

Trading Strategies & Asset Types

Objectives:

- Students will be able to identify the considerations involved in Trend Following.
 - Students will be able to explain how statistical arbitrage relates to mean reversion in trading.
 - Students will become familiar with the Quant Crash of 2007.
 - Students will become familiar with the different types of assets discussed in this lesson.
 - Students will be able to describe the different types of alternative investments.
-

Trading Strategies

Trend Following

Trend following is an investment or trading strategy which tries to take advantage of long, medium or short-term moves that seem to play out in various markets. Traders who employ a trend following strategy do not aim to forecast or predict specific price levels; they simply jump on the trend (when they perceived that a trend has established with their own particular reasons or rules) and ride it. These traders normally enter in the market after the trend "properly" establishes itself, betting that the trend will persist for a long time, and for this reason they forego the initial turning point profit. A market "trend" is a tendency of a financial market price to move in a particular direction over time. If there is a turn contrary to the trend, they exit and wait until the turn establishes itself as a trend in the opposite direction. In case their rules signal an exit, the traders exit but re-enter when the trend re-establishes. Cutting Loss. Exit market when market turn against them to minimize losses, and "let the profits run", when the market trend goes as

expected until the market exhausted and reverses to book profit. This trading or "betting with positive edge" method involves a risk management component that uses three elements: number of shares or futures held, the current market price, and current market volatility. An initial risk rule determines position size at time of entry. Exactly how much to buy or sell is based on the size of the trading account and the volatility of the issue. Changes in price may lead to a gradual reduction or an increase of the initial trade. On the other hand, adverse price movements may lead to an exit from the entire trade.

The key reasons for trending markets are a number of behavioral biases that cause market participants to over-react: Herding: After markets have trended, some traders jump on the bandwagon, and thus prolonging the herding effect and trends. Confirmation Bias: People tend to look for information that confirm their views and beliefs. This can lead investors to buy assets that have recently made money, and sell assets that have declined, causing trends to continue. Risk Management: Some risk-management models will sell in down markets as, for example, some risk budgets have been breached, and buy in up markets as new risk budgets have been unlocked, causing trends to persist. "Don't fight the tape" is a term that means do not bet or trade against the trend in the financial markets, i.e., if the broad market is moving up, do not bet on a downward move. The term "tape" refers to the ticker tape used to transmit the price of stocks. It is analogous to the trader's maxim, "The trend is your friend."

Considerations

- **Price:** One of the first rules of trend following is that the price is the main concern. Traders may use other indicators showing where the price may go next or what it should be but, as a general rule, these should be disregarded. A trader needs only to be worried what the market is doing, no what it might do. The current price and only the

price tells what the market is doing.

- **Money Management:** Instead of the timing of the trade or the indicator, the decision of how much to trade over the course of the trend.
- **Risk Control:** Cut losses is the rule. Meaning that during periods of market volatility, the trading size is reduced. During losing periods, positions are reduced and trade size is cut back. The main objective is to preserve capital until more positive price trends reappear.
 - **Rules:** Trend following should be systematic. Price and time are pivotal at times. This technique is not based on an analysis of fundamental supply and demand factors.
- **Diversification:** Research published by hedge fund manager, Andrew Clenow, shows that cross asset diversification is an essential part of professional trend following.

Mean Reversion

Mean reversion is the assumption that an asset's price will tend to converge to the average price over time. This is a timing strategy involving both the identification of the trading range for a security and the computation of the average price using quantitative methods. It is a phenomenon that can be exhibited in a host of financial time-series data, from price data, earnings data, and book value.

When the current market price is less than the average past price, the security is considered attractive for purchase, with the expectation that the price will rise. When the current market price is above the average past price, the market price is expected to fall. In simpler terms, deviations from the average price are expected to revert to the average.

Stock reporting services commonly offer moving averages for periods such as 50 and 100 days. While reporting services provide the averages, identifying the high and low prices for the study period is still necessary.

Mean reversion has the appearance of a more scientific method of choosing stock buy and sell points than charting, because precise numerical values are derived from historical data to identify the buy/sell values, rather than trying to interpret price movements using charts (charting, also known as technical analysis) although the RSI indicator and Average True Range (ATR) are nascent attempts to capture such systematic pattern.

Many asset classes, even exchange rates, are observed to be mean reverting; however, this process may last for years and thus is not of value to a short-term investor.

Mean reversion should demonstrate a form of symmetry since a stock may be above its historical average approximately as often as below.

Statistical Arbitrage (*Stat Arb* or *StatArb*)

A class of short-term financial trading strategies that employ [mean reversion](#) models involving broadly diversified portfolios of securities (hundreds to thousands) held for short periods of time (generally seconds to days). These strategies are supported by substantial mathematical, computational, and trading platforms.

StatArb is a strategy that is bottom-up, beta-neutral in approach and uses statistical/econometric techniques to provide signals for execution. Signals are generated through a contrarian mean reversion principle but can also be designed using factors such as lead/lag effects and corporate activity.

StatArb evolved out of the simpler pairs trade, in which stocks are put into pairs by fundamental or market-based similarities. When one stock in a pair outperforms the other, the under performing stock is bought long and the outperforming stock is sold short. Many bank proprietary operations now center to varying degrees around statistical arbitrage trading.

StatArb is an attempt to find stocks with high correlation, cointegration, or

other common factor characteristics. Portfolio construction is automated and consists of two phases. Each stock in the market is assigned a numeric score or rank that reflects its desirability. High scores indicate stocks that should be held long and low scores candidates for shorting.

Statistical arbitrage is also subject to model weakness as well as stock- or security-specific risk. Factors which the model may not be aware of having exposure to could become significant drivers of price action. Risk of M&A activity or even default for an individual name.

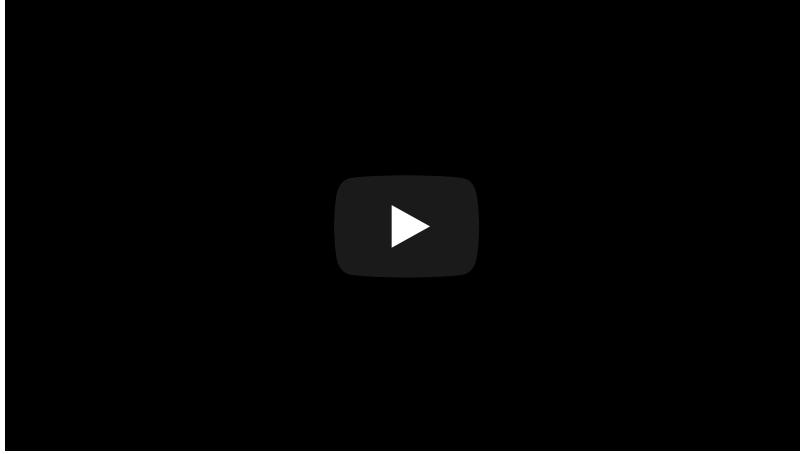
Quant Crash of 2007

During the summer of 2007, a number of StatArb (and other Quant type) hedge funds experienced significant losses at the same time. There have been no exact reasons of why this occurred, several published accounts blame the emergency liquidation of a fund that experienced capital withdrawals or margin calls. By closing out its positions quickly, the fund put pressure on the prices of the stocks. Because other StatArb funds had similar positions, due to the similarity of their alpha models and risk-reduction models, the other funds experienced adverse returns. One of the versions of the events describes how Morgan Stanley's highly successful StatArb fund, PDT, decided to reduce its positions in response to stresses in other parts of the firm, and how this contributed to several days of hectic trading.

StatArb has developed to a point where it is a significant factor in the marketplace, that existing funds have similar positions and are in effect competing for the same returns. Simulations of simple StatArb strategies by Khandani and Lo show that the returns to such strategies have been reduced considerably from 1998 to 2007. These events during August 2007 were linked to reduction of liquidity, possibly due to risk reduction by high-frequency market makers.

Machine Learning and Data Science

For further reading regarding Data Science and Machine Learning in trading check out [Performance analysis of predictive \(alpha\) stock factors](#) and [Advances in Financial Machine Learning](#)



Designated Market Maker

A designated market maker (DMM) is a market maker responsible for maintaining fair and orderly markets for an assigned set of listed stocks. Formerly known as specialists, the designated market maker is the official market maker for a set of tickers and, in order to maintain liquidity in these assigned stocks, will take the other side of trades when buying and selling imbalances occur. The DMM also serves as a point of contact on the trading floor for the listed company, and provides the company with information, such as the general market conditions, the mood of traders, and who is trading the stock.

- A designated market maker is one that has been selected by the exchange as the primary market maker for a given security.
- A DMM is responsible for maintaining quotes and facilitating buy and sell transactions.
- Market makers are sometimes making markets for several hundred of listed stocks at a time.
- Designated Market Makers on NYSE were previously known as specialists.
- DMMs provide a higher level of service compared to electronic trading.

Predatory Trading

Momentum Ignition

Asset Types

Bonds and Why They Trade OTC...

Bonds primarily trade OTC because of three reasons:

- First, there is a very large population of debt securities compared with equities. For example, there are 6,810 shares admitted to trading on regulated markets in the EU on 22 July 2009 whereas Xtrakter's CUPID database contains information on over 150,000 debt securities in issue. Therefore, debt markets are far less concentrated than equity markets.
- Second, the average size of a bond trade tends to be substantially greater than for an equity trade. Xtrakter data indicates that average bond trade sizes are between €1m and €2m while trades in excess of €2m - €5m are common. Prior to the crisis, even trades of €100m or more were not uncommon. The average trade size for equities on the London Stock Exchange, on the other hand, is in the region of £43,000 and European legislation defines the typical retail trade in equities as €7500 or less.
- Third, unlike equities almost all bonds trade very infrequently so there is rarely a constant supply of buyers and sellers looking to trade sufficient to sustain a central pool of investor provided liquidity. Only 3,000 of the top bonds (by volume) traded at least once a day on average. Of the top 100 bonds by volume traded the highest trade count bond traded 10,000 times in the year whilst others traded only 6 times in the year. This contrasts significantly to liquidity in the equity market. Under MiFID a share is considered to be liquid if it is traded daily, with a free float of less than EUR 500 million, and either the average daily number of transactions in the share is not less than 500 or the average daily turnover for the share is not less than EUR 2 million.

Therefore, unlike equity markets there is seldom a continuous two-way market of buyers and sellers whereby a minor change in price by one or the other can result in a trade. Instead, liquidity is provided by dealers who operate in two ways. First they put their own capital at risk by, for example, buying bonds from an investor even if they do not have a buyer to whom

they can sell-on the bonds. They take the risk that in due course they will find a buyer to whom they can sell the bonds at a profit. Second, they take an order e.g. from a client who wants to buy a quantity of a particular bond and will search the market for an investor who is prepared to sell the bonds. The dealer will then seek to negotiate a price with the buyer and then seller which satisfies both clients and which enables the dealer to make a profit from the difference between the price he charges the seller and the price he charges the buyer.

Spot Markets

The spot market is where financial instruments, such as commodities, currencies, and securities, are traded for immediate delivery. Delivery is the exchange of cash for the financial instrument. A futures contract, on the other hand, is based on the delivery of the underlying asset at a future date.

Exchanges and over-the-counter (OTC) markets may provide spot trading and/or futures trading.

- Financial instruments trade for immediate delivery in the spot market.
- Many assets quote a "spot price" and a "futures or forward price."
- Most spot market transactions have a T+2 settlement date.
- Spot market transactions can take place on an exchange or over-the-counter (OTC).
- Spot markets can be contrasted with derivatives markets that instead trade in forwards, futures, or options contracts.

Understanding Contract for Differences

CFDs allow traders to trade in the price movement of securities and derivatives. Derivatives are financial investments that are derived from an underlying asset. Essentially, CFDs are used by investors to make price bets as to whether the price of the underlying asset or security will rise or fall.

CFD traders may bet on the price moving up or downward. Traders who expect an upward movement in price will buy the CFD, while those who see the opposite downward movement will sell an opening position.

Should the buyer of a CFD see the asset's price rise, they will offer their holding for sale. The net difference between the purchase price and the sale price are netted together. The net difference representing the gain or loss from the trades is settled through the investor's brokerage account.

Conversely, if a trader believes a security's price will decline, an opening sell position can be placed. To close the position they must purchase an offsetting trade. Again, the net difference of the gain or loss is cash-settled through their account.

Transacting in CFDs

Contracts for differences can be used to trade many assets and securities including exchange-traded funds (ETFs). Traders will also use these products to speculate on the price moves in commodity futures

contracts such as those for crude oil and corn. Futures contracts are standardized agreements or contracts with obligations to buy or sell a particular asset at a preset price with a future expiration date.

Although CFDs allow investors to trade the price movements of futures, they are not futures contracts by themselves. CFDs do not have expiration dates containing preset prices but trade like other securities with buy and sell prices.

CFDs trade over-the-counter (OTC) through a network of brokers that organize the market demand and supply for CFDs and make prices accordingly. In other words, CFDs are not traded on major exchanges such as the New York Stock Exchange (NYSE). The CFD is a tradable contract between a client and the broker, who are exchanging the difference in the initial price of the trade and its value when the trade is unwound or reversed.

Advantages of a CFD

CFDs provide traders with all of the benefits and risks of owning a security without actually owning it or having to take any physical delivery of the asset.

CFDs are traded on margin meaning the broker allows investors to borrow money to increase leverage or the size of the position to amplify gains. Brokers will require traders to maintain specific account balances before they allow this type of transaction.

Trading on margin CFDs typically provides higher leverage than traditional trading. Standard leverage in the CFD market can be as low as a 2% margin requirement and as high as a 20% margin. Lower margin requirements mean less capital outlay and greater potential returns for the trader.

Typically, fewer rules and regulations surround the CFD market as compared to standard exchanges. As a result, CFDs can have lower capital requirements or cash required in a brokerage account. Often, traders can

open an account for as little as \$1,000 with a broker. Also, since CFDs mirror corporate actions taking place, a CFD owner can receive cash dividends increasing the trader's return on investment. Most CFD brokers offer products in all major markets worldwide. Traders have easy access to any market that is open from the broker's platform.

CFDs allow investors to easily take a long or short position or a buy and sell position. The CFD market typically does not have short-selling rules. An instrument may be shorted at any time. Since there is no ownership of the underlying asset, there is no borrowing or shorting cost. Also, few or no fees are charged for trading a CFD. Brokers make money from the trader paying the spread meaning the trader pays the ask price when buying, and takes the bid price when selling or shorting. The brokers take a piece or spread on each bid and ask price that they quote.

