

FORECASTING DiGi CLOSING SHARE PRICES USING ARMA MODELS

TAN MEI HOON

THIS DISSERTATION IS SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENT FOR THE DEGREE OF BACHELOR OF SCIENCE WITH
HONOURS

MATHEMATICS WITH ECONOMICS PROGRAMME
SCHOOL OF SCIENCE AND TECHNOLOGY
UNIVERSITI MALAYSIA SABAH

April 2008



UMS
UNIVERSITI MALAYSIA SABAH

UNIVERSITI MALAYSIA SABAH

BORANG PENGESAHAN STATUS TESIS@

JUDUL: FORECASTING DIGI CLOSING SHARE PRICES USING ARMA MODEL

IJAZAH: IJAZAH SARJANA MUDA SAINS DENGAN KEPUJIAN (MATEMATIK DENGAN EKONOMI)

SAYA TAN MEI HOON SESI PENGAJIAN: 2007/08
(HURUF BESAR)

mengaku membenarkan tesis (LPSM/Sarjana/Doktor Falsafah) ini disimpan di Perpustakaan Universiti Malaysia Sabah dengan syarat-syarat kegunaan seperti berikut:-

1. Tesis adalah hakmilik Universiti Malaysia Sabah.
2. Perpustakaan Universiti Malaysia Sabah dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (/)

SULIT

(Mengandungi maklumat yang berdarjah keselamatan atau Kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)

TERHAD

(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

TIDAK TERHAD

Disahkan Oleh

Jandrihooon

(TANDATANGAN PENULIS)

(TANDATANGAN PUSTAKAWAN)

Alamat Tetap: 1, JALAN PP10 TAMAN PINGGIRAN PUTRA, 43300 SERI KEMBANGAN, SELANGOR.

PROF. DR. ZAINODIN BIN HAJI JUBOK

Nama Penyelia

Tarikh: 23/4/2008Tarikh: 23/4/2008

CATATAN:- *Potong yang tidak berkenaan.

**Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa /organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT dan TERHAD.

@Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah dan Sarjana secara penyelidikan atau disertai bagi pengajian secara kerja kursus dan Laporan Projek Sarjana Muda (LPSM).



DECLARATION

I hereby declare that this dissertation contains my original research work. Source of findings reviewed herein have been duly acknowledged.

30 April 2008

Tan Mei Hoon .

TAN MEI HOON
HS 2005-2719



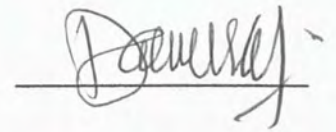
CERTIFIED BY

Signature

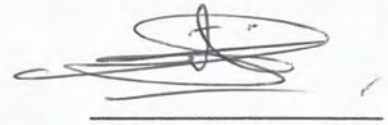
1. **SUPERVISOR**
(Prof. Dr. Zainodin Hj. Jubok)



2. **EXAMINER 1**
(Pn. Darmesah Gabda)

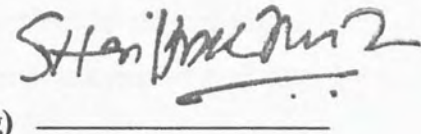


3. **EXAMINER 2**
(Pn. Siti Rahayu Bt. Mohd. Hashim)



4. **DEAN**

(Supt/KS. Assoc. Prof. Dr. Shariff A. Kadir S. Omang)



ACKNOWLEDGEMENT

First of all, I would like to express my thankfulness and gratitude to my supervisor, Prof. Dr. Zainodin Haji Jubok. Along the path for project 1 and project 2, he has given me a lot of guidance, encouragement and concept in order to help me to complete my research on time. Although sometimes I faced failures and obstacles while doing my project, but he will give me salute support and indispensable comments that hold me on. Under his supervision, I have learnt a lot of skills which are very useful and applicable in my future and gained lots of experiences which will enrich my life.

Furthermore, I would like to make known my gratefulness and testimonial to Mr. Ng Ying Kee, who writes the programme with cubic spline approach that help us a lot in the case to estimate the unobserved data in the series. This programme makes the work to estimate the unobserved data less time-consumed.

In addition, I would like to address my appreciation to all of the lecturers of Mathematics with Economics who have given me lots of priceless ideas and support. Lastly, I would like to praise my friends and family for the encouragement and moral support given along the time I faced setback.



