



Universitat de Lleida

# TREBALL FINAL DE GRAU



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## **Chapter 1: Introduction**

This section is created in order to explain the reader the aim of the project and all the little objectives that will need to be achieved to reach the aim. Moreover, in this section we can find the context of the project and how the project will be done, using a Gantt diagram and the budget of the project.

### **1.1 Aim**

The aim of this project is to investigate the automatic trading systems and evaluate two in detail by using an application to check if it is profitable to use them with cryptocurrencies. As everything in this world, we are trying to make everything as technological as possible and trading will not be the exception.

We know that automatic trading systems are very useful nowadays. This is due the fact that is easier to trade and easier to follow your ideas. Automatic trading decreases the use of emotions and increases the options to get more profits.

Even though it seems perfect, it is not. Automatic trading is much more than just code a good algorithm and wait until you get rich. You need to see and check what your algorithm is doing every day; you cannot stay in the sofa while it is working. Moreover, your algorithm might work for a few days or months, but the market is moving all the time so you will need to make some modifications. All this features make automatic trading really interesting and that is why this project will try to find the way to use some automatic trading system in order to get profits from cryptocurrencies. It is important to know that cryptocurrencies, as currencies or shares, works in the same way, offer and demand, but they have some different characteristics, like the volatility and its decentralized nature, that make them very different and much more difficult to find an automatic trading system that fit cryptocurrencies.

The key objective is to find the best way to use automatic trading systems for cryptocurrencies.

### **1.2 Objectives**

To fully satisfy the aim of this project, as a minimum the following objectives must be met.

First of all, we need the fully understanding of the trading system, taking in consideration the conventional and the automatic strategy. And of course, the different types of automatic trading system and how try to understand the market.

In order to understand how to adapt these trading system for cryptocurrencies, it is very important to understand and find the differences between the cryptocurrencies and currencies or shares, because these differences is what make the algorithm useless for the cryptocurrencies.

Once the knowledge of the previous points is done, it is crucial to select two automatic trading systems when we can see the differences between the cryptocurrencies and the others. Furthermore, this process of selection needs to take in consideration the different types of automatic trading systems and how they work and how they can be useful for cryptocurrencies with some modifications.

When the chosen methods are selected, the next step to achieve the final goal will be the design and implementation of a software to check the profitability of cryptocurrencies. This software will be done for myself taking in consideration all the above points.

Finally, the last objectives will be the adaptation of the software to make it profitable for cryptocurrencies, if needed, and the evaluation of the results.

As I said at the beginning of this section, all of these steps will be required in order to achieve the main goal of the project, which is to make automatic trading system useful for cryptocurrencies.

### **1.3 Context**

We always hear that stock market is awesome, gorgeous, and magnificent but as everything, you need to work very hard to become a professional and take profits of it. As an economics lover I have always wanted to know how it works and even more, I have always thought I could earn some money from it. Far from the reality, the world of the stock exchange is really complex. Hopefully for the investors, automatic trading appears and it seems that is a little bit easier to trade. Even though, you have to be sure and study your strategy if you do not want to lose money. However, it makes much easier to trade and much quicker.

Another step further are the cryptocurrencies, which appear to stay for a long time. They are extremely interesting because they are very different from what we know previously.

Because that is what we try it. They do not have any government in the middle of the transactions, for instance. Moreover, banks and other institutions want to use them as a way to pay or to change assets between people or companies. An example of this reason is the Santander bank which wants to use the cryptocurrency Ripple to make exchanges and payments between clients [14].

Due to all these aspects, I found myself interested in both topics. It was then when I realized that it could be amazing to study them and take important conclusions. Thinking about them make me realize that I wanted to learn how to use the advantages of automatic trading with the cryptocurrencies. How I can take profit of two things I find interesting and how they really work. Analyse the algorithms of the chosen automatics system to see if they work as good or as bad for the cryptocurrencies as they work for the fiat currencies.

The theory makes me realize that if automatic trading is not a sure science for fiat currency, it will be even more risky for cryptocurrencies due to their characteristics. Because cryptocurrencies and fiat currencies are far away to be similar as we will see in further chapter of the project. They have meaningful differences such as the volatility or the market. This risky makes me want to do this research and try to understand how to combine both topics in order to get a profit.

## **1.4 Project management**

This section refers to the planning that I will follow and how the project will be organized. This includes the timetable and how the objectives will be reached. It means when I do the research, when I reach the goals and the different tasks that the project is divided.

### **1.4.1 Scheduling**

First of all, I want to mention that the memory of the project will be done at the same time I do the research, not at the end of the project. The task described as Documentation means the time that I will spend doing the design, and final modifications of this memory.

The project is divided in initial tasks and then two big tasks and the finals tasks.

The point of the initial tasks is to get all the knowledge needed to understand the automatic trading systems and how cryptocurrencies work. Moreover, we need to define the project and set the goals.

After that, the project is divided in two parts. The first one deals with the application using the selected methods. In this part I will define which methods I will use for the application and get the historical data of cryptocurrencies and market shares. Furthermore, I will choose the programming language that will be used and implementing the project. Before doing the implementation, I will do the design and the requirements of it in order to follow a Software Engineering methodology to develop the application. This task will end with the testing and the conclusions of the results.

The second task is related with the adaptation. Which means that is related to all the changes that will be done in order to adapt the chosen methods useful for the cryptocurrencies. Moreover, the testing and evaluation of the results for each modification will be done.

Last, the final tasks which will be the final conclusions of the project and to finish the memory.

The Gantt diagram in the figure 1 shows how these different tasks will be organized in hours and months.

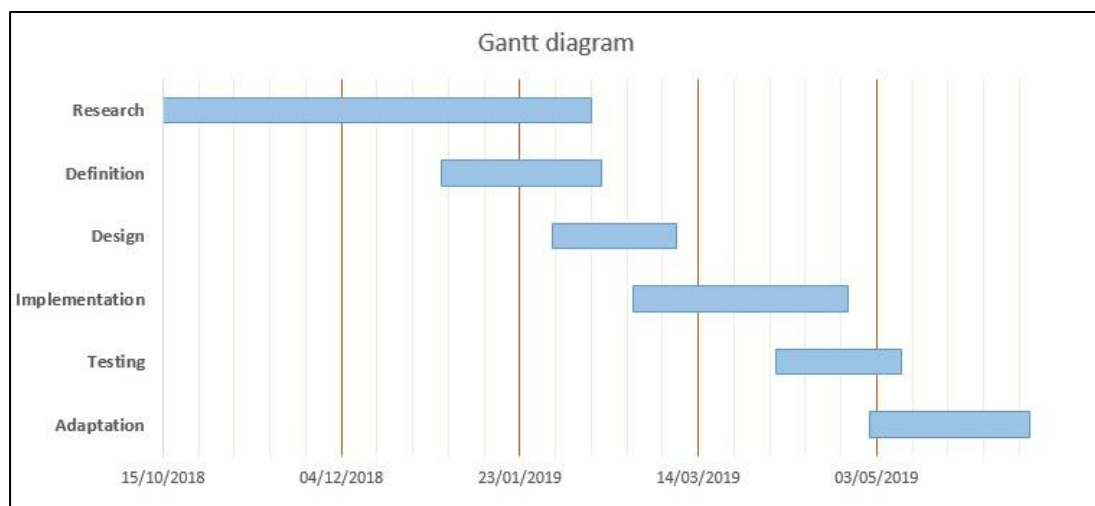


Figure 1: Gantt diagram

The definition of the project is to set up the goals and to pick the automatic trading systems to use. The idea is to start this task while doing the research. While picking the systems, I will also start doing the design of the application because I will already know how the system works so I will be able to start the design process.

The implementation will start in the middle of the design process because I can start coding and in case there is any problem I will be able to redesign it. As always, the testing process will start while the application is already on in order to check every function and once the application is done, will be the moment to just test the whole application.

Finally, the last thing will be the adaptation of the application, which will last till the end of the project. Which means to find out how the strategies can be profitable for cryptocurrencies.

#### 1.4.2 Budget

The budget is divided in the different roles that will be done; we can see them in the Gantt diagram in Table 1. These main roles in the project are design, implementation, testing and adaptation. Indirect costs like electricity or Internet are included in the total cost of each task. Finally, the cost of the software like Chrome, Atom, GitHub is 0 because they are free.

All the research and documentation will be also included because is required in order to do the project.

Table 1: Budget

Product	Price/hour	Hours	Total
Design	15 €/h	85	1.275 €
Implementation	25 €/h	150	3.750 €
Testing	20 €/h	60	1.200 €
Adaptation	20 €/h	90	2.000 €
<b>Total</b>		<b>385</b>	<b>8.225 €</b>



## **Chapter 2: Trading**

Trading is in its excellence the action or activity of buying and selling goods and services. This is what refers this section. First of all we will see a summary of its history in order to introduce how it became important. Secondly, trading and its types, discretionary and automatic, will be presented. As the project is about automatic trading system, there is a section to explain the different strategies of it. And finally, the two strategies that the project will follow, with the explanation, the way they are used and examples in order to understand them very well before coding them to see the results in the cryptocurrencies.

### **2.1 State of the art**

The trade is an innate activity to the human being that has developed in parallel throughout its evolution. With the appearance of the first societies the development of commercial activity began. A research of greater comforts began, arising new nutritional necessities, of housing and of dress, which caused the specialization of the man and the division of the work.

#### **2.1.1 History of the Stock Market**

The development and implementation of agriculture at the end of the Neolithic (9000 BC / 4000 BC) and the subsequent improvement of the techniques used in this area, was the main driver of trade. Based on the exchange of the surpluses of these crops, on those objects and techniques that only other communities could offer, and on the fact that the wealth could be stored, the first capitalist societies emerged. The commercial activity and its gradual effect in the societies, has followed a process of incessant transformation and progress, giving rise to increasingly complex structures. During this long process, it is worth highlighting its beginnings with the "barter" system, the introduction of the currency, the important trade routes during the Middle Ages, the development of Banking, the Globalization process, the development of the Stock Exchange and the appearance of cryptocurrencies.

In the 1100s, for example, France had a system where “courretiers de change” managed agricultural debts throughout the country on behalf of banks. This can be seen as the first major example of brokerage because the men effectively traded debts.

It’s generally accepted that Antwerp had the world’s first stock market system. Antwerp was the commercial center of Belgium and it was home to the influential Van der Beurze family. Thus, early stock markets were typically called Beurzen.

Although the infrastructure and institutions resembled today’s stock markets, nobody was actually trading shares of a company. Instead, the markets dealt with the affairs of government, businesses, and individual debt.

The East India Company is widely recognized as the world’s first publically traded company. There was one simple reason why the East India Company became the first publically traded company: risk. Put simply, sailing to the far corners of the planet was too risky for any single company. When the East Indies was first discovered to be a haven of riches and trade opportunities, explorers sailed there in droves. Unfortunately, few of these voyages ever made it home. Ships were lost, fortunes were squandered, and financiers realized they had to do something to mitigate all that risk [2].

Thus, a unique corporation was formed in 1600 called “Governor and Company of Merchants of London trading with the East Indies”. This was the famous East India Company and it was the first company to use a limited liability formula.

Investors realized that putting all their “eggs into one basket” was not a smart way to approach investment in East Indies trading. Let’s say that a ship returning from the East Indies had a 33% chance of being seized by pirates. Instead of investing in one voyage and risking the loss of all invested money, investors could purchase shares in multiple companies. Even if one ship was lost out of 3 or 4 invested companies, the investor would still make a profit.

The formula proved to be very successful. Within a decade, similar charters had been granted to other businesses throughout England, France, Belgium, and the Netherlands.

In 1602, the Dutch East India Company officially became the world’s first publicly traded company when it released shares of the company on the Amsterdam Stock Exchange. Stocks and bonds were issued to investors and each investor was entitled to a fixed percentage of East India Company’s profits.

The London Stock Exchange was officially formed in 1801. Since companies were not allowed to issue shares until 1825, this was an extremely limited exchange. This prevented the London Stock Exchange from being a true global superpower.

That's why the creation of the New York Stock Exchange (NYSE) in 1817 was such an important moment in history. Because the NYSE has traded stocks since its first day.

### **2.1.2 Trading**

Mainly speaking, the philosophy of financial trading is based on the purchase of an asset or financial instrument, at the lowest possible price, with the intention of subsequently selling it for a higher price or selling that instrument at a high price with the intention to buy it cheaper later [13].

The main objective of the purchase process is to obtain a benefit which can be economic, strategic, etc.

The exchange tool used is money, which provides a huge dynamism and effectiveness to the process against the mechanisms previously used and previously defined in this work such as the barter system.

Trading systems can be broadly classified into two types: Discretionary trading systems and mechanical trading systems. Everything else is either a clone of one of these two [9].

## **2.2 Discretionary trading systems**

A discretionary trading system is where the trades are based on a mix of trading rules and experience.

While other trading styles emphasize the reading of signals based on mathematical formulas, price action patterns or algorithms, discretionary traders not only rely on their well-developed trading processes, but also in the framework in order to make a decision, they also use intuition as well (i.e., years of market experience). Because of their experience, discretionary traders tend to be flexible with their trading rules and more adaptable to market changes [11].