Disadvantages of a CFD

If the underlying asset experiences extreme volatility or price fluctuations, the spread on the bid and ask prices can be significant. Paying a large spread on entries and exits prevents profiting from small moves in CFDs decreasing the number of winning trades while increasing losses.

Since the CFD industry is not highly regulated, the broker's credibility is based on its reputation and financial viability. As a result, CFDs are not available in the United States.

Since CFDs trade using leverage, investors holding a losing position can get a margin call from their broker, which requires additional funds to be deposited to balance out the losing position. Although leverage can amplify gains with CFDs, leverage can also magnify losses and traders are at risk of losing 100% of their investment. Also, if money is borrowed from a broker to trade, the trader will be charged a daily interest rate amount.

Futures

Futures are derivative financial contracts that obligate the parties to transact an asset at a predetermined future date and price. The buyer must purchase or the seller must sell the underlying asset at the set price, regardless of the current market price at the expiration date. Underlying assets include physical commodities or other financial instruments. Futures contracts detail the quantity of the underlying asset and are standardized to facilitate trading on a futures exchange. Futures can be used for hedging or trade speculation.

Understanding Futures

Futures—also called futures contracts—allow traders to lock in the price of the underlying asset or commodity. These contracts have expiration dates and set prices that are known upfront. Futures are identified by their expiration month. For example, a December gold futures contract expires in December.

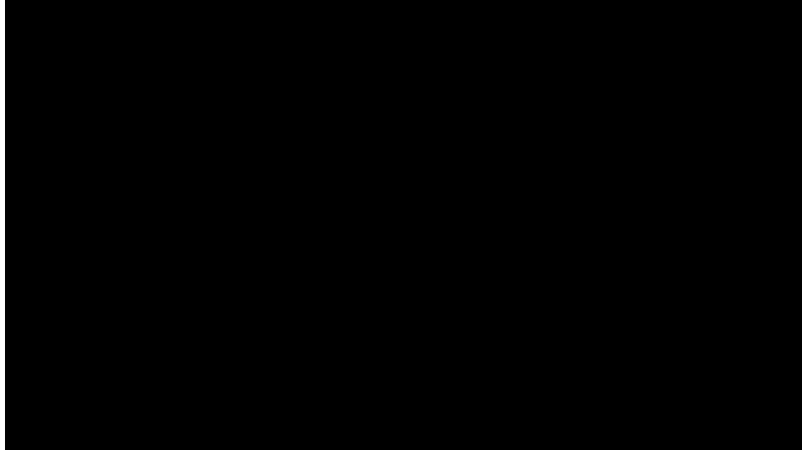
Traders and investors use the term "futures" in reference to the overall asset class. However, there are many types of futures contracts available for trading including:¹

- Commodity futures such as crude oil, natural gas, corn, and wheat
- Stock index futures such as the S&P 500 Index
- Currency futures including those for the euro and the British pound
- Precious metal futures for gold and silver
- U.S. Treasury futures for bonds and other products

It's important to note the distinction between options and futures. American-style options contracts give the holder the right (but not the obligation) to buy or sell the underlying asset any time before the expiration date of the contract; with European options, you can only exercise at expiration but do not have to exercise that right.²

The buyer of a futures contract, on the other hand, is obligated to take

possession of the underlying commodity (or the cash equivalent) at the time of expiration and not any time before. The buyer of a futures contract can sell their position at any time before expiration and be free of their obligation. In this way, buyers of both options and futures contracts benefit from a leverage holder's position closing before the expiration date.



Options

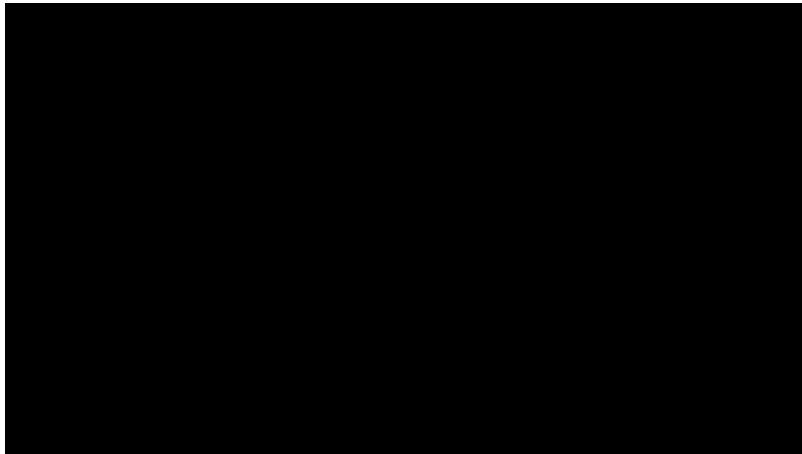
Options are conditional derivative contracts that allow buyers of the contracts (option holders) to buy or sell a security at a chosen price. Option buyers are charged an amount called a "premium" by the sellers for such a right. Should market prices be unfavorable for option holders, they will let the option expire worthless, thus ensuring the losses are not higher than the premium. In contrast, option sellers (option writers) assume greater risk than the option buyers, which is why they demand this premium.

Options are divided into "call" and "put" options. With a call option, the buyer of the contract purchases the right to *buy* the underlying asset in the future at a predetermined price, called exercise price or strike price. With a put option, the buyer acquires the right to *sell* the underlying asset in the future at the predetermined price.

Why Trade Options Rather Than a Direct Asset?

There are some advantages to trading options. The Chicago Board of

Options Exchange (CBOE) is the largest such exchange in the world, offering options on a wide variety of single stocks, ETFs and indexes. Traders can construct option strategies ranging from buying or selling a single option to very complex ones that involve multiple simultaneous option positions.



Alternative Investing

An alternative investment is a financial asset that does not fall into one of the conventional investment categories. Conventional categories include stocks, bonds, and cash. Alternative investments include private equity or venture capital, hedge funds, managed futures, art and antiques, commodities, and derivatives contracts. Real estate is also often classified as an alternative investment.

Most alternative investment assets are held by institutional investors or accredited, high-net-worth individuals because of their complex nature, lack of regulation, and degree of risk. Many alternative investments have high minimum investments and fee structures, especially when compared to mutual funds and exchange-traded funds (ETFs). These investments also have less opportunity to publish verifiable performance data and advertise to potential investors. Although alternative assets may have high initial minimums and upfront investment fees, transaction costs are typically lower than those of conventional assets, due to lower levels of turnover.

Most alternative assets are fairly illiquid, especially compared to their

conventional counterparts. For example, investors are likely to find it considerably more difficult to sell an 80-year old bottle of wine compared to 1,000 shares of Apple Inc., due to a limited number of buyers. Investors may have difficulty even valuing alternative investments, since the assets, and transactions involving them, are often rare. For example, a seller of a 1933 Saint-Gaudens Double Eagle \$20 gold coin may have difficulty determining its value, as there are only 13 known to exist.

Regulation of Alternative Investments

Even when they don't involve unique items like coins or art, alternative investments are prone to investment scams and fraud due to the lack of regulations.

Alternative investments are often subject to a less clear legal structure than conventional investments. They do fall under the purview of the Dodd-Frank Wall Street Reform and Consumer Protection Act, and their practices are subject to examination by the Securities and Exchange Commission (SEC). However, they usually don't have to register with the SEC. As such, they are not overseen or regulated by the SEC or the Financial Services Regulatory Commission as are mutual funds and ETFs.

So, it is essential that investors conduct extensive due diligence when considering alternative investments. In some cases, only accredited investors may invest in alternative offerings. Accredited investors are those with a net worth exceeding \$1 million—not counting their primary residence—or with an annual income of at least \$200,000.

Crypto Trading

What are crypto exchanges and how do you select one?

Crypto trading (trading of cryptocurrency) happens primarily on crypto exchanges which digital marketplaces where you can buy and trade crypto.

You currently cannot buy crypto from your personal bank or investment firm. Once you have decided you want to buy some Bitcoin, Ethereum, or some other cryptocurrency, you will need to create an account on a crypto trading platform to exchange your local currency (e.g. SAR) for digital assets.

Some exchanges, such as Coinbase, have been around since the early days of Bitcoin when there was far less supervision or even concern into how cryptocurrencies were bought, sold, and traded. Others, like PayPal and Robinhood, are better-known for other services, and have only recently allowed customers to trade cryptocurrencies.

Below are just a few of the considerations you need to make when selecting the best cryptocurrency exchange for you:

- **security** some exchanges offer insurance policies to protect their customers from hacking and fraud. For example, Coinbase offers an insurance policy worth \$255 million USD.
- **accessibility** is the exchange even available in your region or country? For example, China has outlawed crypto exchanges altogether. The link

below has some information about popular crypto exchanges in Saudi Arabia:

Popular KSA Crypto Exchanges

- **coins offered** the bottom line here is that not every crypto exchange offers every coin. So if you are looking to buy anything other than Bitcoin or Ethereum, make sure the exchange you are considering supports the coin you are considering purchasing.
- **transaction fees** you need to do your homework on this one because higher fees are not necessarily a bad thing - as higher fees are typically assessed if the exchange makes it easier for you to purchase cryptocurrency.

What are the differences between crypto exchanges and traditional exchanges?

Below are some of the basic differences between traditional exchanges and crypto exchanges:

- Crypto exchanges typically offer several services including order matching, account verification, and transaction processing while traditional exchanges typically offer only one service - carrying out trades through an order matching service
- Crypto exchanges typically offer their APIs for free while traditional exchanges typically charge for access to their APIs
- Traditional financial exchanges still often rely on massive physical data centers where crypto exchanges rely almost exclusively on the cloud

Analysis: Technical, Fundamental & Sentiment

Objectives:

- Students will be able to differentiate the differences amongst technical analysis, fundamental analysis and sentiment analysis.
 - Students will be able to describe the technical indicators associated with the technical analysis.
 - Students will be able to discuss the importance of the LOB (limit order book).
 - Students will be able to explain what tools are used for functional analysis.
 - Students will be able to explain how sentiment analysis is used for predicting stock prices.
-

Technical Analysis

Technical analysis is a tool, or method, used to predict the probable future price movement of a security – such as a stock or currency pair – based on market data.

The theory behind the validity of technical analysis is the notion that the collective actions – buying and selling – of all the participants in the market accurately reflect all relevant information pertaining to a traded security, and therefore, continually assign a fair market value to the security.

Technical traders believe that current or past price action in the market is the most reliable indicator of future price action.

Technical analysis is not only used by technical traders. Many fundamental traders use fundamental analysis to determine whether to buy into a market,

but having made that decision, then use technical analysis to pinpoint good, low-risk buy entry price levels.

Technical traders analyze price charts to attempt to predict price movement. The two primary variables for technical analysis are the time frames considered and the particular technical indicators that a trader chooses to utilize.

The technical analysis time frames shown on charts range from one-minute to monthly, or even yearly, time spans. Popular time frames that technical analysts most frequently examine include:

- 5-minute chart
- 15-minute chart
- Hourly chart
- 4-hour chart
- Daily chart

The time frame a trader selects to study is typically determined by that individual trader's personal trading style. Intra-day traders, traders who open and close trading positions within a single trading day, favor analyzing price movement on shorter time frame charts, such as the 5-minute or 15-minute charts. Long-term traders who hold market positions overnight and for long periods of time are more inclined to analyze markets using hourly, 4-hour, daily, or even weekly charts.

Price movement that occurs within a 15-minute time span may be very significant for an intra-day trader who is looking for an opportunity to realize a profit from price fluctuations occurring during one trading day. However, that same price movement viewed on a daily or weekly chart may not be particularly significant or indicative for long-term trading purposes.

It's simple to illustrate this by viewing the same price action on different time frame charts. The following daily chart for silver shows price trading within

the same range, from roughly \$16 to \$18.50, that it's been in for the past several months. A long-term silver investor might be inclined to look to buy silver based on the fact that the price is fairly near the low of that range.



However, the same price action viewed on an hourly chart (below) shows a steady downtrend that has accelerated somewhat just within the past several hours. A silver investor interested only in making an intra-day trade would likely shy away from buying the precious metal based on the hourly chart price action.

Technical Indicators - Moving Averages

In addition to studying candlestick formations, technical traders can draw from a virtually endless supply of technical indicators to assist them in making trading decisions.

Moving averages are probably the single most widely-used technical indicator. Many trading strategies utilize one or more moving averages. A simple moving average trading strategy might be something like, "Buy as long as price remains above the 50-period exponential moving average (EMA); Sell as long as price remains below the 50 EMA".

Moving average crossovers are another frequently employed technical indicator. A crossover trading strategy might be to buy when the 10-period moving average crosses above the 50-period moving average.

The higher a moving average number is, the more significant price movement in relation to it is considered. For example, price crossing above or below a 100- or 200-period moving average is usually considered much more significant than price moving above or below a 5-period moving average.

Technical Indicators - Pivots and Fibonacci Numbers

Daily pivot point indicators, which usually also identify several support and resistance levels in addition to the pivot point, are used by many traders to identify price levels for entering or closing out trades. Pivot point levels often mark significant support or resistance levels or the levels where trading is contained within a range. If trading soars (or plummets) through the daily pivot and all the associated support or resistance levels, this is interpreted by many traders as "breakout" trading that will shift market prices substantially higher or lower, in the direction of the breakout.

Daily pivot points and their corresponding support and resistance levels are calculated using the previous trading day's high, low, opening and closing prices. I'd show you the calculation, but there's really no need, as pivot point levels are widely published each trading day and there are pivot point indicators you can just load on a chart that do the calculations for you and reveal pivot levels. Most pivot point indicators show the daily pivot point along with three support levels below the pivot point and three price

resistance levels above it.

