Impact of Events on Stock Market and Prediction of Impact status and Period

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2021

Impact of Events on Stock Market and Prediction of Impact status and Period

A dissertation submitted for the Degree of Master of Computer Science

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University of Colombo School of Computing

2021

UCSC

DECLARATION

I hereby declare that the thesis is my original work, and it has been written by me in its entirety. I have duly acknowledged all the sources of information which have been used in the thesis. This thesis has also not been submitted for any degree in any university previously.

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This is to certify that this thesis is based on the work of ~~Mr.~~ /Ms. _____V.P. Wijayaweera_____ under my supervision. The thesis has been prepared according to the format stipulated and is of acceptable standard.

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_____30-11-2021_____

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I would like to dedicate this thesis to...

ACKNOWLEDGEMENTS

ABSTRACT

Stock market is a public place where issuing, buying, and selling of a fractional ownership in a company and it is one of the main focuses which could impact for the economy of a country. Key method where investors could profit from purchasing stocks is by selling their stock for a higher price than the purchased price where they can profit if the stock price increases from their initial purchased price. It is harder to predict how the stock rates change time to time and it is certainly a challenge to predict the rates of the shares. When a special event or an incident is happening or happened in the country or in the company, it will affect for the companies which depend or has an impact from the event. Stock prices of a company reacts according to the new information announced by companies or any event which has an impact for the company happens in the country. Usually, it happens after the reaction of the share prices which happened after receiving the new information about an event as investors pay attention to this information so that this will affect for the asset prices dynamically. Hence, the stock rates will be changed accordingly. At times, it will affect for the stock rates drastically after a certain time. The period can be within a day, a week, a month similarly. After an event or an incident occurred, at present there's no method to predict the bearish or bullish period so that investors couldn't gain a better or a maximum profit from the stock exchanges. Due to that investors could not get the opportunity to have the maximum profit from the stock trading. If an investor has a doubt on the time for the stock trade, then the maximum profit or rather better profit could not be reached if the stocks are bought or sold within an incorrect time frame.

It would help to achieve more profit for an investor if there's a way to predict the periods after a certain event where investors can purchase or sell the stocks. Therefore, to cater that problem, in this research project, it will be examined how the events or incidents impact on the market prices which outcome the bearish and bullish periods. According to that examined results, main goal is to predict the bearish and bullish status and the period after an event which impacts to the share prices. After that the results will be evaluated with the actual values to determine the accuracy of the predictions.

It is always a challenge on determining the movement of stock market as it highly depends on traders' emotions, decisions etc. According to the results from this research study, impact and its period did not always outcome with accurate predictions, hence it also shows that sometimes the predictions could be correct and sometimes it could be incorrect.

Keywords: *stock market, bearish, bullish, technical indicator, impact status*

LIST OF PUBLICATIONS

Jayakody, A., Perera, A.K.A, Perera, G.L.K., Wijayaweera, V.P. and Ali, M.A.M, 2017. Efficient API Migration across Environments. *International Journal of Computer Applications*, 180(6), pp.33-45.

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LIST OF ABBREVIATIONS

Abbreviation	Description
ANN	Artificial Neural Network
ASPI	All Share Price Index
CSE	Colombo Stock Exchange
MACD	Moving average convergence divergence
MAE	Mean absolute error
MLP	Multilayer Perceptron
RMSE	Root Mean Squared Error
SL	Sri Lanka
UI	User Interface

CHAPTER 1

INTRODUCTION

Chapter 1, the introduction chapter will include an overview of the study stating the area of the study, motivation to the research, core information related to the research area which acquired from already available resources, research problem, objectives, scope of the research and at the end of the chapter, structure of the thesis is available.

The stock market is public place where issuing, buying, and selling of a fractional ownership in a company which is also known as stocks or equities of a company that trade according on a stock exchange. Buyers and Sellers are the main two stakeholders who function the stock market. If the stock market is functioning efficiently it will provide companies the capability to rapid entrance to the capital from the public (CHEN, 2021a).

A bull market is a market which is belief that an asset will rise in value and when it is bullish the conditions of the economy are generally believe as favorable. On the other hand, bear market is the exact opposite of the bull market where most stocks are declining in value so that bear market exists in an economy that is receding. When it is bearish many equities will drop their value and then the prices become volatile. Bear market believes as which could be more dangerous to invest in as the investors may withdraw their money from a bear market and wait till the market trend gets reverse, but it will further lower the prices. Bull and bear markets indicate how the investors' sensation about the market and the resulting economic trends as the financial markets are mainly influenced by investors' attitudes (MITCHELL, 2020). Most of the time after every bearish period, there's a bullish and vice versa, after every bullish period, there's a bearish period.

Most of the times variance of the stock market will depend on buyers and sellers as it is a place where they converge. Prices will increase when there are more buyers than the sellers and the price will decreases when there are more sellers than buyers. Buying and selling the stocks will depend on the emotions of the investors. Future is unpredictable and emotions of the investors are unpredictable. Hence, predicting the stock market is also not that easy as it depends on future and emotions of the investors. This research study was carried to find out whether it is possible to find a pattern on how bearish and bullish period has occurred after an event which related to the selected company by investigating the events and the stock price trends which happened past years.

This chapter provides an overview of the research project which includes the information related to the research problem and an indication for the work which will be carried out throughout the project to provide a solution for the problem. Furthermore, introduction chapter contains sub sections motivation, statement of the problem, research aims, objectives and scope. This chapter will be concluded with the structure of the thesis.

1.1   Motivation

Investors have the opportunity to gain a profit from the stocks which they have purchased from the publicly traded companies. Key method where investors could profit from purchasing stocks is by selling their stock for a higher price than the purchased price where they can profit if the stock price increases from their initial purchased price (CHEN, 2021a).

As an example, if an investor has bought 1000 stocks of a company at LKR 20 and the price of that stock subsequently rises to LKR 50, investor can profit on their investment by selling their shares at a higher price. But sometimes, investor could have a doubt on selling the stocks at a certain time. Because the price can be raised more higher and waiting to increase the price. Correspondingly the investor might be waiting to get the price to be increased but the price may decrease, and he/she could not gain the proper profit.

Sri Lanka Stock market has been entered as one of the main focuses for the economy in the country where the main stock exchange is happening daily on weekdays. The Colombo Stock Exchange (CSE) is responsible for the operation of the stock market in Sri Lanka, and it has 283 companies representing 20 GICS industry groups with a Market Capitalization of Rs. 3,178.80Bn as at 30th April 2021 (CSE, 2021). On 21st of January 2021, All Share Price Index (ASPI) of the Colombo Stock Exchange crossed the key psychological mark of 8,000 gaining 246.80 points to end the day on 8,131.25 points which was first time in history that ASPI has ended a trading day above 8,000 points (LBO, 2021). ASPI has increased 2091 points which in percentage 30.87% since the beginning of 2021 and the all-time highest ASPI value with 9425.62 was gained in September of 2021 (tradingeconomics, 2021). Further according to the information, it says that there were 17,000 new deposit accounts for CSE had been opened in 2020 after digitalization the new user creation for CSE due to the COVID pandemic. Hence, it could notice that more users have been moved into using Sri Lanka stock market since 2020 (economynext, 2021).

Figure 1 shows how ASPI has varied in Sri Lanka stock market since end of the year 2018.

Figure 1.   ASPI Variance SL stock market since end of year 2018
Source: CSE data from broker application

Figure 2 shows a panoramic illustration of the stocks with the turnover, changed percentage and the number trades happened on 10th of September 2021.
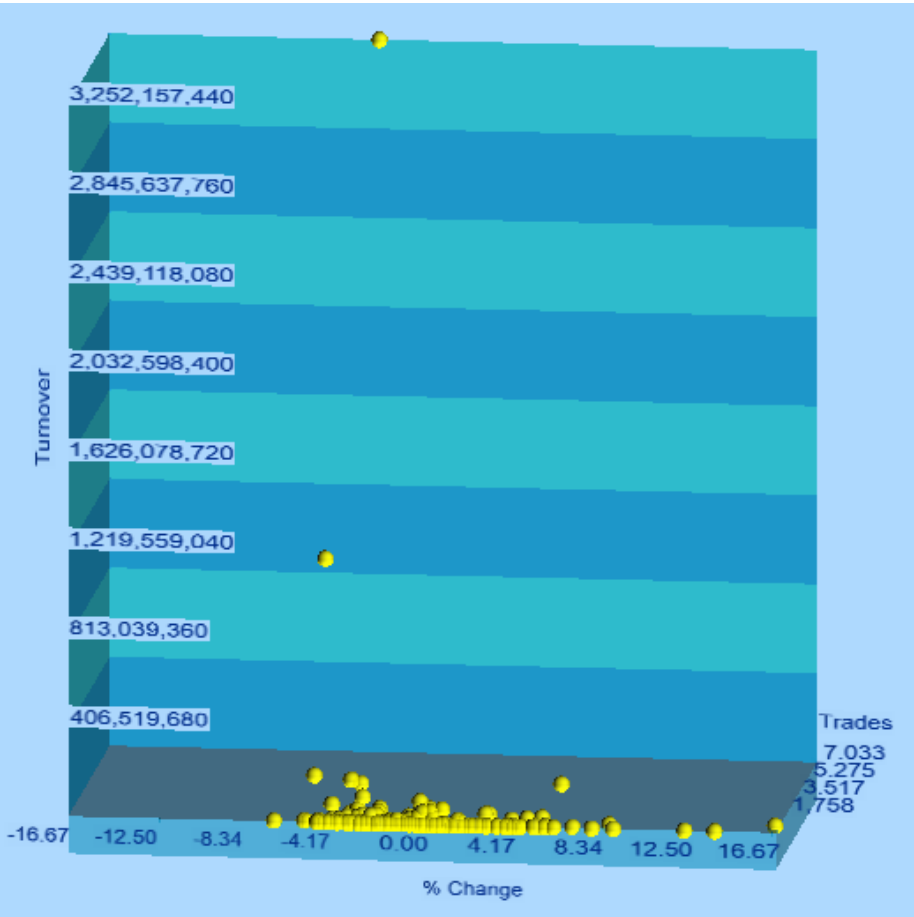
Figure 2.   Panoramic view of stocks in SL stock market
Source: CSE data from broker application

Nowadays people in Sri Lanka are more into stock market to invest their money on stock as it allows individuals to purchase stocks from the publicly companies and sell the shares they owned. Maximum profit can be achieved if an investor could buy the stocks from the bear market where the stock prices are in lower range compared to the stock prices and sell them when the market is bullish where the stock price is comparably higher.

Stock prices of a company reacts according to the new information announced by companies or any event which has an impact for the company happens in the country. It is harder to predict how the stock rates change time to time and it is certainly a challenge to predict the rates of the shares. In order to avoid investment risks, stock market predictions help the investors for their trading decisions. Factors which have an impact to the company affects for the stock prices so that price movements will be dependent on that. Specially, when a special event or an incident is happening or happened in the country or in the company, it will affect for the companies which depend or has an impact from the event. Hence, the stock rates will be changed accordingly. At times, it will affect for the stock rates drastically after a certain time. Events such as the latest COVID-19 pandemic situation are affecting majorly to the economy of the country. Elections, exchange rates changes, exports, bomb attacks, release of annual and interim reports of the company and government restrictions such as lock downs are several more events which could affect for the prices of the shares. Further company announcements such as release of annual reports, dividend announcements, etc. similarly affects for the stock prices. Events are specific for the companies as the dependency is differ from each company according to their business.

Every so often rates get decrease or increases for a certain period after an event. Usually, it happens after the reaction of the share prices which happened after receiving the new information about an event as investors pay attention to this information so that this will affect for the asset prices dynamically.

The period can be within a day, a week, a month similarly. If it is a bearish period of time, investors believes that it might be the lowest value of the stock at the time and they purchase the stocks. But essentially the value might further go down as the bearish period further continues. Besides, if it is a bullish period, rates get high and investors sell the stocks but if the bullish period further continues, the stock value will get higher. Investors miss the chance of getting the highest profit due to the uncertainty of the stock price movements. On the other hand, if investors could find the best period to buy the stocks before the stock goes bullish.

Figure 3 shows some of the changes happened drastically since 2019 for a selected company at CSE. If an investor could predict the bullish or the bearish trends for these occasions, the investor could have gained a proper profit by making correct decisions. If the investor couldn't predict the trends properly, losses or minimum profit could have happened.

Figure 3.　　　　　Illustration on a stock price variance
Source: CSE data from broker application

1.2　Statement of the problem

After an event or an incident occurred, at present there's no method to predict the bearish or bullish period so that investors couldn't gain a better or a maximum profit from the stock exchanges.

