Algorithmic Trading Landscape

Ally Zach

May 17, 2022

Key Insights

- Algorithmic trading programs, or bots, replace the need for traders to manually open and close positions, while taking out the hindrance of emotional attachment.
- Hedge funds, trading platforms and avid programmers make use of directional, market neutral and artificial intelligence based strategies to increase their capital, even in a downtrending market.
- Trading bots continually increase market efficiency, creating liquidity where trading volume is sparse.

Keeping up with crypto's 24/7 marketplace is daunting. Traders often feel addicted to their portfolios, harboring the urge to monitor the rapid price movements out of the fear of missing out. To avoid exchanging a healthy social life for a trading-induced adrenaline rush, algorithmic trading offers an exit strategy for crypto trading fanatics.

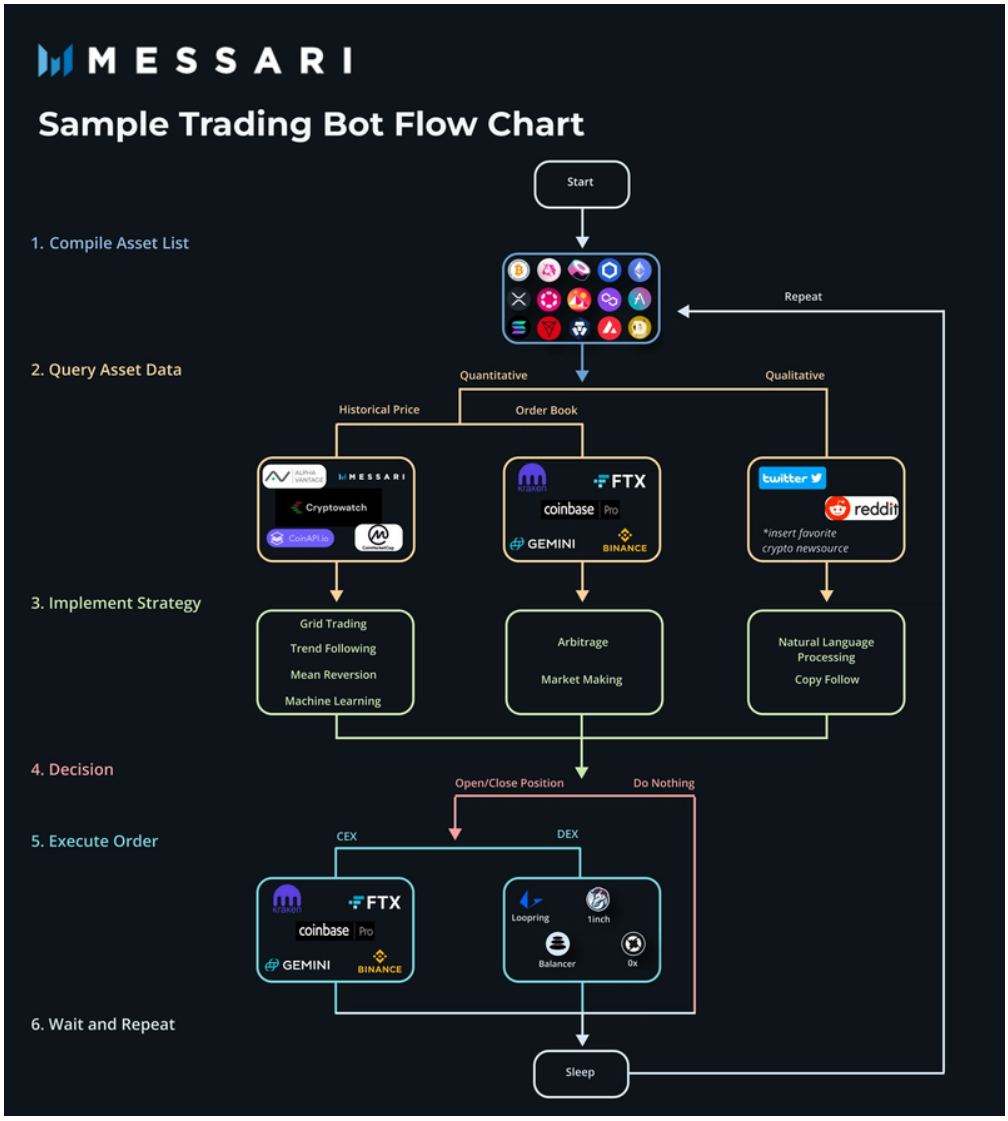
In a nutshell, trading bots are automated trading programs that replace the need for traders to manually open and close positions. Bots stay informed on the rapid swings in the market, take emotion out of a trading strategy, and help investors focus on other aspects of their lives.

