

**Analysis and Optimization of Relative Strength  
Index (RSI) Related Trading  
Strategies  
in The  
Foreign Exchange Market**

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## Abstract

The default setting on the calculation of the Relative Strength Index (RSI) is 14 look-back periods for the RSI-related trading strategies. In this following project, the look-back period is altered to conclude the optimum look-back for each of the different RSI-related trading strategies. The main study is on the forex market where the optimum look-back period for each strategy is identified, and the best strategy for the forex market is determined throughout the 6 different forex key pairs (EUR/USD, USD/JPY, GBP/USD, AUD/USD, USD/CAD, and USD/CNY). The result of the project indicates that the original look-back period for the RSI-related trading strategy is not optimal, and we can always alternate the look-back period for a better trading strategy. By comparing the different RSI-related strategies that uses the optimum look-back period, it is discovered that the RSI Mean Reversion Strategy is effective in the daily forex market with the optimum look-back period of 71 days and the Stochastic RSI strategy is effective in the hourly forex market with the optimum look-back period of 7 hours.

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## Introduction

Traders commonly use technical indicators to study and observe the ongoing movement of the stock market based on historical trading data. This project focuses on optimizing and analysing the Relative Strength Index (RSI), one of the most used trading indicators. The intuition of the RSI is to observe the average gains and average losses over a look-back period. Generally, 14 look-back periods are used to calculate the current value of RSI. The RSI value is between 0 to 100, where the plotted RSI graph is identified as a momentum oscillating graph that can reflect the oversold or overbought condition of the market.

Algorithmic trading strategies that utilize RSI as one of its technical indicators can be generalized into two categories, RSI as a trend oscillator, and RSI as a trend indicator. The difference between the two is that the former uses RSI as an intermediary signal to confirm the current trend of the market, whereas the latter uses RSI to generate buying and selling signals.

The main goal of this project is to determine the optimum look-back period for each of the trading strategies that utilize RSI and the most effective trading strategy among the strategies that make use of RSI in the foreign exchange market. In addition, the trend and result in alternating the look-back period of the RSI are analysed for each of the strategies.

# 1. RSI, Technical Indicators and Strategy

The RSI formula is as follow:

$$RSI = 100 - \left( \frac{100}{1 + \frac{Average\ Gain_n}{Average\ Loss_n}} \right)$$

where:

Average Gain<sub>n</sub> = Average Gain over n-periods

Average Loss<sub>n</sub> = Average Loss over n-periods

- Note that the Average Gain<sub>n</sub> and Average Loss<sub>n</sub> are the average percentage gain or loss during n-periods. Each calculation uses a positive value formula where periods with price losses are counted as 0 for Average Gain<sub>n</sub> and periods with price gain are counted as 0 for the calculation for Average Loss<sub>n</sub>.

The trading strategies used in the project are mainly composed of more than one technical indicator other than the RSI. The following subpoints will demonstrate how each of the following technical indicators is computed and how are the technical indicators used together to compose a trading strategy. The strategies' RSI value is calculated using a look-back period of 14 days.

## 1.1 Technical Indicators

### 1.1.1 Simple Moving Average

The Simple Moving Average (SMA) calculates the average of a selected range of prices by the number of periods.

$$SMA = \frac{A_1 + A_2 + \dots + A_n}{n}$$

where:

A<sub>i</sub> = The price of stock at period i

n = Number of periods

Every price in the period is equally weighted, meaning that if a recent price has dropped dramatically, the SMA might not drop as much. Hence, some delay between the source data and SMA is introduced.

Figure 1 is the comparison between the SMA for 200 periods from tradingview (upper) and the SMA calculated using the forex ticker EURUSD from January 2020 to January 2022.

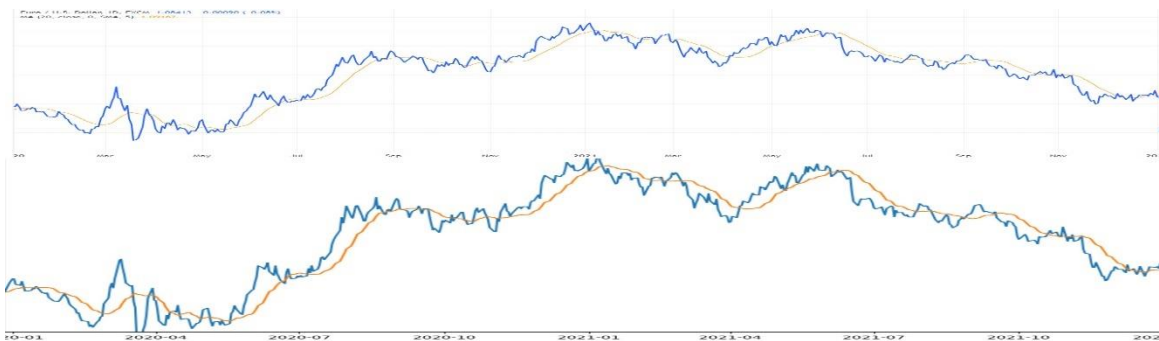


Figure 1

### 1.1.2 Stochastic Oscillator

The stochastic oscillator (%K) compares the closing price of a stock to the range of its prices over a certain period. The standard look-back period is 14 periods.

$$\%K = \left( \frac{\text{Closing} - L_{14}}{H_{14} - L_{14}} \right) \times 100$$

where:

Closing = The current closing price

$L_{14}$  = Lowest price traded of the past 14 trading period

$H_{14}$  = Highest price traded during the past 14 trading period

The stochastic oscillator is range-bound between 0 to 100, where readings over 80 are typically considered as in the overbought region and readings under 20 are considered as oversold.

Figure 2 is the comparison between the %K from tradingview (upper) and the %K calculated using the forex ticker EURUSD from January 2020 to January 2021.

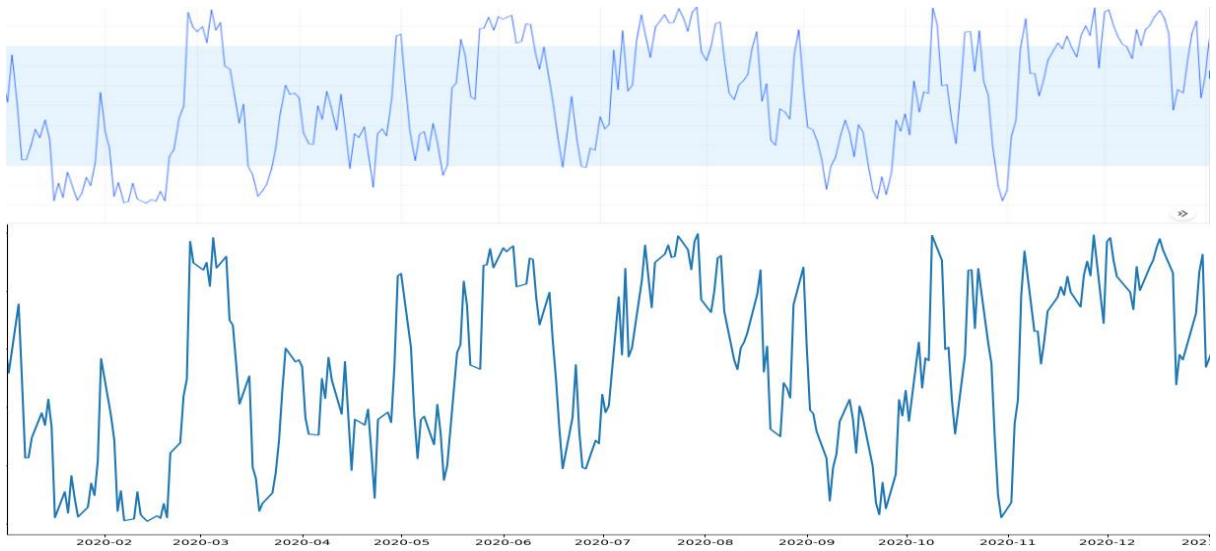


Figure 2

### 1.1.3 Stochastic RSI

The Stochastic RSI (StochRSI) is computed using the regular stochastic oscillator formula but uses RSI value instead of the standard historical price data. Similar as the regular stochastic oscillator formula, a look-back period of 14 period is used to calculate the StochRSI.

$$\text{StochRSI} = \frac{RSI_c - \min [RSI_{14}]}{\max [RSI_{14}] - \min [RSI_{14}]}$$

where:

$RSI_c$  = Current RSI value

$\min [RSI_{14}]$  = Lowest RSI reading over the last 14 periods

$\max [RSI_{14}]$  = Highest RSI reading over the last 14 periods

RSI values are used instead of the regular standard price data to create a more sensitive indicator that is better at reflecting the historical performance of a particular stock. The StochRSI reading is in between 0 to 1 where the reading above 0.8 suggests that the stock is overbought, while reading below 0.2 suggests that the stock is oversold.