After or before an event, due to the non-existence of any technique to predict the bearish period which is the period of downward the stock price and bullish period, which is period of rising the stock price, investors could not get the opportunity to have the maximum profit from the stock exchange. If an investor has a doubt on the time for the stock trade where the investor doesn't know the best period to buy the stocks before the stock goes to bullish or if the investor doesn't know the best period to sell the stocks before the market goes to bearish, then the maximum profit or rather better profit could not be reached if the stocks are bought or sold within an incorrect timing.

Many research projects have examined on how to predict the bear and bull markets and there are less number of projects to even predict the stock performance of the market after an event occurred. There are various algorithms available in present business trading market which also used to build market indicators. Such as, Relative Strength Index (RSI) which is a Momentum Oscillator where it indicates when the market is overbought or oversold, Exponential Moving Average (EMA) which is a trend following indicator where it denotes the average price of a security over a certain period of time with a greater emphasis on latest prices.

Moving Average Convergence Divergence (MACD) is also a Momentum oscillator which can measures both momentum and the trend, Client Sentiment etc. (FERNANDO, 2021) These market indicators support traders to determine market direction by plotting on a chart. But, at present there are no any exact model or an indicator which could predict bearish and bullish periods after an event impacted.

1.3   Research Aims and Objectives

This section will provide information for the primary focus of the research project which has expressed in terms of the research aims and objectives.

1.3.1 Aim

It would help to achieve more profit for the investors if there's a way to predict the periods after a certain event where investors can purchase or sell the stocks. Therefore, to cater that problem, in this research project, it will be examined how the events or incidents impact on the market prices which outcome the bearish and bullish periods. According to that examined results, main goal is to predict the bearish and bullish periods after an event which impacts to the share prices and catch the attention of the investors.

1.3.2 Objectives

- Observe the events which could happened or impact for the company's stock prices annually.
  Selects list of events and then determine their sub events which could influence the stock price movements. Main event can have many sub events which could have an impact on the bearish and bullish periods.

As an example, Election is the main event and announcing election date, day before Election Day, day after Election Day can be taken as sub events. Reason for taking sub events or incidents of the main event is these incidents have major impacts on investors and the companies so that market prices will generally depend on that.

- Classify the selected events with the event occurred dates over the past years. Collecting a data set for the company which includes the required data over a selected period. Discover the major events and their sub events in the company stock data set which had impacted to the share prices in a way which result a bearish or a bullish period.

- Identify whether the stock price has increased or decreased after an event.

- Determine the period where the price was remained as increased or decreased. Identifying how the price has affected from the selected event. After that event impact can be determined, whether it is a bullish or a bearish movement.

- Period along with the impact type whether it is a bearish or a bullish impact will be given as the output once the event and sub event or any other required parameters provided as inputs to the system.

1.4   Scope

- In this project, technical analysis which is a method of analyzing and forecasting of future financial price movements by examining of historical price movements is used as the main stock analysis method.

- Research has carried out to the data for a selected company in Sri Lanka stock market with chosen events which had affected to the stock prices of the company during the past years.

- Historical data for the data mining are within past 10 years. Information of the events and their sub events happened in the country and the selected company are chosen by analyzing the dataset and the events.

- Prediction will be done only to a specific event with the required any other parameters.

- Events are selected and classified by analyzing the historical data.

- Predictions will provide the bearish and bullish periods for the company for a specific selected event along with any selected sub event if required.

1.5 Structure of the Thesis

There will be four main chapters further in this thesis where the next chapter is literature review which includes a background study on the topic referring by the published materials such as research papers, online articles, magazines, etc.

After the Literature review, next chapter will be the methodology which includes the aspects involving to the proof-of-concept specification along with the design of the proposed system. Next chapter will be the evaluation and results from the research project and the final chapter is the conclusion and future work where it summarizes the work and includes the discussions along with the findings, limitations, etc. for the research project.

CHAPTER 2
LITERATURE REVIEW

Chapter 1 described the overview of the research project including the problem statement, motivation, aims and objectives of the research further containing the scope and the structure of the thesis. This chapter gives a vital background study on the research project referring to published material in research papers, URLs, magazine articles related to the research area and similar where the chapter includes a critical review of similar or related research published in recent years and some of the examined methodologies associated to the research area.

2.1   A Literature Review

Numerous researches have been conducted on the impact of the announcements of new information or events on stock prices as well as the performance of overall stock market (Quaye et al., 2016). These researchers have identified the events or the factors which affect for the stock prices. An efficient stock market reacts to new information and to the dependent events. Investors are typically indeterminate about the timing, direction of the stock movements which has occurred due to the reaction thus the challenge for the investors (Schweitzer, 1989).
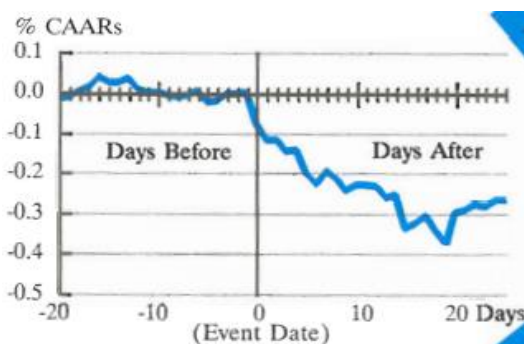
Figure 4.   Negative impact from an event
Source: (Schweitzer, 1989)
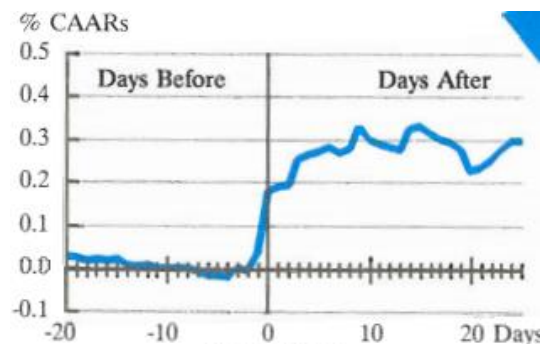
Figure 5.   Positive Impact from an event
Source: (Schweitzer, 1989)

Researcher Schweitzer has examined the impact of events on stock prices using Cumulative Average Abnormal Returns (CAARSs). Indicates whether the event has a positive effect or a negative effect on stock returns for one group of banks. Figure 4 and Figure 5 illustrates the two main price movements of a stock after an event. Research has described how stock behave and how quickly new information affects for the stock returns. Further has mentioned that the event study research might be useful to evaluate the impact on stock prices related to bank sector.

Instabilities can be happened in stock prices and market indices due to the reaction from the investors and stock market for the new information or events because investors as well as the stock market will react to new information or event thereby resulting in fluctuations in stock prices and stock market indices. According to a research study (Vincent and Bamiro, 2013), stock market is more efficient in assigning resources when stock prices reflect the information and the quicker the market engrosses the new information accurately.

Many factors have an inclination of affecting stock prices. Researchers Atiq and Taammia have categorized the factors which affect stock market as Computer fundamentals, technical or external factors and market sentiments. Researcher Al-Tammia has examined and categorized that performance of the company, change in the board of directors, appointments of new managements, dividends, earning, etc. are some of the fundamental factors of a company which might affect for the stock prices (HUSSEIN et al., 2011).

Factors which are recognized as technical factors or external factors are also identified as affecters for the stock prices and its movements (M. et al., 2010). Macroeconomic variables such as inflation, gross domestic product (GDP), foreign direct investment (FDI), money supply, consumer price index (CPI), exchange rate, interest rate, industrial output, and oil price have been identified as the factors which might include as technical factors.

Furthermore, according to the researcher (Agrawal et al., 2010), declarations or new information about enterprise performance, dividends, stock prices of other countries, gross domestic product, exchange rates, interest rates, current account, etc. have an influence on the stock prices (Y. Kurihara, 2006).

Additionally another scholar has mentioned that dividend per share (DPS) and earnings per share (EPS) that can be considered as the most important fundamental factors affecting stock prices (Zacks, 1979).
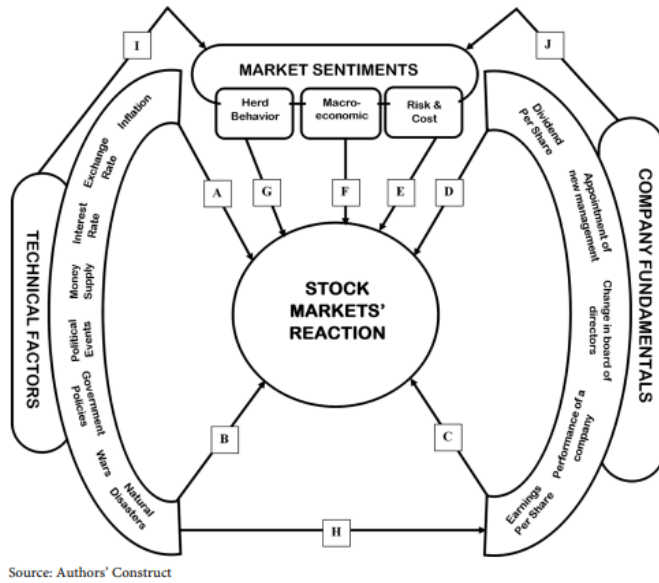
Figure 6.   Impact of factors on stock market reaction
Source: (Quaye et al., 2016)

In Figure 6, A and B represent the impact of technical factors on stock markets, C and D denote the influence of company fundamentals which are on stock markets, E, F and G represent herd behavior, macroeconomic and Risk & Cost, H denotes the interrelation among technical factors and company fundamentals, I denotes the interrelation among technical factors and market sentiments, J denotes the interrelationship between company fundamentals and market sentiments (Quaye et al., 2016).

Different factors will affect to the stock prices in different way according to the impact of the event. A research has conducted for Bangladesh data to study the impact of the export growth to stock market in a managed floating exchange rate regime and the results showed from the research analysis confirmed that the cumulative effect from the export growth is positive for the stock market after a certain period such as 3 months on an average (M. Hasanujzaman, 2016). Another researcher has investigated the relationship between imports, exports, dollar exposure with stock returns.

Study has identified that the companies where the stock performance are in export oriented tends to move against the dollar. Therefore, import and exports information are recognized as the information which can use to enhance the identification of the dollar risk exposure for different industries and how the expected stock return varies with the dollar risk exposure (CHAKRABORTY et al., 2008).

A research has carried out to find the Relationship between exchanges rate and stock process in South Asian countries by testing the two variables through co-integration and error correction models. Pakistan and India have identified as the countries which there is no any association between exchange rate and the stock prices (M. et al., 2010).

An association found between the variables in both short and long term for Sri Lanka so that investors can try to forecast the stock market on the basis of exchange rate for the future price movements (I. Z. I. U. C., 2019).

Scholar has identified that tourist arrivals are impacting on the share prices of hotel and travel companies. In order to identify the association between the share process and tourists' arrivals, Pearson Correlation has used, and the results has shown a significant high correlation between two variables. Regression model has used to examine the effects of independent variable on dependent variable and result shows a significant negative impact (A. A., 2017).

Another researcher has done a study on the impact of internal factors such as earning per share, dividend per share and return on equity (which has taken as the independent variables) on market share value (which has taken as the dependent variable) reference to the hotel industry in CSE. Regression analysis, descriptive analysis and correlation analysis tools and techniques have been used to evaluate data for 20 hotels considering with 5 years of annual reports. Results has shown that there's a positive correlation between the variables so that the listed internal factors have a significant positive influence on share prices (Dissanayake, 2017).

Another study on analyzing the holiday effect on large stock price changes where examining the effect of investors' positive pre-holiday sentiment on stock returns following large daily stock price variations. Study has initiated that immediately before public holidays both positive and negative stock price moves occurring which are followed by significant price implications on the next two trading days and over five- and twenty-day interims following the event. Further the magnitude of the drifts has increased over longer post event windows while large stock price changes taking place on regular days are followed by either non-significant or slightly significant price reversals (Kudryavtsev, 2019).

A researcher has done a study on the impact of Sri Lanka's stock market development on economic performance and identified a relationship between stock market performance and the Sri Lanka's economic growth.

Final result of the study has showed that stock market development has a positive effect on Gross domestic product (GDP) of Sri Lanka (Herath, 2020). Study which to impact of the Government budget announcement on the Colombo Stock Exchange has concluded that price indices will be increased by continuous imposition of taxes direct decrease in price indices and significant tax concessions and exemptions (Ranjani et al., 2009).

Researcher named Shohani has identified the main macroeconomic factors which have an influence on the performance of the stock market and the identified factors are Inflation rate, Exchange rate, Interest rates, Money supply, foreign direct investment, SMI (Stock Market Index), consumer Price Index (CPI). Table 1 shows the impact of the variables on stock market performance (Badullahewage, 2018).