ABSTRAK

Tujuan kajian disertasi ini adalah untuk mendapatkan satu model siri masa yang terbaik supaya penelahan harga tutup bagi DiGi dalam jangka masa yang pendek boleh dilakukan. Kajian ini menggunakan data daripada 3 Januari 2000 sehingga 31 December 2007. Data daripada 3 Januari 2000 sehingga 30 Ogos 2007 akan digunakan untuk membentuk model ARMA manakala data daripada 1 September 2007 sehingga 31 Disember 2007 akan disimpan untuk membuat perbandingan diantara nilai sebenar dan nilai telahan untuk menguji kejituan model yang dibentuk.

Dalam kajian ini, dua siri akan dipertimbangkan iaitu siri yang pertama tidak ada nilai pada hari-hari yang tidak diniagakan. Sebagai contoh hujung minggu (Sabtu dan Ahad) dan cuti-cuti umum. Manakala siri yang kedua dimana nilai-nilai ini telah dianggarkan dengan menggunakan kaedah *cubic spline*.

Dalam disertasi ini, $p+q \leq 10$ telah ditetapkan. Oleh yang demikian, 65 model yang dipertimbangkan akan terhasil bagi setiap siri yang dibincangkan. Daripada 65 model yang dipertimbangkan, model terpilih akan dipilih dengan menggunakan nilai- p . Selain itu, dua model penelahan yang dicadangkan oleh Box-Jenkins juga akan dikaji. Selepas itu, setiap siri akan dipilih model terbaik yang masing-masing. Tetapi, pada akhir disertasi, hanya satu sahaja model terbaik yang akan dipertimbangkan daripada empat model terbaik. Model terbaik yang terpilih ini akan digunakan untuk membuat penelahan pada jangka masa yang singkat dan kejituan penelahan akan diuji dengan menggunakan Purata Peratusan Ralat Mutlak.



ABSTRACT

The purpose of this research is to predict DiGi share market by using time series approach and ARMA model. In this study, the data being employed is from 3 January 2000 to 31 December 2007. The data range from 3 January 2000 to 30 August 2007 was used to form the ARMA models while the remaining of the data which is from 1 September 2007 to 31 December 2007 was used to validate the adequacy of the model formed.

In this study, two series have been considered which are the series with unobserved data and the series with the unobserved data being estimated by using cubic spline approach. In this research, the order of the ARMA models has been set to $p+q \leq 10$. Therefore, there are 65 possible models for each series. These possible models will be eliminated to selected models and lastly the best model.

In this research, four best models have been considered which are the best model from the series with the unobserved data and the best model from the series without unobserved data. Furthermore, there are another two alternative best models were taken into consideration in this research. However, at the end of this study, there is only one “best of the best model” being utilised in this study for future short term forecasting. The accuracy of the forecast was compared by using Mean Absolute Percentage Error (MAPE).



CONTENTS

	Page Number
DECLARATION	ii
CERTIFICATION	iii
ACKNOWLEDGEMENT	iv
ABSTRAK	v
ABSTRACT	vi
LIST OF CONTENTS	vii
LIST OF TABLES	xi
LIST OF FIGURES	xiii
LIST OF SYMBOLS	viii
CHAPTER 1 INTRODUCTION	
1.1 Overview of the Problem	1
1.1.1 History of DiGi	2
1.1.2 Share/Stock	3
1.2 Rationale of Study	6
1.3 Objectives of Study	7
1.4 Scopes of Study	8
1.5 Limitations	9
CHAPTER 2 LITERATURE REVIEW	
2.1 Introduction	10
2.2 Reviews on Time-Series	10
2.3 Reviews on Box-Jenkins	12
2.4 Reviews on Time-Series Application	13
2.5 Reviews on Transformation	20
2.6 Reviews on Model Selection Criteria	21