Technical Indicators - Momentum Indicators

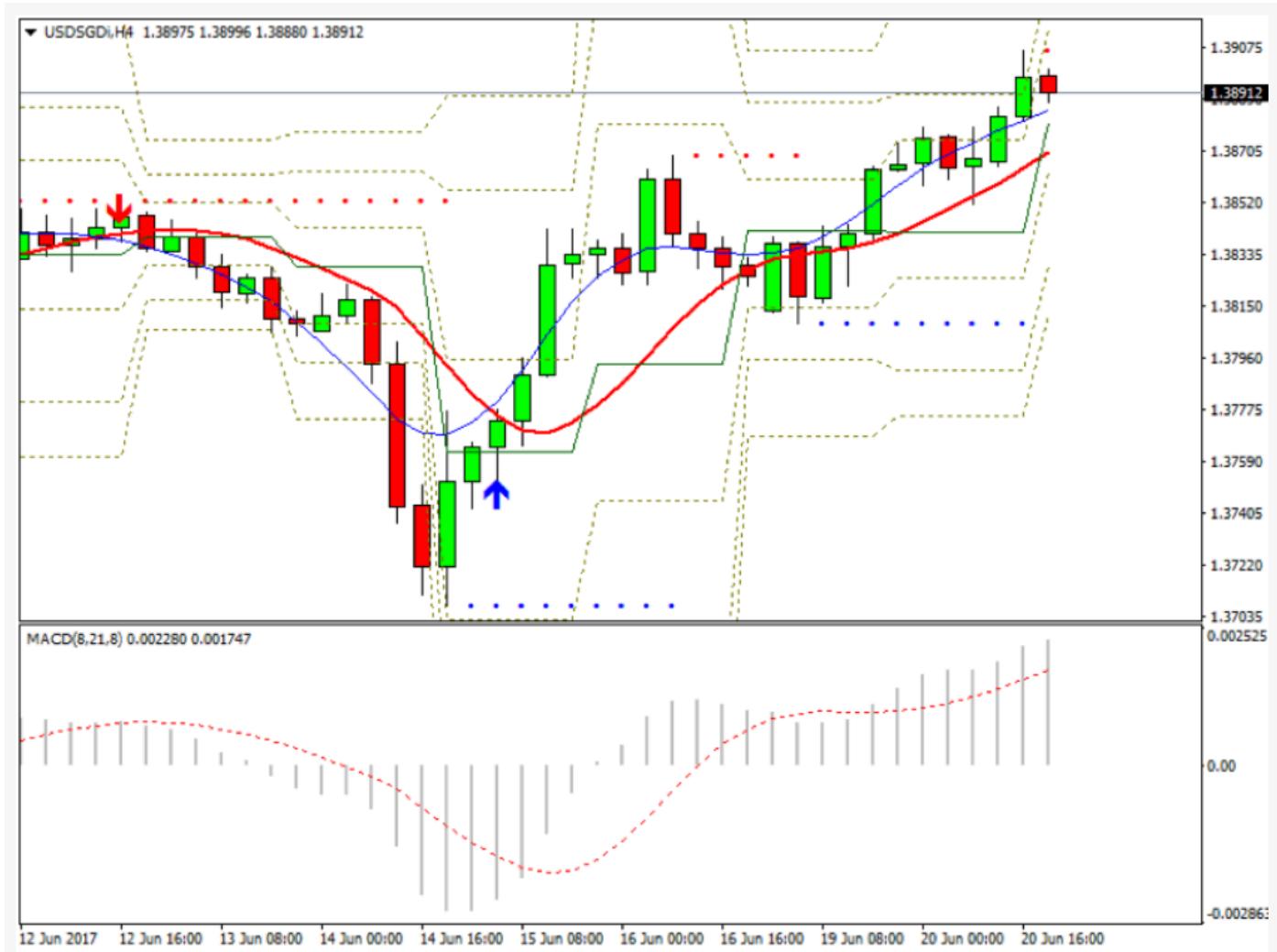
Moving averages and most other technical indicators are primarily focused on determining likely market direction, up or down.

There is another class of technical indicators, however, whose main purpose is not so much to determine market *direction* as to determine market *strength*. These indicators include such popular tools as the Stochastic Oscillator, the Relative Strength Index (RSI), the Moving Average Convergence-Divergence (MACD) indicator, and the Average Directional Movement Index (ADX).

By measuring the strength of price movement, momentum indicators help investors determine whether current price movement more likely represents relatively insignificant, range-bound trading or an actual, significant trend. Because momentum indicators measure trend strength, they can serve as early warning signals that a trend is coming to an end. For example, if a security has been trading in a strong, sustained uptrend for several months, but then one or more momentum indicators signals the trend steadily losing strength, it may be time to think about taking profits.

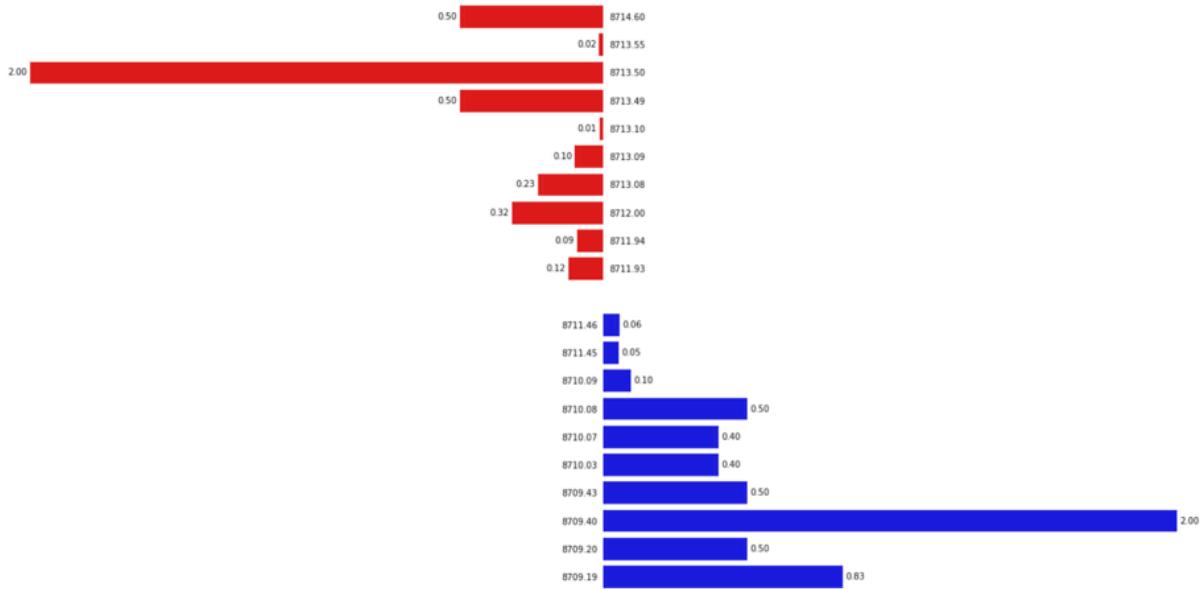
The 4-hour chart of USD/SGD below illustrates the value of a momentum indicator. The MACD indicator appears in a separate window below the main chart window. The sharp upturn in the MACD beginning around June 14th indicates that the corresponding upsurge in price is a strong, trending move rather than just a temporary correction. When price begins to retrace downward somewhat on the 16th, the MACD shows weaker price action, indicating that the downward movement in price does not have much strength behind it. Soon after that, a strong uptrend resumes. In this instance, the MACD would have helped provide reassurance to a buyer of the market that (A) the turn to the upside was a significant price move and (B) that the uptrend was likely to resume after price dipped slightly on the

16th.



Because momentum indicators generally only signal strong or weak price movement, but not trend direction, they are often combined with other technical analysis indicators as part of an overall trading strategy.

Limit Order Book (LOB)



A limit order book is a record of outstanding limit orders maintained by the security specialist who works at the exchange. A limit order is a type of order to buy or sell a security at a specific price or better. A buy limit order is an order to buy at a preset price or lower while a sell limit order is an order to sell a security at a pre-specified price or higher.

When a limit order for a security is entered, it is kept on record by the security specialist. As buy and sell limit orders for the security are given, the specialist keeps a record of all these orders in the order book. The specialist executes the orders at or better than the given limit price when the market moves to the pre-specified price.

The specialist running the limit order book has the responsibility to guarantee that the top priority order is executed before other orders in the book, and before other orders at an equal or worse price held or submitted by other traders on the floor, such as floor brokers and market makers.

The specialist earns a profit from the spread between the difference in prices between the bid and ask orders on their book as they execute the orders. With the advancements in trading system technologies, the process has shifted from a manual process to one that is largely automated.

In 2000, the Securities and Exchange Commission (SEC) began to create a centralized limit order book that keeps track of limit orders on exchanges electronically.¹ This electronic order tracking system automatically matches for the execution of the best possible pair of orders in the system. The best pair is made up of the highest bid, and the lowest ask orders. The bid is the price the specialist or exchange will sell a security or the price at which an investor can buy the security. The ask or offer is the price at which the specialist or exchange will buy a security or the price at which the investor can sell the security.

When a limit order is entered into a trading system and fielded by either a specialist working the book or an electronic database of orders, it will stay on the books until it can be matched with a suitable trade and executed. Buy limit orders are placed with an upper price threshold. The investor would say "I don't want to pay more than \$X for this share." Sell limit orders are placed with a lower price threshold. The investor would say "I don't want to sell this share for less than \$X."

For a more detailed description click on [limit order book](#).

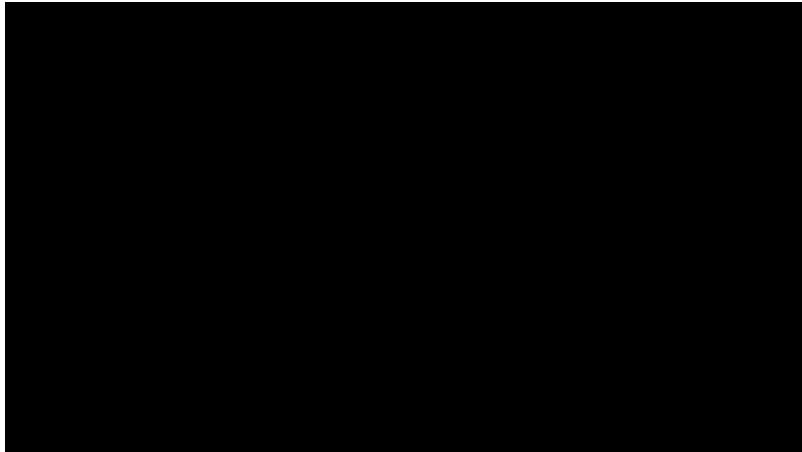
Thinkorswim by TD Ameritrade

An electronic trading platform used to trade financial assets. It is geared for self-directed stock, options and futures traders which was previously offered by ThinkorSwim Group, Inc and was purchased by TD Ameritrade in 2009.

It provides services for self-directed option traders and institutional users who invest in equities, exchange-traded funds, futures, mutual funds and bonds.

Thinkorswim provides financial literacy services for self-directed investors including trading tools and analytics. It offers a range of investor education products in a variety of interactive delivery formats, including instructor-led synchronous and asynchronous online courses, in-person workshops, one-

on-one and one-to-many online coaching programs and telephone, live-chat and email support. Thinkorswim is used in conjunction with trades of equity securities, fixed income, index products, options, futures, other derivatives and foreign exchange. The Thinkorswim software is provided free for account holders of TD Ameritrade and trades via the TD Ameritrade platform are free.



JPM eFX DNA "Deep Neural Network for Algo Execution"

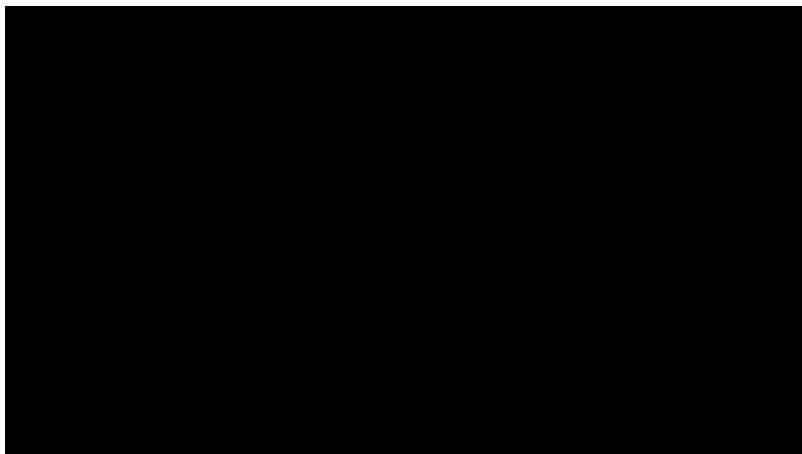
J.P. Morgan is taking technology to a new level in the foreign exchange market, applying machine learning to provide competitive pricing and optimize execution in what is already one of the most liquid and automated asset classes alongside equities. The Deep Neural Network for Algo Execution (DNA) is J.P. Morgan's latest tool to enhance its FX algorithms and uses a machine learning framework to bundle certain existing algos into one streamlined execution strategy.

"DNA is an optimization feature that leverages simulated data from various types of market conditions to select the best order placement and execution style designed to minimize market impact," said Chi Nzelu, head of Macro eCommerce at J.P. Morgan. "It then uses reinforcement learning – a subset of machine learning – to assess the performance of individual order placement choices."

[Read more...](#)

Oscillators

An oscillator is a technical analysis tool that constructs high and low bands between two extreme values, and then builds a trend indicator that fluctuates within these bounds. Traders use the trend indicator to discover short-term overbought or oversold conditions. When the value of the oscillator approaches the upper extreme value, technical analysts interpret that information to mean that the asset is overbought, and as it approaches the lower extreme, technicians consider the asset to be oversold.



The Relative Strength Index is arguably the most popular technical indicator when it comes to trading. But being popular doesn't always make you right or easy. David Jones knows this and is here to give a helping hand to those just starting their journey in the world of the markets, as well as those who've had a bit more experience.

Order Flow

Order flow defines the amount of orders waiting to be executed at a certain price level.



While the price is rising upward in a very strong rally, we know for certain that it will eventually stop somewhere. The rally up happens because there are simply more traders willing to buy than traders that are willing to sell. This creates an imbalance between buyers and sellers, whereas there are more buyers demanding the supply, therefore price shifts upwards. Eventually, the buyer momentum will end and the price will be driven up to a level where there are more sellers than buyers. This new imbalance created by more sellers than buyers will push price downwards.

This simple scenario is what happens in the markets on the macro and micro levels. This is the essence of what makes price move range or reverse.

When you look at a chart of a moving price and interpret this to the forces balance placed on different price levels.

Take a deeper look at Order Flow and VPIN [here](#).

