COMPARING THE APPLICABILITY OF BOX-JENKINS ARIMA METHODOLOGY AND ARCH/GARCH METHODOLOGY AMONG REAL DATA SETS

M.G.S.M.A. Ferdinandis

(8101)

Thesis/Dissertation submitted in partial fulfillment of the requirements for the degree Master of Science

Department of Mathematics

University of Moratuwa

Sri Lanka

February 2011

DECLARATION

"I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any University or other institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text"

Signature: ***UOM Verified Signature*** Date: 08/03/2011

"I hereby grant the University of Moratuwa the right to archive and to make available my thesis or dissertation in whole or part in the University Libraries in all forms of media, subject to the provisions of the current copyright act of Sri Lanka. I retrain all proprietary rights, such as patent rights. I also retain the right to use in future works (such as articles or books) all or part of this thesis or dissertation."

Signature: ***UOM Verified Signature*** Date: 08/03/2011

"I have supervised and accepted this thesis/dissertation for the award of the degree"

Signature of the supervisor: ***UOM Verified Signature*** Date 02/02/2011

ACKNOWLEDGMENTS

I would like to express my special thanks and gratitude to my supervisor, Mr.T.M.J.A Cooray, Senior Lecturer Department of Mathematics, University of Moratuwa for his expertise and assistance in clarifying questions regarding time series analysis and the advise he gave which was invaluable in enabling me to compute this thesis.

A special appreciation to the Head of the Department of Mathematics Dr. M.Z.M Malhardeen , Course Co-ordinator Dr. T.S.G Peiris, all the staff members of the Mathematics Department, University of Moratuwa and my colleagues at the university who provided me with advice and support throughout the writing of the thesis.

Last, but not least I would like to thank my ammi and thathhthi for their ongoing support and encouragement throughout my studies, particularly in the completion of this thesis.

Abstract

The main objective of this research is to compare the applicability of Box-Jenkins ARIMA methodology and ARCH/GARCH methodology among two real data sets. This study addresses the question of how to analyze time series data, identify structures, explain behaviours, model the identified structures and using the insight gained, to analyze and forecast values for the specific time series. For the purpose of this study the time series data included, the total kurakkan yield obtained from the Census department of Sri Lanka and the Money series obtained from the International Financial Statistics data source of Central bank of Sri Lanka. Each of the time series has its own characteristics and different methodologies were needed to require a deeper understanding of the time series data.

The analysis of time series constitutes an important area of statistics. The kurakkan yield data set consisted of a few missing values. Three different approaches namely deterministic, stochastic and state space method were used to estimate these missing values. Out of the three approaches the state space method gave the best estimates. Once the missing values were fitted The complete series was used to analyze and then forecast values. To build the models and perform the analysis a statistical software called "Minitab" and the software package called "E-views" was used. The best model obtained was a seasonal ARIMA model with 2 non-seasonal AR terms and 2 non-seasonal MA terms with one seasonal differencing. The model was used to forecast values and the accuracy measure MAPE was 1.65% for the ARIMA model fitted, which was the minimum value of MAPE for all the en-bloc methods mentioned above. The errors of this model were independent and identically distributed and followed a normal distribution.

The main difference between the two time series data sets used for this study is that the money series obtained is a high-volatile data series which includes heteroscedasticity. For this data series the ARIMA methodology cannot be used since the data will not become stationary to fit a model. Therefore the ARCH/GARCH methodology was used to deal with the money data series. To build models for this series the software package called "E-views" has been used. Different ARCH models and GARCH models were fitted to this data set and the parameters were chosen so that the kurtosis value was closer to three. The best model was, a logarithmic transformation of the money series with one GARCH term and no ARCH terms. This model yielded a kurtosis value of 3.09. The main model for this data set did not include any AR or MA terms. However a very large number of data points are required to model the series with AR and MA terms in the main model.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Abbreviation	Description
ACF	Auto Correlation Function
ADF	Augmented Dickey Fuller test
AIC	Akaike's Information Criterion
AR	Auto Regressive
ARCH	Autoregressive Conditional Heteroscedastic
ARMA	Auto Regressive Integrated Moving Average
ARIMA	Auto Regressive Integrated Moving Average
DW	Durbin Watson statistic
GARCH	Generalized Autoregressive Conditional Heteroscedastic
IID	Independent and Identically Distributed
MA	Moving Average
MAPE	Mean Absolute Percentage Error
MSE	Mean Squared Error
PAC	Partial Auto Correlation
PACF	Partial Auto Correlation Function
SARIMA	Seasonal Auto Regressive Integrated Moving Average
SBC	Schwarz Bayesian Criterion
WN	White Noise