How They Work:

Automated trading programs, or bots, automatically execute trades instead of humans manually entering their trades.

There are several ways to get involved in automated trading. While some retail investors choose to deploy their own programs, investors without coding backgrounds can opt to use popular centralized exchanges, algorithmic trading platforms, and asset managers.

There are many nuances to algorithmic trading, but the typical program structure looks something like this:



1. Copile Asset List

The first step is to determine what you want to trade. Cryptoasset scanners such as TradingView, Crypto.com, CoinTelegraph, and Messari can help narrow the never-ending list of cryptoassets.

2. Query Asset Data

All trading strategies require either quantitative or qualitative inputs. Many crypto data aggregators offer free APIs that users can use to pull historical metrics. Typically, if the trader is implementing a strategy that relies on an order book exchange, they pull the data from said exchanges in real time. Popular qualitative trading strategies make use of sentiment analysis on Twitter, Reddit, or other news sources. Some even employ a copy trading strategy where

they simply mimic the trades of any livestreamed trader.

3. Define and Implement Strategy

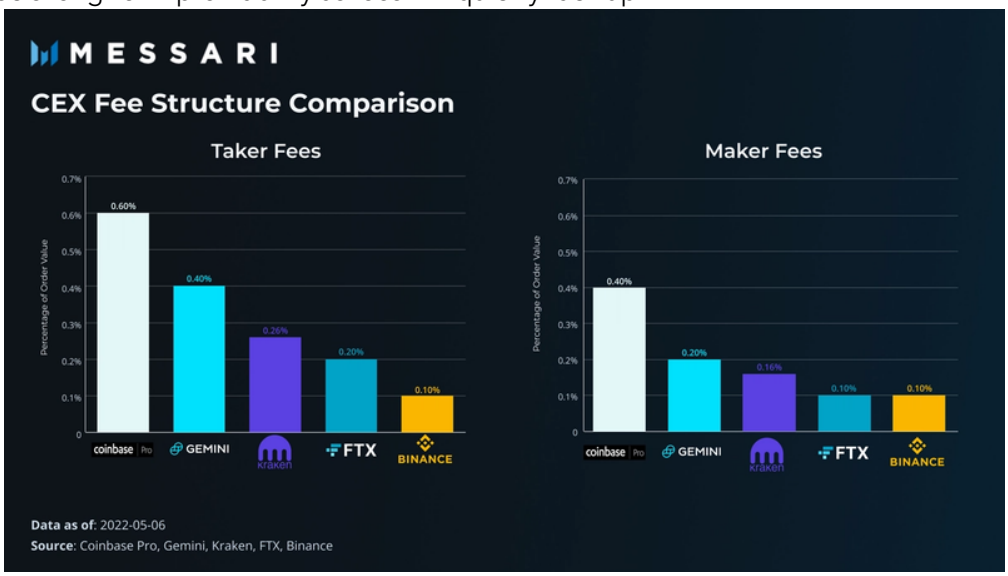
Most of the work is found after processing the accumulated data. Prior to deploying the strategy with actual money, trader's typically backtest, or simulate how the bot would perform with historic data. Backtesting is an often-overlooked fundamental step to algorithmic trading. It not only allows traders to estimate a strategy's performance in a live market but also unearths unforeseen obstacles such as slippage, realized trading fees, and overall flaws in the program.

4. Decision

Based on the prior analysis, the user chooses to open or close a position.

5. Execute Order

Most centralized exchanges (some decentralized exchanges and aggregators like Loopring, 1inch, Balancer, and 0x) have APIs with order functionality. Choosing where to trade greatly affects long-term profitability as fees will quickly rack up.



The fees shown above assume a small portfolio size (30 day trading volume less than $10,000). Taker fees imply that the order placed is taking liquidity out of the market or filling an existing order in the order book, whereas maker fees imply that the order is adding liquidity to the market or creating an order in the order book. Order book exchanges in general, want to encourage users to add liquidity to the market, hence the overall lower fees for market makers.