RSI is a derivative of price while StochRSI is a derivative of RSI, or a second derivative of price. In other words, StochRSI moves faster than regular RSI, therefore StochRSI moves from overbought to oversold signal quickly or vice versa.

Figure 3 is the comparison between the StochRSI from tradingview (upper) and the StochRSI calculated using the forex ticker EURUSD from January 2020 to January 2022.

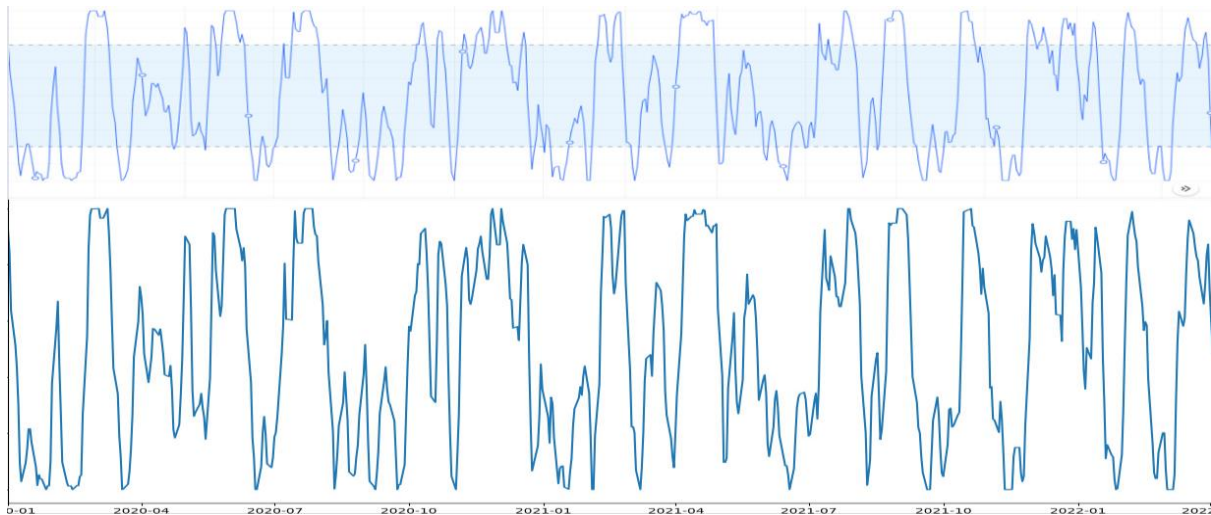


Figure 3

#### 1.1.4 Exponential Moving Average

The Exponential Moving Average (EMA) is a type of moving average that emphasis a greater weight and significance on the recent close prices.

$$EMA_n = Closing \times Multiplier + Previous EMA \times Multiplier$$

where:

Closing = The current closing price

$$Multiplier = \frac{2}{(n+1)}$$

- Note that the first period of  $EMA_n = SMA_n$ , where the first period of  $EMA_n$  is defined as the equivalent as SMA for n-periods

EMA reacts more quickly to recent price changes than a SMA, which have equal weight to all the previous prices. EMA serve to reduce the delay between the current indicator and the real price as the recent price has higher weightage.

Figure 4 is the comparison between the EMA (12-period) from tradingview (upper) and the EMA (12-period) calculated using the forex ticker EURUSD from January 2020 to January 2022.

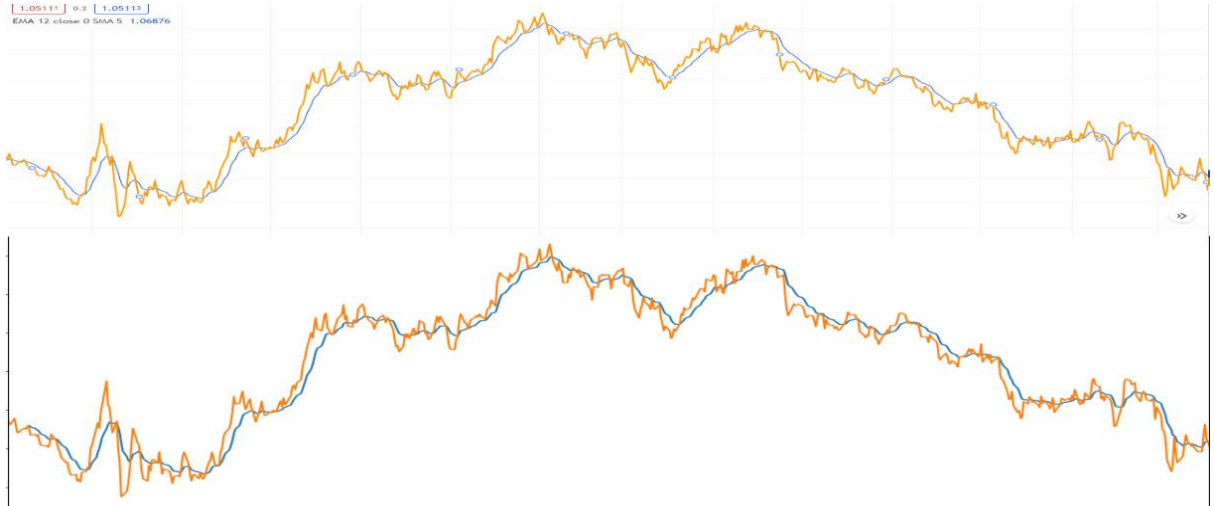


Figure 4

### 1.1.5 Moving Average Convergence Divergence

The Moving Average Convergence Divergence (MACD) shows the relationship between two moving averages of a stock. MACD is calculated by subtracting the 26-period exponential moving average (EMA) from the 12-period EMA.

$$MACD = EMA_{12} - EMA_{26}$$

where:

$EMA_{12}$  = Exponential Moving Average for the past 12 period

$EMA_{26}$  = Exponential Moving Average for the past 26 period

The result calculation is the MACD line, where the nine-period Exponential Moving Average of the MACD is called the 'Signal Line'. The market is in overbought condition when the MACD line crosses below the signal line and the market is in oversold condition when the MACD line crosses above the signal line.

Figure 5 is the comparison between the MACD from tradingview (upper) and the MACD calculated using the forex ticker EURUSD from January 2020 to January 2022.

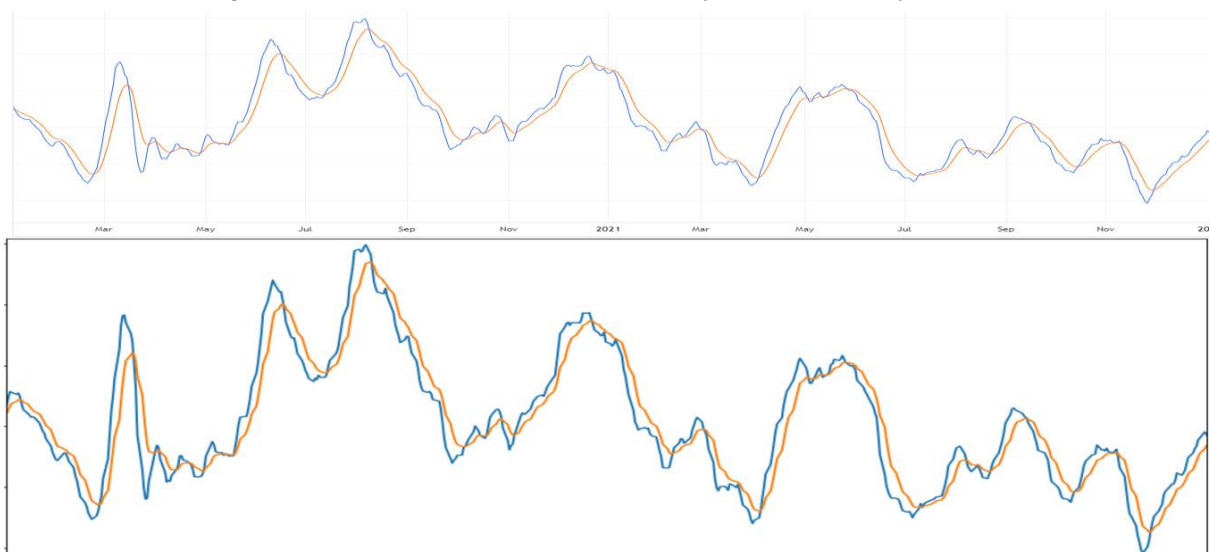


Figure 5



## 1.2 Strategy

### 1.2.1 RSI as Trend Oscillator

#### 1.2.1.1 RSI (2) Strategy

Here we calculate the 200-period SMA to determine the overall price trend. The stock is categorized as an uptrend if the stock price is above the 200-period SMA. Otherwise, when the stock price drops below the 200-period SMA, the stock will be categorized as a downtrend. Note that the '(2)' in the naming signifies that 2 SMA are used in the following trading strategy.

The buying condition for this strategy is when the stock is in an uptrend alongside having the RSI value below 10. Meanwhile, the selling condition is when the particular stock is in a downtrend with the RSI value above 90.