Table 1.   Impact of macroeconomic variable on stock market performance 2009
Source: (Badullahewage, 2018)

Term	Coefficient	T value	Probability
A	-3.416	-2.43	0.033**
Log GDP	1.5196	2.41	0.035**
Log MS	-0.4788	-1.72	0.070
Log ER	1.9777 4.28 0.001*** Log BP 0.0768 1.9777 4.28 0.001*** Log BP 0.0768 1.9777 4.28 0.001*** Log BP 0.0768 1.9666	4.25	0.001***
Log BP	0.0768	0.53	0.490
Log IR	1.8059	2.24	0.045**

IR = Interest Rate, ER = Exchange Rate, I = Inflation, GDP = Gross Domestic Product and MS = Money Supply

Study reveals that there is a strong connection between the macroeconomic variables and the stock market. When these factors vary in time to time, performance of the Sri Lanka stock market also varies. As an example, if there is a rising movement in the factors like interest rate, exchange rate it has be likely to have a better performance of the CPI and ASPI. In order to have better performance in the market, the inflation rate should be as much minimum as possible according to the researcher (Erik Kole, 2011).

Table 1 summarize the some of the research studies which have done related to stock market behaviors and the factors which could affect for the market trends. Table 2 includes the researcher, year of the study, summary of the research and identified factors which impacts for the stock prices.

Table 2.   Researches and identified factors which impact on stock prices

Researcher	Year	Research about (summary)	Factors
Schweitzer	1989	Evaluate the impact positive effect or a negative effect on stock prices related to bank sector. How quickly new information affects for the stock returns.	New information
Vincent and Bamiro	2013	How stock prices reflect the information and the quicker the market engrosses the new information accurately.	New information
Atiq and Taammia	2011	Factors have an inclination of affecting stock prices	Computer fundamentals, technical or external factors and market sentiments Ex. performance of the company, change in the board of directors, appointments of new managements, dividends, earning
Agrawal	2010	Factors have an influence on the stock prices	Announcements or new information about enterprise performance, dividends, stock prices of other countries, gross domestic product, exchange rates, interest rates, current account.
Zacks	1979	DPS & EPS are the most important fundamental factors affecting stock prices	Dividend per share (DPS) and earnings per share (EPS)
Quaye, I., Y. Mu, Abudu, B., Agyare, R.	2016	Factors have an impact on the stock prices	Technical factors Company fundamentals Macroeconomic and Risk & Cost market sentiments
Chakraborty	2008	Relationship between imports, exports, dollar exposure with stock returns	Import and exports
A.A. Amarasinghe	2017	Impact of tourists' arrivals on hotel & travel sector stock prices	Tourist arrivals

There are three main types of stock market analysis namely fundamental analysis, technical analysis, and sentimental analysis. Fundamental analysis is a method of estimating the value of an asset and analyzing the factors that could affect the stock price in the future. Technical analysts evaluate the latest trading movements and trends to determine the next stock price. Sentimental analysis is used to measure the stock market in terms of the attitudes of investors of the company stocks.

The key focus in technical analysis is to discover the direction of an initiated movement and perform upon it in to maximize total profit. Technical analysts examine the historical data and use indicators to predict future movements of the stock price. These technical indicators are heuristic or pattern-based signals or mathematical calculations formed by the price, volume, or open interest of a security or contract used by traders who follow technical analysis. There are two main types of technical indicators, which are overlays and Oscillators. Overlays are the technical indicators that use the same scale as prices which are plotted over the top of the prices on a stock chart. Ex. Moving averages. On the other hand, Oscillators are the indicators that oscillate between a local minimum and maximum which are plotted above or below a price chart. Ex. include MACD or RSI (CHEN, 2021b).

Figure 7.   Example of MACD applied on a stock chart
Source: (FERNANDO, 2021)

Moving average convergence/divergence (MACD) has been identified as a one of the most effective and simple trends following momentum-based indicators. Figure 7 shows an example where MACD indicator applied on a stock graph (FERNANDO, 2021).

It is used to predict the strength, change, direction, momentum and duration of a stock's price trend and was specifically intended to discover variations in movements at a relatively early phase (fidelity, n.d.).

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2.2   Research Gap

There are many studies which are related to the stock market as it is challenging to find a prediction mechanism because market values won't exactly change on specific rates. Some world research has mentioned that stock market can be known as an artificial problem as it is unpredictable. Currently there are some researches to forecast the stock market, market indices, share price index, Bear Stock Market using Macroeconomic Variables etc. (Ilambarathy, 2020) - (R.M.K.T and S. D.M.K.N, 2019). There's a research where it has carried out find the effect of social and news media sentiments on financial markets. Research has been done to compare the performance of social media and news media in predicting the market in the Australian stock market. They have proposed an index namely the standardized bullishness index and that will calculated from below formula (T. Hu and A. Tripathi, 2016).

$$Bullishness_{i,t} = \frac{M_{i,t}^{Bullish} - M_{i,t}^{Bearish}}{M_{i,t}} * LN(1 + M_{i,t})$$

$M^{Bullish}_{I,t}$ has been introduced as the number of messages with "Bullish" sentiment, $M^{Bearish}_{I,t}$ has been introduced as the number of messages with "Bearish" sentiment and $Bullishness_{i,t}$ has the total number of relevant messages. They also has computed an agreement index $Agreement_i$, to measure the disagreement between the sentiments of messages (T. Hu and A. Tripathi, 2016).

$$Agreement_{i,t} = 1 - \sqrt{1 - \left(\frac{M_{i,t}^{Bullish} - M_{i,t}^{Bearish}}{M_{i,t}}\right)^2} \in [0,1]$$

Above research study demonstrates a significant effect of sentiments from media on market returns. They have found that sentiments from social media have a long-term and stronger influence on market returns than the sentiments from news media (T. Hu and A. Tripathi, 2016).

Even though above-mentioned project is somewhat similar to this proposed research project, above research won't do the prediction of the bearish and bullish period after an event happened or happening in the country which could affect for the stock rates.

Researchers Erik, Dick J.C. and Van Dijk (Erik Kole, 2011) has done a study on how to predict the bull and bear market on stock exchanges.

They have come up with identification rules which are mainly last observed extreme value was a peak with index value P max and the last observed extreme value was a trough with index value P min. Further comparison of the identification and predicting of bull and bear markets has done by four different methods. They have evaluated all methods for a weekly investment on an index in US market to determine the best method which works in an investment strategy. Results has shown that the identifications were essentially similar. Figure 8 shows the analytical accuracy of the different methods that were differentiate the bull and bear states (Erik Kole, 2011).

	LTC	LTL	PSC	PSL	RS2C	RS2L
bull correct	532	532	411	412	468	465
bull wrong	22	22	129	128	45	48
% bull correct	96.0%	96.0%	76.1%	76.3%	91.2%	90.6%
bear correct	167	159	168	149	218	204
bear wrong	62	70	75	94	52	66
% bear correct	72.9%	69.4%	69.1%	61.3%	80.7%	75.6%
total correct	699	691	579	561	686	669
total wrong	84	92	204	222	97	114
% correct	89.3%	88.3%	73.9%	71.6%	87.6%	85.4%
benchmark	70.8%	70.8%	69.0%	69.0%	65.5%	65.5%
improvement	18.5%	17.5%	5.0%	2.7%	22.1%	19.9%
Kuipers Score	69.0%	65.5%	45.2%	37.6%	72.0%	66.2%

Figure 8.   Analytical accuracy of methods
Source: (Erik Kole, 2011)

Currently no research works found in online available research documents which is related to predicting the bull or bear period according to an event. It is hard to find a mechanism which could predict the bearish and bullish period even for the main share market. Further below table shows some of the related researches compared with the main research functionalities carried out from this project. Most of them do not have mentioned mechanism or have done a study for on identifying the impact and the impact period for a specific event and predicting for future occasions.

Figure 9 shows a comparison between the investigated functionalities in some of the research studies which allied of finding bull and bear trends with the main functionalities which investigated in the research. Also Figure 9 includes researches, year of the research, research about and the status of the studies which investigated from this research.

Researcher	Year	Research	Identify Bull and Bear Markets	Predict Bull and Bear Markets	Identify impact and period for an event	Predicting impact for an event	Predicting impact period for an event
Erik, Dick J.C. , Van Dijk	2011	Done by four different methods and evaluated methods for a weekly investment on an index in US market to determine the best method which works in an investment strategy	✓	✓	✗	✗	✗
Henri Nyberg	2012	Predicting Bear and Bull Stock Markets with Dynamic Binary Time Series Models	✓	✓	✗	✗	✗
Xingyi Li	2020	Comprehensively examine how volatility forecast ability varies across bull and bear states of the stock market	✓	✓	✗	✗	✗
Ayman E. Khedr, S.E.Salama, Nagwa Yaseen	2017	Predicting Stock Market Behavior whether it is negative or positive using Data Mining Technique and News Sentiment Analysis	✗	✗	✗	✗	✗

Figure 9.　　　　Current studies and the status of the study of functionalities

Chapter 2 described the some of the currently available research findings and the studies from the related work. Next chapter, Chapter no. 3 will define and illustrates the methodology of the study which carried out from this research.

CHAPTER 3

METHODOLOGY

Previous chapter states a background study and the existing theories and researches carried out related to the research area. This chapter will give an outline of the how the research will carry out with the selected methodologies along with the reasons to be chosen the specific methods for the project so that it includes the information of the methodologies that were used for the data gathering, methods used to analyze the data, selection process of the applicable indicator to the project, how the dataset formed for the data mining process. Further in conclusion of the chapter, it includes the design architecture of the proposed system.

Considering the mentioned problem statement in Chapter 1, this project will be carried out to provide a mechanism to predict the bull or the bear period for an event by analyzing the past data. Project will be carried out to company in Sri Lanka Stock Market and the selected company is related to the hotel industry in Sri Lanka as hotel and tourism industry has a major impact to the economy of the country. According to the data provided by central bank of Sri Lanka, Sri Lanka's tourism revenue has reached 682 USD million in Dec 2020 and which is compared with 4 USD billion in the previous year. All time high revenue has been recorded from 1966 to 2021 is 4,381 USD million in Dec 2018 and the lowest is 1 USD million in Dec 1967.
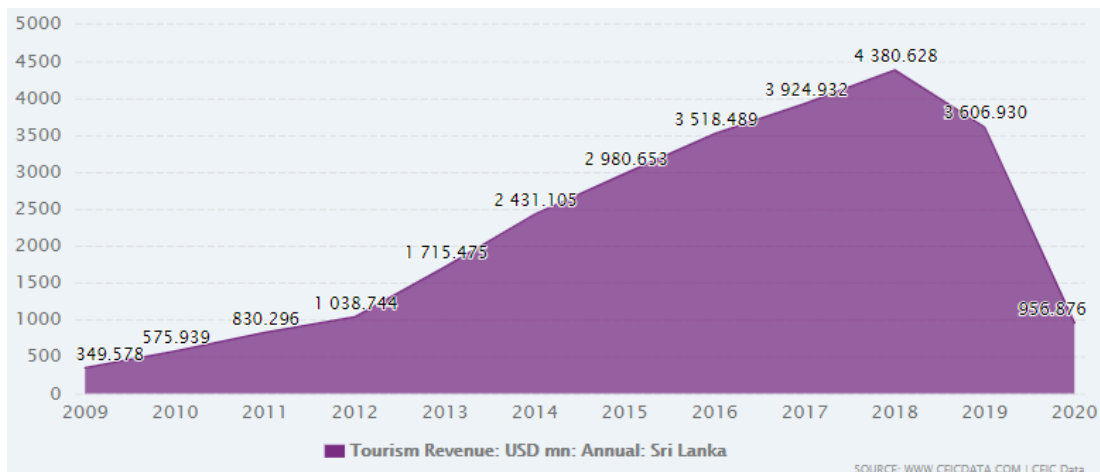
Figure 10.   Tourism Revenue in Sri Lanka annually
Source: https://www.ceicdata.com/en/indicator/sri-lanka/tourism-revenue

Selected company for the research is Galadari Hotels (Lanka) PLC - GHLL.N0000 which holds market capitalization of Rs. 3,906,470,599.20 in Sri Lanka stock exchange.

Figure 11 shows a detailed quote for the company.

GHLL.N0000'N (LKCSE) GALADARI HOTELS (LANKA) PLC			
WTD High	8.00	MTD High	8.00 (2021-05-07)
WTD Low	7.70 (2021-05-04)	MTD Low	7.50
WTD Trades	26	MTD Trades	135
WTD Turnover	1,590,582	MTD Turnover	284,113
WTD Volume	203,918	MTD Volume	80,264,405,030
52Wk. High	10.30	YTD High	10.30 (2021-01-25)
52Wk. Low	6.30	YTD Low	7.00 (2021-03-25)
52 Wk Trades	21,740	YTD Trades	1,795
52 Wk Turnover	246,523,680	YTD Turnover	23,887,954
52 Wk Volume	28,138,664	YTD Volume	2,618,987
Issued Qty	182,434,060	All Time High	12.00 (2016-10-24)
P-E Ratio	0.00	All Time Low	0.00
EPS	0.00	All Time Trades	0
Foreign Holdings	141,615,936.00	All Time Turnover	0
Par Value	10.00	All Time Volume	0

Figure 11.   Galadari Hotel Detailed Quote
Source: CSE data from broker application

Figure 12 shows how the daily share price of the company has been vary within 2 years.

