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“Technical Analysis and the Creation of an Automated Trading Strategy”

Bachelor’s Thesis

Supervisor: Margus Kruus
PhD

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TALLINNA TEHNIKAÜLIKOOL
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“Tehniline analüüs ja automaatse kauplemisstrateegia loomine”

Bakalaureusetöö

Juhendaja: Margus Kruus
PhD

Tallinn 2020

Author’s declaration of originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

Author: Endrik Tamm

6.12.2020

Abstract

This bachelor's thesis contains a brief overview of technical analysis. There are comparisons of technical analysis and fundamental analysis with positive and negative sides of both types of analysis. The principles of Dow theory, which is an integral part of technical analysis are explained and also different methods of analysis are provided. It is explained how to read candlesticks, which are some different candlestick patterns and how to use them to minimize trading risk. Some main indicators that are used the most and which should in theory make it easier to understand price movements are shown. In the practical part of this thesis tradingview's pine script is used to program a strategy which will tell the user when to buy or sell currently viewed asset. All of the figures in this thesis are made by the author using tradingview and/or photoshop.

This thesis is written in english and is 39 pages long, including 6 chapters, 20 figures and 5 tables.

Annotatsioon

Tehniline analüüs ja automaatse kauplemisstrateegia loomine

Selles bakalaureusetöös on tehtud lühike ülevaade tehnilisest analüüsist. Välja on toodud tehnilise ja fundamentaalse analüüsi erinevad omadused ning mõlema positiivsed ja negatiivsed küljed. Tutvustatakse erinevaid analüüsi meetodeid ning ka Dow teooria printsiipe, mis on tehnilise analüüsi suur ja oluline osa. Selgitatakse ära, kuidas küünlaid lugeda, et saada aru, mis moodustavad ühe populaarseimaist hinnakaardistamise tüüpidest ja kuidas hinnaliikumist graafikutelt lugeda. Tuuakse näiteid erinevatest „küünlajala mustritest“, mis on üks põhilisi tehnilise analüüsi oskusi, et saada aimu kuhu hind võiks ja peaks liikuma. Iga näite kohta on ka kerge juhend, kuidas neid kasutada, et kauplemise riski minimaliseerida. On välja toodud mõned põhilised indikaatorid, mida tänapäeval enim kasutatakse ja mis teoorias peaks hinnaliikumiste arusaamist lihtsustama. Mõnda neist indikaatoritest rakendatakse ka praktilises osas. Lisaks tehakse lühike ülevaade tarkvarast, mida paljud kasutavad tehnilise analüüsi põhitööriistana ning mille abil luuakse praktilise osa skriptikood. Praktilises osas kasutatakse Tradingview poolt loodud pine skriptimiskeelt, et luua strateegia, mis ütleks kasutajale, millal vaadeldavat instrumenti osta või müüa. Valminud skript annab kasutajale võimaluse vähendada tehnilise analüüsi poolt nõutud ekraaniaega ostu ja müügi otsuste vastuvõtmiseks. Skript automatiseerib selle protsessi ja annab kasutajale signaale, millal midagi osta ja müüa. Välja tuuakse ka valminud skripti tulemused paari suvaliselt valitud turuinstrumendi vaatlusel, et näidata, kas valminud strateegia on enamasti kasumlik ja kas see strateegia rahuldaks kasutaja soovitud kasumlikkuse tingimusi. Kõik töös olevad pildid on loodud autori poolt kasutades tradingview ja/või photoshop tarkvara.

Lõputöö on kirjutatud inglise keeles ning sisaldab teksti 39 leheküljel, 6 peatükki, 20 joonist, 5 tabelit.

List of abbreviations and terms

Bull Market	An upward trending market
Bear Market	Downward trending market
Bulls	Buyers
Bears	Sellers
SMA	Simple moving average
EMA	Exponential moving average
MACD	Moving average convergence divergence
RSI	Relative strength index
CFD	Contract for differences
DJIA	Dow Jones industrial average
DJTA	Dow Jones transportation average
NYSE	New York Stock Exchange
CBOE	Chicago Board Options Exchange
NASDAQ	The National Association of Securities Dealers Automated Quotations

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1 Introduction

Before understanding the different aspects of technical analysis there has to be a basic knowledge about what trading is. In this context trading is not just the activity of buying or selling of goods and services but entering into trades by buying or selling anything that is available to trade on the open market in order to make a profit by anticipating the future price trend. Instruments that are traded range from basic commodities like coffee and oil all the way to stocks, bonds and even cryptocurrencies.

In trading, it is possible to bet on rising as well as on falling prices and thus make a profit even if the stock market or another financial market falls. If the trader believes, that his currently viewed trading instrument will appreciate in value he/she can buy shares and sell them at a higher price later to make a profit. Should the trader assume that prices will go down, a sell (short) trade can be entered with which a profit will be made if the price of the instrument will depreciate in value. [1]

The topic of trading and the use of technical analysis to enhance potential profits and minimize risk should be interesting to anyone who reads it because who among us wouldn't be interested in making potential profits with a push of a button. That is the end goal, to be able to make money by sitting behind the computer and clicking a button. It sounds really simple but the contrary is true. If you would start trading by simply speculating on the price movement the most likely outcome would be a total loss of capital. Sure, you might get lucky a few times but in the long run, without any analysis or zero risk management it would be really unlikely to be profitable.

Trading is hard. By looking at different trading platforms one can find out that the odds of being profitable are slim at best. Trading platforms are required to display a "standardised risk warning" including the percentage of losses on a CFD provider's retail investor accounts. Basically, trading platforms are forced to be transparent and have to disclose what percentage of their clients are losing money. [2]

Retail investor losing percentage examples on different platforms:

- FXTM - 81% of retail CFD accounts lose money
- Plus500 – 80.5% of retail CFD accounts lose money
- Oanda – 73.5% of retail CFD accounts lose money

To put this into words : Out of 10 traders, only 2-3 are profitable on average.

To try and even the odds, traders can use various methods and tools to analyse price movement in the price charts and stock prices, to make buying or selling decisions. A distinction is made between the fundamental data trader, who makes decisions based on company or economic data, and the so-called technical trader, who only analyses share prices and focuses on specific patterns and price formations. Technical trader is someone who uses technical analysis in his/her decision making process.

2 Technical analysis

2.1 Definition of Technical analysis

Technical analysis is the study of historical market data, including price and volume. Using insights from market psychology, behavioural economics and quantitative analysis, technical analysts aim to use past performance to predict future market behaviour. [3] In its purest form, technical analysis considers only the actual price and volume behaviour of the market or instrument. In addition technical analysists may employ models and trading rules based on price and volume transformations, such as the relative strength index, moving averages, regressions, cycles or, classically, through recognition of chart patterns.

2.1.1 History

The principles of technical analysis derive from the observation of financial markets over hundreds of years. [4] The oldest known hints of technical analysis appear in Joseph de la Vega's accounts of the Dutch markets in the 17th century. In Asia, the oldest example of technical analysis is thought to be a method developed by Homma Munehisa during early 18th century which evolved into the use of candlestick techniques, and is today a main charting tool. [5] [6] In 1948 Edwards and John Magee published *Technical Analysis of Stock Trends* which is widely considered to be one of the seminal works of the discipline. It is exclusively concerned with trend analysis and chart patterns and remains in use to the present. It is now in its 9th edition. As is obvious, early technical analysis was almost exclusively the analysis of charts, because the processing power of computers was not available for statistical analysis. Charles Dow reportedly originated a form of chart analysis used by technicians – point and figure analysis. [7]

2.1.2 Principles

A core principle of technical analysis is that a market's price reflects all relevant information impacting that market. A technical analyst therefore looks at the history of a security or commodity's trading pattern rather than external drivers such as economic,

fundamental and news events. It is believed that price action tends to repeat itself due to the collective, patterned behaviour of investors. Hence technical analysis focuses on identifiable price trends and conditions. [8] [9]

- Market discounts everything

  Technical analysts believe that everything from fundamentals to current economic factors are priced into the stock.

- Price moves in trends

  Technical analysts expect that prices, even in random market movements, will exhibit trends regardless of the time frame being observed. In other words, a stock price is more likely to continue a past trend than move erratically. Most technical trading strategies are based on this assumption. [10]

- History tends to repeat itself

  Many methods of technical analysis are based on the notion that history repeats itself. [11] Many charts of market instruments tend to form patterns that have already happened in the past. This means that studying past price action will help predict the future of price action. This principle focuses on the belief that price action is connected with probability and the analysis of the past provides an edge when opening a trade position.

2.2 Fundamental analysis

All companies that are publicly traded, or take investment money from the public, are required to disclose what they're all about. Just as food processors must list all the ingredients that go into their products, companies must tell investors what they're composed of. Unfortunately, all the information investors need to know about a company doesn't fit inside a tiny rectangle. Instead, the key elements that make up a company are broken down at length in a series of financial statements and other sources of fundamental data.

Reading these critical financial statements and gleaning insights from them are the most basic goals of fundamental analysis. Fundamental analysis is the skill of reading

through all the information companies provide about themselves to make intelligent decisions. [12]

2.2.1 Technical vs fundamental analysis

There are two primary methods used to analyse market instruments and make investment decisions: fundamental analysis and technical analysis. Fundamental analysis involves analysing a company's financial statements to determine the fair value of the business, while technical analysis assumes that the price already reflects all publicly available information and instead focuses on the statistical analysis of price movements.

