DETERMINANTS OF ELECTRICITY DEMAND IN SRI LANKA, UNIVARIATE AND MULTIVARIATE TIME SERIES APPROACH

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Degree of Master of Science

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Thesis submitted in partial fulfillment of the requirements for the degree Master of Science in Operations Research

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Declaration

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Abstract

Studying energy consumption problems has become an important topic of research in recent decades. Efficient energy distribution planning necessitates accurate forecasts of future demand in order to achieve a balance between energy supply and demand. This study was conducted by focusing on developing a demand model for forecasting electricity demand in Sri Lanka. A univariate and multivariate model were focused on forecasting the electricity demand. Economic variables, including gross domestic product, foreign direct investment, inflation rate, population, average unit price, and number of consumer accounts, were used for the multivariate analysis. Data relevant to economic variables and electricity demand was collected from 1969 to 2020. Under the univariate analysis, naive, drift, and mean models were used as benchmark models, and exponential smoothing (ETS) and the ARIMA model were used further for the analysis. Under the multivariate analysis, the Granger causality test was used to identify the nature of the relationship between each economic variable and the electricity demand in Sri Lanka. A VAR modeling approach was used to build up a relationship model between the electricity demand and the selected economic variables under the Granger causality test. Forecast error was used to select the best model. According to the univariate analysis, as per the forecast error calculations, ARIMA(0,2,1) was found to be the best univariate model. The Granger Casualty test under the multivariate analysis indicated that foreign direct investment and average unit price Granger cause the electricity consumption in Sri Lanka. Based on an overall analysis of forecast errors, the VAR model demonstrates superior statistical fitness compared to both univariate and other multivariate analysis for predicting electricity demand in Sri Lanka.

Keywords— Electricity Demand - Univariate Analysis - Multivariate Analysis

Dedication

I dedicate this thesis to the people who have supported me throughout my life journey. Specially for my loving parents for their scarifies to achieve my dreams and for my loving husband and his family for their continuous support for the completion of my thesis. Further, I would like to dedicate my research for all teachers and lecturers who taught and guided me, and especially to Dr.Priyanga Talagala for her excellent guidance for the success of this thesis

Acknowledgements

I would like to express my acknowledgement and warmest thanks to my supervisor, Dr. Priyanga Talagala, who made this thesis possible. Her guidance and advice carried me through all the stages of my thesis.

I would also like to specially thank my loving parents, my husband, and his family for their continuous support and understanding when undertaking my research and writing the thesis.

Finally, I will thank all who supported me throughout my postgraduate journey. Thank you all for making me confident and making this a reality.

Table of Contents

List of Figures

List of Tables

List of Abbreviations

- ACF - Auto Correlation Function
- ADF - Augmented Dickey Fuller
- AIM - Abductory Induction Mechanism
- ANN - Artificial Neural Network
- ARIMA - Auto Regressive Integrated Moving Average
- CEB - Ceylon Electricity Board
- CCM - Convergent Cross Mapping
- ETS - Error, Trend, Seasonality
- FDI - Foreign Direct Investment
- GDP - Gross Domestic Product
- ICT - Information and Communication Technology
- IPP - Independent Power Producers
- KPSS - Kwiatkowski Phillips Schmidt Shin
- LECO - Lanka Electricity Company
- MAE - Mean Absolute Error
- MAPE - Mean Absolute Percentage Error
- MW - Mega Watts
- PUSL - Public Utilities Commission of Sri Lanka
- RMSE - Root Mean Square Error

- SLSEA - Sri Lanka Sustainable Energy Authority
- VAR - Vector Auto Regressive