CHAPTER 3 METHODOLOGY

3.1	The Statement of the Problem	23
	3.1.1 Materials	24
	3.1.2 Computer Software	25
3.2	Time-Series	25
	3.2.1 Components of a Time-Series	26
3.3	Stationary and Nonstationary Time-Series	29
	3.3.1 The Differencing Method	32
	3.3.2 The Exponential Smoothing Method	34
	3.3.3 The Moving Average Method	35
	3.3.4 The Box-Cox Transformation	35
3.4	How to Determine the Stationary of a Series?	36
	3.4.1 The Dickey-Fuller Test	36
	3.4.2 The Equality of Means and Variances	38
	3.4.3 The Graphical Approach (ACF Plot)	42
3.5	Mixed Autoregressive-Moving Average Models (ARIMA)	44
3.6	Autoregressive Models (AR)	45
3.7	Moving Average Models (MA)	46
3.8	The Sample Autocorrelation and Partial Autocorrelation Functions (The ACF and PACF)	48
	3.8.1 The Sample Autocorrelation Function (ACF)	49
	3.8.2 The Sample Partial Autocorrelation Function (PACF)	52
3.9	Estimation of Parameters	54
3.10	Selection of the Best Model by using Eight Model Selection Criteria (8SC)	56
3.11	How to Examine the Adequacy of the Model as the Best Model for Forecasting	58
	3.11.1 Randomness Test	59
	3.11.2 The Global Test	60
	3.11.3 The Wald Test	61
3.12	Forecasting	62



CHAPTER 4 DESCRIPTION OF DATA

4.1	Overview of the Data	65
4.1.1	The Cubic Spline Approach	66
4.2	Testing for Stationary of the Data	67
4.2.1	Testing for Stationary of Closing Price of DiGi (with unobserved data)	68
4.2.2	Testing for Stationary of Closing Price of DiGi (without unobserved data)	78
4.3	The Alternative Models	88
4.3.1	The Alternative Model Suggested by Box-Jenkins for the Series with Unobserved Data	88
4.3.2	The Alternative Model Suggested by Box-Jenkins for the Series without Unobserved Data	90

CHAPTER 5 ANALYSIS OF DATA

5.1	Introduction	93
5.2	Possible Models	94
5.2.1	Possible Models for the Series with the Unobserved Data	94
5.2.2	Possible Models for the Series without the Unobserved Data	96
5.3	Selected Models for the Series With and Without Unobserved Data	97
5.4	The Best Model for the Series With and Without Unobserved Data	103
5.4.1	The Best Model for the Series With Unobserved Data	103
5.4.2	The Best Model for the Series Without Unobserved Data	104
5.5	Tests to Examine the Adequacy of Best Models	106
5.5.1	The Tests against the Best Model of the Series With the Unobserved Data	106
5.5.2	The Tests against the Best Model of the Series Without the Unobserved Data	115
5.6	Forecasting	123



CHAPTER 6 CONCLUSION AND RECOMMENDATION

6.1	Overview	128
6.2	Discussion	129
6.3	Conclusions	130
6.4	Recommendations	132

REFERENCES

APPENDIX



LIST OF TABLES

No. Table	Page Number
3.1	41
3.2	42
3.3	53
3.4	57
3.5	62
4.1	69
4.2	73
4.3	74
4.4	75
4.5	76
4.6	77
4.7	83
4.8	83
4.9	85
4.10	86



4.11	The ACF and PACF for the series with the unobserved data	89
4.12	The output for ARMA(5,5)	90
4.13	The ACF and PACF for the series without the unobserved data	91
4.14	The output for M24, ARMA(3,3)	92
5.1	The possible combination of models from $p+q=7$	94
5.2	The possible model for $p+q=7$, with $p=4$, $q=3$	95
5.3	The possible combination of models from $p+q=10$	96
5.4	The output for M31.1	98
5.5	The output for M31.2	99
5.6	The output for M7	100
5.7	The output for M16	101
5.8	The output for M16.1	101
5.9	The output for M16.2	102
5.10	The output for M61.2	105
5.11	The ANOVA table for Wald test (series with unobserved data)	109
5.12	The output of Wald test for M31.2	110
5.13	The output of Wald test for M16 and M7	111
5.14	The output for M61	117
5.15	The ANOVA table for Wald test of the best model (series without unobserved data)	118
5.16	The output of Wald Test for M61.2	119
5.17	The table of actual values and forecast values for September 2007	125