Fundamental analysts study everything from the overall economy and industry conditions to the financial condition and management of companies to measure the intrinsic value of a stock. Earnings, expenses, assets and liabilities are all important characteristics to fundamental analysts. [13]

Technical analysis differs from fundamental analysis in that the stock's price and volume are the only inputs. The core assumption is that all known fundamentals are factored into price; thus, there is no need to pay close attention to them. Technical analysts don't attempt to measure the intrinsic value of a stock, but instead use stock charts to identify patterns and trends that suggest what the price will do in the future. [14]

Technical and fundamental analysis are at opposite ends of the spectrum. Both methods are used for researching and forecasting future trends in price action, and like any investment strategy or philosophy, both have their supporters and adversaries. [14]

2.3 The Dow theory

Typically, a discussion of technical analysis must start with the Dow Theory. Charles Dow was one of the fathers of modern trading, and his name is still remembered today in the Dow Jones Industrial Average, one of the leading stock market indices that is often simply called the "Dow". [15]

The Dow theory is a financial theory that says the market is in an upward trend if one of its averages (industrials or transportation) advances above a previous important high and is accompanied or followed by a similar advance in the other average. For example, if the Dow Jones Industrial Average (DJIA) climbs to an intermediate high, the Dow Jones Transportation Average (DJTA) is expected to follow suit within a reasonable period of time. [16]

Dow believed that the stock market as a whole was a reliable measure of overall business conditions within the economy and that by analysing the overall market, one could accurately gauge those conditions and identify the direction of major market trends and the likely direction of individual stocks. [16]

It is said that Dow never saw his observations as a means to trade the stock market, but simply a way of describing general economic prosperity. Nonetheless, the principles that he voiced are still considered valid and applicable to trading. They are usually spelled out as six tenets or principles:

- The market discounts everything
- The market exhibit three types of price movement.
- Primary movements have three phases.
- Indices must confirm each other
- Volume must increase in the direction of the trend to confirm it
- A trend continues until there is a clear reversal

2.3.1 The market discounts everything

The first principle leads to one of the fundamental beliefs of technical analysis that the market discounts everything. In other words, the action of the market reflects everything there is to know about a price.

There are many things that can affect the price of a stock or commodity. Sales are obviously important, as are production costs, industrial unrest, government legislation ,the price of raw material and the list goes on. The idea that the “market discounts everything allows the technical analyst to ignore the details of each of these individual factors, and cut to the bottom line.

Accepting this makes the job of the analyst much simpler, indeed it makes in manageable. The reason the price is moving is not important, you simply need to be able to discern that it is, and in what direction. [15]

2.3.2 Three types of movement

Primary movements represent the broad underlying trend of the market and can last from a few months to many years. These movements are typically referred to as bull and bear markets. Once primary trend has been identified, it will remain in effect until proved otherwise. [17]

Figure 1. Dow Jones Industrial Average primary trend

This figure is an example of the primary trend of DJIA. It has been in a bull market since 2009. There have been some price fluctuations but the primary trend has been upwards.

Secondary movements run counter to the primary trend and are reactionary in nature. In a bull market, a secondary move is considered a correction. In a bear market, secondary moves are sometimes called reaction rallies. Secondary moves are a necessary phenomenon to combat excessive speculation. Because of their complexity and deceptive nature investors often mistake a secondary move for the beginning of a new primary trend. [17]

Figure 2. Dow Jones secondary moves.

The above figure is an example of secondary moves happening inside the primary bull trend.

Tertiary movements or daily fluctuations, while important when viewed as a group, can be dangerous and unreliable individually. Due to the randomness of the movements from day to day, the forecasting value of daily fluctuations is limited at best. At worst, too much emphasis on daily fluctuations will lead to forecasting errors and even losses. It is vitally important to keep the whole picture in mind when analysing daily price movements. Think of the pieces of puzzle. Individually, a few pieces are meaningless, yet at the same time, they are essential to complete the picture. [17]

2.3.3 Primary movements have three phases

The 3 stages of an up-trending (bull market)

- Accumulation

  This phase starts when experienced traders or the “smart money” enters their positions. Typically, this would happen at the end of a downtrend. Accumulation phase is hard to identify, since most regular investors might mistake it for a corrective move for further bearish momentum.

- Big move

This phase follows after the accumulation phase finishes. In this phase it becomes more obvious that a new trend is underway. Most of the people will enter the market during this phase and drive the prices higher. This phase is usually the longest

- Excess

Next comes the excess phase, where the price surges further due to euphoria and irrational optimist. This results in a parabolic-like price movement where the smart money investors start to take profit on their positions.

The 3 stages of a down-trending (bear market)

- Distribution

This phase starts when experienced traders and institutions enter their short or sell positions. It is done after they finish unloading their long positions. Typically, the market would be overbought in this phase. Like accumulation, this phase is also hard to identify.

- Big move

By this phase, regular investors also begin to understand that the trend is down. Business conditions worsen and the sell-off would continue in this phase, bringing the price down. This is the longest phase of the primary bear market.

- Despair

This is the third phase where regular investors lose all hope and prices fall further. The market usually continues this decline until the bad news is fully priced in. In this phase prices hit the bottom, after which the cycle starts again with the accumulation phase. [18]

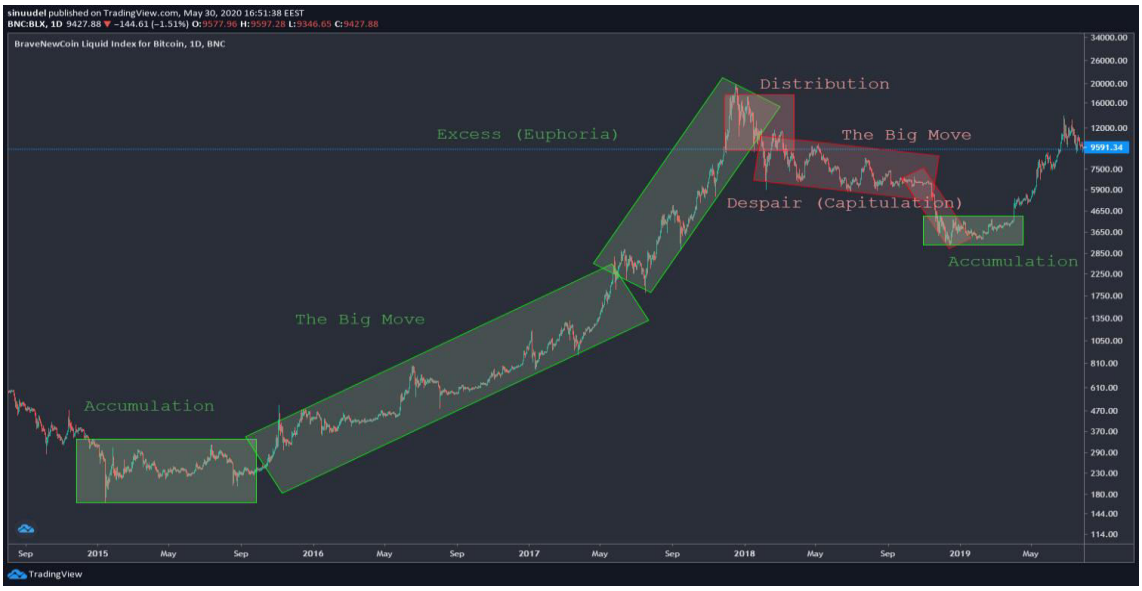

Figure 3. Three phases example on the BTC/USD chart.

Above figure is a visual representation of the three phases on the bitcoin chart. Primary bull market starting with the accumulation phase continuing into the big move and ending with an excessive third phase which leads to the start of distribution.

2.3.4 Indices must confirm each other

In order for a trend to be established, Dow postulated indices or market averages must confirm each other. This means that the signals that occur on one index must match or correspond with the signals on the other. If one index, such as the Dow Jones Industrial Average, is confirming a new primary uptrend, but another index remains in a primary downward trend, traders should not assume that a new trend has begun. [16]

2.3.5 Volume confirms the trend

Volume is the most important factor when confirming the strength of advances and can also help to identify potential reversals. Volume should increase in the direction of the primary trend. For example in a primary bull market, volume should be heavier on advances than during corrections. The opposite is true in a primary bear market. Volume should increase on the declines and decrease during reaction rallies. Thus by analysing the reaction rallies and corrections, it is possible to judge the underlying strength of the primary trend. [19]

Figure 4. Volume confirming trend on Bitcoin chart.

On this chart, we can see that when the price increases volume also increases and when the price decreases volume also decreases. From this we can reach a conclusion that the primary trend is upward and falling prices are not a trend reversal, but instead a corrective price movement.

2.3.6 Trend continues until a clear reversal

Trends are mentioned in several of Dow's principles. The last one might just be the most important one. A trend tends to keep on going unless there is a reason for it to stop. The reason might simply be that it has got to as high (or as low) a level as all the various factors dictate it should, in other words the trend may run out of steam. Technical analysis has tools to give the trader a clue if this is happening. Many traders use "trend following" strategies, which involve identifying a trend as quickly as possible, trading with it, and then exiting the position before the trend fails. [15]

One of the main ways to see when the trend is reversing is through peak-and-trough analysis. A peak is defined as the highest price of a market movement, while trough is seen as the lowest price of a market movement. An upward trend is a series of higher highs (peaks) and lower lows (troughs) while a downward trend is a series of lower highs and lower lows. [16]

A reversal in the primary trend is revealed when the market is unable to create another successive high and low in the direction of the primary trend. For an uptrend, a reversal would be signalled by an inability to reach a new high followed by the inability to reach

a higher low. In this situation, the market would have gone from making higher highs and higher lows to lower highs and lower lows, which are the components of a downward primary trend.

