *Futures* (April 2002).

_____. "Exploiting Report Day Tendencies in Treasuries." *Futures* (February 2001).

_____. *Cybernetic Trading Strategies*. John Wiley & Sons, NY, 1997.

_____. "Artificial Trader Jumps Candlesticks." *Futures* (February 1995); and "Lighting Candlesticks with Fuzzy Logic." *Futures* (March 1996).

_____. "Build a Real Neural Net." *Futures* (June 1996).

_____. "Building the Wave." *Futures* (April 1996).

Alex. Saitta,"A Price and Volume-Based System." *Technical Analysis of Stocks & Commodities* (March 1996).

W. R. Schabacker,*Stock Market Theory and Practice*. B. C. Forbes, New York, 1930.

Harry. Schirding,"Stochastic Oscillator." *Technical Analysis of Stocks & Commodities* (May/June 1984).

D. Jack Schwager,*A Complete Guide to the Futures Markets*. Wiley, New York, 1984.

_____. *Risk and Money Management*. In Perry J. Kaufman.*Handbook of Futures Markets*. Wiley, New York, 1984.

D. J. Schwager,"A Trader's Guide to Analyzing the Potato Futures Market." *1981 Commodity Yearbook*. Commodity Research Bureau, New York, 1981.

D. Jack Schwager,*Schwager on Futures: Fundamental Analysis*. John Wiley & Sons, New York, 1995.

_____. *Schwager on Futures: Technical Analysis*. John Wiley & Sons, New York, 1996.

D., and Andrew Seidel, Philip M. Ginsberg.*Commodities Trading*. Prentice-Hall, Engle-wood Cliffs, NJ, 1983.

H. Kenneth Shaleen, *Volume and Open Interest*. Probus, 1991.

B. John E. Shaw, *A Professional Guide to Commodity Speculation*. Parker Publ., West Nyack, NY, 1972.

Arthur. Sklarew, *Techniques of a Professional Commodity Chart Analyst*. Commodity Research Bureau, New York, 1980.

Adam. Smith, *The Money Game*. Random House, New York, 1967.

H., Clifford Springer, Robert E. Herlihy, and Robert I. Beggs. *Advanced Methods and Models*. Richard D. Irwin, Homewood, IL, 1965.

_____. *Probabilistic Models*. Richard D. Irwin, Homewood IL, 1968.

Statistical Annual. Chicago Board of Trade, Chicago, 1969–1975 eds.

Peter. J. Steidlmayer, *Steidlmayer on Markets*. Wiley, New York, 1989.

Peter, and J. Steidlmayer, Kevin Koy. *Markets & Market Logic*. The Porcupine Press, Chicago, 1986.

Peter, and J. Steidlmayer, Shera Buyer. *Taking the Data Forward*, Market Logic Inc, Chicago, IL 1986.

Nofri. Jeanette Steinberg, "Timing Market Entry and Exit." *Commodities Magazine* (September 1975).

Marsha. Stigum, *Money Market Calculations*. Dow Jones-Irwin, 1981.

D. Norman Strahm, "Preference Space Evaluation of Trading System Performance." In Perry J. Kaufman. *Handbook of Futures Markets*. Wiley, New York, 1984.

John. Sweeney, *Campaign Trading*. Wiley, New York, 1997.

_____. "Maximum Adverse Excursions for Stops." *Technical Analysis of Stocks & Commodities* (April 1987).

Douglass. George Taylor, *The Taylor Trading Technique*. Lilly Pub. Co., Los Angeles, 1950. (This book has been reprinted by Traders Press, P.O. Box 6206, Greenville, SC 29606 in 1994.)

Joel. Robert Taylor, "The Major Price Trend Directional Indicator." *Commodities Magazine* (April 1972).

T. William Taylor, "Fourier Spectral Analysis." *Technical Analysis of Stocks & Commodities* (July/August 1984).

Nicholas. Nassim Teleb, *Fooled by Randomness*. Texere, 2001.

Rudy. Teseo, "LRS + R-Squared = The 95% Solution." *Technical Analysis of Stocks & Commodities* (February 2003).

J., Richard Teweles, Charles V. Harlow, and Herbert L. Stone. *The Commodity Futures Game, Who Wins? Who Uses? Why?* McGraw-Hill, New York, 1974.

The Traders Note Book. Dunn & Hargitt Financial Services, W. Lafayette, IN, 1970.

Charles, and Thiel, R. E. Davis. *Point and Figure Commodity Trading: A Computer Evaluation*. Dunn & Hatgitt, West LaFayette, IN, 1970.

Thiriea, H., and S. Zionts, eds. *Multiple Criteria Decision Making*. Springer-Verlag, Berlin, 1976.

H. Jesse Thompson, "The Livermore System." *Technical Analysis of Stocks & Commodities* (May 1983).

_____. "What Textbooks Never Tell You." *Technical Analysis of Stocks & Commodities* (November/December 1983).

O. Edward Thorp, *Beat the Dealer*. Vintage, New York, 1966.

C. L. Tippett, "Sampling and Standard Error." *The World of Mathematics*, Vol. 3 (James R. Newman, ed.), Simon & Schuster, New York, 1956.

