CLASSIFICATION OF DIVIDEND NEWS BASED ON THE MOVEMENT OF THE SHARE MARKET PRICES OF PUBLIC LISTED COMPANIES IN BURSA MALAYSIA

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DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SOFTWARE ENGINEERING (SOFTWARE TECHNOLOGY)

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CLASSIFICATION OF DIVIDEND NEWS BASED ON THE MOVEMENT OF THE SHARE MARKET PRICES OF PUBLIC LISTED COMPANIES IN BURSA MALAYSIA

ABSTRACT

Stock market is naturally complex and plays a major role in towards the nation's growth. However, the performance of a company in stock market varies due to many influences but not limited to economics, political and financial related news. This study attempts to classify the share market dividend news announcement in Bursa Malaysia based on the pattern of share market price. Samples including five hundred (500) observations of dividend news from forty-seven (47) listed companies in Bursa Malaysia during the period of 2000 to 2018 are used in this study. There are three (3) main objectives in this study which consist of (1) to propose a dividend news classification, (2) to develop a dividend news classification system and (3) to evaluate the accuracy of the news classification approach. The first objective is achieved by proposing a news classification approach to classify the dividend news based on announcement date price, ex-date price, entitlement date price and payment date price. This research uses historic data to analyse and classify the dividend news. The dividend news classification approach is determined by comparing daily closing price difference from the dividend announcement date until dividend payment date and price difference between the four (4) dates - dividend announcement date, ex-date, entitlement date and dividend payment date. The dividend news is classified as a good news if the price difference is more or equal than zero and if it is lower, it is classified as a bad news. Second objective is achieved with the development of the dividend news classification system by imposing the mathematical approach which calculates the price difference between the announcement date, ex-date, entitlement date and payment date. The news classification system is developed by using Joget Workflow which is an open source

platform. In addition, the accuracy of the proposed mathematical approach for dividend news classification system is evaluated using five (5) different Machine Learning Model which consist of Logistic Regression (LR), Linear Discriminant Analysis (LDA), K Neighbours Classifiers (KNN), Gaussian Naïve Bayes (NB) and Support Vector Machine (SVM). As per to achieve the third objective of this study, the mathematical approach is strongly supported by Logistic Regression (LR) model with the highest accuracy of 0.98. The outcome of this study helps to facilitate the investors in interpreting the dividend news easily and faster with simplified methods. Finally, it is important to the investors who would like to analyse and study the dividend news trend in the past years.

Keywords: Dividend news, news classification, share market, Machine Learning, Bursa Malaysia.

KLASIFIKASI BERITA DIVIDEN BERDASARKAN PERGERAKAN HARGA PASARAN SAHAM UNTUK SYARIKAT TERSENARAI AWAM DI BURSA MALAYSIA

ABSTRAK

Pasaran saham secara semula jadi adalah kompleks dan memainkan peranan utama dalam pembentukan pertumbuhan negara. Walau bagaimanapun, prestasi syarikat dalam pasaran saham bervariasi disebabkan oleh banyak pengaruh dan tidak terhad kepada berita berkaitan ekonomi, politik dan kewangan. Kajian ini cuba mengklasifikasikan berita dividen pasaran saham di Bursa Malaysia berdasarkan corak harga pasaran saham. Sampel termasuk lima ratus (500) pemerhatian berita dividen daripada empat puluh tujuh (47) syarikat tersenarai di Bursa Malaysia dalam tempoh tahun 2000 hingga 2018 digunakan untuk kajian ini. Terdapat tiga objektif utama dalam kajian ini yang terdiri daripada (1) mencadangkan klasifikasi berita dividen, (2) membangunkan sistem klasifikasi berita dividen dan (3) menilai ketepatan pendekatan klasifikasi berita dividend. Objektif pertama dicapai dengan mencadangkan pendekatan klasifikasi berita untuk mengklasifikasikan berita dividen berdasarkan harga pada tarikh pengumuman, tarikh matang, tarikh kelayakan dan tarikh pembayaran. Kajian ini menggunakan data bersejarah untuk menganalisa dan mengklasifikasikan berita dividen. Pendekatan klasifikasi berita dividen ditentukan dengan membandingkan perbezaan harga penutupan harian dari tarikh pengumuman dividen sehingga tarikh pembayaran dividen dan perbezaan harga antara empat (4) tarikh - tarikh pengumuman dividen, tarikh matang, tarikh kelayakan dan tarikh pembayaran dividen. Berita dividen diklasifikasikan sebagai berita baik jika perbezaan harga lebih atau sama dengan sifar dan jika ia lebih rendah, ia diklasifikasikan sebagai berita buruk. Objektif kedua dicapai dengan pembangunan sistem klasifikasi berita dividen dengan mengunakan pendekatan matematik yang menghitung perbezaan harga antara tarikh pengumuman, tarikh

matang, tarikh kelayakan dan tarikh pembayaran. Sistem klasifikasi berita dividen dibangunkan menggunakan Joget Workflow yang merupakan pelantar *open source*. Di samping itu, ketepatan pendekatan matematik yang dicadangkan untuk sistem klasifikasi berita dividen dinilai menggunakan lima (5) Model Machine Learning yang berbeza yang terdiri daripada Logistic Regression (LR), Linear Discriminant Analysis (LDA), K Neighbours Classifiers (KNN), Gaussian Naïve Bayes (NB) and Support Vector Machine (SVM). Objektif ketiga dicapai melalui pendekatan matematik yang sangat disokong oleh model Logistic Regression (LR) dengan ketepatan tertinggi 0.98. Hasil kajian ini membantu memudahkan para pelabur untuk mengklasifikasikan berita dividen dengan mudah dan cepat dengan kaedah mudah. Akhir sekali, klasifikasi berita dividend amat penting bagi para pelabur yang ingin menganalisa dan mengkaji trend berita dividen untuk tahun-tahun yang lalu.

Kata Kunci: Berita dividend, klasifikasi berita, pasaran saham, Machine Learning, Bursa Malaysia.

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LIST OF SYMBOLS AND ABBREVIATIONS

ML   :   Machine Learning

KLSE   :   Kuala Lumpur Stock Exchange

KLSEB   :   Kuala Lumpur Stock Exchange Berhad

SES   :   Stock Exchange of Singapore

LR   :   Logistic Regression

LDA   :   Linear Discriminant Analysis

KNN   :   K Neighbours Classifiers

NB   :   Gaussian Naïve Bayes

SVM   :   Support Vector Machines

LR   :   Logistic Regression

CSV   :   Comma-separated values

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CHAPTER 1: INTRODUCTION

1.1   Overview

Savings and investment are two methods in making sure you have sufficient money set aside for any emergency use, day-to-day living expenses or old age living expenses. Looking at the current economic trend, there is no significant return from savings account at current time (Joshua, 2017). However, stock trading can be profitable when right decisions are made. Venturing while investing into trading can be one of the wise decision to further grow your money. However, it is not a risk-free pathway and losses are inevitable. Share market is a platform for buyer and seller to trade in shares. The person who owns shares in a company is basically known as shareholder or stockholder. Basically, as a shareholder, the person has an ownership towards the invested company (Ronak, 2017). There are two terms commonly used in trading which consist of:-

i.   Stock exchange

- A statutory body/organization which approved and regulated by securities commission for brokers and traders to buy and sell stocks. It is also known as stock market or share market (Amit, 2017).

ii.   Share holder

- The person who owns share in a corporation/company (Amit, 2017).

Share market is also known as equity market or stock market. Share market is one of the tool for companies to raise money. Companies sell shares of ownership of the company which allows the business to be traded publicly (Kathy, 2011). This is to raise financial capital. However, share market news has certain impact on share prices which can be classified as good, bad or neutral news by the price trend.

There are two groups of share market news which consist of, the types of news that affects the entire share market and types of news that affects a particular stock. For example, geo hazard and political news can be classified as news which effects the

entire share market. On the other hand, dividend news, change of board of directors, new product launch and earnings can be classified as news which effects a particular stock (Thomas, 2006).

This study will solely be focusing on dividend news. Dividend here refers to the portion of the company's equity where it is given to the shareholder in terms of cash. However, it is not statutory for a company to pay-out dividends to its shareholders. Dividend payment decision is made by its board of directors. In most of the scenarios, companies pay dividend when there are profits. Dividends are paid in four (4) frequencies which are monthly, quarterly, semi-annually or annually. In every dividend news, there are four (4) important dates where shareholders need to take important considerations. The four (4) dates are announcement date, ex-date, entitlement date and payment date (Lawrence, 2010). Announcement date is the date when the dividend announcement is released to the public. Meanwhile, ex-date is the date which is very crucial to determine whether a person is eligible for the dividend pay-out. A person who buys the share from the company before the ex-date will be eligible for the dividend pay-out. Entitlement date is the date when the company checks on their shareholders eligibility for the dividend. A person who has been listed as shareholder on the entitlement date will be entitled for the pay-out. Meanwhile, payment date is the date when the payment is made to its shareholders. Therefore, if a person would like to be entitled for the dividend payment, he / she has to own the shares of the company before the ex-date (Joshua, 2017).

1.2   Research Background

Research background is core in its platform to be able to link many important matters resulting in establishing the research to be accomplished. As per studies, previous researches are only able to provide info on matters about dividend news and share

market prices. However, there are not much studies that is done on dividend news classification during dividend payment period. As a result, most of the previous studies are related to dividend policy and share price, dividend announcement and stock return, dividend payment, and impact of dividend news announcement. Classification is mostly associated to the grouping of dividend news entirely all around the globe but not usually used under its classification terms.

For example, the effect of dividend policy towards the share price volatility comprises of dividend pay-out ratio which significantly influences the changes on share prices (Zuriawati et al., 2012). Besides that, dividend announcement and ex-dividend effects on stock market covers the results which shows positivity or negativity on the dividend announcement on the stock return (Dinh et al., 2016). Apart from all this, there are also impact of dividend payment on the share market price which theoretically means the important attributes to the forces of demand and supply such as commercial policy, corporate office decisions, psycho-social variables, political positions and institutional factors (Ordu et al., 2014).

In this research, the news classification is conducted based on sample data comprising of Trading and Services sector companies listed in Bursa Saham Malaysia within the period of 2000-2018. The dividend news is classified as good, bad or neutral news based on share market prices on announcement date, entitlement date, ex-date and payment date.

Table 1.1: Previous Study on Dividend News and Share Market

No	Title	Type	Year
1	The impact of Dividend Policy on the share price Volatility: Malaysian Construction and Material Companies. (Zuriawati, Joriah and Abdul Hadi)	Journal	2012
2	Dividend Announcement and Ex-Dividend Effects on Stock Return. (Dinh Bao and Nguyen Chi)	Journal	2016
3	Effect of Dividend Payment on the Market Price of Shares:	Journal	2014

No	Title	Type	Year
	A Study of Quoted Firms in Nigeria. (Ordu Monday, Enekwe Chinedu and Anyanwaokoro Mike)		
4	Impact of Dividend Announcement on stock prices: A study in Malaysian Stock Exchange Context. (Ibrahim Sameer)	Thesis	2012
5	The effect of Dividend announcement on share prices: A study on the Ghana Stock Exchange. (Golden Dela Doe)	Thesis	2015

1.3   Research Problem

By the year 2050, Malaysia has planned out measures on Malaysia's future economic growth founded by *Dasar Transformasi Nasional* (TN50). This has been expressed by previously the sixth Prime Minister of Malaysia, Datuk Sri Haji Mohammad Najib bin Tun Haji Abdul Razak. TN50 is a new 30 years' vision of Malaysia succeeding Wawasan 2020. Following the planning, Malaysia is looking into measures for strategic investment and trading activities in order to have economic transition of world economic power in which will ensure Malaysia within the ranked of top 20 countries in the world (Ministry of Finance, 2017).

Researches on trading in share market have been carried out in other countries such as India, United States and China. Researchers found that very few research works have been performed on trading in BURSA Malaysia. It was found that researches are mainly focusing on the directed volatility of trading industry or share market prediction of the companies listed in BURSA Malaysia.

In conjunctions, very limited resources to classify and tabulate the dividend news. This is important for investors as the type of news is needed to establish a strong foundation of buying/selling power within the community. The community in this context needs to be educated with first-hand information on the outcome of the dividend news and the price discrepancy.

1.4 Research Objective

This research aims to classify the share market dividend news announcement in BURSA Malaysia based on the pattern of share market price. The objectives are defined as follow:

- To propose an approach to classify the dividend news during the period from the announcement of the dividend news until dividend payment date.
- To develop a system to facilitate the classification of dividend news.
- To evaluate the accuracy of the proposed dividend news classification approach.

1.5 Research Hypothesis

Based on the research problem, the hypothesis of this study was established to examine the relationship between dividend news and share market.

- H0: Dividend news does not impact on share market prices.
- HA: Dividend news does impact on share market prices.

1.6 Research Scope

This study aims to propose classification approach to categorize the dividend news. This study includes forty-seven (47) companies from the Trading/Services sector which are listed in BURSA Malaysia. Altogether 500 dividend announcement released by these forty-seven (47) companies as well as their market prices within the year 2000 to 2018 will be collected and used in this study.

1.7 Research Contribution

This study can help investors to analyse the share market price reaction during dividend news announcement period for the past years based on the classification of dividend news into good, bad or neutral news according to the trend/pattern of the share market

prices from the respective companies. Investors can decide whether to sell or retain the shares based on the knowledge of the price fluctuation during the dividend news announcement and payment period. Therefore, this study provides an approach and a system to facilitate the investors in the trading of their shares.

CHAPTER 2: LITERATURE REVIEW

2.1 History of Bursa Malaysia

The trading post in securities industry started in Malaya in the 1870s which was mainly centred on rubber and tin-based commodities. The first official body in securities in Malaya back in 1930 is Singapore Stockbrokers' Association (Tan, 2002). In 1819, Sir Stamford Raffless of the British East India Company founded Singapore as a trading post. The expansion of trade formed liability joint stock companies which facilitate the transfer of ownership in companies through transaction in shares (Tan, 2002).

Stock brokers buy and sell shares of British rubber and tin companies in Arcade at Clifford Pier. Trading in shares became a main activity in Singapore as the rapid growth of rubber industry in 1910 and tin mining industry in Malaya. However, the brokerage business was disrupted due to Second World War (Tan, 2002). In 1929 after the Second World War, the Singapore Stockbrokers' Association was introduced. The main objective of the association was to regulate the stockbrokers and protect the investors. No public trading of shares was identified during that time which means public did not participate in the trading of shares. The association was renamed as Malayan Sharebrokers' Association back in 1937 but maintained its practice. The association existed till 1960 (Tan, 2002).

In 1960, the first stock exchange in Malaysia was made with several companies from Singapore, Kuala Lumpur, and Penang. The first stock exchange was named Malayan Stock Exchange and it provided the facilities as trading room to sell or buy shares based on prices shown on board. This is how the public trading started when stockbrokers gathered at Bank Negara Malaysia to mark prices. In 1961, share market was improvised with board system and the two trading places in Singapore and Malaysia

were connected with direct telephone lines. The trading rooms were operating as single market and known as Stock Exchange of Malaysia (Low, 2000).

New rules were adopted after the establishment of the Federation of Malaysia in 1963 and Independence of Singapore in 1965. However, it was renamed as Stock Exchange of Malaysia and Singapore but the stock exchange sustained. Stock Exchange of Malaysia and Singapore split into two in 1973 as Kuala Lumpur Stock Exchange Berhad (KLSEB) and Stock Exchange of Singapore (SES). This is because of the Malaysian Government terminated the currency interchange between Malaysia and Singapore (Low, 2000).

As the stock exchange strengthen the financial institutions in Malaysia, a regulation to protect investors and curb any form of market manipulation through Securities Industry Act 1983 (SIA) was introduced in 1976. KLSEB was replaced by Kuala Lumpur Stock Exchange (KLSE) (Low, 2000).

In 1986, the stockbroking companies (SBCs) was corporatized to improve their financial strength, expertise and professionalism in exchange, and introduced KLSE Composite Index (KLSE CI). In 1987, Maklumat SAHAM (MASA) was launched to provide the real-time share price reporting system (Low, 2000).

In 1988, the smaller companies were introduced to market through KLSE Second Board. This is to help small companies to earn additional capital through public listing. Lim Kim Hai Holdings Berhad was the first company to be listed in Second Board. Next notable development took place in 1989 where System on Computerized Order Routing and Execution (SCORE) was introduced and brought exchange into technological world. By introducing SCORE, the trading in electronic system enhanced the speed of transaction and capacity. As the trading fairly humble made its settlement, central

depository system (CDS) was introduced to minimize risk in securities market through Malaysian Central Depository Sdn Bhd (MCD).

Figure 2.1: Exchange Square (Wikipedia, 2017)

The headquarters of The Kuala Lumpur Stock Exchange was called as Exchange Square was opened in 1997 by then the fourth prime minister of Malaysia, Dr Mahathir Mohamad as prescribed in Figure 2.1. In 1997, the trading hours were extended with trading sessions from 9.00am to 12.30pm, and 2.30pm to 5.00pm. As the Main Board of KLSE was revamped in 1993, four new sectors were launched which consist of Industrial Sector, Loans Sector, Oil Palm and Rubber Sector and were merged into Plantations. Apart from that, Tin Sector was renamed to Mining Sector.