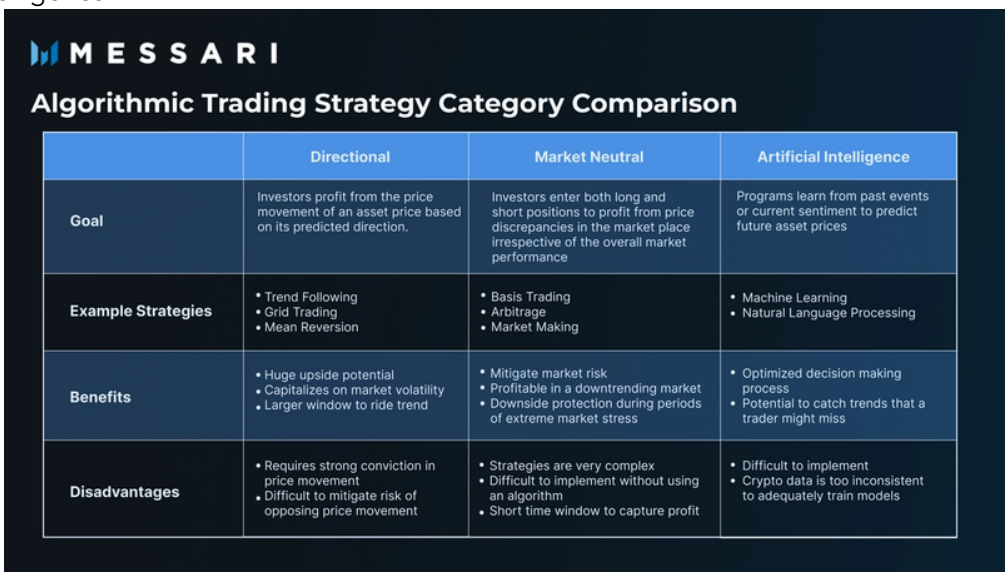
Trading bots with high-frequency trading strategies can quickly accumulate losses due to fees. As tempting as it is to flock to the cheapest CEX, programmers can take advantage of popular DEX and DEX aggregators. Depending on the size of the trade and network gas fees at the time, this may be a more cost-effective route to implement a high-frequency trading strategy. In general, decentralized solutions are migrating toward Layer 2 scaling solutions so gas fees are less of an issue.

6. Wait and Repeat

The beauty of a trading bot is the automatic repetition of the trader's strategy. Whether the trader is employing a high-frequency trading strategy or swing trading, the bot can be programmed to rest for a certain period of time and execute again when ready.

Popular Strategies

There is no catchall solution for beating the crypto market. Retail traders and asset managers alike use numerous strategies, usually implementing a handful at once, to enhance their portfolio value. Most strategies fall into three subgroups: directional, market neutral, and artificial intelligence.



	Directional	Market Neutral	Artificial Intelligence
Goal	Investors profit from the price movement of an asset price based on its predicted direction.	Investors enter both long and short positions to profit from price discrepancies in the market place irrespective of the overall market performance	Programs learn from past events or current sentiment to predict future asset prices
Example Strategies	• Trend Following • Grid Trading • Mean Reversion	• Basis Trading • Arbitrage • Market Making	• Machine Learning • Natural Language Processing
Benefits	• Huge upside potential • Capitalizes on market volatility • Larger window to ride trend	• Mitigate market risk • Profitable in a downtrending market • Downside protection during periods of extreme market stress	• Optimized decision making process • Potential to catch trends that a trader might miss
Disadvantages	• Requires strong conviction in price movement • Difficult to mitigate risk of opposing price movement	• Strategies are very complex • Difficult to implement without using an algorithm • Short time window to capture profit	• Difficult to implement • Crypto data is too inconsistent to adequately train models

Directional trading strategies are often more profitable in the equities market than in crypto, due to the lower amount of volatility and larger liquidity base. However, with the current market state, there are more opportunities in the crypto space for successful market neutral strategies as the market is less efficient.

Directional Trading Strategies:

Trend Following:

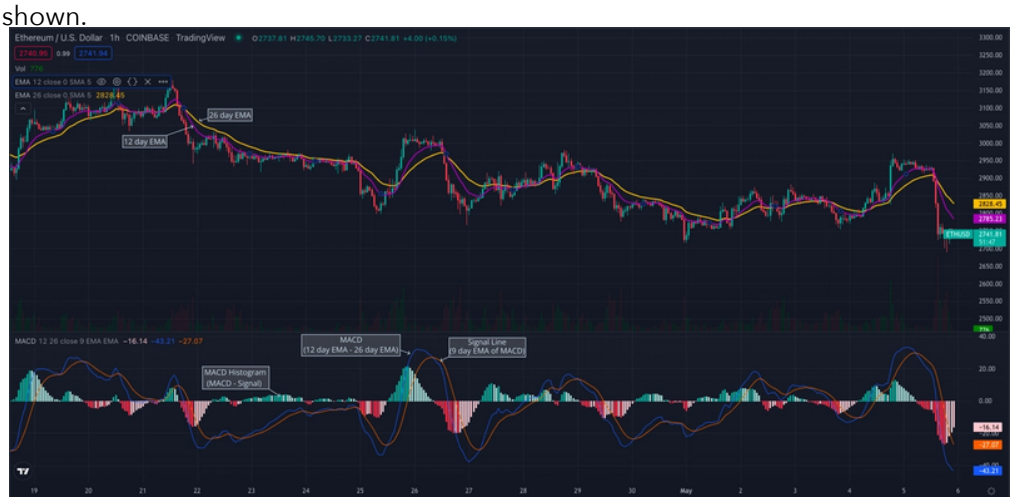
The most common and arguably easiest strategy to implement is trend following. Trend trading first analyzes an asset's price or volume momentum in a particular direction and then makes trades based on the assumption of continued movement. In other words, traders enter long positions for assets with significant upward potential and short positions for downward potential.