Robert. Townsend, *Up the Organization*. Knopf, New York, 1970.

Trading Strategies. Futures Symposium International, Tucson, AZ, 1984.

Frank. Tubbs,"Tubbs' Stock Market Correspondence Lessons." (Chap. 13, Tape Reading.)

Dennis, and Turner, Stephen H. Blinn.*Trading Silver—Profitably*. Arlington House, New Rochelle, NY, 1975.

Ralph. Vince,*Portfolio Management Formulas*. Wiley, New York, 1990.

Visual Numerics. *IMSL Math Library*. 1997. (Available on Internet).

John, and von Neumann, Oskar Morgenstern.*Theory of Games and Economic Behavior*. Princeton University Press, Princeton, 1953. (First published 1943).

Wolf. von Ronik,"System Testing via Monte Carlo." *Futures* (April 2001).

Jeff. Walker,"What K-wave?" *Technical Analysis of Stocks & Commodities* (July 1990).

Marshall. E. Wall,"Rolling with the Punches." *Futures* (July 1996).

Ben. Warwick,*Event Trading*. Irwin, 1996.

Anthony. Warren,"A Mini Guide to Fourier Spectrum Analysis." *Technical Analysis of Stocks & Commodities* (January 1983).

———. "Fourier Analysis! In a Nutshell; Faster and Better." *Technical Analysis of Stocks & Commodities* (December 1983).

———. "An Introduction to Maximum Entropy Method (MEM) Technical Analysis." *Technical Analysis of Stocks & Commodities* (February 1984).

_____. "Optimizing the Maximum Entropy Method." *Technical Analysis of Stocks & Commodities* (March/April 1984).

Anthony, and Warren, Jack K. Hutson."Finite Impulse Response Filter." *Technical Analysis of Stocks & Commodities* (May 1983).

J., and James, Waters, Larry Williams."Measuring Market Momentum." *Commodities Magazine* (October 1972).

F., and T. Watling, J. Morley.*Successful Commodity Futures Trading*. Business Books Ltd., London, 1974.

S., and Donald Watson, Mary A. Holman.*Price Theory and Its Uses*, 4th edition. Houghton Mifflin, Boston, 1977.

K. Howard Waxenberg,"Technical Analysis of Volume." *Technical Analysis of Stocks & Commodities* (March 1986).

Eric. Weiss,"Applying ARIMA Forecasts." *Technical Analysis of Stocks & Commodities* (May 1983).

_____. "ARIMA Forecasting." *Technical Analysis of Stocks & Commodities* (January 1983).

H. F. Weymar,*The Dynamics of the World Cocoa Market*. MIT Press, Cambridge, MA, 1968.

Adam. White,"The Eight-Year Presidential Election Pattern." *Technical Analysis of Stocks & Commodities* (November 1994).

J. Wilder, Jr. Welles,*Chart Trading Workshop 1980*. Trend Research, Greensboro, NC, 1980.

_____. *New Concepts in Technical Trading*, Trend Research, Greensboro, NC, 1978.

Bill. Williams,*Trading Chaos*. Wiley, New York, 1995.

E., and Edward Williams, M. Chapman Findlay III.*Investment Analysis*. Prentice-Hall, Englewood Cliffs, NJ, 1974.

D. J. Williams,*The Complete Strategyst*. McGraw-Hill, New York, 1966.

R. Larry Williams,*How I Made One Million Dollars… Last Year… Trading Commodities*. Conceptual Management, Carmel Valley, CA, 1973.

Larry. Williams,"The Ultimate Oscillator." *Technical Analysis of Stocks & Commodities* (August 1985).

Larry, and Williams, Charles Lindsey.*The Trident System*. Lindsey, O'Brien & Co., Thousand Oaks, CA, 1975. (A report).

Larry, and Williams, Michelle Noseworthy."How Seasonal Influences Can Help You Trade Commodities." *Commodities Magazine* (October 1976).

N. Joseph Winski,"A Sure Thing?" *The Dow Jones Commodities Handbook 1977*. DowJones Books, Princeton, NJ, 1977.

R. John Wolberg,*Expert Trading Systems*. John Wiley & Sons, NY, 2000.

Holbrook. Working,"Test of a Theory Concerning Floor Trading on Commodity Exchanges." *Food Research Institute Studies, Vol. VII: 1967 Supplement*. Stanford University Press, Stanford, 1967.

D. Richard Wyckoff,*The Richard D. Wyckoff Method of Trading and Investing in Stocks*. Wyckoff Associates, Inc., Park Ridge, IL, 1936.

_____. *Stock Market Technique, Number One*. Wyckoff, New York, 1933.

_____. *Wall Street Ventures and Adventures Through Forty Years*. Harper & Brothers, New York, 1930.

C., Kermit Zieg, Jr., and Perry J. Kaufman.*Point and Figure Commodity Trading Techniques*. Investors Intelligence, Larchmont, NY, 1975.

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