Is Algorithmic Trading the Future?

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# What is Algorithmic Trading:

Algorithmic trading (also called as automated trading, black-box trading or algo-trading) uses a computer program that follows a set of instructions (an algorithm) to place a trade. The trade, in theory, can generate profit 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.

1. Advantages:

• Algorithmic trading combines computer programming and financial markets to execute trades at precise moments.

•Algorithmic trading attempts to strip emotions out of trades, ensures the most efficient execution of a trade, places orders instantaneously and may lower trading fees.

•Common trading strategies include trend-following strategies, arbitrage opportunities, and index fund rebalancing.

•Algorithmic trading is also executed based on trading volume (volume-weighted average price) or the passage of time (time-weighted average price).

1. Benefits of Algorithmic Trading:

•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.

1. Algorithmic Trading Strategies:

Any strategy for algorithmic trading requires an identified opportunity that is profitable in terms of improved earnings or cost reduction. The following are common trading strategies used in algo-trading:

•Trend Following Strategies:

The most common algorithmic trading strategies follow trends in moving averages, channel breakouts, price level movements, and related technical indicators. These are the easiest and simplest strategies to implement through algorithmic trading because these strategies do not involve making any predictions or price forecasts.

•Arbitrage Opportunity:

Buying a dual-listed stock at a lower price in one market and simultaneously selling it at a higher price in another market offers the price differential as risk-free profit or arbitrage. The same operation can be replicated for stocks vs. futures instruments as price differentials do exist from time to time. Implementing an algorithm to identify such price differentials and placing the orders efficiently allows profitable opportunities.

•Index Fund Rebalancing:

Index funds have defined periods of rebalancing to bring their holdings to par with their respective benchmark indices. This creates profitable opportunities for algorithmic traders, who capitalize on expected trades that offer 20 to 80 basis points profits depending on the number of stocks in the index fund just before index fund rebalancing. Such trades are initiated via algorithmic trading systems for timely execution and the best prices.

•Mathematical Model-Based Strategies:

Proven mathematical models, like the delta-neutral trading strategy, allow trading on a combination of options and the underlying security.

•Trading Range (Mean Reversion):

Mean reversion strategy is based on the concept that the high and low prices of an asset are a temporary phenomenon that revert to their mean value (average value) periodically. Identifying and defining a price range and implementing an algorithm based on it allows trades to be placed automatically when the price of an asset breaks in and out of its defined range.

•Volume-Weighted Average Price:

Volume-weighted average price strategy breaks up a large order and releases dynamically determined smaller chunks of the order to the market using stock-specific historical volume profiles. The aim is to execute the order close to the volume-weighted average price (VWAP).

•Time Weighted Average Price:

Time-weighted average price strategy breaks up a large order and releases dynamically determined smaller chunks of the order to the market using evenly divided time slots between a start and end time. The aim is to execute the order close to the average price between the start and end times thereby minimizing market impact.

•Percentage of Volume:

Until the trade order is fully filled, this algorithm continues sending partial orders according to the defined participation ratio and according to the volume traded in the markets. The related “steps strategy” sends orders at a user-defined percentage of market volumes and increases or decreases this participation rate when the stock price reaches user-defined levels.

•Implementation Shortfall:

The implementation shortfall strategy aims at minimizing the execution cost of an order by trading off the real-time market, thereby saving on the cost of the order and benefiting from the opportunity cost of delayed execution. The strategy will increase the targeted participation rate when the stock price moves favourably and decrease it when the stock price moves adversely.

1. Technical Requirement for Algorithmic Trading:

Implementing the algorithm using the computer program is the final stage of the algorithmic trading, accompanied by backtesting. The main challenge is to transform the identified strategy into an integrated computerised process that has access to a trading account for placing order. The following are the requirement for the algorithmic trading:

•Computer-programming knowledge to program the required trading strategy, hired programmers, or pre-made trading software.

•Network connectivity and access to trading platforms to place orders.

•Access to market data feeds that will be monitored by the algorithm for opportunities to place orders.

•The ability and infrastructure to backtest the system once it is built before it goes live on real markets.

•Available historical data for backtesting depending on the complexity of rules implemented in the algorithm.

Algorithmic trading is legal. There are no rules or laws that limit the use of trading algorithms. Some investors may contest that this type of trading creates an unfair trading environment that adversely impacts markets. However, there’s nothing illegal about it.

# What is High-Frequency Trading (HFT):

High-frequency trading (HFT) is an automated trading platform that large investment banks, hedge funds, and institutional investors employ. It uses powerful computers to transact a large number of orders at extremely high speeds. These high-frequency trading platforms allow traders to execute millions of orders and scan multiple markets and exchanges in a matter of seconds, thus giving institutions that use the platform an advantage in the open market.

The systems use complex algorithms to analyze the markets and are able to spot emerging trends in a fraction of a second. By being able to recognize shifts in the marketplace, the trading systems send hundreds of baskets of stocks out into the marketplace at big-ask spreads advantageous to the trader.

1. Features of HFT:

•Use of extraordinarily high speed and sophisticated programs for generating, routing, and executing orders

•Use of co-location services and individual data feeds offered by exchanges and others to minimize network and other latencies

•Very short time-frames for establishing and liquidating positions

•Submission of numerous orders that are canceled shortly after submission

•Ending the trading day in as close to a flat position as possible (that is, not carrying significant, unhedged positions overnight)

High-frequency trading became commonplace in the markets following the introduction of incentives offered by exchanges for institutions to add liquidity to the markets. By offering small incentives to these market makers, exchanges gain added liquidity, and institutions that provide the liquidity also see increased profits on every trade they make, on top of their favorable spreads.

