# FORECAST TENAGA SHARE PRICES USING MARKOV CHAIN

LEONG SUE SHYEN



THIS DISSERTATION IS PRESENTED TO FULFIL PART OF THE REQUIREMENT TO OBTAIN A BACHELOR OF SCIENCE DEGREE WITH HONOURS

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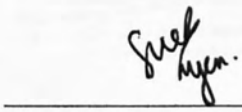

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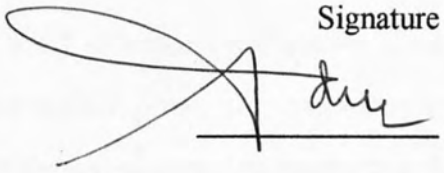

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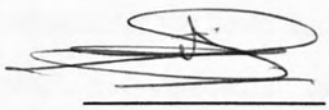

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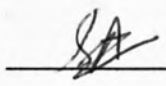

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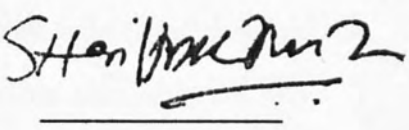

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## ABSTRAK

Peramalan harga saham telah menjadi perhatian pelabur-pelabur sejak beberapa dekad dahulu. Objektif utama kajian ini adalah untuk meramal harga saham TENAGA dengan menggunakan Rangkaian Markov. Penggunaan Rangkaian Markov kurang popular dalam peramalan ekonomi serta peramalan saham walaupun kegunaannya adalah meluas dalam bidang yang lain. Dalam kajian ini, akan dilihatkan keberkesanan Rangkaian Markov dalam peramalan harga saham. Selain itu, kerana wujudnya data yang hilang pada hari Sabtu, Ahad dan Cuti Awam, penganggaran untuk data yang hilang akan dianalisis dengan interpolasi secara linear, kuadratik dan kubik, kaedah *least-squares* secara linear, kuadratik dan kubik serta dengan penganggaran secara Splin Kubik. Model Rangkaian Markov untuk data tercerap dan tidak tercerap dibandingkan untuk melihat pada keberkesanannya. Daripada kajian ini, didapati bahawa pengganggaran data hilang adalah signifikan dalam peramalan harga secara Rangkaian Markov. Rangkaian Markov dibuktikan bukan suatu cara yang berkesan dan efektif dalam peramalan harga saham.

## ABSTRACT

Stock price forecast have been gaining attention since decades ago. The main focus of this dissertation is to obtain the stock price forecast for TENAGA share by using Markov Chain. The Markov Chain concept is less popular compared to other conventional stock forecasting methods. The study will be testing the effectiveness of Markov Chain in stock price forecasting. The missing values of the stock price are estimated by using linear interpolation, quadratic interpolation, cubic interpolation, and cubic spline. The Markov Chain models between that include missing values and that are compared relatively to their accuracy. From this study, it had shown that missing values are not significant for the forecast. Markov Chain is proven to be not so suitable, the reason may be that the basic properties of Markov Chain is overlooked.

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## LIST OF ABBREVIATION

| | |
|---|---|
| BM | Bursa Malaysia |
| KLSE | Kuala Lumpur Stock Exchange |
| ASEAN | Association of Southeast Asian Nations |
| TNB | Tenaga Nasional Berhad |
| SESB | Sabah Electricity Sendirian Berhad |
| SESC | Sarawak Electricity Supply Corporation |
| GARCH | *Generalized Autoregressive Conditional Heteroscedasticity* |
| REGEM | Regression-based Imputation |
| NN | Nearest Neighbour |
| SOM | Self-organising map |
| MLP | Multi-layer perception |
| EOD | End of Day |

## LIST OF SYMBOLS

| | |
|---|---|
| = | equal |
| + | plus |
| - | minus |
| $\sum$ | summation |
| $\in$ | member of |
| $\pi$ | phi |
| < | smaller than |
| $\leq$ | smaller or equal than |
| $\geq$ | larger or equal than |

# CHAPTER 1

# INTRODUCTION

## 1.1 INTRODUCTION TO FORECASTING

Tan (1994) defines forecast as the result of extrapolating the past into the future. Forecasts are achieved by calculating and computing using data of the past to obtain future prediction estimates. Therefore, forecasting is a process which predicts future events or change. Forecasting techniques are vastly explored and is constantly growing knowledge, and at the present state, there are a variety of forecasting models available from the theorists. This abundance of techniques is broadly categorized into two categories namely, qualitative and quantitative.