While some traders may use macroeconomic factors or strong conviction to determine their positions, momentum-based trading bots will repeatedly employ a trader's favorite technical analysis indicators to determine entry and exit points. The most common momentum-

based indicators are built off of moving average calculations, which is a series of averages on different subsets of the full dataset. Moving averages also help smooth out extraneous price data.

Moving Average Convergence Divergence (MACD)

Moving average convergence divergence (MACD) is a momentum-based indicator that quantifies the difference between two moving averages of the asset's price. First, an exponential moving average (EMA) is calculated based on two different time periods (typically 12 days and 26 days). Because EMAs place more weight on the most recent data points, the difference between the short- term EMA and long- term EMA is what makes up the MACD line. Finally, an even shorter period EMA is calculated from the MACD signal (typically 9 days). The difference between this signal and the MACD line is what yields the overall MACD histogram as shown.



Source: TradingView

Traders primarily use the reversal points of the histogram, that is, when it changes from positive to negative and vice versa. When the MACD line crosses above the signal line, rendering a change to a positive histogram value, this tends to be a bullish signal. Likewise, when the MACD crosses below the signal line, this tends to be bearish.

Trend following is one of the most popular strategies for algorithmic trading, especially for retail investors. It is relatively simple and allows for a larger window for execution as it typically follows larger trends in the marketplace. However, stop losses are crucial for this strategy to help mitigate the loss of capital, because unforeseen events can cause even a strong trend to reverse unexpectedly.

Mean Reversion:

Mean reversion is almost the polar opposite of a trend trading approach. This strategy assumes that extreme price action is temporary and the price will naturally return to normal levels. Traders employ a moving average indicator and enter long or short positions to counteract the irregular movement in price.

Bollinger Bands

Source: TradingView

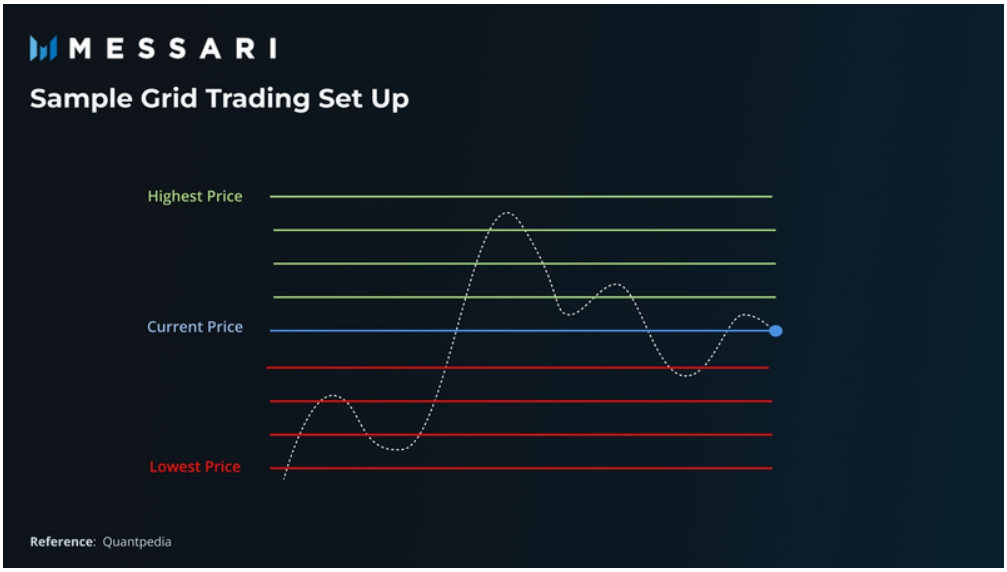
One of the most frequently used indicators built on the basis of mean reversion is the Bollinger Bands envelope. Bollinger Bands are a type of price envelope which define the upper and lower price range levels, plotted at a standard deviation above and below a moving average of the price. Typically, the standard deviation is computed over a time period of 20 days, and the band is plotted at 2 standard deviations away from the mean.

