

Table of Contents

Certificate	<i>VI</i>
Certificate of Examination	<i>VII</i>
Acknowledgement	<i>VIII</i>
Abstract.....	<i>IX</i>
List of Tables	<i>XI</i>
List of Figures	<i>XII</i>
List of abbreviations.....	<i>XV</i>
Chapter 1: Introduction	
1.1 Introduction	1
1.2 Evolution of Manufacturing Strategy	1
1.3 Past and Present Business Models	3
1.3.1 Retrieval and Disposal Cost	4
1.3.2 Warranty Cost	5
1.4 Motivation.....	6
1.5 Organization of the Thesis	8
Chapter 2: Literature Survey	
2.1 Introduction	11
2.2 Types of Warranty Policies.....	12
2.2.1 Free Replacement Warranty (FRW) Policy.....	12
2.2.2 Pro Rata Warranty (PRW) Policy	12
2.2.3 Renewing and Non Renewing Policy	13
2.3 Warranty Study	13
2.3.1 Warranty Cost Analysis.....	13
2.3.1.1 Modelling of Warranty Cost	13
2.3.1.2 Modelling of Failure	16
2.3.1.3 Optimal Policies	17
2.3.2 Warranty and Engineering	18
2.3.3 Warranty Management	19
2.3.4 Other Studies on Warranty.....	22
2.4 Critical Appraisal of surveyed literature.....	22

2.5 Conclusion.....	24
---------------------	----

Chapter 3: Research Objectives and Methodology Selection

3.1 Introduction.....	26
3.2 The Objectives of the Present Research	26
3.3 Scope of the Thesis.....	27
3.4 Methodology to Achieve Research objectives.....	27
3.4.1 Discriminant Analysis.....	29
3.4.2 Neural Networks.....	29
3.4.3 Decision Trees.....	30
3.4.4 k-NN Classifier	30
3.4.5 Rough Sets.....	31
3.4.5.1 An Overview of earlier Work in Rough Set.....	32
3.4.5.1.1 Application in Industry.....	33
3.4.5.1.2 Application of Rough Set in Other Areas.....	34
3.5 Conclusion.....	37

Chapter 4: Rough Set Knowledge Analysis

4.1 Introduction	38
4.2 Essentials of Rough Set	39
4.3 Knowledge Analysis of Warranty Data.....	41
4.3.1 Dimensionality Reduction.....	42
4.3.2 Rule Generation	44
4.4 Limitations of Basic Rough Set Algorithm.....	45
4.5 Conclusion.....	46

Chapter 5: Design and Development of Rough Set Framework

5.1 Introduction.....	47
5.2 Database Operations to Address Scalability.....	48
5.3 Rule Interestingness measures to Address Statistical Significance...52	
5.3.1 An Overview of Earlier Work on Rule Interestingness.....	52

5.4 Statistical Extension for Rule Validation	54
5.4.1 Chi-Square Statistic of Rules	55
5.4.2 Phi-Coefficient (Cramer's V).....	57
5.4.3 R Squared (Shared Variance).....	58
5.4.4 Lift (Link Analysis).....	59
5.4.4.1 A Novel Approach to Dimensionality Reduction ...	60
5.5 Heuristic for Tracking Emerging Issues.....	62
5.6 Proposed Algorithm Design.....	63
5.7 Development of a Visual Basic GUI	66
5.8 Conclusion.....	69

Chapter 6: Data Collection, Pre-processing and Analysis

6.1 Introduction.....	71
6.2 Overview of Automobile Warranty Data Management.....	73
6.3 Warranty Data Collection.....	74
6.3.1 Data Cleaning, Pre-processing and Transformation.....	76
6.4 Rule Generation, Evaluation, and Interpretation.....	79
6.4.1 Pareto Analysis.....	80
6.4.2 Tracking of Emerging Issues	81
6.4.3 Root Cause Analysis	85
6.5 Interpretation of Other Interesting Association Rules.....	94
6.5.1 Market Basket Analysis	94
6.5.2 Analysis of Sequential Failures.....	98
6.5.3 Analysis of Simultaneous Failures	101
6.6 Conclusions.....	102

Chapter 7: Conclusion and Scope for Future work

7.1 Conclusion.....	103
7.2 Scope for Future Work	104
References	107
Appendix: RoughMiner 1.0 Manual	119