Figure 6 is the demonstration of the following strategy using the forex ticker EURUSD from January 2015 to January 2020.

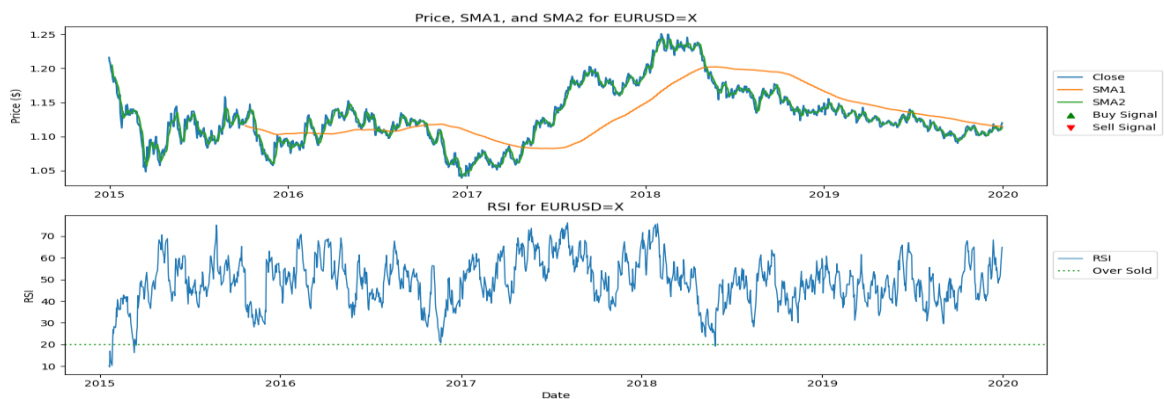


Figure 6

#### 1.2.1.2 RSI Trend Strategy

Here we calculate both the short-term SMA (5 periods) and long-term SMA (20 periods). An uptrend is identified if the short-term SMA crosses over the long-term SMA. Otherwise, when the long-term SMA crosses the short-term SMA, the stock will be categorized as a downtrend.

The buying condition for this strategy is when the stock is in an uptrend alongside having the RSI value larger than the centreline ( $RSI \geq 50$ ). Meanwhile, the selling condition is when the particular stock's RSI value is lower than 50 or a downtrend is identified.

Figure 7 is the demonstration of the following strategy using the forex ticker EURUSD from January 2015 to January 2020.

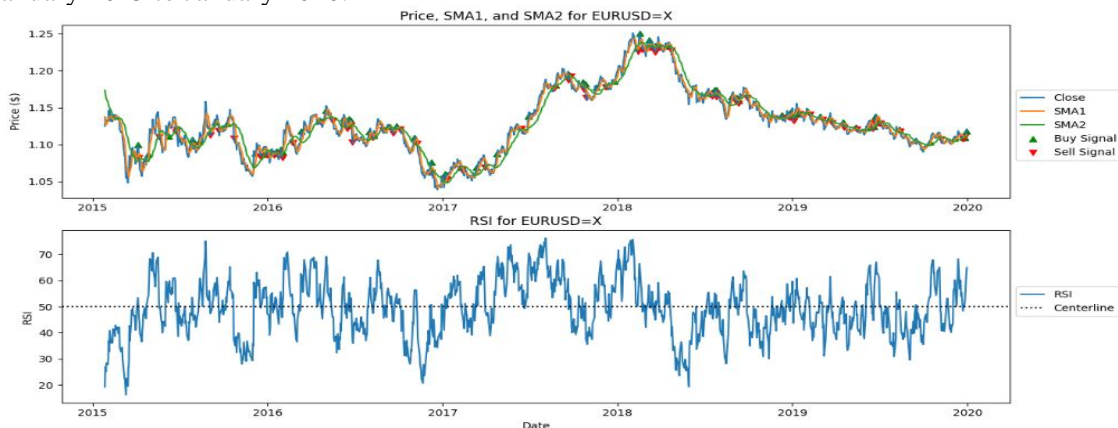


Figure 7

### 1.2.1.3 MACD + RSI Strategy

The MACD signal is calculated by taking the moving average of MACD over the span of 9 periods. When the MACD is larger than the MACD signal, the stock is identified as an uptrend. Otherwise, when the MACD is smaller than the MACD signal, the stock is identified as a downtrend.

The buying condition for this strategy is when the stock is in an uptrend alongside having the RSI crosses the centreline (RSI = 50) from below, where the RSI value is generally increasing. Meanwhile, the selling condition is when the particular stock RSI value crosses the centreline from above, where the RSI is generally decreasing.

Figure 8 is the demonstration of the following strategy using the forex ticker EURUSD from January 2015 to January 2020.

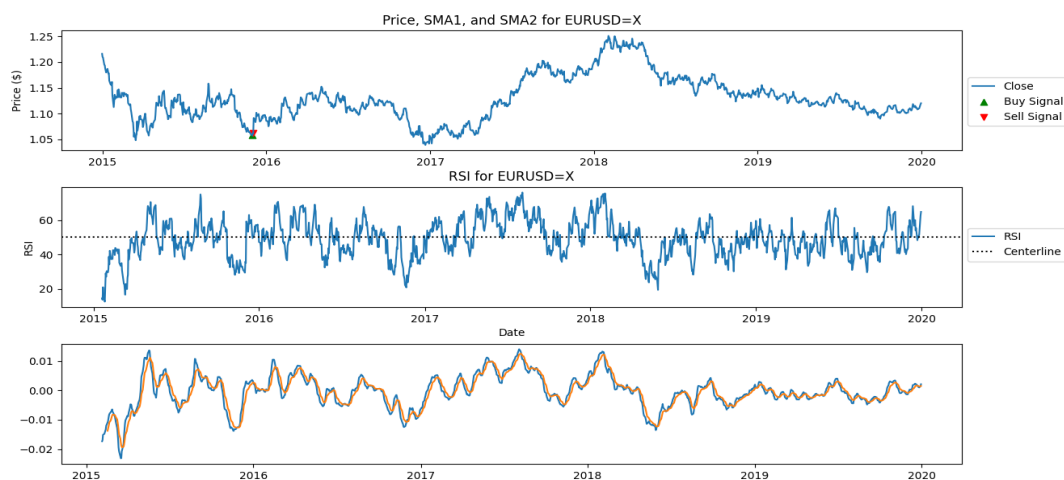


Figure 8

## 1.2.2 RSI as Trend Indicator

### 1.2.2.1 RSI Mean Reversion Strategy

The most classic use of the RSI to identify an oversold and overbought condition in the market. The buying condition for this strategy is when the RSI value is smaller than 30. Meanwhile, the selling condition is when the RSI value is greater than 70.

Figure 9 is the demonstration of the following strategy using the forex ticker EURUSD from January 2015 to January 2020.

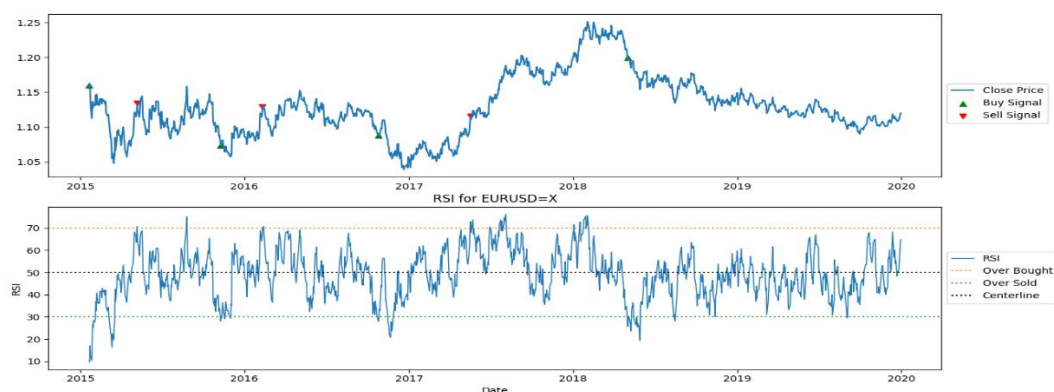


Figure 9

### 1.2.2.2 RSI Divergence Strategy

The buying condition for this strategy is when a higher high divergence is identified on the close price of the particular stock and a lower low divergence is identified on the RSI with the condition that RSI value is greater than 50. Meanwhile, the selling condition is when the RSI value drop below 50.

Figure 10 is the demonstration of the following strategy using the forex ticker EURUSD from January 2019 to January 2020. A lower duration is demonstrated in this case to further show the divergence line.

