

## CHAPTER III : RESEARCH METHODOLOGY

### 3.1 Introduction

As a recap, the aim of this research is to introduced a new RSI variant that replaces the closing price variable with market capitalisation. Other than that, this study aims to measure and compare the performance of this newly introduced RSI formula against other RSIs using the carefully selected 20 stocks. Figure 3.1 below shows the summary of steps used in determining and finalising the sample stocks.

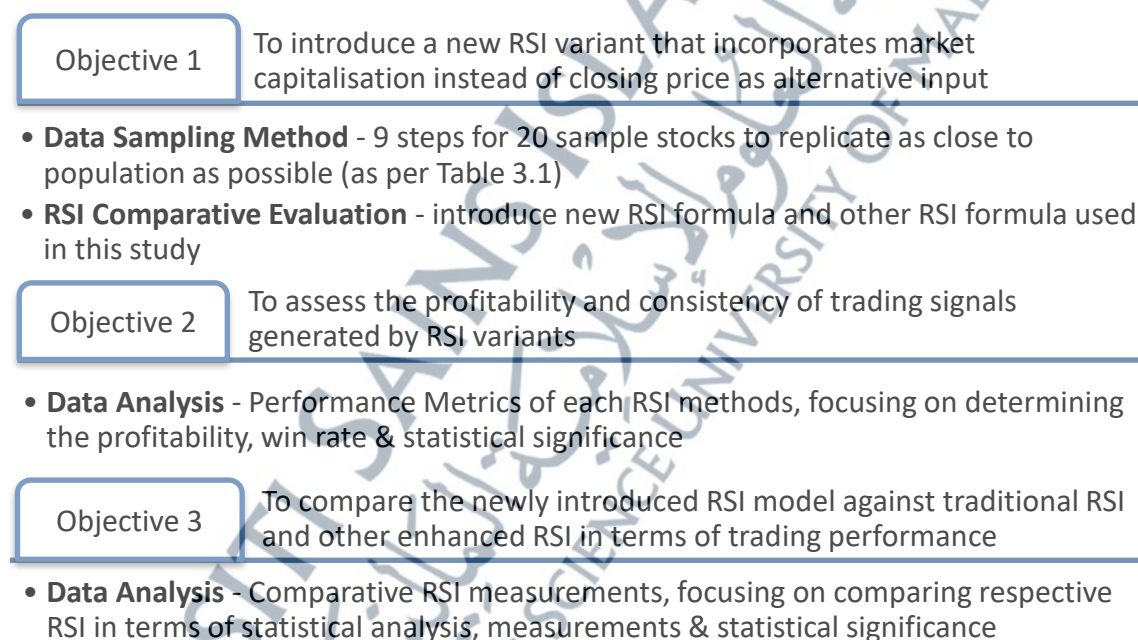


Figure 3.1: Summary of Steps Used in Determining the Sample Stocks.

### 3.2 Sample Selection Criteria

The selection of stocks for this study was guided by two main principles: sectoral proportionality and corporate action frequency. To ensure the sample represent the market, the sample composition mirrors the proportion of sectors from the entire stock

population on Bursa Malaysia. For instance, if the technology sector comprises approximately 10% of all listed companies, then 10% of the sample is drawn from that sector.

Within each sector, priority is given to stocks with the highest number of corporate actions during the study period. This focus ensures that the selected stocks are those most likely to exhibit price adjustments driven by structural changes, making them directly relevant to the research objective of evaluating RSI performance in the context of such events. By combining proportional sector representation with a focus on high corporate action frequency, the sample is designed to both reflect the broader market structure and maximise the relevance of the analysis to the study.