Qualitative techniques provide the framework within which quantitative techniques are applied to generate a solution to a particular problem. Qualitative techniques involve human judgment and rating systems to convert qualitative data into quantitative measure. This is most appropriate when the amount type and quality of historical data are limited. Common qualitative techniques include the Delphi method, market research, panel of consensus, visionary forecast, and historical analogies.

Quantitative techniques are that of using relevant data, it can be said as being deterministic or statistical. Deterministic techniques, also known as causal methods, apply when there is a desire to incorporate the identification and explicit relationships between the predictions to be generated by the forecast to other influencing factors. Popular methods from this category include anticipation surveys, input-output models, econometric models and leading indicators.

Statistical techniques, also known as stochastic methods, analyses trends and perturbations caused by random influences. Common methods include moving averages, exponential smoothing, time series decomposition, regression models and trend projections. All these methods can be grouped under two approaches namely, time series decomposition and econometric time series modeling.

## 1.2 STOCK

The concept of stock is explained by Chambers and Rogers (2004) as a security issued by a corporation or by a government in order to raise long-term capital. The ownership of an organization is divided into shares. By owning a share of stock, a person is part owner of the company, with the authority to claim on every asset, and the earnings of the company. Stock price changes are due to general business conditions and the earnings and future prospects of the company that has issued the stock.

Stock is a type of investment. Stockholders sell their shares in hand and gain profit when the business is good. On contrary, they have to take a loss when they sell.

Dividends are paid to the stockholders out of the corporation's profits. When the profits are used to by the company to expand their business, the directors and stockholders may issue more stocks. These new stocks will be divided among the old stockholders as stock dividends.

There are two forms of stocks, ordinary and preferential. Ordinary stock represents the true ownership of a company. Stockholders not only share the company's profit in the form of dividends, but also have the right to vote for the company's directors at the annual general meeting.

Preferential stockholders have a claim on profits that is preferred to ordinary stockholders. That means they receive dividends before the ordinary stockholders' dividends are announced. They often receive a fixed dividend rate at which even the company's profit increases, the ordinary stockholders may receive a rise in dividend but preferential stockholders do not. Preferential stockholders stand ahead of ordinary stockholders in the distribution of assets upon dissolution of the company.

## 1.3 BACKGROUND OF BURSA MALAYSIA (BM)

Company sells their shares in order to gain capital. The place that stocks are sold and bought is called the stock market. It does not only enable companies to access capital, but also create opportunities for investors to own a share of the company and enjoy potential gains from the company's future performance.

KLSE or Kuala Lumpur Stock Exchange, now called Bursa Malaysia (BM) provides the one and only arcade for stock investment in Malaysia and is one of the largest bourses in ASEAN. Established in 1973 (Saudagaran, 2004), BM acts as a central market place for buyers and sellers to transact business in shares, bonds, and various other securities of Malaysian listed companies. Khai (2004) explained that it was the government intention to set out various acts consequently to serve as guidelines to regulate and supervise the securities market. Among them are the Securities Industries Act 1983, the Securities Commission Act 1993, the Malaysian Code on Takeovers and Mergers, 1987, the Guidelines on the Regulation of Acquisition of Assets, mergers and Takeovers, and the Bursa Malaysia Listing requirements and Practice Notes. The Malaysian Securities Market has once emerged as one of the top performers among bourses in developing countries in terms of market capitalisation in 1993 (Kok and Goh, 1995), and has posted turnover in excess of that on Wall Street or in the City of London, mentioned in *Emerging Malaysia 2006*.