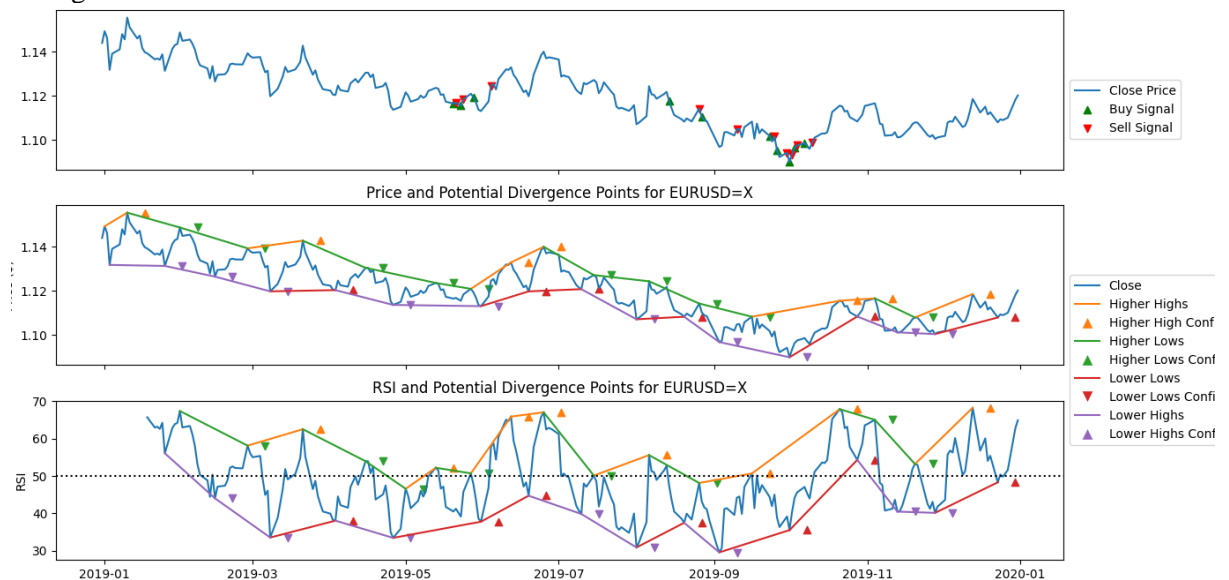


Figure 10

### 1.2.2.3 Stochastic RSI Strategy

The buying condition for this strategy is when the stochastic RSI value is smaller than 20. Meanwhile the selling condition is when the stochastic RSI value is greater than 80.

Figure 11 is the demonstration of the following strategy using the forex ticker EURUSD from January 2015 to January 2020.

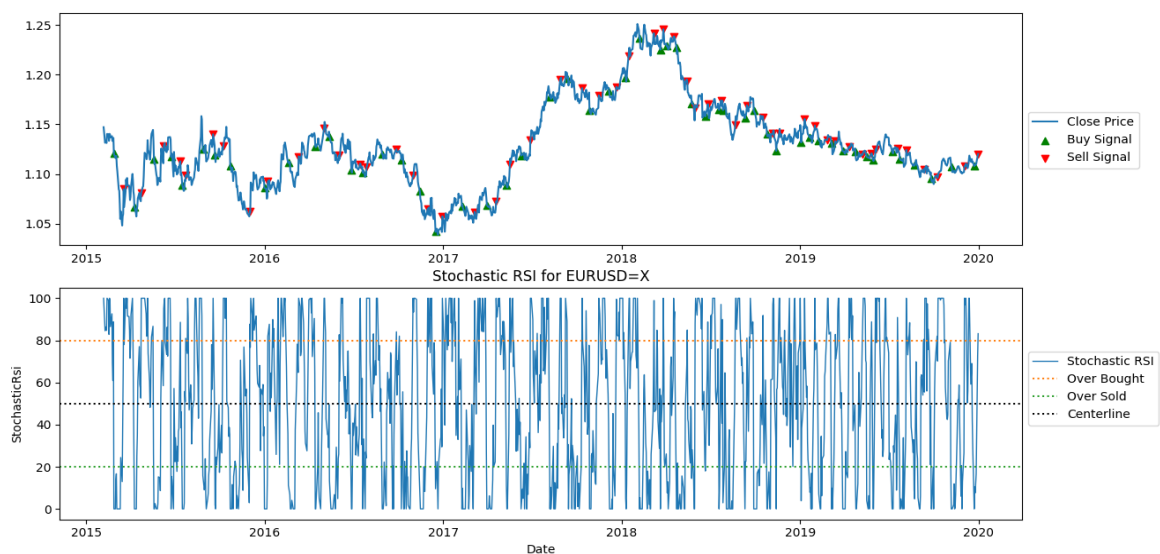


Figure 11

## 2. Methodology, Evaluation and Data

### 2.1 Methodology

The following project will develop algorithms to perform backtesting and evaluate the most effective RSI look-back period for each strategy and the best RSI trading strategy for the forex market using the optimum period computed previously. The algorithms and backtesting system are implemented in Python 3.8.12, with the assistance of open-source libraries such as NumPy, pandas, and matplotlib.

The data will first be loaded by pandas from the CSV files containing the previous historical data. Further processing of the data is done in NumPy and pandas' built-in function. Lastly, the backtested result will be shown in an excel file. Matplotlib is used to better display the data and the correctness can further be checked with tradingview's graph.

The first phase of the evaluation will determine the best strategy that utilizes the RSI indicator with the optimum look-back period for each of the forex key pairs. The second phase evaluation will determine the best strategy that utilizes the RSI indicator with the optimum look-back period calculated among all the forex key pairs and evaluate the overall performance of that strategy. The second phase evaluation looks at the forex data as a whole to prevent overfitting on a particular forex market.

### 2.2 Evaluation Metrics

For the sake of determining the optimum RSI look-back period and the most effective strategy, comparisons between the strategy are evaluated by the following evaluation metrics. The following subpoints will demonstrate the formula for each of the evaluation metric and their general description.

#### 2.2.1 Compound Annual Growth Rate

Compound Annual Growth Rate (CAGR) is the representational figure that describes the rate at which an investment would have grown if it has grown at the same rate for every year and assume the profits were reinvested at the end of each year.

It is one of the most accurate ways of evaluating the performance of a particular strategy. A high CAGR indicates the trading strategy is effective and therefore is the main comparison evaluation metric among the others.

$$CAGR = \left( \frac{V_{final}}{V_{begin}} \right)^{\frac{1}{t}} - 1$$

where:

$V_{final}$  = Ending Portfolio Value

$V_{begin}$  = Starting Portfolio Value

t = Total number of years

### 2.2.2 Sharpe Ratio

The sharpe ratio is the average return earned in the excess of the risk-free rate per unit of the total risk. Since the primary focus of this project is on the forex market, which is relatively more stable,  $R_b$  value of 0.02 is considered.

The greater value of sharpe ratio, the higher the investment return relative to the amount of risk taken, therefore the better the strategy.

$$\text{Sharpe Ratio} = \frac{R_a - R_b}{\sigma_a}$$

where:

$R_a$  = Portfolio Return

$R_b$  = Risk Free Return (typically 0.02)

$\sigma_a$  = Standard deviation of the portfolio's excess return

### 2.2.3 Maximum Drawdown

The maximum drawdown (MDD) is the maximum loss observed from a peak (high-point) to a trough (low-point) throughout the previous period before a new peak is attained. The MDD is an indicator of downside risk throughout the duration of holding the portfolio.

The MDD indicates the relative riskiness of stock, therefore, a low MDD is preferred as this indicates that losses from the investment are small. However, the MDD is merely an indicator of a drawdown, it does not consider how long for a portfolio to recover from the loss or if the investment is recovered at all.

$$MDD = \frac{T_v - P_v}{P_v}$$

where:

$T_v$  = Lowest Value after Peak Value

$P_v$  = Peak Value

## 2.3 Data

The following research uses the forex market as its fundamental study trading market since the forex market is comparably more stable than the other trading markets.

6 different forex currency pairs were used in this research:

EUR/USD, USD/JPY, GBP/USD, AUD/USD, USD/CAD, and USD/CNY.

The data are collected from tradingview where the data will be processed to be backtested on 6 different RSI-related trading strategies. Both daily historical data and hourly historical data are used in the study of this project.

### 3. Data Analysis

#### 3.1 First Phase Analysis

The first phase analysis will run all the strategies above by alternating the RSI look-back period ranging from 7 to 100. The results are then plotted into a heatmap based on the CAGR calculated for each different look-back period. The darker (in blue color) the heatmap is, the better the strategy is using the responding RSI look-back period.

The “buy and hold strategy” is to stay invested over a long period despite any fluctuation in the market. The goal is to beat this strategy by figuring out the strategies that use the optimum look-back period of RSI having a CAGR higher than the ‘buy and hold strategy. For the case where the CAGR of the “buy and hold strategy” is negative, even if the strategy induces less loss, it will still be identified as ineffective since the strategy is not profitable. The CAGR calculated is represented in percentages.

