

Contents

Preface	..	..	..	..	..	..	..	..	..	vii
Acknowledgements	..	..	..	..	..	..	..	..	..	ix
1 Introduction	..	..	..	..	..	..	..	..	..	1
2 Probability Theory	..	..	..	..	..	..	..	..	..	4
2.1 Introduction	..	..	..	..	..	..	..	..	..	4
2.2 Calculus of probabilities	..	..	..	..	..	..	..	..	..	6
2.3 Statistical inference	..	..	..	..	..	..	..	..	..	9
3 Theoretical Distributions: Basic Ideas	..	..	..	..	..	..	..	..	..	12
3.1 Population parameters	..	..	..	..	..	..	..	..	..	12
3.2 Continuous univariate distributions	..	..	..	..	..	..	..	..	..	14
3.3 Expected values	..	..	..	..	..	..	..	..	..	16
3.4 Generating functions and related topics	..	..	..	..	..	..	..	..	..	17
3.5 Discrete univariate distributions	..	..	..	..	..	..	..	..	..	19
3.6 Multivariate distributions	..	..	..	..	..	..	..	..	..	19
3.7 Functions of a random variable	..	..	..	..	..	..	..	..	..	22
4 Theoretical Distributions: Examples	..	..	..	..	..	..	..	..	..	25
4.1 Uniform distribution	..	..	..	..	..	..	..	..	..	25
4.2 Univariate normal distribution	..	..	..	..	..	..	..	..	..	26
4.3 Multivariate normal distribution	..	..	..	..	..	..	..	..	..	30
4.4 Cauchy distribution	..	..	..	..	..	..	..	..	..	35
4.5 Binomial distribution	..	..	..	..	..	..	..	..	..	36
4.6 Multinomial distribution	..	..	..	..	..	..	..	..	..	38
4.7 Poisson distribution	..	..	..	..	..	..	..	..	..	39
5 Sampling	..	..	..	..	..	..	..	..	..	42
5.1 Basic ideas	..	..	..	..	..	..	..	..	..	42
5.2 Sampling distributions: theorems	..	..	..	..	..	..	..	..	..	44
5.3 Experimental errors and their propagation	..	..	..	..	..	..	..	..	..	51
6 Sampling Distributions Associated with the Normal	..	..	..	..	..	..	..	..	..	55
6.1 Chi-square distribution	..	..	..	..	..	..	..	..	..	55
6.2 Student t distribution	..	..	..	..	..	..	..	..	..	61

6.3	<i>F</i> distribution	..	..	..	..	..	..	66
6.4	Relation between χ^2 , <i>t</i> and <i>F</i> distributions	..	..	..	..	..	..	68
7	Estimation I: Maximum Likelihood	..	..	..	..	..	..	72
7.1	Properties of point estimators	..	..	..	..	..	..	72
7.2	Maximum likelihood method	..	..	..	..	..	..	76
8	Estimation II: Least-Squares Method	..	..	..	..	..	..	85
8.1	Linear least-squares	..	..	..	..	..	..	85
8.2	Linear least-squares with constraints	..	..	..	..	..	..	94
8.3	Non-linear least-squares	..	..	..	..	..	..	96
9	Estimation III: Other Methods	..	..	..	..	..	..	99
9.1	Minimum chi-square	..	..	..	..	..	..	99
9.2	Minimum variance	..	..	..	..	..	..	101
9.3	Bayes' estimators	..	..	..	..	..	..	102
9.4	Method of moments	..	..	..	..	..	..	105
10	Confidence Intervals and Regions	..	..	..	..	..	..	109
10.1	Introduction	..	..	..	..	..	..	109
10.2	Normal distributions	..	..	..	..	..	..	111
10.3	General method	..	..	..	..	..	..	114
10.4	Case of large samples	..	..	..	..	..	..	115
11	Hypothesis Testing	..	..	..	..	..	..	118
11.1	Introduction	..	..	..	..	..	..	118
11.2	General hypotheses: likelihood ratios	..	..	..	..	..	..	120
11.3	Normal distribution	..	..	..	..	..	..	131
11.4	Linear hypotheses	..	..	..	..	..	..	144
Appendix A	Miscellaneous Mathematics	..	..	..	..	..	..	148
A1	Matrix algebra	..	..	..	..	..	..	148
A2	Classical theory of minima	..	..	..	..	..	..	150
Appendix B	Orthogonal Polynomials	..	..	..	..	..	..	153
Appendix C	Optimization of Functions of Several Variables	..	..	..	..	..	..	156
C.1	Introduction	..	..	..	..	..	..	156
C.2	Unconstrained minimization	..	..	..	..	..	..	161
C.3	Multivariate problems	..	..	..	..	..	..	162
C.4	Constrained minimization	..	..	..	..	..	..	166
Appendix D	Statistical Tables	..	..	..	..	..	..	168
D.1	Standard normal density function	..	..	..	..	..	..	168
D.2	Standard normal distribution function	..	..	..	..	..	..	170
D.3	Binomial distribution function	..	..	..	..	..	..	171
D.4	Poisson distribution function	..	..	..	..	..	..	177
D.5	χ^2 distribution function	..	..	..	..	..	..	182