LIST OF FIGURES

No. Figure	Page Number
3.1 Seasonal Variation	27
3.2 Cyclical Variation	28
3.3 Secular Trend	29
3.4 Nonstationary Series, X	30
3.5 Stationary Series, Z	31
3.6 The ACF plot for stationary series	43
3.7 The ACF plot for nonstationary series	43
3.8 Example of PACF plot cuts off after lag 1	46
3.9 Example of ACF plot cuts off after lag 1	48
3.10 Damped exponential dying down	51
3.11 Damped sine-wave dying down	51
3.12 Damped exponential dying down with oscillation	51
4.1 Graphical approach for cubic spline estimation	66
4.2 The original closing share price (with unobserved values)	69
4.3 Plot of ACF for the original closing prices until lag 20	70
4.4 The Plot of Closing Prices after taking \ln transformation	71
4.5 ACF plot for the closing prices after taking \ln transformation	72
4.6 Plot of the series after taking \ln transformation and first-order differencing	72
4.7 Stationary ACF plot for the series after taking \ln transformation and first-order differencing	78
4.8 The original closing share price (without unobserved values)	79
4.9 The ACF plot for the original closing prices (without unobserved values)	80
4.10 The ACF plot of the series (with the estimated unobserved values) after taking \log transformation	81
4.11 The ACF plot of the series after taking \log transformation and first differencing	82
4.12 The plot of the stationary series (without unobserved values)	87



5.1	The distribution of residuals for the series with unobserved data	114
5.2	The ACF plot of Residuals for the series with unobserved data	114
5.3	PACF plot of Residuals for the series with unobserved data	115
5.4	The distribution of the residuals for the series without unobserved data	121
5.5	ACF plot of residuals for the series without unobserved data	122
5.6	PACF plot of residuals for the series without unobserved data	122



LIST OF SYMBOLS

p	order of autoregressive models
q	order of moving average models
\leq	less than or equal
\geq	greater than or equal
$=$	equal
\neq	not equal
$+$	addition
$-$	subtraction
\times	multiplication
\div	division
\sum	summation
n	number of observations
k	number of parameters
SSE	sum of square residuals/sum of squared resid
df	degree of freedom
UCL	upper control limit
LCL	lower control limit



CHAPTER 1

INTRODUCTION

1.1 OVERVIEW OF THE PROBLEM

DiGi Communications Sdn. Bhd. (DiGi) is selected in this research basically because of the company's prospect and the annual financial performance of the company. Besides, in these latest years, the share prices of DiGi always shows continually increment or at least maintain at steady growth stage even there are the periods the share prices turn "down". Moreover, DiGi is an active share listed on the Kuala Lumpur Stock Exchange (KLSE) main board under the Infrastructure Project Companies Category which in fact affect the Kuala Lumpur Composite Index (KLCI) as well. According to Bursa Malaysia (2007), DiGi is categorized as one of the blue chip company out of the 100 blue chip companies. Kok and Goh (1995) claimed that as one of the blue chip company, DiGi appeared to has big market capitalization and unrestrained by debt. Market capitalization here defined as the number of outstanding shares of stock multiplied by the current price-per-share. Annual report of DiGi for year 2005 stated that DiGi's mission is to meet individual needs in various functions such as communications, connectivity, and access to information with appropriate security with specific and concrete solution. Along with that,



DiGi also provide an environment where employees can grow and be fulfilled while shareholders to gain superior returns in their investment. Hence, all of the criteria discussed above can actually enhance our country's economic growth and thus improve the standard of living in Malaysia with the advanced communications' technology.

1.1.1 History of DiGi

According to DiGi annual report for year 2001, DiGi is a mobile communication company that provides a comprehensive range of convenient, affordable and easy to use wireless services to simplify and enrich the lives of its customers. On the whole, DiGi creates and attracts customers by selecting the most appropriate cutting edge technology so that users are benefits from its products and services which have various choices to suit variety of customers.

DiGi is the leader in voice and data prepaid services that have set industry benchmarks for creativity and innovation. These services are offered under the DiGi prepaid brand name. Alternatively, DiGi also provides postpaid services under the DiGi postpaid brand name.

From DiGi's annual report for year 2005, DiGi Telecommunications Sdn. Bhd. was founded in September 1994 called Mutiara Telecommunications. At 24 May 1995, DiGi be the first telecommunication company in Malaysia to launch and operate a fully digital cellular network (GSM 1800). In July 1996, Swisscom purchased part of the shares and the name of the company was changed to DiGi Swisscom. In year 1997, DiGi



be the first telecommunication company (then known as Mutiara Swisscom Bhd.) listed on the Kuala Lumpur Stock Exchange (KLSE) main board under the Infrastructure Project Companies Category. Swisscom divested its ownership in 1999. In January 2000, one of the DiGi's main shareholders sold 30 percent of the company's shares to Telenor, Norway's incumbent telecommunication operator. May 2000, the name of DiGi Swisscom Bhd., the holding company of DiGi Telecommunications Sdn. Bhd. was changed to DiGi.Com Berhad. In June 2000, Telenor bought an additional three percent of the company's shares. The remaining shares (11.1 percent traded on the KLSE) are held publicly and 56 percent by private investors. At December 2000, iDiGi have been launched. DiGi's new internet Dial-up Access Services in Klang Valley which ensures faster access speeds and reliability. December 2005, DiGi endorsed an industry standard on mobile broadband service that will enhance confidence in the quality of 3G.

