

CONTENTS

TITLE PAGE	i
HALAMAN PENGESAHAN	ii
HALAMAN PERNYATAAN BEBAS PLAGIASI	iii
ACKNOWLEDGEMENT	iv
PREFACE	v
TABLE OF CONTENTS	vii
LIST OF TABLES	x
LIST OF FIGURES	xi
INTISARI	xii
ABSTRACT	xiii
I INTRODUCTION	1
1.1. Background	1
1.2. Research Question	4
1.3. Research Objectives and Benefits	6
1.4. Literature Review	7
1.5. Research Methodology	9
1.6. Research Structure	10
II THEORETICAL FRAMEWORK	12
2.1. Heritability of Human Diseases	12
2.2. Liability Threshold Model (LTM)	13
2.2.1. Breakdown of Disease Liabilities	15
2.2.2. Polygenic Risk Scores (PRS)	15
2.2.3. PRS in Liability Threshold Model	16
2.2.4. Liability Resemblance Between Parents and Offspring	17
2.3. Onset of Heart Attack	18
2.3.1. 4-State Heart Attack Markov Model	18
2.3.2. Determination of Heart Attack Events	19
2.4. Risk Prediction Model	20
2.5. Evaluation of Predictive Performance of Underwriting Models	20
2.5.1. Receiver Operating Characteristic (ROC)	21
2.5.2. Area Under the Curve (AUC)	22
2.6. Price Elasticity	23
2.7. Expected Claims and Premiums	24

III RESEARCH METHODOLOGY	26
3.1. Synthetic Population Simulation	26
3.1.1. Data Sources and Assumptions	26
3.1.2. Assigning Parental Ages	27
3.2. Genetic Risk Assignment: Family History (FH) and Polygenic Risk Scores (PRS)	28
3.2.1. Family History (FH) Assignment	28
3.2.2. Polygenic Risk Score (PRS) Assignment	29
3.3. Defining the Heart Attack Occurrences	30
3.3.1. Simulate Individual Disease Liability	31
3.3.2. Defining the Heart Attack Probability Threshold	31
3.3.3. Implementation in the Simulation Model	32
3.4. Measuring the Impact of PRS on Insurers	32
3.4.1. Modeling Adverse Selection Behavior	33
3.4.2. Logistic Regression Models for Risk Prediction	34
3.4.3. Premium Estimation	35
3.4.4. Loss Ratio Analysis	36
IV Results and Discussion	37
4.1. Realism of the Simulated Population	37
4.1.1. Population Structure by Age and Sex	38
4.1.2. Distribution of PRS	40
4.1.3. Heart Attack Rates by Family History	42
4.1.4. Heart Attack Rate by PRS Quantile	44
4.2. Predictive Power of Underwriting Factors	45
4.3. Financial Impact of Adverse Selection	48
4.4. Implications for Underwriting Strategy	52
V Conclusion	55
5.1. Objectives Restatement	55
5.2. Key Findings	55
5.3. Actuarial and Policy Implications	58
5.4. Limitations and Recommendations	59
5.5. Final Statement	60
BIBLIOGRAPHY	62
A DATA	65
1.0.1. Age and Sex Distribution	65
1.0.2. First-Ever Heart Attack Incidence Rates	66

B	CORONARY ARTERY DISEASE	69
2.1.	Clinical Features	69
2.2.	Genetic Architecture of CAD	69
2.3.	Implications for Insurance and Genetic Testing	69