The bands will pinch during periods of low volatility, forecasting a sharp movement in the price. Similarly, when the bands expand during periods of high volatility, an end to the current trend could be near. The majority of price action occurs between the upper and lower bands, but any price breakout outside of the bands could mean the current trend will continue.

The main risk associated with this strategy, especially with highly volatile assets, is that an irregular movement in price doesn't always mean that it will correct itself. The mean could just move to meet the current price.

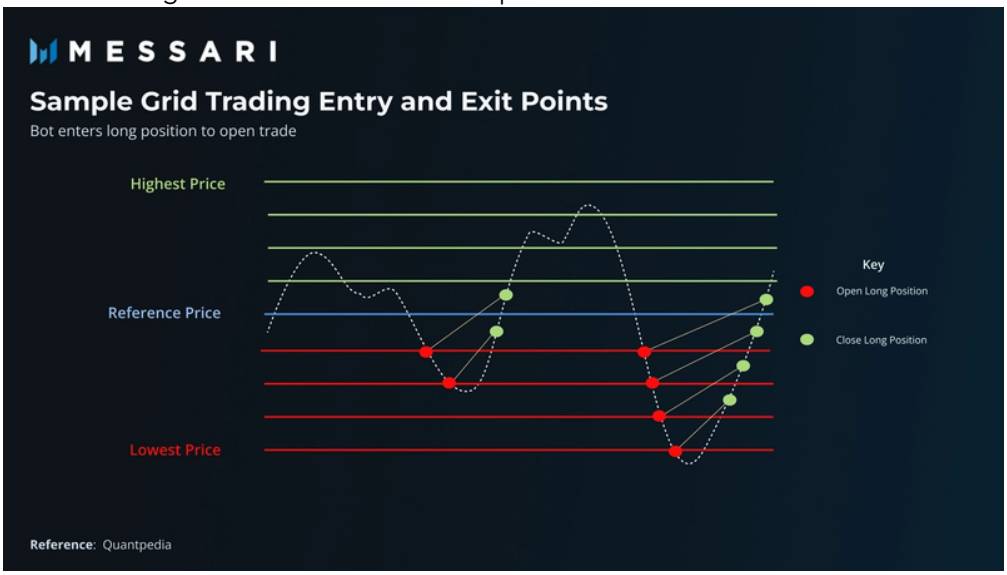
Grid Trading:

Grid trading aims to capitalize on normal price volatility. In this strategy, the automated program will repeatedly buy and sell the asset at set price intervals away from a predefined reference price.



When the program begins, the user specifies a starting reference point, typically at the current asset price. Then, they specify a number of entry and exit points at an equal interval away from the reference point. The highest and lowest execution prices of the grid are usually based on the historical price action of the asset. Traders can enter with either long or short positions.

Assuming the trader wants to initiate a long trade, the program will rapidly purchase the asset at the predefined interval as the price decreases. When the asset price begins to rise again, each trade will close at a certain point above the original purchase price. The difference between each leg of the trade is retained as profit.