Tools for a Fundamental Analysis

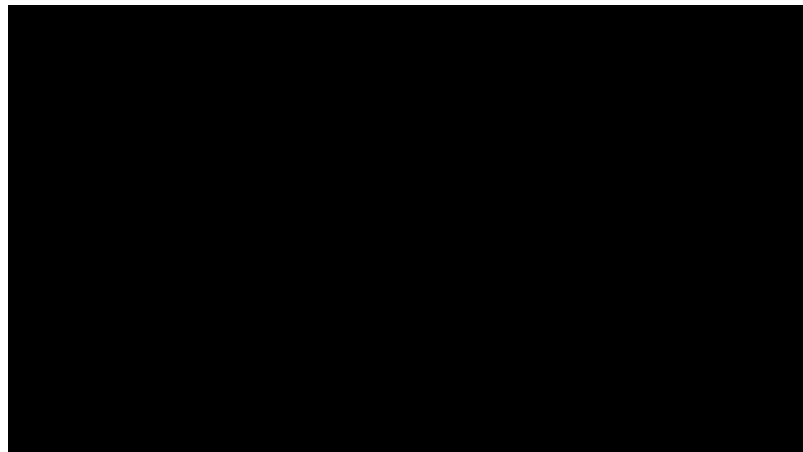
Cross-Sectional Analysis

Cross-sectional analysis is a type of analysis where an investor, analyst or portfolio manager compares a particular company to its industry peers. Cross-sectional analysis may focus on a single company for head-to-head analysis with its biggest competitors or it may approach it from an industry-wide lens to identify companies with a particular strength.

Cross-sectional analysis is often deployed in an attempt to assess performance and investment opportunities using data points that are beyond the usual balance sheet numbers.

When conducting a cross-sectional analysis, the analyst uses comparative metrics to identify the valuation, debt-load, future outlook and/or operational efficiency of a target company. This allows the analyst to evaluate the target company's efficiency in these areas, and to make the best investment choice among a group of competitors within the industry as a whole.

Analysts implement a cross-sectional analysis to identify special characteristics within a group of comparable organizations, rather than to establish relationships. Often cross-sectional analysis will emphasize a particular area, such as a company's war chest, to expose hidden areas of strength and weakness in the sector. This type of analysis is based on information-gathering and seeks to understand the "what" instead of the "why." Cross-sectional analysis allows a researcher to form assumptions, and then test their hypothesis using research methods.



AQR - How It Places Bets Against Beta

AQR, a large hedge fund founded by famed investor Cliff Asness, uses a strategy of statistical arbitrage by taking a short position in stocks with high beta and a long position in stocks with a low beta. This strategy is known as a bet against beta. The theory is based on alleged inefficiencies with

the capital asset pricing model, or CAPM, due to large funds being constrained in the type of leverage they can utilize and the risk they can take.¹ Beta is a statistical measure of the risk of an individual stock or portfolio against the market as a whole. The phrase bet against beta was coined from a few economics papers written by the creators of the strategy.

Beta is a measure of the risk that cannot be reduced by diversification. A beta of one means a stock or portfolio moves exactly in step with the larger market. A beta greater than one indicates an asset with higher volatility tends to move up and down with the market. A beta of less than one indicates an asset less volatile than the market or a higher volatility asset not correlated with the larger market. A negative beta shows an asset moves inversely to the overall market. Some derivatives such as put options have consistently negative betas.

CAPM is a model that calculates the expected return on an asset or portfolio. The formula determines the expected return as the prevailing risk-free rate plus the return of the market minus the risk-free rate times the beta of the stock. The security market line, or SML, is a result of CAPM. It shows an expected rate of return as a function of non-diversifiable risk. The SML is a straight line that shows the risk-return tradeoff for an asset. The slope of the SML is equal to the market risk premium. The market risk premium is the difference between the expected return on a market portfolio and the risk-free rate.

The basic bet against beta strategy is to find assets with higher betas and take a short position in them. At the same time, a leveraged long position is taken in assets with lower betas. The idea is the higher beta assets are overpriced and the lower beta assets are underpriced. The theory posits the prices of the stocks eventually come back into line with each other. This is essentially a statistical arbitrage strategy with the prices of the assets coming back to the median price versus risk. This median is defined as the SML.

A main tenet of CAPM is all reasonable investors invest their money in a portfolio with the highest expected excess return per unit of risk. The expected excess return per unit of risk is known as the Sharpe ratio. The investor can then leverage or reduce this leverage based on his individual risk preferences. However, many large mutual funds and individual investors are constrained in the amount of leverage they can use. As a result, they have a tendency to overweight their portfolios toward higher beta assets to improve returns.

This tilting toward higher beta stocks indicates these assets require lower risk-adjusted returns versus lower beta assets. Essentially, some experts believe the slope of the SML line is too flat for the U.S. market versus CAPM.¹ This allegedly creates a pricing anomaly in the market in which some attempt to profit. Some economic papers doing historical backtesting have shown superior Sharpe ratios versus the market as a whole.

In examining this phenomenon, AQR has constructed market-neutral betting against beta factors that can be used to measure this idea.¹ As a practical matter, the performance of this strategy suffers due to commissions and other trading expenses.³

As such, it may not be useful for individual investors. The strategy likely requires a large amount of capital and access to low trading costs to be successful.

Sentiment Analysis

A Social Sentiment Indicator

A social sentiment indicator analyzes aggregated social media data to help businesses understand how they are performing in the eyes of consumers. Social sentiment indicators enable companies to discover what they are doing right and how they might improve.

These measures can also give investors an idea of how publicly listed stocks

might perform. Social Sentiment should not be confused with market sentiment indicators, which are designed to represent how a group or population feels about the overall market or economy. Keeping customers cheerful is paramount for companies targeting long-term success. When the public is happy with a service or product, and all its other interactions with the provider, company revenues profits are more likely to rise.

In the digital age, it has become much easier for companies and investors to gauge how well businesses are treating their customers. Social sentiment indicators can tell us a lot about the public perception of a company, at least in terms of what is being said on social media.

These indicators extract information users post publicly to Facebook, Twitter, blog posts, discussion groups, and forums. If the social sentiment indicator shows a negative change in reputation, the company might be able to address the problem before it grows and starts potentially heavily weighing on its share price.

The Advantages of Social Sentiment Indicators

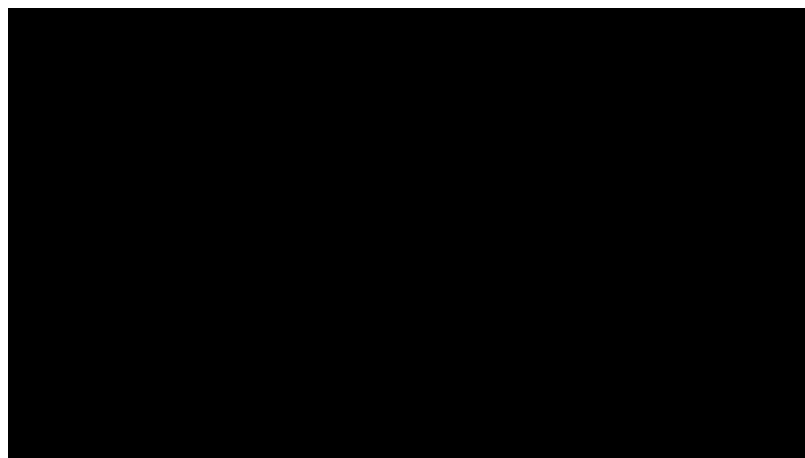
Social sentiment indicators serve a variety of purposes. Companies might blame social media for triggering a rise in complaints and encouraging hate campaigns. However, these same firms can use the internet and social sentiment indicators to their advantage, too, including in the following ways:

- Identify trends to target new customers
- Develop successful marketing campaigns and gauge if they are spending marketing dollars wisely
- Determine how consumers feel about competitors and similar products
- Assess what to expand on and what to drop or change
- Protect and improve their brand identity and image

Social sentiment indicators are also helping to reduce the burden on

customer service email and call centers. Nowadays, it is possible to address questions and problems en masse via social media. In some cases, these communication methods might even be used to reach out to highly influential individuals with a track record of swaying sentiment on popular chat platforms.

Investors, too, can benefit from social sentiment indicators because the type of information that they collate tends to have a bearing on stock prices. If an investor spots that people on social media have suddenly started to complain about a particular company, they could opt to sell before the rest of the market reacts. Value investors, on the other hand, might use these tools to buy into a stock that they believe has been excessively punished by internet gossip.



Third-Party Information Can Enhance Data Analytics

Using third-party data sources can be challenging, but it is crucial for companies who want to gain an analytics edge to tap into data ecosystems. Analyzing external data can help companies see the risks and opportunities that they would miss with inputs limited to data generated from internal operations, customers, and first-tier suppliers.

According to one study, the data stored in data centers will nearly quintuple by 2021, reaching 1.3 zettabytes globally. Along with the volume of data available, the potential value of analyzing this data grows bigger by the day.

It's not surprising that companies on the leading edge of data and analytics are more likely to make use of external data. An MIT Sloan Management Review report published last year found that the companies making the most innovative use of data and analytics were more likely than others to leverage more external data sources, including social, mobile, and publicly available data.

Marketing offers, improved HR processes and new revenue streams gained from new products and services and anticipated shifts in demand are influenced by external data sources. Models have been built from data sourced from third party data to predict the best types of customers to market to with the appropriate campaigns. Several startups monitor data from social networks to predict job-seeking behavior and retention risk.

Size of the data and the complexity of how the data was obtained are challenges for those using external data. Other challenges of using external data include the refresh rate of the data, usage restrictions, if shared revenue is an expectation of the vendor and contractual agreements with the vendor.

Algorithmic Trading Basics

Objectives:

- Students will be able to explain what sets of instructions are used with algorithmic trading basics.
 - Students will be able to grasp an understanding of the benefits of algorithmic trading.
 - Students will be able to define systematic trading and discretionary trading.
 - Students will gain an understanding the differences in systematic trading and discretionary trading.
 - Students will be able to describe the Fundamental Law of Active Management.
 - Students will be able to define the Information Ratio Formula and how it relates to the Fundamental Law of Active Management.
 - Students will be able to provide a description of the Sharpe Ratio and why it is used.
 - Students will be able to define and have an understanding the application of diversification.
-

Algorithmic Trading Basics

Algorithmic trading (also called automated trading, black-box trading, or algo-trading) uses a computer program that follows a defined set of instructions (an algorithm) to place a trade. The trade, in theory, can generate profits at a speed and frequency that is impossible for a human trader.

The defined sets of instructions are based on timing, price, quantity, or any mathematical model. Apart from profit opportunities for the trader, algo-trading renders markets more liquid and trading more systematic by ruling

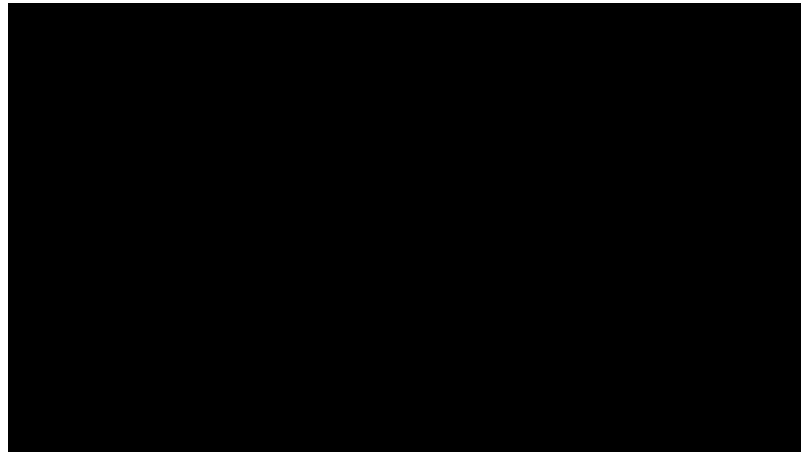
out the impact of human emotions on trading activities.

Algorithmic Trading in Practice

Suppose a trader follows these simple trade criteria:

- Buy 50 shares of a stock when its 50-day moving average goes above the 200-day moving average. (A moving average is an average of past data points that smooths out day-to-day price fluctuations and thereby identifies trends.)
- Sell shares of the stock when its 50-day moving average goes below the 200-day moving average.

Using these two simple instructions, a computer program will automatically monitor the stock price (and the moving average indicators) and place the buy and sell orders when the defined conditions are met. The trader no longer needs to monitor live prices and graphs or put in the orders manually. The algorithmic trading system does this automatically by correctly identifying the trading opportunity.



Benefits of Algorithmic Trading

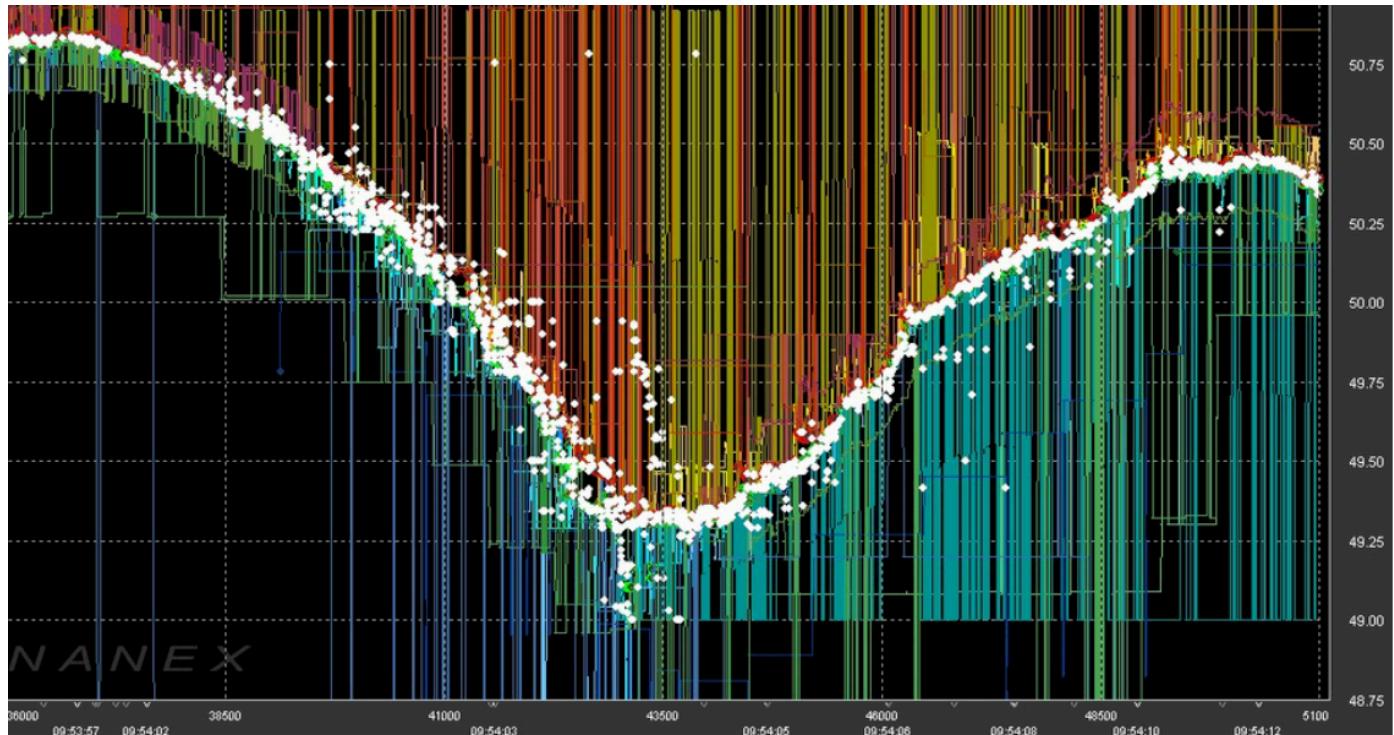
Algo-trading provides the following benefits:

- Trades are executed at the best possible prices.
- Trade order placement is instant and accurate (there is a high chance of

execution at the desired levels).