3 Charting and methods

3.1 Candlestick chart

A candlestick chart is made out of candlesticks. These candlesticks are made up of different components to describe the price movements of financial instruments. [1] It is simply a method of displaying price information in a market. Unlike a simple line chart, each candle contains four data points for each time period chosen to display:

- The opening price
- The high price
- The low price
- The closing price

So if a four hourly chart is displayed, one candlestick shows where the price opened, where the price went during the four hours and where the candle closed.

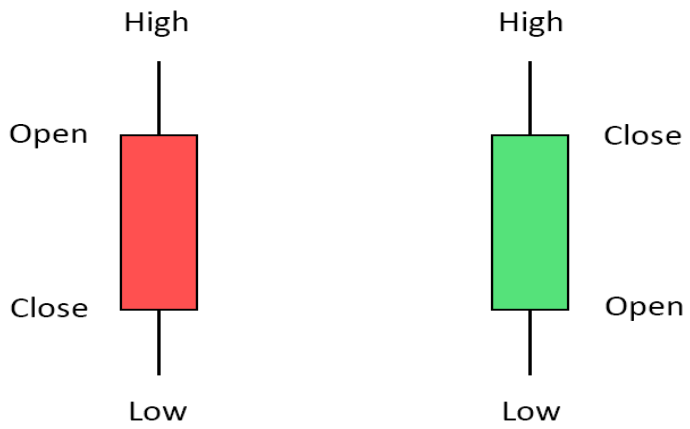

Figure 5. A candlestick

A candlestick has three basic features:

- **The body**, which shows where the price opened and closed during the candle. A long body indicates heavy trading and strong selling or buying pressure, while a small body indicates lighter trading in one direction with minimal selling or buying activity.

- **The wicks**, which may also be called "shadows" of a candle are the long thin lines above and below the main body of a candle. They reveal the displayed time periods high and low. The highest point of the upper wick shows the highest traded price for that time period. Should the open or close be the highest point then there will be no upper wick. The lowest point of the lower wick indicates the lowest traded price for that time period.

- **The color**, which represents the direction of price movement. A green body shows a price increase, while a red body indicates a price decrease. If the main body is green then the candlestick close will be higher than the open and when the body is red, then the candlestick close will be lower than the open. [20]

In technical analysis, people normally differenciate between single candle and multiple candle patterns. In the single candlestick analysis only a single candlestick is examined for specific characteristics to interpret the prevailing market mood. In multiple candlestick analysis, up to three candlesticks are analysed. [1]

3.1.1 Pinbar and Hanging man candle

The pinbar and the hanging man are well-known candles. They have only one long wick, which sticks out to one side. The body is at the opposite end of the wick. It is not so important whether the candlestick has a large or a small body as long as price does not leave a second wick. [1]

A pinbar after a long uptrend often signifies an imminent sell-off. It is, therefore, also listed under the trend reversal candlestick because it indicates that an existing trend is coming to an end. If a pinbar candlestick with a long upstanding wick is seen in an

upward trend, it means that although the buyers have tried to push the price up, the interest to sell has suddenly increased and the sellers have reversed the price direction. [1]

The hanging man is also one of the trend reversal candlestick, but it differs from the pinbar as far as the characteristic and interpretation are concerned. In an upward trend, a candlestick with a long downward wick means that interest in selling has suddenly increased and sellers have managed to move the price down sharply. [1] It indicates that the sellers have taken their positions and the trend may reverse.

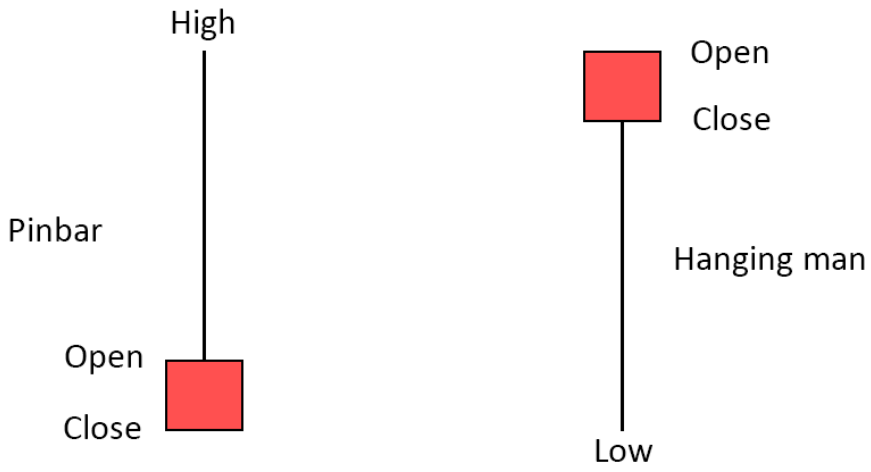

Figure 6. Pinbar and Hanging man candlesticks

3.1.2 Marubozu

The marubozu candlestick has a long real body and it has little to no wick. In other words it's just a big block of a candle. This candlestick tells a story of who controlled the price action during the period, either bulls or bears. A green marubozu indicates that buyers controlled the price from open to close and is considered extremely bullish while a red one indicates that the price was controlled by bears and is extremely bearish sign. [21]

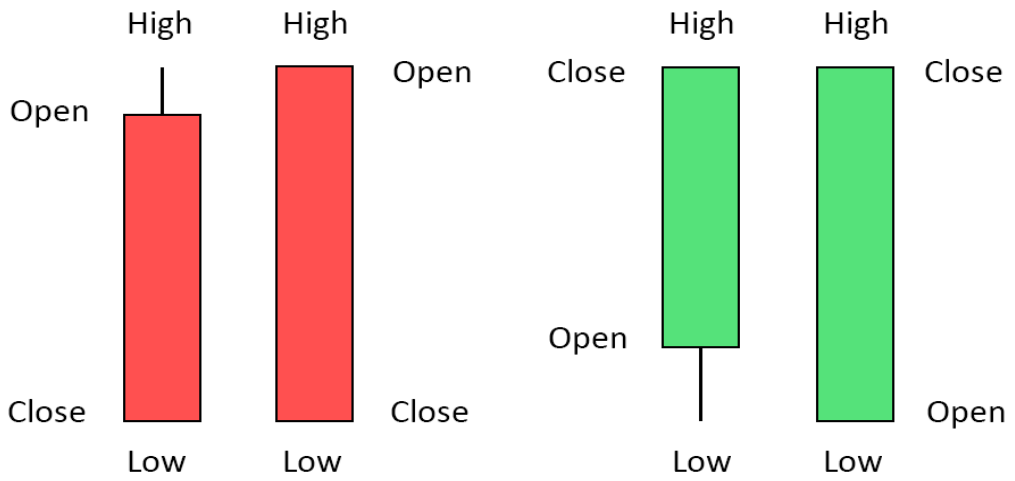

Figure 7. Marubozu candlesticks.

Depending on where a marubozu appears and what color it is, a prediction can be made:

- If a green marubozu occurs at the end of an uptrend, a continuation is likely.
- If a green marubozu occurs at the end of a downtrend, a reversal is likely.
- If a red marubozu occurs at the end of a downtrend, a continuation is likely.
- If a red marubozu occurs at the end of an uptrend, a reversal is likely. [21]

3.1.3 Doij

A doij is formed when the opening and the closing price are equal or close to it. [22] The doji candlestick has little to no real body and wicks on both sides. It is a transitional candlestick formation, signifying equality and/or indecision between bulls and bears. A doij is often found at the bottom and top of trends and thus is considered a sign of possible reversal of price direction, but it can be viewed as a continuation pattern as well. [22]

Doij candlesticks are important ones since they tend to form when price is at an important level, hence the indecision of traders. Many traders view doij candlesticks as potential support and resistance levels where price needs to make a decision to continue or reverse.

There is also a bullish and a bearish version of a doji. The gravestone doji is a bearish variant that suggests a reversal followed by a downtrend in price action. The dragonfly

doji is a bullish variant of the doij which suggest a downtrend reversal followed by bullish price action.

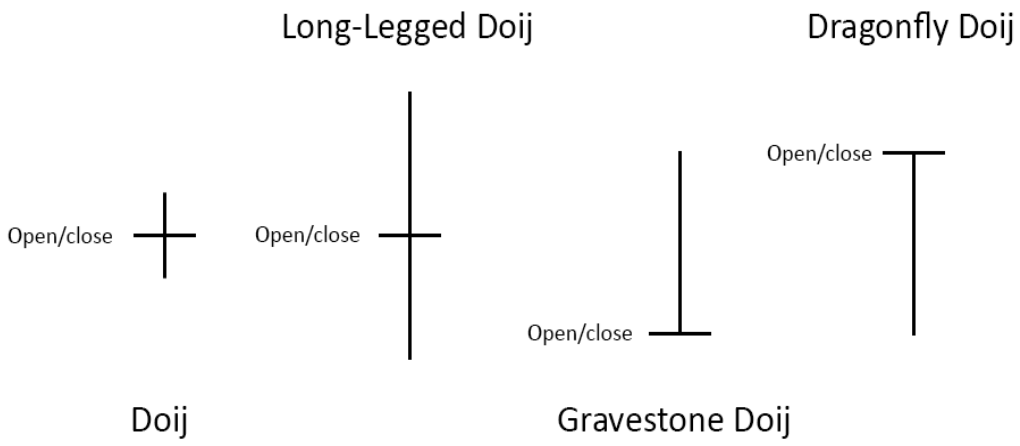

Figure 8. Doij candlesticks

3.2 Patterns

Pattern recognition is one of the most versatile skills that can be learned when it comes to trading. This is the branch of technical analysis that focuses on finding price and patterns. The key is to learn the basic rules so these methods could be used with a trading strategy. While the idea of pattern recognition may seem strange, it's based on carefully tested methods which underline their usefulness to traders. Importantly, patterns are factors to consider when calculating where to enter, set stop-loss and where to set profit targets. [23] These ofcourse are the key factors to a traders strategy and risk management.

