

Contents

PREFACE		XI
PROLOGUE		XIII
Chapter 1		
UNCERTAINTY		1
1.1.	Introduction, 1	
1.2.	Examples, 2	
1.3.	Suppression of Uncertainty, 11	
1.4.	The Removal of Uncertainty, 13	
1.5.	The Uses of Uncertainty, 15	
1.6.	The Calculus of Uncertainty, 17	
1.7.	Beliefs, 18	
1.8.	Decision Analysis, 20	
Chapter 2		
STYLISTIC QUESTIONS		23
2.1.	Reason, 23	
2.2.	Unreason, 26	
2.3.	Facts, 28	
2.4.	Emotion, 29	
2.5.	Normative and Descriptive Approaches, 31	
2.6.	Simplicity, 33	
2.7.	Mathematics, 35	
2.8.	Writing, 37	
2.9.	Mathematics Tutorial, 38	

Chapter 3 PROBABILITY 45

- 3.1. Measurement, 45
- 3.2. Randomness, 48
- 3.3. A Standard for Probability, 50
- 3.4. Probability, 52
- 3.5. Coherence, 54
- 3.6. Belief, 56
- 3.7. Complementary Event, 58
- 3.8. Odds, 60
- 3.9. Knowledge Base, 63
- 3.10. Examples, 66
- 3.11. Retrospect, 68

Chapter 4 TWO EVENTS 69

- 4.1. Two Events, 69
- 4.2. Conditional Probability, 72
- 4.3. Independence, 75
- 4.4. Association, 77
- 4.5. Examples, 79
- 4.6. Supposition and Fact, 81
- 4.7. Seeing and Doing, 82

Chapter 5 THE RULES OF PROBABILITY 85

- 5.1. Combinations of Events, 85
- 5.2. Addition Rule, 87
- 5.3. Multiplication Rule, 89
- 5.4. The Basic Rules, 92
- 5.5. Examples, 95
- 5.6. Extension of the Conversation, 98

- 5.7. Dutch Books, 101
- 5.8. Scoring Rules, 103
- 5.9. Logic Again, 105
- 5.10. Decision Analysis, 106
- 5.11. The Prisoners' Dilemma, 107
- 5.12. The Calculus and Reality, 110
- 5.13. Closure, 112

Chapter 6

BAYES RULE

113

- 6.1. Transposed Conditionals, 113
- 6.2. Learning, 116
- 6.3. Bayes Rule, 118
- 6.4. Medical Diagnosis, 119
- 6.5. Odds Form of Bayes Rule, 123
- 6.6. Forensic Evidence, 125
- 6.7. Likelihood Ratio, 127
- 6.8. Cromwell's Rule, 129
- 6.9. A Tale of Two Urns, 131
- 6.10. Ravens, 135
- 6.11. Diagnosis and Related Matters, 138
- 6.12. Information, 140

Chapter 7

MEASURING UNCERTAINTY

143

- 7.1. Classical Form, 143
- 7.2. Frequency Data, 145
- 7.3. Exchangeability, 147
- 7.4. Bernoulli Series, 151
- 7.5. De Finetti's Result, 152
- 7.6. Large Numbers, 154
- 7.7. Belief and Frequency, 157
- 7.8. Chance, 161

Chapter 8**THREE EVENTS**

165

- 8.1. The Rules of Probability, 165
- 8.2. Simpson's Paradox, 168
- 8.3. Source of the Paradox, 170
- 8.4. Experimentation, 171
- 8.5. Randomization, 173
- 8.6. Exchangeability, 176
- 8.7. Spurious Association, 181
- 8.8. Independence, 183
- 8.9. Conclusions, 186

Chapter 9**VARIATION**

189

- 9.1. Variation and Uncertainty, 189
- 9.2. Binomial Distribution, 191
- 9.3. Expectation, 195
- 9.4. Poisson Distribution, 197
- 9.5. Spread, 201
- 9.6. Variability as an Experimental Tool, 204
- 9.7. Probability and Chance, 206
- 9.8. Pictorial Representation, 208
- 9.9. Probability Densities, 212
- 9.10. The Normal Distribution, 213
- 9.11. Variation as a Natural Phenomenon, 217
- 9.12. Ellsberg's Paradox, 219

Chapter 10**DECISION ANALYSIS**

225

- 10.1. Beliefs and Actions, 225
- 10.2. Comparison of Consequences, 227
- 10.3. Medical Example, 231
- 10.4. Maximization of Expected Utility, 234

- 10.5. More on Utility, 236
- 10.6. Some Complications, 238
- 10.7. Reason and Emotion, 240
- 10.8. Numeracy, 242
- 10.9. Expected Utility, 245
- 10.10. Decision Trees, 246
- 10.11. The Art and Science of Decision Analysis, 249
- 10.12. Further Complications, 252
- 10.13. Combination of Features, 256
- 10.14. Legal Applications, 260

Chapter 11

SCIENCE

265

- 11.1. Scientific Method, 265
- 11.2. Science and Education, 266
- 11.3. Data Uncertainty, 268
- 11.4. Theories, 271
- 11.5. Uncertainty of a Theory, 276
- 11.6. The Bayesian Development, 278
- 11.7. Modification of Theories, 281
- 11.8. Models, 284
- 11.9. Hypothesis Testing, 287
- 11.10. Significance Tests, 291
- 11.11. Repetition, 293
- 11.12. Summary, 296

Chapter 12

EXAMPLES

299

- 12.1. Introduction, 299
- 12.2. Cards, 300
- 12.3. The Three Doors, 301
- 12.4. The Problem of Two Daughters, 305
- 12.5. Two More Daughters and Cardano, 309
- 12.6. The Two Envelopes, 313

- 12.7. Y2K, 316
- 12.8. UFOs, 317
- 12.9. Conglomerability, 321
- 12.10. Efron's Dice, 323

Chapter 13

PROBABILITY ASSESSMENT 327

- 13.1. Nonrepeatable Events, 327
- 13.2. Two Events, 329
- 13.3. Coherence, 333
- 13.4. Probabilistic Reasoning, 336
- 13.5. Trickle Down, 337
- 13.6. Summary, 341

Chapter 14

STATISTICS 343

- 14.1. Bayesian Statistics, 343
- 14.2. A Bayesian Example, 346
- 14.3. Frequency Statistics, 350
- 14.4. Significance Tests, 355
- 14.5. Betting, 360
- 14.6. Finance, 365

EPILOGUE 375

SUBJECT INDEX 383

INDEX OF EXAMPLES 391

INDEX OF NOTATIONS 393