Figure 12.   Galadari Hotel's Stock Price over last 2 years
Source: CSE data from broker application

Qualitative data set of the company is required for the project as the prediction is to find the impact of the event whether it is a bull or bear and then predict the period. Data set is a secondary data set which was collected from a one of the main active brokers connected within Colombo Stock Exchange and records are available within past 7 years. Default data set for a selected range will includes the values for the Date, Open amount, high and low amounts for the day, closed amount, volume, turnover, price change and price change in percentage as shown in Figure 13.

Date/Time	Open	High	Low	Close	Volume	Turnover	Change	% Change
25-05-2021	7.80	7.90	7.70	7.80	178,400	1,391,510.60	-0.10	-1.27
24-05-2021	7.80	8.00	7.70	7.90	25,518	199,070.90	0.20	2.60
21-05-2021	7.80	7.80	7.60	7.70	15,666	121,314.80	0.00	0.00
20-05-2021	7.80	7.80	7.70	7.70	111	855.70	0.00	0.00
19-05-2021	7.60	7.80	7.60	7.70	15,512	119,891.30	0.10	1.32
18-05-2021	7.80	7.80	7.60	7.60	5,325	40,595.00	-0.10	-1.30
17-05-2021	7.90	7.90	7.70	7.70	850	6,565.00	-0.10	-1.28
13-05-2021	7.50	7.80	7.50	7.80	300	2,300.00	0.30	4.00
12-05-2021	7.60	7.60	7.50	7.50	1,300	9,760.00	-0.10	-1.32
11-05-2021	7.60	8.00	7.60	7.60	19,133	145,450.80	0.00	0.00
10-05-2021	7.90	7.90	7.60	7.60	1,100	8,371.70	0.00	0.00

Figure 13.   GHLL.N0000'N Stock price related data
Source: CSE data from broker application

After analyzing the dataset, it was decided to apply one of the currently popular trading indicators for the data set to further proceed the research project using technical analysis. There are many trading indicators available in current industry as mentioned in chapter 2 but unavailability of an indicator which could directly show the bull or bear period status was route this project to find a way to obtain the movement status whether it is bull or bear for a selected day.

In order to obtain the mentioned scenario, an available trading indicator namely MACD (Moving average convergence/divergence) is selected to attain the momentum and the price trend. Reason for choosing MACD indicator is that it can cater the requirement to find the bullish and bearish period for a selected day in a better and efficient manner than other indicators. A financial analyst has mentioned that MACD is more of a leading indicator as it can be used to highlight possible overbought or oversold conditions (A. Thorp, 2000).

MACD has 2 lines, MACD Line and Signal line where MACD is calculated by subtracting 26-Period exponential moving average (EMA) from 12-Period EMA and signal Line is the moving average of the MACD Line. Further, there's a histogram basically plots the difference between the MACD Line and the Signal Line(fidelity, n.d.). Figure 14 illustrates MACD in more efficient manner.
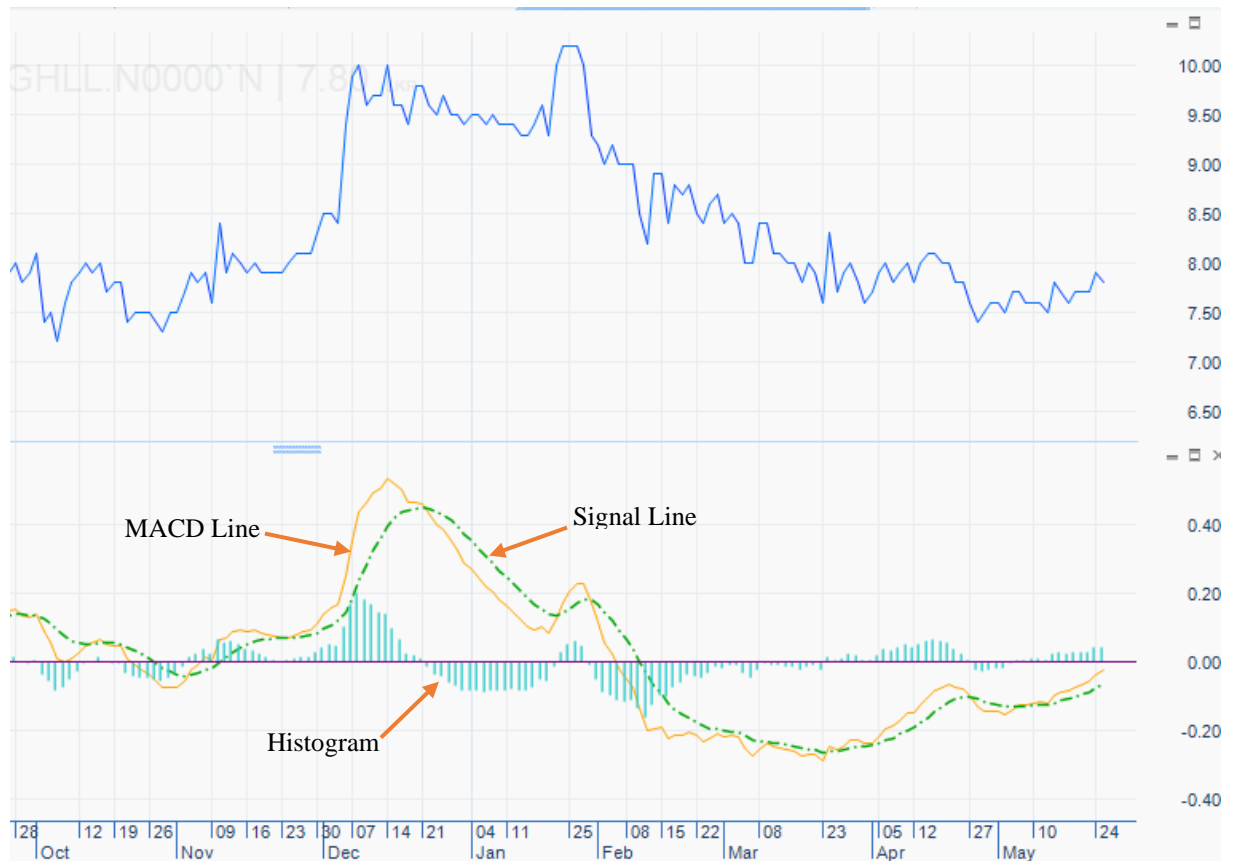
Figure 14.   MACD Illustration

MACD can be used to obtain the bullish, bearish status from the lines and its histogram ("How to Use the MACD Indicator," n.d.).

MACD indicate bullish when,

- MACD crossing above zero,
- MACD turns up from below zero,
- MACD line crosses from below to above the signal line.

MACD indicates bearish when,

- MACD crossing below zero,
- MACD turns down from above zero,
- MACD line crosses from above to below the signal line

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Further analyzing the MACD indicator by comparing it with an indicator named Relative Strength Index (RSI) which is also a popular indicator among traders to analyze the financial market. Usually, RSI indicates whether trend is bullish when it is surpasses the horizontal 30 level and it shows the bearish sign when RSI slides below the horizontal 70 level. Figure 15 illustrates when MACD and RSI indicators applied to the company data.
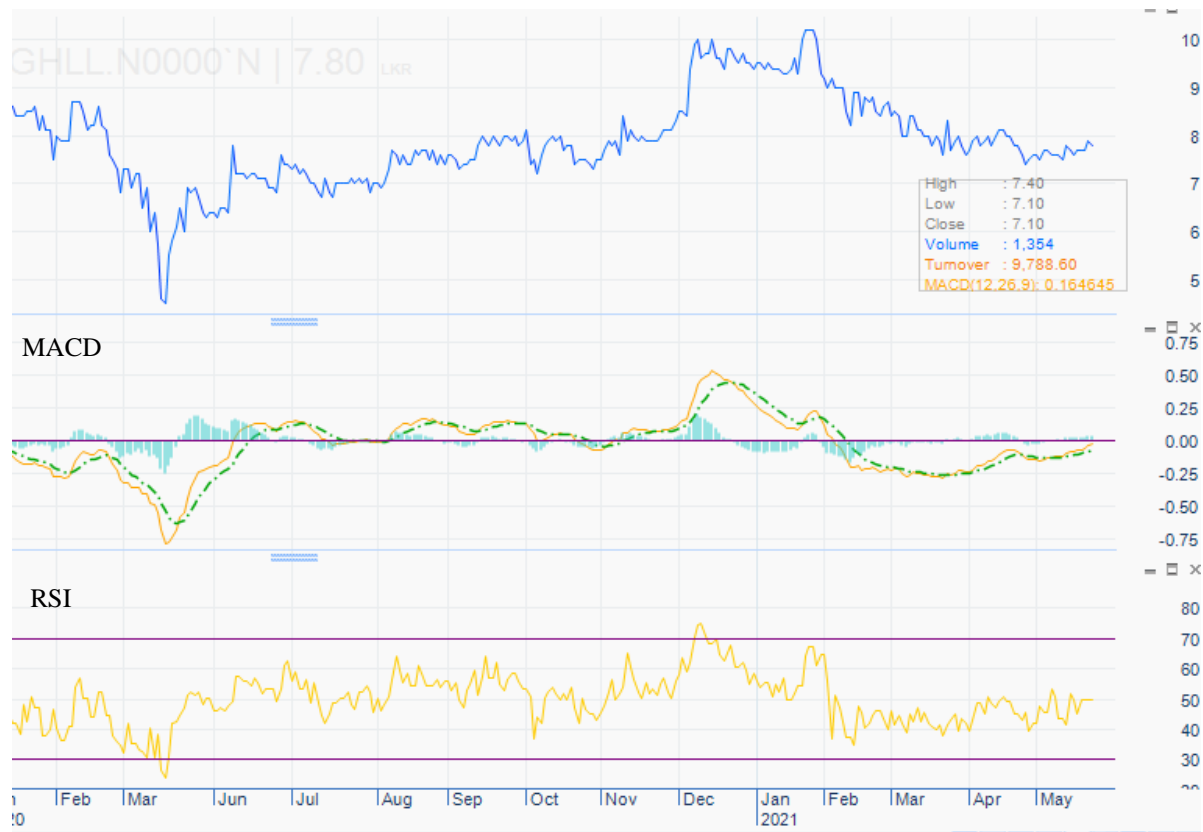
Figure 15.   MACD & RSI applied to company data

According to Figure 15 it illustrates that MACD provides more efficient when there's a requirement to identify the bullish or the bearish status for a selected day. Further there were few available libraries which will directly provide impact status whether it is a bullish, bearish, or neutral for a certain day but most of them were not open source. Furthermore, one available library which was an open-source product, it provides the status by considering the price values for a date but not considering the momentum for a certain period of dates.

Hence, due to above decided to use MACD values in this project as it will help to identify the bullish and bearish status according to the requirement of this project. Hence, the dataset for the project is obtained after applying the MACD indicator as shown in Figure 16 so that it includes more data with MACD value, moving average value of MACD and the value of the histogram.

date	open	high	low	close	volume	turnover	change	percentage	macd	moving_avg	macd_histogram
25-05-2021	7.80	7.90	7.70	7.80	178400.00	1391510.60	-0.10	-1.27	-0.03	-0.07	0.04
24-05-2021	7.80	8.00	7.70	7.90	25518.00	199070.90	0.20	2.60	-0.04	-0.08	0.04
21-05-2021	7.80	7.80	7.60	7.70	15666.00	121314.80	0.00	0.00	-0.06	-0.09	0.03
20-05-2021	7.80	7.80	7.70	7.70	111.00	855.70	0.00	0.00	-0.07	-0.09	0.03
19-05-2021	7.60	7.80	7.60	7.70	15512.00	119891.30	0.10	1.32	-0.07	-0.10	0.03
18-05-2021	7.80	7.80	7.60	7.60	5325.00	40595.00	-0.10	-1.30	-0.08	-0.11	0.02
17-05-2021	7.90	7.90	7.70	7.70	850.00	6565.00	-0.10	-1.28	-0.09	-0.11	0.03
13-05-2021	7.50	7.80	7.50	7.80	300.00	2300.00	0.30	4.00	-0.10	-0.12	0.02
12-05-2021	7.60	7.60	7.50	7.50	1300.00	9760.00	-0.10	-1.32	-0.12	-0.12	0.00
11-05-2021	7.60	8.00	7.60	7.60	19133.00	145450.80	0.00	0.00	-0.12	-0.13	0.01
10-05-2021	7.90	7.90	7.60	7.60	1100.00	8371.70	0.00	0.00	-0.12	-0.13	0.01

Figure 16.   Dataset with MACD related values

After integrating the initial dataset with MACD indicator values, data inserted into a SQL database for further continuation of the project.