Chart patterns are shapes that form within a price chart that help suggest what prices might do next, based on what they have done in the past. There are different types of patterns to look out for, mainly reversal patterns and continuation patterns. Reversal patterns can indicate when a trend might be ready to reverse while continuation patterns are good for setting up an entry for a trend continuation. During continuation patterns prices usually consolidate in a tight range to have a next leg in the direction of the trend.

3.2.1 Head and Shoulders pattern

The head and shoulders chart pattern is a price reversal pattern that helps traders identify when a reversal may be underway after a trend has exhausted itself. This reversal pattern usually signals the end of a trend. The pattern consists of three peaks or troughs depending if the pattern forms after an downtrend or an uptrend.

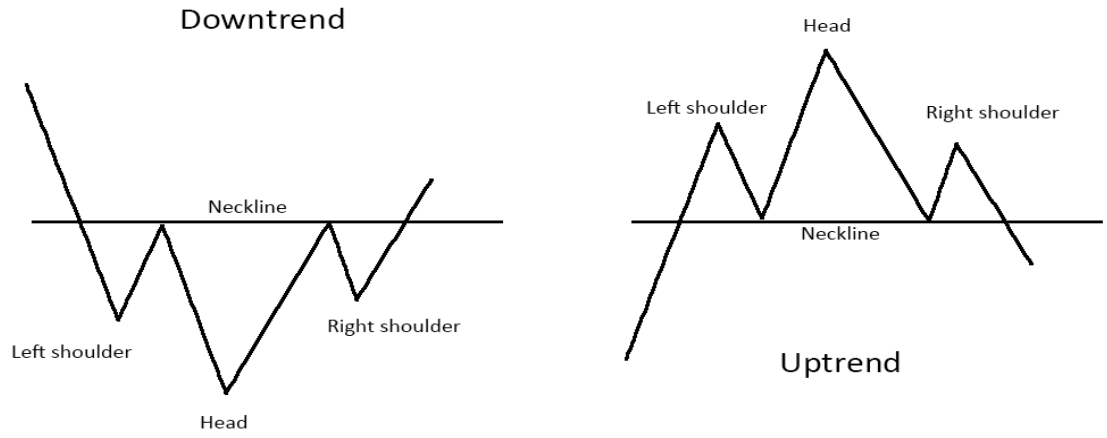

Figure 9. Head and Shoulders pattern.

Trading head and shoulders patterns is relatively simple once the pattern is spotted on a chart. If the pattern forms after an uptrend the entry point should be after the confirmation candle. Confirmation candle is a candle which closes under the neckline after the pattern has formed and after which an entry can be placed at the neckline level with a stop-loss above the right shoulder. Target of the trade would be the hight of the head. Neckline support/resistance level break and confirmation is key, when trading this pattern.

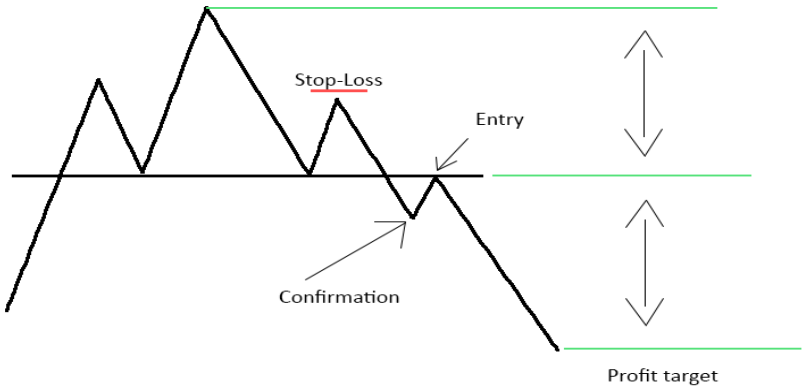

Figure 10. Head and shoulders pattern trade example.

3.2.2 Pennant and flag pattern

Bull/bear pennants and flags are considered as continuation patterns that mark a small consolidation before the primary trend continues. These patterns are usually preceded by an impulsive rise or decline in price with heavy volume. During the consolidation volume should be declining.

The pattern consists of a flag pole, which is the impulsive move and either a pennant or flag consolidating period. In case of a pennant the consolidating move will be in the shape of a symmetrical triangle and if it is a flag then the consolidating would be in the form of a rectangular pattern that slopes against the primary trend.

Figure 11. Uptrending market pennant and flag patterns.

Trading these continuation patterns is relatively easy once they are spotted. A break of the consolidation pattern should have occurred to minimise risk. Entry would be at the level of the breakout with a stop loss below the previous trough/peak depending on the primary trend. Target of the trade would be the length of the flag pole which is the impulsive move that started the consolidation.

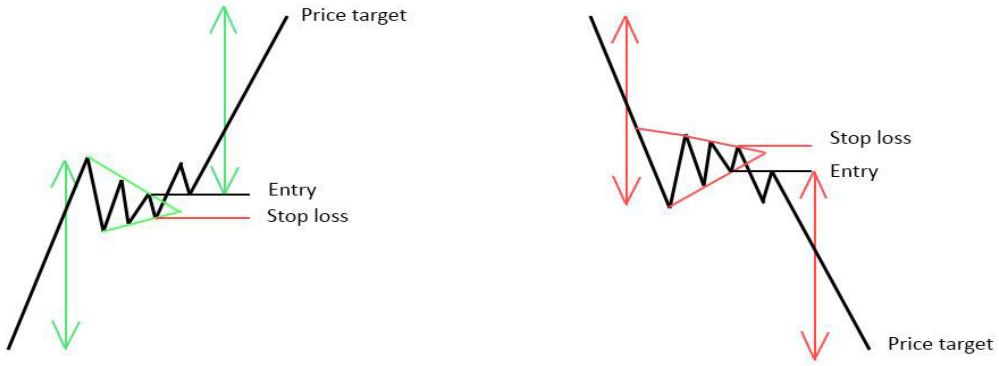

Figure 12. Bull and bear pennant trade example.

3.3 Levels of support and resistance

Support and resistance represent key junctures where the forces of supply and demand meet. In the financial markets, prices are driven by excesses of supply and demand. [24]

Suppliers are sellers or bears and demand is represented by buyers or bulls. As demand increases, prices advance and as supply increases, prices decline. When supply and demand are equal, prices move sideways. [24]

Support is the level at which demand is strong enough to stop the price of an instrument from falling any further. Logic dictates that as the price declines towards support and gets cheaper, more buyers become inclined to buy and sellers become less inclined to sell. By the time the price reaches the support level, it is believed that demand will overcome supply and prevent the price from falling below support. [24]

The levels of support do not always hold, and a break below support signals that the sellers have won out over the buyers. Losing a support level indicates more selling pressure and a lack of buying incentive after which another support level will have to be established at a lower price level.

Resistance is a price level at which supply is strong enough to stop the price of an instrument from moving higher. As the price advances towards resistance, sellers become more inclined to sell and buyers become less inclined to buy and by the time price reaches the resistance level, it is believed that supply will be greater than demand and prevent prices from rising above the level.

Once a resistance level is broken, it signals a lack of sellers and a fresh inflow of buying interest after which a next resistance level will have to be established higher.

A key concept of technical analysis is that when a resistance or support level is broken, its role is reversed. If the price falls below a support level, that level will become resistance. As the price moves past a level of support or resistance, it is thought that supply and demand has shifted, causing the breached level to reverse its role. [25]

Figure 13. Support and Resistance levels GBP/USDT weekly chart

Above figure shows the basic concept of support and resistance levels. Once price claims a level, the level flips either from support to resistance or from resistance to support.

Higher time frame support/resistance flips are among the easiest ways to be profitable in the financial markets. Wait for a support/resistance level to break and sell/buy the retest of the level.

3.4 Indicators

In technical analysis, a technical indicator is a mathematical calculation based on historic price, volume or open interest information. [26] Technical indicators and oscillators are used in technical analysis to try and indicate the market sentiment, which in turn will suggest what may happen to the price in future. [15] As technical as they get, none of them guarantee a specific movement in upcoming price action, and only give an indication of probability.

Oscillators are typically shown underneath the price chart, although they are sometimes superimposed in the price area. Oscillators are indicators that oscillate between a local minimum and maximum. [27] The main point of an oscillator is to indicate when the market is reaching an extreme condition, either over-priced, also called overbought, or undervalued which is known as oversold. If the market is overbought, this shows that

the price has gone up quickly and enthusiastically, and perhaps has reached a level higher than is sustainable. In other words, a correction in price might be coming.

3.4.1 Fibonacci Retracement

The use of Fibonacci levels in trading is based on the principle that the ratios of the Fibonacci sequence tent to coincide with key support and resistance zones, often signaling key pivot areas of price movement. Thus, Fibonacci levels are commonly used as a tool by traders when analysing markets.