### **3.3 Data Sampling Method**

There are 9 steps involved in obtaining data sampling for this study, starting from the population stratification, until gathering closing prices of 10 years period of the 20 samples and Table 3.1 act as a summary of all the 9 steps. The timeframe of 10 years is between July 2014 to June 2024 and closing prices are obtainable from Yahoo Finance. The population consists of 1,040 active stocks and 13 distinct sectors are determined by Bursa Malaysia as of 26 Aug 2024. These active stocks include stocks from Main Market, where warrants and Exchange-Traded Fund (ETF) are excluded. The 13 sectors involved are (1) Construction, (2) Consumer Products and Services, (3) Energy, (4) Financial Services, (5) Healthcare, (6) Industrial Products and Services, (7) Plantation, (8) Property, (9) Real Estate Investment Trusts (REIT), (10) Technology, (11) Telecommunications and Media, (12) Transportation and Logistics and (13) Utilities.

Table 3.1: Summary on Methods and Steps Involved with Data Sampling Method

No.	Step	Description
1	Stratification	The population (1,040 active stocks in Malaysia) is divided into 13 sectors or strata
2	Population Data Gathering	For each stock, determine the number of corporate actions happening within 10 years (July 2014 – June 2024)
3	Stock Sorting	Within respective sector, sort the stocks from highest to lowest, based on their number of corporate actions
4	Percentage Calculation	For each sector, determine the percentage of stocks with corporate actions $\% \text{ of Stocks with Corporate Actions} = \frac{\text{No. of Stocks with Corporate Actions}}{\text{Total stocks}} \times 100\%$
5	Sector Sorting	Sort the sector from highest to lowest, based on their % of Stock with corporate actions
6	Sample Size Determination	Determine the total sample required, which is 20 corporate actions
7	Proportional Allocation	The 20 samples are distributed across sectors based on the percentage of stocks with events, round to the nearest integer
8	Purposive Selection	Based on the samples allocated by sectors, the top number of stocks (based on sorting in Step 2) are selected as sample
9	Sample Data Gathering	Obtain the daily stock closing price for the 20 sample stocks

### 3.3.1 Stratification

This step involves dividing the population of active stocks (1,040 active stocks determined by Bursa Malaysia) into 13 distinct sectors or strata. For this study, sample size determination is based on stratification by sectors, rather than delving into more specific sub-sectors. This stratification ensures that the sample represents various sectors within the stock market, providing a more comprehensive view of market dynamics. Getting samples that are representative of the population as close as possible

is the goal here. Table 3.2 below is a snapshot of population distribution by sector and its allocation of sample.

Table 3.2: A Partial View: Sectoral Distribution and Proportional Sample Allocation

Sector	No. of Stock	Population (%)	Sample	Sample (%)
CONSTRUCTION	53	6.6%	1	5.0%
CONSUMER PRODUCTS & SERVICES	173	21.5%	4	20.0%
ENERGY	29	3.6%	1	5.0%
FINANCIAL SERVICES	32	4.0%	1	5.0%
HEALTH CARE	19	2.4%	1	5.0%
INDUSTRIAL PRODUCTS & SERVICES	229	28.5%	6	30.0%
PLANTATION	42	5.2%	1	5.0%
PROPERTY	100	12.4%	3	15.0%

### 3.3.2 Population Data Gathering

This step involves counting corporate actions for each stock over the past 10 years (July 2014 to June 2024). This includes stock splits and reverse split, right issues, bonus issues, share buybacks, new share issuance and ESOS. This information is obtainable from Bursa Malaysia's website, under "Company Announcements" and "Additional Listing Announcement/Subdivision of Shares". These meticulous steps require care and patience due to the voluminous nature for all 1,040 active stocks individually. These corporate actions exclude any events that may affect stock prices due to demand and supply in nature such as financial results, dividend announcement and changes in corporate structure.

### 3.3.3 Stock Sorting

Within each sector, the stocks are sorted from highest to lowest based on the number of corporate actions they experienced. This sorting helps identify the most

active stocks in terms of corporate actions within each sector. This ranking also shows which stocks are more common to experience corporate actions that could affect their market capitalisation and stock prices.

#### **3.3.4 Percentage Calculation**

For each sector, the percentage of stocks that have experienced corporate actions is calculated. This step provides insight into the prevalence of corporate actions within different market segments. It helps to identify which sectors are more prone towards corporate actions, potentially indicating higher volatility in RSI indicator. This information can be valuable for investors and researchers looking to understand sector-specific trends. It also makes it possible to analyse the market more deeply by identifying sectors that potentially need greater attention in terms of FA and stock price fluctuations.