Although the spreads and incentives amount to a fraction of a cent per transaction, multiplying that by a large number of trades per day amounts to sizable profits for high-frequency traders.

High-frequency traders earn their money on any imbalance between supply and demand, using arbitrage and speed to their advantage. Their trades are not based on fundamental research about the company or its growth prospects, but on opportunities to strike.

Though HFT doesn’t target anyone in particular, it can cause collateral damage to retail investors, as well as institutional investors like mutual funds that buy and sell in bulk.

While algorithmic trading and high-frequency trading have arguably improved market liquidity and asset pricing consistency, their use has also given rise to certain risks, primarily its ability to amplify systemic risk.

1. Algorithmic High-Frequency Trading:

HFT takes algorithmic trading to a different level altogether. It is like algo-trading on steroids. The goal is to make tiny profits on each trade, often by capitalizing on the price discrepancies for the same stock or asset in different markets. HFT is diametrically opposite from traditional long-term buy and hold investing, since the arbitrage and market-making activities that are HFT’s bread and butter generally occur within a small time window before the price discrepancies or mismatch disappear.

Algorithmic trading and HFT have become an integral part of the financial markets due to the convergence of several present-day markets, the increasing complexity of financial instruments and products, and the ceaseless drive towards greater efficiency in trade execution and lower transaction costs.

I. Risks involve in algorithmic HFT:

While algorithmic trading and HFT arguably have improves market liquidity and asset pricing consistency, their growing use also has given rise to certain risks that can’t be ignored.

Some of the risks involved in algorithmic HFT are:

•Amplification of systemic risks:

This is one of the biggest risks of algorithmic HFT. This occurs because of the strong inter-linkages between financial markets such as those in the US, algorithms operating across markets can transmit shocks rapidly from one market to the next, thus amplifying systemic risk.

•Errant Algorithm:

The dazzling speed at which most algorithmic HFT takes place means that one errant or faulty algorithm can rack up millions in losses in a very short period. For example, if a faulty algorithm does trade by buying them at the higher “ask” price and instantly selling them at the lower “bid” price, on the contrary, the market makers buy stocks from investors at the bid price and sell to them at the offer price, the spread being their trading profit. So due to this faulty algorithm, the rival traders can swoop in and can take advantage of this algorithm while we try to isolate the source of the problem. By the time we find the fault, we would have become bankrupt.

•Huge Investor Losses:

Volatility swings worsened by algorithmic HFT can saddle investors with huge losses. Many investors routinely place stop-loss orders on their stock holdings at level that are 5% away from current trading prices. If the market gap is down for no apparent reason (or even for a very good reason), these stop-losses would be triggered. Moreover, if stocks subsequently rebound in short order, investors would have needlessly incurred trading losses and lost their holdings.

•Loss of Confidence in Market Integrity:

Investors trade in financial markets because they have full faith and confidence in their integrity. However, repeated episodes of unusual market volatility could shake this confidence and lead some conservative investors to abandon the markets altogether.

II. Measures to Combat Algorithmic HFT Risks:

With the risks involved in algorithmic HFT, exchanges and regulators have been implementing protective measures. In 2014, the Nasdaq OMX group introduced a “kill switch” for its member firms that would cut off trading once a pre-set risk exposure level is breached. While many HFT firms already have “kill switches” that can stop all the trading activity under certain circumstances, the Nasdaq switch provides an additional level of safety to counter rogue algorithms. Circuit-breakers were also introduced on October 1987, and are used to quell market panic when there’s a huge sell-off.

In Jan. 2021, the Commodity Futures Trading Commission implemented regulations for firm using algorithmic trading in derivatives. These regulations would require such firms to have pre-trade risk controls. A controversial provision that would have required firms to make the source code of their programs available to the government was withdrawn.

The bottom line is that algorithmic HFT has a number of risks, the biggest of which is its potential to amplify systemic risk. Its propensity to intensify market volatility can ripple across to other markets and stoke investor uncertainty. Repeated bouts of unusual market volatility could wind up eroding many investors’ confidence in market integrity.

# Our Work:

Notebook: https://colab.research.google.com/drive/1WAV8pYVLnHdgCPeb4TJ7mrD9fMWWP6x1?usp=sharing

We used yahoo finance to import the details of 5 stock tickers, namely Google, Amazon, Microsoft, Apple, and Facebook. The details include the Date, Open price, High price, Low price, Close price, Adjusted Close price, and Volume of each stock ticker. We then used the Close price of each ticker to analyze the price variability from the start of the year 2022 to the 18th of July 2022 and then compared them by plotting them all in one graph. We used candlestick patterns for each ticker to see the day's open, high, low, and close prices. Then, we took the adjusted close price of each security and concatenated them to create a pandas data frame.

Further, we calculated each security's daily returns and daily returns global statistics. We plotted the daily returns and adjusted close prices of each security side-by-side in subplots to compare them. We calculated the coefficient correlation and p-value for every pair of 5 securities. Through its analysis, we concluded that Google and Microsoft have been trending similarly over the past few months. We also calculated the cumulative returns of each security. We then tried creating two portfolios and calculated and analyzed their cumulative returns and Sharpe ratio to make our conclusions.

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