The Fibonacci sequence begins with the numbers 0 and 1 and is comprised of subsequent numbers in which the next number in the series is the sum of the two previous numbers. The output produces the following sequence 0, 1, 1, 3, 5, 8, 13, 21, 34, 55, 89 and so on. When a number in the Fibonacci series is divided by the number preceding it, the quotients themselves approach the Fibonacci constant (Φ) also known as the Golden Ratio (1.618). 1/1 = 1, 2/1 = 2, 3/2 = 1.5, 5/3=1.666, 8/5 = 1.6, 13/8 = 1.625, 21/13 = 1.61538, 34/21 = 1.619, 55/34 = 1.6176, and 89/55 = 1.618 [28]

The inverse process (55/89 instead of 89/55) also provides a constant: 0.618, or φ. Skipping a number in the sequence (55/144 and 144/55) produces two more constants: 0.382 and 2.618. The ratios of the Fibonacci sequence can be represented through horizontal lines calculated between the start and end point of a measurement. These lines can be plotted to an active price chart. [28]

Traders apply these levels to help interpret market behaviour and to isolate higher probability setups and market pivots. To apply these levels, chartists map an area from 0 to 1, where 1 represents the starting point, which will usually be the starting point of an impulsive move, and 0 represents the end of a move. Fibonacci ratios 0.236, 0.382, 0.5, 0.618 and 0.786 are then mapped between the starting and ending point. [28]

Figure 14. Fibonacci retracement BTC/USD daily chart example

We can clearly see from the above figure, that price tends to find either support or resistance from these Fibonacci levels. Fibonacci retracement is plotted from the start of an impulsive move to the peak.

3.4.2 Moving Averages

Moving averages smooth the price data to form a trend following indicator. They do not predict price direction, but rather define the current direction, though they lag due to being based on previously closed candles. Despite this, moving averages help smooth price action and filter out the noise. Most popular variants of moving averages are the simple moving average (SMA) and exponential moving average (EMA).

A simple moving average is an arithmetic moving average calculated by adding recent prices and then dividing that sum by the number of time periods in the calculation average. For example if a closing price of the last viewed 100 days is added and divided by 100, then an average price of that time period can be known.

Exponential moving average is similar to simple moving average, measuring trend direction over a period of time. However, EMA applies more weight to data that is more recent. Because of its unique calculation, EMA will follow prices more closely than a corresponding SMA. Exponential moving average includes all the price data within its

current value. The newest price data has the most impact on the moving average and the oldest data has the least impact. [29]

$EMA_{[today]} = (Price_{[today]} \times K) + (EMA_{[yesterday]} \times (1 - K))$

Where $K = 2 \div (N+1)$, N= the length of the EMA, $Price_{[today]}$ = the current closing price, $EMA_{[yesterday]}$ = the previous EMA value [30]

Figure 15.SMA 200 and EMA 200 plotted on BTC/USD chart.

Above figure shows that SMA (blue line) is more smooth and gives a relatively understandable indication of the current trend while EMA (yellow line) follows the price more closely and may have a little more noise. Many traders use SMA and EMA lines to find levels of support/resistance and from this specific instrument we can see that EMA line acts as a very good support/resistance line.

3.4.3 MACD

The Moving Average Convergence Divergence (MACD) is a oscillating indicator which simply measures the relationship of exponential moving averages. The MACD displays a MACD line, signal line and a histogram – showing the difference between the MACD line and the signal line. The two lines waver in and around the zero line which gives MACD the characteristics of an oscillator giving overbought and oversold signals. MACD measures momentum of trend strength by using the MACD line and zero line as reference points. When the MACD line is above the zero line, this signals an uptrend and while the MACD line is below the zero line, this signals a downtrend. [31]

In addition to trend indication, the MACD also signals buy or sell signals which are given when the two MACD lines cross over. When the MACD line crosses above the signal line, it can be used as a buy indication and when the MACD line crosses below the signal line, it can be used as a sell indication. [31]

The MACD line is calculated by subtracting 26-period EMA from 12-period EMA. Signal line is a 9-period EMA and histogram is the difference between MACD line and signal line. [31]

Figure 16. MACD indicator with buy and sell signals plotted on BTC/USD chart

3.4.4 RSI

The Relative Strength Index (RSI) is a momentum oscillating indicator that measures the speed and change of price movements. The RSI oscillates between 0 and 100. Traditionally the RSI is considered overbought when above 80 and oversold when below 30. Signals can be generated by looking for divergences and failure swings. RSI can also be used to identify the general trend. [32]

In a bull market RSI tends to oscillate between the upper zone 40-90 while 40-50 tends to act as support. In a bearish market RSI tends to stay between 10-60 with 50-60 zone acting as resistance.

If underlying prices make a new high or low which is not confirmed by the RSI, this divergence can signal a price reversal. If the RSI makes a lower high and then follows with a downside move below a previous low, a top swing failure has occurred. When the RSI makes a higher low and then follows with an upside move above a previous high, a bottom swing failure has occurred.

The basic formula for calculating the RSI is:

RSI = 100 - (100 / (1 + (Average of upward price change/Average of downward price change))) [32]

Figure 17. RSI analysis BTC/USD daily chart example.

Above figure displays the usefulness of this indicator. First a bullish divergence appears signalling that the sellers might be exhausted, after which the price fails to make a new low, breaks the resistance level above and starts trending upwards. During the upward trend the RSI is supported ~50 zone for ~3 months. During the last price peak the RSI makes a high in the overbought territory and the trend starts to change. RSI fails to hold support at the 50 zone then retests it and finds resistance instead, followed by a huge decline in price.

3.5 Trade Volume

In trading, the term volume represents the number of units that change hands during a specific time period. Traders rely on volume as a key metric, because it lets them know the liquidity level of an asset, and how easily they can get into or out of a position close to the current price.

Volume analysis is a technique used to determine the trades you will make by discovering the relationship between volume and prices. The two key concepts behind volume analysis are buying volume and selling volume. [33]

If you want to buy, there must also be a seller for a transaction to occur. When the buying volume is greater than the selling volume prices trend higher and when the selling volume is greater, then prices trend lower.

An increasing volume shows the conviction of buyers and sellers in either pushing the price up or down. A trend can persist on declining volume for long periods of time, but typically declining volume as the price trends indicates a weakening trend. For example, if the trend is up but volume steadily declines, it shows fewer people want to buy and keep pushing the price up - buyers are getting exhausted. That said, the trend won't change until more large-scale selling volume than buying volume takes place. [34]

Volume reflects traders' actions in the marketplace and as a result can be a very useful measure of sentiment. Any price breakout or trend that is accompanied by above average volume is considered to be of potentially greater significance than price movements that are not. [34]

4 Tradingview overview

4.1 Introduction

Tradingview is a well-known cloud based software that is mainly used as a tool for charting. It is a really useful tool for beginner/advanced level technical analysists that are eager to learn more about charting financial instruments. The software incorporates

many charting tools and also has a social features that allows users to share and collaborate with other traders that are using the software. Tradingview is also available on iOS and android devices as an app.

Tradingview was launched in 2011 and it featured historical and real-time market data from major world exchanges like CBOE, NASDAQ, NYSE and more. The site was created by trading software company MultiCharts. [35] Since charts are often the heart of stock/technical analysis discussions, tradingview is a place where those charts are the core of the platform.

Knowing how to use the software is a good skill to a starting technical analyst enthusiast. Since it is a skill that takes a lifetime to master, this software is a good place to learn since you can browse other user's post of their analysis ideas with detailed descriptions and thought processes.

4.2 Social Features

Since the software doubles as a social networking site for users to post and share, it would be reasonable to divide the features into two separate groups: Social features and charting features.

- **Publishing trading ideas**

  This feature allows users to post their chart idea for other users to see, upvote and like. Top authors are shown on the main page and can be filtered by day, week, month or all time. Also the most upvoted ideas are featured in the tradingview gallery for all visitors to see.

- **Publishing scripts**

  Users can publish their own scripts that they have created which then can be accessed by other users. Scripts can also be locked which means they can be monetized by allowing access only to users that have paid the fee.

- **Instant chart snapshot**

A snapshot can be taken with a click of a button in PNG format which gives you a unique link that stays live forever. [36] The picture can be downloaded or instantly shared on twitter with a click of a button.

- **Real-Time conversation**

Tradingview is much about reacting quickly to market changes, so the conversation is a real-time chat for talking to other people while the moment lasts. You can instantly share chart snapshots and talk only to the people looking at the same instrument, or message the entire community. [36]

4.3 Charting features

- **Personalized watchlist**

Users are able to add the financial instruments of their choice to their own personal watchlist. The watchlist is saved automatically and is displayed when the user logs in for easier access. Any stock can be searched and filtered by ticker name.

- **Charting Tools**

There is a wide variety of charting tools available for the users. Starting from simple drawing and text tools to more complex retracing, price channel and elliot wave tools. The options provided are truly amazing and will most definetly suit every users need.

- **Alerts**

Alerts can be set in specific zones on the chart or can even be combined with the users used tools like trendlines or support lines. User can set an alert to his/her drawed trendline, should the price reach the desired level or cross it so that they wont miss a possible setup for entering. Alerts can be sent via web browser, e-mail or even as a notification from the app.

- **Indicators**

The indicator library of the software is pretty much endless. Most of the indicators that are used in technical analysis are built in and if the user wants a specific or custom indicator, it can be created using tradingview's on pine script language.

- **Trade within the platform**

Users can connect supported exchanges to tradingview and trade directly from the software. The supported list currently features 15 different exchanges. Most known are Oanda, Forex.com and Gemini.