There are around 1028 listed companies in Bursa Malaysia, pointed out by the CEO of BM himself in the interview by *Emerging Malaysia 2006* and are categorized into 15 different sectors representing over 50 different economic activities from Consumer Products, Construction, Finance, Mining, Plantation, Properties, Trading/Services, to Technology, Infrastructure, just to name a few. They are either listed on the Main board for larger capitalized companies, the Second Board for medium sized companies or the MESDAQ Market for high growth and technology companies. The listing requirements will be mentioned in the subtopics.

Bursa Malaysia's offshore market is based in Labuan, where the offshore exchange in Malaysia facilitates the listing and trading of various financial instruments and securities which are based on both conventional and Islamic principles. Labuan has been offering a wide range of offshore financial services from the incorporation of offshore companies to banking, insurance and fund management. *Emerging Malaysia* 2006 stated that, by the end of 2004, there were 2,700 companies from more than 70 nations registered on the island.

### 1.3.1 Main Board

The various sectors in Main Board include consumer products, industrial products, construction, trading, services, finance, properties, plantations, and mining. Saudagaran (2004) stated that the minimum paid-up for listing on the Main Board is RM60 million comprising ordinary shares with a minimum par value of RM0.10 each. It must have an operating history for at least five full financial years. The uninterrupted profit record of three to five full financial years, with an aggregate after-tax profit of not less than RM30 million over the said three to five financial years and an after-tax profit of not less than RM8 million in respect of the most recent financial year.

### 1.3.2 Second Board

From Saudagaran (2004), the minimum paid-up for listing on the Second Board is RM40 million comprising ordinary shares with a minimum par value of RM0.10 each. It must have at least five full financial years of operating history. The uninterrupted

profit record of three to five full financial years, with an aggregate after-tax profit of not less than RM12 million over the said three to five financial years and an after-tax profit of not less than RM4 million in respect of the most recent financial year.

### 1.3.3 MESDAQ Market

From *Emerging Malaysia* 2006, the CEO of BM also talked about the role of MESDAQ that is to cater the listing of technology intensive industries and high-growth companies. The companies' goals are to develop a science and technology base for Malaysia through research development which has not yet achieved a profit track record over a period of time. Hence, the main objective of MESDAQ is to support R&D by creating an open source of raising capital. The listing requirements are mentioned by Saudagaran (2004). The minimum paid-up for listing on the MESDAQ is RM2 million for technology and non-technology companies and minimum RM20 million for Technology Incubators with a minimum par value of RM0.10 each. The operating history for companies involved in technology-based business activities is to have commenced operations and have commercialized the principal products and/or services under its core business. A Technology Incubator must have commenced operation of its corporate business for at least 12 months. For all other companies, a minimum period of generating operating revenue of at least three full financial years based on audited accounts. There is no specific profit record required. However, a listing applicant must be in a healthy financial position and have sufficient level of working capital at the point of listing.

## 1.4 BACKGROUND OF TENAGA NASIONAL BERHAD (TNB)

Sivalingam (2005) stated that there are currently three state owned utilities that dominate power generation and distribution in Malaysia, they are: Tenaga Nasional Berhad (TNB), the Sabah Electricity Sendirian Berhad (SESB) and the Sarawak Electricity Supply Corporation (SESC). TNB has jurisdiction in Peninsular Malaysia, whereas SESB and SESC in Sabah and Sarawak. In *Emerging Malaysia 2006*, Tenaga Nasional Berhad (TNB) is stated to represent Malaysia's capital market in electricity. With TNB being the largest electricity utility company in Malaysia, it boasts assets worth more than RM65 billion and serves over 6 million customers throughout Peninsular Malaysia and Sabah. It also has a generation capacity of 11,500 megawatts. TNB is a greatly performing company recognized globally and regionally, and is ranked among the top 50 energy companies in Asia in 2006, based on the prestigious Platts' survey of the top 250 Global Energy Companies. Internationally, Platts ranks TNB at 168th among the top 250 Global Energy Companies.