1.1.2 Share/Stock

Sincere (2004) stated that a share is simply part of ownership of a business. Owning share means participate in the company's performance in the form of profits which can be given as dividends and/or capital growth through the value of shares increasing. The money that investors invest in the company will be used for other investors to finance its business or expand the business without having to borrow money. However, Hirt and Block (2005) proposed that owning the common stock of a large corporation does not carry the same ownership rights. For example, shareholders of DiGi cannot tell the management how to run the company or what types of products and services they should be producing. Its



existence does not depend on the people who run it. Hirt and Block (2005), this is because shareholders' rights are limited.

In Malaysia, Kok and Goh (1995) said that Kuala Lumpur Stock Exchange (KLSE) is the only stock market. KLSE plays a very crucial and climactic function in developing the economic of the country. Wong (1993) defined stock market as a marketplace where people come together to buy and sell shares. Therefore, the price of share is determined by the buying and selling pressure. Stock prices change everyday as a result of market forces. Sincere (2004) explained this by the mean share prices change because of supply and demand. If more people want to buy a stock (demand) than sell it (supply), then the price moves up. Conversely, if more shareholders want to sell their stocks than buy it, there could be greater supply than demand, and the price would fall. The principal theory is that the price movement of a stock indicates what investors feel a company is worth. This involves what news is positive for a company and what news is negative. The company which has a lot of positive news will assure a higher share prices and vice versa.

When the price of a particular stock rises, that stock is said to be "up", meaning increase in the price. When the price falls, the stock is said to have gone "down". The terms "up" and "down" are also use to describe the rise and fall of the market as a whole. As a shareholder or stockholder, as a company makes money, the value of its stock goes up. Conversely, if a company loses money, shareholder or stockholder would also share the loss. Furthermore, the price of a stock does not only reflect a company's current value but it also reflects the growth that investors expect in the future.



Faerber (2000) stated that the most important factor that affects the value of a company is its earnings. Here, earnings are the profits a company makes, and in the long run no company can survive without these earnings or profits. Public companies are required to report their earnings. The reason behind this is that analyst base on their future value of a company on their earnings projection. If a company's results surprise (are better than expected), the price jumps up. If a company's results disappoint (are worse than expected), then the price will fall.

“Bear market” can be described as a time when stock prices have been falling on the whole. Meanwhile, a “bull market” is a period when stock prices are generally rising.

Generally, Kok and Goh (1995) advocated that stock market plays very important and decisive roles in stimulating a country's economics growth. Rising share prices, for instance, tend to be associated with increased business investment and vice versa. Share prices also have an effect on the wealth of households and their consumption. In additional, stock market acts as a medium for various types of securities of companies to be sold and to raise money. Besides, stock market is a medium to enhance healthy competition among the company. With the stock market, people can buy and sell shares easily and less time consuming through agents or brokers. Investment in stock market is therefore said to have greater flexibility. This concept is well-known as liquidity.

A shareholder of the company of course wishes to have plenty of returns for example capital gains, yearly dividend as well as bonus stated by Ch'ng (2003). Returns in the form of capital growth are basically profits earned when the share is traded at the



stock market base on the market value. For example, when one unit of share can be sold higher than its selling price then the principal will be higher. On the other hand, yearly dividend is the earnings given base on the percentage of the company's share owned by that particular shareholder. Ch'ng (2003) commended that the shareholder who owned larger part of the company's share will gain more yearly dividend. Bonus is the shares which publicized by the company to distribute free to the company's shareholder. So, the particular shareholders can enlarge their shares of that company and sell it in the market to make profits.

Hirt and Block (2005) pointed out that risks associated in different types of investments and almost all investments regardless short term or long term. Risks might be generated from outside events for example war, recession, or terrorism. Although the share market historically has outperformed other investments over the long term, the market can experience volatility in the short term. Individual stock prices can go down as well as up. It is important to keep an eye on the share's performance and to regularly re-evaluate whether they are still continued to be a good investment.