The downside to the discretionary trading style is that trading decisions are more susceptible to the strong emotional effects of managing financial risk, for example, greed, fear or anger. This aspect makes trades even more complicated because even though your formula is right, you feel like it is not the right decision and you might go short or long and that it's not what the formula said.

Another drawback is that depending on the time frame; it requires more attention to the market than mechanical or automated trading methods.

A good example with an eye to get a completely understand of a discretionary trading system is when a trader hears about a hot stock on something, and immediately decides to buy. That's discretionary trading.

Another example is that a trader has a chart that she stares at all day. It may be filled with indicators, trend lines, moving averages, price data, etc. Once that trader makes a trade decision based on all she sees, this makes it discretionary trade.

The truth is discretionary traders may or may not have rules, they may or may not follow these rules, and they may not be consistent in applying these rules. And sometimes, they might not even be able to describe the rules that caused them to trade.

Discretionary trading involves trading decisions that involve some degree of human judgment. Maybe it is intuition, or a sixth sense, or even random guessing, but the trade selection usually includes something that can't easily be defined or tested.

On the other hand, as I said, discretionary systems are simply adaptable to new market conditions, which is perfect because the market is never the same and it never does the same moves. Also, they are based on experience that means that when a trader knows which trading signals have a higher probability of success (i.e. they can be profitable).

## **2.3 Automatic/Algorithmic trading systems**

Algorithmic trading, automated trading, black-box trading or simply algo-trading is the process of using computers programmed to follow a defined set of instructions, an algorithm, for placing a trade in order to generate profits at a speed and frequency that is impossible for a human trader. The defined sets of rules are based on timing, price, quantity or any mathematical model. Apart from profit opportunities for the trader, algo-trading

makes markets more liquid and makes trading more systematic by ruling out the impact of human emotions on trading activities.

The main advantages of the automatic trading systems are the efficiently back tested and the avoidance of human emotions. These two characteristics are very important because they are the ones that make us loss money while trading. Moreover, automatic trades are executed at the best possible prices, they can simultaneous check on multiple market conditions and reduce risk of manual errors in placing the orders.

The greatest portion of today's algo-trading is high frequency trading (HFT), which attempts to capitalize on placing a large number of orders at very fast speeds across multiple markets and multiple decision parameters, based on preprogramed instructions.

On the other hand, even though is back tested, the market is always changing and your strategy might work for the past days or months but not any more in the present or near future.

### **2.3.1 Algorithmic Trading Strategies**

The following are common trading strategies used in algo-trading [20].

#### **Trend-following Strategies**

The most common algorithmic trading strategies follow trends in moving averages, channel breakouts, price level movements and related technical indicators. These are the easiest and simplest strategies to implement through algorithmic trading because these strategies do not involve making any predictions or price forecasts. Trades are initiated based on the occurrence of desirable trends, which are easy and straightforward to implement through algorithms without getting into the complexity of predictive analysis. The 50- and 200-day moving averages are a popular trend-following strategy. We will explain it later because we will work with it in the application.

#### **Arbitrage Opportunities**

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

### **Index Fund Rebalancing**

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

### **Mathematical Model Based Strategies**

Proven mathematical models, like the delta-neutral trading strategy, allow trading on a combination of options and its underlying security. Delta neutral is a portfolio strategy consisting of multiple positions with offsetting positive and negative deltas – a ratio comparing the change in the price of an asset, usually a marketable security, to the corresponding change in the price of its derivative – so that the overall delta of the assets in question totals zero.

### **Trading Range (Mean Reversion)**

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

### **Implementation Shortfall**

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

After all these strategies, the chosen ones are the simple moving averages and the RSI. With these two strategies the application will try to see if we can improve our profit for the cryptocurrencies.

## 2.4 System 1 automatic trading - Moving averages

The first strategy I am going to use is the Trend-following Strategies and as I said before, I will work with the moving average trough 50 and 200 days.

A moving average is, in statistics, a calculation to analyse data points by creating a series of averages of different subsets of the full data set. It is also called a moving mean (MM) or rolling mean and is a type of finite impulse response filter. A moving average is an average of past data points that smooths out day-to-day price fluctuations and thereby identifies trends.

Given a series of numbers and a fixed subset size, the first element of the moving average is obtained by taking the average of the initial fixed subset of the number series. Then the subset is modified by "shifting forward"; that is, excluding the first number of the series and including the next value in the subset.

Make no mistakes about it, in theory; there are an infinite number of simple moving averages. But if you think you will come up with some weird 46 SMA to beat the market, stop thinking in that way. It is proved that in order to get coherent results you need to use numbers like 5, 10, 20, 50, 100. It means that it is critical to use the most common SMAs as these are the ones many traders will be using daily.

By using the web application of Plus500 [19], we can see the figures 2, 3, 4, 5 and 6 the most common SMAs, which are the 5SMA, 10SMA, 20SMA, 50SMA and 200SMA. As we can see, increasing the number of the SMA will make the chart more different than the closed prices, so we can see the trend of it. Which means, when using a 5 SMA, the trend is really similar to the stock closing prices while a 100 or 200 SMA is very different and without many highs and downs as the 5 SMA.

In the Figure 2, we can see a 5-SMA, which is for the hyper trader. The shorter the SMA, the more signals you will receive when trading. The best way to use a 5-SMA is as a trade trigger in conjunction with a longer SMA period. For a short-term traders we can also use a 10-SMA, as we can see in the Figure 3 , which is great for swing traders and day traders.

The last stop on short-term traders it is a 20-SMA that we can see at the Figure 4. We can notice what it is already explained that the SMA is becoming more different from the stock prices. In the Figure 5, we can see the 50-SMA, which is mainly used by traders to gauge mid-term trends.

Finally, in the Figure 6 we can see the 200-SM, which takes in consideration 200 days and is for long-term trend followers. Most investors will look for a cross above or below this average to represent if the stock is in a bullish or bearish trend. The 200-day simple moving average (SMA) is considered a key indicator by traders and market analysts for determining the overall long-term market trend. The price level in a market that coincides with the 200-day SMA is recognized as a major support level when price is above the 200-day SMA or resistance level when price is below the 200-day SMA level.



Figure 2: 5 SMA



Figure 3: 10 SMA



Figure 4: 20 SMA



Figure 5: 50 SMA



Figure 6: 200 SMA

One of the most popular simple moving averages to use with a crossover strategy are the 50 and 200 days. When the 50-simple moving average crosses above the 200-simple moving average, it generates a golden cross. Conversely, when the 50-simple moving average crosses beneath the 200-simple moving average, it creates a death cross.

In other words, when the 50-MA is above the 200-MA, we're in an uptrend. When the 50-MA is below the 200-MA we're in a downtrend. The 50 and 200 are the most popular moving averages for longer-term investors [12].

50 and 200 SMA will be used in the application.

In order to use this strategy, the indicators we use are:

- 200 SMA applied to closing prices.
- 50 SMA applied to closing prices. This moving average will be the key towards managing risks in our trade.

The strategy is based in two options as I explained before, when the 50 MA cross over the 200 MA and the other way. We buy shares of a stock when its 50-day moving average goes above the 200-day moving average and we sell shares of the stock when its 50-day moving average goes below the 200-day moving average [3].

In the Figure 7 we can see the chart of Apple stock prices. At the end of 2018 we can see that the red line (50 SMA) crosses beneath the blue line (200SMA), which means that we will sell the stocks. This means we are in a downtrend and the stock price is going to be lower.



Figure 7: Apple's stock prices with 50-200 SMA

Now, we have the Facebook stock prices in the Figure 8 and we can see two moments when we will use our moving averages. One in June, when we will buy stocks and the other in September when we will sell them because the red line (50 SMA) crosses below the blue line (200 SMA).



Figure 8: Facebook's stock prices and 50-200 SMA

In the Figure 9 we have Gold stock prices and different points when we have to buy or sell. As we can see, in February the red line (50 SMA) crosses above the blue line (200SMA), which is a golden point, and we will buy shares. In June we will sell these stocks and in December we will buy again. All these movements are because the SMA crosses the other SMA.



Figure 9: Gold's stock prices and 50-200 SMA

Using the two moving averages and entering after the trend is established offers a low risk trading strategy and is very objective but requires a bit of practice to identify the trade set ups.

A moving average helps cut down the amount of "noise" on a price chart. Look at the direction of the moving average to get a basic idea of which way the price is moving. If it is angled up, the price is moving up (or was recently) overall; angled down, and the price is moving down overall; moving sideways, and the price is likely in a range.

On the other hand, moving averages are calculated based on historical data, and nothing about the calculation is predictive in nature. Therefore, results using moving averages can be random. At times, the market seems to respect MA support/resistance and trade signals, and at other times, it shows these indicators no respect. But this happens with all indicators because the market is moving.

## **2.5 System 2 automatic trading - RSI**

The second strategy I use is based on the RSI, the Relative Strength Index.

The RSI, developed by J. Welles Wilder, is a momentum oscillator that measures the speed and change of price movements. The RSI oscillates between zero and 100. Signals can be generated by looking for divergences and failure swings. RSI can also be used to identify the general trend [10].

RSI offers a chance to define the market sentiment and spot the points at which the market is overbought and oversold. It is also used to detect times when the price is about to reverse, and a new trend rises .

RSI is considered overbought when above 70 and oversold when below 30. These traditional levels can also be adjusted if necessary to better fit the stock. For example, if a stock is repeatedly reaching the overbought level of 70 you may want to adjust this level to 80.

In an uptrend or bull market, the RSI tends to remain in the 40 to 90 range with the 40-50 zone acting as support. During a downtrend or bear market the RSI tends to stay between the 10 to 60 range with the 50-60 zone acting as resistance. These ranges will vary depending on the RSI settings and the strength of the security's or market's underlying trend.

Usually standard overbought and oversold levels are 70 and 30. If the indicator's line goes above the 70 level, it signals that market is overbought and the trend may reverse downwards.

We can see in the Figure 10 that at the beginning of June, end of July of 2018 and end at March of 2019, we had an RSI above 70, which means that it was overbought

If the indicator's line goes below the level 30, it signifies that market is oversold and the trend may reverse upwards.

The reference level is 50, and it is the median value. If the indicator chart is ranging between the levels 30 and 70, the market is flat or that the current trend is smooth, steady and there is less of a likelihood for reversal in short-term.



Figure 10: Microsoft's stock prices and RSI

Sometimes, overbought and oversold levels are set at 80 and 20 instead of 70 and 30. This setting is used during increased market volatility. It means that might be sometimes that we are going below 30 very often or above 70. In those moments is recommended to increase the values to buy or sell in order to avoid this volatility and be sure that is the right moment to act.

In the application, we will buy when the RSI is under 30 and we will sell when the RSI is over 70 [15].

RSI Calculation Formula is a bit difficult to understand but it follows the following steps.

$$RSI = 100 - \frac{100}{(1 + RS)}$$

$$RS \text{ (Relative Strenght)} = \frac{AvgU}{AvgD}$$

AvgU = average of all up moves in the last N price bars

AvgD = average of all down moves in the last N price bars

$N$  = the period of RSI

The main point is to keep track of the increase and decrease for each day. With these values we will be able to get the relative strength of that period. Afterwards, we will only need to use the formula in order to get a number between 0 and 100, which has the meaning that the RSI method wants us to see.

The most common  $N$  period of RSI is 14 days and this is exactly what it will be used in the application. Moreover, for the calculation of the RSI it will be used the simple moving averages but we have to know that the RSI can be calculated through the exponential moving averages too.



## **Chapter 3: Cryptocurrencies**

A digital or virtual currency that uses cryptography for security. This section will explain its history and its characteristics. The main objective of this section is to let the reader know how they work, which ones are the most important nowadays and to see some differences between currencies or shares.

### **3.1 State of the art**

This chapter wants to give us some history about the cryptocurrencies and the main types.

#### **3.1.1 History of Cryptocurrencies**

A cryptocurrency (or crypto currency) is a digital asset designed to work as a medium of exchange that uses strong cryptography to secure financial transactions, control the creation of additional units, and verify the transfer of assets. Cryptocurrencies are a kind of alternative currency and digital currency. Cryptocurrencies use decentralized control as opposed to centralized digital currency and central banking systems [4].

The decentralized control of each cryptocurrency works through distributed ledger technology, typically a blockchain, which serves as a public financial transaction database. We will see it later because now we are going to focus on its history to understand them better.

We have had digital currency systems before the well-known cryptocurrencies existed, but they were not the same thing. Former versions of digital currencies were strictly centralized, whereas these new forms of cryptocurrency, such as Bitcoin and Ethereum, are decentralized in nature.

In a decentralized digital currency system, every single user or entity needs to agree on every single account balance and transaction for it to work.

Bitcoin and other cryptocurrencies demonstrate how there is no need for any kind of central authority to control spending and account balances as long as there is total consensus among all parties involved.

Now, what is really interesting about cryptocurrencies is that they were never intended to be invented as they are known today. This all started with the now infamous Bitcoin and a

man or group of people under the name of Satoshi Nakamoto. Nakamoto's goal in the beginning was to create nothing more than an electronic peer to peer cash system. People had for a long time been trying to create some kind of online digital cash system, but had always failed due to the issues with centralization.