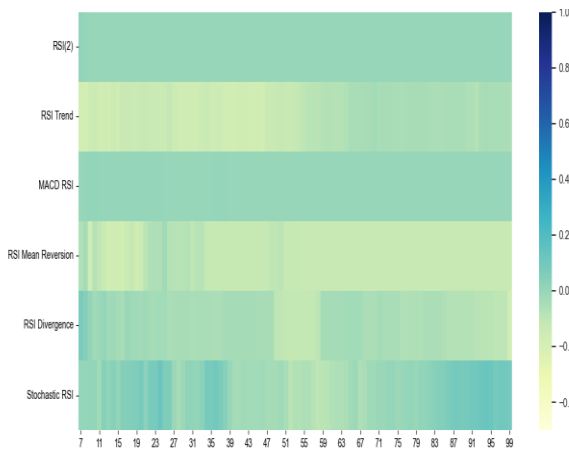
The past ten years of historical daily data were analyzed, where the starting date of the daily data is **2012-01-01** and ends on **2022-01-01**.

On the other hand, the past two years of historical hourly data were analyzed, where the starting date is **2020-01-01** and ends on **2022-04-01**.

### 3.1.1 Heatmap For Each of the Forex Data

#### 3.1.1.1 EUR/USD

Daily Data

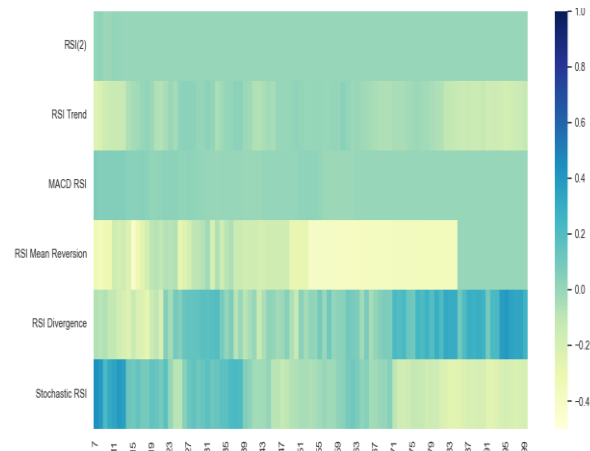


\*\* The darker (in blue color) the graph, the more profitable the strategy is using the responding look-back period.

Color Coding

Light Blue = Best Strategy among the other strategies that uses the optimal look-back period for RSI  
 Light Green = Profitable Strategy (beats 'buy and hold' with the optimal look-back period)

Hourly Data



\*\* The darker (in blue color) the graph, the more profitable the strategy is using the responding look-back period.

Color Coding

Light Blue = Best Strategy among the other strategies that uses the optimal look-back period for RSI  
 Light Green = Profitable Strategy (beats 'buy and hold' with the optimal look-back period)

Strategy	Optimum look-back period (Days)	CAGR (%)
Buy and Hold	N/A	-1.2390
<b>RSI (2) Strategy</b>	7	0.1585
RSI Trend Strategy	70	-0.3000
<b>MACD + RSI Strategy</b>	9	0.1084
RSI Mean Reversion Strategy	25	-0.2230
<b>RSI Divergence Strategy</b>	7	0.7843
Stochastic RSI Strategy	24	<b>1.3120</b>

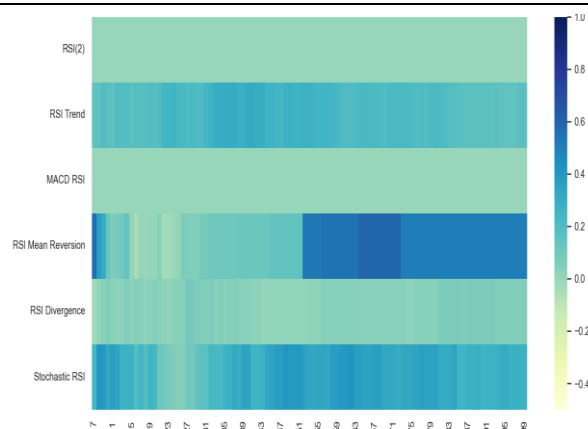
Strategy	Optimum look-back period (Hours)	CAGR (%)
Buy and Hold	N/A	-1.1877
<b>RSI (2) Strategy</b>	8	0.2700
<b>RSI Trend Strategy</b>	60	0.3846
<b>MACD + RSI Strategy</b>	7	0.6757
RSI Mean Reversion Strategy	31	-0.0204
<b>RSI Divergence Strategy</b>	95	3.9430
Stochastic RSI Strategy	7	<b>5.3268</b>

Remarks:

- 1) The most effective strategy for daily historical data would be the **Stochastic RSI Strategy** with the optimum look-back period of **24 days**.
- 2) The most effective strategy for hourly historical data would be the **Stochastic RSI Strategy** with the optimum look-back period of **7 hours**.

### 3.1.1.2 USD/JPY

#### Daily Data

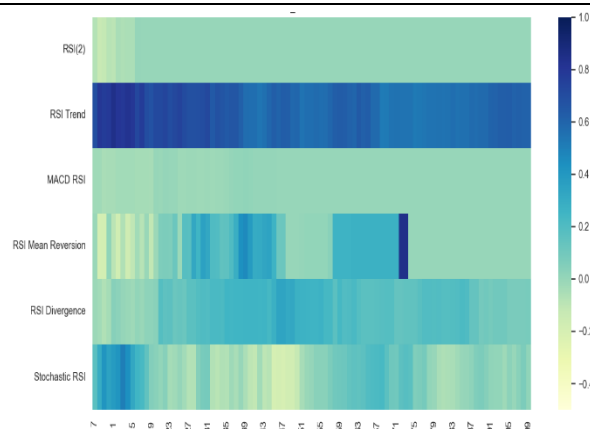


\*\* The darker (in blue color) the graph, the more profitable the strategy is using the responding look-back period.

#### Color Coding

Light Blue = Best Strategy among the other strategies that uses the optimal look-back period for RSI  
 Light Green = Profitable Strategy (beats 'buy and hold' with the optimal look-back period)  
 Light Gray = Unapplicable Analysis

#### Hourly Data



\*\* The darker (in blue color) the graph, the more profitable the strategy is using the responding look-back period.

#### Color Coding

Light Blue = Best Strategy among the other strategies that uses the optimal look-back period for RSI  
 Light Green = Profitable Strategy (beats 'buy and hold' with the optimal look-back period)

Strategy	Optimum look-back period (Days)	CAGR (%)
Buy and Hold	N/A	5.0750
RSI (2) Strategy	7	0.0955
RSI Trend Strategy	41	3.1224
MACD + RSI Strategy	N/A	N/A
RSI Mean Reversion Strategy	64	5.9397
RSI Divergence Strategy	27	0.8327
Stochastic RSI Strategy	62	4.1657

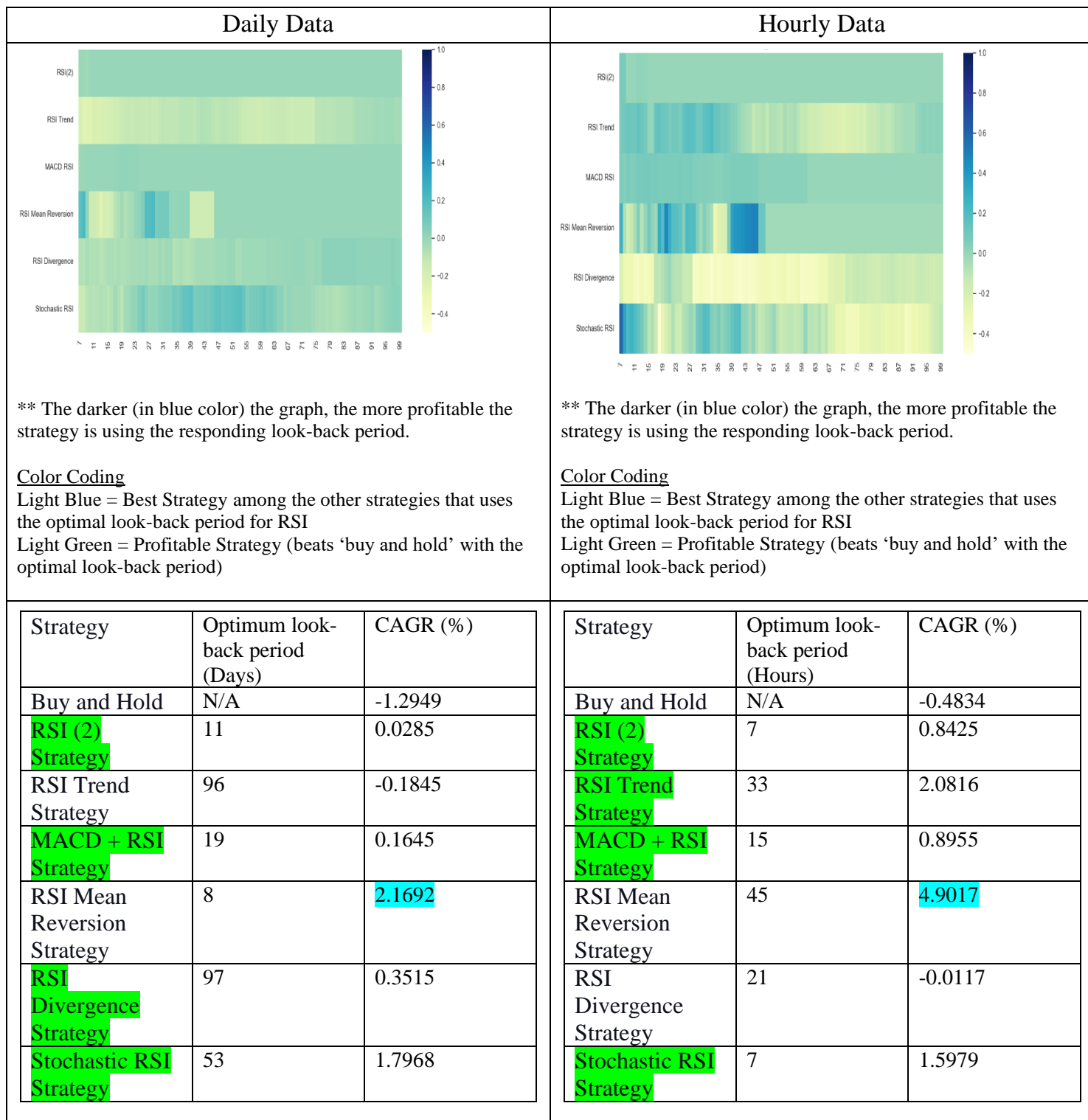
Strategy	Optimum look-back period (Hours)	CAGR (%)
Buy and Hold	N/A	6.3194
RSI (2) Strategy	16	0.0684
RSI Trend Strategy	11	8.4397
MACD + RSI Strategy	39	0.1724
RSI Mean Reversion Strategy	72	8.4356
RSI Divergence Strategy	47	3.4023
Stochastic RSI Strategy	12	6.0323