In 1994, KLSE was renamed by dropping the term 'The' as Kuala Lumpur Stock Exchange. Kuala Lumpur Stock Exchange was renamed again to Bursa Malaysia Berhad in 2004. Bursa Malaysia Berhad comprises of Main Board, Second Board and MESDAQ (Malaysian Exchange of Securities Dealing and Automated Quotation) as shown in Figure 2.2.
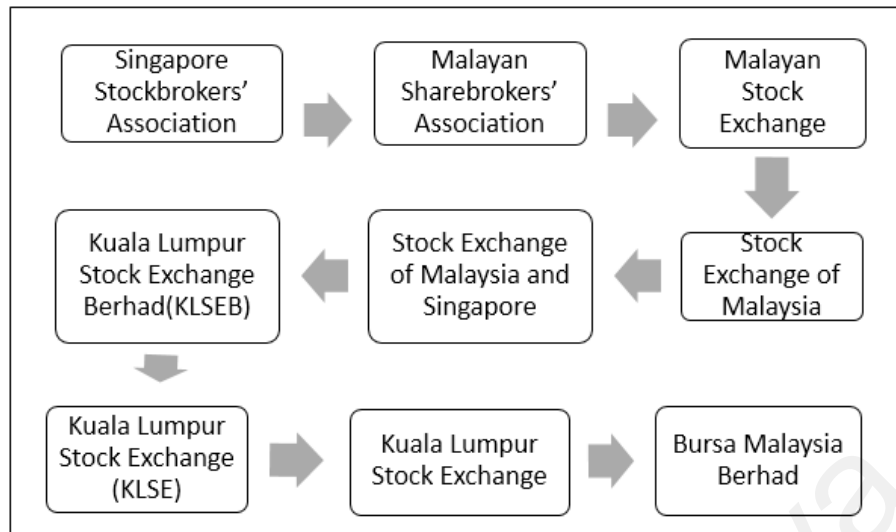
Figure 2.2: History of Bursa Malaysia

2.2 Types of Market in Bursa Malaysia

Bursa Malaysia is the most prominent stock market in Malaysia. Bursa Malaysia provides two markets which are Main Market and Ace Market. Main market is the platform for established firms such as SASBADI, AIRASIA and PETRONAS to raise fund. Meanwhile, Ace market is a medium for growing and developing firms to raise fund. Companies which are growing in Ace market will eventually move to the main market at a later stage (Bursa Malaysia, 2017).
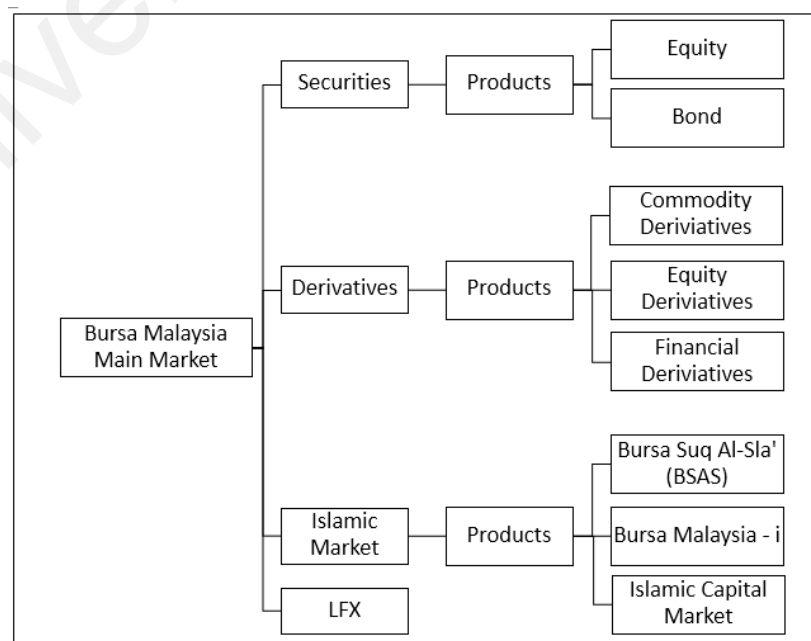
Figure 2.3: Bursa Malaysia Market Diversions

Figure 2.3 shows the summary of main market diversion in Bursa Malaysia. The Main Market diversion in Bursa Malaysia consist of securities, derivatives, Islamic and market.

1. Securities

   - Bursa Malaysia has a number of securities products which offer potential capital growth and risk investment. Investors who invest in a particular company deserves a part in company ownership and known as shareholders. There are two classifications under securities which are Equities and Bonds (Bursa Malaysia, 2017).

     - Equities: Shares, Company Warrants, Structured Warrants, Exchange Traded Funds (ETFs), Real Estate Investment Trusts (REITs) and Closed-End Funds.

     - Bonds: Exchange Traded Bonds and Sukuk (ETBS), Exempt Regime and Loan Stocks

2. Derivatives

   - This is handled by Bursa Malaysia Derivatives Berhad (BMD) which is a Bursa Malaysia Berhad subsidiary. BMD's main role is to maintain three different derivatives categories which are Commodity Derivatives, Equity Derivatives and Financial Derivatives (Bursa Malaysia, 2017).

     - Commodity Derivatives

       o Gold Futures (FGLD)

       o Crude Palm Oil Futures (FCPO)

       o USD RBD Palm Oil Futures (EPOL)

       o USD Crude Palm Oil Futures (FUPO)

       o Crude Palm Kernel Oil Futures (FPKO)

       o Options on Crude Palm Oil Futures (OCPO)

- o Tin Futures (FTIN)
- ▪ Equity Derivatives
  - o FTSE Bursa Malaysia KLCI Futures (FKLI)
  - o FTSE Bursa Malaysia KLCI Options (OKLI)
  - o Single Stock Futures (SSFs)
- ▪ Financial Derivatives
  - o 3-Month Kuala Lumpur Interbank Offered Rate Futures (FKB3)
  - o 3-Year Malaysian Government Securities Futures (FMG3)
  - o 5-Year Malaysian Government Securities Futures (FMG5)
  - o 10-Year Malaysian Government Securities Futures (FMCA)

3. Islamic Market

- • This market is to provide a trading platform for Shariah Compliant capital markets products. Besides, it is also to promote Malaysia an international hub for Islamic Finance (Bursa Malaysia, 2017). Products offered are:
  - ▪ Bursa Suq Al-Sila' (BSAS)
  - ▪ Bursa Malaysia
  - ▪ Islamic Capital Market
    - o Shariah Compliant Listed Equities
    - o Shariah Compliant Exchange Traded Funds (i-ETFs)
    - o Islamic Real Estate Investment Trusts (i-REITs)
    - o SUKUK

4. LFX

- LFX stands for Labuan International Financial Exchange. Since 1970 Labuan already well-recognised as an International Financial centre and hence, LFX was launched officially in 2000 (Bursa Malaysia, 2017).

2.3   Impact of Capital Market in Malaysia

Capital market is part of financial market where it provides a platform to buy and sell equity and debt instruments. In Malaysia, Securities Commission Malaysia was established in 1993, a governmental body which regulates and develops Malaysia's capital market. This governmental body supervises and monitors the activities of the market institutions and regulating under the Capital Markets and Services Act 2007 (Securities Commission Malaysia, 2014).

According to Securities Commission, historically, capital market is one of the main components of Malaysia's economic growth. Besides, in 1997-1998 after the Asian financial crisis, followed by the war in Iraq, Malaysia's economy returned to positive state in 2003 and grew steadily with gross of domestic products. Malaysia marked its return of positive growth in private investment - a rose by 1.1% after two years of steep decline. It has continuously aggregated the business expansion and rise the financing demand (Securities Commission Malaysia, 2014).

Although the expansion in capital market took place between 2003 and 2013, the capital market sustained resilience throughout global financial crisis in 2008 – 2009. Nevertheless, the demand in corporate finance sustained as the economy and private investment recorded recovery in 2009. The Economic Transformation Programme (ETP) in 2010, helped the development of private investment. In order to sustain the financing pipeline, Malaysian Government encouraged privatisation of projects. Although the scale of investment in infrastructure dropped slightly from 2003 to 2012, nevertheless the

participation in the country's energy and telecommunication continued to rise. On the other hand, the reduction of public sector's participation in business has also contributed to Equity Market (Securities Commission Malaysia, 2014).

As reported in a newspaper article on March 17, 2006, the reformation of regulatory and intensifying surveillance effort in Securities Commission (SC) has boost the Malaysia's capital market. The growth was RM2.82 trillion in 2016 and made Malaysia as the third biggest bond market in Asia (Jalil et al, 2016).

2.4 Future of Trading in Malaysia

The new government of Malaysia which was elected during the 2018 general election, has a few approaches in warranting the thriving of Malaysia's trading market and restoring the Malaysia economy as "The Tiger of Asian". The 2019 Nation's Budget is the initial budget announced by new Malaysian government while focusing on elevating Malaysian economy through investment. The new government intends to privatise the infrastructure assets by setting up the world's primary "Airport Real Estate Investment Trust (REIT)" (BDO, 2019). As Malaysia Airports Holding Bhd (MAHB) has the authority to operate airports, the collected user fees will be a return for investors of the Airport REIT. Another initiative proposed by Government in 2019 budget in order to promote investment is to review over 130 types of fiscal incentives (BDO, 2019). On the other hand, manufacturing sector is rapidly growing and contributing the largest share of investment. However, this attracts investors and gives them confidence to invest trade in Malaysia.

Apart from all above, Malaysian government also propose to enhance the current incentive for those companies participating in the Principal Hub activities (Justin, 2019). Furthermore, Bursa Malaysia is also open for worldwide stockholders to capitalize in country's stock exchange but the U.S stockholders must have foreign brokerage accounts

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(Justin, 2019). Another option for international stockholders who would like to avoid foreign exchange would be American Depository Receipts (ADRs) (Justin, 2019). Below is the list of popular Malaysian ADRs:

- Malayan Banking Berhad (MLYBY)

- Genting Berhad (GEBHY)

- Genting Malaysia Bhd (GMALY)

- MBF Holdings Berhad (MBFBY)

- Tenaga Nasional Berhad (TNABY)

Lastly, there is also simplest way to invest in Malaysia such as Exchange Traded Funds (ETFs) (Justin, 2019).

2.5 Stock Market Dividend News and Prediction

Table 2.1 shows a summary of literature review tabulated based on the research done towards stock market and dividend news worldwide. Several researches on stock market price prediction has been studied in due time. Those studies focus on improving prediction accuracy by combining classification and prediction such as [1], [2], [14] and [15]. Xiaodong Li (2010) used an SVM classifier to categorize news articles and make predictions. The news classification is done in 5 steps. Firstly, the Chinese articles are segmented and the stop words are removed. Then, the articles are transformed using vector space model. Thirdly, the opening price for each trading day is mined and the news articles are mapped with price. Next, the news articles are labelled as up, neutral or down based on the price difference. Lastly, the LibSVM is used as model learning. The result of this study shows that stock prices are influenced by the news articles.

Yuh-Jen Chen et al (2013) developed a fundamental analysis-based method to forecast stock market by manipulating the loads of financial variables using Grey Relational Analysis (GRA), CCR (Charnes, Cooper, and Rhodes) Model and Decision-

Making Unit (DMU). The accurateness of the financial news categorization is evaluated using Naive Bayes. According to the study from A.S.M Shihavuddin, the correlation between the word's attributes and the movement of the stock price either up or down in the stock market are being analysed (Shihavuddin et al, 2010). The attributes are used to indicate the possibility of the stock movements as positive, negative or neutral. In this study, Naive Bayes classifier is used to handle the news classification and the prices of the next day is used as target values to study the correlations. However, the limitation of this study is the number of training and testing datasets used which gives a result of 50% accuracy. The researcher stated that the increase of training examples can increase the performance of the system.

However, most of the researches have made use of SVM and Naive Bayes to analyse the news articles content in order to classify the news and show that the dividend news gives impact on stock prices. In addition, lots of researchers also uses event study methodology to focus on impact of dividend announcement on share price using different event windows such as [3], [10], [13] and [16]. Legenzova et al (2017) studied the stock price behaviour during the pre-announcement and post-announcement periods where the investor buys the share 30 days before the dividend announcements and sell the shares either 1,3 or 7 days after the announcement. According to the researcher, the interrelations on stock prices cannot be captured by event study methodology in this research and other methods should be applied.

Hu Zuguang (2010) and Gordon (2010) uses event study methodology with longer event window and eventually found that stock prices increases no matter the dividend increases or decreases. These findings are similar to current research where the closing price is analysed instead of the content of the dividend news. So far, no previous work has been done in combining the dividend news period from announcement date till payment date with stock closing price to classify the news as good, bad or neutral.

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Possibly, there is no prior research in the Bursa Malaysia that has been found on dividend news classification, it is relevant to perform research exploring Bursa Malaysia stock price reaction to dividend announcement. Therefore, this study considers the dividend news period to design and develop a news classification system. Moreover, to accomplish the objectives, this research does the following: (1) Analyse the share market closing price during the period from announcement of the dividend news until dividend payment date. (2) Develop a news classification system. (3) Evaluate the accuracy of the system using data analytical tool.

Table 2.1: Summary of Literature Review

No	Paper / Journal / Conference Paper Title & Author	Brief Description	Strength	Weakness
1	News and Events Aware Stock Price Forecasting Technique (Aditi et al, 2017)	This study is conducted to forecast the stock prices by considering the impact of news and event on stock prices. A sentiment model is designed and implemented to convert text articles into numeric vectors and regression model is built to study the impact of news/events on changes in stock market prices.	The sentiment analysis model performance in tested using 70-30 data split and 80-20 data split for training and testing data. However, the best accuracy is obtained using 70-30 data split. The author automated the entire workflow and the polarity of news articles is not evaluated manually. SVM model returned the high accuracy result.	Although, this study analyses on news related to stock prices but it doesn't incorporate the external factors which can affect the stock prices.
2	Predicting stock market behavior using data mining technique and news sentiment analysis (Ayman et al, 2017)	This study aims at constructing an effective model to predict stock market future trends with small error ratio and improve the accuracy of prediction.	The news sentiment is analysed using Naive Bayes algorithm and the prediction is done using K-Nearest Neighbour. Three categories of news data used: news relevant to market, company news and financial reports. All the prices including opening, high, low and closing prices are analysed to predict the future trends. The sentiment analyse model has achieved highest accuracy up to 86.21% and the prediction model using KNN obtained an accuracy up to 89.80%.	
3	The analysis of dividend announcement impact on stock prices of Baltic Companies (Legenzova et al, 2017)	This paper uses event study analysis to analyse the stock price behaviour during pre-announcement, announcement and post-announcement periods.	It uses event study methodology and calculating AARs based on investors buying shares 30 days prior to dividend announcement and sell them either 1,3 or 7 days after dividend announcement.	The researcher concluded that ARR does not bring any significant and Event Study Methodology

No	Paper / Journal / Conference Paper Title & Author	Brief Description	Strength	Weakness
				cannot capture the effects of stock prices.
4	Stock Price Prediction Based on Stock- Specific and Sub-Industry-Specific News Article (Yauheniya et al, 2015)	This research studies the simultaneous usage of different categories of news articles can improve the stock price predictions. It uses Multiple Kernel Learning approach and the result is compared with KNN and SVM approach.	The Multiple Kernel Learning approach effectively combine information extracted from stock-specific news articles for prediction of an upcoming price movement. Multiple Kernel Learning has the higher prediction performance which is 81.63% compared to SVM and KNN.	
5	The prediction System for Data Analysis of Stock Market by Using Genetic Algorithm (Ching-Te, 2015)	This paper discusses Web Robot and Genetic Algorithm which can provide framework for data analysis and predict the stock market.	Web Robot used to capture from downloaded web pages of information about stocks. Term Frequency and Inverse Document Frequency in Genetic Algorithm (TFXIDF) is used to analyse and predict the stock market data. The best predictive result achieved in this research is 61.1%.	
6	A fundamental Analysis-based Method for Stock Market Forecasting (Yuh-Jen et al, 2013)	This study developed a decision support system for a fundamental analysis-based stock market forecasting to select optimal stocks from the stock market and predict their future price trends to provide a reference for investor decisions.	Naive Bayes is used for classification whereas Adaboost.M2, support vector machine and queen genetic algorithm is used to increase the forecast accuracy. In order to implement the stock market forecasting model, the researchers utilized Visual Studio C#2010, DEA-Solver, Weka 3.6.6, and Matlab R2010b.	
7	Analysis of Stock Market using Text Mining and Natural Language Processing	This study is to extract fundamental information from relevant news sources and use them to forecast the stock market.	The researcher proposed a framework which uses text parser and analyzer algorithm with an open source natural language processing tool to analyze (machine learning and text	Unable to categorise the news if the news does not follow any pattern

No	Paper / Journal / Conference Paper Title & Author	Brief Description	Strength	Weakness
	(Sheikh, 2013)		mining), retrieve (natural language processing), and forecast (compare with historic data) investment decisions from any text data source on stock market. Apache OpenNLP which is a Java based machine learning toolkit for natural language processing is been used in this research.	of any particular format.
8	Effects of dividend announcement on stock prices: evidence from Pakistan (Faiza et al, January 2013)	This research study is to analyse the impact of dividend announcement on stock prices in Pakistani economy. The research shows that there is a rise in stock price when there is an announcement of increase in dividend payments. However, the stock price declines when there is an announcement of decrease in dividend payments.	This research uses ratio analysis which consists of Dividend Payout Ratio, Dividend Yield, Earning Per Share, Price Earnings Ratio, and Dividend Cover Ratio.	The research conducted on small scale which consist of 5 selected companies from each oil and textile sector.
9	Reading all the news at the same time: Predicting mid-term stock price developments based on news momentum (Micheal et al, 2013)	This paper is to investigate if the news momentum can predict medium-term stock index developments.	The researcher uses two different news data sets and analyse both different investment horizons and aggregation times for their news momentum to predict medium-term stock index developments. The prediction accuracy achieved in this research is up to 60%.	
10	Stock price reaction to dividend announcements and information	This study is to examine stock price reaction to subsequent dividend announcements and information	This study applies abnormal return method to examine the stock market response to subsequent dividend announcements.	

No	Paper / Journal / Conference Paper Title & Author	Brief Description	Strength	Weakness
	efficiency in Sri Lankan share market (Dharmarathne, 2013.)	efficiency in Sri Lankan Share Market using event study methodology.		
11	Analysis of Financial News Impact on Stock based on A Statistical Learning Method with News Density. (Feng Xiaodong, 2011)	The paper uses a statistical learning methodology to analyze the time lag between the price moves and the released news. The result of this result is that in most cases the time lag is equals to 1 day.	Statistical learning methodology used to map price movements and the volume of the news articles. The researcher also used cross validation to train and test the data. The summary of this research is the price of the stock would change in the next trading day of the news article.	
12	Combining Technical Analysis with Sentiment Analysis for Stock Price Prediction (Shangkun et al, 2011)	This paper proposes a stock price prediction model which extracts features from time series data and social networks for prediction of stock prices and evaluates its performance. The researcher uses features such as numerical dynamics (frequency) of news and comments, overall sentiment analysis of news and comments as well as technical analysis of historic price and volume. The regression problem is solved in a Multiple Kernel Learning regression framework.	For the technical analysis, the researcher used Rate of Change (ROC) to show the difference between today's closing price and the closing price of 1-day ahead, Moving Average Convergence Divergence (MACD) is used to predict the market tendency changes and BIAS is used to observe the differences in the closing price. Multiple Kernel Learning (MKL) is used to integrate multiple data sources and trained the data using SVM. Moreover, SentiWordNet is used as tool to perform sentiment analysis of the text for news and comments.	The word order is not considered during the sentiment analysis
13	Dividend announcement effect on stock return: an event study on Shanghai Stock Exchange (Hu Zuguang et al, 2010)	This paper is to analyze the price reaction towards announcement of dividend news in Shanghai Stock Exchange. The outcome of this research is on the dividend announcement day, the stock price	In order to calculate the abnormal return at each day, the researcher uses Mean Adjusted Returns, Market Adjusted Returns and OLS (Ordinary Least Square) Market Model. The event window used in this paper is 5 days before and 5 days after the announcement	

No	Paper / Journal / Conference Paper Title & Author	Brief Description	Strength	Weakness
		increases and investors gain abnormal returns regardless of dividend increase or decrease.	day. The findings of this paper are stock prices increases no matter the dividend increase or decreases.	
14	Empirical Analysis: News Impact on Stock Prices based on News Density (Xiaodong, 2010)	In this paper, new model is proposed to capture the density of news articles and mines the latent relationship by employing information entropy to explore the news impact on the market. Besides, an empirical study is conducted to analyze market news articles' impact on stock prices.	SVM Classifier is used for news classification and predictions. This research shows that news article has impact on stock prices.	
15	Prediction of Stock Price analyzing the online financial news using Naïve Bayes classifier and local economic trends. (Shihavuddin et al, 2010)	This research represents data mining algorithms to interpret the present and predict the next stock price.	Naive Bayes Algorithm is used to classify text news. The Naive Bayes classifier gives an accuracy of 50% in this research.	
16	The impact of dividend announcement on share price behavior in Ghana (Gordon, 2010)	The purpose of the study is to determine whether there is a sudden reaction of the companies' share prices to dividend announcement in order to provide the basis for confirming or dispelling the Efficient Market Hypothesis.	Event study methodology is used to study the reaction of stock prices to dividend announcements. The Abnormal Returns is measured and the event window used is 12 months before the event and 6 months after the event. The author also used Wilcoxon Matched-Pair Signed-Ranked Test to analyse the significant of abnormal returns.	

