

Contents

<i>Preface</i>	<i>page viii</i>
Part I Foundations of Decision Modelling	
1 Introduction	3
1.1 Getting started	9
1.2 A simple framework for decision making	9
1.3 Bayes rule in court	20
1.4 Models with contingent decisions	24
1.5 Summary	26
1.6 Exercises	26
2 Explanations of processes and trees	28
2.1 Introduction	28
2.2 Using trees to explain how situations might develop	29
2.3 Decision trees	34
2.4 Some practical issues*	41
2.5 Rollback decision trees	46
2.6 Normal form trees	54
2.7 Temporal coherence and episodic trees*	58
2.8 Summary	59
2.9 Exercises	60
3 Utilities and rewards	62
3.1 Introduction	62
3.2 Utility and the value of a consequence	64
3.3 Properties and illustrations of rational choice	77
3.4 Eliciting a utility function with a dimensional attribute	82
3.5 The expected value of perfect information	84
3.6 Bayes decisions when reward distributions are continuous	86
3.7 Calculating expected losses	87
3.8 Bayes decisions under conflict*	91
3.9 Summary	98
3.10 Exercises	99

vi	<i>Contents</i>	
4	Subjective probability and its elicitation	103
4.1	Defining subjective probabilities	103
4.2	On formal definitions of subjective probabilities	108
4.3	Improving the assessment of prior information	112
4.4	Calibration and successful probability predictions	118
4.5	Scoring forecasters	123
4.6	Summary	127
4.7	Exercises	128
5	Bayesian inference for decision analysis	131
5.1	Introduction	131
5.2	The basics of Bayesian inference	133
5.3	Prior to posterior analyses	136
5.4	Distributions which are closed under sampling	139
5.5	Posterior densities for absolutely continuous parameters	140
5.6	Some standard inferences using conjugate families	145
5.7	Non-conjugate inference*	151
5.8	Discrete mixtures and model selection	154
5.9	How a decision analysis can use Bayesian inferences	158
5.10	Summary	162
5.11	Exercises	162
Part II Multidimensional Decision Modelling		
6	Multiattribute utility theory	169
6.1	Introduction	169
6.2	Utility independence	171
6.3	Some general characterisation results	177
6.4	Eliciting a utility function	178
6.5	Value independent attributes	180
6.6	Decision conferencing and utility elicitation	187
6.7	Real-time support within decision processes	193
6.8	Summary	196
6.9	Exercises	196
7	Bayesian networks	199
7.1	Introduction	199
7.2	Relevance, informativeness and independence	200
7.3	Bayesian networks and DAGs	204
7.4	Eliciting a Bayesian network: a protocol	217
7.5	Efficient storage on Bayesian networks	224
7.6	Junction trees and probability propagation	229
7.7	Bayesian networks and other graphs	239
7.8	Summary	243
7.9	Exercises	243

<i>Contents</i>		vii
8	Graphs, decisions and causality	248
8.1	Influence diagrams	248
8.2	Controlled causation	261
8.3	DAGs and causality	265
8.4	Time series models*	276
8.5	Summary	279
8.6	Exercises	280
9	Multidimensional learning	282
9.1	Introduction	282
9.2	Separation, orthogonality and independence	286
9.3	Estimating probabilities on trees	292
9.4	Estimating probabilities in Bayesian networks	298
9.5	Technical issues about structured learning*	302
9.6	Robustness of inference given copious data*	306
9.7	Summary	313
9.8	Exercises	313
10	Conclusions	318
10.1	A summary of what has been demonstrated above	318
10.2	Other types of decision analyses	319
	<i>References</i>	322
	<i>Index</i>	335