1.2 RATIONALE OF THE STUDY

Hirt and Block (2005) suggested that forecasting is very important to the strategic growth of a company or organization even to a shareholder. With the ability to predict for the future, management can plan ahead and to make necessary adjustments before actual lose occur. The outcome might be a function not only of their risk-taking desires, but also of their ability to be cautious and alert against risk with careful planning or strategies.



This research is basically focused on forecasting the share market movement of DiGi in the future. This study is to observe the prospect of DiGi's share price whether it will "up" or "down" in the future at BSKL. Such prediction might benefit shareholders, government, and also private sectors as well. With this prediction, shareholders can consider to keep the share for a certain long periods or to sell it in order to make profit or reduced lose. Furthermore, Hirt and Block (2005) stressed that with such prediction, the particular company can plan ahead to increase their share prices in the future.

1.3 OBJECTIVES OF THE STUDY

The purposes of this study are

- OB 1: to identify the trend or movement of the share prices based on the past daily data from year 2000 to 2007.
- OB 2: to examine the influence of the higher order ARMA model towards forecasting whereas in this case the order $p+q \leq 10$ is considered.
- OB 3: to justify whether the best model determined by emphasising the elimination of the lag with insignificant coefficient is superior than the alternative models.
- OB 4: to examine the adequacy of the best model in future forecasting.
- OB 5: to investigate the effect of forecasting in short term period.

Hirt and Block (2005), share market requires forecast of the future behaviour of the shares. For example, forecasters will begin to predict the "up" and "down" of shares



for specific time periods. These predictions are to determine whether to invest in those particular shares.

1.4 SCOPES OF THE STUDY

This study is written based on the data provided by Bursa Saham Malaysia, BSKL. This research is only applicable to predict the share market of DiGi, a telecommunication company in Malaysia. Moreover, the prediction might be not so accurate because the data collection is only within eight years. This lack of data scenario might be caused by those data are private and confidential in nature. So, only the last eight years' data (2000-2007) managed to be obtained. Besides, the model which formed by using these eight years' data will only applicable to forecast the share prices for a short period. This is because ARMA approaches only valid or as a well-predictor for short-term prediction rather than long-term forecasting due to the variation in economic conditions or rapid change in share market. In this study, constant economic conditions will be assumed for the periods (2000-2007) the time series data being collected and for the time period the ARMA model formed uses to forecast. Otherwise, the model that finalised from the data collected from year 2000-2007 may not be adequate. In this case, economic conditions included three elements those are financial position, fiscal capacity and service capacity. Economic conditions can be described as composite of a government's financial health/status and its endowment and willingness to meet its financial obligations and commitments to provide services.

REFERENCES

- Akaike, H. 1970. Statistical Predictor Identification. *Annals Institute of Statistical Mathematic* **22**: 203-217.
- Akaike, H. 1974. A New Look at Statistical Model Identification. *IEEE Trans Auto Control* **19**: 716-723.
- Bowermann, B.L., O'Connell, R. T. & Koehler, A. B. 2005. *Forecasting, time series and regression*. 4th Edition. Thomson Brooks/Cole, California.
- BuHamra, S., Smaoui, N. & Gabr, M. 2003. The Box-Jenkins analysis and neural networks: prediction and time-series modelling. *Applied Mathematical Modelling* **27** (10): 805-815.
- Chatfield, C. 1996. *The Analysis of Time Series: An Introduction*. Chapman and Hall, London.
- Chatfield, C. 2000. *Time-Series Forecasting*. Chapman and Hall, London.
- Ch'ng, B. S. 2003. *Penganggaran indeks perlombongan dengan harga empat saham perlombongan dengan menggunakan kaedah siri masa*. Disertasi Ijazah Sarjana Muda, Universiti Malaysia Sabah, Kota Kinabalu (Not published).
- Chor, Y. S. & White, H. 1996. Information criteria for selecting possibly misspecified parametric models. *Journal of Econometric* **71**: 207-225.
- Coakes, S. J. & Steed, L. G. 2003. *SPSS: Analysis without Anguish: version 11.0 for Window*. John Wiley & Sons, New Jersey.