Set of events which could affect for the stock movements for the related company are selected. Events such as releasing of Annual Reports, Releasing Interim reports, Budget report releases, announcing election dates were selected. Among them releasing of interim reports was selected as the event for this research study. Data was acquired from internet resources such as official Colombo stock exchange (CSE) website, Galadari hotel's official website etc.

After identifying the events and their dates, data transformation process needs to be carried out so that a new dataset will be created. Conditions are required to analyze the data to obtain the status of the movement and the period of days using initial dataset. Conditions written using C# programming language to identify the status of the movement whether it is a bearish, bullish or neutral using the MACD values and the values included in the initial dataset. Logic for the conditions was written by considering how MACD indicated bullish and bearish from the MACD value, moving average and MACD histogram value.

Transformed new data set includes an event id, date, movement status (bull, bear, neutral), movement start date, movement end date, number of days (period). As a result, this data set will include movement status with its period of days for many dates happened in past years for one

event. Event details will be saved separately in another table of the database to make the query performance better. Figure 17 shows the attributes which includes in the transformed new data set that used for the training and prediction of the data.

Year	Month	Date	Event Impact	Impact Start Date	Impact End Date	Impact Period	Price Changed
2015	2	12	Bullish	2/12/2015	3/1/2015	17	0.6
2015	5	05	Bullish	5/5/2015	5/25/2015	20	1.6
2015	8	06	Bullish	8/6/2015	8/11/2015	5	0.6
2015	11	12	Neutral	11/12/2015	11/11/2015	0	0
2016	2	29	Bullish	2/29/2016	3/8/2016	8	0.9
2016	5	16	Bullish	5/16/2016	5/26/2016	10	1.1
2016	8	12	Bullish	8/12/2016	8/24/2016	12	0.4
2016	11	11	Bearish	11/11/2016	11/29/2016	18	-1
2017	2	27	Bearish	2/27/2017	3/1/2017	2	-0.5
2017	5	15	Bearish	5/15/2017	5/21/2017	6	-0.4
2017	8	15	Neutral	8/15/2017	8/14/2017	0	0

Figure 17.　　　Transformed new data set

Finally, a data mining model will be applied to the above-mentioned new data set to predict the impact and its period. After applying the data set to different classifiers, classifier with better accuracy will be selected. Then supply the test data to predict the values from the trained model. Data mining model named Multilayer perceptron (MLP) was used to trained and predict the impact of the events. MLP is a class of artificial neural network which has three layers. Predicative model for one or more dependent variables can be produce by MLP and the dependent variable can be in types of ordinal, nominal, scale, etc. (ibm, 2016) Random Forrest was the data mining model which used to predict the event impact. It was the same process for both impact status and impact period. Finally, evaluation approach is done by comparing the predicted data with the actual values.

Predicted values will be stored in another database table. Final system will show the user the available events so that he could select one of the events as per the user's requirement. After that system will provide the predicted values for the impact and the period to the user. Figure 18 shows the general architecture of the proposed system.
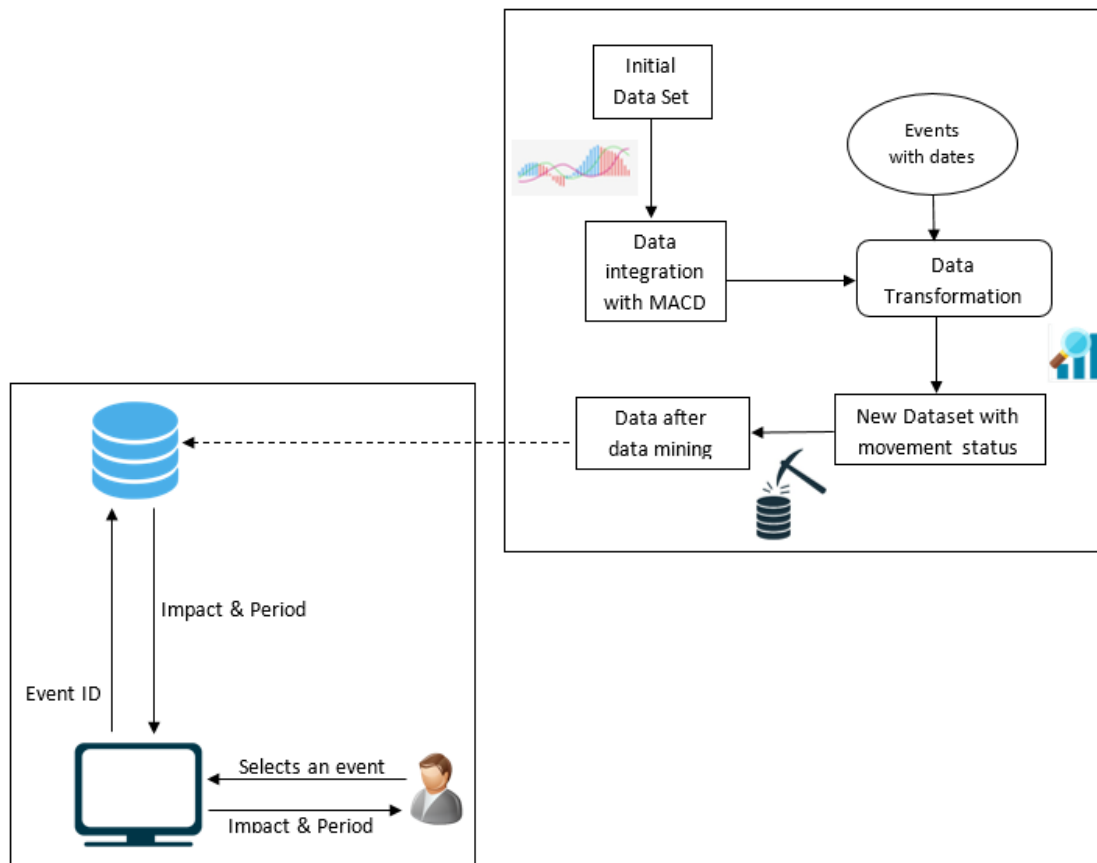
Figure 18.   General Design architecture of the proposed system

Above architecture illustrates the model of proposed system. Data which acquired after data mining process will be saved in a database and it will use for the system which interacts with the user's end. If this proposed system uses as an actual product, then the product owner has capability of feeding the database with latest relevant data or can add new events so that the updated data will be fetched for the user's end.

This chapter described how the research project is carried out from the initial step of data gathering to the proposed system by explaining the selected methodologies along with the reasons to choose the specific methods. Next chapter will describe the evaluation and results of the research study.

CHAPTER 4

EVALUATION AND RESULTS

This chapter will present the findings and the evaluation of the research which will include evaluation protocol, designed experiments, results obtained and a critical evaluation of the research work.

Output of the final product is a web application which can be accessed through a browser. As shown in Figure 19, main page of the application will show the graph of the stock prices variation of past years.
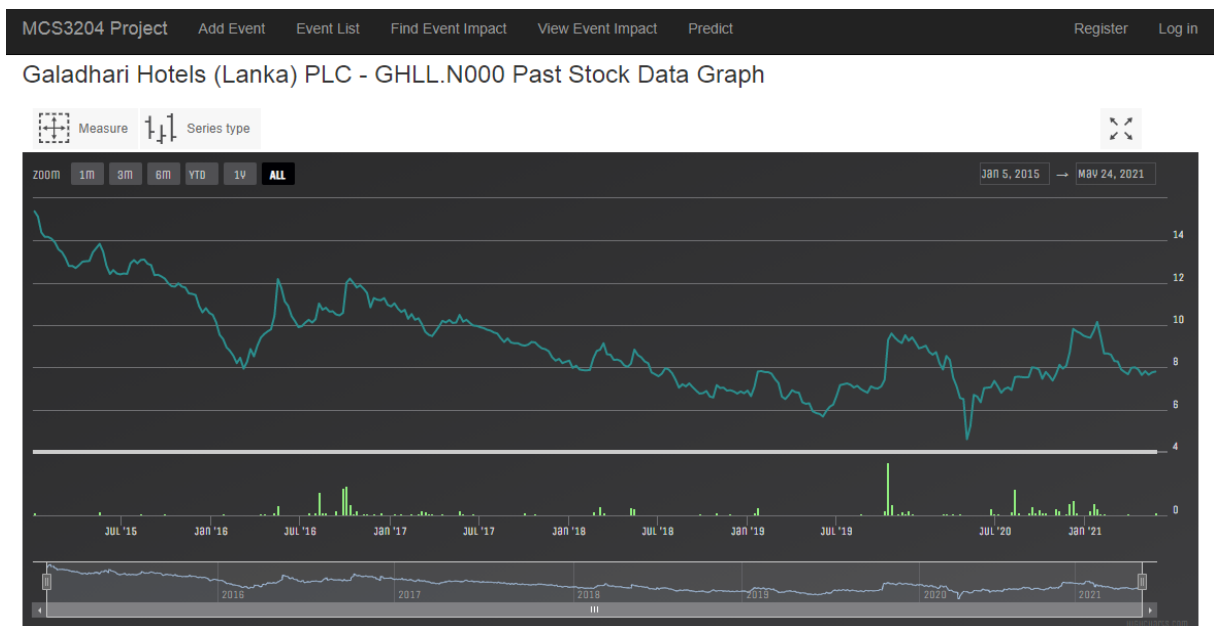
Figure 19.   Final Application - Web App
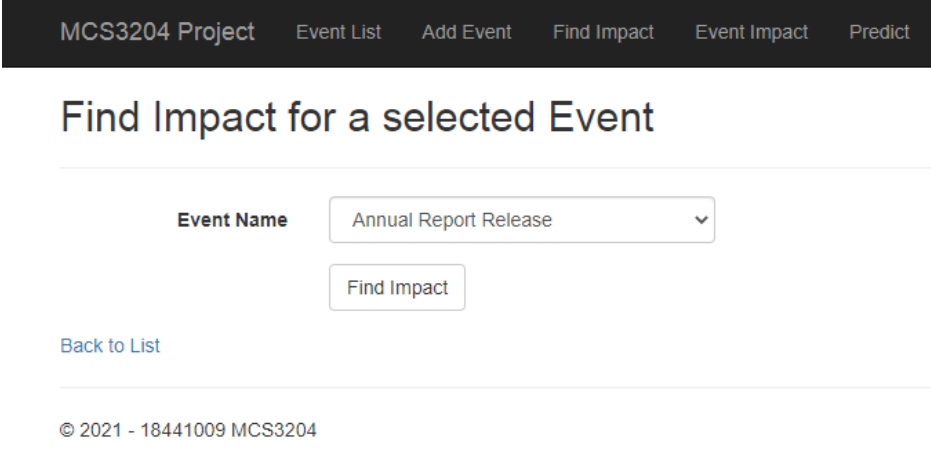
Application facilitates the user to enter events for a particular date which will store in a database to use the inputted event data for the future predictions when required. User can view the already inserted events with the dates from the application. It was design as above by considering an administrative perspective who will feed the event data to a data source.

Figure 20.   UI of Adding New event information

Below are the main functions of the project where the research study was carried out.

- Finding impact status and impact period for past dates.

Since the research is carried out to predict the impact status and the impact period after an event, it is required to obtain the impact and the period for the past dates as the prediction is done by analyzing the past data for an event. MACD values was used to obtain the impact status and the period for the past dates and the logic was written by considering the conditions mentioned in Chapter 3. Written logic will be executed once the user selects an event to find the impact for past dates. It can be used as an admin perspective as well as a user perspective because information from past dates will be useful for an investor to proceed with stock trading. Figure 21 shows the user interface of the web application to find the impact and the impact period for an event for past dates.

Figure 21.   User interface of finding impact for past dates

Once user selects 'Find Impact' button, results from the written logic will shows in the user interface in Figure 22 which has the calculated event impact, impact period in no of days and the changed price during that period. Price changed value was acquired from the past data as it would be helpful for an investor to get an idea on the stock price during the period.

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Figure 22. Results after obtaining impact and period for past data

Further to facilitate a better illustration, charts were designed to view the data in graph mode. A pie chart for the impact states and a column chart for the impact periods for past dates.