4.4 Subscriptions

There are four levels of subscription plans available for the users to choose. The most commonly used one is the basic one, which is free. The most expensive plan costs 59.95$ per month. The table below will highlight the differences of the plans:

Table 1. Tradingview's subscription plans comparison.

Plan :	Basic	Pro	Pro+	Premium
Cost:	Free	14.95$	29.95$	59.95$
Maximum indicators on chart	3	5	10	25
Maximum charts in one layout	1	2	4	8
Maximum server side alerts	1	10	30	400
Volume profile indicators	-	+	+	+
Custom time intervals	-	+	+	+
Intraday bar replay	-	+	+	+
Chart data export	-	-	+	+
Publishing of invite only indicators	-	-	-	+
Alerts that don't expire	-	-	-	+
Second based intervals	-	-	-	+

4.5 Pine script

Pine script is the name of the programming language created and utilized by Tradingview's proprietary HTML5 charting software. It is a cloud-based lightweight scripting language which allows to do some useful things with analysis such as create or customize indicators, strategies and tools, backtest custom strategies and create trading signals. [37] Using code and scripts is a way to enhance one's edge in technical analysis.

Pine is cloud-based and therefore different in nature to client-side programming languages. Pine script was designed to be lightweight, and in most cases, the objective can be achieved with fewer lines of code compared to other programming languages. [38] Because each script uses computational resources in the cloud, there must be limits in order to share the resources fairly among the users. The imposed limits apply to elements such as the amount of data from additional symbols, execution time, memory usage and script size. [39]

The main advantage of pine script is the built-in data. Testing strategies or creating indicators in other languages involves sourcing one's own data. Not only does that mean you have to find a place to grab your data from, but you'll also then have to format it in a certain way which is very time consuming. Tradingview has a plethora of data available at one's fingertips, ready to access with as little as one line of code. [38]

5 Custom strategy script programming

In this practical part of this thesis I will use pine script to create a strategy which will give the user signals when to enter a long or short position. Firstly an overlook of the advantages hoped to achieve with this practical part is given, after which i will explain the method that hopefully achieves all of the advantages described when the strategy is completed. I will also show what the available inputs will be for the user, which can be customized to achieve a higher profitability percentage. Also the raw code will be displayed with some back-test results.

5.1 Advantages of the completed script

The advantages that this script will try to achieve with are:

- Reduce needed screen time for technical analysts to view charts
- Catch the primary trend of markets
- Achieve a profitability a high profitability rate

- Automate the process of picking long/short entry positions
- Give the user different input choices to tailor the strategy to a specific financial instrument to maximize profitability
- Gain a better understanding of how automated signals work
- Make it easier to be profitable for anybody using the script

5.2 Method and inputs

I want this strategy to catch the big moves that markets make during the primary trend cycle. This means that the strategy must incorporate indicators that best suit for trend defining.

The indicator best used and most used for trend defining is a moving average. In this script a set of 18 moving averages are used to give an entry to a long or short position. The first moving average's length can be chosen by the user, but by default it is set to 3, which should be good enough for most markets. Each next moving average is calculated by the "Step" option from the input which by default is 5, so if the first moving average length is 3, the next one's length will be 3+5=8 and the one after that will be 8+5=13 and so on. Entry signal for a buy/long position signal will be generated when all the faster moving averages are above each other and a sell/short position signal will be generated once all the faster moving averages are below each other. This idea is simple yet very effective for spotting a beginning trend and the strategy will keep the position open long enough so that secondary market moves won't exit the position.

Since there are different kinds of moving averages and each different kind might suit a specific financial instrument, I will give the user options to choose between them. Here is a list of available moving average input choices for the user:

- Simple Moving Average
- Exponential Moving Average
- Smoothed Moving Average

- Volume Weighted Moving Average
- Double Exponential Moving Average
- Triple Exponential Moving Average

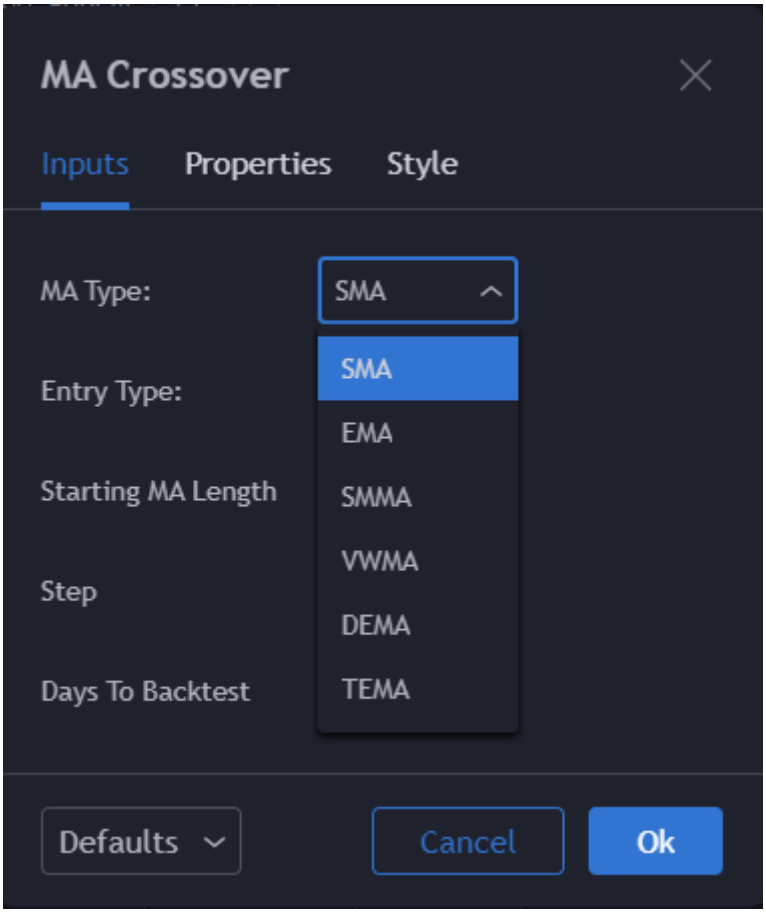

Figure 18. MA type choices.

The user of this script has a choice between two entry types, which are suited for different market conditions:

- Regular

  This is suited for most markets on higher time frame. It uses all the 18 moving averages to generate entry signals. I would recommend this option to be used to get the best profit factor with the least trades made. Time frame used should be daily candles or higher (weekly, monthly). This option will most of the time have the best profit factor, but might not have the best winning/losing trade

percentage, but that does not matter if it catches the big moves, since they are the most profitable trades.

- Early

  This choice uses only 9 moving average to find entries and has more aggressive exit conditions. A long position in this choice will only be opened once the first 8 moving averages are above each other and as an extra condition – a position can be opened only if moving average nr8 is crossing over moving average nr9. This extra is to prevent a position from instantly opening after the aggressive exit conditions, since the moving averages might still be over each other. For exiting the position this option utilizes the relative strength index. When the relative strength index enters overbought conditions, the buy position will be closed or when it enters oversold conditions, an open sell positions will be closed. Also, should a candle close below the slowest moving average and a long position is open, it will be closed and vice versa for the short position. This option will give a lot more trading opportunities and will most likely suit a non-trending market better than the other option.

To my knowledge this coded strategy in pine script should be one of a kind. There might be some similarities to some people's ideas since moving averages are widely used in the technical analysis space but none of them are programmed in pine script or use the flexibility and customization of different input options.

5.3 Code of the completed script

```
strategy(title = "MA crossover strategy", shorttitle = "MA Crossover", overlay = true, pyramiding = 0,
default_qty_type = strategy.percent_of_equity, default_qty_value = 10, calc_on_every_tick = false)
src = close,

Type = input(defval = "SMA", title = "MA Type: ", options = ["SMA", "EMA", "SMMA", "VWMA", "DEMA", "TEMA"])
Option = input(defval = "Regular", title = "Entry type: ", options = ["Early", "Regular"])
MAstart = input(3, minval = 1, title = "Starting MA length")
MAstep = input(5, minval = 1, maxval = 10, title = "Step")
Bars = input(defval = 10000, minval = 0, title = "Days to backtest")

variant(type, src, len) =>
SMA = sma(src, len)
EMA = ema(src, len)
SMMA = 0.0
SMMA: = na(SMMA[1]) ? sma(src, len) : (SMMA[1] * (len - 1) + src) / len
VWMA = vwma(src, len)
DEMA = 2 * EMA - ema(EMA, len)
TEMA = 3 * (EMA - ema(EMA, len)) + ema(ema(EMA, len), len)
Type == "EMA" ? EMA : Type == "SMMA" ? SMMA : Type == "VWMA" ? VWMA : Type == "DEMA" ? DEMA : Type == "TEMA" ? TEMA : SMA


MA1 = variant(Type, src, MAstart)
MA2 = variant(Type, src, MAstart + MAstep)
MA3 = variant(Type, src, MAstart + MAstep * 2)
MA4 = variant(Type, src, MAstart + MAstep * 3)
MA5 = variant(Type, src, MAstart + MAstep * 4)
MA6 = variant(Type, src, MAstart + MAstep * 5)
MA7 = variant(Type, src, MAstart + MAstep * 6)
MA8 = variant(Type, src, MAstart + MAstep * 7)
MA9 = variant(Type, src, MAstart + MAstep * 8)
MA10 = variant(Type, src, MAstart + MAstep * 9)
MA11 = variant(Type, src, MAstart + MAstep * 10)
MA12 = variant(Type, src, MAstart + MAstep * 11)
MA13 = variant(Type, src, MAstart + MAstep * 12)
MA14 = variant(Type, src, MAstart + MAstep * 13)
MA15 = variant(Type, src, MAstart + MAstep * 14)
MA16 = variant(Type, src, MAstart + MAstep * 15)
MA17 = variant(Type, src, MAstart + MAstep * 16)
MA18 = variant(Type, src, MAstart + MAstep * 17)
MA19 = variant(Type, src, MAstart + MAstep * 18)
MA20 = variant(Type, src, MAstart + MAstep * 19)
MA21 = variant(Type, src, MAstart + MAstep * 20)
MA22 = variant(Type, src, MAstart + MAstep * 21)

mafastcond1 = (MA1 > MA2 and MA2 > MA3 and MA3 > MA4 and MA4 > MA5 and MA5 > MA6 and MA6 > MA7 and MA7 > MA8)
mafastcond2 = (MA1 < MA2 and MA2 < MA3 and MA3 < MA4 and MA4 < MA5 and MA5 < MA6 and MA6 < MA7 and MA7 < MA8)
maslowcond1 = (MA6 > MA7 and MA7 > MA8 and MA8 > MA9 and MA9 > MA10 and MA10 > MA11 and MA11 > MA12 and MA12 > MA13
and MA13 > MA14 and MA14 > MA15 and MA15 > MA16 and MA16 > MA17 and MA17 > MA18)
maslowcond2 = (MA6 < MA7 and MA7 < MA8 and MA8 < MA9 and MA9 < MA10 and MA10 < MA11 and MA11 < MA12 and MA12 < MA13
and MA13 < MA14 and MA14 < MA15 and MA15 < MA16 and MA16 < MA17 and MA17 < MA18)
earlylongcond = crossover(MA8, MA9)
earlyshortcond = crossunder(MA8, MA9)
RSIcond = rsi(src, 14)
exitlong = close < MA18
```