- Trades are timed correctly and instantly to avoid significant price changes.
- Reduced transaction costs.
- Simultaneous automated checks on multiple market conditions.
- Reduced risk of manual errors when placing trades.
- Algo-trading can be backtested using available historical and real-time data to see if it is a viable trading strategy.
- Reduced the possibility of mistakes by human traders based on emotional and psychological factors.

Most algo-trading today is high-frequency trading (HFT), which attempts to capitalize on placing a large number of orders at rapid speeds across multiple markets and multiple decision parameters based on preprogrammed instructions.



Algo-trading is used in many forms of trading and investment activities including:

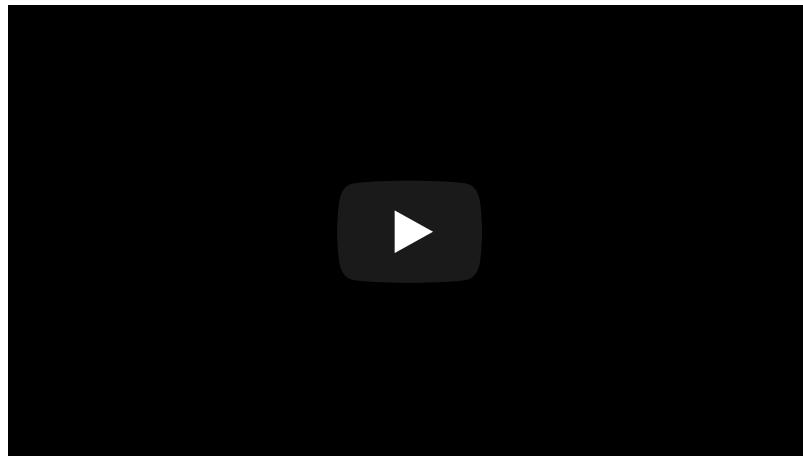
- Mid to long-term-investors or buy-side firms - pension funds, mutual

funds, insurance companies—use algo-trading to purchase stocks in large quantities when they do not want to influence stock prices with discrete, large-volume investments.

- Short-term traders and sell-side participants – market makers (such as brokerage houses), speculators, and arbitrageurs – benefit from automated trade execution; in addition, algo-trading aids in creating sufficient liquidity for sellers in the market.
- Systematic traders—trend followers, hedge funds, or pairs traders (a market-neutral trading strategy that matches a long position with a short position in a pair of highly correlated instruments such as two stocks, exchange-traded funds (ETFs) or currencies)—find it much more efficient to program their trading rules and let the program trade automatically.

Algorithmic trading provides a more systematic approach to active trading than methods based on trader intuition or instinct.

Discretionary Trading vs. Systematic Trading



When an investor enters the Managed Futures space, two of the first terms that he/she hears is “systematic” and “discretionary.” Those are the two most frequently used expressions when it comes to describing a Commodity Trading Advisor’s (CTA) investment strategy. As a new Managed Futures investor, it’s important to understand the differences between the two to fully comprehend the potential benefits and pit-falls of each.

A systematic trader or CTA is one that relies solely on signals produced by a computer program or model. Many times, these signals can consist of technical analysis (recognizing patterns or trends in historical charts) of market data, or fundamental analysis of economic data, to identify and make trades, with limited or no human intervention. Since all trades are being provided by a “computer,” all human emotions are removed from the trading process allowing for the most unbiased form of investing. The downside to systematic strategies is that because they are so carefully designed and programmed, it can take a long period of time to make changes to them. Therefore, if certain market or economic conditions change over time, a system may not be able to adapt to the new conditions and require some “tweaks” and changes.

On the other end of the spectrum from Systematic trading, is discretionary trading. As the name suggests, discretionary trading advisors’ investment decisions are all made by a human-being. All trading decisions are made based on real-time market data, and it is ultimately the trader’s discretion to decide which market to trade, when to trade, and how much to risk. While discretionary CTAs have the ability to immediately react to changing market conditions, they also have to battle their own emotions when picking a trade to enter. While this may be good in certain instances, in other instances it may lead to a bad trade being selected or a good trade being missed.

Expected Return

Expected return measures the mean, or expected value, of the probability distribution of investment returns. The expected return of a portfolio is calculated by multiplying the weight of each asset by its expected return and adding the values for each investment.

For example, a portfolio has three investments with weights of 35% in asset A, 25% in asset B, and 40% in asset C. The expected return of asset A is 6%, the expected return of asset B is 7%, and the expected return of asset C

is 10%.

Asset	Weight	Expected Return
A	35%	6%
B	25%	7%
C	40%	10%

Therefore, the expected return of the portfolio is

$$[(35\% * 6\%) + (25\% * 7\%) + (40\% * 10\%)] = 7.85\%$$

This is commonly seen with hedge fund and mutual fund managers, whose performance on a particular stock isn't as important as their overall return for their portfolio.

Standard Deviation

Conversely, the standard deviation of a portfolio measures how much the investment returns deviate from the mean of the probability distribution of investments.

The standard deviation of a two-asset portfolio is calculated as:

$$\sigma_P = \sqrt{(w_A^2 * \sigma_A^2 + w_B^2 * \sigma_B^2 + 2 * w_A * w_B * \sigma_A * \sigma_B * \rho_{AB})}$$

Where:

- σ_P = portfolio standard deviation
- w_A = weight of asset A in the portfolio
- w_B = weight of asset B in the portfolio
- σ_A = standard deviation of asset A
- σ_B = standard deviation of asset B; and
- ρ_{AB} = correlation of asset A and asset B

For example, consider a two-asset portfolio with equal weights, standard

deviations of 20% and 30%, respectively, and a correlation of 0.40. Therefore, the portfolio standard deviation is:

$$[\sqrt{(0.5^2 * 0.2^2 + 0.5^2 * 0.3^2 + 2 * 0.5 * 0.5 * 0.2 * 0.3 * 0.4)}] = 21.1\%$$

Standard deviation is calculated to judge the realized performance of a portfolio manager. In a large fund with multiple managers with different styles of investing, a CEO or head portfolio manager might calculate the risk of continuing to employ a portfolio manager who deviates too far from the mean in a negative direction. This can go the other way as well, and a portfolio manager who outperforms their colleagues and the market can often expect a hefty bonus for their performance.

Sharpe Ratio

The Sharpe ratio was developed by Nobel laureate William F. Sharpe and is used to help investors understand the return of an investment compared to its risk. The ratio is the average return earned in excess of the risk-free rate per unit of volatility or total risk. Volatility is a measure of the price fluctuations of an asset or portfolio.

Formula and Calculation of Sharpe Ratio

$$\text{Sharpe Ratio} = \frac{R_p - R_f}{\sigma_p}$$

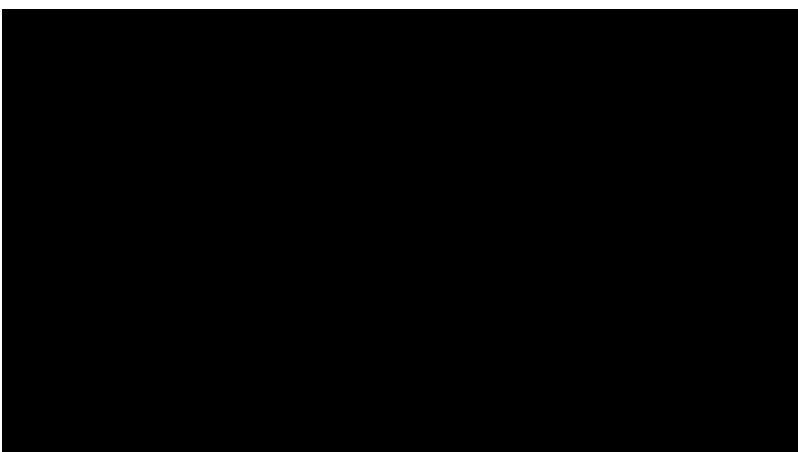
R_p = Return of portfolio

R_f = Risk-Free rate

σ_p = Standard deviation of portfolio's excess return

The Sharpe ratio is calculated as follows:

1. Subtract the risk-free rate from the return of the portfolio. The risk-free rate could be a U.S. Treasury rate or yield, such as the one-year or two-year Treasury yield.
2. Divide the result by the standard deviation of the portfolio's excess return. The standard deviation helps to show how much the portfolio's return deviates from the expected return. The standard deviation also sheds light on the portfolio's volatility.



The Sharpe ratio can be used either to calculate past performance or expected performance in the future, using expected return and the expected risk-free rate.

To put this into an example, let us assume that an investor is planning to add a fund to a portfolio that has a return of 12% over the past year and has a current risk-free rate of 3%. The volatility of the returns was 11%:

$$\text{Sharpe ratio} = (12\% - 3\%) / 11\% = 81.8\% \text{ or } 0.8$$

By adding in the new fund, the investor expects the portfolio to see its return fall to 9%, but the volatility to also fall, to 6%. If the risk-free rate remains the same, then the calculation is as follows:

$$\text{Sharpe ratio} = (9\% - 3\%) / 6\% = 100\% \text{ or } 1$$

While the returns are lower, the Sharpe ratio has improved, so on a risk-adjusted basis the returns have also improved.

Essentially, the Sharpe ratio is used to determine whether the higher risk of some investments is justified. If a portfolio has higher returns, but with higher risk, it is debatable whether those risks are justified.

In general, the higher the Sharpe ratio, the more attractive a portfolio is. A Sharpe ratio of 1 is good, 2 is even better and anything 3 or above is very good.

Essentially, the ratio shows how much excess return you are receiving in return for the extra volatility endured as the 'price' for holding a riskier asset.

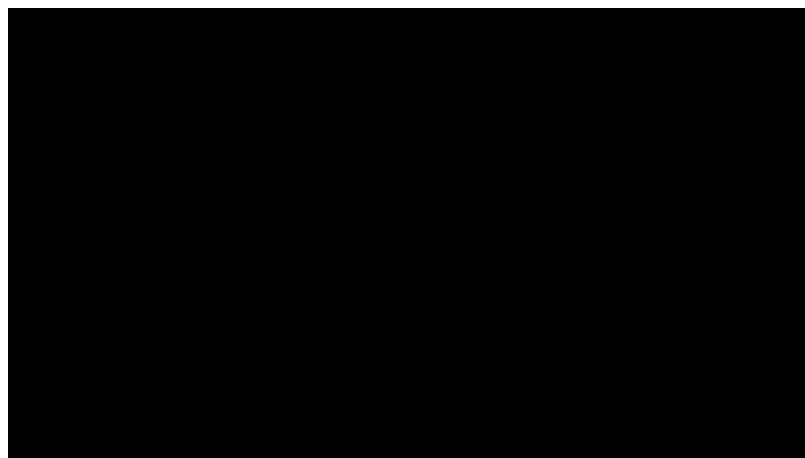
Portfolios that have a higher return, but also come with significantly higher risk, are not necessarily the best portfolio for an investor. Both traders and investors should think of volatility as the price they pay for holding assets with potentially large returns. As in most things in life, there is no 'free lunch' in markets, and higher returns usually imply higher volatility as well.

It is up to each investor to determine whether they are happy to bear the potential risk for the higher return. This is a matter of personal preference.

Can the Sharpe ratio be negative?

A negative Sharpe ratio either means that the risk-free rate is greater than the portfolio's return, or that the expected return is likely to be negative. A negative Sharpe ratio conveys little in the way of useful information.

The Sharpe ratio vs The Treynor ratio



The Treynor ratio is also known as the reward-to-volatility measure. While the Sharpe ratio looks at portfolio's return against the rate of return for a risk-free investment, the Treynor ratio looks at the portfolio against a benchmark, for example for S&P 500.

For example, a portfolio that has a return of 13%, versus an overall stock market return of 10%, will only be measured on the 3% it actually delivered over the broader market's performance. It is useful for determining whether a carefully constructed portfolio is actually performing more effectively than a simple tracker.

Information Ratio Formula

To produce the Information Ratio (IR), the manager's skillset is expressed by

the Information Coefficient (IC)². The extent of skill application is expressed as Breadth, which is the manager's derived independent signals. The formula is given below:

$$IR = IC * \sqrt{Breadth}$$

Where:

- **IC** is the Information Coefficient
- **Breadth** is the number of investment decisions in a year

In the equation, the risk is the input, the strategy's productivity is IR, and the value-added is the output. At a particular risk level, the value-added should be the specified risk multiplied by the IR. Therefore, the active manager needs to increase the frequency of utilizing his/her skills at work, which is positive Breadth, or he/she can increase the quality of his/her skill set, which is positive IC.

Transaction Costs

Information Coefficient (IC) can be defined as the level of correlation in a forecast with returns realized. The correlation shows how good a manager is at forecasting. The higher the correlation, the better a manager is rated in their forecasting ability. Forecasting, however, is just the tip of the iceberg in rating a manager's ability. Transaction costs determine a manager's success rating in a portfolio.

Transaction costs offset profits realized in a successful campaign in forecasting. However, they reduce the bets available for the manager to undertake. Such circumstances of reduction tend to make rather skillful managers fail in their forecasting campaigns, especially in asset management.

Transaction costs are a vital concern for an active manager. He/She is

interested in the net in transaction costs that have been realized in that instance. Managers who take transaction costs into account while maximizing IC are successful in maximizing IR. The alpha obtained in a skilled forecast can be much less than the ones measured in IC due to the presence of transaction costs.