No	Paper / Journal / Conference Paper Title & Author	Brief Description	Strength	Weakness
17	Discovering the Correlation between Stock Time Series and Financial News (Tak-Chung et al, 2008)	This study is to investigate the correlation between stock prices and news sentiment.	There are two categories of algorithms adopted which are stock time series analysis and sentiment analysis. For the stock time series analysis, the study adopted Perceptual Important Point (PIPs). The precision result of this research is 80%.	

2.6 Classification using Machine Learning and Deep Learning

In previous years, analysis of financial text data has become famous using Machine Learning (Leonardo et al, 2017). Since the advent of deep learning, stock market classification and prediction have been revolutionized in applications such as image, text and speech recognition – multi-layer neural networks are used to train large datasets (Justin et al, 2018). Recently, financial time series classification and prediction adapts deep learning algorithm which has Machine Learning elements (Takuya et al, 2019).

Table 2.2 shows a summary of literature review focusing on the research works done using machine learning to classify and predict the stock market price movements based on news events. Deepika (Deepika et al, 2014) proposed an integration of genetic algorithm into SVM and ANN model to classify stock prices. Based on the researcher's observation, the accuracy of ANN combined with genetic algorithm increased by 30%

Minjae Park (2019) conducted a study to monitor and predict stock market indices using variety of classification tool. The classification accuracy of the financial time series data was evaluated using AdaBoost algorithm with extension - Support Vector Machine (SVM), K-nearest neighbour, probabilistic neural network and the classification and regression tree. The result indices AdaBoost with SVM gives the best prediction.

Sheikh (2019) stated that the accuracy of classification and prediction has increased with increasing use of artificial intelligence and its technology. In this paper, the researcher evaluated three machine learning algorithms for stock market prediction – artificial neural network (ANN), Decision Tree and SVM. The study found that ANN and SVM are mostly used as stock prediction models.

According to Leonardo, most of the stock market classification and prediction are using models with more complex deep learning architectures and external features like indicators.

Leonardo presented stock market news classification using simple neural network with character level embedding. On the other hand, he also highlighted the risk of character embedding which is lower data sparsity when the unknown tokens in test data is removed (Leonardo et al, 2017).

Naman Arora (2019) analysed three main deep learning algorithms to identify the best algorithm for stock market classification and prediction – Back Propagation, Long Short-Term Memory (LSTM) and SVM. Back Propagation algorithm was implemented using Numpy and Pandas Library, whereas SVM used Scikit Learn (Sklearn) library. Based on 30 test runs, the researcher found that LSTM performs better compared to SVM and Back Propagation with no huge fluctuation.

Svetlana (2018) proposed a LSTM neural networks using variety of network inputs for intraday stock classification and prediction. LSTM is evaluated against lasso and ridge logistic classifiers. Based on the evaluation the researcher found that LSTM model performs better than lasso and ridge logistic classifiers.

Rosdyana (2019) uses Deep Convolutional Network and Candlestick Chart to classify and predict the stock price movement. In this research, the stock market historical data is converted into candlestick chart and the chart is fed as training data into Convolutional Neural Network Model. The proposed model gave an accuracy of 92.2% and 92.1% for Taiwan and Indonesian stock market, respectively.

Based on literature, the use of deep learning in financial market for financial market analysis mainly in stock market movement prediction is still an open problem. A large number of data sample is required to learn and train data. However, different segments of the training dataset return-varieties of pattern as the results of long training period are not always stationary (Takuya et al, 2019). Gary (2018) also mentioned that deep learning generally needs large

amount of data and training datasets, which must be the same as the testing datasets. However, deep learning works well in stable domain such as speech recognition. However, the debugging ability issue in domains like financial trades is still an open problem due to lack of transparency.

Table 2.2: Classification using Machine Learning and Deep Learning

No	Paper / Journal / Conference Paper Title & Author	Technique	Classifier	Result
1	Stock Direction Forecasting Techniques: An Empirical Study Combining Machine Learning System with Market Indicators in the Indian Context (Deepika et al, 2014)	Machine Learning	Integration of genetic algorithm into SVM and ANN	Genetic algorithm with ANN returns high accuracy.
2	Predicting Stock Market Indices using Classification Tools (Minjae Park et al, 2019)	Machine Learning	AdaBost with SVM, KNN, PNN and CART	AdaBoost with SVM gives high accuracy
3	Analysis on Stock Market Prediction using Machine Learning Techniques (Sheikh Irfan, 2019)	Machine Learning	Comparison among ANN, Decision Tree and SVM	ANN and SVM are mostly used
4	Stock Market Prediction with Deep Learning: A Character-based Neural Language Model for Event-Based Trading (Leonardo et al, 2017)	Deep Learning	Character Level Embedding	Character Level Embedding for classification is better than word level embedding
5	Financial Analysis: Stock Market Prediction Using Deep Learning Algorithms (Naman et al, 2019)	Deep Learning	Back Propagation, LSTM and SVM	LSTM has no huge fluctuation in accuracy.
6	An ensemble of LSTM neural networks for high-frequency stock market classification (Svetlana et al, 2018)	Deep Learning	LSTM	LSTM performs better than lasso and regression
7	Using Deep Learning Neural Networks and Candlestick Chart Representation to Predict Stock Market (Rosdyana et al, 2019)	Deep Learning	Deep Convolutional Network and Candlestick Charts	Deep Convolutional Network gives an accuracy more than 90%

2.7 Summary

This chapter discusses studies pertaining to the existing techniques and limitations of existing classification techniques, particularly in trading industry. The literature review is conducted to find the suitable technique(s) in order to overcome the research problems. Based on the literature review, identifying the stock price difference from the dividend news announcement to dividend payment period to classify the stock price movement can be a suitable solution to overcome this problem.

CHAPTER 3: RESEARCH METHODOLOGY

3.1   Introduction

Research methodology is an analytical approach to resolve an analogical research problem. This understanding is portrayed through a systematic study on how a research is conducted precisely. Through this, it is a practice with several steps that are usually adopted by researcher to study about the problem and figuring the rationality behind the entire case scenario. According to Kothari (2004) research is a search for knowledge on a specific topic in a scientific and systematic way. On the other hand, research can be an approach to find solutions to a problem. There are a few activities involved in a research which includes identifying the problem, data collection, data analysis and making conclusion of the findings or also known as solutions. A research can be consisting of the followings:-

3.1.1   Descriptive vs Analytical

Descriptive research is a research which reports on what has happened or what is currently happening as it uses survey and fact finding techniques. This research type is used to measure frequency or preferences. Besides that, researcher analyse the available info to produce an evaluation in analytical research (Imed, 2013).

3.1.2   Applied vs Fundamental

Applied research is where an action is applied to find a solution. The action can consist of social, economic or political trends. However, fundamental research is more to basic or pure research where it is focused in discovering information from a wide platform of knowledge (Pauline, 1939).

3.1.3   Quantitative vs Qualitative

The term describes the differences between these two methods. Quantitative is based on amount or quantity whereas qualitative is based on quality such as attitude or opinion of survey participants. (Johnson, 2008).

3.1.4   Conceptual vs Empirical

Thinkers or theorists usually uses conceptual research to produce new conceptions or modify the existing ones. Meanwhile, empirical research is where the researcher has to prove his/her research through experiments or empirical studies (Levering, 2002).

3.1.5   Some other types of research

Other forms of researches are just variations of above stated research types. Example of other type of research is simulation research.

3.2   Research Approach

Among all the research types, the two most common research types are quantitative and qualitative approach (Kothari, 2004). The research which classified into simulation or experimental approaches are known as quantitative research.

- Inferential: Survey-based research analyses a sample of data to determine its characteristics and infer the sample data.

- Experimental: Experiment-based research is where parameters are tuned to observe the impacts on other parameters.

- Simulation: Simulation-based research is where a model is built to run the simulation to produce the behaviour of the process.

Quantitative research is a systematic investigation by gathering data through online surveys, polls and questionnaire, and performing statistical techniques to analyse the data. Quantitative research are usually to generalise results from a sample to populate the

interest or various views in a chosen sample (Kothari, 2004). This research is conducted using quantitative approach where analysis on share market price has been imposed to categorise the dividend news.

3.3   Research Process

Research process is a sequence of steps to conduct a study effectively. The research process of this research is explained by introducing the research methodology used to achieve the research objectives. This research proposes a news classification system based on mathematical approach to classify the dividend news for 47 Trading and Services sector companies listed in BURSA Malaysia. The methodology includes several key steps such as defining research scope and problems, data collection and analysis, system development, evaluation of the news classification model and discussion of findings. Figure 3.1 shows the steps conducted to complete this research.
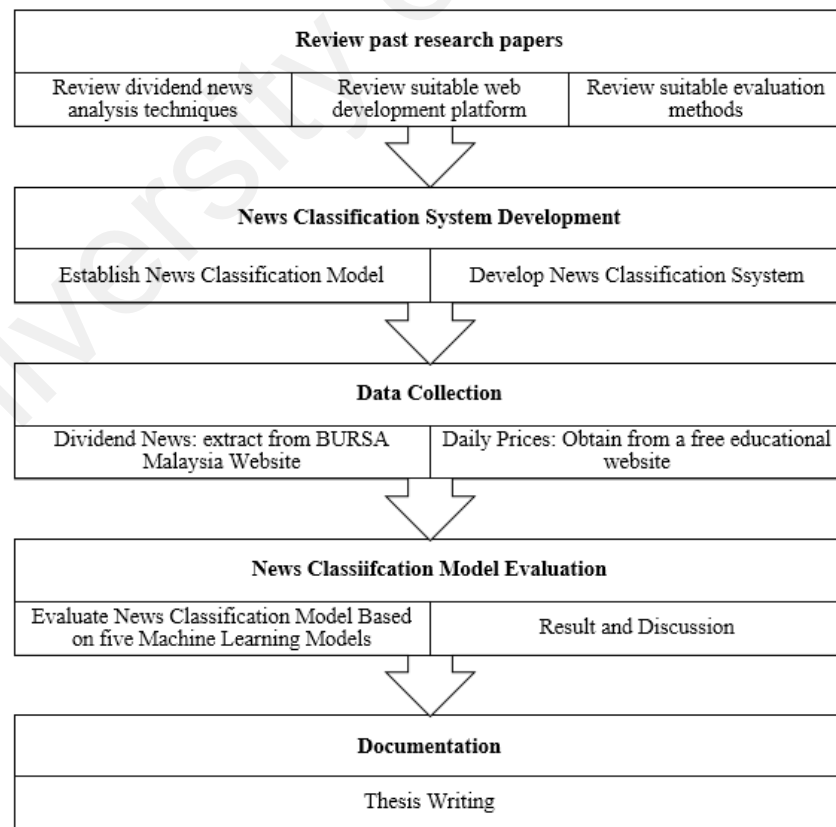
Figure 3.1: Research Process

3.4 Research Problems and Solutions

Many researches have been conducted in the area of news classification based on price movements using event study methodology. Recently, most of the researchers used ratio analysis and abnormal return method to analyse and classify dividend news (Faiza et al., 2013; Dharmarathre, 2013). With reference to the current issue which is classifying dividend news in stock market, it is necessary to develop a news classification system that can classify the dividend news correctly and precisely. Then, evaluation of the news classification model will be conducted using machine learning algorithm.

The proposed classification system would be able to classify the dividend news of the Trading and Services sector companies. The functionalities of the system incudes data collection, dividend news classification and news classification model evaluation. The classification formula is derived by comparing two closing price difference approach. Detailed description about the derived formula is presented in Chapter 4.

3.5 Development of News Classification System

The next process will be development of the News Classification System. At this step, two activities will be conducted. Firstly, the news classification model will be established using mathematical approach. The model is presented in Chapter 4.

Secondly, based on the established model, the news classification system will be developed. This can be achieved by coding the system in development platform. The news classification system in developed in Joget Workflow platform. Before start working on the system development, the design and architecture of the news classification system is designed.

Architecture of a system is an essential part of a system as it gives an overall picture how the components are connected among them. Hence, architecture is an abstract of a system which contains the details of components, the relations and interactions of

components. Besides that, reliability or usability of a system can be analysed at the software architectural level and not at code level (Imed, 2018). Figure 3.2 shows the architecture of the suggested system. The proposed system comprises of two modules - the stock price and dividend news processing module and the dividend news classification module.
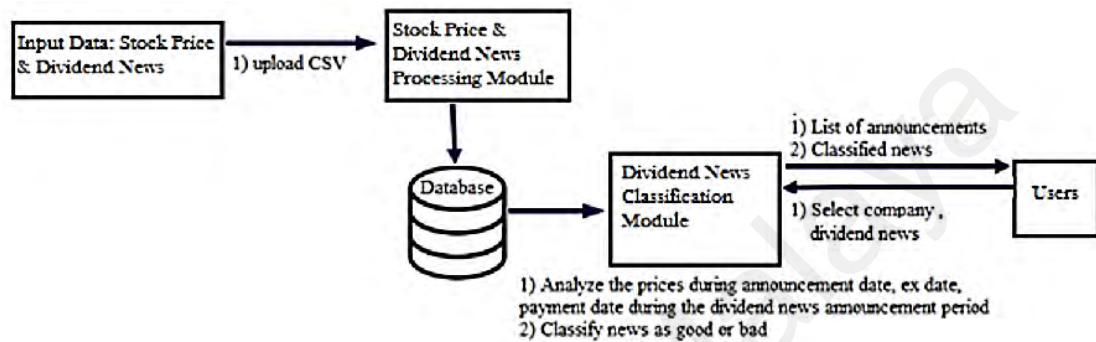
Figure 3.2: Proposed System Architecture

The aim of stock price and dividend news processing module is to store the uploaded data from CSV into database. Meanwhile, dividend news classification module is responsible to analyse the stock price based on announcement date, ex-date and payment date to classify the dividend news. The dividend news will be classified into three types – good, bad or neutral news.

3.6   Data Collection

According to Kothari (2004), appropriate data has to be collected to achieve the objective and test the hypothesis. Primary data and secondary data are two types of data which are commonly collected for analysis. The data collected by the researcher himself/herself is known as primary data whereas data collected by observation, interviews and survey are known as secondary data. This research is using secondary data where the share market prices are downloaded from an educational website, and the share market dividend news announcements are collected from the BURSA Malaysia website.

In addition, any inappropriate or missing prices in the dataset are pre-processed and removed to ensure that all the extracted data are valid. The share market price dataset must be labelled properly and converted into a compatible format that can be uploaded in the proposed and evaluation model.

3.7   Evaluation Methods

The evaluation process to measure the accuracy of the proposed model in classifying the share market dividend news. Machine learning is used in this research to evaluate the accuracy of the news classification approach by learning trends based on the trained data and predict the outcome with the test data. Both machine learning and deep learning is part of Artificial Intelligence. Computer program which learns from experience is known as Machine Learning (ML) whereas Deep Learning (DL) is one kind of machine learning which has the flexibility by learning and applies neural network approach (Faizan, 2017). The dissimilarities of ML and DL includes the following:

1) **Data Dependencies:** The main dissimilarity between machine learning and deep learning is the scale of data. The performance of deep learning algorithm is better when the amount of data is larger compared to machine learning (Faizan, 2017).

2) **Hardware Dependencies:** As deep learning manipulates large volume of background operations, it requires high-end engines. On the other side, machine learning can work on low-end engines (Faizan, 2017).

3) **Problem Solving Approach:** The problem solving in Machine learning is divided into two parts - label the features individually by expertise and combine them to retrieve the result. However, deep learning doesn't require features labelling and it does the process end-to-end. Due to this, machine

learning algorithm requires lesser time to train the data compared to deep learning (Faizan, 2017).

4) **Interpretability:** As deep learning applies neural network approach, it is difficult to identify neural network nodes used to solve a problem. On the other hand, machine learning uses mathematical approach and it is easy to interpret the result (Faizan, 2017).

As this study comprises classification and data has been labelled, machine learning will be the suitable platform to evaluate the accuracy of the proposed mathematical approach. Programming language that is being incorporated within the machine learning analysis is Python which has been coded in spider-web compiler.

3.7.1 Machine Learning

Machine learning is an element of Artificial Intelligence (AI). It is used to understand the structure of data from examples and experiences, and then fit the data into generic algorithm without being explicitly programmed. Logics are built based on the given data (Vihar, 2017). Machine learning is different from traditional computational approaches. It allows computer to output values by training the input data using statistical analysis and automates decision-making based on the input data (Lisa, 2017). There are three (3) parts in Machine Learning which are Model, Parameters and Learner (Danny, 2018).