#### Remarks:

- 1) The most effective strategy for daily historical data would be the **RSI Mean Reversion Strategy** with the optimum look-back period of **64 days**.
- 2) The most effective strategy for hourly historical data would be the **RSI trend Strategy** with the optimum look-back period of **11 hours**.
- 3) For the MACD+RSI strategy in the daily historical data, no trade signals are produced for the duration of the look-back period ranging from 7 to 100, therefore is unapplicable in this analysis.



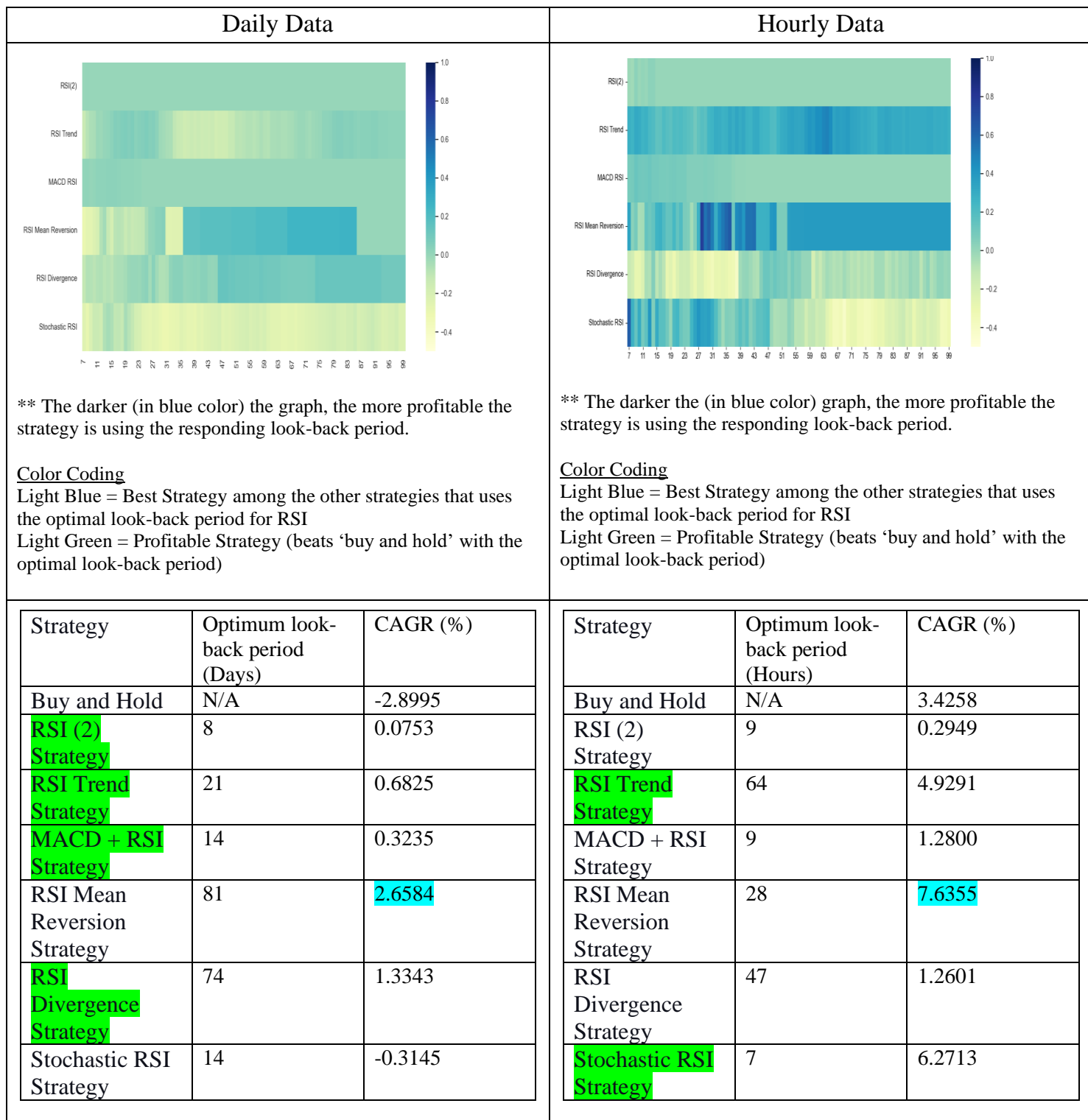
### 3.1.1.3 GBP/USD



Remarks:

- 1) The most effective strategy for daily historical data would be the **RSI Mean Reversion Strategy** with the optimum look-back period of **8 days**.
- 2) The most effective strategy for hourly historical data would be the **RSI Mean Reversion Strategy** with the optimum look-back period of **45 hours**.

### 3.1.1.4 AUD/USD

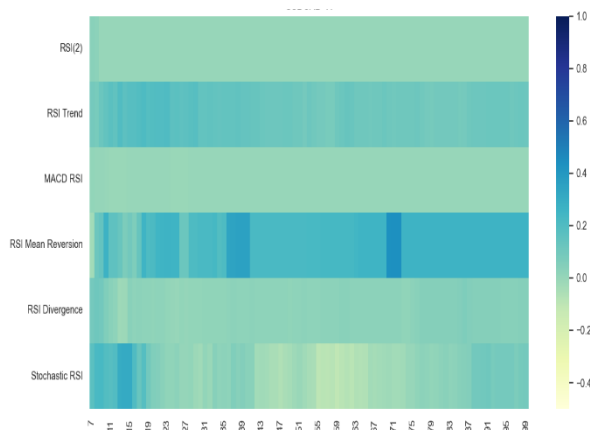


Remarks:

- 1) The most effective strategy for daily historical data would be the **RSI Mean Reversion Strategy** with the optimum look-back period of **81 days**.
- 2) The most effective strategy for hourly historical data would be the **RSI Mean Reversion Strategy** with the optimum look-back period of **28 hours**.

### 3.1.1.5 USD/CAD

#### Daily Data

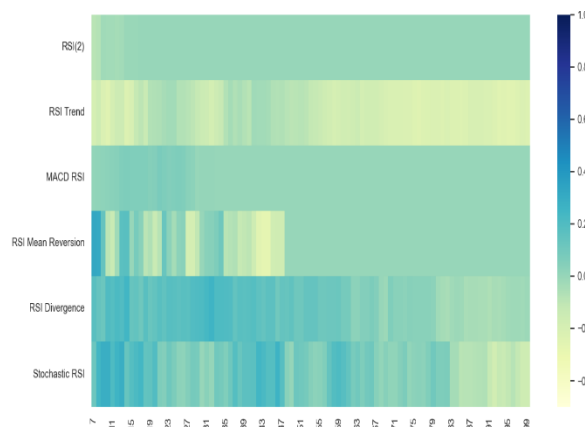


\*\* The darker (in blue color) the graph, the more profitable the strategy is using the responding look-back period.