Satoshi Nakamoto knew that another attempt at building an online centralized cash system would only result in more failure, so he decided to create a digital cash system that had no centralized authority. And so came the birth of the Bitcoin. Yes, Satoshi Nakamoto invented the Bitcoin, the very first decentralized form of digital cash that had no central governing or controlling body. Bitcoin was to be the property of the entirety of the Bitcoin community.

Later on 2010, the inaugural Bitcoin sale takes place, enabling a monetary value to be attached to cryptocurrency for the first time. A Bitcoin user swaps 10,000 coins for two pizzas. Given that 10,000 Bitcoins would be worth more than £55m last year, these would be the most expensive pizzas in history [8].

Rival cryptocurrencies begin to emerge, with Litecoin, Namecoin and Swiftcoin all making their debut. Meanwhile, Bitcoin is criticised after claims emerge it is being used on the so-called "dark web", particularly on sites such as Silk Road. Proving that no publicity is bad publicity, the price of Bitcoin skyrockets before crashing back down again.

Around 2015, new cryptocurrencies emerge, including Ethereum and coinbase. Bitstamp, a European based Bitcoin exchange, is the victim of a security breach after being hacked, but resumes trading a few days later, assuring customers that they have not lost their funds.

On 2016, Cryptocurrencies continue to become more mainstream. The number of Bitcoin ATMs rises from around 500 at the beginning of the year to just under 900 by the end of the year; Uber in Argentina switches to Bitcoin payments, and the Swiss national railway and software website Steam are among new users accepting the currency.

The DAO (decentralised autonomous organisation) is founded in May – a stateless venture capital fund on the Ethereum blockchain and the largest crowdfunded project to date.

### 3.1.2 Cryptocurrencies

Cryptocurrency is best thought of as digital currency (it only exists on computers). It is transferred between peers (there is no middleman like a bank). Transactions are recorded on a digital public ledger (called “blockchain”). Transaction data and the ledger are encrypted using cryptography (that’s why it is called “crypto” “currency”). It is decentralized, meaning it is controlled by users and computer algorithms and not by a central government. It is distributed, meaning the blockchain is hosted on many computers all over the world. Meanwhile, cryptocurrencies are traded on online cryptocurrency exchanges, like stock exchanges.

These are some of the most popular cryptocurrencies in circulation today:



Bitcoin

The original and most widely used. There are currently more than 16.8 million Bitcoin tokens in circulation, against a present capped limit of 21 million.

Bitcoin’s market capitalization varies significantly from day to day but has hit a record high of more than \$200bn. It remains the poster-child for the cryptocurrency industry, though critics suggest that it’s volatility, slow speeds, energy usage and higher transaction fees will put a limit on its growth [5].



Bitcoin cash

This offshoot of the original Bitcoin, which launched in the summer of 2017, has already soared to become one of the most traded cryptocurrencies.

A little like a share split, there is now approximately the same amount of Bitcoin cash in circulation as Bitcoin. Nevertheless, there are key differences – most notably, Bitcoin cash has an 8MB block size compared with 1MB for the original Bitcoin.

This means faster processing speeds, but on the downside it is more memory-intensive.



Litecoin

Known as “Bitcoin’s little brother”, Litecoin resembles it’s older sibling in that it is a peer-to-peer cryptocurrency, but has faster transaction speeds as well as a substantially higher token limit of 84 million.

However, its mining process is more memory-intensive and its market cap is around 1/20th of the size of Bitcoin.



Ethereum

Ethereum has been labelled a “decentralized app” provider. Originally developed as a “world computer” super network, it aimed to get rid of the need for third-party companies such as Apple in the creation of apps.

The apps developed on Ethereum are on a distributed public platform where miners can earn “ether” to fuel the network.



Ripple XRP

Ripple has been designed as a centralized transaction network to be used by banks for money transfers in much the same way as, say, SWIFT.

It uses the XRP currency – money is converted to the XRP token to be sent via the Ripple network and then converted back to money when it is withdrawn.

It is designed to be faster, more reliable and less volatile than other cryptocurrencies.

### **3.2 Characteristics**

In this chapter we are going to see the main characteristics of the cryptocurrencies in order to understand them. It is crucial to understand them for the results of the application and the ideas of the adaptation.

### **3.2.1 Trustless**

Bitcoin is trustless because it was designed in a way that nobody has to trust anybody, in order to the network's function.

Every form of currency before Bitcoin required a central authority that you have to trust in order to use it. In all cases, that central authority becomes the central weakness that leads to the demise of the currency.

With Bitcoin, each part of the ecosystem validates what the other parts are telling it without needing to trust anybody. If you broadcast a Bitcoin transaction, all nodes receive it and verify that the signatures are valid. If the signatures are not valid, they discard the transaction.

Everyone on the network has a copy of the ledger so we no longer need to trust a single entity/organization/third-party because there is no need to trust when you can just verify against this ledger because you have a copy of it. The decentralized ledger is known as the blockchain.

The incentivization of individual network actors through the proof-of-work (PoW) consensus algorithm is one of the most ground-breaking ideas in modern economics [18].

### **3.2.2 Immutable**

"Immutable", in its simplest sense, means "cannot be undone."

Immutability in regards to blockchain and cryptocurrency should follow 3 principles:

- It should be highly improbable or difficult to rewrite history.
- It should be impossible for anyone, but the owner of a private key to move funds.
- All transactions are recorded on the blockchain. (to guarantee the above 2 principles)

When we want to check how money has been spent from our bank accounts, we check our transaction history with the bank. We trust our banks not to fabricate transactions or manipulate our money as we trust them to deliver our transactions to recipients. If there are fraudulent transactions, the bank also needs to be trusted to change them and fix the situation.

As we have already seen that the elements of centralization and trust are removed from cryptocurrency, there is no longer a third party for us to trust to do these things. Therefore, transaction records are made public and unchangeable (immutable).

Although it isn't impossible to change the transaction ledger, cryptographic security makes it extremely difficult. It requires you to compromise the entire network of cryptocurrency users.

### **3.2.3 Decentralized**

Since "decentralization" is such a relevant buzzword in the crypto community, it's important to define it well. It can take on different meanings.

"Blockchains are politically decentralized (no one controls them) and architecturally decentralized (no infrastructural central point of failure) but they are logically centralized (there is one commonly agreed state and the system behaves like a single computer)" [7].

Fault tolerance: decentralized systems are less likely to fail accidentally because they rely on networks of separate components.

Attack resistance: decentralized systems are more expensive to attack and destroy or manipulate because they don't have vulnerable central points.

Collusion resistance: it is hard for members of decentralized systems to act in ways that benefit them at the expense of others. We can take this point as an advantage because the society use to think that there are some corporations that try to benefit themselves without thinking about others.

With central banks and governments, only the banks control the supply and creation of money through mints and interest rates.

### **3.2.4 Volatility**

The term volatility is important to understand since investors react to volatility differently. In the investment world, no two investors are the same. This means that every investor has different expectations of return, holding period of the investment, and so on.

The most basic definition of volatility is:

“A statistical measure of the dispersion of returns for a given security or market index. Volatility is measured either by using the standard deviation or variance between returns from that same security or market index. Commonly, the higher the volatility, the riskier the security.”

As we see in the Table 2, we can have an idea about how this volatility works for cryptocurrencies. In around 8 months the prices changes between 48 and 72 %, which is a very significant and not usual for fiat currencies.

Table 2: Percentage cryptocurrencies' prices changed

<b>Crypto Price Changes</b>			
<b>Currency</b>	<b>January 1, 2018</b>	<b>August 31, 2018</b>	<b>Price Change %</b>
Bitcoin	\$13,676.07	\$7,111.30	-48.00%
Ethereum	\$767.85	\$290.56	-62.16%
Litecoin	\$229.36	\$64.44	-71.90%

Cryptocurrencies are notorious for their volatility and we see this volatility in the table below:

Factors that contributed to this changes:

- (1) Bull run towards end of 2017. Starting in November 2017, there was an amazing bull run on the market. To give you some idea as to its intensity, we can check the Table 3, where we can see how the price changed during one year.
- (2) shows what happened to prices between November 1, 2018 and January 1, 2018.
- (3) Advertising ban. Facebook, Google, Twitter and others have banned advertisements showing cryptocurrencies and related products from their search engines.

Bitcoin fell 12% after Facebook said it would ban all ads that promote cryptocurrencies.

- (4) The possibility of unfavourable government regulations. In most cases, the news of governments wanting to regulate the crypto markets spooks investors. At the beginning of the year, the South Korean government announced it would consider regulating and even banning crypto trading. The government shortly rectified their statement about the ban, but the damage had been done. At about the same time, there was news that the Chinese government was actively preparing to block access to international Bitcoin exchanges, as well as ICOs.

Table 3: Cryptocurrencies prices

<b>Price Changes:</b>			
<b>Currency</b>	<b>November 1, 2017</b>	<b>December 17, 2017</b>	<b>January 1, 2018</b>
Bitcoin	\$6,525.77	\$19,453.36	\$13,676.07
Ethereum	\$301.31	\$720.71	\$767.85
Litecoin	\$55.11	\$320.94	\$229.36

Cryptocurrencies aren't much different from other commodities in that their prices are driven by the laws of supply and demand—if people want to buy, prices increase; if people want to sell, prices decrease. However, there are two main factors that make cryptocurrencies volatile: its size and its novelty.

The first factor is that cryptocurrencies have smaller market sizes as compared to established forms of currency. This means that even small movements of a cryptocurrency can have a pronounced effect on its price. Adding to this, cryptocurrency wealth distribution is even more skewed than that of traditional wealth, so the few with large stakes in a cryptocurrency (e.g., Bitcoin “whales”) hold disproportionate amounts of power over its pricing.

The second factor is that public perception of cryptocurrencies (Bitcoin in particular) is quite dichotomous. The recent price hike (Q2 2017) can be attributed to a number of factors (e.g., increased interest throughout Asia, increased enterprise adoption, Litecoin successfully activating SegWit to increase transaction throughput) that have increased positive sentiment in this space. On the flip side, a hard-fork, negative changes in the legality of cryptocurrencies, and hacks could very easily destroy their public interest.

As we can see in the Figure 11 [21], there is a very big difference between the volatility between U.S equities and cryptocurrencies. This difference is, in a big part, because of the factors above about volatility.

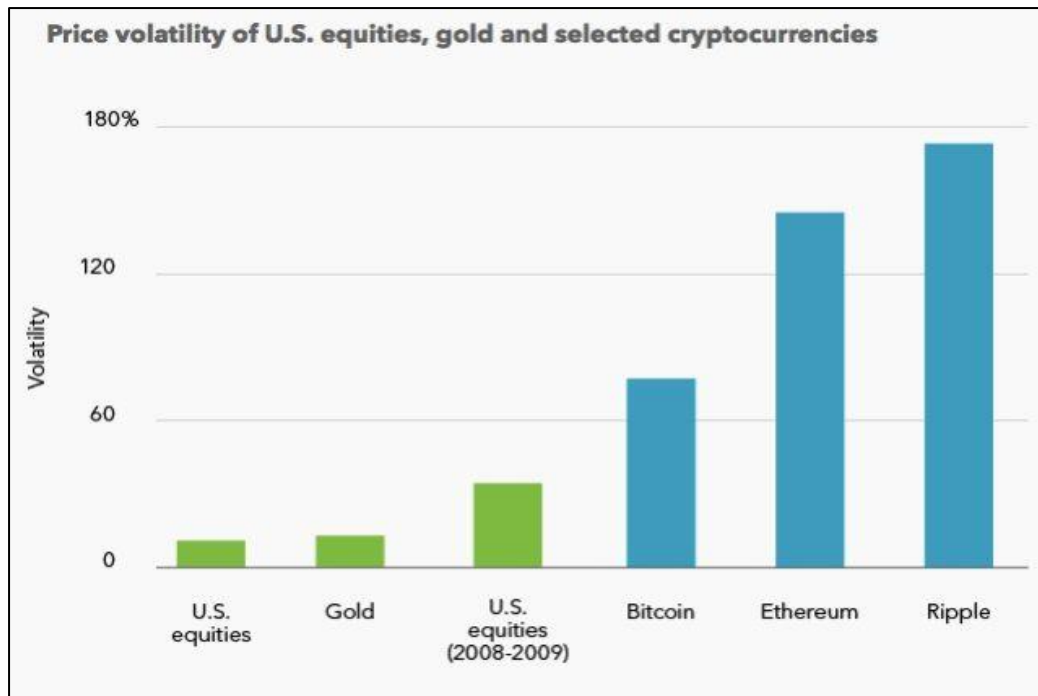


Figure 11: Price volatility of U.S. equities, gold, and cryptocurrencies

### 3.3 How cryptocurrencies work

Transactions are sent between peers using software called “cryptocurrency wallets.” The person creating the transaction uses the wallet software to transfer balances from one account (AKA a public address) to another. To transfer funds, knowledge of a password (AKA a private key) associated with the account is needed.