Figure 23 shows the pie chart which was generated by passing the calculated data about the impact statuses from past dates for a selected event, releasing Interim Financial Statement.
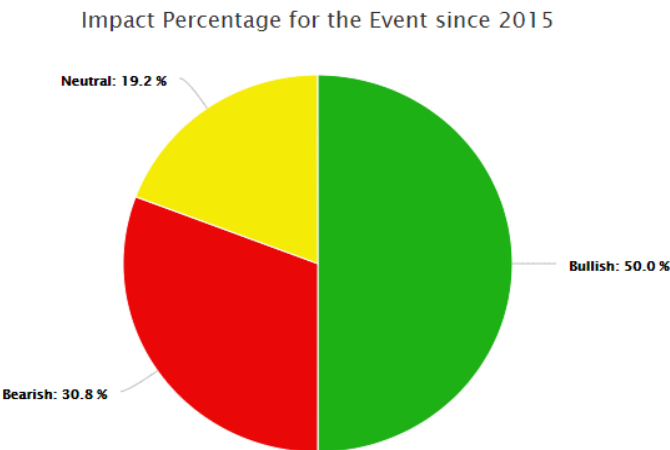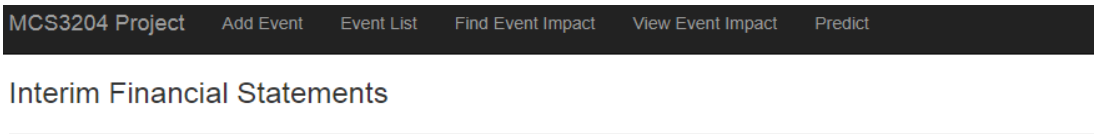
Figure 23.   Pie chart with the probability of the Impact status for the event from past data

User can get another idea on the impact status using the probabilities. But it might not be always valid to decide the impact from an event by using probability created from past dates. Because there can be aspects which could affect for the impact.

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As an example, according to below data, impact from releasing financial statement has 50% of bullish impact. But we cannot exactly say that the next release would also give a bullish impact because if the report shows a loss to the company and it could give a negative feeling for the investors. Investors' emotions majorly affect for the stock prices so that buyers will reduce, and sellers will increase then it may result a bearish trend.

Figure 24 shows the column chart which was designed to illustrate the impact period respective to the impact status for the selected event. Green columns show the impacts with bullish status, Red columns illustrate the impact of Bearish and the empty spaces without a column are for the neutral impacts.
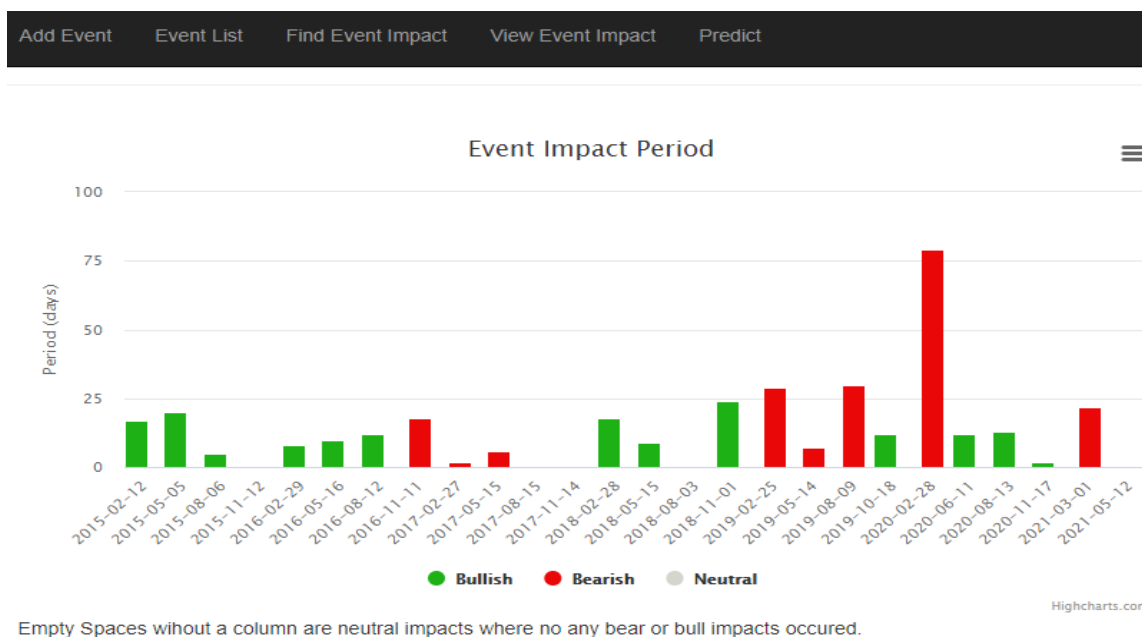
Figure 24.   Column Chart with the Impact periods for event with the status

According to above data, 50% of event dates have been in bullish state. But after the year 2019 it seems that the bearish trends were there more than compared to past years. When looking at the data, it is hard and challenging to determine what would be the next trend which could be happened when releasing the next interim report.

After applying the above logical conditions for past data, values were obtained to use for the prediction of the impact and the impact period for a future event.

In order to predict the data, past data set with impact status and impact period needs to be trained using a data mining classifier. Furthermore, the evaluation approach carried out was using experiment based.

- Predicting impact status for a future event

  Attributes selected for the training set: Event date, month, and impact status (class attribute).

Weka data mining tool was used to apply the classifications. Classifiers from the tool will connect with the application. Figure 25 shows the attributes used as the training set for the prediction of the impact status.
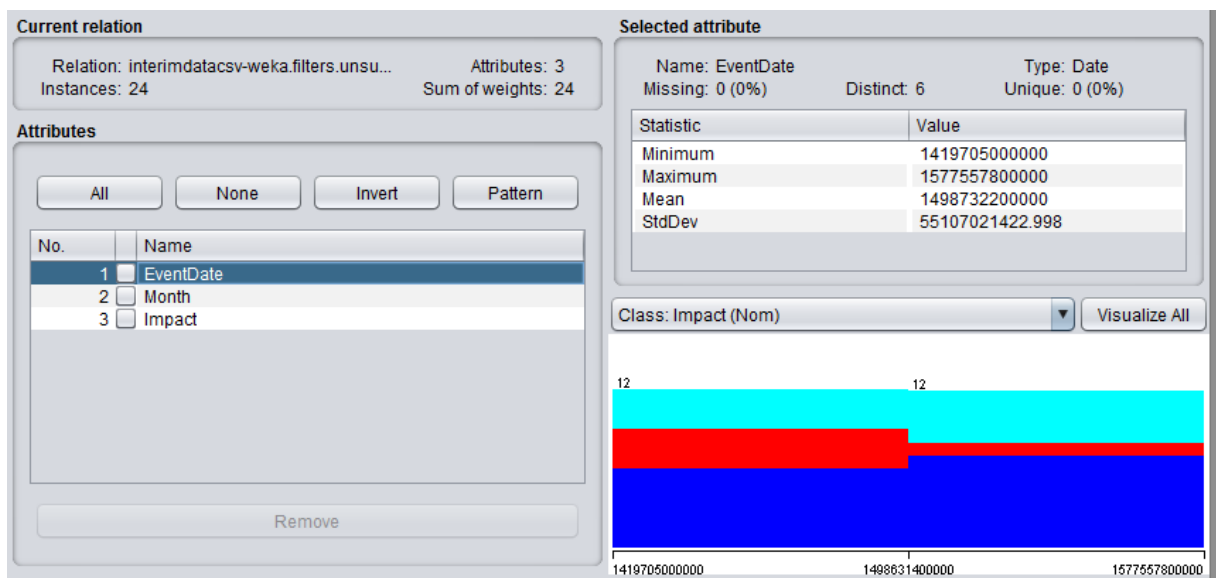
Figure 25.   Attributes for training set for impact status

Trained the data set using different classifies to investigate which classifier results the better accurate results. Figure 26 shows the accuracy from the classier named logistic regression which gave accuracy around 54%. Logistic Regression is one of machine leaning algorithms which used for classification problems. It can be used to predict categorical dependent variables such as binary, nominal, or ordinal etc. using a specified set of independent variables (javatpoint, 2011). Figure 26 shows the evaluation on training set for the classifier logistic regression

```
=== Evaluation on training set ===

Time taken to test model on training data: 0.02 seconds

=== Summary ===

Correctly Classified Instances          13               54.1667 %
Incorrectly Classified Instances        11               45.8333 %
Kappa statistic                          0.1927
Mean absolute error                      0.3039
Root mean squared error                  0.3869
Relative absolute error                 75.7484 %
Root relative squared error             86.9127 %
Total Number of Instances               24
```

Figure 26.   Evaluation on training set for classifier Logistic Regression

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Figure 27 shows how the predictions have been resulted for the logistic regression.

```
=== Predictions on training set ===

    inst#     actual  predicted error prediction
        1  1:Bullish  1:Bullish         0.785
        2  1:Bullish  1:Bullish         0.817
        3  1:Bullish  2:Neutral     +   0.499
        4  2:Neutral  2:Neutral         0.571
        5  1:Bullish  1:Bullish         0.686
        6  1:Bullish  1:Bullish         0.727
        7  1:Bullish  1:Bullish         0.508
        8  3:Bearish  2:Neutral     +   0.502
        9  3:Bearish  1:Bullish     +   0.563
       10  3:Bearish  1:Bullish     +   0.612
       11  2:Neutral  1:Bullish     +   0.533
       12  2:Neutral  1:Bullish     +   0.437
       13  1:Bullish  3:Bearish     +   0.565
       14  1:Bullish  3:Bearish     +   0.515
       15  2:Neutral  1:Bullish     +   0.535
       16  1:Bullish  1:Bullish         0.43
       17  3:Bearish  3:Bearish         0.685
       18  3:Bearish  3:Bearish         0.64
       19  3:Bearish  1:Bullish     +   0.507
       20  1:Bullish  1:Bullish         1
       21  3:Bearish  3:Bearish         0.784
       22  1:Bullish  1:Bullish         1
       23  1:Bullish  1:Bullish         0.448
       24  1:Bullish  3:Bearish     +   0.501
```

Figure 27.   Prediction Result from the classifier Logistics Regression

Figure 28 shows the results for a sample test set using logistic regression. Actual values for the three rows are Bearish, Bearish and Neutral.

```
=== Predictions on user test set ===

    inst#     actual  predicted error predictio
        1       1:?   1:Bullish         0.937
        2       1:?   1:Bullish         0.55
        3       1:?   1:Bullish         0.537
```

Figure 28.   Sample Prediction Results from Classifier Logistic Regression

Since above classier didn't provide a better accuracy on the predictions, another classifier was evaluated with the same data sets.

Classifier named 'Multilayer perceptron' (MLP) was evaluated. It was evaluated using the training set and Figure 29 shows the accuracy for the training data set from the classifier.

It is a class of artificial neural network which has three layers namely: an input layer, hidden layer, and an output layer. Predicative model for one or more dependent variables can be produce by MLP and the dependent variable can be in types of ordinal, nominal, scale, etc. (ibm, 2016) Further reference studies says that multilayer perceptron are useful for classifying data sets that are linearly separable (deepai, 2020).

As shown in Figure 29, after evaluating the data on the training set, classifier gave around 95% of accurate results which was much better than logistic regression classifier.

```
=== Summary ===

Correctly Classified Instances          23                95.8333 %
Incorrectly Classified Instances         1                 4.1667 %
Kappa statistic                          0.9304
Mean absolute error                      0.1155
Root mean squared error                  0.1769
Relative absolute error                 28.7776 %
Root relative squared error             39.7379 %
Total Number of Instances               24
```
Figure 29.   Accuracy results of MLP on training data set

24 of instances are from the data which acquired years 2015 to 2020. There will be four interim reports release per year so that 6 years into 4 releases will be equal to 24 releases for the years. Test data was carried out for the interim report releases on year 2021.

Table 3 shows the predicted and actual values from the classifier for the training data set acquired from an example event.

Table 3.　　　　　Predicted and Actual values with the error status

Actual	Predicted	Error
Bullish	Bullish	0
Bullish	Bullish	0
Bullish	Bullish	0
Neutral	Neutral	0
Bullish	Bullish	0
Bullish	Bullish	0
Bullish	Bullish	0
Bearish	Neutral	1
Bearish	Bearish	0
Bearish	Bearish	0
Neutral	Neutral	0
Neutral	Neutral	0
Bullish	Bullish	0
Bullish	Bullish	0
Neutral	Neutral	0
Bullish	Bullish	0
Bearish	Bearish	0
Bearish	Bearish	0
Bearish	Bearish	0
Bullish	Bullish	0
Bearish	Bearish	0
Bullish	Bullish	0
Bullish	Bullish	0
Bullish	Bullish	0

Figure 30 shows an example predicted results on the test set which are for 3 instances of releasing interim reports for year 2021 from the classifier Multilayer perceptron.

```
inst#     actual  predicted error prediction
    1       1:?   2:Neutral      0.6
    2       1:?   1:Bullish      0.526
    3       1:?   2:Neutral      0.839
```

Figure 30.　　　　Predicted Results for impact status on TEST data set

Above classifiers executed for different event datasets and it was decided to use the model from the classifier Multilayer Perceptron to predict the impact status for the events as it gave a better accuracy on the training sets.