An adjustment of the IC is prudent for the proper presentation of the fundamental law equation to reflect the prioritized bets that the manager needs to act upon. The prioritized bets should be those that have more forecasted returns than the transaction costs projected.

Fundamental Law of Active Management

The Fundamental Law of Active Management by Grinold and Kahn is designed to assess the value of active management, as expressed by the information ratio, using only two variables. The first variable is the portfolio manager 'skill' in selecting securities. In other words, how well is the portfolio manager at forming correct predictions? The second variable is breadth; the number of independent investment opportunities.

$$IR = IC \times \sqrt{N}$$

IR= information ratio

IC= information coefficient or selection skill

N= number of independent investment opportunities

If two portfolio managers have the same investment skills but one manager follows an investment strategy that relies on a higher level of breadth compared to the second manager, the first manager is more likely to outperform. The analogy can be made to the game of roulette in a casino. If the wheel spins 100 times and at each spin the player's bet is EUR 1, the expected return is the same as when the wheel spins only once and the bet is EUR 100. But for 'the house', the first option is far more preferable, because the level of breadth is higher and it offers a better reward-risk ratio.

The quantitative equity strategies we offer at Robeco benefit from the implications that follow from this formula. First, the 'skill' lies in years of our in-house research on equity markets and investor behavior. This resulted in our Quantitative Stock Selection Models which are designed to systematically identify and exploit market inefficiencies arising as a result of predictable patterns in investor behavior. Second, the level of breadth is high since we can use our models to analyze thousands of stocks in only a short period of time.

Let's take Robeco Emerging Markets Enhanced Index Equities as an example. The individual stock exposures are only 20 bps versus the benchmark, whereas a traditional portfolio manager can have an individual active weights of 300 bps or even more. However, since the individual active weights of Emerging Markets Enhanced Index Equities are small, the number of positions is in the hundreds and the level of breadth thus is high.

The combination of having a well-developed stock selection model with using a high level of breadth has led to a consistently strong track record for our Emerging Markets Enhanced Index Equities strategy (3 years = 1.24; and 5 years = 0.78, since inception= 1.27, as of end of March 2018).

Weaknesses in the Fundamental Law of Active Management

The simplicity of the law exposes it to a lot of weaknesses. For example, most of the assumptions in the law prove to be an omission. The equation seems to have been developed in the absence of transaction costs. When the transaction cost is put into perspective, there arises the urgent need to redefine Breadth and IC. Breadth should be taken into account for a complete equation and should not be influenced by other factors. However, independence cannot be precisely measured without an estimation error.

So, the equation conceals technical activities, such as asset allocation, and it can be difficult since the results will be inaccurate. The formula also ignores important portfolio considerations as it takes the expected IR of each manager in isolation.

Information Ratio does not need to show a correlation with the rest of the portfolio. When IR is uncorrelated to the rest of the portfolio, even a negative value can contribute positively to the portfolio.

Diversification

Diversification is a technique that reduces risk by allocating investments across various financial instruments, industries, and other categories. It aims to maximize returns by investing in different areas that would each react differently to the same event.

Most investment professionals agree that, although it does not guarantee against loss, diversification is the most important component of reaching

long-range financial goals while minimizing risk. Here, we look at why this is true and how to accomplish diversification in your portfolio.

Let's say you have a portfolio that only has airline stocks. Share prices will drop following any bad news, such as an indefinite pilot strike that will ultimately cancel flights. This means your portfolio will experience a noticeable drop in value.

You can counterbalance these stocks with a few railway stocks, so only part of your portfolio will be affected. In fact, there is a very good chance that these stock prices will rise, as passengers look for alternative modes of transportation.

You could diversify even further because of the risks associated with these companies. That's because anything that affects travel will hurt both industries. Statisticians may say that rail and air stocks have a strong correlation. This means you should diversify across the board—different industries as well as different types of companies. The more uncorrelated your stocks are, the better.

Be sure to diversify among different asset classes, too. Different assets such as bonds and stocks don't react the same way to adverse events. A combination of asset classes like stocks and bonds will reduce your portfolio's sensitivity to market swings because they move in opposite directions. So if you diversify, unpleasant movements in one will be offset by positive results in another.

And don't forget location, location, location. Look for opportunities beyond your own geographical borders. After all, volatility in the United States may not affect stocks and bonds in Europe, so investing in that part of the world may minimize and offset the risks of investing at home.

Trading APIs Interactions

Objectives:

- Students will be able to describe how to utilize APIs in FinTech.
 - Students will gain an understanding of the benefits of APIs.
 - Students will be able to differentiate the differences between APIs and API-led connectivity builds.
-

APIs in FinTech

Financial technology refers to the new breed of companies that provide financial services and products through the use of high-tech, computer-based systems. The FinTech sector is one of the most rapidly growing tech sectors, offering a wide range of financial services and products through innovative digital platforms.

An API is a program that lets other programs talk to each other. For example, an API allows a FinTech program to interact with a financial institution's server. APIs are the technological means by which FinTech and financial services communicate with each other. Using APIs, programs can access information from one another and make transactions or make modifications.

Benefits of APIs

Cost-Effective:

APIs help to tailor a client's experience, saving banks money in the long run and helping their customers. Instead of being stuck with a boring, over-simplified platform, banking customers can customize their services exactly to their needs.

Thanks to the use of APIs, banks are able to provide customers with even

more services. One example is the integration of bank accounts with software that allows customers to manage their finances in one place.

Data Accessibility:

Before the introduction of PSD2 in 2016, banks could keep their data and information hidden from the public. Keeping the data and information locked away was seen as a good thing, but it made it hard for programs and users to access the valuable data they need. PSD2 makes financial data accessible to third parties.

The right to manage or access one's data has always been a core property of the digital age, and it is the foundation of both the GDPR and PSD2. In this new era of intelligent automation, we can now use our mobile phones to control all aspects of our lives.

The new EU regulation will make users even more aware of what is going on with their data. Users will now have the legal right to know how their personal information is used. Before, users had to trust a company not to misuse their data. Now, they can let companies know if they want to continue to use their information.

Growth-led

The number of financial technology APIs has increased dramatically in recent years, helping to provide a wide variety of financial data for use in FinTech applications. The continued growth and development have meant that financial technology is becoming more and more robust. It will continue to develop and grow into the future.

Trading APIs



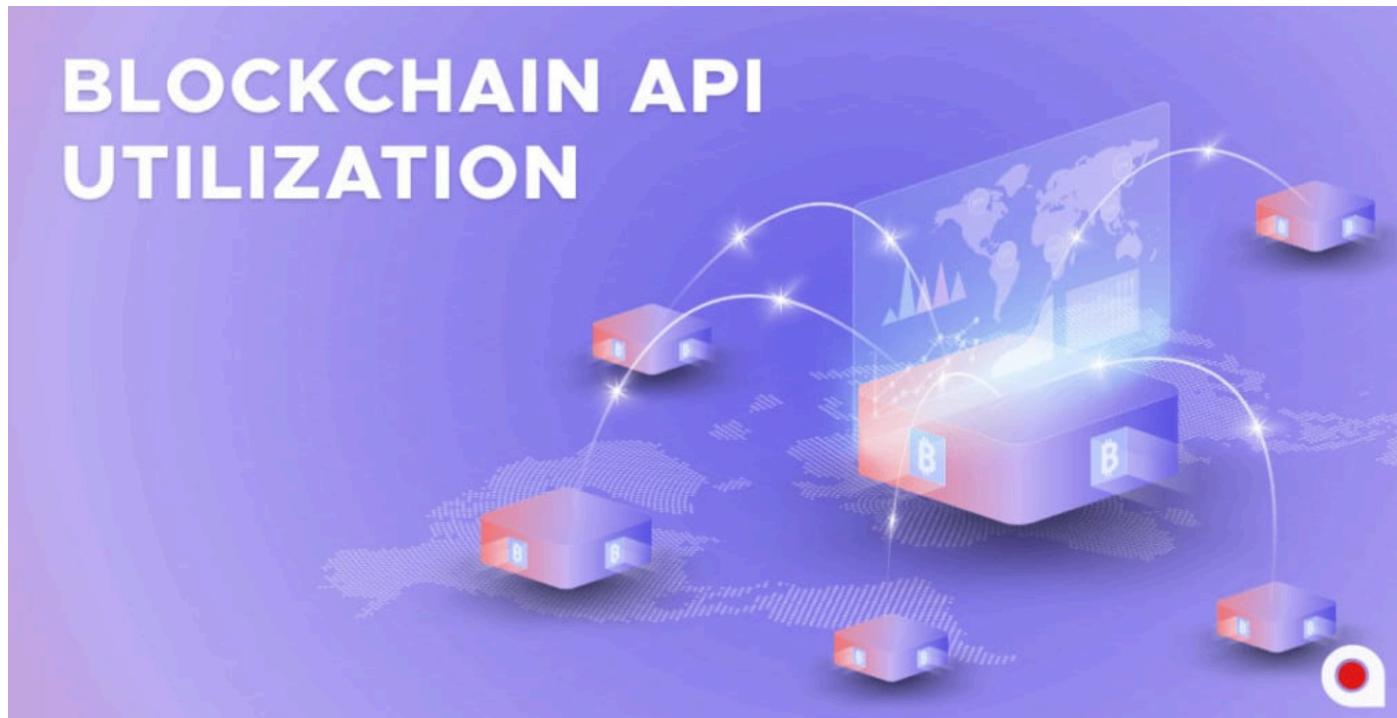
An application programming interface (API) is a software bridge that allows computers to communicate and execute tasks with each other. You can think of it as a language translator for computers. An API links a trader's account with a broker's automated trading system to execute trades quickly and efficiently, and to perform (algo) or programmable trades in certain scenarios. APIs have gained popularity as traders realize the benefits of automated trading tools, which allow them to hedge bets into the future, and abandon traditional manual trades. Whether it's a stock trading API or a bitcoin trading API, the key functions and benefits remain the same.

What Can an API Do?

A cryptocurrency exchange's API acts as a middleman between you and your broker so you can perform various transactions. These may include buying and selling assets, viewing real-time market data, and executing more sophisticated trading strategies. Cryptocurrency exchanges, for instance, use APIs to offer customers the ability to trade cryptocurrency

pairs and carry out basic to high-performance trading through premium trading platforms. Experienced day traders can engage in advanced charting, multiple order types, auctions, and block trading, among other functions.

Top APIs for Crypto Traders



Gemini, Binance, Bittrex, Bitfinex, Coinbase, and Kraken, for example, are some of the top crypto exchanges to offer API trading. For algorithmic traders with customized programs, they offer various ways to connect through popular API protocols such as REST, WebSocket, and FIX.

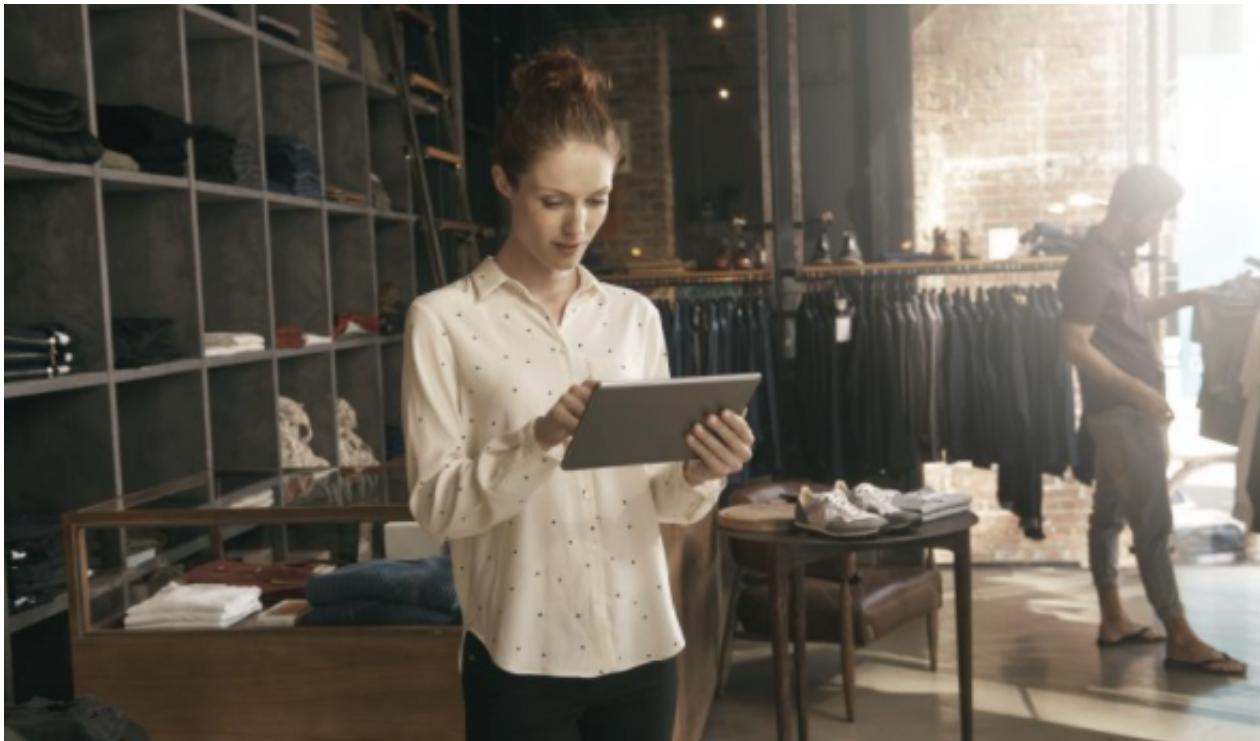
Who Can Benefit From API Trading?

Anyone interested in trading can benefit from using APIs. Traders can use APIs to trade stocks, crypto, commodities, and virtually every other asset under the sun. Traders who wish to develop their own trading strategies can also use niche API protocols such as MetaTrade, which targets currency traders, or charting and futures platforms such as AmiBroker or NinjaTrader, respectively. Those who want to develop trading strategies from scratch can

use coding software such as Python, C++, or Java.

APIs in Retail and Ecommerce

Close to 80 percent of Americans have purchased [at least one item online](#), the Pew Research Center has found, as e-commerce and mobile devices forever change the retail space.



- Most point-of-sale (POS) systems today have internet connectivity, with APIs helping to connect the POS with internal databases and bank-owned systems. APIs also help POS terminals accept payments from a wide variety of sources, including cash, cards and mobile devices like smart watches.
- Shops—both brick and mortar stores and e-commerce sites—use APIs to keep track of inventory. This technology ensures that customers can see if a desired item is in stock beforehand and that businesses can proactively keep supplies full.
- With e-commerce, a lot can go wrong in the process of getting an item to a customer's front door. APIs help customers and companies track shipments and stay on top of packages.