#### **3.3.5 Sector Sorting**

Sorting the sectors from highest to lowest based on their percentage of stocks with corporate actions is a crucial step in this sampling method. This process serves to identify which market sectors have been more active in terms of prices affected by corporate actions, providing valuable insights into the dynamics of different sectors within the stock market. Organising sectors in this manner facilitate easy comparison, potentially highlighting which sectors might have significant RSI differences. This comparative aspect can provide a broader perspective on the overall market structure and sector-specific characteristics, informing both the sampling process and wider market analyses.

### 3.3.6 Sample Size Determination

20 sample stocks are determined to be the total sample size required for the study. This number is chosen to provide a manageable yet representative sample of the overall market. The selection of 20 stocks strikes a balance between having enough data points for data gathering and keeping the analysis feasible within the constraints of the research timeline and resources. The relevance of using 20 sample stocks lies in its ability to capture a diverse range of market behaviours while remaining practical for in-depth analysis. Moreover, 20 stocks are presumably sufficient to observe patterns and trends without being overwhelmed by data complexity. Additionally, this sample size aligns with similar studies in financial literature, such as those conducted by Demirel et al., (2021), where their study used 9-year data of 42 stocks using daily opening and closing prices (resulting in total of about 94,000 datasets, equivalent to about 47,000 data set if only using closing prices). In comparison to this study, with 20 sample stocks chosen for 10-year period of daily closing prices, the dataset is equivalent to about 50,400 data set (assuming 252 trading days per annum).

### 3.3.7 Proportional Allocation

The 20 samples across sectors are distributed based on the percentage of stocks with corporate actions, rounding to the nearest integer. This step ensures that sectors with higher corporate actions are represented proportionally in the final sample. For example, if a sector has 30% of stocks with corporate actions and the total sample size is 20, this sector would be allocated 6 stocks (30% of 20, rounded). This proportional allocation method helps maintain the relative importance of each sector in the overall market structure, providing a more accurate representation of the stock market's

landscape in the sample. Table 3.3 illustrate a table to rank the sample by the highest number of corporate actions and by sector.

Table 3.3: A Partial View: Sort by the Highest Number of Corporate Actions Among Selected Sample by Sector

No.	Sector	Company Name	Company Short	Total Corporate Actions
1	CONSTRUCTION	IJM CORPORATION BERHAD	IJM	772
2	CONSUMER PRODUCTS & SERVICES	BESHOM HOLDINGS BERHAD	BESHOM	813
3		PARKSON HOLDINGS BERHAD	PARKSON	484
4		POWER ROOT BERHAD	PWROOT	424
5		7-ELEVEN MALAYSIA HOLDINGS BERHAD	SEM	412
6		ENERGY	YINSON HOLDINGS BERHAD	YINSON
7	FINANCIAL SERVICES	MALAYAN BANKING BERHAD	MAYBANK	686
8	HEALTH CARE	KPJ HEALTHCARE BERHAD	KPJ	430

### 3.3.8 Purposive Selection

Once the number of samples per sector is determined, the top stocks from each sector is selected based on their number of corporate actions (as sorted in Step 3.2.3). This purposive selection ensures that the most active stocks within each segment are included in the sample. This approach allows for a focused analysis on stocks that have experienced significant corporate actions, potentially providing more insightful data on the relationship between corporate actions and price movements.

### 3.3.9 Sample Data Gathering

For the 20 selected sample stocks, daily stock closing prices are obtainable from Yahoo Finance, based on the 10-year period mentioned earlier. This final step provides the necessary price data for further analysis on comparison across different RSI formulas and other performance metrics. It is also important to cross-reference this data with the respective annual report to ensure accuracy and account for any discrepancies

in the number of stocks (one of the key components of market capitalisation, apart of closing price).