- **Model:** predictions or identifications are made by the system.
- **Parameters:** decisions are made by the model using the signals or factors that passed to the system.
- **Learner:** parameters are adjusted and in turn the model

Figure 3.3 shows the theory of machine learning model. Machine learning starts with a model. Particular example of data has to be provided to the model. The model makes its calculations depending on the parameters. Machine Learning actually uses mathematical equation to form a model. Once the model is set, the real data is inputted into the system to train the machine learning algorithm. The score might partially or may not match the model. This initial real data is known as "training set" or "training data" as it is used by the learner to train itself to create a better model. The more data being trained, the more learner makes adjustment to the parameters to refine the model. Once the model has been created, a few sets of test data have to be inputted to allow the learner to make comparison and adjust the model to produce accurate prediction (Danny, 2018).
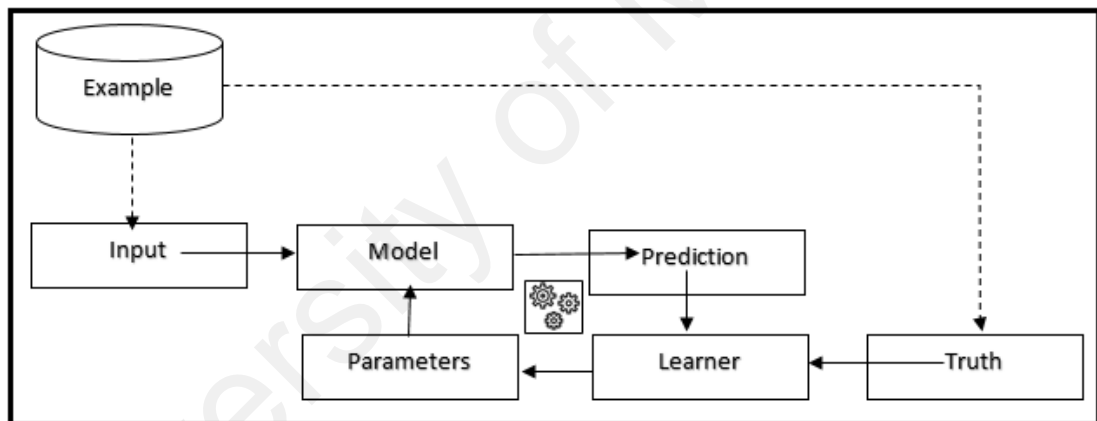
Figure 3.3: Machine Learning Model (Danny, 2018)

Table 3.1 shows the machine learning categories being used in industries.

Table 3.1: Machine Learning Categories (Lisa, 2017)

Categories	Description
Face Detection / Recognition	Identify faces in images
Email Filtering	Classifying emails into spam and not spam
Weather Prediction	Predict weather
Medical Diagnosis	Diagnose a patient of some disease
Optical Character Recognition	Converts images of text into movable type
Recommendation Engines	Suggest / recommend based on user preferences

Supervised learning and unsupervised learning are two types of machine learning algorithms. Supervised learning is whereby a system tries to learn from previous examples to predict a pattern. In unsupervised learning, a system attempts to find the arrangements directly from the prearranged examples (Vihar, 2017).
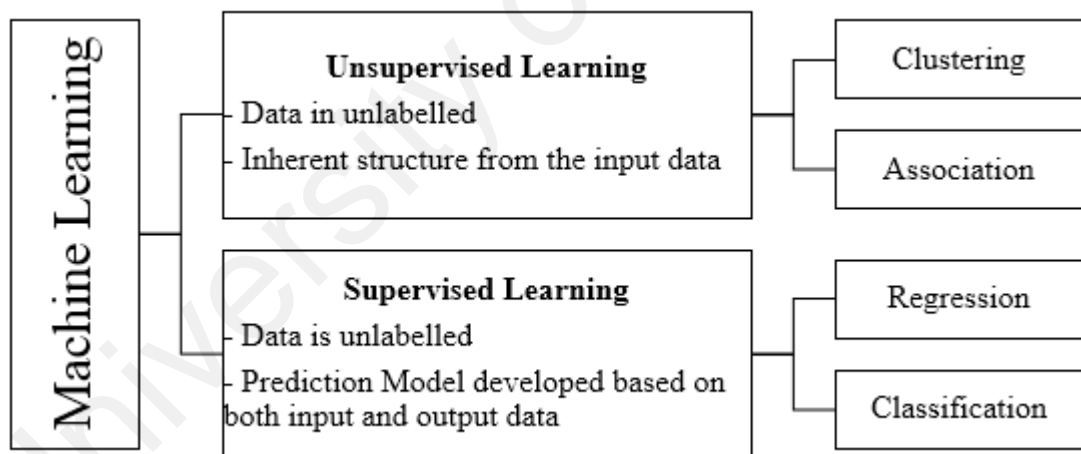
Figure 3.4: Machine Learning Types

Figure 3.4 describes the machine learning types. In supervised learning, the trained data which has been labelled with desired output are fed into computer to enable the algorithm to learn by comparing the actual output to find errors. For an example, images of sharks labelled as fish and images of oceans labelled as water are fed into algorithm. These two types of images are called trained data. Based on the trained data, the algorithm should

be able to identify the unlabelled images of sharks and ocean as fish or water, respectively. Supervised learning is used to predict future events using historical data. (Lisa, 2017)

As shown in Figure 3.4, there are two divisions of supervised learning which are classification and regression. Firstly, classification is when the output is being categorized or grouped, and regression is when the output is an actual value. In unsupervised learning, the algorithm discovers the raw data structure on its own with no corresponding output or labelled input. For example, by having a large dataset of customers and their purchases, it is unlikely to find the similarities based on customer profile and types of purchases. However, unsupervised learning can help to determine the similarities such as age range who buys scent soaps. Unsupervised learning can also be used as recommender system to recommend the customer on what products to buy next based on their purchase profile (Lisa, 2017)

Unsupervised learning can be divided into two which are association and clustering. Association means when the rules are discovered from the large dataset and clustering means when you want to group data with inherent. This research is using supervised learning models to identify the accuracy of the proposed method to classify the dividend news as good, bad or neutral news.

3.7.1.1   Supervised Learning Models

The five different models used to test the accuracy of this research findings are Logistic Regression (LR), Linear Discriminant Analysis (LDA), K Neighbours Classifiers (KNN), Gaussian Naïve Bayes and Support Vector Machines (SVM). Table 3.2 below describes each model and its usage. The models are mainly used for classification and the news classification result is evaluated using all the models below.

Table 3.2: Supervised Learning Models (Lisa, 2017)

Models	Description
Logistic Regression (LR)	• Used for binary classification • Uses Maximum Likelihood Estimation
Linear Discriminant Analysis (LDA)	• Used in pattern classification. • Finds optimal linear model that best separates two classes.
K Neighbours Classifiers (KNN)	• Both classification or regression • Compute a distance value between the item to be classified and pick the closest data point
Gaussian Naïve Bayes	• Used in text classification. • Uses Bayes Theorem - probability of an event
Support Vector Machines (SVM)	• Both classification and regression. • Best segregates the two classes (hyperplane / line)

3.8 Documentation

Documentation is an important segment in a research. Research work which has been carried out will be incomplete without proper documentation to support the research claim. This research work has been documented as part of this study which consist of six chapters as listed below:

- **Introduction** - Introduction of research work including research problems, objectives and scope of work.

- **Literature Reviews** - Review of past research works which are related to share market dividend news and identify the suitable method to be carried out for this research.

- **Research Methodology** - Research process carried out in this research work.

- **Classification of Dividend News** – Establishment of News Classification Model.

- **Result, Analysis and Discussion** - Discussion on result and analysis.

- **Discussion and Conclusion** - Conclusion of the research work

CHAPTER 4: CLASSIFICATION OF DIVIDEND NEWS

4.1   Overview

The aim of this study is to develop a news classification model to classify the dividend news as good, bad or neutral. This is to help the investors to know the positive, negative or neutral impact of dividend news during the dividend announcement period which is from the dividend announcement date until the dividend payment date. The definition of good news is when the share price on the payment date is higher than the announcement date, and if it is lower, it is classified as bad news. On the other hand, the news is classified as neutral when the difference in the share prices is zero.

A sample of 500 dividend news from 47 listed companies in Bursa Malaysia listed at the main board during the period of 2000 to 2018 are used in this study. This research uses historic data and the data used in this research work were retrieved from a free educational Website, Free88.org. This Website provides End-Of-Day (EOD) data and historic data for stock analysis for free.

4.2   Analysis of Share Price during Announcement Period

The dividend news classification is determined using mathematical approach which can be obtained in two ways. The first way is to classify the data using daily share price difference from the dividend announcement date until dividend payment date. It is not able to give the price difference between the interval dates. The second way is to find the price difference between the dividend announcement date, ex-date, entitlement date and dividend payment date. The mathematical formulas for these two ways are explained below.

Using the first way, comparison is made based on the daily difference of the closing price from the period of announcement date until the payment date. If the price difference is greater than zero (0), it is classified as good news; if less than zero (0), it is classified as bad news. and it is classified as neutral if the difference is zero (0). The news classification formula is as below:

$$PD = \sum(CP^n - CP^{n-1}) \quad\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4.1)$$

Where:-

PD: Price Difference

CP: Closing Price

n: Event day

News Classification:

PD >0, good news

PD < 0, bad news

PD = 0, neutral news

Using the second way, comparison is made based on the closing price difference between the announcement date, ex-date, entitlement date and the payment date. As shown in News Classification equation above, if the price difference is more than zero (0), then it is classified as good news whereas if it is less than 0, then it is classified as bad news. If there is no price difference, then the news is classified as neutral news. The formula is illustrated in Figure 4.1 below.
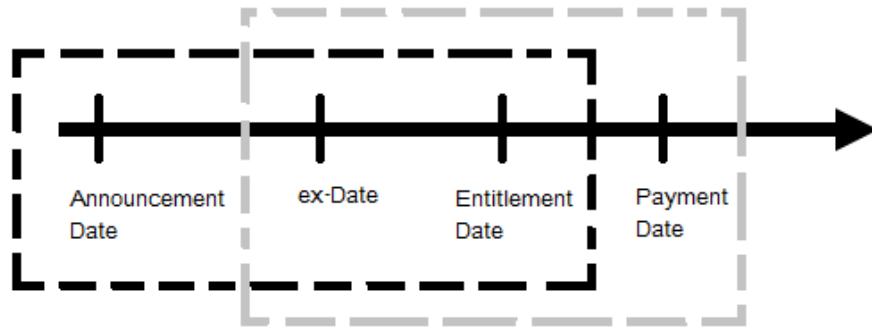
Figure 4.1: Second Way Formula Breakdown

$$PD = [(exDatePrice - ancDatePrice) + (entDatePrice - exDatePrice)] +$$

$$[(entDatePrice - exDatePrice) + (payDatePrice - entDatePrice)] \dots\dots\dots\dots(4.2)$$

Where:-

PD: Price Difference

exDatePrice: Price of Cut-off Date

ancDatePrice: Price of Announcement Date

entDatePrice: Price of Entitlement Date

payDatePrice: Price of Payment Date

Table 4.1 shows details on the dates of dividend payment for 10 listed companies at the main board of BURSA Malaysia. In this chapter, both the ways are explained to determine the more accurate/appropriate formula in order to classify the dividend news. A total of 500 dividend payment details of 47 companies are used in this research. Details of the dividend payment dates, closing prices, and price differences of 10 selected Trading and Services sector companies are shown in the following tables.

Table 4.1: Details of the Dates of Dividend Payment of 10 Companies (Listed at BURSA Main Board)

No.	Company	Dividend News Reference No.	Announcement Date	Ex-Date	Entitlement Date	Payment Date
1	Oldtown Berhad	ENT-06092017-00005	6/9/2017	25/9/2017	27/9/2017	3/10/2017
2	Sunway Berhad	ENT-20022017-00010	27/2/2017	4/4/2017	6/4/2017	28/4/2017
3	Amway (Malaysia) Holdings Berhad	CC-140206-7F380	25/2/2014	10/3/2014	12/3/2014	21/3/2014
4	Kamdar Group (M) Berhad	CC-130603-38581	3/6/2013	18/7/2013	22/7/2013	19/8/2013
5	KPJ Healthcare Berhad	JC-110520-65089	20/5/2011	28/6/2011	30/6/2011	29/7/2011
6	Fraser & Neave Holdings Bhd	F&-040526-55142	26/5/2004	11/6/2004	15/6/2004	25/6/2004
7	Magnum Berhad	ENT-23082017-00006	23/8/2017	13/9/2017	15/9/2017	29/9/2017
8	YTL Corporation Berhad	ENT-23082016-00024	25/8/2016	27/10/2016	31/10/2016	15/11/2016
9	Pansar Berhad	MB-100824-64801	24/8/2010	7/9/2010	9/9/2010	27/9/2010
10	Hap Seng Consolidated Berhad	ENT-31052017-00006	31/5/2017	13/6/2017	15/6/2017	28/6/2017

4.2.1 Oldtown Berhad

As shown in Table 4.2, for the announcement date from 6th of September 2017 until the dividend payment date on 3rd of October 2017, the price difference within these 19 days period using the first way is -0.18. Table 4.3 shows the news classification using the second way as explained below where the price difference is -0.27. Both ways classify the dividend news during this period as bad news.

Table 4.2: Difference in Daily Closing Price for Oldtown Berhad (First Way)

Date	Closing Price	Price Difference
5/9/2017	2.7	0
6/9/2017	2.74	0.04
7/9/2017	2.75	0.01
8/9/2017	2.75	0
11/9/2017	2.73	-0.02
12/9/2017	2.72	-0.01
13/9/2017	2.76	0.04
14/9/2017	2.74	-0.02
15/9/2017	2.68	-0.06
18/9/2017	2.69	0.01
19/9/2017	2.7	0.01
20/9/2017	2.69	-0.01
21/9/2017	2.6	-0.09
25/9/2017	2.65	0.05
26/9/2017	2.6	-0.05
27/9/2017	2.6	0
28/9/2017	2.59	-0.01
29/9/2017	2.56	-0.03
2/10/2017	2.51	-0.05
3/10/2017	2.52	0.01
Total ($\sum(CP^n - CP^{n-1})$)		-0.18

Table 4.3: Difference in Closing Price for Oldtown Berhad (Second Way)

Price on announcement date	Price on ex-date	Price on entitlement date	Price on payment date	Price Difference
2.74	2.65	2.6	2.52	-0.27

4.2.2 Sunway Berhad

As shown in Table 4.4, for the announcement date from 27th February 2017 until the dividend payment date on 28th April 2017, the price difference within these 44 days period using the first way is 0.1324. Table 4.5 shows the news classification using the second way as explained below where the price difference is 0.1495. Both ways classify the dividend news during this period as good news.

Table 4.4: Difference in Daily Closing Price for Sunway Berhad (First Way)

Date	Closing Price	Price Difference
26/2/2017	1.3491	0
27/2/2017	1.3491	0
28/2/2017	1.379	0.0299
1/3/2017	1.3534	-0.0256
2/3/2017	1.3491	-0.0043
3/3/2017	1.3406	-0.0085
6/3/2017	1.3406	0
7/3/2017	1.3491	0.0085
8/3/2017	1.3491	0
9/3/2017	1.3449	-0.0042
10/3/2017	1.3449	0
13/3/2017	1.3491	0.0042
14/3/2017	1.3491	0
15/3/2017	1.3449	-0.0042
16/3/2017	1.3491	0.0042
17/3/2017	1.3876	0.0385
20/3/2017	1.3662	-0.0214
21/3/2017	1.3705	0.0043
22/3/2017	1.3705	0
23/3/2017	1.3918	0.0213
24/3/2017	1.3876	-0.0042
27/3/2017	1.3876	0
28/3/2017	1.3876	0
29/3/2017	1.3876	0
30/3/2017	1.3876	0
31/3/2017	1.3876	0
3/4/2017	1.3961	0.0085
4/4/2017	1.3833	-0.0128

Date	Closing Price	Price Difference
5/4/2017	1.3961	0.0128
6/4/2017	1.4004	0.0043
7/4/2017	1.4132	0.0128
10/4/2017	1.4303	0.0171
11/4/2017	1.4089	-0.0214
12/4/2017	1.4046	-0.0043
13/4/2017	1.4089	0.0043
14/4/2017	1.4046	-0.0043
17/4/2017	1.4046	0
18/4/2017	1.4174	0.0128
19/4/2017	1.4217	0.0043
20/4/2017	1.4303	0.0086
21/4/2017	1.4516	0.0213
25/4/2017	1.4772	0.0256
26/4/2017	1.4729	-0.0043
27/4/2017	1.4687	-0.0042
28/4/2017	1.4815	0.0128
	Total ($\sum(CP^n - CP^{n-1})$)	0.1324

Table 4.5: Difference in Closing Price for Sunway Berhad (Second Way)

Price on announcement date	Price on ex-date	Price on entitlement date	Price on payment date	Price Difference
1.3491	1.3833	1.4004	1.4815	0.1495

4.2.3 Amway (Malaysia) Holdings Berhad

As shown in Table 4.6, for the announcement date from 25th Feb 2014 until the dividend payment date on 21st March 2014, the price difference within these 19 days period using the first way is 0. Table 4.7 shows the news classification using the second way as explained below where the price difference is 0. Both ways classify the dividend news during this period as neutral news.

Table 4.6: Difference in Daily Closing Price for Amway (Malaysia) Holdings Berhad (First

Way)

Date	Closing Price	Price Difference
25/2/2014	12	**0**
26/2/2014	12.3	0.3
27/2/2014	12.3	0
28/2/2014	12.3	0
3/3/2014	12.3	0
4/3/2014	12.22	-0.08
5/3/2014	12.26	0.04
6/3/2014	12.26	0
7/3/2014	12.28	0.02
10/3/2014	12	-0.28
11/3/2014	12.02	0.02
12/3/2014	12	-0.02
13/3/2014	12.14	0.14
14/3/2014	12.14	0
17/3/2014	12.1	-0.04
18/3/2014	12	-0.1
19/3/2014	12.1	0.1
20/3/2014	12	-0.1
21/3/2014	12	0
	Total ($\sum(CP^n - CP^{n-1})$)	0

Table 4.7: Difference in Closing Price for Amway (Malaysia) Holdings Berhad (Second

Way)

Price on announcement date	Price on ex-date	Price on entitlement date	Price on payment date	Price Difference
12	12	12	12	0

4.2.4 Kamdar Group (M) Berhad

As shown in Table 4.8, for the announcement date from 3rd June 2013 until the dividend

payment date on 19th August 2013, the price difference within these 54 days period using the

first way is -0.025. Table 4.9 shows the news classification using the second way as explained

below where the price difference is -0.04. Both ways classify the dividend news during this period as bad news.