Transactions made between peers are encrypted and then broadcast to the cryptocurrency’s network and queued up to be added to the public ledger. Transactions are then recorded on the public ledger via a process called “mining” (explained below). All users of a given cryptocurrency have access to the ledger if they choose to download a “full node” wallet (as opposed to holding their coins in a third-party wallet like Coinbase).

The transaction amounts are public, but who sent the transaction is encrypted (it is pseudo anonymous). Each transaction leads back to a unique set of keys. Whoever owns a set of keys, owns the amount of cryptocurrency associated with those keys (just like whoever owns a bank account owns the money in it). Many transactions are added to a ledger at once. These “blocks” of transactions are added sequentially by miners. That is why the ledger and the technology behind it are called “block” “chain.” It is a “chain” of “blocks” of transactions [6].

### **3.4 Block chain**

The blockchain is like a decentralized bank ledger; in both cases the ledger is a record of transactions and balances. When a cryptocurrency transaction is made, that transaction is sent out to all users hosting a copy of the blockchain.

Specific types of users called miners then try to solve a cryptographic puzzle (using software), which lets them add a “block” of transactions to the ledger. Whoever solves the puzzle first gets a few “newly mined” coins as a reward (they also get transaction fees paid by those who created the transactions).

Sometimes miners pool computing power and share the new coins. The algorithm relies on consensus. If the majority of users trying to solve the puzzle all submit the same transaction data, then it confirms that the transactions are correct. Further, the security of the blockchain relies cryptography. Each block is connected to the data in the last block via one-way cryptographic codes called hashes which are designed to make tampering with the blockchain very difficult. Offering new coins as rewards, the difficulty of cracking the cryptographic puzzles, and the amount of effort it would take to add incorrect data to the blockchain by faking consensus or tampering with the blockchain, helps to ensure against bad actors.

Those who confirm transactions by breaking cryptographic codes are called miners. Mining is a process that creates new coins.

### **3.5 Difference between fiat and crypto currencies**

Normal currencies (fiat currencies) are printed and controlled by a central authority and these currencies are officially designed for running the monetary network whereas cryptocurrencies are opposite as they have no central authority, they are not printed as they are mined with electronic software.

Otherwise, there is no intrinsic difference. Both fiat currency and cryptocurrency can be called money or currency, both are mediums of exchange that are used to store and transfer value, both can be used to purchase goods and services, both have their value governed by supply, demand, work, scarcity, and other economic factors, both have their value affected by the quality of the system surrounding it and both can be traded on exchanges.

Moreover, fiat currencies are issued by government, which make unlimited supply and can be produced more by the government when necessary. They have a physical way of exchange money, because their form of coin or paper. Due to the fact that they are issued by the government they are centralized and controlled by the law and banks.

On the other hand, cryptocurrencies are created by computers, they have limited supply and has a set of maximum. They are a digital way of money exchange and presented by private and public piece of code. Because they are created by computers they are decentralized and not controlled by any single entity or government.

## **Chapter 4: Automatic Trading Application**

### **4.1 Purpose**

The main idea of the project is to develop a software that will work as an automatic trading system. We will pick one strategy between the chosen ones that will say when to buy or sell our shares. At the end, it will show the profits we have got during that period using our variables.

This software is able to explain us a lot of market stock, and cryptocurrency stock, and we will be able to check different periods of time and variables. With all this information, we can decide if that strategy can be worth it or not in cryptocurrencies. Before knowing that it is important to find the right dates/numbers to use for them taking in consideration that they are different from fiat currencies.

First of all, the software needs to read a csv file. This file contains the stock information of the currency or cryptocurrency. It will be like the Table 4. Through the <https://es.investing.com> we can obtain the csv file. In the website we can select which dates we would like to check and then, the program will only take in consideration those days.

Table 4: Application's cvs format

	A	B	C	D	E
1	Date	Price	Open	High	Low
2	06-May-19	6,070.00	6,042.00	6,079.90	5,906.80
3	05-May-19	6,042.00	6,098.20	6,112.00	5,956.20
4	04-May-19	6,098.30	6,019.90	6,149.10	5,868.20
5	03-May-19	6,016.00	5,729.60	6,139.90	5,716.50

The program will take in consideration only the values "Date" and "Price". These two values will be what the system needs in order to provide us the good answer. Even though, the idea is to read the complete sentence and keep all the values in case to keep working on the program after the project.

Once that information is read, the software will work with it. It will do the same as the real indicator, which means that will show us the same information if we check some official stock market webs.

If we run the SMA strategy, the program will ask us which values we want to use to do the average. As I said before, the main point is to use the 50-200 moving averages but it would be up to the user to pick which ones to try.

On the other hand, if we run the RSI strategy, the program will ask to choose the variable days, that is almost always set in 14, but just in case if the user wants to make some tests.

After we set the variables, the program will finish showing us the profit, how many shares we have bought, how many we have sold, and the profitability.

Moreover, the program will use a commission for every time that we buy. These commissions will be a 0,05% of the price when we buy. This commission wants to make the program more realistic with more real results.

#### 4.1.1 Application SMA

The project will be in a python file that have, as others python file, different ways to execute it. In my case, using PyCharm idea and in the console is only need to write `ProjectName.py`.

Before running the project the user must check if the csv file is correctly written in the program. This means that the code is reading the project from its directory and its name. We must check that this information is correct. If not, the program will not be able to find the csv file.

As I said, the program uses a csv file that will be downloaded from the Internet. To put that csv file into the program we need to put the path of that file into the variable ready for it.

When I worked with the code I found myself in a problem with the date 0. In the first day the application can never buy or sell because we cannot compare with the day before. Even though we cannot buy or sell we need to keep track of which mean is higher that day. In order to do that, I created a variable yesterday which is a boolean and it has to be checked at the same time the code checks which mean is higher. Both conditions must be met in order to buy or sell. Moreover, I had to create a variable called adjustment in order to bring the shortest mean at the same time for the biggest one to have a result. I mean, the program will not take in consideration the dates when we will only have one mean instead of the two needed. This is done in order to avoid useless information so the program will not need to check some dates.

To summarize the code, it will read the data and then, for every day it will do the means and check if we have to buy, sell or do nothing.

Once the project ends up reading all the dates, it will show us the results like in the Figure 12.

```
The profit during that period is: -312.29999999999995
We have 1 share, with a value of: 143.5
During that period we bought 4 times
```

Figure 12: Example results applications SMA

The first line shows us the profit per coin that we got during that period of time that we already chose in the csv file. The result is for coin, which means that is a result that shows at the same time the profitability. If we bought more coins, the result would have increased in the same amount. The profit/loss will be the profit that the program shows times the number of coins we would have bought.

In the second line, we see if we still have a share/coin. The idea of this line is to know if the program could not find a moment to sell it. If we check the value of the day after the period of time, we can transform that share/coin into money to know if the profit can increase or decrease. Or we can just keep the coin until it is the moment to sell it.

Finally, in the third line we see how many times we bought a share/coin. This line is quite important in order to understand if this method is buying every day or if it is only buying a few times.

### 4.1.2 RSI Application

This application is quite similar as the SMA application that I have just explained. We will execute it in the same way and it needs the same input of the csv file.

I had a little program coding it because I wanted to do everything just in one loop but it was impossible. The program needs two loops. One to get all the data and send it to the RSI function, and another loop for checking the values and after that, buying or selling when is needed.

Once the project ends up reading all the dates, it will show as the following screenshot the results.

```
The profit during that period is: -37.229999999999996  
We have 0 share, with a value of: 0  
During that period we bought 5 times
```

Figure 13: Example results application RSI

The first line shows us the profit per coin that we got during that period of time that we already chose in the csv file. The result is for coin, which means that is a result that shows at the same time the profitability. If we bought more coins, the result would have increased in the same amount.

In the second line, we see if we still have a share/coin or not. The idea of this line is to know if the program could not find a moment to sell it. In this example we see there is no coins left to sell which means that the program could sell all of them.

Finally, in the third line we see how many times we bought a share/coin. This line is quite important in order to understand if this method is buying every day or if it is only buying a few times.

As the SMA application, the RSI application also shows us a graph to see the results. We can see them in the chapter 5, Results.

### 4.1.3 Data

The data will come from a csv file that the user will download from the following website:  
<https://es.investing.com/crypto/Bitcoin/btc-usd-historical-data>.

The collected data will be used in both applications; it will be the same for both of them.

The idea to use it in that way is because I want to avoid as much as possible the yahoo or Google Finance APIs. The main reason is because they can have from time to time problems and make the program useless. As much as I know, when I started doing the program, Google Finance was giving problems and some other APIs can be problematic if we run the application a lot of times in a very short period.

In order to avoid all those reasons, I prefer to do it a little bit more “dirty” but being sure that the program will give us a correct result and we can decide if the strategy is worth it or not.

The user will need to go to the website already mention. Once there, he can choose the currency or cryptocurrency that he would like to check. Before downloading the data the user has to check that the Time Frame is Daily and then, pick the dates that we want to check. It can be a year, two, three or even a few months. The only important thing to take in consideration while choosing the dates is to know before which means he wants to check. With this I mean that if the user wants to use the SMA 200, he must use more than a year to have relevant information and not a few months.

Once we download the file we will have a csv file like we see in the Table 5. The information of the csv file will be the date, the price, the opening price, the highest and lowest price of that day, the volume and the change in percentage. The field delimiter or separator it is a coma (,). Even though we are not going to use all the data, I think is important to code the program taking all of it in consideration. Otherwise we can remove the last two columns without problems because I do not see any possibility to improve the code with that information.

Table 5: Csv file

	A	B	C	D	E	F	G	H
1	Date	Price	Open	High	Low	Vol.	Change %	
2	06-May-19	6,070.00	6,042.00	6,079.90	5,906.80	6.58K	0.46%	
3	05-May-19	6,042.00	6,098.20	6,112.00	5,956.20	5.82K	-0.92%	
4	04-May-19	6,098.30	6,019.90	6,149.10	5,868.20	9.44K	1.37%	
5	03-May-19	6,016.00	5,729.60	6,139.90	5,716.50	19.48K	5.11%	
6	02-May-19	5,723.80	5,629.50	5,779.80	5,618.00	11.06K	1.67%	
7	01-May-19	5,629.60	5,599.60	5,655.00	5,585.50	5.53K	0.54%	
8	30-Apr-19	5,599.50	5,480.00	5,612.00	5,454.90	7.44K	2.18%	
9	29-Apr-19	5,480.10	5,486.80	5,515.20	5,370.30	7.81K	-0.12%	
10	28-Apr-19	5,486.80	5,400.60	5,542.20	5,400.60	7.76K	1.57%	
11	27-Apr-19	5,401.80	5,410.90	5,456.90	5,355.40	4.57K	-0.17%	
12	26-Apr-19	5,410.80	5,215.60	5,517.10	5,174.10	21.53K	3.68%	
13	25-Apr-19	5,219.00	5,479.60	5,556.80	5,065.20	21.49K	-4.77%	
14	24-Apr-19	5,480.30	5,547.10	5,647.40	5,415.00	16.53K	-1.27%	
15	23-Apr-19	5,550.90	5,417.80	5,645.00	5,395.20	18.76K	2.46%	
16	22-Apr-19	5,417.80	5,320.30	5,447.50	5,276.50	11.95K	1.80%	
17	21-Apr-19	5,321.90	5,340.10	5,366.10	5,259.40	6.15K	-0.34%	

Once the last two columns are removed we will have a csv file like the following and then we will only need to make sure that the program is reading the right file with the right route of it.

## 4.2 Requirements

For the application will be needed a function to deal with a csv file in order to get all the information and after that, it will be needed to process it in order to keep the dates that the method says we should do a transaction. While doing the transaction it is important to also keep the values in order to get the right profit.

In order to accomplish the right use of the application we do not think too much things. It is a must to have the computer program that can read csv files, does not matter if they are current or not. Moreover, we need network connection to download that file. Some basic knowledge of python to understand where to write the route of the csv file. But what is really necessary is a knowledge of what it might mean the results because without that, the user will read some numbers but will not be able to get conclusions.

## 4.3 Diagram

The diagram of the application is the following:

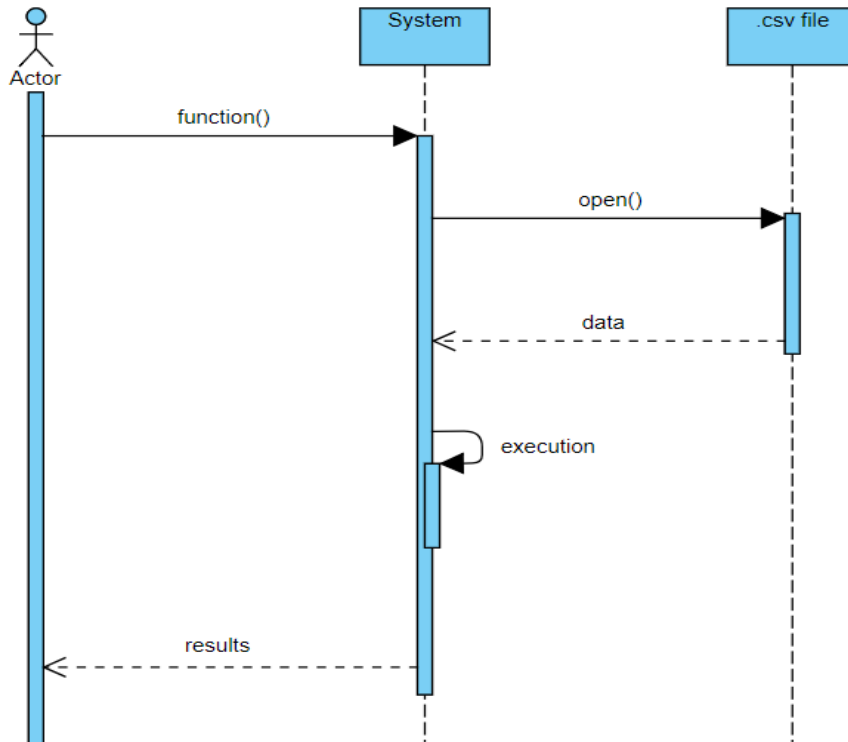


Figure 14: Application's diagram

As we can see, the project calls the csv file, which is on our computer. After that, it reads the data and once it collects every line, it does the strategy in order to return to the user the results.