### 3.4 RSI Comparative Evaluation

In this comprehensive investigation, a comparative analysis will be conducted utilising four distinct RSI formulations. The second and third objectives of this study is to ascertain which RSI variant yields the most advantageous financial outcomes and to highlight the disparities in their respective RSI readings. This methodological approach aims to provide an understanding of the relative efficacy of these RSI formulations within the context of contemporary financial markets. The 4 RSI formula involved are Traditional RSI (Wilder, 1978),  $RSI_M$  (Țăran-Moroșan, 2011), TN-RSI (Sahin and Ozbayoglu, 2014) and lastly, a newly introduced RSI focusing on market capitalisation. Notwithstanding the variations in formula, this research implements specific constraints and standardisation protocols to enhance the comparability of outcomes. These methodological considerations serve to standardise the analytical framework, thereby facilitating more robust and meaningful comparisons across diverse datasets and experimental conditions. Table 3.2 can be referred to summarise in tabular form of the difference between all 4 RSI features and blanket assumptions used in this study.

Table 3.4: Summary of RSI Comparative Evaluation

Type of RSI	RSI	RSI <sub>M</sub>	TN-RSI	RSI <sub>MC</sub>
Developed by	Wilder, J. W. (1978)	Morosan, A. T. (2011)	Sahin, A. & Ozbayoglu, A. M. (2014)	Proposed model by author
RSI Main scope	Momentum Oscillator	Include Volume Variable	Normalised Trend	Replace Closing Price with Market Capitalisation
Moving Average Method	W-MA	EMA	W-MA	W-MA
<b>Blanket Assumptions</b>				
Buy/Sell Strategy	30/70 Strategy: Upwards to 30 units (Buy signal) and Downward to 70 units (Sell signal)			
Period	14 trading period			
Cut Loss Strategy	Downwards to 30 units (after Buy signal)			

### 3.4.1 Traditional RSI

In this research, this RSI will predominantly preserve the foundational assumptions outlined in Wilder (1978) original work. This includes the application of the RSI formula, the buy and sell thresholds at 30 and 70 respectively, and the use of a 14-period Wilder Moving Average (W-MA). The study introduces an additional element by incorporating a cut loss strategy set at 30 units.

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

Where:

$$RS = \frac{\text{Average Win}}{\text{Average Loss}} \quad (2)$$

$$\text{Average Win} = \frac{(\text{previous Average Win}) * 13 + \text{Current Gain}}{14} \quad (3)$$

$$\text{Average Loss} = \frac{(\text{previous Average Loss}) * 13 + \text{Current Loss}}{14} \quad (4)$$

### 3.4.2 Modified RSI (RSI<sub>M</sub>)

The key innovation in Taran-Morosan (2011) adjusted RSI lies in its merging of price changes variable and their corresponding trading volumes variable. Taran-Morosan's formula modifies the traditional RSI calculation while ensuring the RSI readings are between 0 to 100 units, for ease of comparability.

$$RSI_M = 50 * \left(1 + \frac{1}{(1+RS_V)} - \frac{1}{(1+RS_P)}\right) \quad (5)$$

where:

$$RS_{P/V} = \frac{EMA \text{ of } U_{P/V}}{EMA \text{ of } D_{P/V}} \quad (6)$$

$$EMA_{today} = \left(Price_{today} * \left(\frac{Smooth}{1+n}\right)\right) + (EMA_{yesterday} * \left(1 - \left(\frac{Smooth}{1+n}\right)\right)) \quad (7)$$

where P refers to the closing price and V refers to the volume. As for EMA, n refers to the number of observations, Smooth is the smoothing factor of 2 and Price<sub>today</sub> refers to today's closing price.

### 3.4.3 Trend-Neutralised RSI (TN-RSI)

At its core, the TN-RSI incorporates a trend normalisation factor into the standard RSI calculation. This modification allows the indicator to adjust its readings based on the prevailing market trend, thereby reducing the occurrence of false signals that can arise when using the traditional RSI in trending markets. In order to calculate a trend factor that is normalised and incorporated into the RSI formula, a moving average and current prices are compared. This process is known as trend normalisation.

