

# Contents

<b>Preface</b>	<b>ix</b>
<b>1 Combinatorics and Probability</b>	<b>1</b>
1.1 Combinatorics . . . . .	4
1.1.1 Sampling without replacement . . . . .	6
1.1.2 Sampling with replacement . . . . .	23
1.2 Summations . . . . .	34
1.3 Probability spaces and random variables . . . . .	44
1.4 Conditional probability . . . . .	61
1.5 Joint distributions . . . . .	69
1.6 Summary . . . . .	82
<b>2 Discrete Distributions</b>	<b>91</b>
2.1 The Bernoulli and binomial distributions . . . . .	93
2.2 Power series . . . . .	108
2.3 Geometric and negative binomial forms . . . . .	128
2.4 The Poisson distribution . . . . .	150
2.5 The hypergeometric distribution . . . . .	164
2.6 Summary . . . . .	172
<b>3 Simulation</b>	<b>179</b>
3.1 Random number generation . . . . .	180
3.2 Inverse transforms and rejection filters . . . . .	189
3.3 Client-server systems . . . . .	205
3.4 Markov chains . . . . .	227
3.4.1 Irreducible aperiodic Markov chains . . . . .	238
3.4.2 Convergence properties . . . . .	247
3.5 Summary . . . . .	264
<b>4 Discrete Decision Theory</b>	<b>271</b>
4.1 Decision methods without samples . . . . .	272
4.2 Statistics and their properties . . . . .	285
4.3 Sufficient statistics . . . . .	314
4.4 Hypothesis testing . . . . .	333
4.4.1 Simple hypothesis versus simple alternative . . . . .	339

4.4.2	Composite hypotheses . . . . .	354
4.5	Summary . . . . .	363
<b>5</b>	<b>Real Line-Probability</b>	<b>371</b>
5.1	One-dimensional real distributions . . . . .	374
5.2	Joint random variables . . . . .	396
5.3	Differentiable distributions . . . . .	416
5.4	Summary . . . . .	432
<b>6</b>	<b>Continuous Distributions</b>	<b>437</b>
6.1	The normal distribution . . . . .	437
6.1.1	The univariate and bivariate normal distributions . . . . .	437
6.1.2	The multivariate normal distribution . . . . .	455
6.2	Limit theorems . . . . .	468
6.2.1	Convergence concepts . . . . .	471
6.2.2	An inversion formula . . . . .	477
6.3	Gamma and beta distributions . . . . .	490
6.4	The $\chi^2$ and related distributions . . . . .	504
6.5	Computer simulations . . . . .	527
6.6	Summary . . . . .	540
<b>7</b>	<b>Parameter Estimation</b>	<b>545</b>
7.1	Bias, consistency, and efficiency . . . . .	546
7.2	Normal inference . . . . .	557
7.3	Sums of squares . . . . .	568
7.4	Analysis of variance . . . . .	575
7.5	Linear regression . . . . .	608
7.6	Summary . . . . .	635
<b>A</b>	<b>Analytical Tools</b>	<b>641</b>
A.1	Sets and functions . . . . .	641
A.2	Limits . . . . .	647
A.3	Structure of the real numbers . . . . .	659
A.4	Riemann-Stieltjes integrals . . . . .	672
A.5	Permutations and determinants . . . . .	688
<b>B</b>	<b>Statistical Tables</b>	<b>713</b>
	<b>Bibliography</b>	<b>733</b>
	<b>Index</b>	<b>739</b>