This diagram is made by myself using the following website:

<https://online.visual-paradigm.com/> [17].

## Chapter 5: Results

This chapter is about the results. The following results take in consideration all what it is explained before. Trading, automatic trading, SMA, RSI, cryptocurrencies in order to achieve the goal, which is to know if cryptocurrencies work in the same way as fiat currencies.

## 5.1 Samples

To see the results and afterwards, to adapt them, I will use two cryptocurrencies and one fiat currency. The meaning of using also a fiat currency is to see if there is the difference that I think they should have due to the different characteristics of them.

The cryptocurrencies are Bitcoin, because is the most known and used worldwide and Ethereum. I chose Ethereum because the apps developed on it are on a distributed public platform where miners can earn “ether” to fuel the network.

For the fiat currency, I will use the European Euro against the American Dollar because from my point of view is one of the most widely used and a very strong currency.

Referred to period, I will use two. One of seven years, when we can check the methods when the cryptocurrencies more or less started to have a little bit more importance. This means that the time frame will be from around March 2012 – March 2019. Only Bitcoin and the fiat currency will be available to study this period of time because Ethereum was created around 2015.

The second period of time I will take in consideration will use three years. From March 2016 to March 2019. This period is because I want to check the methods once the cryptocurrencies had more importance in the market. Moreover, this period should suffer more than the other the decreases of the value of the cryptocurrencies in the last months of 2018 and beginning of 2019. During this period I will use both cryptocurrencies and the fiat currency.

For what we have learnt in the theory of this memory, we should see some difference between the cryptocurrencies and the currencies. A main point should be that cryptocurrencies might not be as profitable as the fiat currencies with a 200-50 SMA method because it takes a huge amount of days in consideration. Moreover, the cryptocurrencies had an important peak very quickly and a relative huge drop and maybe the method will not be able to see what was happening due to the amount of days.

At the same time, we need to remember that the result will be a profit/loss per coin, so the gain or loss of money is not quite important than the % of it in order to compare the results.

Furthermore, I think that the cryptocurrencies should have a better profit/loss in the period of three years than the one with seven because we will start with a higher close prices and with the “boom” of it already finished.

## 5.2 SMA results

This section shows the results obtained during the period and the currency that we can see in the heading of it. As a remember the period of seven years is for March 2012-2019 and the period of three years is for March 2016-2019. Moreover, there is a graph than can give us a better idea about the method. The graph in the Figure 16 is only in the seven years for EUR/USD but it would be the same for each currency and period, it shows the two moving averages and the buy or sell signals that activated the application.

### 5.2.1 Seven years EUR/USD

In figures 15 and 16 we can see the results of using the SMA as an automatic system during the period of March 2012-March 2019 buying and selling EUR/USD. The unit in the profit is USD per coin.

```
The profit during that period is: -0.046400000000000022
We have 0 share, with a value of: 0
During that period we bought 5 times
```

Figure 15: Results SMA 50-200 EUR/USD 7 years

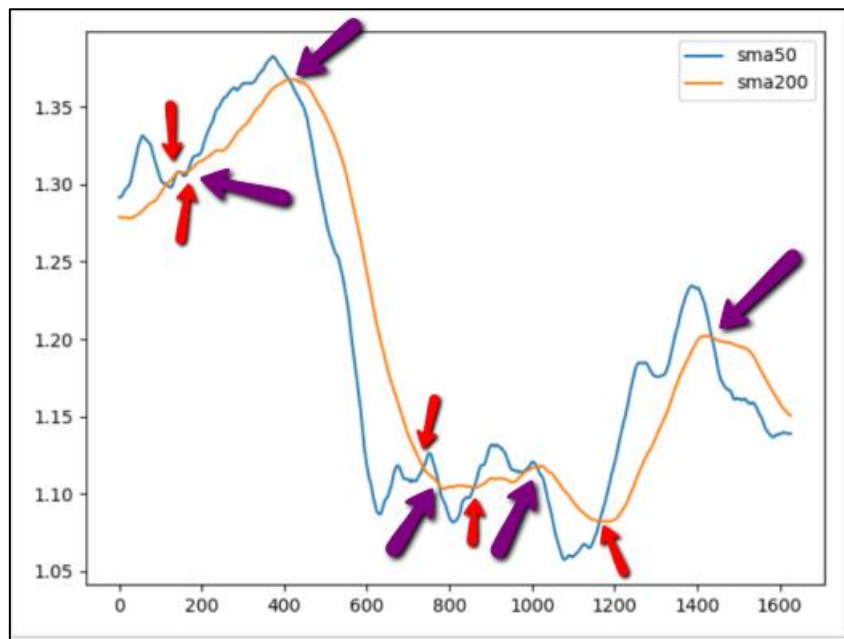


Figure 16: Graph SMA 50-200 EUR/USD 7 years

In red we can see all the times we have bought a coin and in purple all the times have sold it. As we can see, we bought one coin once we have sold them. It means, we cannot buy more

than once at a time. The last arrow is purple which means we have sold. It matches with the results that say we do not have any coin left to sell.

The program says that during that period of time we bought 5 times, we keep 0 coins left to sell and we have got a loss of 4 cents per coin bought. Even though it seems is a little loss, it is quite significant because one coin is bought for a little bit more than a USD, which means that 4 cents it is not very much but we cannot avoid its importance.

In the graph I draw 5 arrows that show the moment when we bought. As we know from the theoretical part, we have to buy then when the 50SMA crosses the 200SMA. This occurs 5 times.

### 5.2.2 Three years EUR/USD

Results of using the SMA as an automatic system during the period of March 2016-March2019 buying and selling EUR/USD. The unit in the profit is USD per coin.

```
The profit during that period is: 0.06159999999999988  
We have 0 share, with a value of: 0  
During that period we bought 1 times
```

Figure 17: Results SMA 50-200 EUR/USD 3 years

For the three years period we only bought one time and with that buy we got a profit of 6cents. These periods show us that from 2012-2016 we got an important loss that from 2016 we could reverse it a little bit. If we have only bought during the last three years we would have get an important profit per coin.

### 5.2.3 Seven years Bitcoin

Results of using the SMA as an automatic system during the period of March 2012-March 2019 buying and selling Bitcoin. The unit in the profit is USD per coin.

```
The profit during that period is: 6335.099999999999  
We have 0 share, with a value of: 0  
During that period we bought 3 times
```

Figure 18: Results SMA 50-200 Bitcoin 7 years

If we would have bought Bitcoin at its very beginning we would have get a very big profit. We are talking about a profit above 6,000 USD per Bitcoin. It is really incredible the profit

but we have to remember that Bitcoin has had his uptrends and downtrends and this profit only deals with buying the coins starting 7 years ago. It is also remarkable that in order to get this profit we only need to buy and sell 3 times.

#### 5.2.4 Three years Bitcoin

Results of using the SMA as an automatic system during the period of March 2016-March 2019 buying and selling Bitcoin. The unit in the profit is USD per coin.

```
The profit during that period is: 0  
We have 0 share, with a value of: 0  
During that period we bought 0 times
```

Figure 19: Results SMA Bitcoin 3 years

This result really surprises me but there is an explanation for it. Bitcoin started decreasing his value during 2018 and got his maximum at 2017. Using this method is we avoided buying when the coin was really expensive. Moreover, when it started to decrease we did not have any coin and the 50SMA was impossible to cross above the 200SMA. This is because the 200SMA take in consideration 200 days and taking that many days in consideration, even though the price was falling down, the 200SMA was still very high in compare with the 50SMA. We might not get any profit during the last three years because we did not buy, but we have to think that we also got any loss when the Bitcoin was falling down which is also very important and an advantage of using it.

#### 5.2.5 Three years Ethereum

Results of using the SMA as an automatic system during the period of March 2016-March 2019 buying and selling Ethereum. The unit in the profit is USD per coin.

```
The profit during that period is: 417.34  
We have 0 share, with a value of: 0  
During that period we bought 1 times
```

Figure 20: Results SMA 50-200 Ethereum

We can only study this coin, Ethereum, during the last three years because it did not exist before that time. Which means, that this result is talking about buying the coin at its very beginning like the case of Bitcoin with the period of seven years. Also, as Bitcoin in the period of seven years, we got an important profit around 400 USD.

This result can make us think that maybe cryptocurrencies are profitable if we buy them at their beginnings and not when they already have a huge value. But being fair, this cannot be a conclusion of this result because we know the uptrends and downtrends of the cryptocurrencies. What it can be a conclusion is that even though we bought from the very beginning of the existence of Ethereum, we have only bought one time using the 50 and 200SMA. It seems quite interesting to reduce the value of the SMA to buy more coins instead of only one because it might not really show the reality.

### 5.3 RSI results

This section shows the results obtain during the period and the currency that we can see in the heading of it. As a remember the period of seven years is for March 2012-2019 and the period of three years is for March 2016-2019. Moreover, there is a graph than can give us a better idea about the method. The graphs in the Figure 22 is only in the seven years for EUR/USD but it would be the same for each currency and period, and it shows the stock prices and the value of the RSI for each day, checking if it is above 70 or below 30.

#### 5.3.1 Seven years EUR/USD

Results of using the RSI as an automatic system during the period of March 2012-March 2019 buying and selling EUR/USD. The unit in the profit is USD per coin.

```
The profit during that period is: -0.16969999999999996  
We have 1 share, with a value of: 1.1993  
During that period we bought 5 times
```

Figure 21: Results RSI 30-70 EUR/USD 7 years

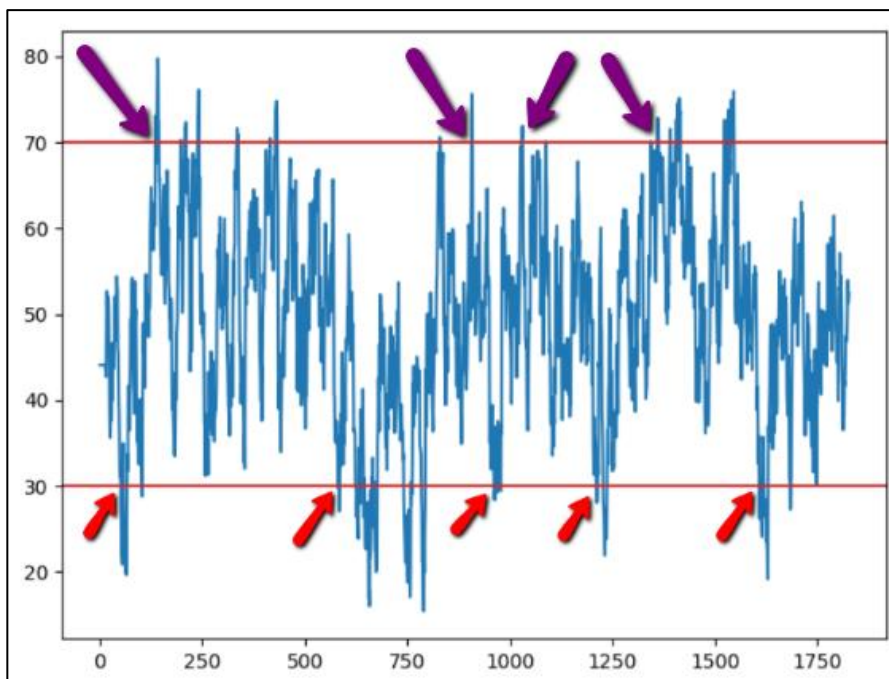
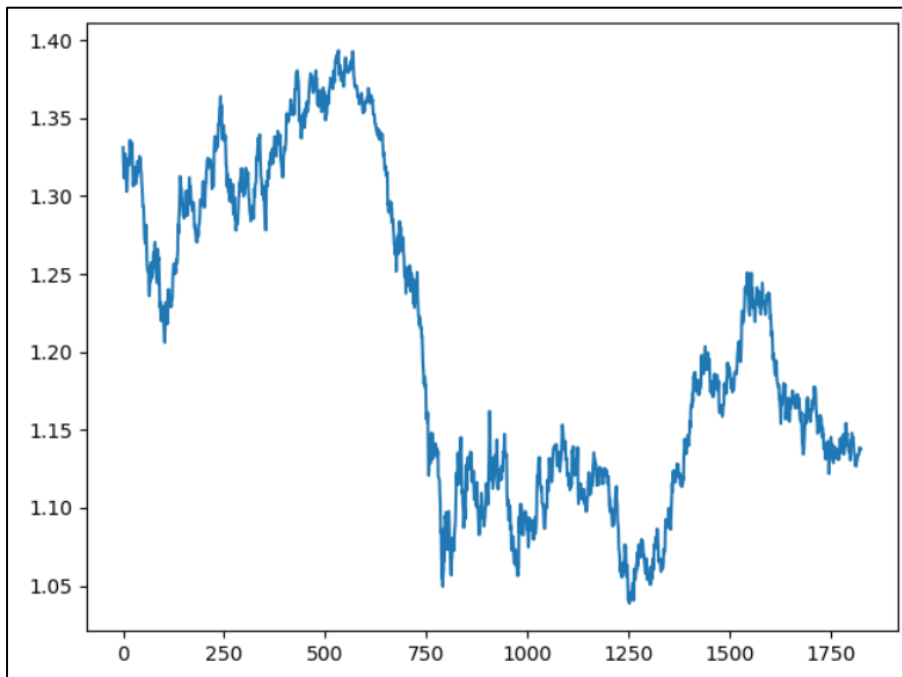


Figure 22: Close prices and RSI 30-70 EUR/USD graph for 7 years

The graph in the Figure 22 show how many times we have bought and sold. The red arrow represents the times we have bought a coin, which is five. The purple arrow represents the times we have sold a coin, which is 4. As we see in the results we still have a coin that we could not sell yet and we can see in the graph that is because we did not reach the RSI 70 anymore.