Figure 19. Completed script code

```
exitshort = close > MA18
barsmax = 1000 * 60 * 60 * 24 * Bars
inrange = (barsmax == 0 or(time > (timenow - barsmax)))

colcond = mafastcond1 and Option == "Early"
and earlylongcond ? color.lime : mafastcond2 and Option == "Early"
and earlyshortcond ? color.red : mafastcond1 and maslowcond1 and Option == "Regular" ? color.lime : mafastcond2
and maslowcond2 and Option == "Regular" ? color.red : color.gray
barcolor(colcond, 1)

plot(MA1, title = "MA1", linewidth = 1, color = colcond, transp = 50)
plot(MA2, title = "MA2", linewidth = 1, color = colcond, transp = 50)
plot(MA3, title = "MA3", linewidth = 1, color = colcond, transp = 50)
plot(MA4, title = "MA4", linewidth = 1, color = colcond, transp = 50)
plot(MA5, title = "MA5", linewidth = 1, color = colcond, transp = 50)
plot(MA6, title = "MA6", linewidth = 1, color = colcond, transp = 50)
plot(MA7, title = "MA7", linewidth = 1, color = colcond, transp = 50)
plot(MA8, title = "MA8", linewidth = 1, color = colcond, transp = 50)
plot(MA9, title = "MA9", linewidth = 1, color = colcond, transp = 50)
plot(MA10, title = "MA10", linewidth = 1, color = colcond, transp = 50)
plot(MA11, title = "MA11", linewidth = 1, color = colcond, transp = 50)
plot(MA12, title = "MA12", linewidth = 1, color = colcond, transp = 50)
plot(MA13, title = "MA13", linewidth = 1, color = colcond, transp = 50)
plot(MA14, title = "MA14", linewidth = 1, color = colcond, transp = 50)
plot(MA15, title = "MA15", linewidth = 1, color = colcond, transp = 50)
plot(MA16, title = "MA16", linewidth = 1, color = colcond, transp = 50)
plot(MA17, title = "MA17", linewidth = 1, color = colcond, transp = 50)
plot(MA18, title = "MA18", linewidth = 1, color = colcond, transp = 50)


if (Option == "Regular"
    and inrange)

    strategy.entry(id = "LONG", long = true, when = maslowcond1 and mafastcond1)
strategy.close(id = "LONG", when = maslowcond2 and mafastcond2)
strategy.entry(id = "SHORT", long = false, when = maslowcond2 and mafastcond2)
strategy.close(id = "SHORT", when = maslowcond1 and mafastcond1)


else if (Option == "Early"
    and inrange)

    strategy.entry(id = "BUY", long = true, when = mafastcond1 and earlylongcond)
strategy.close(id = "BUY", when = mafastcond2 or RSIcond >= 75 or exitlong)
strategy.entry(id = "SELL", long = false, when = mafastcond2 and earlyshortcond)
strategy.close(id = "SELL", when = mafastcond1 or RSIcond <= 20 or exitshort)
```

Figure 20. Completed script code

5.4 Back-test results and examples of positions taken

Below are tables that are results of the script running on different randomly chosen financial instruments. All signals are generated on daily timeframe charts. Every instrument has two different tables. One where the script is running with default input options and the second is where i tried to optimize the script to minimize drawdown of the initial investment.

Table 2. Results of script running on USD/JPY daily chart

Instrument	Signal given	Price	Profit/Loss %	1000€ initial investment
USD/JPY	Entry Short	89.67		
With default	Exit Short	81.072	9.59	1095.88
input options	Entry Long	81.072		
	Exit Long	112.545	38.82	1521.32
	Entry Short	112.545		
	Exit Short	112.751	-0.18	1518.53
	Entry Long	112.751		
	Exit Long	109.088	-3.25	1469.20
	Entry Short	109.088		
	Exit Short	112.835	-3.43	1418.74
USD/JPY	Entry Long	102.11		
With optimized	Exit Long	118.845	16.39	1163.89
input options	Entry Short	118.845		
	Exit Short	110.192	7.28	1248.63
	Entry Long	110.192		
	Exit Long	110.916	0.66	1256.84
	Entry Short	110.916		
	Exit Short	109.418	1.35	1273.81
	Entry Long	109.418		
	Exit Long	112.549	2.86	1310.26

Page 55 has the picture of USD/JPY chart that is running the script.

Table 3. Results of script running on Silver USD/OZ daily chart

Instrument	Signal given	Price	Profit/Loss %	1000€ initial investment
Silver USD/OZ	Entry Short	26.965		
With default	Exit Short	16.919	37.26	1372.56
input options	Entry Long	16.919		
	Exit Long	15.72	-7.09	1275.29
	Entry Short	15.72		
	Exit Short	15.62	0.64	1283.40
	Entry Long	15.62		
	Exit Long	14.6	-6.53	1199.59
	Entry Short	14.6		
	Exit Short	17.073	-16.94	996.40
Silver USD/OZ	Entry Short	17.43		
With optimized	Exit Short	17.8	-2.12	978.77
input options	Entry Long	14.991		
	Exit Long	17.339	15.66	1132.07
	Entry Short	17.327		
	Exit Short	17.426	-0.57	1125.61
	Entry Long	19.908		
	Exit Long	21.245	6.72	1201.20
	Entry Short	26.732		
	Exit Short	25.035	6.35	1277.46

Page 56 has the picture of Silver USD/OZ chart that is running the script.

Table 4. Results of script running on TESLA INC. daily chart.

Instrument	Signal given	Price	Profit/Loss %	1000€ initial investment
TESLA INC.	Entry Long	6.04		
With default	Exit Long	31.74	425.50	5254.97
input options	Entry Short	31.74		
	Exit Short	50.61	-59.45	2130.79
	Entry Long	50.61		
	Exit Long	53.94	6.58	2271.00
	Entry Short	53.94		
	Exit Short	70.58	-30.85	1570.41
	Entry Long	70.58		
	Exit Long	429.95	509.17	9566.44
TESLA INC.	Entry Long	42.98		
With optimized	Exit Long	67.76	57.65	1576.55
input options	Entry Short	67.76		
	Exit Short	63.23	6.69	1681.95
	Entry Long	63.23		
	Exit Long	51.05	-19.26	1357.95
	Entry Short	51.05		
	Exit Short	49.86	2.33	1389.61
	Entry Long	49.86		
	Exit Long	421.84	746.05	11756.75

Page 57 has the picture of Tesla INC. chart that is running the script.

Table 5. Results of script running on BITCOIN/USD daily chart.

Instrument	Signal given	Price	Profit/Loss %	1000€ initial investment
BITCOIN/USD	Entry Short	464.8		
With default	Exit Short	268.53	42.23	1422.27
input options	Entry Long	268.53		
	Exit Long	4349.41	1519.71	23036.63
	Entry Short	4349.41		
	Exit Short	5041	-15.90	19373.62
	Entry Long	5041		
	Exit Long	7427	47.33	28543.52
	Entry Short	7427		
	Exit Short	10229.19	-37.73	17774.12
BITCOIN/USD	Entry Short	8765.53		
With optimized	Exit Short	7521.88	14.19	1141.88
input options	Entry Long	8200		
	Exit Long	9305.4	13.48	1295.81
	Entry Short	8778.37		
	Exit Short	4841.67	44.85	1876.92
	Entry Long	7794.22		
	Exit Long	10008.19	28.41	2410.07
	Entry Long	9941.25		
	Exit Long	11049.4	11.15	2678.72

Page 58 has the picture of BITCOIN/USD chart that is running the script.

