CHAPTER 1

The Whats, Whos, and Whys of Quantitative Trading

If you are curious enough to pick up this book, you probably have already heard of quantitative trading. But even for readers who learned about this kind of trading from the mainstream media before, it is worth clearing up some common misconceptions.

Quantitative trading, also known as algorithmic trading, is the trading of securities based strictly on the buy/sell decisions of computer algorithms. The computer algorithms are designed and perhaps programmed by the traders themselves, based on the historical performance of the encoded strategy tested against historical financial data.

Is quantitative trading just a fancy name for technical analysis, then? Granted, a strategy based on technical analysis can be part of a quantitative trading system if it can be fully encoded as computer programs. However, not all technical analysis can be regarded as quantitative trading. For example, certain chartist techniques such as "look for the formation of a head and shoulders pattern" might not be included in a quantitative trader's arsenal because they are quite subjective and may not be quantifiable.

Yet quantitative trading includes more than just technical analysis. Many quantitative trading systems incorporate fundamental data in their inputs: numbers such as revenue, cash flow, debt-to-equity ratio, and others. After all, fundamental data are nothing but

numbers, and computers can certainly crunch any numbers that are fed into them! When it comes to judging the current financial performance of a company compared to its peers or compared to its historical performance, the computer is often just as good as human financial analysts—and the computer can watch thousands of such companies all at once. Some advanced quantitative systems can even incorporate news events as inputs: Nowadays, it is possible to use a computer to parse and understand the news report. (After all, I used to be a researcher in this very field at IBM, working on computer systems that can understand approximately what a document is about.)

So you get the picture: As long as you can convert information into bits and bytes that the computer can understand, it can be regarded as part of quantitative trading.

WHO CAN BECOME A QUANTITATIVE TRADER?

It is true that most institutional quantitative traders received their advanced degrees as physicists, mathematicians, engineers, or computer scientists. This kind of training in the hard sciences is often necessary when you want to analyze or trade complex derivative instruments. But those instruments are not the focus in this book. There is no law stating that one can become wealthy only by working with complicated financial instruments. (In fact, one can become quite poor trading complex mortgage-backed securities, as the financial crisis of 2007–08 and the demise of Bear Stearns have shown.) The kind of quantitative trading I focus on is called *statistical arbitrage trading*. Statistical arbitrage deals with the simplest financial instruments: stocks, futures, and sometimes currencies. One does *not* need an advanced degree to become a statistical arbitrage trader. If you have taken a few high school–level courses in math, statistics, computer programming, or economics, you are probably as qualified as anyone to tackle some of the basic statistical arbitrage strategies.

Okay, you say, you don't need an advanced degree, but surely it gives you an edge in statistical arbitrage trading? Not necessarily. I received a PhD from one of the top physics departments of the world (Cornell's). I worked as a successful researcher in one of the top computer science research groups in the world (at that temple of high-techdom: IBM's T. J. Watson Research Center). Then I worked in a string of top investment banks and hedge funds as a researcher and finally trader, including Morgan Stanley, Credit Suisse, and so on. As a researcher and trader in these august institutions, I had always strived to use some of the advanced mathematical techniques and training that I possessed and applied them to statistical arbitrage trading. Hundreds of millions of dollars of trades later, what was the result? Losses, more losses, and losses as far as the eye can see, for my employers and their investors. Finally, I quit the financial industry in frustration, set up a spare bedroom in my home as my trading office, and started to trade the simplest but still quantitative strategies I know. These are strategies that any smart high school student can easily research and execute. For the first time in my life, my trading strategies became profitable (one of which is described in Example 3.6), and has been the case ever since. The lesson I learned? As Einstein said: "Make everything as simple as possible." But not simpler.

(Stay tuned: I will detail more reasons why independent traders can beat institutional money managers at their own game in Chapter 8.)

