

CONTENTS

Chapter 1 Introduction and Descriptive Statistics

1.1	Statistics and statistical analysis	1
	<i>Descriptive Statistics</i>	5
1.2	Graphical forms	5
1.3	Central location	12
1.4	Measures of dispersion	16
1.5	Other measures	25
1.6	Summary	31

Chapter 2 Probability Theory: Discrete Sample Spaces

2.1	Introduction	36
2.2	Introduction to set theory	39
2.3	Probability fundamentals	46
2.4	Probability rules for a complement and a union	50
2.5	Rules involving conditional probabilities	53
2.6	Independent events	56
2.7	Summary of probability rules	58
2.8	Marginal probability	59
2.9	Application of probability theory: An example	61
2.10	Bayes' rule	64
2.11	Probabilities of repeated trials	68
*2.12	Extensions of the rules for permutations and combinations	76

Chapter 3 Probability Theory: Random Variables

3.1	Introduction	86
3.2	Discrete random variables	89
3.3	Continuous random variables	94
3.4	Approximating a discrete random variable by a continuous random variable	101
3.5	Discrete bivariate probability	104

3.6	Expected value: The discrete case	108
3.7	Expected value: The continuous case	112
3.8	Expectation rules	114
*3.9	Bivariate expectations	118
*3.10	Continuous bivariate probability	123

Chapter 4 Discrete Probability Distributions

4.1	Introduction	131
4.2	Hypergeometric distribution	131
4.3	The binomial distribution	133
4.4	The Poisson distribution	145
4.5	Poisson approximation to the binomial	152
*4.6	Derivation of the Poisson mean and variance ,	154

Chapter 5 Continuous Probability Distributions

5.1	Introduction	160
5.2	The normal distribution	160
5.3	Standardized normal	165
5.4	Normal approximation to the binomial	172
5.5	Exponential distribution	175
5.6	The chi-square distribution	180

Chapter 6 Sampling and Sampling Distributions

6.1	Introduction	189
6.2	Sample designs	189
6.3	Sample mean and sample variance	196
6.4	Sampling distribution of \bar{x} , with σ known	199
6.5	Sampling distribution of \bar{x} , normal population, with σ known	203
6.6	Sampling distribution of \bar{x} , population distribution unknown, with σ known	206
6.7	Finite population correction factor	210
6.8	Sampling distribution of \bar{x} , normal population, σ unknown	211
6.9	Sampling distribution of s^2 , normal population	216
6.10	The F -distribution	220
6.11	Summary	223

Chapter 7 Estimation

7.1	Introduction	229
7.2	Properties of estimators	231
7.3	The method of maximum likelihood	237
7.4	Interval estimation	243
7.5	Confidence intervals for μ , with σ known	246
7.6	Confidence intervals for μ , with σ unknown	249

7.7	Confidence intervals for the binomial parameter p , using the normal approximation	251
7.8	Determining the size of n	253
*7.9	Confidence interval for σ^2	256
7.10	Summary	258
Chapter 8 Hypothesis Testing		
8.1	Introduction	263
8.2	Type I and type II errors	266
8.3	Balancing the risks of making an incorrect decision	272
8.4	Balancing the risks and costs of making a wrong decision	274
8.5	The power function of a critical region	278
8.6	Testing hypotheses	281
8.7	One-sample tests about μ (with σ known)	282
8.8	One-sample tests about μ (with σ unknown)	288
8.9	Two-sample tests about μ (σ_1 and σ_2 known)	291
8.10	Two-sample tests about μ (σ_1 and σ_2 unknown)	292
8.11	A t -test for matched pairs	295
8.12	Testing the binomial parameter p	298
8.13	Summary	301
Chapter 9 Statistical Decision Theory		
9.1	Introduction	307
9.2	Certainty vs. uncertainty	308
9.3	Criteria for decision-making under uncertainty	309
9.4	The revision of probabilities	313
9.5	The value of information	317
9.6	Determining the optimal sample size	322
9.7	Decision-making under uncertainty: An example	328
*9.8	Bayes' rule for normal distributions	335
9.9	Inference and decision	338
9.10	Utility	341
Chapter 10 Simple Linear Regression		
10.1	Introduction	357
10.2	Assumptions and estimation	364
10.3	Estimating the values of α and β by least squares	366
10.4	The standard error of the estimate	375
10.5	Test of the significance of the sample regression line	379
10.6	Constructing a forecast interval	384
Chapter 11 Simple Linear Correlation		
11.1	Introduction	392
11.2	The simple linear correlation model	393
11.3	Sample correlation coefficient and coefficient of determination	395

11.4	The relationship between correlation and regression	398
11.5	Tests on the correlation coefficient	400
11.6	A sample problem	403

Chapter 12 Multiple Regression and Correlation

12.1	Multiple linear regression: The population	409
12.2	Ideal assumptions for the multiple regression model	411
12.3	Multiple least-squares estimation	412
12.4	Multiple standard error of the estimate	415
12.5	Tests for multiple linear regression	416
*12.6	Least-squares regression in matrix form	418
*12.7	Nonlinear relationships	420
12.8	Multiple linear correlation	422
12.9	Multiple linear regression: An example	426

Chapter 13 Time Series and Index Numbers

13.1	Introduction to time series	439
13.2	Linear trend	442
13.3	Nonlinear trends	445
13.4	Moving averages to smooth a time series	452
13.5	Estimation of seasonal and cyclical components	455
*13.6	An exponential smoothing model	463
13.7	Index numbers	465
13.8	Price index numbers	468
13.9	Economic indexes and their limitations	473

Chapter 14 Analysis of variance

14.1	Introduction	486
14.2	The simple one-factor model	487
14.3	The F -test in the analysis of variance	490
14.4	Computational forms for the one-factor model	495
14.5	Multiple comparisons	498
14.6	The two-factor model	500
14.7	Inferences in the two-factor model	503
14.8	Computational forms for the two-factor model	506
14.9	Experimental design	510
14.10	Regression and analysis of variance: The general linear model	512

Chapter 15 Nonparametric Statistics

15.1	Introduction	518
15.2	Measurement	518
15.3	Parametric vs. nonparametric tests	520
15.4	Tests equivalent to the t -test for independent samples	521
15.5	Tests equivalent to the t -test for matched pairs	525

15.6	Goodness-of-fit tests	529
15.7	Chi-square test for independence	534
15.8	Nonparametric measures of correlation	538
	Selected Bibliography	550
	Glossary of Undefined Symbols	552
Appendix A	Calculus Review	A-1
Appendix B	Tables	A-9
Table I	Binomial distribution	A-11
II	Poisson distribution	A-23
III	Cumulative normal distribution	A-27
IV	Exponential distribution	A-28
V	Critical values of the chi-square distribution	A-29
VI	Random digits	A-33
VII	Critical values of the <i>t</i> -distribution	A-34
VIII	a) Critical values of the <i>F</i> -distribution ($\alpha = 0.05$)	A-36
	b) Critical values of the <i>F</i> -distribution ($\alpha = 0.01$)	A-38
IX	Values of $z = \frac{1}{2} \ln \frac{1+r}{1-r}$	A-40
X	Critical values of <i>r</i> in the runs test	A-41
XI	Critical values of <i>T</i> for the Wilcoxon matched-pairs signed-ranks test . .	A-42
XII	Critical values of <i>D</i> in the Kolmogorov-Smirnov one-sample test	A-43
	Answers to Selected Exercises	A-45
	Index	I-1