Contents

Preface to the Cambridge University Press Edition xi
Preface to First Edition xv

1. THE PROBLEM **1**
1.1 Sketches of Motivating Examples 1
1.2 Paradigm of Decision Analysis 5
1.3 Comments About the Paradigm 7
1.4 Complex Value Problems 14
1.5 Classes of Examples and Methodological Nightmares 19
1.6 Organization of Remaining Chapters 26

2. THE STRUCTURING OF OBJECTIVES **31**
2.1 Objectives and Attributes 32
2.2 Generation of Objectives and Attributes 34
2.3 Hierarchical Nature of Objectives 41
2.4 Sets of Objectives and Attributes 49
2.5 Proxy Attributes and Direct Preference Measurements 55
2.6 Summary and Perspective on the Practical Aspects of Specifying Objectives and Attributes 64

3. TRADEOFFS UNDER CERTAINTY **66**
3.1 The Multiattribute Value Problem 66
3.2 Choice Procedures That Do Not Formalize Preference Structures 69
3.3 Structuring of Preferences and Value Functions 77
3.4 Preference Structures and Value Functions for Two Attributes 82

3.5 The Case of Three Attributes 100
3.6 The Case of More Than Three Attributes 108
3.7 Assessment of an Additive Value Function: An Abstract Hypothetical Example 117
3.8 Willingness to Pay 125
3.9 Brief Summary and Guide to Some Relevant Literature 129

4. UNIDIMENSIONAL UTILITY THEORY 131
4.1 The Motivation for Utility Theory 131
4.2 Direct Assessment of Utilities for Consequences 140
4.3 Unidimensional Utility Functions 141
4.4 Risk Aversion 148
4.5 A Measure of Risk Aversion 159
4.6 Constant, Decreasing, and Increasing Risk Aversion 165
4.7 Proportional Risk Aversion 174
4.8 Monotonically Decreasing and Nonmonotonic Utility Functions 179
4.9 A Procedure for Assessing Utility Functions 188
4.10 Illustrations of the Assessment of Unidimensional Utility Functions 203
4.11 Explicating a Single Attribute by Means of Multiple Attributes 212
4.12 Conditional Unidimensional Utility Theory 214
4.13 Where We Stand 218

5. MULTIATTRIBUTE PREFERENCES UNDER UNCERTAINTY: THE TWO-ATTRIBUTE CASE 219
5.1 Approaches for Multiattribute Assessment 219
5.2 Utility Independence 224
5.3 Additive Independence and the Additive Utility Function 229
5.4 The Implications of Mutual Utility Independence 232
5.5 Use of Certainty Equivalents 242
5.6 Utility Functions with One Utility-Independent Attribute 243
5.7 What to Do if No Independence Properties Hold 255
5.8 Assessment Procedure for Mulitattribute Utility Functions 261
5.9 Interpreting the Scaling Constants 271
5.10 The Assessment of a Utility Function in a Hospital Blood Bank 273

6. MULTIATTRIBUTE PREFERENCES UNDER UNCERTAINTY: MORE THAN TWO ATTRIBUTES 282
6.1 Overview of the Chapter 282
6.2 Utility Functions with Three Attributes 286
6.3 The Multiplicative Utility Function 288
6.4 The Multilinear Utility Function 293
6.5 The Additive Utility Function 295
6.6 Assessing Multiattribute Utility Functions 297
6.7 A Fundamental Relationship Between Preferential Independence and Utility Independence 310
6.8 Relationships Among Utility Independence Assumptions 316
6.9 Decomposition of Multiattribute Utility Functions 319
6.10 Additional Representation Theorems 324
6.11 Hierarchical Structures and Conditional Preferences 332
6.12 Summary 344
Appendix 6A Generalization of Preferential Independence and Utility Independence 345
Appendix 6B Evaluating the Scaling Constant in the Multiplicative Utility Function 347
Appendix 6C An Interactive Computer Program for Assessing and Using Multiattribute Utility Functions 349

7. ILLUSTRATIVE APPLICATIONS 354
7.1 Air Pollution Control 355
7.2 Preference Tradeoffs among Instructional Programs 365
7.3 Fire Department Operations 377
7.4 Structuring Corporate Preferences for Multiple Objectives 390
7.5 Evaluating Computer Systems 408
7.6 Siting and Licensing of Nuclear Power Facilities 412
7.7 Other Applications 417

8. AIRPORT DEVELOPMENT FOR MEXICO CITY: A CASE STUDY 436
8.1 The Problem 436
8.2 Background Information 437
8.3 Evolution of the Analysis 441
8.4 The Static Model 442

8.5 Specifying the Possible Impacts of Each Alternative 445
8.6 Assessing the Multiattribute Utility Function 451
8.7 The Analysis 459
8.8 The Dynamic Analysis 463
8.9 Impact of the Results 470

9. PREFERENCES OVER TIME 473
9.1 Characteristics of the Time Problem 474
9.2 The Certainty Case: Value Functions over Time Streams 476
9.3 The Uncertainty Case: Utility Functions over Time Streams 488
9.4 Relaxing the Independence Assumptions 494
9.5 Uncertain Horizon 497
9.6 State-Dependent Utilities 501
9.7 Problems of Application 503
9.8 Time Resolution of Uncertainty 509
Appendix 9A. Derivation of a Utility Function for Consumption and Lifetime 513

10. AGGREGATION OF INDIVIDUAL PREFERENCES 515
10.1 The Decision Maker as Synthesizer or Amalgamator 516
10.2 Aggregating Individuals' Preferences under Certainty 523
10.4 Additive Utility and Equity Considerations 532
10.5 Appraisal of the Independence Assumptions 536
10.6 Assessing Group Utility Functions 539
10.7 Uses of Multiattribute Utility Analysis for Groups 542

Bibliography 549

Index 561