Though I became a quantitative trader through a fairly traditional path, many others didn't. Who are the typical independent quantitative traders? Among people I know, they include a former trader at a hedge fund that has gone out of business, a computer programmer who used to work for a brokerage, a former trader at one of the exchanges, a former investment banker, a former biochemist, and an architect. Some of them have received advanced technical training, but others have only basic familiarity of high school–level statistics. Most of them backtest their strategies using basic tools like Excel, though others may hire programming contractors to help. Most of them have at some point in their career been professionally involved with the financial world but have now decided that being

independent suits their needs better. As far as I know, most of them are doing quite well on their own, while enjoying the enormous freedom that independence brings.

Besides having gained some knowledge of finance through their former jobs, the fact that these traders have saved up a nest egg for their independent venture is obviously important too. When one plunges into independent trading, fear of losses and of being isolated from the rest of the world is natural, and so it helps to have both a prior appreciation of risks and some savings to lean on. It is important not to have a need for immediate profits to sustain your daily living, as strategies have intrinsic rates of returns that cannot be hurried (see Chapter 6).

Instead of fear, some of you are planning to trade because of the love of thrill and danger, or an incredible self-confidence that instant wealth is imminent. This is also a dangerous emotion to bring to independent quantitative trading. As I hope to persuade you in this chapter and in the rest of the book, instant wealth is not the objective of quantitative trading.

The ideal independent quantitative trader is therefore someone who has some prior experience with finance or computer programming, who has enough savings to withstand the inevitable losses and periods without income, and whose emotion has found the right balance between fear and greed.

THE BUSINESS CASE FOR QUANTITATIVE TRADING

A lot of us are in the business of quantitative trading because it is exciting, intellectually stimulating, financially rewarding, or perhaps it is the only thing we are good at doing. But for others who may have alternative skills and opportunities, it is worth pondering whether quantitative trading is the best business for you.

Despite all the talk about untold hedge fund riches and dollars that are measured in units of billions, in many ways starting a quantitative trading business is very similar to starting any small business. We need to start small, with limited investment (perhaps

only a $50,000 initial investment), and gradually scale up the business as we gain know-how and become profitable.

In other ways, however, a quantitative trading business is very different from other small businesses. Here are some of the most important.

Scalability

Compared to most small businesses (other than certain dot-coms), quantitative trading is very scalable (up to a point). It is easy to find yourselves trading millions of dollars in the comfort of your own home, as long as your strategy is consistently profitable. This is because scaling up often just means changing a number in your program. This number is called *leverage.* You do not need to negotiate with a banker or a venture capitalist to borrow more capital for your business. The brokerages stand ready and willing to do that. If you are a member of a proprietary trading firm (more on this later in Chapter 4 on setting up a business), you may even be able to obtain a leverage far exceeding that allowed by Securities and Exchange Commission (SEC) Regulation T. It is not unheard of for a proprietary trading firm to let you trade a portfolio worth $2 million intraday even if you have only $50,000 equity in your account (a $\times 40$ leverage). At the same time, quantitative trading is definitely not a get-rich-quick scheme. You should hope to have steadily increasing profits, but most likely it won't be 200 percent a year, unlike starting a dot-com or a software firm. In fact, as I will explain in Chapter 6 on money and risk management, it is dangerous to overleverage in pursuit of overnight riches.

Demand on Time

Running most small businesses takes a lot of your time, at least initially. Quantitative trading takes relatively little of your time. By its very nature, quantitative trading is a highly automated business. Sometimes, the more you manually interfere with the system and override its decision, the worse it will perform. (Again, more on this in Chapter 6.)

How much time you need to spend on day-to-day quantitative trading depends very much on the degree of automation you have achieved. For example, at a hedge fund I used to work for, some colleagues come into the office only once a month. The rest of the time, they just sit at home and occasionally remotely monitor their office computers, which are trading for them.