- Predicting impact period for a future event

    Attributes used: Event Date, month, impact, and impact period (class attribute)

As used in prediction for the impact status, attributes were selected and preprocessed for the training set to use for the prediction of the impact period. Impact status which was predicted before for the event will be used for the test set to predict the impact period.

Figure 31 shows the attributes used to train the data set for the prediction of the impact period.
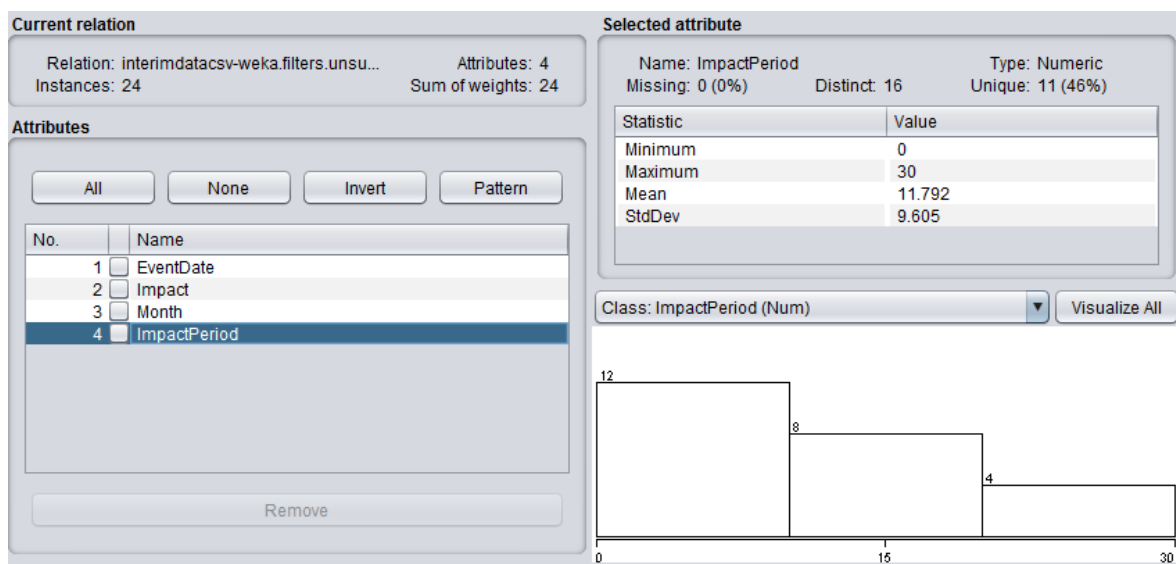
Figure 31.   Attributed Selected for train data set for predict Impact status

Same as training the data for impact status, classifiers used for the training set of the impact period as well. Then obtained the accuracy results and selected the classifier with most accurate results. Figure 32 shows the summary of the evaluation on the training set which gave the most accurate results with compared to other classifiers. Name of the classifier is 'Random Forrest'.

```
=== Evaluation on training set ===

Time taken to test model on training data: 0.01 seconds

=== Summary ===

Correlation coefficient                   0.9409
Mean absolute error                       3.6742
Root mean squared error                   6.4431
Relative absolute error                  35.5475 %
Root relative squared error              40.5814 %
Total Number of Instances                25
```

Figure 32.   Training Accuracy for classifier Random Forrest for Impact Period

According to the results, classifier named Random Forrest generated somewhat better accurate results.

Table 4 shows the actual and predicted values for the training data set.

Table 4.   Actual and Predicted value comparison with the error value

Actual (Days)	Predicted	Rounded Value (Days)	Difference (Error)
17	15.658	16	1
20	15.319	15	5
5	9.43	9	4
0	1.509	1	1
8	11.225	11	3
10	10.936	11	1
12	10.668	11	1
18	16.692	17	1
2	11.21	11	9
6	6.216	6	0
0	0.512	1	1
0	1	1	1
18	16.275	16	2
9	11.151	11	2
0	2.34	2	2
24	17.5	18	6
29	29.25	29	0
7	6.902	7	0
30	23.88	24	6

Figure 33 shows an example predicted data for an event by using the classifier Random Forrest. Results will be rounded as the tool won't facilitate rounding options for a predicting of numerical values.

```
=== Predictions on user test set ===

    inst#      actual  predicted       error
       1          ?     13.904            ?
```

Figure 33.   Predicted impact period value for a test set

After selecting a classifier model for the predictions by first evaluating the classifier models accuracy on training sets, test sets were re-evaluated with the selected classifiers.

Then the compared the predicted values with the actual values to evaluate the predicted results. Table 5 shows the evaluated values for two events for impact status.

Table 5.   Results of Impact predictions for selected events

Event	Event Date	Predicted	Actual	Error
Interim Financial Statement	**2021/03/01**	Neutral	Bearish	1
Interim Financial Statement	**2021/05/12**	Bullish	Bearish	1
Interim Financial Statement	**2021/08/13**	Neutral	Neutral	0
Annual Report Release	**2021/07/20**	Bullish	Bullish	0

Model was executed for selected two events and total of four dates.

Number of coorectly predicted occassions = 2/4

Number of inccorectly predicted ocassions = 2/4

Accuaracy rate of prediction in event impact state = 2/4 * 100 = 50%

Error rate of prediction in event impact state = 2/4 * 100 = 50%

Hence, the results shows that there's a chance of 50% in both correctly and incorrectly predictions could be happened out of four ocassions.

After predicting the impact status, next step is it predict the impact period. Prediction for the impact period needs the impact status so that predicted impact status was also used to predict the period. If the impact status was predicted as 'Neutral', then the period will be 0. Impact period will be calculated since the date which the event happened, and it will move further until the status get neutral. Somehow the neutral status denotes that, event hasn't impacted for the stock price so that bullish period or a bearish period haven't happened since the event date.

Therefore, when the model for predicting the impact status predicts the status as 'Neutral' for any event date, system won't pass that date to predict the impact period as the impact period will be 0.

Table 6 has the results of predicting impact period for two days of two events. Model will predict the value until two decimal points. Since days cannot be in decimal values, predicted value is rounded.

Table 6.   Results of predicting impact period

Event	Event Date	Predicted	Actual	Error (No. of Days
Interim Financial Statement	**2021/05/12**	13	11	2
Annual Report Release	**2021/07/20**	18	6	12

Number of exact coorectly predicted occassions = 0/2

Number of exact inccorectly predicted ocassions = 2/2

Accuaracy rate of prediction in impact period for same as actual = 0%

Error rate of prediction in impact period for same as actual = 2/2 * 100 = 100%

But user could get an idea if the model could predict the data to somewhat near to the actual value. Hence, the error rate calculated as below.

Mean absolute error = (absolute value (prediction – actual value))/ number of instances

= (2 + 12)/ 2

MAE = 7 days

Root Mean Squared Error (RMSE) = Sqrt (Avg (Power (Actual - Predicted)))

= Sqrt (avg (power (2) + power (12)))

= Sqrt (avg (4+144))

= Sqrt (148/2)

= Sqrt (74)

= RMSE = 8.6

According to the results, there can be an error with 7 days from the prediction and the results present that predicting the exact period is more challenging and difficult.

This chapter presented the evaluation and the results of the research study with including how the results were obtained, what were the outcome, evaluation of the results and the designs of the product as well. Next chapter will be the final chapter of the document which present the conclusion with the limitations of this research study and the future works which could continue related to the topic.

CHAPTER 5

CONCLUSION AND FUTURE WORK

This chapter summarizes the work, discusses its findings and contributions, points out limitations of the current work, and outlines directions for a future research.

Nowadays, stock market is a trending platform for people as many people are interest in investing their money on company equities. Every single investor's hope is to obtain a good income by earning a maximum profit from the invested money on the equities. Predicting stock price movements has a great attention as successful prediction could lead to an attractive profit for the investors by taking an accurate decision on the trading. But it is a challenge on deciding on how the stock prices will move in each and every day. Success rate of a stock trade has said to be as 20% for investment professionals. Moreover, traders could be successful using a specific strategy some of the time but also could be fail under the same approach due to different market conditions.

Any event, incident or an information which has an impact for a particular company will affect for the momentum of the stock prices. Because an event could have an impact for the company's future revenue or the company's revenue will reflect from an event or sometimes nothing could affect for the stock prices from the event. If an investor could know what the impact status and impact period after an event has happened, a better profit can be gained by trading from the stocks. This research was carried by considering the mentioned statement. Unavailability of a mechanism on predicting the impact status and impact period in current industry, it was lead for this study to find a way find a way to predict the impact status and the impact period after an event. There are researches which has carried out related to identifying bull and bear markets, but which haven't had a mechanism or a study on identifying nor predicting impact and impact period after an event occurred.

Some events which have an impact for the price of a company stock could be happened more than once. Hence the event could have an impact for the bearish and bullish period trends. This study was carried out on finding impact of such events which could happen more than once for the bearish and bullish period, and then predicting the impact for a future occasion alone with the impact period for the event. Impact of an event on the trend was identified using MACD values as it is a momentum indicator, and it was possible to identify the bearish and bullish trends for a selected past date from the MACD values.

After identifying the impact trend for the selected events for past dates, it could notice that it was not the same impact trend whether it is a bullish or a bearish period happened for every date. Hence, it was required to predict the impact status for a future date for the same event as identified data from the past years could not directly recognize the impact status for the event. Classifiers was tested using the training data sets and the classifier with most accuracy prediction was selected to predict the test data set. Same as for the impact status, same process was conducted to select a better classifier to predict the impact period. Evaluation for the research was carried out by testing the using the identified models and comparing the predicted results with the actual values. Results shows that some predicted data was similar, some are a likely similar and some are not even matching with the actual values. Thus, the conclusion was that it was tough to find a better method to predict the impact and impact period affected from an event related to the stock market.

However, predicting the trends in stock market is challenging as it depends on the future situations and it is inherently unpredictable. Further there could be some other events which could impact for the stock price on the same day. As an example, let's say there are two events e1 and e2 happened on the same day and e1 has a negative impact while e2 has a positive impact on the stock prices. Bearish and bullish state will depend on how sentiments of the investors affected from both events. If the positively impacted event had a high sentiment impact for the investors, then the stock price might go up and there could be bullish period occurred from the day. Likewise, if the negatively impacted event had a high sentiment impact on the investors than the positively impacted event then the stock prices might go down and a bearish period could be occurred. Because emotions of the investors have a major impact for the stock prices to be varied. Emotions are unpredictable so that momentum of the stock prices are also not easy to predict as it depends on the investors' emotions. Consequently, it is hard and challenging on predicting the stock trends for an event as the sentiments of the investors could also depend on other the factors/events which could occur on the same event day. Similarly, according to the predicted data from this study also shows that sometimes the predictions could be correct and sometimes it could be wrong.

5.1 Limitations in this Research Study

- Research was carried out only to a one company at CSE. All the study was conducted on the data related to Galadari Hotels.

- System perspective: used C# version is platform dependent as it is required windows platforms to be run. But the modern C# and .NET have been developed to run in many platforms.
- In this research study did not consider the positivity status from the main event.
- Did not consider the sub events which could happened alone with the main event.

5.2   Future Work

As an outline for a future research study, consider the positivity status from an event along with the identifying the impact status from past data. There can be a negative or positive from a particular event. As an example, main event Release of Annual report. If the report shows a loss, then the positivity status is FALSE as it shows negative impact for the company. If report shows a profit report then there's a positivity from the event to the company so that it could be considered as the positivity status as TRUE. If could further narrow down the events with this positivity status, there can be another study carried out as positivity status can be obtained for any events which affects for the company. Then further compare the positivity status with the impact status. As per the general theorem when the positivity status is a negative one, it would be a negative impact for the company so that a bearish period could be occurred. Similarly, if the positivity status is a positive one from an event, then it would be positive impact for the company and stock prices could be rise so that a bullish period could be happened. Compare the past data with the positivity status and the impact status. If could identify a pattern, it can be used to investigate on the success rate for predicting the data for a future event.

