MODELLING AND FORECASTING THE KUALA LUMPUR COMPOSITE INDEX RATE OF RETURNS USING GENERALISED AUTOREGRESSIVE CONDITIONAL HETEROSCEDASTICITY MODELS

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By

MAIYASTRI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia in Fulfilment of the Requirements for the Degree of Doctor of Philosophy

November 2004
This Thesis is dedicated to:

My Mother

CHAMSIAH BT ZAINUDDIN
And

My late Father

ABDUL MUTHALIB BIN ABDUL MUNAF
May Allah rest his soul in heaven
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The work in this thesis is concerned with the modelling and forecasting of the KLCI’s returns with a ‘complete’ technique. The selection of the model for estimation is not only based on the value of the goodness of fit test, but also on the test of the stability of parameters obtained, the checking of the characteristic of the standardized residual such as the ARCH-LM test, Ljung-Box test, asymmetry test (SB, NSB, and PSB test). Its distribution is examined by qq-plot. The forecasting is carried out by using the multi-step-ahead forecast.

This study also proposes the PCA(Principal Component Analysis) as an alternative method to compare the performance of several GARCH models. It is found that this method has a clear edge over its rival because PCA uses actual values of the goodness of fit test criteria (LogL, SBC, and AIC in estimation and RMSE, MAE,
AMAPE and MAPE in forecasting) and hence the inability to specify exactly the relative positions of each of the competing models as faced by the ranking method may be overcome. Another plus point is that, this method enables models to be classified into several distinct groups ordered in such a way that each group is made up of models with about the same level of fitting and forecasting abilities.

The characteristics of the numerous tests in modelling for GARCH have been checked by Monte Carlo simulation. The tests are the ARCH-LM test, the SB, NSB and PSB tests, the parameters constancy test and the ARCH remaining test (to test whether the standardized residual still contain signs of conditional heteroscedasticity). The results show that the ARCH remaining test is inconsistent, but the other tests are accurate and stable for all experiments.

Since the volatility of the KLCI’s returns series is non-uniform, the data is split into three periods of time. In the beginning, the division of the data is based on the plot of the returns, but for the later part, it is based on the distribution of the returns. Methods for correcting the outliers and splitting the heterogeneous data are proposed. The EM algorithm is applied to split the heterogeneous data, and the estimated parameters are used to correct the outlying data using the Mahalanobis Distance.

The last part of the thesis is concerned with the validation of the model obtained for fitting the GARCH model for the new data set (January 2001-April 2004 or Period IV). It is found that the pattern of the new data set resembles of Period III, and both
models are also the same. Finally, the model selected for Period IV is used to determine the VaR (Value at Risk) of the KLCI. The VaR at the 5% level for next 5 trading days (the next week) starting from the forecast origin on the 30\textsuperscript{th} April 2004 is RM 35,492.55, which means that if someone invest RM 1 million in the KLSE, and if some extraordinary event happens, the maximum loss incurred for the next 5 trading days (starting from the forecast origin on the 30\textsuperscript{th} April 2004) with 95% probability is RM 35,492.55.
Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah

PEMODELAN DAN PERAMALAN PULANGAN INDEKS KOMPOSIT KUALA LUMPUR MENGGUNAKAN MODEL ‘GENERALISED AUTOREGRESSIVE CONDITIONAL HETEROSCEDASTICITY’

Oleh
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Kajian dalam teisis ini adalah berkaitan dengan pemodelan dan peramalan pulangan KLCI dengan teknik yang ‘lengkap’. Pemilihan model untuk penganggaran tidak hanya berdasarkan kepada nilai ujian kebagusan penyuaian, akan tetapi juga berdasarkan kepada ujian kestabilan parameter yang diperolehi, pemeriksaan ke atas ciri reja terpiawai seperti ujian ARCH-LM, ujian Ljung-Box, ujian asimetri (ujian SB, NSB, dan PSB) dan pemeriksaan ke atas taburannya berdasarkan plot qq. Peramalan dilakukan dengan ramalan multi-langkah kehadapan

Kajian ini juga mencadangkan PCA(Principal Component Analysis) sebagai kaedah alternatif untuk membandingkan pencapaian beberapa model GARCH. Kaedah yang dicadangkan mempunyai kelebihan yang ketara ke atas lawannya, kerana PCA menggunakan nilai sebenar dari ujian kebagusan penyuaian (LogL, SBC, dan AIC
dalam penganggaran dan RMSE, MAE, AMAPE dan MAPE dalam peramalan), dan oleh itu ketidak upayan untuk menyatakan dengan tepat kedudukan secara relatif setiap model yang bersaing seperti yang dihadapi oleh kaedah pangkat dapat diatasi. Kelebihan lain ialah kaedah ini juga dapat mengklasifikasikan model ke dalam beberapa kumpulan berbeza, disusun sedemikian rupa supaya setiap kumpulan terdiri daripada model dengan paras keboleh penyuaian dan peramalan yang hampir sama.

Simulasi Monte Carlo digunakan untuk memeriksa ciri-ciri pelbagai ujian dalam pemodelan GARCH. Ujian-ujian tersebut adalah ujian ARCH-LM, ujian-ujian SB, NSB and PSB, ujian kemalaran parameter, uji baki ARCH (bagi menguji sama ada reja terpawai masih menunjukkan tanda-tanda keheteroskedastisiti bersyarat). Keputusan menunjukkan bahawa uji baki ARCH tidak konsisten tetapi ujian-ujian lain adalah tepat dan stabil dalam semua eksperimen.

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I certify that an Examination Committee met on 8th November 2004 to conduct the final examination of Maiyastri on her Doctor of Philosophy thesis entitled “Modelling and Forecasting the KLCI’s Rate of Returns Using GARCH Models” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded a relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

MAIYASTRI

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