Brief Contents

Part I **Exploring Data**

Exploring Data: Variables and Distributions

- **Picturing Distributions with Graphs** 3 **CHAPTER 1**
- **Describing Distributions with CHAPTER 2** Numbers 39

Part III Inference about Variables 435 **Quantitative Response Variable CHAPTER 18** Inference about a Population Mean 437

The Normal Distributions 69 CHAPTER 3 **Exploring Data: Relationships** Scatterplots and Correlation 97 CHAPTER 4 **Regression** 125 **CHAPTER 5** Two-Way Tables* 159 **CHAPTER 6 Exploring Data: Part | Review** 175 CHAPTER 7 Part II **From Exploration to** Inference 197 **Producing Data Producing Data: Sampling** 199 **CHAPTER 8 Producing Data: Experiments 223 CHAPTER 9 Commentary:** Data Ethics* **Probability and Sampling Distributions** 246 **Introducing Probability** CHAPTER 10 259 **Sampling Distributions** 285 CHAPTER 11 **General Rules of Probability*** 307 CHAPTER 12 **Binomial Distributions* 331** CHAPTER 13 Foundations of Inference **CHAPTER 14** Confidence Intervals: The Basics 351 **CHAPTER 15** Tests of Significance: The Basics 369 **CHAPTER 16** Inference in Practice 391 From Exploration to Inference: Part II CHAPTER 17 Review 417 How to sample badly 202 . * 416 vilidadorg Isnelsione.

CHAPTER 19 Two-Sample Problems 465 **Categorical Response Variable CHAPTER 20** Inference about a Population **Proportion** 493 CHAPTER 21 Comparing Two Proportions 515 **CHAPTER 22** Inference about Variables: Part III Review 533 Part IV Inference about 551 Relationships CHAPTER 23 Two Categorical Variables: The Chi-Square Test 553 **CHAPTER 24** Inference for Regression 587 CHAPTER 25 One-Way Analysis of Variance: **Comparing Several Means** 623 Part V **Optional Companion** Chapters (available online) **CHAPTER 26** Nonparametrics Tests 26-3 CHAPTER 27 Statistical Process Control 27-3 CHAPTER 28 Multiple Regression* 28-3 **CHAPTER 29** More about Analysis of Variance 29-3

V

*Starred material is not required for later parts of the text.

Detailed Table of Contents

To the Instructor x Media and Supplements xxi About the Authors xxiii To the Student xxv

Part I Exploring Data CHAPTER 1

CHAPTER 4

Scatterplots and Correlation * 97

Explanatory and response variables 97 Displaying relationships: scatterplots 99 Interpreting scatterplots 101 Adding categorical variables to scatterplots 104 Measuring linear association: correlation 106 Facts about correlation 108 **CHAPTER 5 Regression** 125 **Regression lines** 125 The least-squares regression line 128 Using technology 130 Facts about least-squares regression 132 Residuals 135 Influential observations 139 Cautions about correlation and regression 142 Association does not imply causation 144

Picturing Distributions with Graphs 3

Individuals and variables 3 Categorical variables: pie charts and bar graphs 6 Quantitative variables: histograms 11 Interpreting histograms 15 Quantitative variables: stemplots 20 Time plots 23

CHAPTER 2 Describing Distributions with Numbers 39 Measuring center: the mean 40 Measuring center: the median 41 Comparing the mean and the median 42 Measuring spread: the quartiles 43 The five-number summary and boxplots 45 Spotting suspected outliers* 48 Measuring spread: the standard deviation 49 Choosing measures of center and spread 51 Using technology 53 Organizing a statistical problem 55

CHAPTER 6

Two-Way Tables* 159 Marginal distributions 160 Conditional distributions 162 Simpson's paradox 166 CHAPTER 7 Exploring Data: Part I Review 175 Part I summary 177 Test yourself 180 Supplementary exercises 191 CHAPTER 15 Tests of Significance: The Basics 369 Part II From Exploration to Inference 197 **CHAPTER 8 Producing Data: Sampling** 199 Population versus sample 199 How to sample badly 202 Simple random samples 203

CHAPTER 3 The Normal Distributions 69 Describing density curves 73 Normal distributions 75 The 68–95–99.7 rule 77 The standard Normal distribution 80 Finding Normal proportions 81 Using the standard Normal table 83 Finding a value given a proportion 86

*Starred material is not required for later parts of the text.

vi

DETAILED TABLE OF CONTENTS

Inference about the population 208 Other sampling designs 209 Cautions about sample surveys 210 The impact of technology 213

CHAPTER 9 Producing Data: Experiments 223 Observation versus experiment 223 Subjects factors treatments 225

Subjects, factors, treatments 225 How to experiment badly 228 Randomized comparative experiments 229 The logic of randomized comparative experiments 232 Cautions about experimentation 234 Matched pairs and other block designs 236 **Commentary: Data Ethics* 246** Institutional review boards 248 Informed consent 248 Confidentiality 250 Clinical trials 252 Behavioral and social science experiments 253

CHAPTER 13 Binomial Distributions* 331 The binomial setting and binomial distributions 331 Binomial distributions in statistical sampling 333 Binomial probabilities 334 Using technology 336 Binomial mean and standard deviation 338 The Normal approximation to binomial distributions 340

CHAPTER 14 Confidence Intervals: The Basics

wo-sample / procedures

vii

CHAPTER 10 Introducing Probability 259 The idea of probability 260 The search for randomness* 262 Probability models 264 Probability rules 266 Finite and discrete probability models 268 Continuous probability models 271 Random variables 275 Personal probability* 276 The reasoning of statistical estimation 352 Margin of error and confidence level 354 Confidence intervals for a population mean 357 How confidence intervals behave 361

