

## Contents

<b>TITLE PAGE</b>	<b>i</b>
<b>SURAT KETERANGAN PENGANTI LEMBAR PENGESAHAN</b>	<b>ii</b>
<b>STATEMENT SHEET</b>	<b>iii</b>
<b>ACKNOWLEDGEMENT SHEET</b>	<b>iv</b>
<b>MOTTO SHEET</b>	<b>v</b>
<b>PREFACE</b>	<b>vi</b>
<b>CONTENTS</b>	<b>viii</b>
<b>LIST OF TABLES</b>	<b>x</b>
<b>LIST OF FIGURES</b>	<b>xi</b>
<b>LIST OF APPENDICES</b>	<b>xiii</b>
<b>LIST OF SYMBOLS</b>	<b>xvi</b>
<b>ABSTRAK</b>	<b>.xviii</b>
<b>ABSTRACT</b>	<b>xx</b>
<b>I INTRODUCTION</b>	<b>1</b>
1.1 Background	1
1.2 Problem Formulation	4
1.3 Research Purposes and Impacts	5
1.4 Literature Review	5
<b>II THEORY</b>	<b>10</b>
2.1 Probability and Random Variables	10
2.1.1 Probability : A Probability Measure, Independence and Conditional Probabilities and Cumulative Distributions	10
2.1.2 Random Variables and Distributions	13
2.2 Point Estimations and Likelihood Ratio Tests	15
2.2.1 The Method of Moments	16
2.2.2 Maximum Likelihood Estimators (MLE)	17
2.2.3 Likelihood Ratio Tests	19
2.3 Geometric Series, Monotone Sequences, and The Maximum-Minimum	20
2.4 Parametric Change Point Analysis	21
2.4.1 A Changepoint Formulation for Shifts in Mean or Variance	22
2.5 Time Series Analysis	24
2.5.1 Basic Concepts	24
2.5.2 Residual Checking	27
2.5.3 Autoregressive (AR) Models	28
2.5.4 ARIMA Models	37
2.5.5 Outliers	38
2.6 Fuzzy Theory	39
2.6.1 Fuzzy Sets	40
2.6.2 Fuzzy Time Series (FTS)	41
<b>III CHANGE POINT DETECTION BASED ON FUZZY TIME SERIES</b>	<b>45</b>
3.1 The Basic Idea of Using FTS in Change Point Detection	45
3.2 Change Point Model of The Underlying series	46

3.2.1	Variance of ARIMA(1,1,1) . . . . .	47
3.2.2	The Size of Break . . . . .	52
3.3	Fuzzy Time Series . . . . .	54
3.4	Procedure to detect abrupt changes using Fuzzy Time Series and Change Point Model . . . . .	56
<b>IV</b>	<b>SIMULATION AND EMPIRICAL RESULTS . . . . .</b>	<b>59</b>
4.1	Simulation . . . . .	59
4.1.1	Change Point Detection in the ARI(1,1) Model . . . . .	60
4.1.2	Change Point Detection in the IMA(1,1) Model . . . . .	72
4.1.3	Change Point Detection in the ARIMA(1,1,1) Model . . . . .	76
4.2	Empirical Results . . . . .	83
4.2.1	Example 1: Detecting SARS in Taiwan Tourism . . . . .	84
4.2.2	Example 2: Detecting Bali Bombings . . . . .	89
4.2.3	Comparisons to An Existing Detecting Algorithm . . . . .	94
<b>V</b>	<b>CONCLUSIONS AND FUTURE RESEARCH . . . . .</b>	<b>98</b>
5.1	Conclusions . . . . .	98
5.2	Future Research . . . . .	100
	<b>REFERENCES . . . . .</b>	<b>101</b>
<b>A</b>	<b>MATLAB SCRIPTS . . . . .</b>	<b>105</b>
<b>B</b>	<b>R SCRIPTS . . . . .</b>	<b>129</b>
<b>C</b>	<b>Percentage of Uncorrelated Residuals of ARIMA(1,1,1) . . . . .</b>	<b>134</b>
<b>D</b>	<b>Performance of Detection of the Proposed Method on ARIMA(1,1,1) . . . . .</b>	<b>138</b>
<b>E</b>	<b>CURRICULUM VITAE . . . . .</b>	<b>153</b>