

**UNIVERSITI TEKNOLOGI MARA**

**TECHNICAL REPORT**

**FORECASTING UNDER-5 MORTALITY RATE BY  
USING LEE-CARTER MODEL**

**P32M19**

**FATIN SYAHIRAH BINTI NASURI (2017412464)**

**NURSHAFARIWANI BINTI JUHARI (2017412462)**

**Report submitted in partial fulfilment of the requirement  
for the degree of  
Bachelor of Science (Hons.) Management Mathematics  
Faculty of Computer and Mathematical Sciences**

**JULY 2019**

## **ACKNOWLEDGEMENTS**

IN THE NAME OF ALLAH, (ALMIGHTY) THE MOST GRACIOUS, THE MOST MERCIFUL

First, we would like to thank Allah the Almighty the Most Gracious and the Most Merciful. We are grateful to ALLAH S.A.W because giving us strength and idea to complete this project.

Next, we would like to express our appreciation to our supervisor, Miss Teng Pek Eng for her interest, advices, help and guidance us in preparation of this project. All support and advices are very helpful to us complete this project.

Moreover, we would like to express our sincere gratitude to the University Technology Mara (UiTM) and especially to Faculty of Computer Science and Mathematics has been contributed to complete in this project. We also want to thank to our Final Year Project lecturer, Dr. Mat Salim Bin Selamat for his guidance, advices and support in the progress of this project. Not be forgotten to our beloved family for their motivation and support throughout the preparation of this project. The biggest appreciate to another lecturer, Madam Norani Binti Amit and Madam Noorezatty Binti Mohd Yusop for helping and guide us in this project.

After all commitments and hard works, Alhamdulillah this project finally it comes to end. It is impossible to us to finish this project without the guidance, support, advices and motivation people around us. Finally, we would like to express our special thanks to all our friends for the contribution and support for this study.

## TABLE OF CONTENTS

ACKNOWLEDGEMENTS.....	ii
TABLE OF CONTENTS.....	iii
LIST OF TABLES.....	iv
LIST OF FIGURES.....	iv
ABSTRACT.....	vi
CHAPTER 1: INTRODUCTION.....	1
1.1 Background of study.....	1
1.2 Problem of Statement.....	2
1.3 Objectives.....	3
1.4 Scope of study.....	3
1.5 Significant and Benefit of Study.....	3
CHAPTER 2: LITERATURE REVIEW.....	4
2.1 Fitting U5MR data using Lee-Carter model.....	4
2.2 Estimate parameter of Lee-Carter model.....	5
2.3 Forecasting using Box-Jenkins.....	5
2.4 Summary of findings on selected literature on forecasting U5MR.....	6
CHAPTER 3: DATA AND METHODOLOGY.....	8
3.1 Introduction.....	8
3.2 Lee-Carter model.....	8
3.3 Parameter of Lee-Carter model and singular value decomposition.....	9
3.4 Box-Jenkins in forecasting U5MR.....	11
CHAPTER 4: RESULT AND DISCUSSION.....	13
4.1 U5MR data.....	13
4.2 Fitting Lee-Carter model.....	14
4.2.1 Singular Value Decomposition approach.....	15
4.2.2 Fitted Lee-Carter model.....	16
4.3 Performing Box-Jenkins model.....	19
4.4 Forecast.....	27
CHAPTER 5: CONCLUSION AND RECOMMENDATION.....	29
APPENDIX.....	30

REFERENCES .....	35
------------------	----

## LIST OF TABLES

Table 1: Summary on selected literature for fitting and forecasting U5MR (1).....	6
Table 2: Summary on selected literature for fitting and forecasting U5MR (2).....	7
Table 3: Estimated LC model parameter, $c_x$ .....	14
Table 4: Estimated parameter $r_x$ by using SVD approach.....	15
Table 5: Estimated parameter $n_t$ by using SVD approach .....	15
Table 6: Equation of fitted LC model.....	16
Table 7: Summary of parameter estimation for Box-Jenkins model.....	26
Table 8: Forecast value of specific-age U5MR by gender at 2018.....	28

## LIST OF FIGURES

Figure 1: Flowchart of Box-Jenkins model .....	11
Figure 2: Graph of Partitioned U5MR by specific-age group in gender from 1990-2017 .....	13
Figure 3: Graph of Partitioned U5MR (with natural log function) by specific-age group in gender from 1990-2017 .....	14
Figure 4: Graph of actual and fitted for IMR male.....	16
Figure 5: Graph of actual and fitted for IMR female.....	17
Figure 6: Graph of actual and fitted for CMR male.....	17
Figure 7: Graph of actual and fitted for CMR female .....	18
Figure 8: Plotted graph for parameter $n_t$ .....	19
Figure 9: The Correlogram output for level.....	20
Figure 10: The Correlogram output for 1st differencing .....	20
Figure 11: The Correlogram output for 2nd differencing.....	21
Figure 12: The result of Augmented Dickey-Fuller test after 2nd differencing .....	21
Figure 13: Parameter estimation output for ARIMA (1, 2, 1) .....	22
Figure 14: Parameter estimation output for ARIMA (1, 2, 2) .....	23
Figure 15: Parameter estimation output for ARIMA (2, 2, 1) .....	24
Figure 16: Parameter estimation output for ARIMA (2, 2, 2) .....	25
Figure 17: Correlogram for ARIMA (1,2,1) of Q-statistic .....	26

## **ABSTRACT**

Mortality rate is one of the important indexes in health sector that indicates the level of development and health status of countries. The aim of the study is to estimate the parameter of Lee-Carter model by using Singular Value Decomposition (SVD) and the time series values for general level of mortality used to forecast from 2011 to 2018 by using Auto Regressive Integrated Moving Average (ARIMA) by its specific- age group and gender. This method is applied to Malaysian under-five mortality rate (U5MR) data from 1990 to 2017 with specific-age of infant and child (under five years old) of male and female. The fitted and actual result for each specific-age group and gender with natural logarithm ( $\ln$ ) function is likely to have the same pattern and the best forecasting model which is ARIMA (1,2,1). This study can be extended to different extensions approach to estimate Lee-Carter model or any stochastic mortality model.