

CONTENTS

Introduction and Descriptive Statistics	1	1
1.1 Statistics and statistical analysis	1	
1.2 Descriptive statistics	6	
1.3 Central location	13	
1.4 Measures of dispersion	20	
1.5 Other descriptive measures	30	
1.6 Summary	35	
Glossary	39	
Probability Theory: Discrete Sample Spaces	41	2
2.1 Introduction	41	
2.2 The probability model	42	
2.3 Subjective and objective probability	46	
2.4 Counting rules	50	
2.5 Permutations and combinations	54	
2.6 Probability rules	60	
2.7 Special cases of probability rules	69	
2.8 Marginal probability	79	
2.9 Bayes' rule	82	
2.10 Application of probability theory: An example	85	
Glossary	92	
Discrete Random Variables and Expectations	95	3
3.1 Introduction and probability models	95	
3.2 Probability mass functions (p.m.f.)	101	
3.3 Expected values	106	

	3.4 Expectation rules*	118
	3.5 Bivariate probability functions*	120
	3.6 Bivariate expectations*	125
	Glossary	134
4	Discrete Probability Distributions	135
	4.1 Introduction	135
	4.2 Binomial distribution	135
	4.3 Characteristics and use of the binomial distribution	144
	4.4 Binomial proportions	152
	4.5 The hypergeometric distribution	156
	4.6 The Poisson distribution†	161
	4.7 Approximation of discrete random variables by continuous random variables	168
	Glossary	171
5	Probability Theory: Continuous Random Variables	173
	5.1 Introduction	173
	5.2 Probability density functions	173
	5.3 Similarities between probability concepts for discrete and continuous random variables	182
	5.4 The normal distribution	187
	5.5 Standardized normal	192
	5.6 Normal approximation to the binomial	202
	5.7 Exponential distribution†	209
	5.8 Probability distributions—Summary	212
6	Sampling and Sampling Distributions	219
	6.1 Introduction	219
	6.2 Sampling designs	220
	6.3 Sample statistics	227
	6.4 Sampling distribution of \bar{x}	234
	6.5 Sampling distribution of \bar{x} , normal parent population	239
	6.6 Sampling distribution of \bar{x} , population distribution unknown, σ known	242
	6.7 Finite population correction factor	246
	6.8 Sampling distribution of \bar{x} , normal population, σ unknown	250

6.9 The sampling distribution of s^2 , normal population*	257	
Glossary	264	
Estimation	269	7
7.1 Introduction	269	
7.2 Four properties of a “good” estimator	270	
7.3 Estimating unknown parameters	275	
7.4 Confidence intervals for μ (σ known)	281	
7.5 Confidence intervals for μ (σ unknown)	286	
7.6 Confidence intervals for the binomial parameter p , using the normal approximation	289	
7.7 Determining the size of the sample (n)	293	
7.8 Confidence interval for σ^2 †	296	
Glossary	303	
Hypothesis Testing: One-sample Tests	305	8
8.1 Introduction and basic concepts	305	
8.2 The standard format of hypothesis testing	311	
8.3 One-sample tests on μ	321	
8.4 Measuring β and the power of a test*	328	
8.5 Test on the binomial parameter	334	
8.6 Balancing the risks and costs of making a wrong decision*	340	
8.7 Tests using the chi-square distribution*	345	
8.8 Summary	349	
Glossary	354	
Hypothesis Testing: Multi-sample Tests	357	9
9.1 Introduction	357	
9.2 Test on the difference between two means (σ_1^2 and σ_2^2 known)	357	
9.3 Test on the difference between two means (σ_1^2 and σ_2^2 unknown, but assumed equal)	360	
9.4 Test on the difference between two proportions	364	
9.5 Two-sample tests for population variances	366	
9.6 A nonparametric test on differences between two populations*	374	
9.7 Chi-square test for independence	379	

9.8 Analysis-of-variance test of differences among means of two or more populations*	384
Glossary	397

10

Statistical Decision Theory	399
10.1 Introduction to a decision problem	399
10.2 Expected monetary value criterion	402
10.3 Perkins Plastics—An example	403
10.4 The revision of probabilities	406
10.5 The value of information ($n = 1$)	409
10.6 Analysis for larger sample sizes	412
10.7 Utility analysis*	421
10.8 Decision analysis for continuous functions*	427
10.9 Bayes' rule for continuous functions	432
10.10 Bayesian analysis: Advantages and disadvantages	438
Glossary	442

11

Simple Regression and Correlation Analysis	445
11.1 Introduction	445
11.2 Estimating the values of α and β by least squares	452
11.3 Assumptions and estimation	460
11.4 Measures of goodness of fit	467
11.5 Correlation analysis	473
11.6 Test on the significance of the sample regression line	481
11.7 A sample problem	485
11.8 The F -test*	488
11.9 Constructing a forecast interval	491
Glossary	499

12

Extensions of Regression Analysis and Correlation	501
12.1 Introduction to multiple regression	501
12.2 Multiple least-squares estimation	503
12.3 Goodness-of-fit measures in multiple analysis	506
12.4 Multiple correlation analysis	510
12.5 Tests for the multiple analysis*	512
12.6 Multicollinearity	519
12.7 Violation of assumptions 4 or 5	522
12.8 Dummy variables in regression analysis	529
12.9 Nonparametric correlation measures	535
Glossary	545

Time Series and Index Numbers	547
13.1 Introduction	547
13.2 Linear trend	550
13.3 Nonlinear trends	556
13.4 Moving averages to smooth a time series	562
13.5 Estimation of seasonal and cyclical components	565
13.6 Index numbers	577
13.7 Price index numbers	581
13.8 Economic indexes and their limitations	586
Glossary	593
Selected bibliography	595
Appendixes	
A Subscriptions, summations, variables and functions	A.1
B Tables of functions	A.9
Answers to odd-numbered problems	A.35
Index	I.1
Endpapers: Glossary of symbols	