**Step 1:** Normalised the price trend using linear regression, where  $y$  being the trend value (or the predicted price) and  $x$  being the time period (20-day period will be used and re-calculate daily from Day 21 onwards).  $b_0$  and  $b_1$  being the  $y$ -intercept and slope respectively.

$$y = b_0 + b_1x \quad (8)$$

**Step 2:** To determine the Normalised Price, subtract the trend value ( $y$ ) from the actual price

$$\text{Normalised Price} = \text{Actual Price} - \text{Trend Value} \quad (9)$$

**Step 3:** Calculate Relative Index (RS) using the Average Win and Average Loss as in equation (2), (3), and (4) based on the Normalised Price (cumulative gains for Average Win and cumulative loss for Average Loss) using W-MA method.

**Step 4:** Calculate TN-RSI using similar RSI formula as per J. W. Wilder (1978)

$$TN - RSI = 100 - \frac{100}{(1+RS)} \quad (10)$$

#### 3.4.4 Newly Introduced RSI Market Capitalisation (RSI<sub>MC</sub>)

The RSI<sub>MC</sub> represents an alternative approach to technical analysis that adapts the traditional RSI by focusing on changes in market capitalisation rather than price fluctuations. This methodology aims to provide a more comprehensive view of market

momentum by incorporating both normalised price movements and changes in outstanding shares. By utilising market capitalisation as its primary metric,  $RSI_{MC}$  offers a unique perspective on market trends, potentially revealing insights that might be overlooked by conventional price-based indicators.

Building upon the outlined in Chapter 1.2: Problem Statement section, this research introduced an alternative input to the RSI by utilising market capitalisation as the primary variable instead of closing prices. This methodology aims to differentiate between price movements caused by stock-specific events (structural adjustments) and those driven by market sentiment (supply and demand dynamics). By focusing on market capitalisation, this adapted version of RSI seeks to provide a more refined reflection of market sentiment, potentially offering more accurate buy and sell signals. The underlying hypothesis is that by isolating the effects of market sentiment from stock-specific events, this modified RSI will yield a more precise indicator of market trends and momentum.

$$RSI_{MC} = 100 \frac{100}{(1+RS_{MC})} \quad (11)$$

where:

$$RS_{MC} = \frac{Average\ Win_{MC}}{Average\ Loss_{MC}} \quad (12)$$

$$Average\ Win_{MC} = \frac{(previous\ Average\ Win_{MC}) * 13 + Current\ Gain_{MC}}{14} \quad (13)$$

$$Average\ Loss_{MC} = \frac{(previous\ Average\ Loss_{MC}) * 13 + Current\ Loss_{MC}}{14} \quad (14)$$

Market Capitalisation (MC) = Outstanding Shares \* Normalised Price

### 3.4.5 Blanket Assumptions

For the purpose of this comparative analysis, two universal assumptions are applied across all four RSI formulas discussed. Firstly, the implementation of a stop-loss strategy is assumed as a standardised risk management approach. Secondly, it is presumed that each RSI variant generates buy and sell signals based on its specific calculations and thresholds. These assumptions provide a common framework for evaluating the relative effectiveness and practical applications of each RSI modification in diverse market conditions.

#### A. Stop-loss as Risk Management Strategy

Stop-loss orders are a crucial risk management tool in stock trading, designed to limit an investor's potential losses in a security position. In essence, a stop-loss is an order placed with a broker to sell a security when it reaches a predetermined price point, usually when the price drops lower than anticipated. This mechanism allows investors to set a maximum acceptable loss, thereby protecting their investment from significant downturns. When the stock price reaches the specified stop price, it automatically triggers a market order to sell, executing the trade at the best available price. Stop-loss also acts as an easy fix to disposition effect (Shefrin and Statman, 1985) (psychological mindset where investors are more willing to hold stocks at a loss and sell when profitable) as it can automate exit strategy and reduce reliance on investors' emotions in trading (Richards et al., 2017).

The implementation of stop-loss orders in stock market trading offers several advantages and one of them is to provide insurance against significant potential losses, particularly in the event of volatile market conditions. By setting a stop-loss, investors can effectively cap their potential losses, providing a measure of financial protection.