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APPENDICES

APPENDIX A – DATA SETS

- Initial data set acquired from the stockbroker. Data from 2015 to current.

date	open	high	low	close	volume	turnover	change	percentage	macd	moving_avg	macd_histogram
25-05-2021	7.80	7.90	7.70	7.80	178400.00	1391510.60	-0.10	-1.27	-0.03	-0.07	0.04
24-05-2021	7.80	8.00	7.70	7.90	25518.00	199070.90	0.20	2.60	-0.04	-0.08	0.04
21-05-2021	7.80	7.80	7.60	7.70	15666.00	121314.80	0.00	0.00	-0.06	-0.09	0.03
20-05-2021	7.80	7.80	7.70	7.70	111.00	855.70	0.00	0.00	-0.07	-0.09	0.03
19-05-2021	7.60	7.80	7.60	7.70	15512.00	119891.30	0.10	1.32	-0.07	-0.10	0.03
18-05-2021	7.80	7.80	7.60	7.60	5325.00	40595.00	-0.10	-1.30	-0.08	-0.11	0.02
17-05-2021	7.90	7.90	7.70	7.70	850.00	6565.00	-0.10	-1.28	-0.09	-0.11	0.03
13-05-2021	7.50	7.80	7.50	7.80	300.00	2300.00	0.30	4.00	-0.10	-0.12	0.02
12-05-2021	7.60	7.60	7.50	7.50	1300.00	9760.00	-0.10	-1.32	-0.12	-0.12	0.00
11-05-2021	7.60	8.00	7.60	7.60	19133.00	145450.80	0.00	0.00	-0.12	-0.13	0.01
10-05-2021	7.90	7.90	7.60	7.60	1100.00	8371.70	0.00	0.00	-0.12	-0.13	0.01

APPENDIX B – PREDICTION RESULTS FROM WEKA

- Predicted results on the training set using Multilayer perceptron

```
=== Predictions on training set ===

    inst#     actual  predicted error prediction
        1  1:Bullish  1:Bullish       0.985
        2  1:Bullish  1:Bullish       0.985
        3  1:Bullish  1:Bullish       0.959
        4  2:Neutral  2:Neutral       0.698
        5  1:Bullish  1:Bullish       0.892
        6  1:Bullish  1:Bullish       0.881
        7  1:Bullish  1:Bullish       0.864
        8  3:Bearish  2:Neutral    +  0.608
        9  3:Bearish  3:Bearish       0.82
       10  3:Bearish  3:Bearish       0.839
       11  2:Neutral  2:Neutral       0.831
       12  2:Neutral  2:Neutral       0.592
       13  1:Bullish  1:Bullish       0.752
       14  1:Bullish  1:Bullish       0.729
       15  2:Neutral  2:Neutral       0.733
       16  1:Bullish  1:Bullish       0.959
       17  3:Bearish  3:Bearish       0.769
       18  3:Bearish  3:Bearish       0.787
       19  3:Bearish  3:Bearish       0.723
       20  1:Bullish  1:Bullish       0.988
       21  3:Bearish  3:Bearish       0.932
       22  1:Bullish  1:Bullish       0.977
       23  1:Bullish  1:Bullish       0.806
       24  1:Bullish  1:Bullish       0.972
```

- Predicted results for impact period on the training set using Multilayer perceptron

```
=== Predictions on training set ===

    inst#    actual  predicted       error
        1        0       3.649       3.649
        2        5      12.718       7.718
        3       17      15.168      -1.832
        4       20      21.595       1.595
        5        8      15.186       7.186
        6       10      16.893       6.893
        7       12      15.414       3.414
        8       18      20.208       2.208
        9        0        3.88        3.88
       10        0      -9.989      -9.989
       11        2       8.985       6.985
       12        6       6.829       0.829
       13        0       1.869       1.869
       14        9       9.289       0.289
       15       18      21.156       3.156
       16       24      26.936       2.936
       17        7        7 09         4 07
```

- Predicted results on the training set using Random Forrest

```
=== Predictions on training set ===

    inst#    actual  predicted       error
        1        0       1.875       1.875
        2        5         7.7         2.7
        3       17      14.338      -2.662
        4       20      16.394      -3.606
        5        8      10.455       2.455
        6       10      11.825       1.825
        7       12       9.828      -2.172
        8       18      14.944      -3.056
        9        0       0.783       0.783
       10        0       1.389       1.389
       11        2         8.4         6.4
       12        6         6.8         0.8
       13        0       3.624       3.624
       14        9      10.764       1.764
```

APPENDIX C - SOURCE CODES

- Logic to find the impact status for past dates.

```
// POST: Find Impact for past days for a selected event
        [HttpPost]
        [ValidateAntiForgeryToken]
        public ActionResult Create([Bind(Include =
"id,EventCode,EventName,EventDate,Impact1,StartDate,EndDate,ImpactPeriod")] Impact
impact)
        {
            if (ModelState.IsValid)
            {
                string selectedEvent = Request.Form["Events"].ToString();
                string eventImpact = "";
                string eventCode = "";
                DateTime selectedEventDate, EndDate;

                var EventData = (from e in db.Event_Tab
                                 where e.Event_Name == selectedEvent
                                 select e).ToList();

                DateTime EventDate, CheckDates;



                foreach (var events in EventData)
                {
                    System.Diagnostics.Debug.WriteLine("Event {0}: {1}",
events.EventCode, events.Event_Date);

                    EventDate = DateTime.Parse(events.Event_Date.ToString());
                    selectedEventDate = DateTime.Parse(events.Event_Date.ToString());
                    EndDate = EventDate;
                    eventCode = events.EventCode;

                    var GetData = from r in db.Galadari_Data_Tab
                                  where r.date == EventDate
                                  select r;

                    if (GetData.Count() == 0)
                    {
                        while (GetData.Count() == 0)
                        {
                            int count = 1;
                            EventDate = EventDate.AddDays(count);
                            GetData = from b in db.Galadari_Data_Tab
                                      where b.date == EventDate
                                      select b;

                        }
                    }

                    foreach (var t in GetData)
                    {

                        double macdHistogram, macd, signal, nextMacd, nextSignal;

                        macdHistogram = t.macd_histogram;
                        macd = t.macd;
```

III

```csharp
signal = t.moving_avg;

CheckDates = EventDate;
if (macdHistogram != 0)
{
    //bullish
    if (t.macd > t.moving_avg)
    {
        eventImpact = "Bullish";
        nextMacd = t.macd;
        nextSignal = t.moving_avg;

        while (nextMacd > nextSignal)
        {
            int i = 1;
            CheckDates = CheckDates.AddDays(i);

            GetData = from b in db.Galadari_Data_Tab
                      where b.date == CheckDates
                      select b;

            if (GetData.Count() == 0)
            {
                while (GetData.Count() == 0)
                {

                    CheckDates = CheckDates.AddDays(i);
                    GetData = from b in db.Galadari_Data_Tab
                              where b.date == CheckDates
                              select b;

                }
            }

            foreach (var q in GetData)
            {
                macdHistogram = q.macd_histogram;
                nextMacd = q.macd;
                nextSignal = q.moving_avg;
            }
        }
        EndDate = CheckDates;
    }
    //bearish
    else if (t.macd < t.moving_avg)
    {
        nextMacd = t.macd;
        nextSignal = t.moving_avg;
        eventImpact = "Bearish";

        while (nextMacd < nextSignal)
        {
            int i = 1;
            CheckDates = CheckDates.AddDays(i);

            GetData = from b in db.Galadari_Data_Tab
                      where b.date == CheckDates
                      select b;

            if (GetData.Count() == 0)
            {
                while (GetData.Count() == 0)
                {
                    CheckDates = CheckDates.AddDays(i);
```

IV

```csharp
                                 GetData = from b in db.Galadari_Data_Tab
                                           where b.date == CheckDates
                                           select b;
                    }
                }

                foreach (var q in GetData)
                {
                    macdHistogram = q.macd_histogram;
                    nextMacd = q.macd;
                    nextSignal = q.moving_avg;
                }
            }
            EndDate = CheckDates;
        }

        //neautral
        else
        {
            eventImpact = "Neutral";
        }
    }
    else
    {
        eventImpact = "Neutral";
    }
}


int period = (Int32)((EndDate.AddDays(-1)) -
(EventDate)).TotalDays;

if (period < 0)
{
    period = 0;
}

var priceValues = (from p in db.Galadari_Data_Tab
                   where p.date >= EventDate && p.date <= EndDate
                   select p.high);

double[] priceAmt = new double[priceValues.Count()];
double maxVal, minVal;
double changedPrice;

maxVal = priceValues.Max();
minVal = priceValues.Min();


if (eventImpact == "Bullish")
{
    changedPrice = maxVal - minVal;

}
else
{
    changedPrice = minVal - maxVal;
}


Double dPriceChanged = Math.Round((Double)changedPrice, 2);

impact.EventName = selectedEvent;
impact.EventCode = eventCode;
```

V

```
                    impact.Impact1 = eventImpact;
                    impact.StartDate = EventDate;
                    impact.EventDate = EventDate;
                    impact.EndDate = EndDate.AddDays(-1);
                    impact.ImpactPeriod = period;
                    impact.Year = EventDate.Year;
                    impact.Month = EventDate.Month;
                    impact.PriceChanged = dPriceChanged;

                    if (events.postivity == null)
                    {
                        impact.positivity = null;
                    }
                    else
                    {
                        impact.positivity = events.postivity;
                    }

                    db.Impacts.Add(impact);
                    db.SaveChanges();

                }
                return RedirectToAction("Index");
            }

            return View(impact);
        }
```

- Generation of Pie chart

```
<script>

$(document).ready(function () {
    $.getJSON("/Impact/GetImpactData", function (data) {

        var bull, bear, neutral;

        for (a = 0; a < data.length; a++) {
            bear = data[0].state;
            bull = data[1].state;
            neutral = data[2].state;

        }
// Build the pie chart
Highcharts.chart('container', {
    chart: {
        plotBackgroundColor: null,
        plotBorderWidth: null,
        plotShadow: false,
        type: 'pie'
    },
    title: {
        text: 'Impact Percentage for the Event since 2015'
    },
    tooltip: {
        pointFormat: '{series.name}: <b>{point.percentage:.1f}%</b>'
    },
    accessibility: {
        point: {
            valueSuffix: '%'
        }
    },
```

```
    plotOptions: {
        pie: {
            allowPointSelect: true,
            cursor: 'pointer',
            dataLabels: {
                enabled: true,
                format: '<b>{point.name}</b>: {point.percentage:.1f} %',
                connectorColor: 'silver'
            }
        }
    },


    series: [{
        name: 'Impact',
        data: [
            { name: 'Bullish', y: bull, color: "#1eb116" },
            { name: 'Bearish', y: bear, color: "#e90707" },
            { name: 'Neutral', y: neutral, color: "#f4ec06" }
        ]
    }]
});
    });

});
```

- Generation of Column chart

```
//column chart
$(document).ready(function () {
    $.getJSON("/Impact/GetPeiodData", function (data) {

        var bullish = [],
            bearish = [],
            neutral = [],
            dateCat = [],
            a = 0;

        for (a = 0; a < data.length; a++) {

            if (data[a].state == "Bullish") {
                bullish.push([
                    data[a].period
                ]);

                bearish.push([
                    0
                ]);

                neutral.push([
                    0
                ]);

            } else if (data[a].state == "Bearish") {
                bearish.push([
                    data[a].period
                ]);

                bullish.push([
                    0
                ]);
```

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```
                    neutral.push([
                            0
                    ]);

              } else {
                    neutral.push([
                            data[a].period
                    ]);

                    bullish.push([
                            0
                    ]);

                    bearish.push([
                        0
                    ]);

              }

              dateCat.push([
                    new Date(parseInt(data[a].date.substring(6, 19))).toLocaleString('fr-
CA', { year: 'numeric', month: '2-digit', day: '2-digit' })
              ]);
          }

Highcharts.chart('container2', {
    chart: {
        type: 'column'
    },
    title: {
        text: 'Event Impact Period'
    },
    subtitle: {
        text: ''
    },
    xAxis: {
        categories: dateCat,
        crosshair: true
    },
    yAxis: {
        min: 0,
        title: {
            text: 'Period (days)'
        }
    },
    tooltip: {
        headerFormat: '<span style="font-size:10px">{point.key}</span><table>',
        pointFormat: '<tr><td style="color:{series.color};padding:0">{series.name}:
</td>' +
            '<td style="padding:0"><b>{point.y:.0f} days</b></td></tr>',
        footerFormat: '</table>',
        shared: true,
        useHTML: true
    },
    plotOptions: {
        column: {
            pointPadding: 0.2,
            borderWidth: 0
        }
    },
    series: [{
        name: 'Bullish',
        data: bullish,
        color: "#1eb116",
```

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```
        pointWidth: 15

    }, {
        name: 'Bearish',
        data: bearish,
        color: "#e90707",
        pointWidth: 15

    }, {
        name: 'Neutral',
        data: neutral,
        color: "#d5d5cd",
        pointWidth: 10

    }]
});

    });
});
```

x