
CONTENTS

Preface	xii	
Chapter 1	Introduction	1
1.1	Structure of Decision and Estimation Problems	1
1.2	Outline of the Book	4
Chapter 2	Review of Probability Theory	6
2.1	Discrete Probability Theory	6
2.2	Random Variables	8
2.3	Random Processes	14
2.4	Summary	16
2.5	Problems	16
Chapter 3	Binary Decisions: Single Observation	21
3.1	Maximum-Likelihood Decision Criterion	21
3.2	Neyman-Pearson Criterion	27
3.3	Probability-of-Error Criterion	38
3.4	Bayes Risk Criterion	44
3.5	Min-Max Criterion	47
3.6	Summary	53
3.7	Problems	53

Chapter 4 Binary Decisions: Multiple Observations	60
4.1 Vector Observations	60
4.2 The General Gaussian Problem	69
4.3 Waveform Observations and Additive Gaussian Noise	77
4.4 Summary	90
4.5 Problems	91
Chapter 5 Multiple Decisions	96
5.1 Multiple Decisions: Bayes Risk	96
5.2 Probability of Error: General Case	105
5.3 Probability of Error: Gaussian Case	110
5.4 Erasure Decision Problems	125
5.5 Summary	130
5.6 Problems	130
Chapter 6 Sequential Decision Theory	134
6.1 Binary Erasure Criteria	135
6.2 Sequential Bayes Tests	140
6.3 The Wald Sequential Test	146
6.4 Average Sample Number	151
6.5 Summary	155
6.6 Problems	156
Chapter 7 Composite and Nonparametric Decision Theory	159
7.1 Composite Decisions	159
7.2 Sign Test	166
7.3 Wilcoxon Test	169
7.4 Summary	174
7.5 Problems	174
Chapter 8 Fundamentals of Estimation	179
8.1 Maximum-Likelihood Method	180
8.2 Bayes Cost Method	182
8.3 Relationship of Estimators	192
8.4 Linear Minimum-Variance and Least-Squares Methods	195
8.5 Summary	206
8.6 Problems	207
Chapter 9 Estimation with Gaussian Noise	211
9.1 Linear Observations	211
9.2 Sequential Estimation	216
9.3 Nonlinear Estimation	219
9.4 Summary	224
9.5 Problems	224

Chapter 10 Properties of Estimators	227
10.1 Unbiased Estimators	227
10.2 Efficient Estimators	231
10.3 Asymptotic Properties	237
10.4 Sensitivity and Error Analysis	238
10.5 Summary	241
10.6 Problems	241
Chapter 11 State Estimation	243
11.1 Problem Statement	243
11.2 Kalman Filter	244
11.3 Summary	250
11.4 Problems	250
Appendix A Table of Densities	252
Table A.1 Uniform Density	252
Table A.2 Scalar Gaussian Density	253
Table A.3 Vector Gaussian Density	253
Table A.4 Exponential Density	254
Table A.5 Laplacian Density	254
Table A.6 Rayleigh Density	255
Table A.7 Bernoulli Density	255
Table A.8 Binomial Density	255
Table A.9 Poisson Density	256
Appendix B Probability Tables	257
Table B.1 Q Function	257
Table B.2 Cumulative Binomial Distribution	259
Table B.3 Wilcoxon-Test False-Alarm Probability	264
References	267
Index	269