- Craven, P. and Wahba, G. 1979. Smoothing Noisy Data with Spline Functions. *Numerical Mathematics* **13**: 377-403.
- Croucher, J. S. 2002. *Statistic: Making Business Decision*. McGraw-Hill, Beijing.
- Cryer, J. D. 1996. *Time- Series Analysis*. Duxbury Press, Boston.
- Delurgio, S. A. 1998. *Forecasting Principles and Applications*. McGraw-Hill, Boston.
- DiGi, 2001. *Annual Report of DiGi. Com Berhad*. Shah Alam.
- DiGi, 2005. *Annual Report of DiGi. Com Berhad*. Shah Alam.
- Dooley, G. & Lenihan, H. 2005. An assessment of time-series method in metal price forecasting. *Resources Policy* **30** (3): 208-217.
- Faerber, E. 2000. *All about Stock: The Easy way to get started*. 2nd Edition. McGraw-Hill, New York.
- Ghysels, E. 1997. On seasonality and business cycle durations: A nonparametric investigation. *Journal of Econometric* **79**: 269-290.
- Giordano, F. R., Weir, M. D., Fox, W. P. 2003. *A First Course in Mathematical Modeling*. 3rd Edition. Code Publishing Co. London.
- Halcoussis, D. 2005. *Understanding Econometrics*. South Western, Ohio.
- Hanke, J. E. & Wichern, D.W. 2005. *Business Forecasting*. 8th Edition. Pearson Prentice Hall, New Jersey.



- Hannan, E. J. and Quinn, B. 1979. The Determination of the Order of an Autoregression. *Journal of Royal Stat. Society, Series B*41: 190-195.
- Hill, R. C., Griffiths, W. E. & Judge, G. G. *Undergraduate Econometrics*. 2nd Edition. John Wiley & Sons, New York.
- Hirt, G. A. & Block, S. B. 2005. *Foundations of Financial Management*. 11th Edition. McGraw-Hill, Boston.
- Hoang, P. 2006. *Springer Handbook for Engineering Statistics*. Springer, London.
- Ismail, M., Ningsih, S. C. & Pasvil, Y. 2007. Unimodality tests for globalization of single variable function using statistical method. *Malaysian Journal of Mathematical Sciences*, 1(2): 43-53.
- Kok, K. L. & Goh, K. L. 1995. *Malaysian Securities Market*. Pelanduk Publications, Petaling Jaya.
- Lind, D. A., Marchal, W. G. & Wathen, S. A. 2005. *Statistical Techniques in Business and Economics*. 12th Edition. McGraw-Hill, New York.
- McDonald, M. 2002. *Predict Market Swings with Technical Analysis*. John Wiley & Sons, New York.
- Nellis, J. G. & Fleming, M. G. 1994. *Principles of Applied Statistics*. Routledge, London.
- Newbold, P., Carlson, W. L. & Thorne, B. M. 2003. *Statistics for Business and Economics*. 5th Edition. Pearson Education, New Jersey.



- Pitfield, D. E. 2007. The impact on traffic, market shares and concentration of Airline Alliances on selected European-US routes. *Journal of Air Transport Management* 13 (4): 192-202.
- Ramanathan, R. 2002. *Introductory Econometrics with Applications*. 5th Edition. Thomson Learning, Fort Worth.
- Reiman, M. A., Hill, R. C., Griffiths, W. E. & Judge, G. G. *Using EViews for Undergraduate Econometrics*. 2nd Edition. John Wiley & Sons, New York.
- Rice, J. 1984. Bandwidth Choice for Nonparametric Kernel Regression. *Annals of Statistics* 12: 1215-1230.
- Schwarz, G. 1978. Estimating the Dimension of a Model. *Annals of Statistics* 6: 461-464.
- Shibata, R. 1981. An Optimal Selection of Regression Variables. *Biometrika* 68(1): 45-54.
- Sincere, M. 2004. *Understanding Stocks*. McGraw-Hill, New York.
- Su, V. 1996. *Economic Fluctuation and Forecasting*. Harpercollins College, New York.
- Unakrtan, G. & Akdemir, B. 2006. Tractor demand projection in Turkey. *Biosystems Engineering* 97 (1): 19-25.
- Vogelvang, B. 2005. *Econometrics: Theory and Applications with EViews*. Pearson Education Limited, Harlow.
- Wong, Y. 1993. *Key to Singapore Stocks Market Profits: The Trend Principle*. Heinemann Asia, Singapore.



Yurekli, K. & Kurunc, A. 2006. Simulating agricultural drought periods based on daily rainfall and crop water consumption. *Journal of Arid Environments* 67 (4): 629-640.