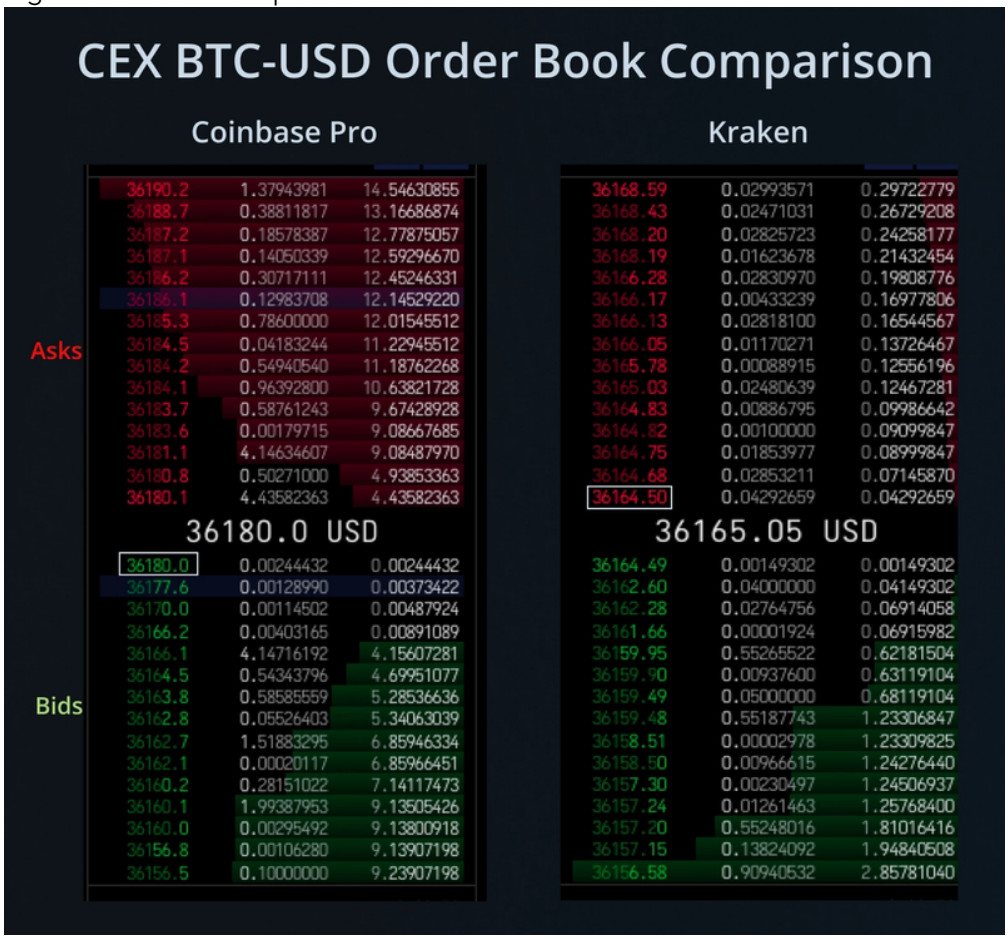


The main risk with grid trading is the potential for trades to not close when the price doesn't move the way the program intended. As with other strategies, stop losses can be used to mitigate this risk.

Market Neutral Trading Strategies:

Arbitrage Trading:

At any point in time, the price of Bitcoin can vary by up to a few percentage points on different exchanges. The different prices are a result of varying levels of trading volume, liquidity, and fees. The variation in price is what is known as an arbitrage opportunity. Traders can take advantage of the price discrepancies by buying a digital asset on one exchange then quickly selling it on another for a profit.



Source: Cryptowatch

The BTC/USD order books for Coinbase Pro and Kraken reveal a chance for a profitable arbitrage opportunity. A trader could make a small profit by purchasing the lowest asking price on Kraken ($36,164) and selling for the highest bid price on Coinbase Pro ($36,180).

An important aspect to note is the far right column on the order book, which lists the cumulative volume of orders waiting to be filled on the exchange. For the example trade, the trader would be able to purchase about 0.044 BTC, but they would only be able to sell 0.002 BTC at their chosen sell point. However, the trader could incrementally offload their purchase at lower prices until the entire quantity is resolved at the original price.

Cryptoassets are highly volatile in nature, resulting in an extremely short window to take advantage of price differentials. Bots can outperform human traders because they can ana-

lyze large data sets and make trades automatically.

While price exploitation might seem sketchy, it is actually encouraged in the United States. Arbitrageurs provide liquidity to the market, since prices become more aligned with each trade. Overall, the strategy leads to a more efficient marketplace and even competition on exchanges. However, arbitrage opportunities are growing sparse and are less profitable with the increasing number of bots in the marketplace.

Cost Basis Trading:

Cost basis trading (also called "cash and carry") profits from price differences of a single cryptocurrency by taking opposing positions in the spot and derivatives market. By taking advantage of market inefficiencies, bots can find moments where the futures price of the asset is higher than the current spot price.

For example, a trader can purchase ETH/USD on an exchange for $1,900 and short sell the same amount of the ETH/USD futures contract for $2,100. Upon expiration of the derivative contract, the trader can lock in $200 of profit.

Naturally as the contract expires, the premium decays and converges with the current spot price, rendering an almost riskless trade. As the crypto market becomes more efficient and perhaps even less volatile, the opportunities to profit from this strategy will become few and less profitable.

Market Making:

Illiquid markets are governed by low trading volume and often result in greater price volatility and wider bid-ask spreads.

Market making bots take advantage of the wide bid-ask spreads, by simultaneously submitting buy and sell orders to take the spread as a profit. For example, if the highest bid price on an exchange for a token is $1000 and the lowest asking price is $1,100, the spread is $100. A bot could submit a buy order for $1,000 and sell order for $1,100 and retain the spread as profit.

Market making bots are sometimes employed by the exchange itself, to help provide liquidity to its users. By flooding the marketplace with orders targeting illiquid assets, the bid-ask spread should tighten as other orders find their corresponding trading pair. Although the strategy seems fairly straight forward, it's oftentimes difficult to employ. Bots only have fractions of a second to successfully use this strategy because of how volatile the crypto market is.