5.5 Used methods/indicators and tools

In this practical thesis part the following methods and indicators were used:

- Primary movements of markets
- Trend spotting technique
- Candlestick charting
- Trending market principles
- Technical analysis
- Moving Averages
- Relative Strength index

For this practical strategy script creation the following tools were used:

- Tradingview
- Excel
- Pine script programming language
- Photoshop
- Mozilla Firefox
- Google Chrome
- Brave

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6 Summary and further steps

In this thesis the main principles and fundamentals of technical analysis are explained. This should create an understanding of trending market rules and market cycles . A brief overview of fundamental analysis with a comparison to technical analysis is also provided. Many of the principles are shown in practice with visual representation of price action charts to help the reader further understand trading and show how to better position themselves. The second part of this thesis is more technical where candlestick charting is explained and the main methods and indicators are shown with detailed explanation and examples. Some of them are also used in the practical part of this thesis. Also some of the most commonly traded patterns are provided with rules on how to trade them.

In the practical part of the thesis a strategy is programmed which gives any user the ability to trade based on the signals it provides. The most commonly used indicator to find trend forming conditions is the moving average which is the backbone of this strategy. Since the probability of a new trader being profitable is slim, this strategy should give an edge in the market.

In conclusion it can be said that it is impossible to predict future price action with 100% accuracy however technical analysis improves the odds of predicting the next move correctly and gives the trader an advantage over the competition.

This thesis can be further developed in many ways. These are some of the possibilities for that:

- The strategy can be further optimized
- The strategy can be converted to alerts, which would notify the user via app or web to open a specific position
- The strategy can be combined with a bot that is connected to an exchange API to fully automate trading
- More methods can be implemented to the strategy

- Explain price action and provide more examples of how and where to take trading positions

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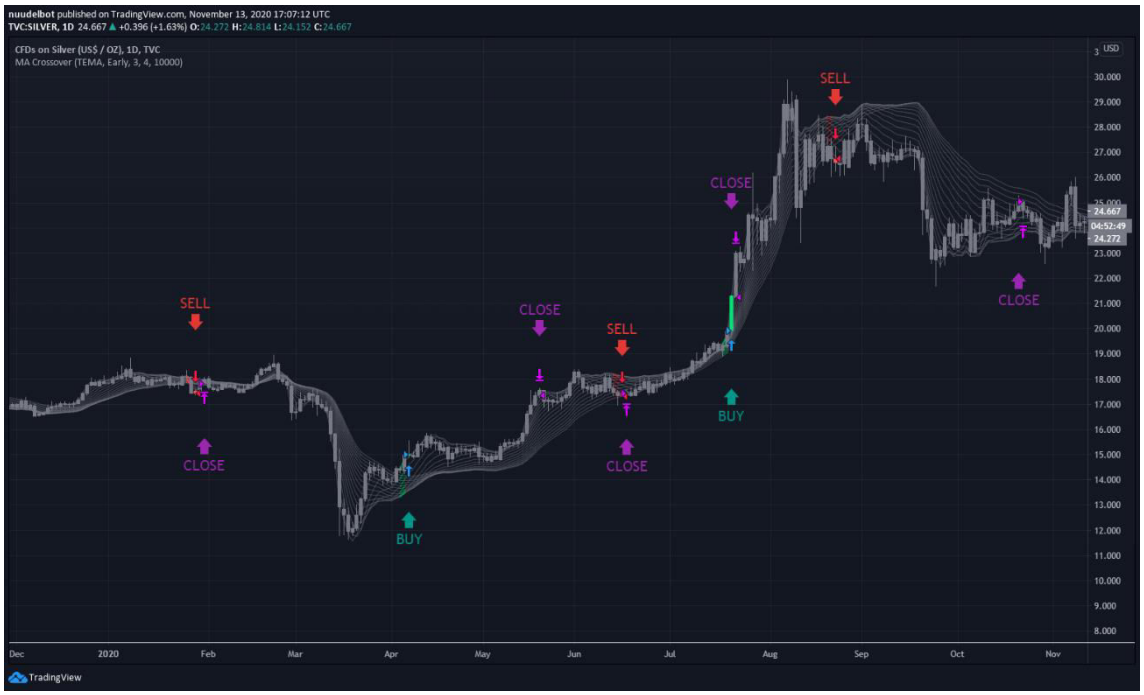
Appendix 2 – Charts with the script running

1. USD/JPY default inputs

USD/JPY optimized inputs

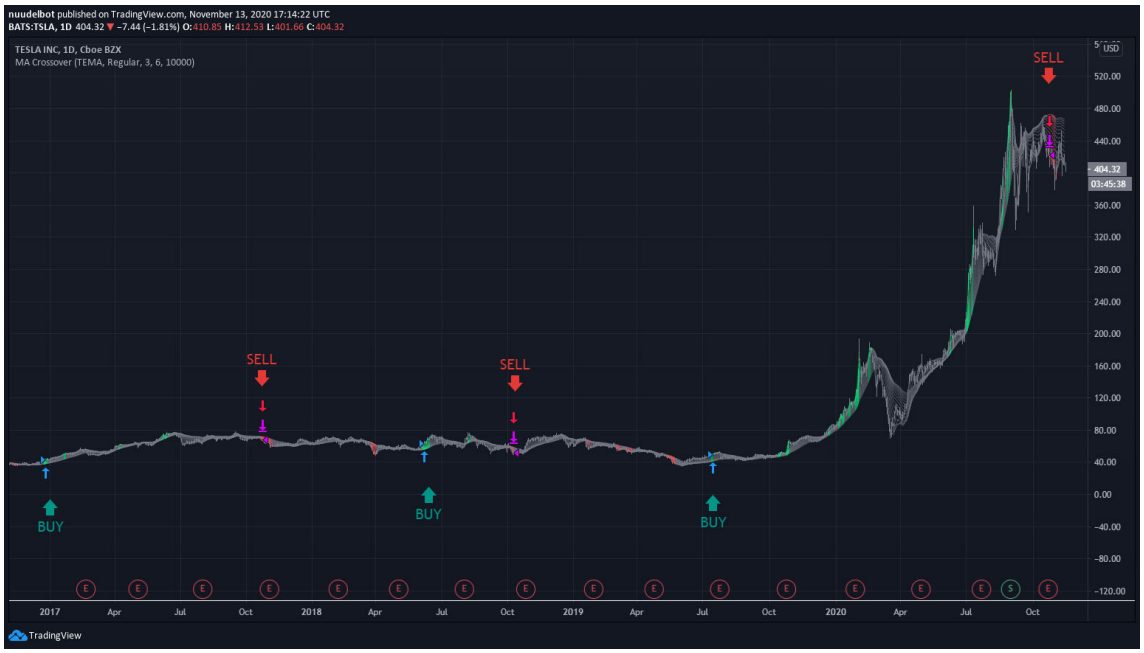
2. Silver USD/OZ default inputs

Silver USD/OZ optimized inputs

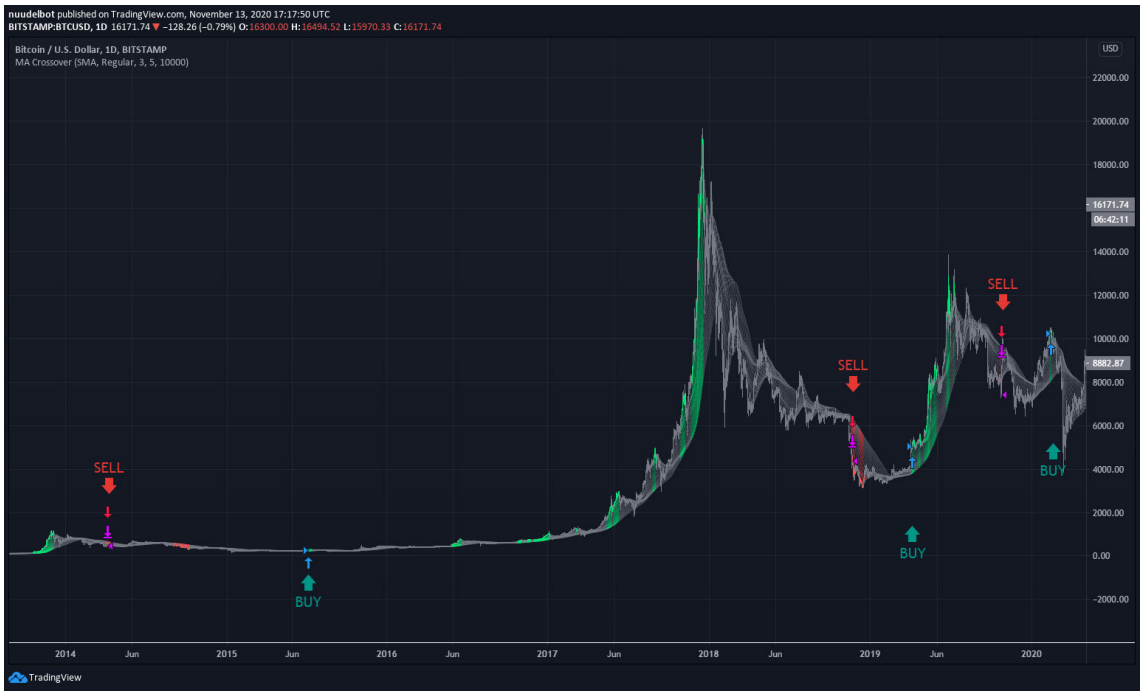


3. Tesla INC. default inputs

Tesla INC. optimized inputs



4. BITCOIN/USD default inputs



BITCOIN/USD optimized inputs