- APIs also underpin much of what happens inside a physical store, including software that handles employee scheduling and analytics solutions that help determine when to stock seasonal items.

While connectivity demands have changed, the central tenets of SOA (Service Oriented Architecture) have not, that is, the distillation of software into services that are well-defined, reusable, and discoverable. This vision is perhaps even more important given the proliferation of endpoints. The complexity of providing multiple stakeholders customized views of the same underlying data source, whether it be a core banking system or an ERP system, increases exponentially with the number of channels through which that data must be provided. It also reinforces the need for data at the point of consumption to be decoupled and independent from the system of record. This problem lends itself to a service-oriented approach in which application logic is broken down into individual services and then reused across multiple channels. Yet, the heavyweight, top-down implementation approaches previously noted are not a fit for the agility that today's digital transformation initiatives demand.

API-led connectivity builds on the central tenets of SOA, yet re-imagines its implementation for today's unique challenges. API-led is an approach that defines methods for connecting and exposing assets. The approach shifts the way IT operates and promotes decentralized access to data and capabilities, while not compromising governance. And the outcome of API-led connectivity is an application network: a network of applications, data, and devices that are 'pluggable', providing the agility that the speed of today's digital transformation demands.

API-led connectivity calls for a distinct connectivity building block that encapsulates three components:

- **Interface:** Presentation of data in a governed and secured form.
- **Orchestration:** Application of logic to that data, such as transformation and enrichment.

- **Connectivity:** Access to source data, whether from physical systems or from external services.

Designed with the consumption of data top of mind, APIs are the instruments that provide both a consumable and controlled means of accessing connectivity. They serve as a contract between the consumer of data and the provider of that data that acts as both a point of demarcation and a point of abstraction, decoupling the two parties and allowing both to work independently of one another (as long as they continue to be bound by the API contract). Finally, APIs also play an important governance role in securing and managing access to that connectivity.

However, the integration application must be more than just an API; the API can only serve as a presentation layer if it sits over a set of orchestration and connectivity flows. This orchestration and connectivity are critical: without it, API-to-API connectivity is simply another means of building out point-to-point integration. These APIs perform specific functions and provide access to non-central data and may be built by either central IT or line of business IT.

APIs vs. API-led connectivity Stripe, an “API as a company” disintermediating the payments space, is an archetype of the API economy. At MuleSoft’s CONNECT conference, Stripe’s CEO John Collison was quoted saying, “you don’t slather an API on a product like butter on toast.” Thought of in isolation, the API is only a shim that hides complexities of back-end orchestration and connectivity yet does nothing to address those issues. Connectivity is a multi-faceted problem across data access, orchestration, and presentation, and the right solution must consider this problem holistically rather than in a piecemeal fashion. To only consider APIs is to only solve only one part of the connectivity challenge.



Read how APIs are enabling innovation in [retail](#)...

FinTech Use Cases

Though the tech industry is associated with disruptive technology and startups, big businesses and banks are also using the same FinTech services. Here's a quick look at a few FinTech examples and how the industry is using these same technologies to enhance their existing business strategies and disrupt how they do things in the future.

Banking:

Mobile banking has become an important part of the financial services industry. With the spread of neobanks such as GoCardless and Revolut, many banks are offering mobile-friendly banking features. These features attract a diverse customer base, making it easier for consumers to manage their finances.

Neobanks are essentially mobile-optimized banks, offering a variety of banking services on their web and app-only platforms. They operate without the need for physical branch locations or brick-and-mortar offices. From personal checking accounts to money transfers, loans to savings accounts, these banks have it all. Some of the more popular neobanks include Chime,

Simple, and Varo.

Cryptocurrency & Blockchain:

The crypto-currency phenomenon is a new kind of financial innovation that will allow us to rethink the way we engage with money, with money transforming into data. Blockchain, the technology upon which cryptocurrency is built, is a new kind of database that can be used to store and share information. Both of these are considered outside the realm of FinTech, but they are increasingly working together as complementary solutions for consumers.

Investment & Savings:

FinTech has caused a revolution in investing. The barriers to investing are falling as more and more easy-to-use apps are made available to consumers. With hundreds of apps on the market, this booming industry is making it easier than ever for consumers to invest their money. One of the most popular and best-known apps is Robinhood, which makes it incredibly easy for anyone to invest their money and learn about the markets.

Trading:

The evolution of financial technology has seen the rise of Artificial Intelligence technologies that can extract financial insights from massive datasets. By using advanced natural language processing, these technologies allow traders and investors to gain meaningful insights in a matter of seconds.

Seven Common Myths About APIs

“APIs are a new technology”

APIs as Application Programming Interfaces have been around since the advent of software, but the first time the term was officially coined was in

1968. But from the 1990's and the era of Services and SOA, the service interface concept has been tightly coupled with vendors and software products (eg. ESB, Webmethods, SOAP/XML Webservices, CORBA). As this set of technology did not deliver its promises, in the 2000's, the industry pushed the word "API" as the new concept to enable the transition to a new set of technologies and products and detach the service interface concept from their out of fashioned products.

APIs are not binded to any technology. Would you say that HMI (Human Machine Interface) is a technology or is a design practice that involves technologies that can change over time? APIs are these Software to Software Interfaces.

"APIs are a technical topic"

Originally yes, but in a world where IT capabilities are a competitive advantage, APIs are also a business topic. Especially when you consider Conway's law, that states that organizations who design communication systems are condemned to reproduce their organization's structure inside their communication systems. APIs are a way to expose capabilities as products and liberate interactions in the organizations, making them discoverable, autonomously integrable by others and managed like products. In that sense, APIs are an IT term, with business implications and must be considered now not only like a technical topic. The APIs-as-product concept reinforces the idea that APIs are not just a technical topic.

"APIs must be handled by the IT department"

Because of their ability to re-align business with IT, exposing capabilities as products, IT department is not designed to handle alone all the aspects of API-led transformation. Most of the time, when IT is the only one involved in APIs, APIs are designed more towards integration and technical interoperability between internal services instead of focusing on exposing

capabilities towards business departments. This is why most of company-wide API-led transformations involved often an API-Center of Enablement group, that mixes IT departments stakeholders but also business stakeholders, and sometimes Sales, compliance and HR!

"APIs must expose the data or the service as it is in the system"

The main interest of designing APIs is the ability to use the interface representation to expose only what needs to be exposed, and in the way that will help and inspire future implementers to understand the underlying capabilities in his context. This is why we often consider APIs as much exposing interfaces ads hiding interfaces.

Your interface is not your data model or object model. A restaurant menu is not the floor plan of the kitchen and is not the list of ingredients in the fridge! It exposes what can be ordered and hide what the kitchen can probably do but that the Chef don't want you to know.

"There is a 1to1 relationship between APIs and services"

When most of the time it is designed that way, there is not necessarily a 1 to 1 relationship between services and APIs. 1 APIs can be the interface to access one or multiple service capabilities and 1 service can have multiple APIs depending on its interactions with others. Example : 1 API for exposing a Banking scoring capability that call behind the scene 3 different services for current scoring, probability of default in the next 3 months and country risk. It is like a restaurant that would provide 1 menu with food and drinks to customers to make things simple to order, but behind the scene would have an independent kitchen and a bar, that have 2 different P&L. 1 interface, 2 independent services.

On the other side, a Hotel database that expose 1 REST/JSON API to other

travel platforms which work with this set of technologies, and expose 1 SOAP/XML API for the Airline ticketing industry that still works in majority with this set of technology. It is like a restaurant that for the same kitchen and food production capabilities design 1 menu for adults and 1 menu for kids. 2 interfaces, 1 service.

So when simplicity or business needs requires it, you can overcome the 1to1 relationship between APIs and Services.

"API Management is about API gateways and security"

API management is the practice to align API enablement and consumption with business priorities, inside or outside the organization, while securing and monitoring traffic and threats. It involves API gateways but also Analytics, Traffic Monitoring, User role management, Developer portals, and more and more features on the API lifecycle management like API design, API documentation, API testing and API Versioning. The end-goal of API management is to align APIs with Business KPIs.

"APIs need a business model"

Not all APIs are made to be exposed outside the organization, and when they are, lots of people consider that they must be monetized and thought with a dedicated business model in mind. Unless your main company product is an API, for organizations which have already a business model, you should not think in terms of what is the best business model for your APIs, but what are the best APIs for my business model. For example, Insurers may want to open API for free to create an ecosystem of applications for their customer and become a platform, to at the end create more customer acquisition and retention on sold policies, just sticking and scaling their existing business model, and not inventing new ones for their APIs.

Other myths that have been spread about APIs are as follows:

- "Micro-services don't need APIs"
- "Designing an API is to write its Open API specification"
- "Documenting an API is to provide a good API reference"
- "Developers portals are for external developers only"
- "Developer portals are the only way to expose APIs for discoverability"
- " API keys and OAuth are authentications method for APIs"

Algorithmic Trading Tech Stack

Objectives:

- Students will gain an understanding of what to look for in an algorithmic trading software.
 - Students will be able to learn which is better: build or buy.
 - Students will gain an understanding of Calypso markets and how they relate to algorithmic trading.
-

While using algorithmic trading, traders trust their hard-earned money to their trading software. For that reason, the correct piece of computer software is essential to ensure effective and accurate execution of trade orders. On the other hand, faulty software—or one without the required features—may lead to huge losses, especially in the lightning-fast world of algorithmic trading. A Quick Primer on Algorithmic Trading An algorithm is defined as a specific set of step-by-step instructions to complete a particular task. Whether it is the simple-yet-addictive computer game like Pac-Man or a spreadsheet that offers a huge number of functions, each program follows a specific set of instructions based on an underlying algorithm.

- Picking the correct software is essential in developing an algorithmic trading system.
- A trading algorithm is a step-by-step set of instructions that will guide buy and sell orders.
- Faulty software can result in hefty losses when trading financial markets
- There are two ways to access algorithmic trading software: buy it or build it.
- Ready-made algorithmic trading software usually offers free trial versions with limited functionality.

Algorithmic trading is the process of using a computer program that follows a defined set of instructions for placing a trade order. The aim of the algorithmic trading program is to dynamically identify profitable opportunities and place the trades in order to generate profits at a speed and frequency that is impossible to match by a human trader. Given the advantages of higher accuracy and lightning-fast execution speed, trading activities based on computer algorithms have gained tremendous popularity.

Who Uses Algorithmic Trading Software?

Algorithmic trading is dominated by large trading firms, such as hedge funds, investment banks, and proprietary trading firms. Given the abundant resource availability due to their large size, such firms usually build their own proprietary trading software, including large trading systems with dedicated data centers and support staff.

At an individual level, experienced proprietary traders and quants use algorithmic trading. Proprietary traders, who are less tech-savvy, may purchase ready-made trading software for their algorithmic trading needs. The software is either offered by their brokers or purchased from third-party providers. Quants generally have a solid knowledge of both trading and computer programming, and they develop trading software on their own.

Algorithmic Trading Software: Build or Buy?

There are two ways to access algorithmic trading software: build or buy.

Purchasing ready-made software offers quick and timely access while building your own allows full flexibility to customize it to your needs. The automated trading software is often costly to purchase and may be full of loopholes, which, if ignored, may lead to losses. The high cost of the software may also eat into the realistic profit potential from your algorithmic trading venture. On the other hand, building algorithmic trading software on

your own takes time, effort, a deep knowledge, and it still may not be foolproof.

The Key Features of Algorithmic Trading Software

The risk involved in automatic trading is high, which can lead to large losses. Regardless of whether you decide to buy or build, it is important to be familiar with the basic features needed.

Availability of Market and Company Data

All trading algorithms are designed to act on real-time market data and price quotes. A few programs are also customized to account for company fundamentals data like earnings and P/E ratios. Any algorithmic trading software should have a real-time market data feed, as well as a company data feed. It should be available as a build-in into the system or should have a provision to easily integrate from alternate sources.

Connectivity to Various Markets

Traders looking to work across multiple markets should note that each exchange might provide its data feed in a different format, like TCP/IP, Multicast, or FIX. Your software should be able to accept feeds of different formats. Another option is to go with third-party data vendors like Bloomberg and Reuters, which aggregate market data from different exchanges and provide it in a uniform format to end clients. The algorithmic trading software should be able to process these aggregated feeds as needed.

Latency

This is the most important factor for algorithm trading. Latency is the time-delay introduced in the movement of data points from one application to the

other. Consider the following sequence of events. It takes 0.2 seconds for a price quote to come from the exchange to your software vendor's data center (DC), 0.3 seconds from the data center to reach your trading screen, 0.1 seconds for your trading software to process this received quote, 0.3 seconds for it to analyze and place a trade, 0.2 seconds for your trade order to reach your broker, 0.3 seconds for your broker to route your order to the exchange.

Total time elapsed = 0.2 + 0.3 + 0.1 + 0.3 + 0.2 + 0.3 = Total 1.4 seconds.

In today's dynamic trading world, the original price quote would have changed multiple times within this 1.4 second period. Any delay could make or break your algorithmic trading venture. One needs to keep this latency to the lowest possible level to ensure that you get the most up-to-date and accurate information without a time gap.

Latency has been reduced to microseconds, and every attempt should be made to keep it as low as possible in the trading system. A few measures to improve latency include having direct connectivity to the exchange to get data faster by eliminating the vendor in between; improving the trading algorithm so that it takes less than $0.1+0.3 = 0.4$ seconds for analysis and decision-making; or by eliminating the broker and directly sending trades to the exchange to save 0.2 seconds.

Configurability and Customization

Most algorithmic trading software offers standard built-in trade algorithms, such as those based on a crossover of the 50-day moving average (MA) with the 200-day MA. A trader may like to experiment by switching to the 20-day MA with the 100-day MA. Unless the software offers such customization of parameters, the trader may be constrained by the built-ins fixed functionality. Whether buying or building, the trading software should have a high degree of customization and configurability.

Functionality to Write Custom Programs

Matlab, Python, C++, JAVA, and Perl are the common programming languages used to write trading software. Most trading software sold by third-party vendors offers the ability to write your own custom programs within it. This allows a trader to experiment and try any trading concept. Software that offers coding in the programming language of your choice is obviously preferred.