CHAPTER 15

Tests of Significance: The Basics 369The reasoning of tests of significance 370Stating hypotheses 372P-value and statistical significance 374Tests for a population mean 378Significance from a table* 382

CHAPTER 16 Inference in Practice 391

Conditions for inference in practice Cautions about confidence intervals

CHAPTER 11Sampling Distributions285Parameters and statistics285Statistical estimation and the law of large numbersSampling distributions290The sampling distribution of \overline{x} 293The central limit theorem295

CHAPTER 12 Seneral Rules of Probability* 307 Independence and the multiplication rule 308 The general addition rule 312 Conditional probability 314 The general multiplication rule 316

287

Cautions about significance tests 397 Planning studies: sample size for confidence intervals 401 Planning studies: the power of a statistical test* 402

392

395

CHAPTER 17 From Exploration to Inference: Part II Review 417 Part II summary 419 Test yourself 423 Supplementary exercises 431

Part III Inference about
Variables435CHAPTER 18437Inference about a Population Mean437Conditions for inference about a mean437The t distributions438

meeendence again 318

Thee diagrams 318

The one-sample t confidence interval 440

viii **DETAILED TABLE OF CONTENTS**

The one-sample *t* test 443 Using technology 446 Matched pairs t procedures 449 Robustness of t procedures 452

CHAPTER 19 Two-Sample Problems 465 Two-sample problems 465 Comparing two population means 466 Two-sample t procedures 469 Using technology 474 Robustness again 477

The chi-square test statistic 560 Cell counts required for the chi-square test 561 Cautions about sample surveys Using technology 562 Uses of the chi-square test 567 The chi-square distributions 570 The chi-square test for goodness of fit* 572 **CHAPTER 24** Inference for Regression 587 Conditions for regression inference 589 Estimating the parameters 590 Using technology 593 Testing the hypothesis of no linear relationship 597 Testing lack of correlation 598 Confidence intervals for the regression slope 600 Inference about prediction 602 Checking the conditions for inference 607 **CHAPTER 25 One-Way Analysis of Variance: Comparing Several** Means 623 Comparing several means 625 The analysis of variance F test 625 Using technology 628 The idea of analysis of variance 631 Conditions for ANOVA 633 F distributions and degrees of freedom 637 Some details of ANOVA* 640 **Notes and Data Sources** 655

Details of the *t* approximation* 480 Avoid the pooled two-sample t procedures* 481 Avoid inference about standard deviations* 482

CHAPTER 20

Inference about a Population Proportion 493

The sample proportion \hat{p} 494 Large-sample confidence intervals for a proportion 496 Accurate confidence intervals for a proportion 499 Choosing the sample size 502 Significance tests for a proportion 504

CHAPTER 21 Comparing Two Proportions 515 Two-sample problems: proportions 515 The sampling distribution of a difference between proportions 516 Large-sample confidence intervals for comparing

proportions 517 Using technology 518 Accurate confidence intervals for comparing proportions 520 Significance tests for comparing proportions 522

CHAPTER 22 Inference about Variables: Part III Review 533 Part III summary 536

Test yourself 538 Supplementary exercises 545

Part IV Inference about Relationships 551 CHAPTER 23 **Two Categorical Variables: The Chi-Square Test** 553 Two-way tables 553

Tables 675

Standard Normal probabilities 676 TABLE A Random digits 678 TABLE B t distribution critical values 679 TABLE C Chi-square distribution critical values 680 TABLE D Critical values of the correlation r 681 TABLE E

Answers to Selected Exercises 682 733 Index



Part V **Optional Companion** Chapters (available online) **CHAPTER 26 Nonparametric Tests** 26-3

The problem of multiple comparisons 556

Expected counts in two-way tables 558

Comparing two samples: the Wilcoxon rank sum test 26-4 The Normal approximation for W 26-8

DETAILED TABLE OF CONTENTS

ix

Using technology 26-10 That hypotheses does Wilcoxon test? 26-13 Dealing with ties in rank tests 26-14 Matched pairs: the Wilcoxon signed rank test 26-19 The Normal approximation for W^+ 26-22 Dealing with ties in the signed rank test 26-24 Comparing several samples: the Kruskal-Wallis test 26-27 Hootheses and conditions for the Kruskal-Wallis test 26-29 The Kruskal-Wallis test statistic 26-29

CHAPTER 27

Selectical Process Control 27-3 Processes 27-4 The idea of statistical process control 27-9 Control of statistical process control 27-9 Control charts for process monitoring 27-10 Control charts 27-23 Control charts 27-25 Control charts 27-25 Confuse control with capability! 27-34 Confuse control with capability! 27-34 Confuse control with capability! 27-34 Confuse for sample proportions 27-36 Confuse for p charts 27-37

CHAPTER 28

Multiple Regression* 28-3

Parallel regression lines 28-4 Estimating parameters 28-8 Using technology 28-13 Inference for multiple regression 28-16 Interaction 28-26 The multiple linear regression model 28-32 The woes of regression coefficients 28-39 A case study for multiple regression 28-41 Inference for regression parameters 28-53 Checking the conditions for inference 28-58

CHAPTER 29

More about Analysis of Variance 29-3 Beyond one-way ANOVA 29-3 Follow-up analysis: Tukey pairwise multiple comparisons 29-8 Follow-up analysis: contrasts* 29-12 Two-way ANOVA: conditions, main effects, and interaction 29-16 Inference for two-way ANOVA 29-23 Some details of two-way ANOVA* 29-32

car equiperative matrix of the optimal section 2. These characteries is the definition between the control of the end of the end of the control of the end of the end of the end of the control of the end of the control of the end of the control of the end of

David Minuredas based BRS on threagnindiples: balanded cohreaters

ciansiconcelhed about feaching and are diniconwhomaster in an