Furthermore, this tool removes the emotional element from decision-making, allowing for more objective and disciplined trading practices.

The effectiveness of stop-loss orders can be synergised when collaborating with other tools such as RSI. One of the four stop-loss categories highlighted by Dai et al. (2023) is the Moving Average, which indicates that a sell signal will occur when the price falls below the average historical price. Similarly applicable for this study, since 30/70 units threshold being used, the stop-loss is when the RSI reading revert back to 30 units, after passing thru 30 units from bottom up (without even reaching 70 units mark), as illustrated in Figure 3.2. Empirical studies showing mixed view on stop-loss strategy, where Han and Zhou (2014) commented that downside risk can be reduced with stop-loss rule. Meanwhile, Lei and Li (2011) find stop-loss brings no added value. Therefore, for this study, to supplement comparability between RSIs, both with and without stop-loss elements are factored in.

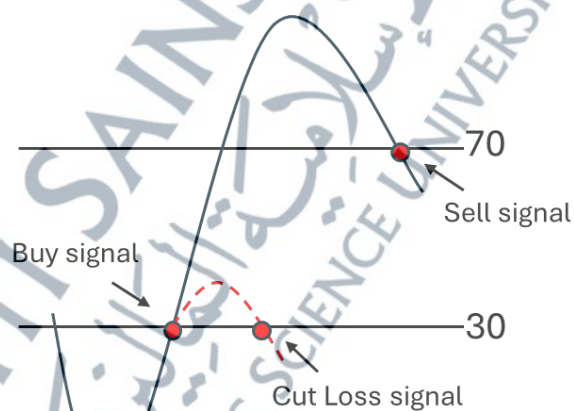


Figure 3.2: Illustration of RSI 30/70 Threshold and Stop Loss Signals

## B. Buy and Sell Signal

In traditional RSI analysis, buy and sell signals are typically determined by specific threshold values. When the value of RSI is 30 units, it is considered as buy

signal or oversold. Contrary if the value of RSI is 70 units, as it is considered as sell signal or overbought. However, as noted by Anson (2009), these 30/70 units thresholds can be interpreted differently depending on traders' perspectives. One interpretation suggests a buy signal occurs when the RSI reaches 30 units from above and a sell signal when it reaches 70 units from below. An alternative view proposes the opposite: a buy signal when the RSI touches 30 units from below and a sell signal when approaching 70 units from above. The midpoint of the RSI at 50 units serves as a crucial reference. When the indicator crosses this level from bottom to top, it may signify the emergence or continuation of an upward (bullish) trend. Conversely, crossing from top to bottom could indicate a downward (bearish) trend.

It's worth noting that in highly volatile markets, some technical analysts recommend using 20/80 units thresholds instead of 30/70 units for buy or sell signals (Hari & Dewi, 2019; Țăran-Moroșan, 2011). In the development of Improvised RSI (iRSI), Rodríguez-González et al. (2011) allow room for adaptability to 65 units (instead of 70 units) and 35 units (instead of 30 units). Similarly, Gurrib and Kamalov (2019) used 25/65 units adaptable boundaries in testing their Adjusted RSI (AdRSI). Despite these variations in threshold determination, which may lead to different investment decisions, this study will consistently employ the standard 30/70 units thresholds for RSI analysis to maintain consistency and comparability, where RSI reading increases to 30 is buy decision (exiting oversold region) and reading decreases to 70 is considered sell decision (exiting overbought region) (Țăran-Moroșan, 2011).

### **3.5 Data Analysis**

This section outlines a detailed analytical framework used to evaluate the performance of 20 selected Malaysian stocks across four (4) RSI models: RSI, RSI<sub>M</sub>,

TN-RSI and  $RSI_{MC}$ . The analysis was conducted under two separate trading conditions: Without Stop Loss and With Stop Loss.

The core performance metrics calculated include: net profit, average profit per trade, annualised profit, win rate, profit and loss index, average holding period and complete trade frequency. For the stop loss condition, stop loss frequency and stop loss percentage are included as additional metrics.

