

I FUNDAMENTALS OF DECISION ANALYSIS IN
EXTENSIVE FORM 2

Chapter One INTRODUCTION AND PREVIEW 3

- 1.1 Introduction 3
- 1.2 Perception, Formulation, and Analysis of Decisions 3
- 1.3 How Many Decision Makers? 4
- 1.4 Decision under Uncertainty 4
- 1.5 Examples 6
- 1.6 Encouragement 12
- 1.7 Role of Decision Analysis 13

Chapter Two PROBLEM FORMULATION:
DECISIONS IN EXTENSIVE
FORM 14

A: Fundamentals

- 2.1 Parlor-Game Model 14
- 2.2 \mathcal{G} -Moves and \mathcal{E} -Moves 15
- 2.3 Concatenating Moves—Decision Trees 17
- 2.4 General Principles in Formulating Decision Trees 21

B: On Formulating Decision Trees

- 2.5 On Describing the Elements of Moves 23
- 2.6 On the Extension and Truncation of Decision Trees 26
- 2.7 Consequence Descriptions Compatible with the Decision Tree 27
- 2.8 Preview of Decision Analysis 29
- 2.9 Clarity Achieved with the Extensive Form 31

C: Equivalent Reformulation Techniques

- 2.10 Inserting and Deleting Dummy Moves 32
- 2.11 Combining Successive Choices by the Same Player 34
- 2.12 Decisions in Standard Extensive Form 38

D: Realism and Infinitude

- 2.13 Infinite Decision Trees 44

Chapter Three **FOUNDATIONS OF DECISION ANALYSIS 46**

A: Preliminaries and Review

- 3.1 Preliminaries 46
- 3.2 Preview of the Basic Results in This Chapter 51

B: Ingredients of Decision Analysis

- 3.3 Principles of Consistent Choice among Lotteries 61
- 3.4 Canonical Randomizations 66
- 3.5 Quantification of Preferences 72
- 3.6 Quantification of Judgments 78
- 3.7 Combining Successive ϵ -Moves and Conditional Probability 84
- 3.8 Proofs of Previously Asserted Facts 97

C: Analysis of ϵ -Moves with Infinitely Many Branches

- *3.9 Discrete Random Real k -Tuples 108
- *3.10 Continuous Random k -Tuples 120
- *3.11 Combining Successive ϵ -Moves and Bayes' Theorem 141

Chapter Four **ANALYSIS OF DECISIONS IN EXTENSIVE FORM 158**

- 4.1 Introduction 158
- 4.2 Preliminaries 159
- 4.3 Analysis of a dpuu in Standard Extensive Form 162
- 4.4 Example 1.5.1c 166
- 4.5 Analysis of Decisions in Nonstandard Extensive Form 174
- 4.6 Consistent Decision Making under Uncertainty 177
- 4.7 Exercises 179

II MORE ON PREFERENCE AND JUDGMENT QUANTIFICATIONS

Chapter Five **QUANTIFICATION OF PREFERENCES 187**

- 5.1 Introduction 187
- 5.2 Preliminaries 187
- 5.3 Assessing a Utility on a (Small-) Finite Set 194
- 5.4 Assessing Utility on an Interval of Monetary Returns 199

- 5.5 Utility as a Cartesian Product (I): Generalities and Separable Utility 213
- 5.6 Utility as a Cartesian Product (II): Extreme Preferences and Lexicographic Utility Functions 223
- 5.7 Utility as a Cartesian Product (III): Utility on R^n and Multivariate Constant Risk Aversion 232

Chapter Six **QUANTIFICATION OF JUDGMENTS 239**

- 6.1 Introduction 239
- 6.2 Preliminaries 240
- 6.3 Assessing a Probability Function on a (Small-) Finite Set Ω 245
- 6.4 Assessing a Probability Function on a Large-Finite or Infinite Set of Numbers 248
- 6.5 Independence (I): Introduction to Sampling Theory 258
- 6.6 Independence (II): Introduction to Stochastic Simulation 273

III FURTHER TOPICS IN INDIVIDUAL DECISION MAKING

Chapter Seven **DECISIONS IN NORMAL FORM AND SENSITIVITY ANALYSIS 295**

- 7.1 Introduction 295
- 7.2 Any dpuu Can Be Represented in Normal Form 306
- 7.3 Sensitivity Analysis When u Is Agreed on 320
- 7.4 Sensitivity Analysis When u and Some Judgments Are Agreed on 345
- *7.5 Sensitivity Analysis When " \succ " Is Agreed on 351
- 7.6 Ramifications of Confining \mathcal{U} 's Choice to a Proper Subset \mathcal{U}'_s of \mathcal{U}_s 364

Chapter Eight **MONETARY EVOLUTIONS OF OPPORTUNITIES AND INFORMATION 370**

- 8.1 Introduction 370
- 8.2 Properties of $u(\mathcal{U}'_s, c')$ 373
- 8.3 Exchange Values and Their Applications 381
- 8.4 Statistical Decision Problems 399
- 8.5 Single-Stage-of-Experimentation Problems 402

**Chapter Nine APPROACHES TO STATISTICAL
INFERENCE 414**

- 9.1 Introduction 414
- 9.2 Sampling-Theoretic Estimation 418
- 9.3 Sampling-Theoretic Tests of Hypotheses 429
- 9.4 Bayesian Inference 435
- 9.5 Some Axiomatic Principles of Inference 445

**Chapter Ten INTRODUCTION TO MARKOVIAN
DECISION PROCESSES 454**

- 10.1 Introduction 454
- 10.2 Infinite-Horizon Markovian dpuu When $0 \leq \beta < 1$ 463
- 10.3 Infinite-Horizon Markovian dpuu When $\beta = 1$ 468
- 10.4 Some Generalizations, Extensions, and Variations 476

IV SEVERAL-PERSON DECISIONS

**Chapter Eleven MONETARY GROUP DECISION
PROBLEMS 481**

- 11.1 Introduction 481
- 11.2 Formal Structure of the Group Decision Problem 485
- 11.3 One Approach to Selecting a Pareto-Optimal Total Strategy 507
- 11.4 Collective Choice in General 515

**Chapter Twelve A GLIMPSE AT GAME
THEORY 518**

A: Introduction

- 12.1 What Is Game Theory? 518
- 12.2 Games in Extensive and Normal Form 521

B: Noncooperative Games

- 12.3 Maximin and Equilibrium Approaches 533
- 12.4 Two-Person Zerosum Games 550
- 12.5 Two-Person Cooperative Games 562
- 12.6 Coalitions and n -Person Cooperative Games 577

APPENDICES

<i>Appendix 1</i>	Greek Alphabet	591
<i>Appendix 2</i>	Review of Basic Concepts and Terminology of Set Theory	592
<i>Appendix 3</i>	Convexity and Related Topics in Analysis	601
<i>Appendix 4</i>	Bisection Technique for Finding Roots	611
<i>Appendix 5</i>	References	615
<i>Index</i>		623