Table 4.8: Difference in Daily Closing Price for Kamdar Group (M) Berhad (First Way)

Date	Closing Price	Price Difference
3/6/2013	0.535	0
3/6/2013	0.535	0
4/6/2013	0.54	0.005
5/6/2013	0.535	-0.005
6/6/2013	0.535	0
7/6/2013	0.54	0.005
10/6/2013	0.54	0
11/6/2013	0.53	-0.01
12/6/2013	0.55	0.02
13/6/2013	0.515	-0.035
14/6/2013	0.54	0.025
17/6/2013	0.52	-0.02
18/6/2013	0.525	0.005
19/6/2013	0.51	-0.015
20/6/2013	0.515	0.005
21/6/2013	0.515	0
24/6/2013	0.52	0.005
25/6/2013	0.52	0
26/6/2013	0.535	0.015
27/6/2013	0.545	0.01
28/6/2013	0.555	0.01
1/7/2013	0.53	-0.025
2/7/2013	0.57	0.04
3/7/2013	0.57	0
4/7/2013	0.53	-0.04
5/7/2013	0.53	0
8/7/2013	0.55	0.02
9/7/2013	0.545	-0.005
10/7/2013	0.545	0
11/7/2013	0.545	0
12/7/2013	0.53	-0.015
15/7/2013	0.54	0.01
16/7/2013	0.54	0
17/7/2013	0.545	0.005
18/7/2013	0.515	-0.03
19/7/2013	0.5	-0.015

Date	Closing Price	Price Difference
22/7/2013	0.5	0
23/7/2013	0.5	0
24/7/2013	0.5	0
25/7/2013	0.5	0
26/7/2013	0.5	0
29/7/2013	0.55	0.05
30/7/2013	0.55	0
31/7/2013	0.55	0
1/8/2013	0.59	0.04
2/8/2013	0.62	0.03
5/8/2013	0.62	0
6/8/2013	0.62	0
7/8/2013	0.53	-0.09
12/8/2013	0.515	-0.015
13/8/2013	0.515	0
14/8/2013	0.515	0
15/8/2013	0.515	0
16/8/2013	0.5	-0.015
19/8/2013	0.51	0.01
	Total ($\sum(CP^n - CP^{n-1})$)	-0.025

Table 4.9: Difference in Closing Price for Kamdar Group (M) Berhad (Second Way)

Price on announcement date	Price on ex-date	Price on entitlement date	Price on payment date	Price Difference
0.535	0.515	0.5	0.51	-0.04

4.2.5 KPJ Healthcare Berhad

As shown in Table 4.10, for the announcement date from 20th May 2011 until the dividend payment date on 29th July 2011, the price difference within these 51 days period using the first way is 0.0623. Table 4.11 shows the news classification using the second way as explained below where the price difference is 0.0821. Both ways classify the dividend news during this period as good news.

Table 4.10: Difference in Daily Closing Price for KPJ Healthcare Berhad (First Way)

Date	Closing Price	Price Difference
19/5/2011	0.6942	0
20/5/2011	0.6842	-0.01
23/5/2011	0.6907	0.0065
24/5/2011	0.6858	-0.0049
25/5/2011	0.6875	0.0017
26/5/2011	0.6907	0.0032
27/5/2011	0.6858	-0.0049
30/5/2011	0.6875	0.0017
31/5/2011	0.7138	0.0263
1/6/2011	0.7006	-0.0132
2/6/2011	0.7039	0.0033
3/6/2011	0.7072	0.0033
6/6/2011	0.7006	-0.0066
7/6/2011	0.7072	0.0066
8/6/2011	0.7121	0.0049
9/6/2011	0.7154	0.0033
10/6/2011	0.7368	0.0214
13/6/2011	0.7253	-0.0115
14/6/2011	0.7351	0.0098
15/6/2011	0.75	0.0149
16/6/2011	0.7384	-0.0116
17/6/2011	0.7582	0.0198
20/6/2011	0.745	-0.0132
21/6/2011	0.7648	0.0198
22/6/2011	0.7615	-0.0033
23/6/2011	0.7483	-0.0132
24/6/2011	0.7483	0
27/6/2011	0.75	0.0017
28/6/2011	0.75	0
29/6/2011	0.7516	0.0016
30/6/2011	0.7598	0.0082
1/7/2011	0.7582	-0.0016
4/7/2011	0.7582	0
5/7/2011	0.7516	-0.0066
6/7/2011	0.7483	-0.0033
7/7/2011	0.7516	0.0033
8/7/2011	0.75	-0.0016
11/7/2011	0.7483	-0.0017
12/7/2011	0.7483	0
13/7/2011	0.7483	0

Date	Closing Price	Price Difference
14/7/2011	0.7467	-0.0016
15/7/2011	0.7368	-0.0099
18/7/2011	0.7368	0
19/7/2011	0.7335	-0.0033
20/7/2011	0.745	0.0115
21/7/2011	0.745	0
22/7/2011	0.7549	0.0099
25/7/2011	0.7532	-0.0017
26/7/2011	0.7483	-0.0049
27/7/2011	0.7598	0.0115
28/7/2011	0.7549	-0.0049
29/7/2011	0.7565	0.0016
	Total ($\sum(CP^n - CP^{n-1})$)	0.0623

Table 4.11: Difference in Closing Price for KPJ Healthcare Berhad (Second Way)

Price on announcement date	Price on ex-date	Price on entitlement date	Price on payment date	Price Difference
0.6842	0.75	0.7598	0.7565	0.0821

4.2.6   Fraser & Neave Holdings Bhd

As shown in Table 4.12, for the announcement date from 26th May 2004 until the dividend payment date on 25th June 2004, the price difference within these 23 days period using the first way is 0. Table 4.13 shows the news classification using the second way as explained below where the price difference is 0. Both ways classify the dividend news during this period as neutral news.

Table 4.12: Difference in Daily Closing Price for Fraser & Neave Holdings Bhd (First

Way)

Date	Closing Price	Price Difference
26/5/2004	4.18	0
27/5/2004	4.22	0.04
28/5/2004	4.22	0

Date	Closing Price	Price Difference
31/5/2004	4.22	0
1/6/2004	4.18	-0.04
2/6/2004	4.22	0.04
3/6/2004	4.2	-0.02
4/6/2004	4.18	-0.02
7/6/2004	4.22	0.04
8/6/2004	4.22	0
9/6/2004	4.22	0
10/6/2004	4.24	0.02
11/6/2004	4.16	-0.08
14/6/2004	4.16	0
15/6/2004	4.18	0.02
16/6/2004	4.24	0.06
17/6/2004	4.12	-0.12
18/6/2004	4.2	0.08
21/6/2004	4.18	-0.02
22/6/2004	4.1	-0.08
23/6/2004	4.14	0.04
24/6/2004	4.14	0
25/6/2004	4.18	0.04
	Total ($\sum(CP^n - CP^{n-1})$)	0

Table 4.13: Difference in Closing Price for Fraser & Neave Holdings Bhd (Second Way)

Price on announcement date	Price on ex-date	Price on entitlement date	Price on payment date	Price Difference
4.18	4.18	4.18	4.18	0

4.2.7   Magnum Berhad

As shown in Table 4.14, for the announcement date from 23rd August 2017 until the dividend payment date on 29th September 2017, the price difference within these 24 days period using the first way is 0.1. Table 4.15 shows the news classification using the second way as explained below where the price difference is 0.09. Both ways classify the dividend news during this period as good news.

Table 4.14: Difference in Daily Closing Price for Magnum Berhad (First Way)

Date	Closing Price	Price Difference
22/8/2017	1.71	0
23/8/2017	1.71	0
24/8/2017	1.8	0.09
25/8/2017	1.81	0.01
28/8/2017	1.81	0
29/8/2017	1.84	0.03
30/8/2017	1.9	0.06
5/9/2017	1.89	-0.01
6/9/2017	1.87	-0.02
7/9/2017	1.87	0
8/9/2017	1.88	0.01
11/9/2017	1.89	0.01
12/9/2017	1.89	0
13/9/2017	1.86	-0.03
14/9/2017	1.84	-0.02
15/9/2017	1.85	0.01
18/9/2017	1.84	-0.01
19/9/2017	1.83	-0.01
20/9/2017	1.81	-0.02
21/9/2017	1.82	0.01
25/9/2017	1.79	-0.03
26/9/2017	1.78	-0.01
27/9/2017	1.79	0.01
28/9/2017	1.8	0.01
29/9/2017	1.81	0.01
Total ($\sum(CP^n - CP^{n-1})$)		0.1

Table 4.15: Difference in Closing Price for Magnum Berhad (Second Way)

Price on announcement date	Price on ex-date	Price on entitlement date	Price on payment date	Price Difference
1.71	1.86	1.85	1.81	0.09

4.2.8   YTL Corporation Berhad

As shown in Table 4.16, for the announcement date from 25th August 2016 until the dividend payment date on 15th November 2016, the price difference within these 55 days period using the first way is -0.1413. Table 4.17 shows the news classification using the second way as explained below where the price difference is -0.1979. Both ways classify the dividend news during this period as bad news.

Table 4.16: Difference in Daily Closing Price for YTL Corporation Berhad (First Way)

Date	Closing Price	Price Difference
24/8/2016	1.5927	0
25/8/2016	1.6022	0.0095
26/8/2016	1.6022	0
29/8/2016	1.6022	0
30/8/2016	1.5833	-0.0189
1/9/2016	1.5927	0.0094
2/9/2016	1.6022	0.0095
5/9/2016	1.6116	0.0094
6/9/2016	1.621	0.0094
7/9/2016	1.621	0
8/9/2016	1.621	0
9/9/2016	1.6304	0.0094
13/9/2016	1.6399	0.0095
14/9/2016	1.6304	-0.0095
15/9/2016	1.6399	0.0095
19/9/2016	1.6493	0.0094
20/9/2016	1.6587	0.0094
21/9/2016	1.6964	0.0377
22/9/2016	1.7153	0.0189
23/9/2016	1.6964	-0.0189
26/9/2016	1.6776	-0.0188
27/9/2016	1.6964	0.0188
28/9/2016	1.687	-0.0094
29/9/2016	1.687	0
30/9/2016	1.687	0
4/10/2016	1.687	0
5/10/2016	1.6681	-0.0189
6/10/2016	1.6776	0.0095

Date	Closing Price	Price Difference
7/10/2016	1.6681	-0.0095
10/10/2016	1.6587	-0.0094
11/10/2016	1.6681	0.0094
12/10/2016	1.6681	0
13/10/2016	1.6587	-0.0094
14/10/2016	1.6681	0.0094
17/10/2016	1.6493	-0.0188
18/10/2016	1.6776	0.0283
19/10/2016	1.6587	-0.0189
20/10/2016	1.6681	0.0094
21/10/2016	1.6493	-0.0188
24/10/2016	1.6304	-0.0189
25/10/2016	1.6493	0.0189
26/10/2016	1.6399	-0.0094
27/10/2016	1.5456	-0.0943
28/10/2016	1.5079	-0.0377
31/10/2016	1.4985	-0.0094
1/11/2016	1.5079	0.0094
2/11/2016	1.4796	-0.0283
3/11/2016	1.4608	-0.0188
4/11/2016	1.4419	-0.0189
7/11/2016	1.4608	0.0189
8/11/2016	1.4985	0.0377
9/11/2016	1.4891	-0.0094
10/11/2016	1.4702	-0.0189
11/11/2016	1.4702	0
14/11/2016	1.4702	0
15/11/2016	1.4514	-0.0188
Total ($\sum(CP^n - CP^{n-1})$)		-0.1413

Table 4.17: Difference in Closing Price for YTL Corporation Berhad (Second Way)

Price on announcement date	Price on ex-date	Price on entitlement date	Price on payment date	Price Difference
1.6022	1.5456	1.4985	1.4514	-0.1979

4.2.9 Pansar Berhad

As shown in Table 4.18, for the announcement date from 24th August 2010 until the dividend payment date on 27th September 2010, the price difference within these 22 days period using the first way is 0. Table 4.19 shows the news classification using the second way as explained below where the price difference is also 0. Both ways classify the dividend news during this period as neutral news.

Table 4.18: Difference in Daily Closing Price for Pansar Berhad (First Way)

Date	Closing Price	Price Difference
24/8/2010	0.0144	0
25/8/2010	0.0144	0
26/8/2010	0.0144	0
27/8/2010	0.0144	0
30/8/2010	0.0144	0
1/9/2010	0.0144	0
2/9/2010	0.0144	0
3/9/2010	0.0144	0
6/9/2010	0.0144	0
7/9/2010	0.0144	0
8/9/2010	0.0144	0
9/9/2010	0.0144	0
13/9/2010	0.0144	0
14/9/2010	0.0144	0
15/9/2010	0.0144	0
17/9/2010	0.0144	0
20/9/2010	0.0144	0
21/9/2010	0.0144	0
22/9/2010	0.0144	0
23/9/2010	0.0144	0
24/9/2010	0.0144	0
27/9/2010	0.0144	0
	Total ($\sum(CP^n - CP^{n-1})$)	0

Table 4.19: Difference in Closing Price for Pansar Berhad (Second Way)

Price on announcement date	Price on ex-date	Price on entitlement date	Price on payment date	Price Difference
0.0144	0.0144	0.0144	0.0144	0

4.2.10 Hap Seng Consolidated Berhad

As shown in Table 4.20, for the announcement date from 31st May 2017 until the dividend payment date on 28th June 2017, the price difference within these 18 days period using the first way is -0.05. Table 4.21 shows the news classification using the second way as explained below where the price difference is -0.03. Both ways classify the dividend news during this period as bad news.

Table 4.20: Difference in Daily Closing Price for Hap Seng Consolidated Berhad (First Way)

Date	Closing Price	Price Difference
30/5/2017	9.2	0
31/5/2017	9.18	-0.02
1/6/2017	9.2	0.02
2/6/2017	9.21	0.01
5/6/2017	9.22	0.01
6/6/2017	9.22	0
7/6/2017	9.2	-0.02
8/6/2017	9.2	0
9/6/2017	9.2	0
13/6/2017	9.11	-0.09
14/6/2017	9.12	0.01
15/6/2017	9.11	-0.01
16/6/2017	8.79	-0.32
19/6/2017	8.99	0.2
20/6/2017	9	0.01
21/6/2017	9	0
22/6/2017	9.18	0.18
23/6/2017	9.09	-0.09
28/6/2017	9.15	0.06

Date	Closing Price	Price Difference
	Total ($\sum(CP^n - CP^{n-1})$)	-0.05

Table 4.21: Difference in Closing Price for Hap Seng Consolidated Berhad (Second Way)

Price on announcement date	Price on ex-date	Price on entitlement date	Price on payment date	Price Difference
9.18	9.11	9.11	9.15	-0.03

4.3   Comparison of Daily Price and Proposed Method

The results of both ways are summarised in Table 4.22. Although both ways show the same news classification result, but the second way helps investors to classify the news easily and faster.

Table 4.22: Summary of Results using Both Ways

No.	Company	First Way	Second Way	Result of News Classification
1	Oldtown Berhad	-0.18	-0.27	Bad
2	Sunway Berhad	0.1324	0.1495	Good
3	Amway (Malaysia) Holdings Berhad	0	0	Neutral
4	Kamdar Group (M) Berhad	-0.025	-0.04	Bad
5	KPJ Healthcare Berhad	0.0623	0.0821	Good
6	Fraser & Neave Holdings Bhd	0	0	Neutral
7	Magnum Berhad	0.1	0.09	Good
8	YTL Corporation Berhad	-0.1413	-0.1979	Bad
9	Pansar Berhad	0	0	Neutral
10	Hap Seng Consolidated Berhad	-0.05	-0.03	Bad

The daily closing price difference using the first way is evaluating the difference on daily basis instead of price difference within intervals. On the other hand, it compares the price with the previous day. However, the proposed formula evaluates the price in the interval period like announcement period to entitlement period and entitlement period to payment.

This is because the price pattern is not the same all the time and it might increase or decrease after the ex-date or entitlement period. The second way shows the amount of total increment or decrement of the mentioned price instead of just the price difference during the announcement period. On the other hand, second way is a simplified mathematical formula and helps investors to classify the dividend news easily and faster rather than calculating the daily price difference from dividend announcement date until dividend payment date. The accuracy of the second way result will be evaluated in the following chapter using machine learning models.

CHAPTER 5: RESULT, ANALYSIS AND DISCUSSION

5.1   Introduction

In this chapter, values and data are posed into the mathematical formula which has been derived in Chapter 4 to classify the dividend news. The collected data is being analysed to view significant result, which is the important part of this study. The main goal is to help investors to classify the dividend news easily and without any hassle. The result derived are also being used to study the price trend during dividend news announcement and determine whether or not to invest into share market. Objectives in Chapter 1 are concurrently checked for consistency over results, which brings discussion towards the collected data. The data used in this chapter shows the practicality of dividend news, where application is being observed through the targeted sector.

5.2   The Proposed News Classification Model

5.2.1   Process Flow

Figure 5.1 shows the overall process flow of the proposed news classification system. The first stage is the setup of the company, dividend news and daily price entry. The setup is then uploaded using a csv file. Once the setup is done, the user will be able to view the news classification result.
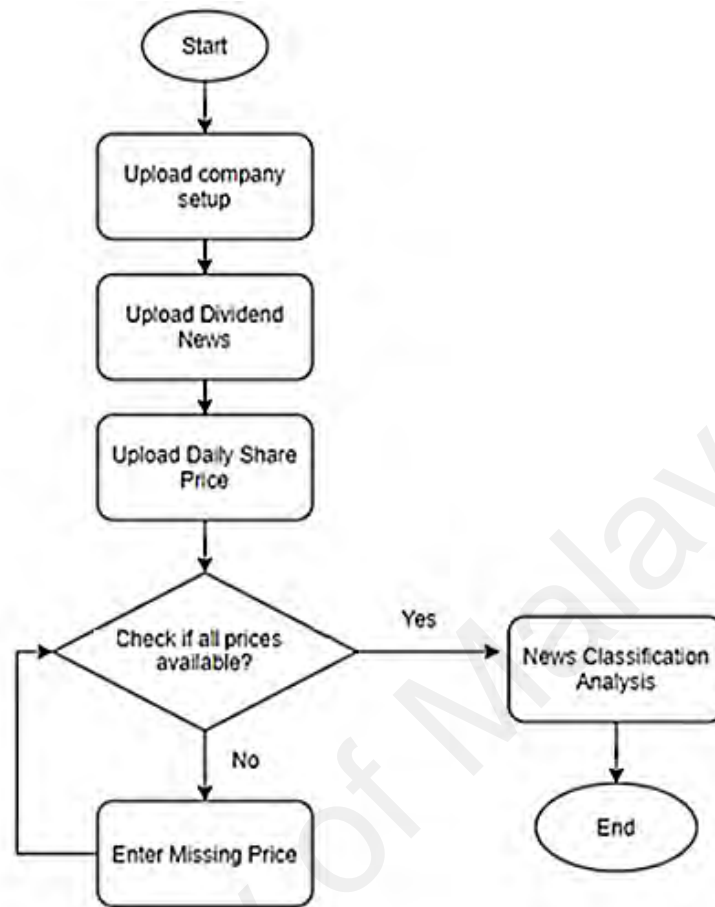
Figure 5.1: News Classification Process Flow

5.2.2 Company Setup

The company setup is done by uploading a csv file. As shown in Figure 5.2, the csv file consists of top stocks, market, sector, company code, company short name, company name, ticker and status. All these information are taken from Bursa Saham webpage. Below is the sample of company setup file contents.