Net profit percentage is another essential performance metric in trading that measures the overall financial gain or loss from a series of completed buy/sell trades. The formula for net profit percentage is:

$$\text{Net Profit} = \text{Sum all winning trades} - \text{Sum all losing trades} \quad (15)$$

Average profit per trade is used for this study to determine the profitability average for each complete trade. The formula for average profit per trade is:

$$\text{Average Profit per Trade} = \frac{\text{Net Profit}}{\text{Number of Complete Trade}} \quad (16)$$

Annualised profit is a crucial metric that measures the percentage gain or loss of an investment over a one-year period. It's particularly useful for comparing investments or trading strategies over different time periods. The formula for calculating annualised profit is:

$$\text{Annualised Profit} = (1 + \text{total profit})^{(12/((12*10)))} - 1 \quad (17)$$

Win rate, which calculates the proportion of profitable transactions to all trades made, is a critical trading performance parameter. A higher win rate generally indicates a more successful trading strategy. Complete trade frequency is the number of complete signals for both buy and sell, where a profit (or loss) is able to be determined. This formula is used to compute it:

$$\text{Win Rate} = \frac{\text{No. of Positive Trades}}{\text{Complete Trade Frequency}} * 100 \quad (18)$$

Profit and Loss Index is a measurement to determine how profitable (or vice versa) the trading strategy is. The net profit is divided with the higher of between total profit or total loss, in this index. This index reflects value between -100 (worst) to +100 (best) (Tharavanij et al., 2015). The following equation defines it mathematically.

$$\text{Profit and Loss Index} = \frac{\text{Net Profit}}{\text{Max(Total Profit, Total Loss)}} * 100 \quad (19)$$

Stop loss frequency is a measurement used to detect the number of times stop loss is triggered. As the stop loss frequency is high, that indicated the RSI revert back to 30 unit marks, instead of completing it sell signals at 70 unit. As for stop loss percentage, it is calculated to understand the complete buy-sell cycles were inclined towards stop loss signal or sell signal at 70 unit. The formula for this is:

$$\text{Stop Loss Percentage} = \frac{\text{Stop Loss Frequency}}{\text{Complete Trade Frequency}} \quad (20)$$

The results of the analyses were presented in four tables in Chapter 4. Each table is designed to present specific aspects of the performance and comparative strength of the RSI models across the sample stocks and trading conditions.

### 3.6 Hypothesis Testing

Hypothesis testing used in this study to determine whether the observed differences in net profit among the RSI models are statistically significant, both at the RSI-pairing and individual stock levels. Two complementary approaches are applied: a paired sample t-test to compare model performance across the full sample, and a one-sample t-test conducted at the per-stock level to assess model performance for individual securities. Together, these methods provide both an overall statistical validation and a stock-specific perspective on the models' profitability.

#### 3.6.1 Paired t-test for RSI variants

To validate the performance differences among the four RSI models statistically, this study used paired sample t-test, where the aim is to examine any statistical (net profit) differences across any two models. Hypothesis testing is conducted for both with and without stop loss scenarios. Additional p-values is calculated per stock per model to determine whether each RSI model's output is significantly different from a null benchmark (which is zero net profit), using a 5% significance level. The hypotheses are formulated as follows:

Null Hypothesis ( $H_0$ ): There is no significant difference in net profit between the two RSI models being compared

Alternative Hypothesis ( $H_1$ ): There is significant difference in net profit between the two RSI models being compared

### 3.6.2 t-test for per-stock net profit

To complement the paired sample t-test results, an independent one-sample t-test was conducted at the individual stock level. This analysis evaluates whether the mean net profit generated by each RSI model for a specific stock is statistically different from zero, under both with and without stop loss conditions. By testing each stock independently, this method allows for the identification of cases where model performance is stock-specific rather than consistent across the full sample, using the same 5% significance level. The hypotheses are defined as follows:

Null Hypothesis ( $H_0$ ): There is no significant difference in net profit for the particular stock

Alternative Hypothesis ( $H_1$ ): There is significant difference in net profit for the particular stock