# Contents

## Preface

1. Initiation and Motivation
   1.1 Introduction and Examples
   1.2 Remarks on Example 1.1
   1.3 Remarks on Example 1.2
   1.4 Remarks on Example 1.3
   1.5 Remarks on Examples 1.4 and 1.5
   1.6 Concluding Comments and a Preview of the Forthcoming Chapters

2. Uncertainty and its Measurement
   2.1 Introduction
   2.2 Some Comments
   2.3 Probability as a Relative Frequency
   2.4 Probability Derived from Equal Likelihood
   2.5 Another Example
   2.6 Some Difficulties with this Method
   2.7 Subjective Probability
   2.8 Probability Assignment
   2.9 Further Reading
   2.10 A Summary of Our Results in Probability
       Exercises for Chapter 2

3. Utility and its Measurement
   3.1 Introduction
   3.2 Expectation as a Measure
   3.3 Some Assumptions
   3.4 Expected Utility
   3.5 Properties of Utility Functions
   3.6 Utility Assessment
   3.7 Multi-Attribute Problems
   3.8 Further Reading
       Exercises for Chapter 3

4. Criteria for Decision
   4.1 Introduction
   4.2 The Criterion of Wald

vii
4.3 The Criterion of Savage .......................... 85
4.4 The Expected Utility Criterion ....................... 90
4.5 A More Formal Statement of the Criterion and
    Some Properties .................................. 94
4.6 The Refined Investment Problem ...................... 96
4.7 Further Reading .................................. 97
    Exercises for Chapter 4 ......................... 97

5. Decision Problems with Information .................. 101
5.1 Introduction .................................... 101
5.2 The Investment Problem and the Use of Forecasts .... 102
5.3 Bayes' Theorem and the Extensive Form of Analysis ... 109
5.4 The Car Exchange Problem with Information ........ 113
5.5 The Value of Information .......................... 117
5.6 Multiple Observations .............................. 122
5.7 Further Reading .................................. 128
    Exercises for Chapter 5 ......................... 129

6. Decision Trees .................................... 139
6.1 Introduction .................................... 139
6.2 A Sequential Test Problem ........................ 141
6.3 Another Example of Sequential Decisionmaking .... 146
6.4 Further Reading .................................. 156
    Exercises for Chapter 6 ......................... 157

7. Sequential Decision Problems ........................ 160
7.1 Introduction and a First Example ................... 160
7.2 Another Example .................................. 169
7.3 A Third Example .................................. 171
7.4 A First Deterministic Example ...................... 173
7.5 A Second Deterministic Example and
    First Solution Technique ........................ 177
7.6 A Second Solution Technique ....................... 180
7.7 Further Reading .................................. 181
    Exercises for Chapter 7 ......................... 182

8. Markov Chains ..................................... 189
8.1 Introduction .................................... 189
8.2 Markov Chains ................................... 190
8.3 Multi-step Transition Probabilities ................ 196
8.4 State Probabilities ................................ 202
8.5 Some Classes of Markov Chain ....................... 205
8.6 Absorbing Markov Chains ......................... 209
8.7 Regular Markov Chains ............................ 212
8.8 Further Reading .................................. 215
    Exercises for Chapter 8 ......................... 216
9. Infinite Stage Markovian Decision Processes ........................................ 220
   9.1 Introduction ................................................................................. 220
   9.2 The Undiscounted Case .............................................................. 221
   9.3 An Alternative Solution Scheme .................................................... 224
   9.4 The Discounted Case ................................................................. 233
   9.5 Further Reading ........................................................................... 237
   Exercises for Chapter 9 ................................................................. 238

10. Decisions in Absorbing Chains ........................................................... 244
   10.1 Introduction and First Example .................................................... 244
   10.2 A Second Example ..................................................................... 246
   10.3 A Third Example with Variations ................................................. 248
   Exercises for Chapter 10 ................................................................. 250

References ......................................................................................... 254

Index ..................................................................................................... 256