This graph, figure 22, is the representation of the close price of the coin in order to have an idea about when we have bought and sold the coin.

Buying the EUR/USD during the last seven years using the method of RSI we would have bought 5 times, still keep a coin that we could have not sell yet and get a loss of almost 17 cents per coins, which quadruplicate the loss we would have suffer using the SMA method.

In the graph we can see the moment when we bought and we can also see that we could not get the chance to sell the last coin we acquired. We have to remember that we can only buy once we have already sold the last coin. To buy, the RSI needs to be below 30 and to sell it needs to be over 70.

As it is hard to see the values for the close price there is also the graph of them to see when we bought and sold the coins.

### 5.3.2 Three years EUR/USD

Results of using the RSI as an automatic system during the period of March 2016-March 2019 buying and selling EUR/USD. The unit in the profit is USD per coin.

```
The profit during that period is: 0.0041999999999999815  
We have 1 share, with a value of: 1.1993  
During that period we bought 2 times
```

Figure 23: Results RSI 30-70 EUR/USD 3 years

During the period of the last three years we would have bought 2 times and still get a coin. The profit is almost none. Similar as it happened with the SMA strategy, we got the loss from 2012-2016 and a profit afterwards.

### 5.3.3 Seven years Bitcoin

Results of using the RSI as an automatic system during the period of March 2012-March 2019 buying and selling Bitcoin. The unit in the profit is USD per coin.

```
The profit during that period is: 2453.60000000000004  
We have 0 share, with a value of: 0  
During that period we bought 13 times
```

Figure 24: Results RSI 30-70 Bitcoin 7 years

Using the RSI method we would have got a profit around 2,500 USD buying 13 times which it seems a lot if we compare it with the coins or periods.

#### 5.3.4 Three years Bitcoin

Results of using the RSI as an automatic system during the period of March 2016-March 2019 buying and selling Bitcoin. The unit in the profit is USD per coin.

```
The profit during that period is: 2609.0  
We have 0 share, with a value of: 0  
During that period we bought 5 times
```

Figure 25: Results RSI 30-70 Bitcoin 3 years

Buying Bitcoins during the last three years would have been profitable due to the profit of 2,600 USD buying only 5 times. This result, figure 26, is quite interesting because if we remember, during that period but using the SMA method we did not buy any single time. This makes think that maybe it is needed to us both of them because we could have got a profit in that period but the SMA was not the perfect strategy and the RSI may be.

#### 5.3.5 Three years Ethereum

Results of using the RSI as an automatic system during the period of March 2016-March 2019 buying and selling Ethereum. The unit in the profit is USD per coin.

```
The profit during that period is: -37.229999999999996  
We have 0 share, with a value of: 0  
During that period we bought 5 times
```

Figure 26: Results RSI 30-70 Ethereum

This result, figure 27, is also really interesting because it differs from the SMA result. With the SMA we got a big profit and we could have got a conclusion that the cryptocurrencies may be worth it at their beginning. Further from the reality, we can see that with the RSI we would have got a loss around 37 USD per coin buying 5 times.

## 5.4 Conclusions

Using the selected methods we can see different results and achieve not exactly right conclusions. What we can see is that both methods differs when we use them with the cryptocurrencies but work pretty similar for the EUR/USD.

We have seen that SMA said not buy for the three years period for Bitcoin when RSI said the opposite and we got an important profit. On the other hand, the SMA method gave us a profit buying Ethereum instead of the RSI method which gave us a loss.

What we can be sure is that using the methods we got profits with the cryptocurrencies almost in every periods and also the SMA said when we did not have to buy because the trend for the Bitcoin was going down.

With the results I got surprise because I did expect profits but they really overcome my predictions. Moreover, I thought that the 200SMA was not worth it for the cryptocurrencies due to their uptrends and downtrends but it really is because it avoided get losses and this is as important as gain profits.

To sum up, I think the selected methods are useful for the cryptocurrencies but they might be even more worth it, or at least I will try that, with little modifications. We saw that the period of time is not quite important but it might help to reduce the means in order to get more profit.



## **Chapter 6: Adaptation Strategy**

We have seen that with the selected methods we can gain profits, but we want to make them even higher. We know the methods, we know the cryptocurrencies, we know the periods and we know the gain/loss we got. This chapter wants to improve them. In order to do that the idea is to adapt the codes, to change them a little bit, to find the best way to adapt them.

We are going to see a few different ways to adapt the methods and we will see if the changes improve the profit.

### **6.1 Shorter SMAs**

The first idea that came to my mind was to decrease the value of the SMA method that it was 50 and 200, in days for the means.

Cryptocurrencies are much more volatile and as we have seen, they had important uptrends and downtrends. Decreasing the SMA wants to take in consideration that. I mean, with the 200SMA it was impossible to know that we could be in a downtrend because the value of the 200SMA was still very high. As we said in the results in the chapter 5.2.4 the 200SMA also kept us away of getting a big loss. This new strategy wants to see if reducing the means we can obtain a profit or, on the other hand, we will get a loss because the mean is getting lower. For what we have seen I think that this method can improve the profit for the cryptocurrencies. Although, at the same time it will increase the times we will have to buy and sell.

We will study changing the values of the SMA50-200 to SMA10-20 for the short term and SMA20-50 for the short-midterm because the SMA50-200 was for the long term investments.

#### **6.1.1 SMA10-20**

This chapter shows the results using a short term automatic trading method. The SMA will be taking a mean of the last 10 and 20 days.

### 6.1.1.1 Seven years EUR/USD

Results of using the SMA as an automatic system during the period of March 2012-March 2019 buying and selling EUR/USD. The unit in the profit is USD per coin.

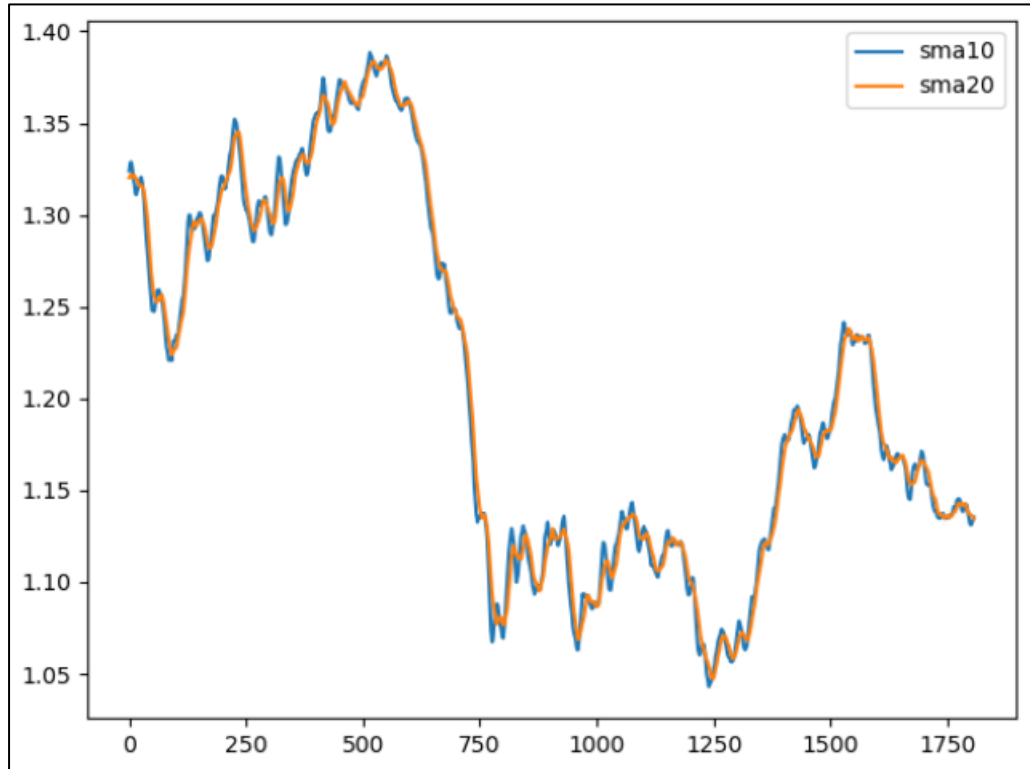


Figure 27: Graph SMA 10-20 EUR/USD 7 years

```
The profit during that period is: -0.21310000000000007  
We have 1 share, with a value of: 1.1377  
During that period we bought 58 times
```

Figure 28: Results SMA 10-20 EUR/USD 7 years

We see that using lower means the times we buy increases from 5 to 58. It is a lot but as we can see in the graph the means are much closer to each other what makes more likely to change the mean with the higher value.

Although, buying a lot of times is not a synonym of getting a bigger profit. As we see we have a loss and is much higher than the want we got using the SMA50-200.

#### 6.1.1.2 Three years EUR/USD

Results of using the SMA as an automatic system during the period of March 2016-March 2019 buying and selling EUR/USD. The unit in the profit is USD per coin.

```
The profit during that period is: -0.1155000000000006  
We have 1 share, with a value of: 1.1377  
During that period we bought 28 times
```

Figure 29: Results SMA 10-20 EUR/USD 3 years

In this case it happens the same as before. We bought much more times, from 1 to 28, and we have a loss when using the other SMA we got 6 cents of profit.

#### 6.1.1.3 Seven years Bitcoin

Results of using the SMA as an automatic system during the period of March 2012-March 2019 buying and selling Bitcoin. The unit in the profit is USD per coin.

```
The profit during that period is: 8473.599999999999  
We have 1 share, with a value of: 3631.8  
During that period we bought 64 times
```

Figure 30: Results SMA 10-20 Bitcoin 7 years

A profit of more than 8,000 dollars decreasing the means. It is really important because we see that cryptocurrencies may need to be checked using short terms methods due to their volatility.

Moreover, we bought a coin 64 times which seems a lot because using the SMA50-200 we bought only 3 times.

#### 6.1.1.4 Three years Bitcoin

Results of using the SMA as an automatic system during the period of March 2016-March 2019 buying and selling Bitcoin. The unit in the profit is USD per coin.

```
The profit during that period is: 7467.199999999993  
We have 1 share, with a value of: 3631.8  
During that period we bought 27 times
```

Figure 31: Results SMA 10-20 Bitcoin 3 years

Buying 27 times in order to get a profit of more than 7,000 dollars seems quite interesting. As before, we have to keep in mind what a cryptocurrency is and that may those special characteristics makes this big profit.

#### 6.1.1.5 Three years Ethereum

Results of using the SMA as an automatic system during the period of March 2016-March 2019 buying and selling Ethereum. The unit in the profit is USD per coin.

```
The profit during that period is: 480.97000000000025  
We have 1 share, with a value of: 121.3  
During that period we bought 26 times
```

Figure 32: Results SMA 10-20 Ethereum

As Bitcoin, Ethereum is similar and we also got a profit. From now, is the biggest one we have get buying this coin. As it happens with all the results before, the number of transactions increased and in this case it increases 25 times.

#### 6.1.2 SMA20 -50

This chapter shows the results using a short-midterm automatic trading method. This method is based in the SMA but using as the means the value of 20 and 50.

##### 6.1.2.1 Seven years EUR/USD

Results of using the SMA as an automatic system during the period of March 2012-March 2019 buying and selling EUR/USD. The unit in the profit is USD per coin.