It was the government's idea in order to increase competition when the public monopoly utility, the National Electricity Board is converted into Tenaga Nasional Berhad through a corporatisation and privatisation exercise in September 1990 (Sivalingam, 2005) by amending the Electricity Act 1951. TNB was listed on the KLSE (now BM) on February 29, 1992 issued 625,047,000 new ordinary shares at an initial price of RM4.50 and sold 60 million new shares by tender. With the monopoly of TNB in generation, transmission distribution and billing, investors were generally confident in the TNB share. Sivalingam (2005) also mentioned that TNB is Malaysia's largest company by market capitalization. In 2002, the shareholding

structure of TNB shows that it was 80 percent owned by government and government linked funds and the remaining 20 percent owned by the public, which owns 17 percent of the shares and foreigners, who own the remaining three percent of the Shares.

As in Plunkett's (2007) Research, TNB not only supports a complete power supply system, including the national grid, customer service centres, call management centres and administrative offices, through its 32 subsidiaries, it is also involved in several diversified businesses linked to the power industry. TNB offers higher education classes through its university, Universiti Tenaga Nasional and technical training through another institution in order to develop talent for the national and regional power sectors. Apart from improving yields on its existing businesses in Malaysia, TNB has recently begun to venture overseas, establishing a joint venture for a water and power project in Saudi Arabia in 2005.

## 1.5 MISSING VALUES

Ahmed and Abeer (2006) define missing values as incomplete measurements in some analysis, where data is dropout somewhere either completely randomly, missing at random or nonrandom. But that is not in this study the case of defining missing values. In financial time series we often encounter missing data, according to Keynes (1999), some sort of filling or interpolation is normally required as a first step in any analysis. There may be missing values in time series of stock prices because trading in a stock was suspended for a particular day, because trading was suspended at midday and the prices are closing price, or because the stocks are traded in two different geographic

markets. Besides, we also consider the missing (or some may say, the inexistence) data for Saturday, Sunday and public holidays because there is no market trading on the days.

## 1.6 INTRODUCTION TO MARKOV CHAIN

Accoring to Brémaud *et al.* (1999), Markov chain is firstly founded at 1906 by Andrey Markov and named after him. The first model was not preoccupied with applications but soon enough Markov chain is studied for the purpose of gambling. Poincaré, a French gambling probabilist, had studied Markov chain on finite groups, and applied it to card shuffling. The work of Markov challenged the best probabilists, such as Kolmogorov, Doeblin, and Fréchet, as the outcome of Markov model was a clean and sound theory ready for applications. Nowadays, the existence of Markov model can be found in various fields, especially in applied sciences. In biology, Markov model are mostly applied on genetics and population theory. For social sciences, social mobility can be described by Markov model. Electrical engineering used Markov theory to perform analysis of multiple access communications protocols and of communications networks, in coded modulation, and in image processing. Markov chain has also contributed to the application of operations research, in reliability theory and queuing theory. Just to name a part of them.

The main concept of Markov chain is that the previous states are irrelevant for predicting the probability of subsequent states, given the current state. Tan & Yilmaz (2001) stated that over the last forty years, Markov chain based tests have been frequently used in the analysis of statistical properties of various economic time series.

Market efficiency literature is the area that made the most use of Markov chain based tests. Markov chain based tests are also applied on stock markets, and in testing market efficiency in the foreign exchange markets.

Wang (1997) said that in stock market analysis, Markov chain can be employed. This is because that Markov Chain can be used to study the nature or sequences of events ranging from purely random to purely deterministic. Other than that, Markov Chain addresses nonlinearity by allowing the parameters, which is the transition probability to vary depending on a given sequence of prior states. And also Markov Chain can be applied to quality information such as the combinations of volume and volatility, the chart transformation, etc.

## 1.7 PROBLEM

The predictability of stock price movement interests academics and practitioners because of the ability to lower the risk and higher the return. However, according to the efficient market theory (Liu and Kwong, 2007; Yao *et al.*, 2003), it is practically impossible to infer a fixed long-term global forecasting model from historical stock market information. The stock price movements are not predictable in a market where stock is priced immediately with an unbiased response to available information. Despite the fact, more and more models and techniques are applied. Markov Chain is less used in forecasting share prices although the history and successfulness of it has proven over the century. There are researches using other forms of Markov concept, but in this study, we focus more on the basic concepts and application of Markov

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