I consider myself to be in the middle of the pack in terms of automation. The largest block of time I need to spend is in the morning before the market opens: I typically need to run various programs to download and process the latest historical data, read company news that comes up on my alert screen, run programs to generate the orders for the day, and then launch a few baskets of orders before the market opens and start a program that will launch orders automatically throughout the day. I would also update my spreadsheet to record the previous day's profit and loss (P&L) of the different strategies I run based on the brokerages' statements. All of this takes about two hours.

After that, I spend another half hour near the market close to direct the programs to exit various positions, manually checking that those exit orders are correctly transmitted, and closing down various automated programs properly.

In between market open and close, everything is supposed to be on autopilot. Alas, the spirit is willing but the flesh is weak: I often cannot resist the urge to take a look (sometimes many looks) at the intraday P&L of the various strategies on my trading screens. In extreme situations, I might even be transfixed by the huge swings in P&L and be tempted to intervene by manually exiting positions. Fortunately, I have learned to better resist the temptation as time goes on.

The urge to intervene manually is also strong when I have too much time on my hands. Hence, instead of just staring at your trading screen, it is actually important to engage yourself in some other, more healthful and enjoyable activities, such as going to the gym during the trading day.

When I said quantitative trading takes little of your time, I am referring to the operational side of the business. If you want to grow your business, or keep your current profits from declining due to

increasing competition, you will need to spend time doing research and backtesting on new strategies. But research and development of new strategies is the creative part of any business, and it can be done whenever you want to. So, between the market's open and close, I do my research; answer e-mails; chat with other traders, collaborators, or clients; go to the gym; and so on. I do some of that work in the evening and on weekends, too, but only when I feel like it—not because I am obligated to.

When I generate more earnings, I will devote more software development resources to further automate my process, so that the programs can automatically start themselves up at the right time, know how to download data automatically, maybe even know how to interpret the news items that come across the newswire and take appropriate actions, and shut themselves down automatically after the market closes. When that day comes, the daily operation may take no time at all, and it can run as it normally does even while I am on vacation, as long as it can alert my mobile phone or a technical support service when something goes wrong. In short, if you treasure your leisure time or if you need time and financial resources to explore other businesses, quantitative trading is the business for you.

The Nonnecessity of Marketing

Here is the biggest and most obvious difference between quantitative trading and other small businesses. Marketing is crucial to most small businesses—after all, you generate your revenue from other people, who base their purchase decisions on things other than price alone. In trading, your counterparties in the financial marketplace base their purchase decisions on *nothing but* the price. Unless you are managing money for other people (which is beyond the scope of this book), there is absolutely no marketing to do in a quantitative trading business. This may seem obvious and trivial but is actually an important difference, since the business of quantitative trading allows you to focus exclusively on your product (the strategy and the software), and not on anything that has to do with influencing other people's perception of yourself. To many people, this may

be the ultimate beauty of starting your own quantitative trading business.

THE WAY FORWARD

If you are convinced that you want to become a quantitative trader, a number of questions immediately follow: How do you find the right strategy to trade? How do you recognize a good versus a bad strategy even before devoting any time to backtesting them? How do you rigorously backtest them? If the backtest performance is good, what steps do you need to take to implement the strategy, in terms of both the business structure and the technological infrastructure? If the strategy is profitable in initial real-life trading, how does one scale up the capital to make it into a growing income stream while managing the inevitable (but, hopefully, only occasional) losses that come with trading? These nuts and bolts of quantitative trading will be tackled in Chapters 2 through 6.

Though the list of processes to go through in order to get to the final destination of sustained and growing profitability may seem long and daunting, in reality it may be faster and easier than many other businesses. When I first started as an independent trader, it took me only three months to find and backtest my first new strategy, set up a new brokerage account with $100,000 capital, implement the execution system, and start trading the strategy. The strategy immediately became profitable in the first month. Back in the dot-com era, I started an Internet software firm. It took about 3 times more investment, 5 times more human-power, and 24 times longer to find out that the business model didn't work, whereupon all investors including myself lost 100 percent of their investments. Compared to that experience, it really has been a breeze trading quantitatively and profitably.