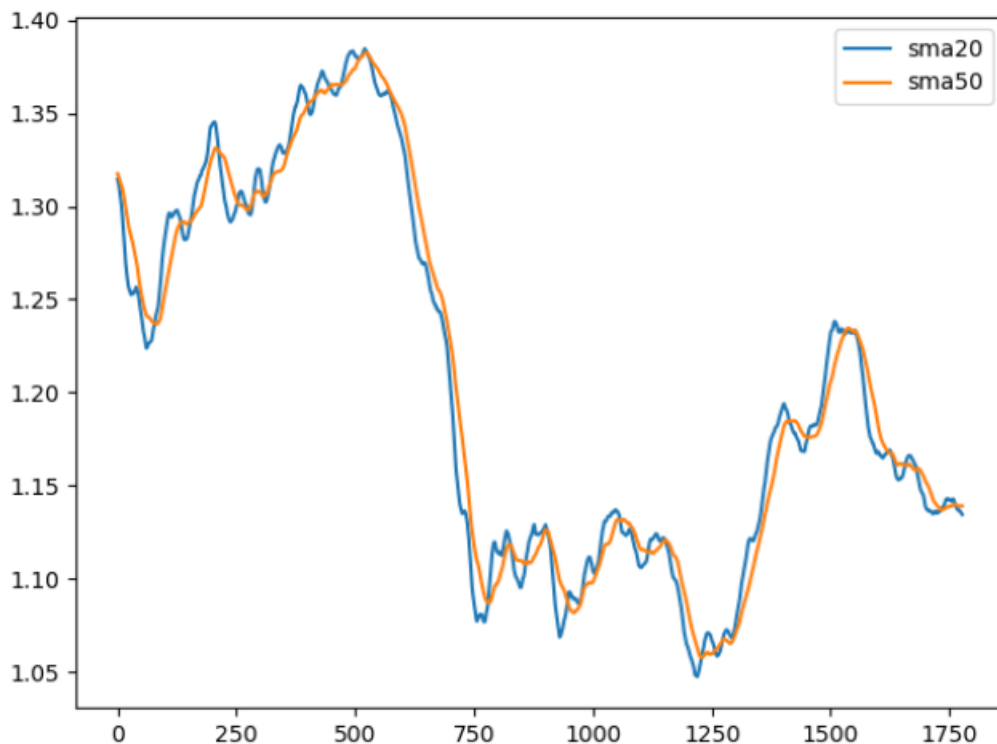


Figure 33: Results SMA 20-50 EUR/USD 7 years

```
The profit during that period is: -0.046800000000000175
We have 0 share, with a value of: 0
During that period we bought 18 times
```

Figure 34: Results SMA 20-50 EUR/USD 7 years

Using a short-midterm automatic method decreases the times we buy the coin in compare with the short term but at the same time it increases comparing with the long term method.

The results are a loss quite similar with the SMA50-200 which are the same time are very different from the SMA10-20. We have a loss of 4 cents buying 18 times.

### 6.1.2.2 Three years EUR/USD

Results of using the SMA as an automatic system during the period of March 2016-March 2019 buying and selling EUR/USD. The unit in the profit is USD per coin.

```
The profit during that period is: 0.045099999999999474
We have 0 share, with a value of: 0
During that period we bought 8 times
```

Figure 35: Results SMA 20-50 EUR/USD 3 years

During the period of the last three years we got a benefit of 4 cents buying 8 times.

### 6.1.2.3 Seven years Bitcoin

Results of using the SMA as an automatic system during the period of March 2012-March 2019 buying and selling Bitcoin. The unit in the profit is USD per coin.

```
The profit during that period is: 4135.299999999996  
We have 1 share, with a value of: 3936.6  
During that period we bought 24 times
```

Figure 36: Results SMA 20-50 Bitcoin 3 years

With the short-midterm we bought 24 times getting a profit of more than 4,000 dollars. Far away from the profit we got using the short term method.

### 6.1.2.4 Three years Bitcoin

Results of using the SMA as an automatic system during the period of March 2016-March 2019 buying and selling Bitcoin. The unit in the profit is USD per coin.

```
The profit during that period is: 3491.699999999997  
We have 1 share, with a value of: 3936.6  
During that period we bought 11 times
```

Figure 37: Results SMA 20-50 Bitcoin 3 years

As before, we are far away from the profit we got using the short term. The results are a profit of more than 3,400 dollar buying 11 times.

### 6.1.2.5 Three years Ethereum

Results of using the SMA as an automatic system during the period of March 2016-March 2019 buying and selling Ethereum. The unit in the profit is USD per coin.

```
The profit during that period is: 546.6799999999998  
We have 1 share, with a value of: 147.97  
During that period we bought 10 times
```

Figure 38: Results SMA 20-50 Ethereum

Using the short-midterm we got the biggest profit from now for Ethereum buying 10 times and getting a return of more than 500 dollars.

## **6.2 Shorter RSI**

This chapter shows the results using the RSI method but increasing the variables. In the results in the chapter 5 we used 30 and 70 as minimum and maximum for buying and selling. In this case the variables will be 20 and 80. This change will make the investor more sure about the right moment of buying or selling. Changing the variables to 20 and 80 will avoid the false calls to buy or sell.

With change, the number of buys will decrease in compare with the RSI with 30-70 as variables. This is because it is more difficult to get an RSI below 20 or above 80 as the RSI is normally around 50 as a mid-point.

### 6.2.1 Seven years EUR/USD

Results of using the RSI as an automatic system during the period of March 2012-March 2019 buying and selling EUR/USD. The unit in the profit is USD per coin.

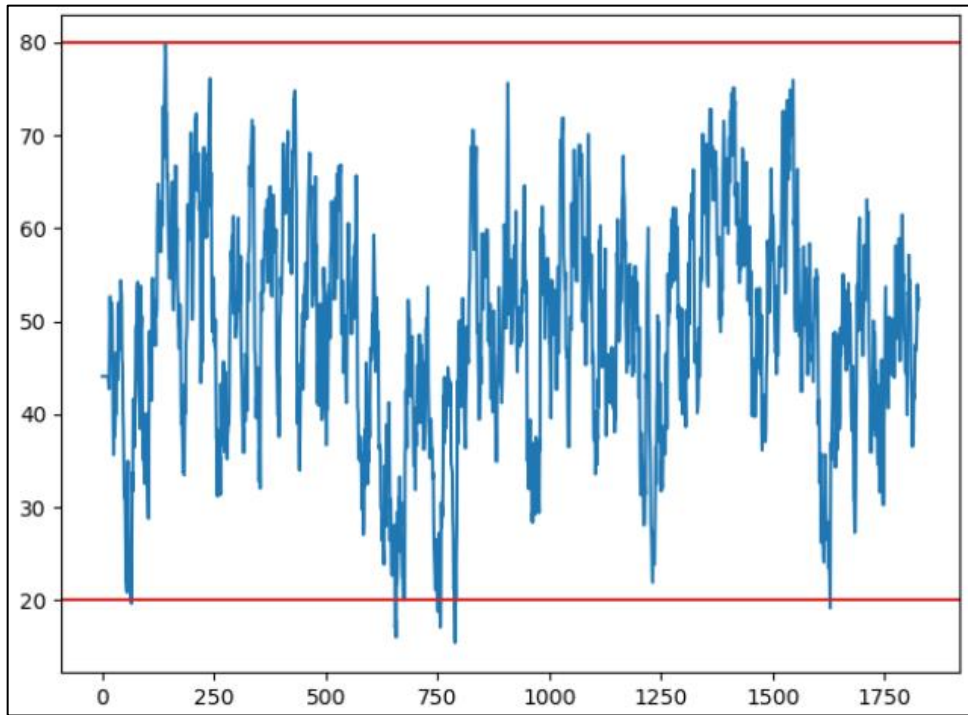


Figure 39: Graph RSI 20-80 EUR/USD 7 years

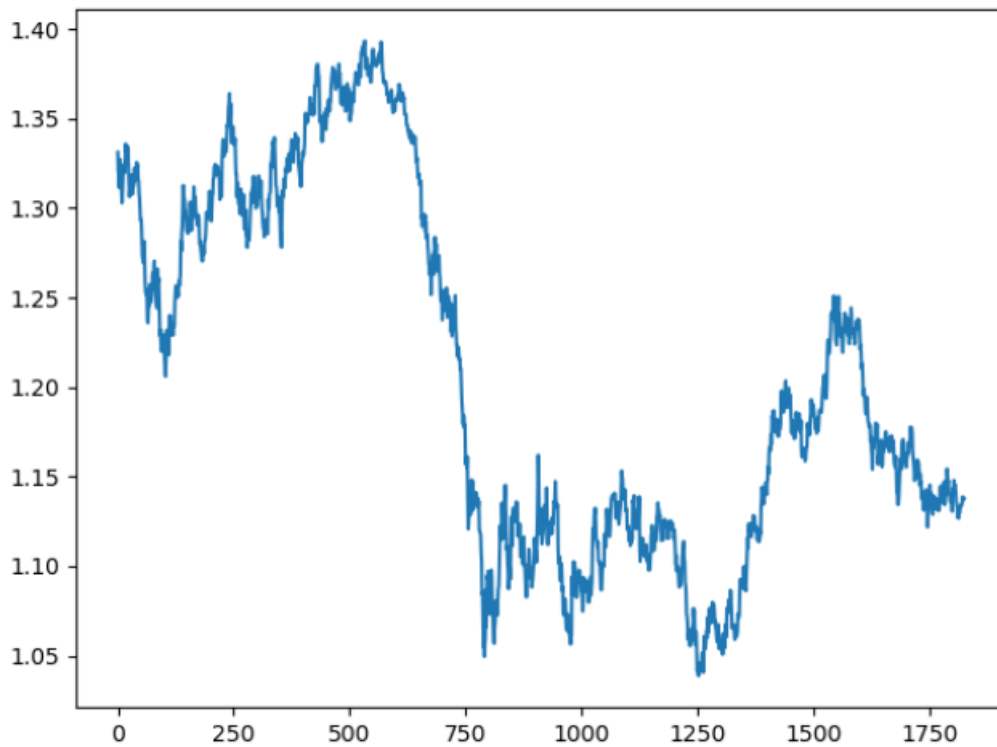


Figure 40: Stock prices EUR/USD 7 years

```
The profit during that period is: 0
We have 1 share, with a value of: 1.237
During that period we bought 1 times
```

Figure 41: Results RSI 20-80 EUR/USD 7 years

As I expected it is much harder to buy or sell. As we can see in the graph in the figure 40, the RSI never became above 80 which means we could have never sold any coin. It makes us see there is no signal strong enough to make us selling the coin in order to get a high profit.

### 6.2.2 Three years EUR/USD

Results of using the RSI as an automatic system during the period of March 2016-March 2019 buying and selling EUR/USD. The unit in the profit is USD per coin.

```
The profit during that period is: 0
We have 1 share, with a value of: 1.154
During that period we bought 1 times
```

Figure 42: Results RSI 20-80 EUR/USD 3 years

As before, we got the chance to buy a coin but we did not sell it because we did not reach a RSI above 80.

### 6.2.3 Seven years Bitcoin

Results of using the RSI as an automatic system during the period of March 2012-March 2019 buying and selling Bitcoin. The unit in the profit is USD per coin.

```
The profit during that period is: 105.39999999999998
We have 1 share, with a value of: 5636.2
During that period we bought 4 times
```

Figure 43: Results RSI 20-80 Bitcoin 7 years

We can see in the figure 44 that we get the lowest profit until now for Bitcoin in the seven years period. 100 dollars buying 4 times it seems a good profit but it is not if we compare it with the other selected methods.

#### 6.2.4 Three years Bitcoin

Results of using the RSI as an automatic system during the period of March 2016-March 2019 buying and selling Bitcoin. The unit in the profit is USD per coin.

```
The profit during that period is: 172.80000000000007  
We have 1 share, with a value of: 5636.2  
During that period we bought 2 times
```

Figure 44: Results RSI 20-80 Bitcoin 3 years

As before, a very low profit buying 2 times and still keeping one coin. Which means we got 172 dollars with only one transactions. Quite impressive but far away from the profits we got using the other automatic methods.

#### 6.2.5 Three years Ethereum

Results of using the RSI as an automatic system during the period of March 2016-March 2019 buying and selling Ethereum. The unit in the profit is USD per coin.

```
The profit during that period is: 0  
We have 1 share, with a value of: 384.12  
During that period we bought 1 times
```

Figure 45: Results RSI 20-80 Ethereum

Increasing the values in the RSI to 20-80 we also bought less using Ethereum as the goal. We have only bought one time and we did not find a moment to sell it which make a 0 profit.

### 6.3 SMA and RSI same time

This chapter shows the results using a mix of both strategies, SMA and RSI.

As we have seen, we have got the biggest profit using the SMA10-20 in the Bitcoin, and not far away for the Ethereum. This is the reason why for the mix strategy I will use the SMA10-20 instead of SMA20-50 or SMA50-200.

For the RSI, the selected one is the 30-70 because it can make more transactions instead of the RSI 20-80 in which the maximum number of transaction we did was 4.

In this strategy we will buy when both methods say to buy. They need to agree in order to buy and sell, it is not enough if only one of them says to buy.