	A	B	C	D	E	F	G	H
1	topStocks	market	sector	companyCode	compShortName	companyName	ticker	status
2	Top Active	MAIN MARK	TRAD/SERV	7209	CHEETAH	CHEETAH HOLDINGS BERHAD [S] (7209.KL)	CHEETAH.KL	A

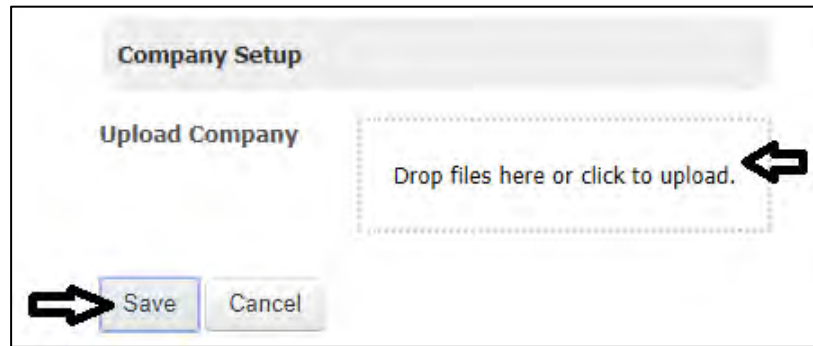Figure 5.2: CSV File Contents of Company Setup

Figure 5.3: Company Setup

Figure 5.3 shows the company setup screen. Upon uploading the company setup file, user will be able to view the company code, company short name, company name, ticker and status from the "Company Setup" menu as shown in Figure 5.4.

Figure 5.4: Company Setup Display

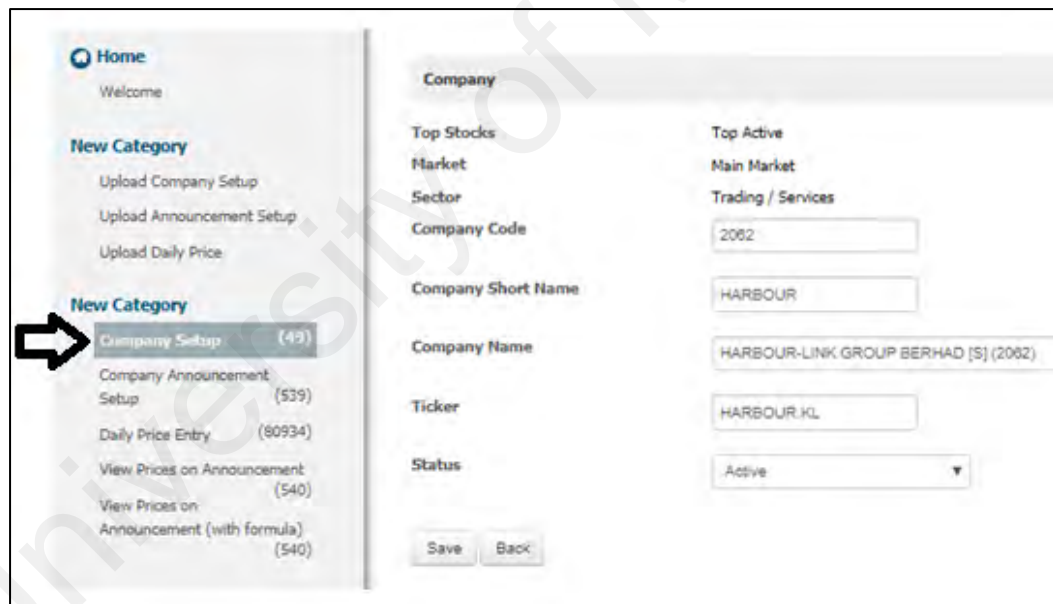### 5.2.3 Dividend News Announcement Setup

Dividend news announcement is linked with company setup by ticker. As shown in Figure 5.5, the csv file of dividend news announcement setup consists of dividend news reference number, date announced, company name, stock name, company code, category, ex-date, entitlement date, entitlement subject, entitlement description, payment date and entitlement

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in currency. The reference no is unique and it is retrieved from Bursa Saham webpage. The date format is dd/mm/yyyy.

Figure 5.5: CSV File Contents of Dividend News Announcement

Figure 5.6 shows the Dividend News Announcement setup screen.
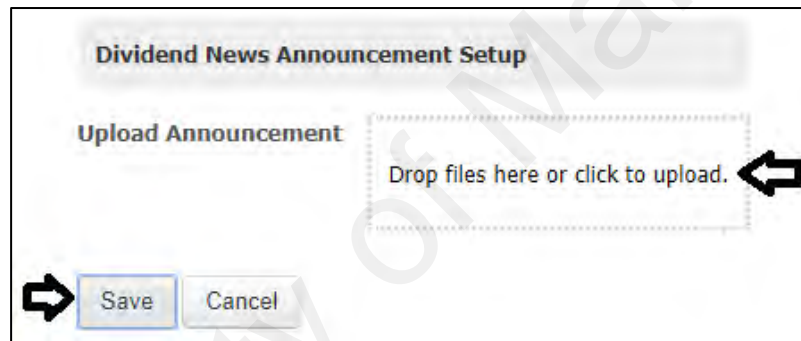
Figure 5.6: Dividend News Announcement

Upon uploading the dividend news announcement setup, users will be able to view the list of announcements for a specific company in a glance under the 'Company Announcement Setup' menu. The announcement setup consists of two sections which are company details and announcement details. Company details consists of top stocks, market, sector, company code, company name and status whereas announcement details shows the list of announcements announced by the respective company. Figure 5.7 shows the dividend news announcement screen.
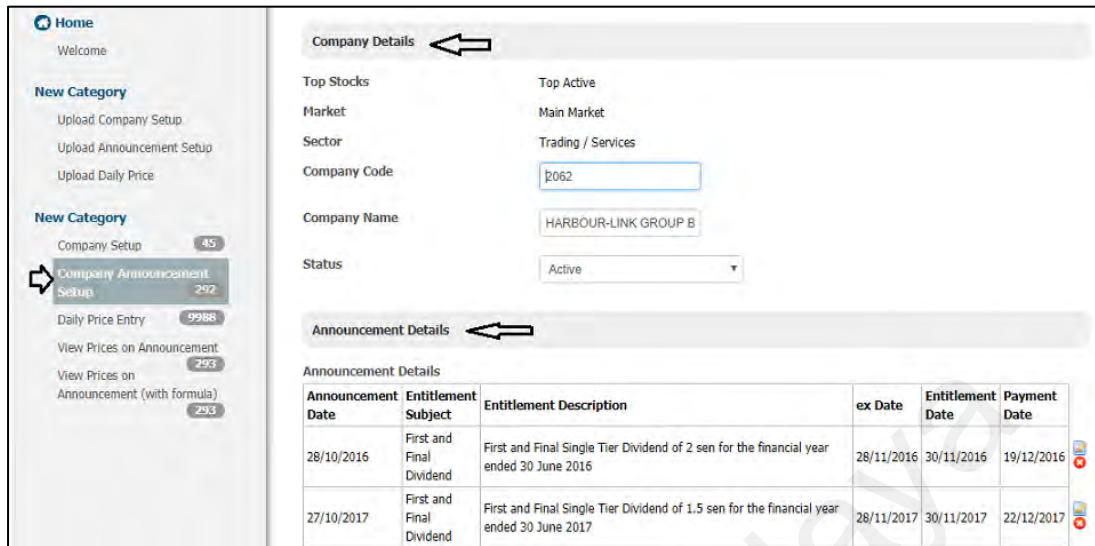
Figure 5.7: Dividend News Announcement Display

5.2.4 Daily Price Entry setup

The daily price setup is linked by ticker with company setup. The daily price entry setup csv file as shown in Figure 5.8 consists of id, name, ticker, company code, date, volume and prices of open, high, low and close.

	A	B	C	D	E	F	G	H	I	J
1	<id>	<name>	<ticker>	compCode	<date>	<open>	<high>	<low>	<close>	<vol>
2	FREIGHT.KL20180816	FREIGHT MANAGEMENT HOLDINGS BERHAD [S] (7210.KL)	FREIGHT.KL	7210	16/8/2018	1.1	1.1	1.1	1.1	50

Figure 5.8: CSV File Contents of Daily Price Entry

Figure 5.9 shows the daily price entry screen.
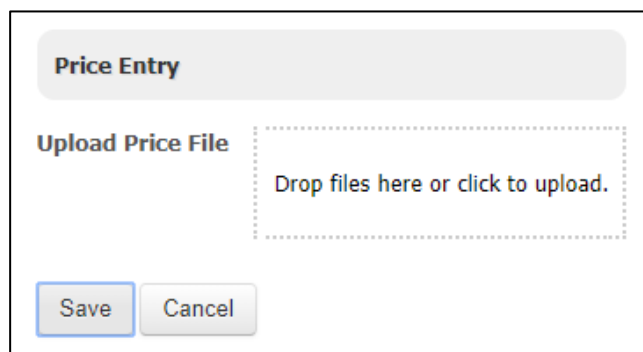
Figure 5.9: Daily Price Entry

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Figure 5.10 shows the screen upon performing the daily price entry setup. Users will be able to view the prices by clicking the 'Daily Price Entry' option as shown in Figure 5.10. The grid shows the details of prices for each day.

Figure 5.10: Daily Price Entry Display

5.2.5 Formula Derivation

As discussed in Chapter 4, the formula used to classify the news is the price differences between announcement date, ex-date and entitlement date and payment date. If the return result is greater than zero, then it is classified as good news, else, it is classified as bad news. If the result is equal to zero, then it is classified as neutral news.

$$PD = [(exDatePrice - ancDatePrice) + (entDatePrice - exDatePrice)] + [(entDatePrice - exDatePrice) + (payDatePrice - entDatePrice)] \ldots\ldots\ldots(5.1)$$

Where:-

PD: Price Difference

exDatePrice: Price of Cut-off Date

ancDatePrice: Price of Announcement Date

entDatePrice: Price of Entitlement Date

payDatePrice: Price of Payment Date

News Classification :

PD > 0, good news

PD < 0, bad news

PD = 0, neutral news

5.3   Dataset Description

5.3.1   Good News

A dividend news announcement is categorized as good news when the price is increasing from announcement date to payment date. For example, the data shown in Table 5.1 show that the price is increasing from announcement date to payment date.

Table 5.1: Sample Prices of Good News

Price / Dividend News	CC-120521-360922	CC-130219-417252	CC-130529-5BF092	CK-140214-369832
Anc Date Price	0.4	11.06	12.18	1.92
Ex-date Price	0.425	11.2	12	2.01
Entitlement Date Price	0.425	11.16	12.16	2.02
Payment Date Price	0.42	11.3	12.2	1.99

Figure 5.11 shows that the price is increasing and the price on payment date is higher than the price on the announcement date.

Figure 5.11: Price Plot of Good News

Below is the calculation based on the proposed equation to classify the news is good. Table 5.2 shows the result of 10 dividend news calculation which has been classified as good news.

Table 5.2: 10 Sets of Good News Data

No	Dividend Reference No.	Company	Announcement Date Price	Ex-Date Price	Entitlement Date Price	Payment Date Price	Price Difference (PD)
1	ENT-29082017-00016	AIRASIA BERHAD	3.33	3.41	3.41	3.5	0.17
2	ENT-14102016-00002	AMWAY (MALAYSIA) HOLDINGS BERHAD	7.5	7.43	7.5	7.5	0.07
3	ENT-06092017-00001	ASTRO MALAYSIA HOLDINGS BERHAD	2.63	2.82	2.8	2.82	0.17
4	ENT-26092017-00003	AXIATA GROUP BERHAD	5.18	5.32	5.33	5.44	0.27
5	BC-011201-61740	BONIA CORPORATION BERHAD	0.0709	0.1032	0.1026	0.107	0.0355
6	ENT-19052015-00002	BARAKAH OFFSHORE PETROLEUM BERHAD	0.855	0.94	0.93	0.925	0.06
7	ENT-12122017-00001	BERJAYA FOOD BERHAD	1.7	1.86	1.84	1.82	0.1
8	ENT-27042016-00019	BUMI ARMADA BERHAD	0.79	0.74	0.745	0.795	0.01
9	ENT-27092017-00011	CARING PHARMACY GROUP BERHAD	1.74	1.75	1.75	1.8	0.06
10	ENT-07122017-00007	DATASONIC GROUP BERHAD	1.15	1.17	1.18	1.25	0.11

5.3.2 Bad News

A dividend news announcement is classified as bad news when the price decreases from announcement date to payment date. For example, the data below shows that the price is decreasing from announcement date to payment date.

Table 5.3: Sample Prices of Bad News

Price / Dividend News	CC-131018-D04DA	CK-141111-68463	CL-130923-FF381	ENT-08022017-00006
Anc Date Price	12.5	11.56	2.152	7.72
Entitlement Date Price	12.24	11.24	2.056	7.75
Ex-date Price	12.5	11.34	2.064	7.92
Payment Date Price	12.12	10.8	1.992	7.69

Figure 5.12 below shows that the price is decreasing and the price on payment date is lower than announcement date.
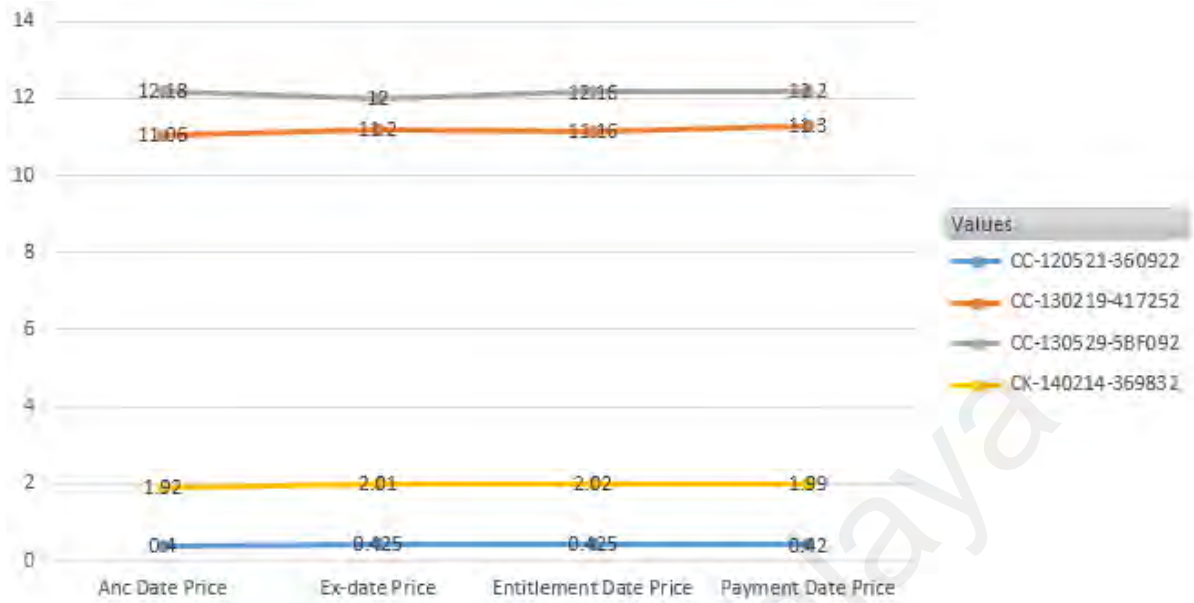

Figure 5.12: Price Plot of Bad News

Below is the calculation based on the proposed equation to classify the news is bad. Table
5.4 shows the result of 10 dividend news calculation which has been classified as bad
news.

Table 5.4: 10 Sets of Bad News Data

No	Entitlement Reference No.	Company	Announcement Date Price	Ex-Date Price	Entitlement Date Price	Payment Date Price	Price Difference (PD)
1	ENT-22042015-00009	AIRASIA BERHAD	2.3	2.2	2.12	1.53	-0.85
2	ENT-22042017-00002	AMWAY (MALAYSIA) HOLDINGS BERHAD	7.75	7.7	7.6	7.5	-0.35
3	ENT-30052018-00005	ASTRO MALAYSIA HOLDINGS BERHAD	1.83	1.6	1.57	1.63	-0.23
4	ENT-21052018-00012	AXIATA GROUP BERHAD	4.42	4.34	4.33	4.4	-0.03
5	BC-001027-61641	BONIA CORPORATION BERHAD	0.1032	0.0945	0.0964	0.0777	-0.0236
6	ENT-20062018-00003	BERJAYA FOOD BERHAD	1.66	1.49	1.61	1.51	-0.03
7	BK-040729-67210	BINTAI KINDEN CORPORATION BERHAD	0.9857	0.8857	0.8929	0.8786	-0.0999
8	CM-150216-50358	CARIMIN PETROLEUM BERHAD	0.99	0.95	0.985	0.91	-0.045
9	ENT-05062018-00001	DATASONIC GROUP BERHAD	0.915	0.96	0.935	0.775	-0.165
10	CC-120103-58126	FIAMMA HOLDINGS BERHAD	0.4167	0.4067	0.4033	0.4	-0.0201

5.3.3 Neutral News

A dividend news announcement is classified as neutral news when there is no price difference from announcement date to payment date. For example, the data below shows that there is no price change from announcement date to payment date.

Table 5.5: Sample Prices of Neutral News

Price / Dividend News	F&-040526-55142	JC-140826-27591	CC-140206-7F380	MB-100824-64801
Anc Date Price	4.18	0.9425	12	0.0144
Entitlement Date Price	4.18	0.97	12	0.0144
Ex-date Price	4.18	0.9775	12	0.0144
Payment Date Price	4.18	0.95	12	0.0144

Figure 5.13 below shows that from announcement date until payment date, there is no change in the price.
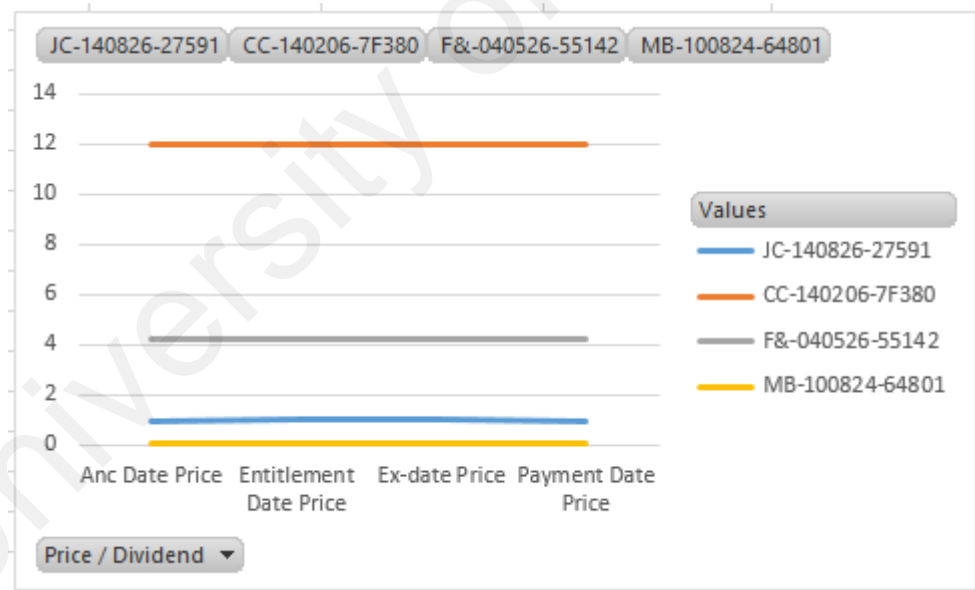
Figure 5.13: Price Plot of Neutral News

Below is the calculation based on the proposed equation to classify the news as neutral. Table 5.6 shows the result of 10 dividend news calculation which has been classified as neutral news.