Artificial Intelligence:

Artificial intelligence is the art of training a computer to learn from data and make informed decisions to replicate (or enhance) the human thought process. Given the success of AI algorithms in other industries, it's no surprise that they have made their way into the financial markets. Training a computer to learn from historic asset data to predict future movement seems like the ultimate dream come true.

Machine learning and natural language processing (NLP) are two common artificial intelligence strategies for crypto bots. Machine learning uses data sets to train a model that can

make its own predictions. NLP is a subset of machine learning in which the program analyzes written text in place of raw, quantitative data.

There are three core types of machine learning processes: supervised, unsupervised, and reinforcement. Trading bots typically make use of the reinforcement type of machine learning wherein the bot learns by trial and error. The program is rewarded for making the correct decision or disciplined for incorrect decisions. In terms of an algorithmic trading strategy, the model receives historical price data and learns to pick entry and exit points based on previous patterns.

There are three fundamental steps to developing a machine learning trading bot algorithm. First, the trader collects and cleans the data then sets it up for processing. The data should be reliable and should omit extraneous data points. Inaccurate data will render inaccurate results 100% of the time. The cleaned data set is split into two: one set for training the model and the other for testing what the model learned.

The second and most critical step is training the model. Here, the programmer feeds the cleaned data to the model to find trends and eventually make predictions. Finally, the programmer tests their trained model with the second prepared data set and makes adjustments after reviewing the results.

While machine learning seems like a cure-all strategy for trading crypto, it's often very difficult to see returns that are as consistent as some of the other strategies we discussed. More specifically, the biggest hurdle is overcoming inconsistencies in data. From an approach based on sentiment analysis, irrelevant noise tends to crowd out actionable data from the most consistent sources. Take crypto Twitter for example. While there might be a few meaningful notes and general traction in the feelings about a certain asset, it's hard to filter out what matters versus the constant shilling and memes floating around in the space.

Furthermore, crypto is a fairly new space and asset prices are often affected by idiosyncratic events. Forks, new protocol launches, and random mass sell-offs make it near impossible to train a model. Although machine learning could take over the trading industry, the crypto market needs more time to develop into a more stable environment.

Implementation

Algorithmic Trading Platforms

Although the cryptocurrency market is fairly young, developers have already constructed platforms to help crypto investors who lack the programming skills to implement their own automated strategies.

Some of the more popular algorithmic trading platforms like 3Commas, Cryptohopper, and TradeSanta offer a range of bots to choose from. After paying a small membership fee, users can select trend following, grid trading, dollar cost averaging, and even a copy following feature that mimics a specified trader's moves. Cryptohopper even offers arbitrage and artificial intelligence-based strategies for their premier membership tier.

The aforementioned platforms integrate the user's centralized exchange account to exercise trades. Pionex, on the other hand, is a standalone exchange that uses a merged liquidity base from its own users, Binance and Huobi, to fill orders. All of these platforms inherit the fees associated with the exchange they are deployed on.

Certain exchanges, like FTX, have built out software that allows users to apply simplified code to execute their own trading algorithms. Quant Zone provides a simple framework,

made up of triggers and action statements to supplement a range of strategies, from scaling into a position to basis trades. Although it may be easy to implement, Quant Zone does not provide any resources to backtest.

In the equities market, automated platforms like Wealthfront and M1 Finance have given retail investors the ability to automate deposits and structure portfolios without the painstaking manual calculation process. The market for automated management has unsurprisingly transitioned into crypto. With the number of cryptocurrencies growing exponentially, investors will seek out more efficient methods to manage their portfolios, reiterating the importance of the aforementioned platforms.