#### Color Coding

Light Blue = Best Strategy among the other strategies that uses the optimal look-back period for RSI  
 Light Green = Profitable Strategy (beats 'buy and hold' with the optimal look-back period)

#### Hourly Data



\*\* The darker (in blue color) the graph, the more profitable the strategy is using the responding look-back period.

#### Color Coding

Light Blue = Best Strategy among the other strategies that uses the optimal look-back period for RSI  
 Light Green = Profitable Strategy (beats 'buy and hold' with the optimal look-back period)

Strategy	Optimum look-back period (Days)	CAGR (%)
Buy and Hold	N/A	2.5490
RSI (2) Strategy	7	0.3805
RSI Trend Strategy	18	2.1342
MACD + RSI Strategy	7	0.1219
RSI Mean Reversion Strategy	71	4.4278
RSI Divergence Strategy	8	1.1018
Stochastic RSI Strategy	15	3.1339

Strategy	Optimum look-back period (Hours)	CAGR (%)
Buy and Hold	N/A	-1.6141
RSI (2) Strategy	17	-0.0176
RSI Trend Strategy	41	-0.2156
MACD + RSI Strategy	21	0.7446
RSI Mean Reversion Strategy	7	3.2060
RSI Divergence Strategy	32	2.5935
Stochastic RSI Strategy	9	2.8867

#### Remarks:

- 1) The most effective strategy for daily historical data would be the **RSI Mean Reversion Strategy** with the optimum look-back period of **71 days**.
- 2) The most effective strategy for hourly historical data would be the **RSI Mean Reversion Strategy** with the optimum look-back period of **7 hours**.

### 3.1.1.6 USD/CNY



**Remarks:**

1) The most effective strategy for daily historical data would be the **RSI Trend Strategy** with the optimum look-back period of **18 days**.

2) The most effective strategy for hourly historical data would be the **RSI Mean Reversion Strategy** with the optimum look-back period of **10 hours**.

### 3.2 Second Phase Analysis

The second phase analysis will accumulate all the results of the different forex data key pairs calculated in the first phase where the RSI look-back period is ranged from 7 to 100. The algorithm will then determine the most effective RSI look-back period by comparing the CAGR to find the maximum CAGR obtain within the look-back period range. Evaluation metrics are further computed to determine the feasibility and effectiveness of the strategies. All the evaluation metrics are represented in percentage.

#### 3.2.1 Daily Data

Evaluation Metrics/ Strategy	Optimum look-back period (Days)	CAGR (%)	Sharpe Ratio (%)	Maximum Drawdown (%)
Buy and Hold Strategy	N/A	0.39	97.53	31.17
RSI (2) Strategy	7	0.10 (n=36)	97.96	1.55
RSI Trend Strategy	80	0.67 (n=383)	97.74	13.28
MACD + RSI Strategy	15	0.06 (n=637)	97.82	0.48
RSI Mean Reversion Strategy	71	1.94 (n=7)	97.76	11.63
RSI Divergence Strategy	84	0.28 (n=248)	97.84	9.29
Stochastic RSI Strategy	24	1.11 (n=621)	97.67	15.45

\*\*Light Blue = Best Strategy among the other strategies that uses the optimal look-back period for RSI

\*\*Light Green = Profitable Strategy (beats 'buy and hold' with the optimal look-back period)

\*\*n = total of trades over 10 years daily data for the 6 different forex key pairs

Remark:

- 1) The most effective strategy for daily historical data is the **RSI Mean Reversion Strategy** with the optimum look-back period of **71 days**.
- 2) The sharpe ratio is not the highest among the strategy, indicating that even though the strategy is able to produce the max profit, it is not best profit earning strategy relative to risk.
- 3) The maximum drawdown is better than the 'buy and hold strategy', implying that the strategy is able to exit the market before any drastic drawdown happen.
- 4) The total number of trades is 7 across the 10 years for 6 different forex key pairs, indicating that there is only one trade per 10 years for every forex key-pair. Since **RSI Mean Reversion Strategy** has the best CAGR performance, the strategy faces a tradeoff on getting the best trade available by drastically reducing the number of trades.

Statistics of the best strategy for daily forex market:

Statistics / Evaluation Metrics	Mean	Standard Deviation	Max	Min
CAGR (%)	1.94	2.59	5.94	-1.26
Sharpe Ratio (%)	18.64	42.59	85.82	-49.66
Maximum Drawdown (%)	11.63	10.33	29.33	1.27

### 3.2.2 Hourly Data

Strategy	Optimum look-back period (Hours)	CAGR (%)	Sharpe Ratio (%)	Maximum Drawdown (%)
Buy and Hold Strategy	N/A	0.45	97.90	15.50
RSI (2) Strategy	7	-0.13 (n=245)	97.99	1.92
RSI Trend Strategy	36	0.31 (n=2579)	97.94	9.62
MACD + RSI Strategy	13	0.50 (n=3345)	97.96	0.66
RSI Mean Reversion Strategy	28	0.31 (n=74)	97.93	10.32
RSI Divergence Strategy	78	0.57 (n=1270)	97.96	5.64
Stochastic RSI Strategy	7	2.23 (n=3687)	97.93	8.88

\*\*Light Blue = Best Strategy among the other strategies that uses the optimal look-back period for RSI

\*\*Light Green = Profitable Strategy (beats 'buy and hold' with the optimal look-back period)

\*\*n = total of trades over 3 years hourly data for the 6 different forex key pairs

Remark:

- 1) The most effective strategy for daily historical data is the **Stochastic RSI Strategy** with the optimum look-back period of **7 hours**.
- 2) The sharpe ratio is not the highest among the strategy, indicating that even though the strategy is able to produce the max profit, it is not best profit earning strategy relative to risk.
- 3) The maximum drawdown is better than the 'buy and hold strategy', implying that the strategy can exit the market before any drastic drawdown happen.
- 4) The total number of trades is the highest among other strategy, indicating the **Stochastic RSI Strategy** takes advantage of the number of trades to get the highest CAGR possible. The strategy faces the tradeoff of properly identifying the current trend of the market by quickly buying and selling out the stocks without further observation of the market.

Statistics of the best strategy for the hourly forex market:

Statistics / Evaluation Metrics	Mean	Standard Deviation	Max	Min
CAGR (%)	2.23	2.32	5.33	-1.34
Sharpe Ratio (%)	97.93	0.02	97.96	97.90
Maximum Drawdown (%)	8.93	3.34	14.70	4.83

### 3.3 Evaluation on Each Strategy

RSI (2) Strategy primarily relies on both the long-term SMA (200-period) and short-term SMA (5-period) value to generate the buying signal while having RSI as an extra confirmation indicator. Generally, this strategy uses a shorter look-back period. As the RSI look-back period increases, the graph of the RSI becomes smoother and eventually, no RSI value will be under 10, therefore no buying signal will be generated. Even with the optimum look-back period, RSI (2) strategy is not able to outperform the 'buy and hold strategy' for daily data and hourly data, indicating the following strategy is ineffective in the forex market.

RSI Trend Strategy uses the same principle on moving average but instead uses a lower period for the long-term SMA (20-period) and a 5-period for the short-term SMA. The buying signal is identified when the long-term SMA crosses the short-term SMA, while the extra confirmation from RSI is that the RSI needs to be above 50. On the other hand, if either condition fails, we enter a sell position. Generally, RSI Trend Strategy is best utilizing a higher look-back period for the RSI since a higher look-back period will smoothen out the RSI graph, hence, the buying signal and selling signal are easier to be generated with regard that the market is in an uptrend or downtrend from the two SMA used. RSI Trend Strategy is proven to have better performance using daily historical data while being ineffective in the hourly historical data.

The MACD + RSI strategy uses MACD to identify the trend of the market while having RSI be the extra indication of the overbought and oversold condition. The following strategy priorities in getting into the market when it is stable, hence having a stricter entry condition where the MACD signal must agree with the RSI symbol where the RSI value must be lower than 30. The look-back period is suggested to be near the original look-back period which is 13-to-14 for both the daily historical data and hourly historical data. The following strategy is proven to be only effective in the hourly historical data.

RSI Mean Reversion strategy uses the most basic method to enter and exit the market where an RSI value below 30 is the indication of an oversold market and an RSI value above 70 is the indication of an overbought market. RSI mean reversion strategy is proven to be the most effective in the historical daily data where it has the highest CAGR when utilizing the optimum RSI look-back period. For daily data, the condition of the market can be correctly identified with a higher value of look-back period since for a longer look-back period, additional close price is considered the calculation of RSI, hence better performance. By having a look-back period of 71, roughly one trade happens every 10 years, indicating that we can secure the best trade available at the cost of having multiple trades. However, RSI mean reversion strategy is proven to be ineffective for the hourly data since it is underperforming despite utilizing the optimum look-back period.