Table 5.6: 10 Sets of Neutral News Data

No	Entitlement Reference No.	Company	Announcement Date Price	Ex-Date Price	Entitlement Date Price	Payment Date Price	Price Difference (PD)
1	CC-140206-7F380	AMWAY (MALAYSIA) HOLDINGS BERHAD	12	12	12	12	0
2	BA-120528-34779	BUMI ARMADA BERHAD	2.4391	2.4452	2.433	2.4513	0
3	ENT-25102016-00001	CHEETAH HOLDINGS BERHAD	0.44	0.47	0.46	0.45	0
4	ENT-15122016-00003	DATASONIC GROUP BERHAD	1.28	1.23	1.22	1.29	0
5	ENT-16052017-00001	DIALOG GROUP BERHAD	1.9	1.95	1.93	1.92	0
6	GM-120809-70056	GAS MALAYSIA BERHAD	2.63	2.63	2.63	2.63	0
7	JC-140826-27591	KPJ HEALTHCARE BERHAD	0.9425	0.9775	0.97	0.95	0
8	CBM-100930-7AB81	HAI-O ENTERPRISE BERHAD	1.96	2	1.9867	1.9733	0
9	MB-100824-64801	PANSAR BERHAD	0.0144	0.0144	0.0144	0.0144	0
10	F&-040526-55142	FRASER & NEAVE HOLDINGS BHD	4.18	4.18	4.18	4.18	0

5.4 Accuracy of News Classification System

As explained in Chapter 3, Machine Learning is the method used to identify patterns. In this research, the news classification result generated from proposed formula and system is evaluated using machine learning.

5.4.1 Types of ML models used

In this research, five machine learning models were used to validate the accuracy of the proposed equation explained in Chapter 4. The models used are Logistic Regression, Linear Discriminant Analysis, K Neighbours Classifiers, Gaussian Naïve Bayes and Support Vector Machine (SVM). Two sets of data being inputted to train the model. The first dataset consists of 250 records whereas the second dataset comprises 500 records as shown in Figure 5.15 and Figure 5.17, respectively. Figure 5.14 displays how the machine learning model is being initialized. Shape command shows the total rows and columns of data used whereas the describe command describes the data's total count, mean standard deviation, min, percentiles, and max. However, the input data has been grouped and the size of the first data set is 114 sets of good news, 122 sets of bad news and 14 sets of neutral news. For the second dataset, the size of the input data is 500 sets of news consists of 237 good news, 249 bad news and 14 neutral news. Figure 5.14 shows the command for shape, describe and size for the first set of data.

```
url = "E:\BM_PhythonData\sbursa_news_250.data"
names = ['c_ancDP=a',
         'c_exDP=b',
         'c_entDP=c',
         'c_payDP=d',
         'NewType']
dataset = pandas.read_csv(url, names=names)

# shape
print(dataset.shape)

# head
#print(dataset.head(20))

# descriptions
print(dataset.describe())

# class distribution
print(dataset.groupby('NewType').size())            Code Section
```

Figure 5.14: Code Section of First Data Set

Figure 5.15 shows the results of shape, describe and size for the first set of data. The result screen shows that the dataset consists of five columns which are prices on the four dates and news type.

```
In [4]: runfile('C:/Users/ACER/.spyder-py3/temp.py', wdir='C:/Users/ACER/.spyder-py3')
(250, 5)
        c_ancDP=a    c_exDP=b    c_entDP=c    c_payDP=d
count  250.000000  250.000000  250.000000  250.000000
mean     3.563713    3.592468    3.589499    3.613413
std      5.019865    5.116167    5.125831    5.193388
min      0.014400    0.014400    0.014400    0.014400
25%      0.714150    0.729250    0.723550    0.726675
50%      1.650000    1.605000    1.615000    1.630000
75%      3.060000    3.070000    3.070000    3.062500
max     26.380000   28.400000   29.100000   30.000000
NewType
Bad         122
Good        114
Neutral      14
dtype: int64                                         Result Screen
```

Figure 5.15: Results of First Data Set

Figure 5.16 shows the shape, describe and size commands for second dataset.

```
url = "E:\BM_PhythonData\sbursa_news_500.data"
names = ['c_ancDP=a',
         'c_exDP=b',
         'c_entDP=c',
         'c_payDP=d',
         'NewType']
dataset = pandas.read_csv(url, names=names)

# shape
print(dataset.shape)

# head
#print(dataset.head(20))

# descriptions
print(dataset.describe())

# class distribution
print(dataset.groupby('NewType').size())
```

Code Section

Figure 5.16: Code Section of Second Data Set

Figure 5.17 shows that the second dataset consists of five columns which are the prices of the four dates and news type. It also shows the count, mean, standard deviation, min and quartile for each prices.

```
In [5]: runfile('C:/Users/ACER/.spyder-py3/temp.py', wdir='C:/Users/ACER/.spyder-py3')
(500, 5)
        c_ancDP=a   c_exDP=b    c_entDP=c   c_payDP=d
count   500.00000   500.000000  500.000000  500.000000
mean      2.76409     2.789819    2.785395    2.795641
std       3.83851     3.905295    3.912973    3.960733
min       0.01440     0.014400    0.014400    0.014400
25%       0.73710     0.751200    0.757125    0.781075
50%       1.55330     1.560000    1.540000    1.540000
75%       2.97090     2.950000    2.940000    2.960000
max      26.38000    28.400000   29.100000   30.000000
NewType
Bad        249
Good       237
Neutral     14
dtype: int64
```

Result Screen

Figure 5.17: Results of Second Data Set

The dataset contains the prices on the four important dates, and news type information. The data are divided into two datasets. The first dataset consists of the first 250 sets of data out

of the 500 sets of data, whereas the second dataset consists of the 500 sets of data. The accuracy of the news classification is evaluated using five machine learning models.

An accuracy score is used to measure performance. It is percentage of the correctly forecast observation over the overall observation (Renuka, 2019). The validation dataset consists of three parts. The first part is the accuracy score, the second part is the confusion matrix and the third part is the classification report. The confusion matrix used in this research is a 2-class problem. Confusion Matrix is a summary of prediction results which illustrates the number of both correct and incorrect likelihoods with a breakdown of each class and its count values (Abhishek, 2019). It has four terms which are True Positive (TP), False Negative (FN), False Positive (FP) and True Negative (TN) as shown in Table 5.7. True Positive (TP) means the model correctly foresees the positive class, True Negative (TN) means the model correctly forecasts the negative class, False Positive (FP) means the models incorrectly expects the positive class and False Negative (FN) means the model incorrectly expects the negative class (Badreesh, 2019).

Table 5.7: Confusion Matrix

		Predicted Class	
		No / Bad	Yes / Good
Observed Class	No / Bad	TN	FP
	Yes / Good	FN	TP

Other than that, the classification report consists of values for precision, recall, f1-score and support as shown in Figure 5.18. Precision is actually showing when it predicts yes, and how often it is correct. Recall shows that when it is yes, how often it predicts as yes. Besides that, f1-score or f-measure represents both the precision and recall but it is always nearer to the smaller value of the both mentioned. For example, a High Precision for Good News indicates

that the dataset classified as good news is indeed good. However, for a High Recall, it indicates that the class is recognised appropriately (Abhishek, 2019). Support shows the numbers of data supports the classification class.

Figure 5.18: Results of Dataset Accuracy

As shown in Figure 5.19, the accuracy of using Logistic Regression (LR) for the first dataset and second dataset are 0.94 and 0.92, respectively.

Figure 5.19: Accuracy of using LR Model

Figure 5.20 shows the accuracy of using Linear Discrimination Analysis (LDA) which is 0.82 and 0.85 for the first and second dataset, respectively.

First Dataset

```
Make predictions on validation dataset ---250 LDA---
0.82
[[23  3  0]
 [ 3 18  0]
 [ 3  0  0]]
             precision    recall  f1-score   support

        Bad      0.79      0.88      0.84        26
       Good      0.86      0.86      0.86        21
    Neutral      0.00      0.00      0.00         3

  micro avg      0.82      0.82      0.82        50
  macro avg      0.55      0.58      0.56        50
weighted avg     0.77      0.82      0.79        50
```

Second Dataset

```
Accuracy on validation dataset ---500 LDA---
0.85
[[47  1  0]
 [ 9 38  0]
 [ 5  0  0]]
             precision    recall  f1-score   support

        Bad      0.77      0.98      0.86        48
       Good      0.97      0.81      0.88        47
    Neutral      0.00      0.00      0.00         5

  micro avg      0.85      0.85      0.85       100
  macro avg      0.58      0.60      0.58       100
weighted avg     0.83      0.85      0.83       100
```

Figure 5.20: Accuracy of using LDA Model

Figure 5.21 shows the result of using KNN Model. The accuracy score for the first dataset is 0.6 whereas for the second dataset is 0.75.

First Dataset

```
Make predictions on validation dataset ---250 KNN---
0.6
[[21  5  0]
 [12  9  0]
 [ 2  1  0]]
             precision    recall  f1-score   support

        Bad      0.60      0.81      0.69        26
       Good      0.60      0.43      0.50        21
    Neutral      0.00      0.00      0.00         3

  micro avg      0.60      0.60      0.60        50
  macro avg      0.40      0.41      0.40        50
weighted avg     0.56      0.60      0.57        50
```

Second Dataset

```
Accuracy on validation dataset ---500 KNN---
0.75
[[42  6  0]
 [14 33  0]
 [ 5  0  0]]
             precision    recall  f1-score   support

        Bad      0.69      0.88      0.77        48
       Good      0.85      0.70      0.77        47
    Neutral      0.00      0.00      0.00         5

  micro avg      0.75      0.75      0.75       100
  macro avg      0.51      0.53      0.51       100
weighted avg     0.73      0.75      0.73       100
```

Figure 5.21: Accuracy of using KNN Model

Figure 5.22 shows the accuracy of using Gaussian Naïve Bayes which are 0.6 and 0.75 for the first and second datasets, respectively.

First Dataset

```
Accuracy on validation dataset ---250 GaussianNB---
0.6
[[21  5  0]
 [12  9  0]
 [ 2  1  0]]
             precision    recall  f1-score   support

        Bad      0.60      0.81      0.69        26
       Good      0.60      0.43      0.50        21
    Neutral      0.00      0.00      0.00         3

  micro avg      0.60      0.60      0.60        50
  macro avg      0.40      0.41      0.40        50
weighted avg     0.56      0.60      0.57        50
```

Second Dataset

```
Accuracy on validation dataset ---500 GaussianNB---
0.75
[[42  6  0]
 [14 33  0]
 [ 5  0  0]]
             precision    recall  f1-score   support

        Bad      0.69      0.88      0.77        48
       Good      0.85      0.70      0.77        47
    Neutral      0.00      0.00      0.00         5

  micro avg      0.75      0.75      0.75       100
  macro avg      0.51      0.53      0.51       100
weighted avg     0.73      0.75      0.73       100
```

Figure 5.22: Accuracy of using Gaussian Naïve Bayes

Figure 5.23 shows the accuracy of using SVM model which are 0.6 and 0.75 for the first and second datasets, respectively.

First Dataset   **Second Dataset**

```
Make predictions on validation dataset ---250 SVM---    Accuracy on validation dataset ---500 SVM---
0.6                                                     0.75
[[21  5  0]                                             [[42  6  0]
 [12  9  0]                                              [14 33  0]
 [ 2  1  0]]                                             [ 5  0  0]]
             precision  recall  f1-score  support                 precision  recall  f1-score  support

        Bad      0.60    0.81      0.69       26              Bad      0.69    0.88      0.77       48
       Good      0.60    0.43      0.50       21             Good      0.85    0.70      0.77       47
    Neutral      0.00    0.00      0.00        3          Neutral      0.00    0.00      0.00        5

  micro avg      0.60    0.60      0.60       50        micro avg      0.75    0.75      0.75      100
  macro avg      0.40    0.41      0.40       50        macro avg      0.51    0.53      0.51      100
weighted avg     0.56    0.60      0.57       50      weighted avg     0.73    0.75      0.73      100
```

Figure 5.23: Accuracy of using SVM

Table 5.8 shows a summary of all the five models for both the datasets. LR has the highest accuracy for both datasets with the result of 0.94 but KNN, Gaussian Naïve Bayes and SVM are the lowest with the same accuracy result of 0.75.

Table 5.8: Comparison of the Five Machine Learning Models (Accuracy Score)

Model	Accuracy of First Dataset	Accuracy of Second Dataset
LR	0.94	0.92
LDA	0.82	0.85
KNN	0.6	0.75
NB	0.6	0.75
SVM	0.6	0.75

Each dataset is split into two which are the train and test data. Sub-library model selection in Sklearn is used to train and test the datasets. The validation set = 0.2 shows the split percentage used in this study. The split ratio used in this study is 80:20 as more data in training set gives better accuracy and it is an ideal split as it does not underfit or overfit training and testing data. Figure 5.24 shows the snippet of machine learning algorithm on how the data is divided into training and testing.

```
# Split-out validation dataset
array = dataset.values
X = array[:,0:4]
Y = array[:,4]
validation_size = 0.20
seed = 7
X_train, X_validation, Y_train, Y_validation = model_selection.train_test_split
                        (X, Y, test_size=validation_size, random_state=seed)
```

Figure 5.24: Algorithm of Training and Testing of the Machine Learning

As explained earlier, five machine learning models are used to evaluate the classification accuracy. Figure 5.25 shows that the training dataset is fit into the five machine learning models which consist of Logistic Regression, Linear Discriminant Analysis, K Neighbors Classification, Gaussian Naïve Bayes and Support Vector Machines.

```
## Spot Check Algorithms
models = []
models.append(('LR', LogisticRegression()))
models.append(('LDA', LinearDiscriminantAnalysis()))
models.append(('KNN', KNeighborsClassifier()))
models.append(('NB', GaussianNB()))
models.append(('SVM', SVC()))
```

Figure 5.25: Algorithm of Five Machine Learning Model

As the train/test split dataset has been created and fitted into five machine learning models, the cross validation is applied to evaluate the accuracy in different machine learning models. KFold 10 split is used to estimate the accuracy on the models. Figure 5.26 shows the code snippet for the comparisons of the five machine learning models in Python.

```
# evaluate each model in turn
results = []
names = []
for name, model in models:
    kfold = model_selection.KFold(n_splits=10, random_state=seed)
    cv_results = model_selection.cross_val_score
                 (model, X_train, Y_train, cv=kfold, scoring=scoring)

    results.append(cv_results)
    names.append(name)

    msg = "%s: %f (%f)" % (name, cv_results.mean(), cv_results.std())
    print(msg)
```

Figure 5.26: Algorithm to Compare the Five Machine Learning Models in Python

The accuracy of the five Machine Learning models is shown in Figure 5.27 by comparing the mean and standard deviation. LR has the highest mean for the first and second datasets while Gaussian Naïve Bayes shows the lowest mean for both datasets.

First Dataset	Second Dataset
LR: 0.845000 (0.082006)	LR: 0.882500 (0.058149)
LDA: 0.780000 (0.084261)	LDA: 0.852500 (0.072844)
KNN: 0.600000 (0.100000)	KNN: 0.730000 (0.048477)
NB: 0.475000 (0.138293)	NB: 0.482500 (0.130886)
SVM: 0.495000 (0.093408)	SVM: 0.617500 (0.078302)

Figure 5.27: Comparison of the Five Machine Learning Models (Mean and Standard Deviation)

Results in Figure 5.27 show that Logistic Regression model is the model with highest accuracy. The second highest accuracy model is Linear Discrimination Analysis. The second dataset is also compared separately by each model and the highest accuracy result is Logistic Regression. Table 5.9 shows the differences of Logistic Regression (LR) and Linear Discrimination Analysis (LDA). Based on the study, LR is more robust compared to LDA and it is able to perform probability immediately compared to LDA.

Table 5.9: Comparison of Logistic Regression and Linear Discrimination Analysis (Efron, 1975)

Logistic Regression (LR)	Linear Discrimination Analysis (LDA)
Efficiency: Robust and Less Exigent Demand	**Efficiency:** Less Robust and More Demanding with all its requirements met
Estimates Probability immediately	Estimates Probability mediately
Based on Maximum Likelihood Estimation	Based in Least Square Estimation

5.5 News Classification System Analysis Result

Based on this news classification system, user will be able to view the classified news results by dividend news announcement. This can be achieved by selecting an announcement in the system and the system displays the announcement details, prices on the four important dates and the news classification result. The announcement details section consists of the announcement reference number, subject, description, currency, company code, company name, category of announcement, stock name and the four important dates. Meanwhile in price on the important dates section shows the prices on the 4 important dates. Figures 5.28, 5.29 and 5.30 show a sample display of good news, bad news and neutral news, respectively.

Figure 5.28: Sample of Good News in News Classification System

Figure 5.29: Sample of Bad News in News Classification System

Announcement Details

Reference No	CC-140206-7F380	Company Code	6351
Entitlement Subject	Interim Dividend	Company Name	AMWAY (MALAYSIA) HOLDINGS BERHAD
Entitlement Description	A fourth interim single tier dividend of 10.0 sen net per share and special interim single tier dividend of 22.5 sen net per share for the financial year ended 31 December 2013	Category	Entitlements (Notice of Book Closure)
		Stock Name	AMWAY
		Announcement Date	2014-02-25
Entitlement in Currency	0.325	ex Date	2014-03-10
		Entitlement Date	2014-03-12
		Payment Date	2014-03-21

Price on the Important Dates

Price on Announcement Date	12
Price on Ex Date	12
Price on Entitlement Date	12
Price on Payment Date	12

Classification of News

News Type	Neutral News

Figure 5.30: Sample of Neutral News in News Classification System

5.6   Summary of News Classification System

Based on the results and findings obtained, it can be concluded that the first objective of the project which is: to propose an approach to classify the dividend news during the period from the announcement of the dividend news until dividend payment date has been achieved through the derivation of mathematical formula and evaluated using Bursa Malaysia price data. The proposed mathematical formula is more practical in usage compared to classifying the news based on daily price difference. The mathematical formula consists of the prices of four dates to classify the dividend news instead of using the daily price difference which consists of all the prices starting from the announcement date until the payment date. The mathematical formula also takes lesser time compared to the daily price difference approach to classify the dividend news.

The second objective which is: to develop a system to facilitate the classification of dividend news has been achieved by developing a Web-based news classification system – the news classification system. This system embeds the mathematical formula into a module of the system to analyse and classify the news into good, bad and neutral. The developed system helps investor to view the news classification result by uploading the relevant information – company details, dividend news announcements and share market prices. Investors are also able to view the news classification result by each announcement. These may also help the investors to view the pattern of 500 dividend news classification result.

