

Contents

Preface			
1	The role of statistics in decision making	1	
1.1	Introduction	2	
1.2	The role of statistics in decision making	2	
1.3	Basic principles and concepts of special studies	3	
1.4	Steps involved in planning and conducting special studies	3	
2	Organizing and summarizing data	5	
2.1	Introduction	6	
2.2	Some basic vocabulary	6	
2.3	Summarizing data: the ordered array	8	
2.4	Summarizing data: the frequency distribution	8	
2.5	Summarizing data: the histogram and frequency polygon	11	
2.6	Summarizing data: stem and leaf displays	13	
2.7	Graphical representation of qualitative data	13	
2.8	Summarizing data: descriptive measures	14	
2.9	Descriptive measures computed from grouped data	18	
2.10	Index numbers	22	
2.11	Aggregative price indexes	22	
	Review questions	25	
3	Some elementary probability concepts	30	
3.1	Introduction	31	
3.2	Set concepts and notation (basic notions)	31	
3.3	Counting techniques—permutations and combinations	37	
3.4	Different views of probability	40	
3.5	Elementary properties of probability	41	
3.6	Calculating the probability of an event	42	
3.7	Bayes' theorem	44	
	Review questions	45	
4	Some important probability distributions	50	
4.1	Introduction	51	
4.2	Probability distributions of discrete random variables	51	
4.3	The binomial distribution	53	
4.4	The Poisson distribution	56	
4.5	The hypergeometric distribution	59	
4.6	Probability distributions of continuous random variables	60	
4.7	The normal distribution	61	
4.8	The uniform distribution	69	
	Review questions	69	
5	Some important sampling distributions	75	
5.1	Introduction	76	
5.2	Simple random sampling	76	
5.3	Sampling distributions	77	
5.4	Distribution of the sample mean	78	
5.5	Distribution of the difference between two sample means	84	
5.6	Distribution of the sample proportion	86	
5.7	Distribution of the difference between two sample proportions	88	
	Review questions	90	
6	Statistical inference I: estimation	95	
6.1	Introduction	96	
6.2	Properties of good estimators	96	
6.3	Estimating the population mean—known population variance	98	
6.4	Estimating the population mean—unknown population variance	103	

6.5	Estimating the difference between two population means—known population variances	108	8	Analysis of variance	156
6.6	Estimating the difference between two population means—unknown population variances	108	8.1	Introduction	157
6.7	Estimating a population proportion	110	8.2	The completely randomized design	157
6.8	Estimating the difference between two population proportions	112	8.3	Testing for significant differences between individual pairs of means	161
6.9	Determining sample size for estimating means	113	8.4	The randomized complete block design	164
6.10	Determining sample size for estimating proportions	115	8.5	The Latin square design	168
6.11	Estimating the variance of a normally distributed population	117	8.6	The factorial experiment	173
6.12	Estimating the ratio of the variances of two normally distributed populations	118		Review questions	177
	Review questions	120	9	Simple linear regression and correlation	185
7	Statistical inference II: hypothesis testing	124	9.1	Introduction	186
7.1	Introduction	125	9.2	The simple linear regression model	186
7.2	Hypothesis testing—some general considerations	125	9.3	The assumptions underlying simple linear regression	187
7.3	A test for the mean of a normally distributed population—known population variance	131	9.4	Obtaining the sample regression equation	188
7.4	A test for the mean of a normally distributed population—unknown population variance	133	9.5	Evaluating the sample regression equation	189
7.5	A test for the mean of a population that is not normally distributed	136	9.6	Using the sample regression equation	194
7.6	A test for the difference between the means of two normally distributed populations	139	9.7	The linear correlation model	195
7.7	A test for the difference between the means of two populations not normally distributed	140	9.8	The correlation coefficient	196
7.8	A test for a population proportion	141		Review questions	197
7.9	A test for the difference between two population proportions	143	10	Multiple regression and correlation	204
7.10	A test for the variance of a normally distributed population	144	10.1	Introduction	205
7.11	A test for the ratio of the variances of two normally distributed populations	145	10.2	The multiple-regression model and its underlying assumptions	205
7.12	The Type II error and the power of a test	146	10.3	Obtaining the sample multiple-regression equation	206
7.13	Determining sample size to control both Type I and Type II errors	149	10.4	Evaluating the regression equation	210
	Review questions	151	10.5	Using the sample multiple-regression equation	213
			10.6	Qualitative independent variables	215
			10.7	The multiple-correlation model	217
			10.8	Choosing independent variables for the regression equation	219
				Review questions	219
			11	The chi-square distribution and the analysis of frequencies	227
			11.1	Introduction	228
			11.2	The mathematical properties of the chi-square distribution	228
			11.3	Tests for goodness of fit	229

11.4	Tests of independence	234	13.10	Measuring forecast error and evaluating models	287
11.5	Tests of homogeneity	237		Review questions	290
	Review questions	240			
12	Nonparametric statistics	245	14	Elementary survey sampling	293
12.1	Introduction	246	14.1	Introduction	294
12.2	When to use nonparametric statistics	246	14.2	Applications	294
12.3	Measurement and measurement scales	247	14.3	Basic theory	294
12.4	Advantages and disadvantages of nonparametric statistics	247	14.4	Additional concepts	295
12.5	The one-sample runs test	248	14.5	Steps involved in a sample survey	296
12.6	The Wilcoxon signed-rank test for location	249	14.6	Stratified random sampling	296
12.7	The Mann-Whitney test	250	14.7	Cluster sampling	298
12.8	The sign test	252	14.8	Systematic sampling	300
12.9	The Kruskal-Wallis one-way analysis of variance by ranks	253	14.9	Costs, efficiency, and sample size	301
12.10	The Friedman two-way analysis of variance by ranks	254	14.10	Nonprobability sampling procedures	306
12.11	The Spearman rank correlation coefficient	256		Review questions	306
12.12	Nonparametric linear regression	258			
	Review questions	259	15	Statistical decision theory	310
13	Time-series analysis and forecasting	266	15.1	Introduction	311
13.1	Introduction	267	15.2	Some basic ideas	311
13.2	Components of time-series data	267	15.3	Application of the Bayes criterion	315
13.3	Graphs and freehand fitting	268	15.4	Utility theory	316
13.4	Moving averages	271	15.5	Bayesian decision theory and classical statistical inference	317
13.5	Exponential smoothing	273		Review questions	317
13.6	Measuring trend	275	16	Some statistical applications in quality control	324
13.7	Measuring seasonal variation	278	16.1	Introduction	325
13.8	Measuring cyclical variation	283	16.2	Control charts—variables	325
13.9	Business forecasting	284	16.3	Control charts—attributes	327
			16.4	Acceptance sampling for attributes	328
			16.5	Acceptance sampling by variables	329
				Review questions	330