RSI Divergence Strategy uses the standard divergence strategy where the buying signal is generated when the close price is moving in the opposite direction of the RSI. The selling signal is when the RSI value falls below 50. The following strategy identifies the trend in both close price and value; therefore, a higher look-back period of RSI is preferred since the RSI covers more historical value, hence a more accurate representation of the trend. Nevertheless, the following strategy is only proven to be effective in hourly data.

Stochastic RSI strategy uses RSI to further generate a technical indicator, hence being more sensitive in generating buying and selling signal. Whenever the StochRSI falls below 20, the market is in an oversold condition, and we enter the market. We exit the market whenever the StochRSI rise above 80. The look-back period for Stochastic RSI strategy is short in general since we would want the indicator to represent the current value as close as possible. By having more buying and selling signals are generated, we can find more trades which in result gives a better result. Stochastic RSI strategy is proven to be the most effective for hourly data since it has the highest value of CAGR among the other strategies when utilizing the optimum look-back period. Daily trade wise, the following strategy is also effective as outperform the 'buy and hold strategy'.

For daily trading in general, the RSI Trend Strategy and the Stochastic Strategy are profitable, whereas RSI Mean Reversion Strategy is the best trading strategy among the others. Overall, RSI as the trend indicator is proven to be more effective than RSI as the trend oscillator in daily trading. On the other hand, for hourly trading, the MACD + RSI Strategy and the RSI Divergence Strategy are profitable, whereas the Stochastic RSI Strategy is the best trading strategy. In general, RSI as the trend oscillator is proven to be more effective than RSI as the trend indicator for hourly trading.

## 4. Implication on Other Markets

The analysis on the optimal look-back period for each strategy is tested on the different market, namely on the ETF Market - SPDR S&P 500 ETF Trust (SPY) and Dow Jones Industrial Average (^DJI) alongside with the Cryptocurrency Market – Bitcoin (BTC) and Ethereum (ETH). Only daily historical data is used for the sake of simplicity.

The same backtesting algorithm was run using the past 10 years of daily historical data (2012-01-01 to 2022-01-01) for the stock mentioned above except for ETH which used 4 years of historical data (2018-01-01 to 2022-01-01)

### 4.1 ETF Market

#### 4.1.1 SPY

Strategy	Optimum look-back period (Days)	CAGR (%)	Sharpe Ratio (%)	Maximum Drawdown (%)
Buy and Hold Strategy	N/A	20.95	96.77	41.71
RSI (2) Strategy	N/A	N/A	N/A	N/A
RSI Trend Strategy	9	12.73 (n=44)	97.40	11.59
MACD + RSI Strategy	36	7.76 (n=17)	97.59	6.11
RSI Mean Reversion Strategy	27	27.98 (n=2)	97.16	18.90
RSI Divergence Strategy	48	1.24 (n=4)	97.90	0.68
Stochastic RSI Strategy	53	11.04 (n=37)	96.95	36.89

\*\*Light Blue = Best Strategy among the other strategies that uses the optimal look-back period for RSI

\*\*Light Gray = Invalid analysis since there are no trading signals created from ranging the RSI look-back period from 7-100

\*\*n = total of trades over 10 years daily data for the SPY stock

#### 4.1.2 ^DJI

Strategy	Optimum look-back period (Days)	CAGR (%)	Sharpe Ratio (%)	Maximum Drawdown (%)
Buy and Hold Strategy	N/A	12.18	96.66	46.34
RSI (2) Strategy	8	1.50 (n=3)	97.91	0.59
RSI Trend Strategy	7	4.02 (n=61)	97.41	11.76
MACD + RSI Strategy	78	6.45 (n=12)	97.54	7.40
RSI Mean Reversion Strategy	32	19.54 (n=1)	97.01	22.08
RSI Divergence Strategy	19	5.06 (n=14)	97.70	3.31
Stochastic RSI Strategy	46	6.48 (n=36)	96.88	43.82

\*\*Light Blue = Best Strategy among the other strategies that uses the optimal look-back period for RSI

\*\*n = total of trades over 10 years daily data for the ^DJI stock



## 4.2 Cryptocurrency Market

### 4.2.1 BTC

Strategy	Optimum look-back period (Days)	CAGR (%)	Sharpe Ratio (%)	Maximum Drawdown (%)
Buy and Hold Strategy	N/A	77.99	94.21	168.92
RSI (2) Strategy	8	1.53 (n=2)	97.71	6.18
RSI Trend Strategy	37	1020.51 (n=30)	95.89	45.19
MACD + RSI Strategy	99	30.04 (n=26)	96.39	52.23
RSI Mean Reversion Strategy	100	31.85 (n=1)	94.79	145.15
RSI Divergence Strategy	10	11.24 (n=46)	96.72	30.65
Stochastic RSI Strategy	45	15.22 (n=48)	95.28	81.88

\*\*Light Blue = Best Strategy among the other strategies that uses the optimal look-back period for RSI

\*\*n = total of trades over 10 years daily data for the BTC stock

### 4.2.2 ETH

- Note that Ethereum was launched in 2015, therefore for the analysis below, the daily data is taken from 2018-01-01 to 2022-01-01, a total of 4 years historical daily data.

Strategy	Optimum look-back period (Days)	CAGR (%)	Sharpe Ratio (%)	Maximum Drawdown (%)
Buy and Hold Strategy	N/A	921.21	93.16	280.72
RSI (2) Strategy	7	3.50 (n = 1)	97.78	0.00
RSI Trend Strategy	9	4441079.80 (n = 63)	95.00	54.70
MACD + RSI Strategy	63	13.29 (n=35)	95.88	117.03
RSI Mean Reversion Strategy	35	337.17 (n = 2)	96.13	41.15
RSI Divergence Strategy	27	6.41 (n = 24)	96.98	23.01
Stochastic RSI Strategy	12	-1.34 (n= 60)	94.23	226.23

\*\*Light Blue = Best Strategy among the other strategies that uses the optimal look-back period for RSI

\*\*n = total of trades over 4 years daily data for the ETH stock

### 4.3 Best RSI Strategy Analysis on Other Markets

In the ETF market, RSI Mean Reversion is proven to be the most effective strategy. The optimal look-back period for the ETF market is roughly a month, SPY's optimal look-back period is 27 days, while ^DJI optimal look-back period is 32 days. Similarly, the RSI Mean Reversion faces a trade-off of getting the best trade available against the total number of trades. Since ETF is a type of mutual fund that has a portfolio constructed to match and track the financial market index. ETF has a broad market exposure and a low portfolio turnover, which in turn is proven to be a relatively stable market over time. Therefore, the RSI Mean Reversion Strategy with a monthly look-back period indicates that staying in the market over a longer period is the best trading strategy among the other RSI trading strategies.

On the other hand, the Cryptocurrency Market is relatively more volatile, where the price of the cryptocurrency fluctuates regularly. The best RSI strategy, in this case, is the RSI trend strategy. The optimal look-back period for BTC is 37 days while the optimal look-back period for ETC is 9 days. RSI Trend Strategy primarily uses two SMA to identify the trend and RSI as an extra indicator of the state of the market. Roughly a month of historical daily data is used to compute the RSI value for the RSI Trend Strategy, indicating that the RSI value computed is more smoothed out but covers more instances of historical data. A shorter RSI look-back period is used in ETH indicating that the RSI value calculated is more responsive to the current data. Therefore, with the prices of the market changing regularly, the two SMA and the RSI computed with the optimal look-back period can correctly identify the condition of the market and perform the trade efficiently by entering the market during an uptrend and exiting the market before any drastic downtrend happens.

## 5. Conclusion

Further developments in composing the RSI-related trading strategy are feasible via confluence, where additional trading indicator can be considered. The project can further be extended to analyse the best parameter for each trading indicator in each strategy. Moreover, additional markets can be explored with daily and hourly historical data to further conclude the analysis of each RSI-related trading strategy.

From the analysis and optimization of the look-back period for the RSI and its trading strategy, it can be inferred that the original look-back period for the RSI (14 periods) is ineffective in most RSI-related trading strategies. For the daily forex market, RSI Mean Reversion Strategy is the most effective strategy with a look-back period of 71 days. In the forex hourly market, the Stochastic RSI Strategy is the most effective strategy with a look-back period of 7 hours. Since the trend in daily data and hourly data behaves differently, it is undisputedly that both have a different optimal strategy with different optimal RSI look-back periods. The analysis on the ETF market and Cryptocurrency market further concludes the truth that an RSI-related trading strategy is only effective in a specific market. In short, there is not a single best RSI-related trading strategy that can prevail in all the different markets. In addition, for all the best RSI-related trading strategies in its specific market, we can achieve a smaller drawdown than the 'buy and hold strategy', indicating that we can reduce the risk of holding the stock during a major drawdown of the stock. In conclusion, fine-tuning the RSI look-back period for each RSI-related strategy is one of the ways to increase profit in trading since various market behaves contrastingly, and therefore, an adjustment to the look-back period of the RSI should be made accordingly.