The third objective: to evaluate the accuracy of the proposed dividend news classification approach has been achieved through training and testing the data in five different machine learning models which consist of Logistic Regression, Linear Discriminant Analysis, K Neighbours Classifiers, Gaussian Naïve Bayes and SVM as shown in Table 5.8. The mathematical approach is supported by Logistic Regression model with the highest accuracy of 0.92 and followed by Linear Discrimination Analysis (LDA) which is 0.85. KNN, Gaussian Naïve Bayes and Support Vector Machine have the lowest accuracy of 0.75. Logistic regression is one of the widely used and robust classification models compared to Linear Discrimination Analysis and uses Maximum Likelihood Estimation to solve the classifications (Dimitris, 2019).

CHAPTER 6: DISCUSSION & CONCLUSION

6.1 Conclusion

Dividend income is a fund which provides an income and help investors to grow their investment portfolio over time. This study proposed a share market dividend news classification using mathematical approach which has been achieved through the tabulation of objectives in Chapter 1. The dividend news is classified into good, bad or neutral news based on four (4) important dates which are announcement date, ex-date, entitlement date and payment date. From the two hypothesis that were developed, the null hypothesis is rejected and the alternate hypothesis of dividend news does impact on share market prices is accepted to be true. Based on the findings which has been presented, all the three objectives have been achieved - to analyze and classify the pattern of share market in Trading and Services sector, to develop a news classification system and finally, evaluating the accuracy of dividend news classification. The dividend news brings an impact to the share market price pattern as the price pattern can be negative or positive.

Apart from that, this study can help investors to analyze the price pattern reaction during the dividend news announcement for the past years through the news classification result. On the other hand, some investors may have more than one investment portfolio and may have difficulties to analyze the price pattern and classify the news during share market dividend news announcement. Hence, this study can help those investors in evaluating all their investment portfolio during the dividend news announcement easily using the proposed news classification system. As investment is a known risk, it is decent that a proper platform such as this can help the investors to manage the risk and secure their financial position. Finally, the number of dividend news announced by a company determines the establishment of a company and to further top it, the classification of each dividend news is able to attract

more investors to invest with the company or entity due to a better understanding of its financial standings.

6.2   Future Works

Based on the findings of the discussion and the conclusion, the strength of this study is the technique provided to the investors to classify the dividend news using a simplified approach. Besides, a news classification system is developed for the investors to view the news classification result for past years and analyze the company performance during the dividend news announcement. Nonetheless, this study consists of a few weaknesses and which can be improved in the future. These weaknesses are:

i)   This research considers dividend news only. Other types of news which can affect the share market price should be taken into consideration. This news includes: changes in management, policy changes and new product launches.

ii)   This research considers dividend news classification only. Share market price prediction after the payment date should be taken into consideration.

iii)   This research uses historical data which have been downloaded from a free web site. Protocols to retrieve the data directly from Bursa Malaysia page which will improve the data collection process and integrity of the data should be taken into consideration.

6.3   Research Limitations

This research also has a few limitations:

1. Research data is focused on Trading and Services sector in Bursa Malaysia. Therefore, the findings of this research cannot be generalized to represent other types of news for other sectors or the entire sector in Bursa Malaysia.

2. This research used 500 sets of share market dividend news announcements released from the year 2000 until 2018 of 47 public listed companies of the Trading and Services sector. The findings of this research cannot be generalized for dividend news announcements released during other periods, or other companies in the same Trading and Services sector, or companies from other sectors

3. In this research, dividend refers to cash dividend paid out to the shareholders by check or cash on the payment date, in Malaysian currency only. This research cannot be generalized for other types of dividend entitlement such as special dividend, stock dividend, property dividend, scrip dividend and liquidating dividend.

REFERENCES

A Jalil Hamid and Lokman Mansor (2016, March 17). SC forging ahead with reforms. Critical Agenda : Retaining investor trust, public confidence a priority, *New Straits Times*.

Abhishek Sharma. (2019). *Confusion Matrix in Machine learning*. Retrieved from, https://www.geeksforgeeks.org/confusion-matrix-machine-learning/

Aditi Kaushal & Prerit Chaudhary. (2017, Dec). *News and Events Aware Stock Price Forecast Technique*. Paper presented at the 2017 International Conference on Big Data, IoT and Data Science (BID), Vishwakarna Institute of Technology, Pune.

Amanda Briney (2017). *The Dutch East India Company. The Rise and Decline of an Early Global Corporation*. Retrieved from, https://www.thoughtco.com/ the-dutch-east-india-company-1434566

Amit Sharda. (2017). *A beginner's guide to stock trading: 50 terms that you should know*. Retrieved from, https://www.businessinsider.in/A-Beginners-Guide-To-Stock-Trading-50-Terms-That-You-Should-Know/articleshow/45714291.cms

Anne Marie Helmenstine. (2018). *Dependent Variable Definition and Examples*. Retrieved from, https://www.thoughtco.com/definition-of-dependent-variable-604998

Ayman E.Khedr, Salama S.E & Nagwa Yaseen. (2017). Predicting Stock Market Behavior using Data Mining Technique and News Sentiment Analysis. *International Journal of Intelligent Systems and Applications*, 22-30.DOI: 10.5815/ijisa.2017.07.03

Badreesh Shetty. (2019, January). *Supervised Machine Learning: Classification*. Retrieved from, https://towardsdatascience.com/supervised-machine-learning-classification-5e685fe18a6d

Baranes, A., & Palas, R. (2019). Earning Movement Prediction Using Machine Learning-Support Vector Machines (SVM). In Journal of Management Information and Decision Sciences. 22(2), 36-53.

BDO. (2018). Malaysia: 2019 Budget Highlights. JBS Print Sdn Bhd,

Bjoern Krollner, Bruce Vanstone and Gavin Finnie. (2010). Financial Time Series Forecasting with Machine Learning Techniques: A survey. Proceedings European Symposium on Artificial Neural Networks – Computational Intelligence and Machine Learning.

Bursa Malaysia (2017,December), *Equities*. Retrieved from, http://www.bursamalaysia.com/ market

C.R.Kothari. (2004). Research Methodology Methods & Techniques. *New Age International (P) Limited, Publishers*

Charles S. Wasson. (2006). System Analysis, Design and Development, *Wiley Interscience, A John Wiley &Sons, Inc., Publication*.

Ching-Te Wang & Yung-Yu Lin. (2015). *The Prediction System for Data Analysis of Stock Market by Using Genetic Algorithm*. Paper presented at 2015 12th International Conference on Fuzzy Systems and Knowledge Discovery (FSKD)

Danny Sullivan. (2018). *How Machine Learning Works, As Explained By Google*. Retrieved from, https://martechtoday.com/how-machine-learning-works-150366

Deepika Chandwani and Manminder Singh Saluja. (2014). Stock Direction Forecasting Techniques: An Empirical Study Combining Machine Learning System with Market Indicators in the Indian Context. In International Journal of Computer Application. 92(11). pp 8 – 17.

Dennis, Wixom and Roth. (2012) Systems Analysis & Design, *John Wiley & Sons, Inc.*

Dharmarathne D G. (2013, October). Stock Price Reaction To Dividend Announcements And Information Efficiency In Sri Lankan Share Market. *International Journal of Management and Social Sciences*, 3(2),100-111

Dimitris Bertsimas, Jack Dunn, Colin Pawlowski, Ying Daisy Zhuo (2019) Robust Classification. *INFORMS Journal on Optimization* 1(1):2-34. https://doi.org/10.1287/ijoo.2018.0001

Dinh Bao and Nguyen Chi. (2016). Dividend Announcement and Ex-Dividend Effects on Stock Return. *International Journal of Economics and Finance*. 8(70), 207-215.

Efron, B. (1975). The efficiency of logistic regression compared to normal discriminant analysis. *J Am Stat Assoc*,70, pp 892-898.

Ellen Terrell (2017). *History of the American and NASDAQ Stock Exchanges*. Retrieved from, http://www.loc.gov/rr/business/amex/amex.html

Faiza Saleem et al. (2013). Effects Of Dividend Announcement On Stock Prices: Evidence From Pakistan. *Interdisciplinary Journal of Contemporary Research in Business*. 4(9), 211-224.

Faiza Saleem et al. (2013). Effects Of Dividend Announcement On Stock Prices: Evidence From Pakistan. *Interdisciplinary Journal of Contemporary Research in Business*. 4(9), 211-224.

Faizan Shaikh. (2017). *Deep Learning vs. Machine Learning – the essential differences you need to know*. Retrieved from, https://www.analyticsvidhya.com/blog/2017/04/comparison-between-deep-learning-machine-learning/

Feng Wang & Xiaodong Li. (2011). Analysis of Financial News Impact on Stock Based on A Statistical Learning Method with News Density. *2011 Fourth International Conference on Business Intelligence and Financial Engineering*

Franco Valencia, Alfonso Gomez-Espinosa and Benjamin Valdes-Aguirre. (2019). Price Movement Prediction of Cryptocurrencies Using Sentiment Analysis and Machine Learning

Gary B.Shelly and Harry J. Rosenblatt. (2012). Systems Analysis and Design, *Course Technology, Cengage Learning*,

Gary Marcus. (2017). Deep Learning: A Critical Appraisal.

Gordon Newlove Asamoah. (2010). The Impact Of Dividend Announcement On Share Price Behaviour In Ghana. *Journal of Business & Economics Research*, 8(4), 47-58

Hu Zuguang & Minhaz Uddin Ahmed. (2010). Dividend Announcement Effect on Stock Return: An Event Study on Shanghai Stock Exchange. *2010 Second WRI Global Congress on Intelligent Systems*

Hunkar Ozyasar. (2018, 30 March). *What is the dependent variable in stocks?* Retrieved from, https://finance.zacks.com/dependent-variable-stocks-11442.html

Imed Hammouda, (2015). Introduction of Software Architecture. *Chalmers University of Gothenburg*.

Jay Liebowitz, (1999). Knowledge Management Handbook*, CRC Press*

Johnson Hur (2017, December). *History of Stock Market*. Retrieved from, https://bebusinessed.com/ history/history-of-the-stock-market

Johnson, B., & Christensen, L. (2008). Educational research: Quantitative, qualitative, and mixed approaches, *Thousand Oaks, CA: Sage Publications*, p. 34

Joshua Kennon. (2017, November). *Investing Lesson 1 – Introduction to the Stock Market*. Retrieved from, https://www.thebalance.com/investing-lesson-1-introduction-to-the-stock-market-356170

Joshua Kennon. (2017, November). *Saving vs Investing Money*. Retrieved from, https://www.thebalance.com/saving-money-vs-investing-money-358062

Justin Kuepper (2019, 20 January), *Making Investments in Malaysia and Its Growing Economy*, Retrieved from https://www.thebalance.com/investment-in-malaysia-from-a-to-z-1979055

Justin Sirignano & Rama Cont. (2018). Universal features of price formation in financial markets: perspectives from Deep Learning.

Kathy Furgang. (2011). How the Stock Market Works, *The Rosen Publishing Group, Inc,*

Lawrence Carrel. (2010) Dividend Stocks for Dummies. *Wiley Publishing, Inc*.

Leen Bultinck (2017, 4 December). *The stock market: from the 'Ter Buerse' inn to Wall Street*. Retrieved from, https://www.nbbmuseum.be/en/2010/01/stockmarket.htm

Legenzova, R., Jurakovaitė, O. & Galinskaitė, A. (2017). The Analysis of Dividend Announcement Impact On Stock Prices Of Baltic Companies. *Central European Business Review* ,6(1).

Leonardo Dos Santos Pinheiro and Mark Dras. (2017). Stock Market Prediction with Deep Learning: A Character-based Neural Language Model for Event-based Trading. In Proceedings of Australasian Language Technology Association Workshop, pp. 6-15

Levering. B. , (2002). *Concept analysis as empirical method. International Journal of Qualitative Methods*. Retrieved from, http://www.ualberta.ca/~ijqm/

Lisa Tagliaferri. (2017, 28 September). *An Introduction to Machine Learning*. Retrieved from https://www.digitalocean.com/community/tutorials/an-introduction-to-machine-learning

Low Chee Keong, (2000) Financial Markets in Malaysia, *Malayan Law Journal Sdn Bhd Kuala Lumpur*, pp. 67-71

Malav Shastri, Sudipta Roy and Mamta Mittal. (2018). Stock Price Prediction using Artificial Neural Model: An Application of Big Data.

McGinnity T.M. ,Sonya Coleman, Ammar Belatreche. (2015). Stock Price Prediction based on Stock-Specific and Sub-Industry-Specific News Articles. *Northern Ireland Capital Market Engineering Research Initiatives*

Micheal Hagenau, Matthias Hauser, Micheal Liebmann & Dirk Neumann. (2013). *Reading all the news at the same time: Predicting mid-term stock price developments based on news momentum*. Paper presented at 2013 46th Hawaii International Conference on System Sciences.

Ministry of Finance. (2017). Budget Speech 2018. *Percetakan Nasional Malaysia Berhad: Publication Data*.

Minjae Park, Mi Lim Lee and Jinpyo Lee. (2019). Predicting Stock Market Indices using Classification Tools. In Asian Economic and Financial Review. 9(2). pp 243-256.

Najeb M.H. Masoud. (2013). The Impact of Stock Market Performance upon Economic Growth. *International Journal of Economics and Financial Issues*, 3(4), pp.788-798.

Naman Arora, Parimala M (2019). Financial Analysis: Stock Market Prediction Using Deep Learning Algorithms. In International Conferences on Sustainable Computing in Science, Technology & Management. pp 2191-2197

Ordu Monday, Enekwe Chinedu and Anyanwaokoro Mike. (2014) Effect of Dividend Payment on the Market Price of Shares: A Study of Quoted Firms in Nigeria. *International Journal of Economics and Finance*, 5(4), pp.49-62.

Pauline V. Young. (1939). Scientific Social Surveys and Research. *Prentice-Hall Inc*. p. 30.

Reena Shaw. (2019, January). *Top 10 Machine Learning Algorithm for Beginners*. Retrieved from, https://www.kdnuggets.com/2017/10/top-10-machine-learning-algorithms-beginners.html

Renuka Joshi. (2019, February).*Accuracy, Precision, Recall and F1 Score*. Retrieved from, https://blog.exsilio.com/all/accuracy-precision-recall-f1-score-interpretation-of-performance-measures/.

Reuters Limited. (1999) *An Introduction to Equity Market*, pp. 234-239

Ronak Nangalia, (2017). Basics of Stock Market. *FLAME Investment Lab, FLAME University*

Rosdyana M. I. K., Trang-Thi Ho, Wei-Chun Kao, Yu-Yen & Kai-Lung Hua. (2019). Using Deep Learning Neural Networks and Candlestick Chart Representation to Predict Stock Market.

Securities Commission Malaysia. (2014) *Capital Market Development in Malaysia. Growth, Competitiveness and Resilience*, pp.1-8

Shanghai Stock Exchange (2017, November), *Brief Introduction| Shanghai Stock Exchange*. Retrieved from, http://english.sse.com.cn/aboutsse/sseoverview/brief/info/

Shangkun Deng, Takashi Mitsubuchi, Kei Shioda, Tatsuro Shimada & Akito Sakurai. (2011). Combining Technical Analysis with Sentiment Analysis for Stock Price Prediction. *2011 Ninth IEEE International Conference on Dependable, Autonomic and Secure Computing*

Sheikh Irfan Akbar. (2019). Analysis on Stock Market Prediction using Machine Learning Techniques. In International Journal of Creative and Innovative Research in All Studies, 1(8). pp 30-34

Sheikh Shaugat Abdullah, Mohammad Saiedur Rahaman & Mohammad Saidur Rahman. (2013) *Analysis of Stock Market using Text Mining and Natural Language Processing*.

Shihavuddin A.S.M, Mir Nahidul Ambia & Mir Mohammad Nazmul Arefin. (2010). Prediction of Stock Price analyzing the online financial news using Naive Bayes classifier and local economic trends. *2010 3rd International Conference on Advanced Computer Theory and Engineering (ICACTE)*

Silvan S., Shirin S., Micheal Katz & Patrick Ferber. (2019). Deep Learning for Cost-Optimal Planning: Task-Dependent Planner Selection.

Svetlana B., & Ioannis T. (2019). An ensemble of LSTM neural networks for high-frequency stock market classification. In Journal of Forecasting. pp 600-619

Tak-Chung Fu, Ka-ki Lee, Donahue Sze, Fu-lai Chung & Chak-man Ng. (2008). Discovering the Correlation between Stock Time Series and Financial News. *2008*

IEEE/WIC/ACM International Conference on Web Intelligence and Intelligent Agent Technology, 880- 883

Takuya Shintate & Lukas Pichl. (2019). Trend Prediction Classification for High Frequency Bitcoin Time Series with Deep Learning

Tan Chwee Huat. (2002). Markets and Institutions in Singapore. *Singapore University Press*, pp. 243-244

Thomas Schuster, (2006). The Markets and the Media: Business News and Stock Market Movements, *Lexington Books*

Ting Yu, John Debenham and Simeon Simoff. (2006). Classify Unexpected News Impacts to Stock Price by Incorporating Time Series Analysis into Support Vector Machine. In 2006 International Joint Conference on Neural Networks. pp 2993 – 2998.

University of Sydney. (2013, February). *What is the difference between descriptive, analytical, persuasive and critical writing?* Retrieved from, http://sydney.edu.au/stuserv/learning_centre/help/analysing/an_distinguishTypes.shtml

Vihar Kurama. (2017, July). *An Introduction to Machine Learning*. Retrieved from https://towardsdatascience.com/introduction-to-machine-learning-db7c668822c4.

W.A. Neiswanger. (1956). Elementary statistical methods as applied to business and economic data. *New York: Macmillan*

Xiao Zhong and David Enke. (2019). Predicting the daily return direction of the stock market using hybrid machine learning algorithms. Zhong and Enke Innovation, pp.1-20

Xiaodong Li, Xiotie Deng, Feng Wang & Keren Dong. (2010). Empirical Analysis: News Impact on Stock Prices based on News Density. *2010 IEEE International Conference on Data Mining Workshops*

Yauheniya Shynkevich, T.M. Mcginnity, Sonya Coleman and Ammar Belatreche. (2015). Stock Price Prediction based on Stock-Specific and Sub-Industry-Specific News Articles

Yuh-Jen Chen & Yuh-Min Chen. (2013). A Fundamental Analysis-based Method for Stock Market Forecasting. Paper presented at *2013 Fourth International Conference on Intelligent Control and Information Processing (ICICIP), Beijing, China*.

Zuriawati, Joriah and Abdul Hadi. (2012). The Impact of Dividend Policy on the share price Volatility: Malaysian Construction and Material Companies. *International Journal of Economics and Management Science*, 2(5), pp.01-08.