Backtesting Feature on Historical Data

Backtesting simulation involves testing a trading strategy on historical data. It assesses the strategy's practicality and profitability on past data, certifying it for success (or failure or any needed changes). This mandatory feature also needs to be accompanied by the availability of historical data on which the backtesting can be performed.

Integration With Trading Interface

Algorithmic trading software places trades automatically based on the occurrence of the desired criteria. The software should have the necessary connectivity to the broker(s) network for placing the trade or a direct connectivity to the exchange to send the trade orders.

Plug-n-Play Integration

A trader may be simultaneously using a Bloomberg terminal for price analysis, a broker's terminal for placing trades, and a Matlab program for trend analysis. Depending upon individual needs, the algorithmic trading software should have easy plug-and-play integration and available APIs across such commonly used trading tools. This ensures scalability, as well as integration.

Platform-Independent Programming

A few programming languages need dedicated platforms. For example, certain versions of C++ may run only on select operating systems, while Perl may run across all operating systems. While building or buying trading software, preference should be given to trading software that is platform-independent and supports platform-independent languages. You never know how your trading will evolve a few months down the line.

A common saying goes, "Even a monkey can click a button to place a trade." Dependency on computers should not be blind. It is the trader who should understand what is going on under the hood. While buying trading software, one should ask for (and take the time to go through) the detailed documentation that shows the underlying logic of a particular algorithmic trading software. Avoid any trading software that is a complete black box, and that claims to be a secret moneymaking machine.

While building software, be realistic about what you are implementing and be clear about the scenarios where it can fail. Thoroughly backtest the approach before using real money.

Where to Begin?

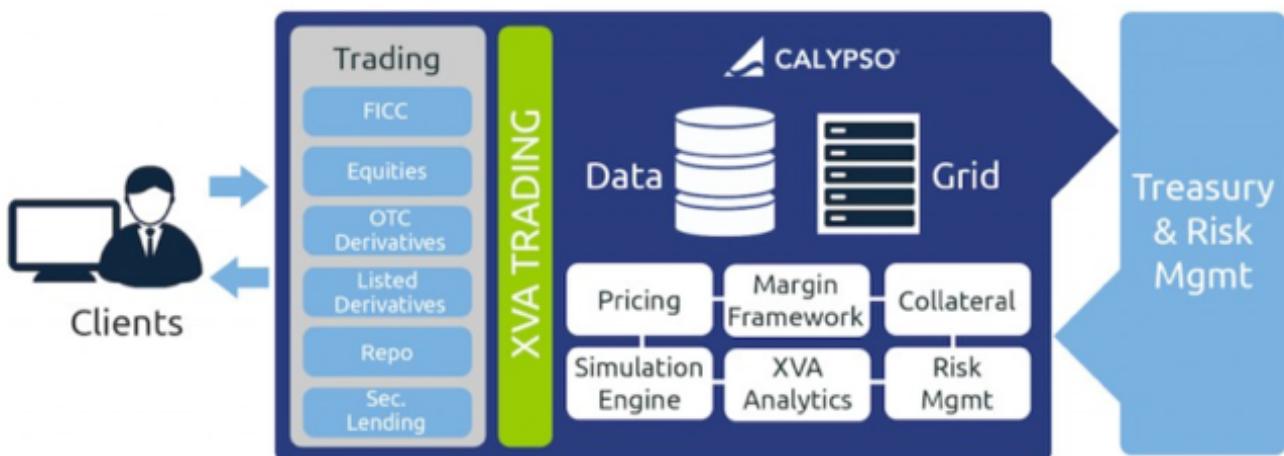
Ready-made algorithmic trading software usually offers free limited functionality trial versions or limited trial periods with full functionality. Explore them in full during these trials before buying anything. Do not forget to go through the available documentation in detail.

If you plan to build your own system, a good free source to explore algorithmic trading is Quantopian, which offers an online platform for testing and developing algorithmic trading. Individuals can try and customize any existing algorithm or write a completely new one. The platform also offers built-in algorithmic trading software to be tested against market data.

The Bottom Line

Algorithmic trading software is costly to purchase and difficult to build on your own. Purchasing ready-made software offers quick and timely access, and building your own allows full flexibility to customize it to your needs. Before venturing into algorithmic trading with real money, however, you must fully understand the core functionality of the trading software. Failure to do so may result in big losses.

Calypso Markets



Calypso Technology, Inc. is a cloud-enabled provider of cross-asset front-to-back solutions for financial markets with over 40,000 users in 60+ countries. Its award-winning software improves reliability, adaptability, and scalability across several verticals, including capital markets, investment management, central banking, clearing, treasury, liquidity, and collateral. Calypso is leveraging innovative cloud microservices and blockchain distributed ledger technology (DLT) based solutions to reduce trading costs and improve time to value.

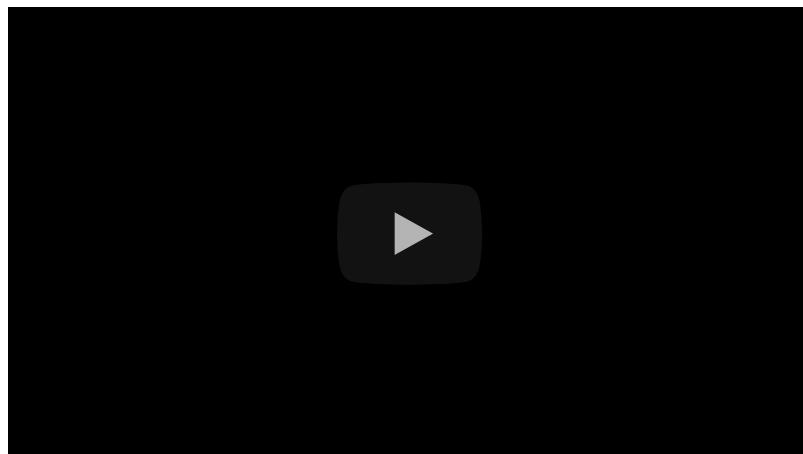
With 20 years of experience delivering cross-asset solutions for trading, processing, risk management and accounting, we are able to focus our significant resources on customer problems, bringing simplicity to the most

complex business and technology issues. The constant pressures for better allocation of capital and improved risk management, matched by an ever changing regulatory landscape in the financial markets demand technology solutions that are reliable, adaptable and scalable. In response Calypso provides customers with a single platform designed from the outset to enable consolidation innovation and growth.

The result is compelling. Faster time to new markets, enterprise risk reduction and lower technology costs drive immediate improvements to our customers' bottom line.

Calypso software and Cloud services support trading, risk management, collateral, processing, accounting and compliance needs in a uniquely integrated platform, bringing simplicity and cost efficiency to address today's business and regulatory imperatives. The firm is consistently granted the most prestigious product and technology awards in the industry.

The facts speak for themselves. Calypso is used by over 40,000 market professionals in over 60 countries. Representing more than 200 financial institutions, our customers operate in a diverse range of developed and emerging markets across Asia, Americas, Europe, Middle East and Africa. Calypso has over 800 staff in over 23 global offices, with headquarters in San Francisco, California.



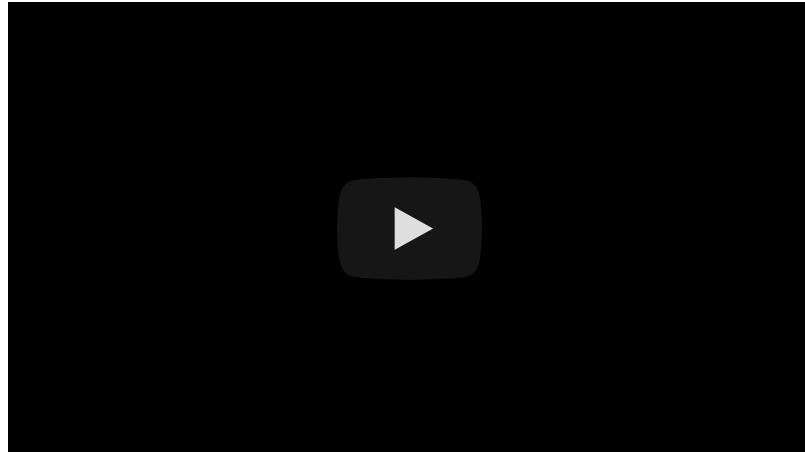
For more information regarding algorithmic trading platforms click [here](#).

Algorithmic Trading Models using Python

Objectives:

- Students will be able to describe how Python is useful in creating and executing algorithmic trading
 - Students will be able to implement basic algorithmic trading functions using Python
-

Introduction



Got Python? If you're serious about financial markets and algorithmic trading, then you're going to need it. Python is a computer programming language that is used by institutions and investors alike every day for a range of purposes, including quantitative research, i.e. data exploration and analysis, and for prototyping, testing, and executing trading algorithms. In the recent past, however, only the big institutional players had the money and tech know-how to harness the benefits

of algorithmic trading, but the times they are a-changin'. Before we dig deeper into the finer points of Python and how to get started in algorithmic trading with Trality, let's take a brief trip back to the future.

Getting Started with Python and Algorithmic Trading

With Trality's industry-leading technology, anyone can take advantage of Python in order to build a crypto trading bot and gain a leg up in algorithmic trading. Our world-beating Code Editor is the world's first browser-based Python Bot Code Editor, which comes with a state-of-the-art Python API, numerous packages, a debugger and end-to-end encryption. We offer the highest levels of flexibility and sophistication available in private trading. In fact, it's the core of what we do at Trality. If you're already proficient in Python, then take a look at the informative video that Trality co-founder and CEO Moritz Putzhammer has put together about coding your first (or next) bot. Follow the step-by-step guide, which covers topics including choosing a bot template, the four basic steps in algorithm creation, Trality's all new Position Management System (tracks key metrics automatically), backtesting, fine-tuning your strategy, adding exchanges, and virtual/live trading. We also urge you to take advantage of Trality Documentation, a really useful tool that provides a detailed introduction to our Code Editor (e.g. core concepts, APIs, and our Cook Book).

What makes a good algorithmic trader?

Sprint, swim, cycle—algorithmic trading is a lot like being a triathlete. Now I know what you're thinking: not another one of those inspirational sports analogies... Just like triathletes, though, traders must master three essential skills in order to succeed: math, finance and coding. You can be brilliant at math and know coding inside-out, but if you don't know much about finance

then you're going to have difficulty making it to the finish line. You need to have creative ideas about how to trade, you need to be able to translate those ideas into mathematical models, and finally implement them in code. But it's more than just mastering technical skills. Anyone can learn to swim. Or become good at running. Or be a whiz on a bike. Those are the things that will get you past the qualifying stage and into the race. But to really outperform others or exceed what you thought was possible for yourself, you've got to love the feel of the water and the ground beneath your feet, and that metal frame, with its gears, pedals and wheels, needs to become an extension of your body. At Trality, we can equip you with world-class, state-of-the-art tools to put you in the best position possible when it comes to the big race. The rest is up to you.

Learn How to Crunch Financial Data

Data analysis is a crucial part of finance. Besides learning to handle dataframes using Pandas, there are a few specific topics that you should pay attention to while dealing with trading data.

How to exploring data using Pandas

One of the most important packages in the Python data science stack is undoubtedly Pandas. You can accomplish almost all major tasks using the functions defined in the package. Focus on creating dataframes, filtering (loc, iloc, query), descriptive statistics (summary), join/merge, grouping, and subsetting.

How to deal with time-series data

Trading data is all about time-series analysis. You should learn to resample or reindex the data to change the frequency of the data, from minutes to hours or from the end of day OHLC data to end of week data. For example, you can convert 1-minute time series into 3-minute time series data using

the resample function:

```
df_3min = df_1min.resample('3Min', label='left').agg({'OPEN':  
'first', 'HIGH': 'max', 'LOW': 'min', 'CLOSE': 'last'})
```

How to Write Fundamental Trading Algorithms

A career in quantitative finance requires a solid understanding of statistical hypothesis testing and mathematics. A good grip over concepts like multivariate calculus, linear algebra, probability theory will help you lay a good foundation for designing and writing algorithms.

You can start by calculating moving averages on stock pricing data, writing simple algorithmic strategies like moving average crossover or mean reversion strategy and learning about relative strength trading.

After taking this small yet significant leap of practicing and understanding how basic statistical algorithms work, you can look into the more sophisticated areas of machine learning techniques. These require a deeper understanding of statistics and mathematics.

Here are two books you can start with:

- Quantitative Trading: How to build your own Algorithmic Trading Business —By Dr. Ernest Chan
- Book on Algorithmic Trading and DMA — By Barry Johnson

Learn About Backtesting

Once you are done coding your trading strategy, you can't simply put it to the test in the live market with actual capital, right? The next step is to expose this strategy to a stream of historical trading data, which would generate trading signals. The carried out trades would then accrue an

associated profit or loss (P&L) and the accumulation of all the trades would give you the total P&L. This is called backtesting.

Backtesting requires you to be well-versed in many areas, like mathematics, statistics, software engineering, and market microstructure. Here are some concepts you should learn to get a decent understanding of backtesting:

- You can start by understanding technical indicators. Explore the Python package called TA_Lib to use these indicators.
- Employ momentum indicators like parabolic SAR, and try to calculate the transaction cost and slippage.
- Learn to plot cumulative strategy returns and study the overall performance of the strategy.
- A very important concept that affects the performance of the backtest is bias. You should learn about optimization bias, look-ahead bias, psychological tolerance, and survivorship bias.

Performance Metrics—How to Evaluate Trading Strategies

It's important for you to be able to explain your strategy concisely. If you don't understand your strategy, chances are on any external modification of regulation or regime shift, your strategy will start behaving abnormally.

Once you understand the strategy confidently, the following performance metrics can help you learn how good or bad the strategy actually is:

Sharpe Ratio—heuristically characterizes the risk/reward ratio of the strategy. It quantifies the return you can accrue for the level of volatility undergone by the equity curve.

- Volatility—quantifies the “risk” related to the strategy. The Sharpe ratio also embodies this characteristic. Higher volatility of an underlying asset often leads to higher risk in the equity curve and that results in

smaller Sharpe ratios. Maximum Drawdown—the largest overall peak-to-trough percentage drop on the equity curve of the strategy.

- Maximum drawdowns are often studied in conjunction with momentum strategies as they suffer from them. Learn to calculate it using the numpy library.
- Capacity/Liquidity—determines the scalability of the strategy to further capital. Many funds and investment management firms suffer from these capacity issues when strategies increase in capital allocation.
- CAGR—measures the average rate of a strategy's growth over a period of time. It is calculated by the formula: $(\text{cumulative strategy returns})^{(252/\text{number of trading days})}$