

Contents

CHAPTER I BASIC CONCEPTS	1
1.1 Introduction	1
1.2 A Priori Probability	1
1.3 Relative Frequency Probability	3
1.4 Axiomatic Probability	4
1.5 Conditional Probability	9
1.6 Stochastic Independence	16
1.7 Combinatorial Probability	19
CHAPTER II PROBABILITY DISTRIBUTION AND DENSITY FUNCTIONS	27
2.1 Introduction	27
2.2 Random Variables	27
2.3 Discrete Random Variables	28
2.4 Discrete Probability Density and Distribution Functions	29
2.5 Multivariate Discrete Density and Distributions	36
2.6 Independence of Random Variables	40
2.7 Continuous Random Variables, Densities, and Distributions	41
2.8 Functions of Random Variables	52
CHAPTER III MOMENTS AND LIMIT THEOREMS	58
3.1 Introduction	58
3.2 Expectation	58

3.3 The Variance of a Random Variable	62
3.4 Higher-Order Moments	67
3.5 The Moment-Generating Function	69
3.6 Laws of Large Numbers	74

CHAPTER IV IMPORTANT PROBABILITY DENSITY FUNCTIONS 78

4.1 Introduction	78
4.2 The Point Binomial Distribution	78
4.3 The Binomial Distribution	79
4.4 The Negative Binomial Distribution	81
4.5 The Hypergeometric Distribution	84
4.6 The Poisson Distribution	86
4.7 The Multinomial Distribution	91
4.8 The Normal Distribution	94
4.9 The Chi-Square Distribution	103
4.10 The Cauchy Distribution	106
4.11 The t -Distribution	107
4.12 The F -Distribution	108
4.13 Reliability and Hazard Functions	109
4.14 The Exponential Distribution	112
4.15 The Gamma Distribution	115
4.16 The Weibull Distribution	118
4.17 The Log Normal Distribution	119
4.18 The Uniform Distribution	120
4.19 The Multivariate Normal Distribution	123

CHAPTER V STATISTICAL ESTIMATION 126

5.1 Introduction	126
5.2 Unbiased Estimators	127
5.3 Minimum Variance Estimators	129
5.4 Maximum Likelihood Estimation	135
5.5 Interval Estimators	139

CHAPTER VI	STOCHASTIC PROCESSES	152
6.1	Introduction	152
6.2	The Probability Density Function and Moments	156
6.3	Time Averages	160
6.4	Ergodicity	165
6.5	The Poisson Process	171
6.6	The Derivative Process	173
6.7	The Normal Process	175
CHAPTER VII	LINEAR ESTIMATION OF STOCHASTIC PROCESSES	178
7.1	Introduction	178
7.2	Best Estimators	179
7.3	Linear Systems with Noncausal Impulse Response Functions	185
7.4	Linear Systems with Causal Impulse Response Functions	190
7.5	The Spectral Density and System Response Function	191
7.6	White Noise	196
7.7	Band-Limited Noise	198
7.8	Concluding Remarks	199
REFERENCES AND SELECTED READINGS		201
APPENDIX		203
SYMBOLS		213
INDEX		215