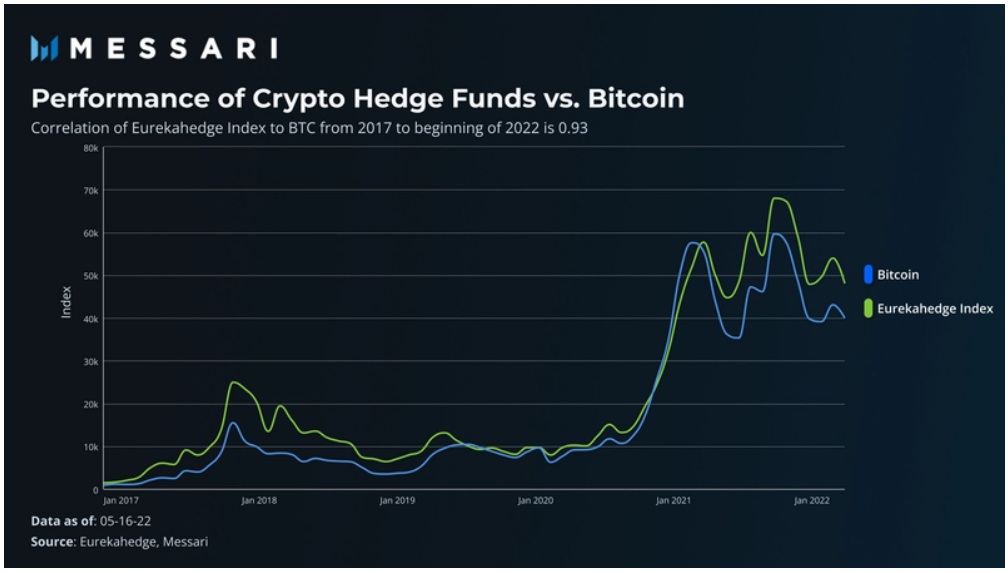
Hedge Funds

Algorithmic portfolio management is hardly a new concept to the finance industry. It's estimated that nearly 40% of crypto hedge funds are primarily quant based with many funds at least dabbling in the algorithmic approach.

The vast majority of cryptocurrency hedge funds rely on algorithms to maintain at least a portion of their portfolios. An asset manager may systematically allocate capital or scale in and out of certain assets to automate risk management. At a very basic level, hedge funds make use of exchange APIs to automate their order process. Compared to their quant fund counterparts, typical hedge funds prioritize human oversight to their algorithms, trusting human intuition over a program. Between 2017 and 2020, many hedge funds also used a mix of human oversight and quantitative strategies, allowing the bot to find investment ideas, but ultimately allocation decisions remained in the hands of humans.

Quant funds typically offer their clients both market neutral and directional-based funds to choose from. Market neutral portfolios focus on mitigating some of their client's risk in the crypto market place, thus prioritizing consistent profitability. Directional strategies, on the other hand, can offer greater overall returns, but they typically are more risk prone and result in larger drawdowns.

As algorithmic trading continues to solidify its place in the crypto market, the market has become increasingly more efficient. This leaves fewer arbitrage opportunities left for price exploitation. As a result, hedge funds may choose to optimize their more directional-based trading strategies. In order to provide a risk-averse fund for their clients, these strategies tend to have a heavy correlation to their underlying assets.



Historically, hedge fund portfolios have had a high beta with bluechip cryptocurrencies. The Eurekahedge cryptocurrency hedge fund index comprises 19 equally weighted funds. As shown above, the index maintained a high correlation of 0.93 to Bitcoin from 2017 to the beginning of 2022. While this may be favorable in an uptrending market, in stressful times, investors seek more balanced portfolios. Professional portfolios tend to diversify their assets and promise steady overall returns.

DIY

Starting a trading bot from scratch can be intimidating, especially for novice programmers. Luckily, there are hundreds of sample bots on GitHub and an abundance of courses and resources available for free online. Overall, constructing a crypto bot can save on membership fees, yield a broader reach to various marketplaces, and be an extremely rewarding endeavor.

As with any programming project, the main risk with deploying your own bot is in the code. Before deployment, the trader needs to thoroughly vet and backtest their strategy. Exchanges with paper trading and frameworks like BackTrader are great resources for ensuring the bot operates as anticipated.

Building a homemade trading bot is often the most effective way for traders to trade algorithmically as most investors lack the investment capital to participate in a hedge fund. Even if traders were to use automated trading platforms, they would have limited options compared to the freedom of developing their own bots.

Final Thoughts

Although most traders have good intentions when implementing an automated trading strategy, the ease of price exploitation has also paved the way for scalpers. Because the bulk of algo trading is performed with crypto tokens, opportunities have emerged for applications in the Web3 space. NFT scalping bots have notoriously made their way to recent headlines, excluding common investors from projects. At the community's expense, bots are capable

of controlling the overall floor price to make a quick profit. With the steady release of NFT aggregators, the control will hopefully begin to fall back into the communities hands.

Although price exploitation seems unfair to common investors, it also provides a more efficient market to trade in. Arbitrageurs and high-frequency trading bots bring about higher trading volumes and consistent market prices across exchanges. In addition, market neutral and some directional trading bots allow investors to maintain a steady income even in a downtrending market.

Algo trading is shaping the crypto landscape, providing liquidity where trading volume is sparse. As technology progresses, algorithmic trading continues to solidify its place in investors' toolkits. Hedge funds and retail investors alike see the potential of automating their crypto portfolios. Trading algorithms will only become stronger and more popular as the crypto space continues to exponentially expand.