This strategy wants to make a better decision combining the best of both of them in order to get a bigger profit doing less transactions. We can already imagine that the number of transaction cannot be bigger than the times we bought the coin using one of them in the last chapters. It means, if we bought 5 times using RSI 30-70 and 50 times using SMA10-20, the maximum number of transactions will be 5 because both strategies need to meet in order to buy or sell.

### 6.3.1 Seven years EUR/USD

Results of using the SMA and RSI as an automatic systems during the period of March 2012-March 2019 buying and selling EUR/USD. The unit in the profit is USD per coin.

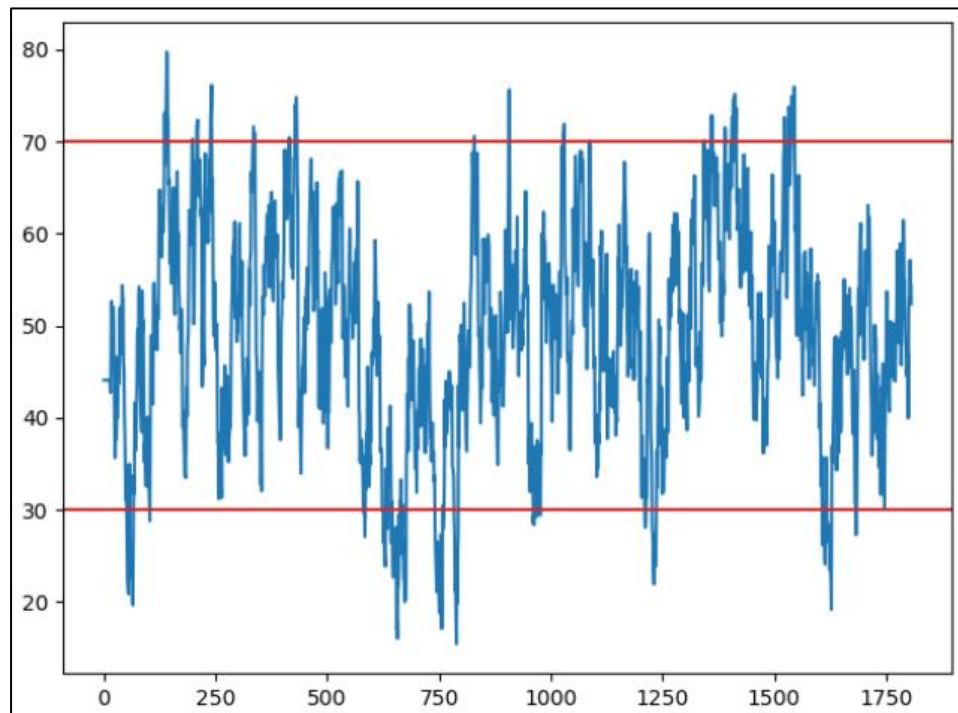


Figure 46: Graph Mix strategy EUR/USD 7 years RSI

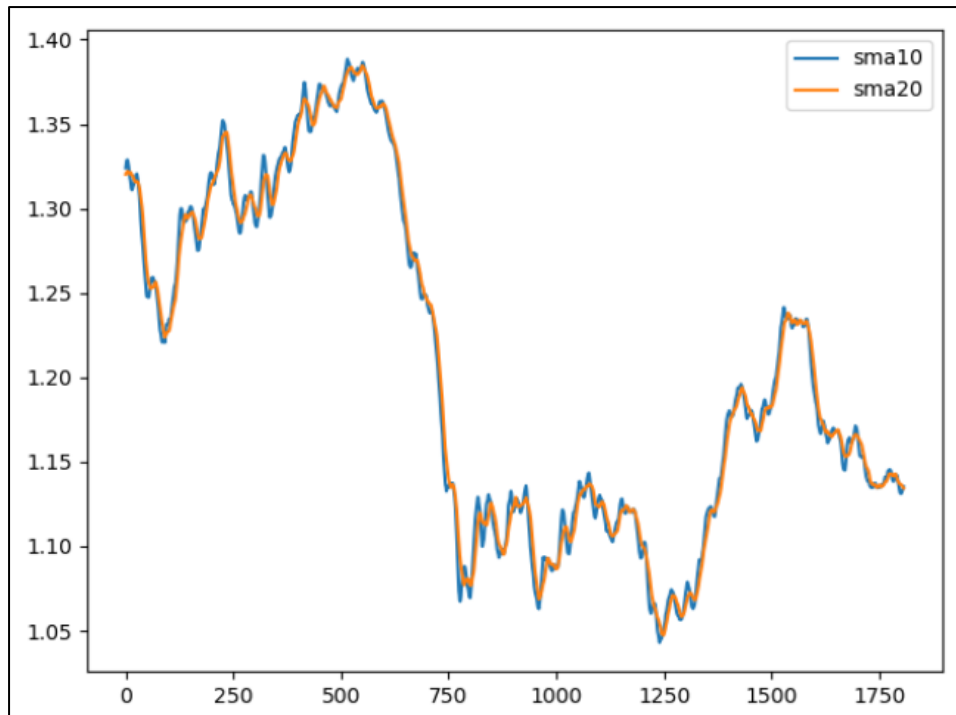


Figure 47: Graph Mix strategy EUR/USD 7 years SMA

```
The profit during that period is: 0.013699999999999823
We have 1 share, with a value of: 1.1807
During that period we bought 4 times
```

Figure 48: Results Mix strategy EUR/USD 7 years

Using the mix strategy make us buy 4 times and get a profit of one cents, which, even though it seems impossible, is the higher profit we got since now with the EUR/USD in the seven year period. Moreover, we still have a coin and it can make us get a bigger profit or get a loss, but for all what we could sell we got a profit.

It seems that combining both strategies is profitable in the fiat currency.

### 6.3.2 Three years EUR/USD

Results of using the SMA and RSI as an automatic systems during the period of March 2016-March 2019 buying and selling EUR/USD. The unit in the profit is USD per coin.

```
The profit during that period is: 0.091499999999999991
We have 1 share, with a value of: 1.1807
During that period we bought 2 times
```

Figure 49: Results Mix strategy EUR/USD 3 years

As before, we got the biggest profit for the fiat currency with the mix strategy. We have a profit of 9 cents buying 2 times and keeping one, which means its a 9 cents profit per only one transaction.

### 6.3.3 Seven years Bitcoin

Results of using the SMA and RSI as an automatic systems during the period of March 2012-March 2019 buying and selling Bitcoin. The unit in the profit is USD per coin.

```
The profit during that period is: 6921.1  
We have 1 share, with a value of: 3771.6  
During that period we bought 12 times
```

Figure 50: Results Mix strategy Bitcoin 7 years

Almost 7,000 dollars of profit buying 12 times and still keeping one. Seems likely to be a very useful method for Bitcoin in the period of the last seven years. Even though is not the higher profit but in compare with it we bought much less time.

### 6.3.4 Three years Bitcoin

Results of using the SMA and RSI as an automatic systems during the period of March 2016-March 2019 buying and selling Bitcoin. The unit in the profit is USD per coin.

```
The profit during that period is: 6785.5  
We have 1 share, with a value of: 3771.6  
During that period we bought 5 times
```

Figure 51: Results Mix strategy Bitcoin 3 years

More than 6,500 dollars buying only 5 times. Really far away the number of transactions we did in compare to the method used to get the biggest profit but with 22 transactions more.

### 6.3.5 Three years Ethereum

Results of using the SMA and RSI as an automatic systems during the period of March 2016-March 2019 buying and selling Ethereum. The unit in the profit is USD per coin.

```

The profit during that period is: 738.52
We have 1 share, with a value of: 278.19
During that period we bought 4 times

```

Figure 52: Results Mix strategy Ethereum

The highest profit for Ethereum. More than 700 dollars buying 4 times. Completely the best automatic method for it.

### 6.4 Conclusion

We can see in the Table 6 the results for each strategy and coin. As we said, the results are based in the profit, the number of transactions and the coins left to sell. In green we see the highest profit per each coin. Both periods of the fiat currency have the highest profit mixing both strategies and also the cryptocurrency Ethereum.

On the other hand, Bitcoin has their best results using the short term means with the SMA10-20.

Table 6: Results all strategies

		SMA 50-200	RSI 30-70	SMA 10-20	SMA 20-50	RSI 20-80	Mix	Long investor
EUR/USD 7 years	Profit	-0.0464	-0.1697	-0.2131	-0.0468	0	0.0137	-0.1935
	Times bought	5	5	58	18	1	4	1
	Coin keep	0	1	1	0	1	1	0
EUR/USD 3 years	Profit	0.0616	0.0042	-0.1155	0.0451	0	0.0915	0.051
	Times bought	1	2	28	8	1	2	1
	Coin keep	0	1	1	0	1	1	0
Bitcoin 7 years	Profit	6335.09	2453.6	8473.59	4135.29	105.39	6921.1	3817
	Times bought	3	13	64	24	4	12	1
	Coin keep	0	0	1	1	1	1	0
Bitcoin 3 years	Profit	0	2609	7467.199	3491.699	172.8	6785.5	3387.9
	Times bought	0	5	27	11	2	5	1
	Coin keep	0	0	1	1	1	1	0
Ethereum	Profit	417.34	-37.2299	480.97	546.679	0	738.52	123.97
	Times bought	1	5	26	10	1	4	1
	Coin keep	0	0	1	1	1	1	0

The idea of the adaptation was to improve the profit and it sure did. All currencies have their highest profit in one of the four adaptations. As we have been seeing, all adaptations did what was expected referring to transactions, which might seem insignificant but it is not the same winning 1,000 dollar with 7 transactions than winning the same amount of money but with 52 transactions. If we can win the same doing fewer transactions it is much better because we avoid the risk of having a bad transaction on some point and then to have a lower profit.

Adapting the methods for cryptocurrencies was and still is the main point of the chapter. We see that it is needed to improve the system for them in order to get a bigger profit. Bitcoin and Ethereum had their highest result using a short term strategy. We have to remind that the mix strategy is using the SMA10-20, which makes it a short term strategy too. We also see that the fiat currency had their biggest value using the mix strategy but it is tricky. We can think that they are also better in a short term strategy but actually, what they need is also more conditions in order not to do a lot of transactions. Their bigger problem is that they did a lot of transactions that were false signals of buying. While using both of them, we decrease the number of false signal and make increase the profit. That is why we need to see it in a different way from the cryptocurrencies, which they really needing the short term strategy.

It is important also to compare these results with a long investor. A long investor is someone who buys the first day and sells the last day of the period. In the Table 6 we can also see the profit that the long investor had buying at the beginning one coin and selling it the last day, keeping 0 coins left.

We see that is important to do the transactions in order to get a higher profit. In all coins the profit are much higher if we do transactions instead of doing nothing like a long investor. This wants to show that in order to make a big profit, it is important to choose the right method and do the right transactions.

As a conclusion, we see that taking in consideration the cryptocurrencies' characteristics we know that a short term might be more profitable than a long term to do our investment. It is quite important to study the coin as it was done and try different adaptations and periods to do a back testing before starting to invest on it.



## Chapter 7: Conclusions

When I started this thesis I was really motivated because both topics, trading and cryptocurrencies, really interested me. I was hoping to know them much better than I did in the beginning because my knowledge of them was really limited. But after some research I start understanding them and being more confident with them. Even though I improved my knowledge, both topics are huge and it is impossible to know everything about them or to be able to understand everything about how they work.

Despite of that, my interest in them was increasing at the same time they were getting work. An interest that, as I said at the beginning of the thesis, came to me because both subjects are dealing with a huge amount of money and becoming more and more important in our lives.

Picking the selected strategy was hard because I had to choose from a large number of automatic methods but now, once it is done, I think I picked the right ones.

Coding was more complicated than I thought but using all the knowledge I had acquired in the university I could make 3 right codes that show what I wanted and needed.

This project make me understand how the trading works and how hard is to have profits while it is very still to lose all your money you invest. While studying all the results and get to see the importance of the good preparation. When I started this idea I wanted to learn and to understand if this word is for me. Now, I know it is not, it is pretty interesting and I will keep learning but for now, it is very complicated with too much information.

Another point I wanted to see with this thesis was to know how to study cryptocurrencies, if they are or they are not dangerous as some people can say, if they can give us profit or if they are only a nightmare. As everything in trading, they can give you profit and a very important profit. Also, as everything in trading, is you do not prepare yourself and your system, it will become a nightmare and you will lose a lot of money. In the case of my studies, I would have earn money with very good profits. The main aspect to see was to taking in consideration their particular characteristics and getting a profit instead of losing the money. These characteristics are dealing with the short and long term. As we saw in the study, they became more profitable in the short term even though we did more transactions. What we saw was that the mix of the strategies, SMA and RSI, was the best idea in profitability terms.

Mixing them take the best of them, the short term for the SMA and the capability of reducing the number of transactions for the RSI. With this, we make sure we buy when it really is a buy signal and we avoid the false moments.

The ways to keep working on this project would be :

- Testing more automatic methods
- Doing the analysis using more cryptocurrencies
- Check if it is possible to use artificial intelligence in order to improve its activity.

To sum up, I end up with personal thoughts about the main topics, trading and cryptocurrencies, which lead me to see things differently. Moreover, I understood the meaning of back testing and that being sure before buying or selling is crucial for trading.

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