Statistics

THIRTEENTH EDITION

James McClave • Terry Sincich

Pearson

APPLET CORRELATION

Applet	Concept Illustrated	Description	Applet Activity
Sample from a population	Assesses how well a sample represents the population and the role that sample size plays in the process.	Produces random sample from population from specified sample size and population distribution shape. Reports mean, median, and standard deviation; applet creates plot of sample.	**4.4**, 240; **5.1**, 355; **5.3**, 279
Sampling distributions	Compares means and standard deviations of distributions; assesses effect of sample size; illustrates unbiasedness.	Simulates repeatedly choosing samples of a fixed size *n* from a population with specified sample size, number of samples, and shape of population distribution. Applet reports means, medians, and standard deviations; creates plots for both.	**6.1**, 330; **6.2**, 330
Random numbers	Uses a random number generator to determine the experimental units to be included in a sample.	Generates random numbers from a range of integers specified by the user.	**1.1**, 47; **1.2**, 48; **3.6**, 203; **4.1**, 221; **5.2**, 265
Long-run probability demonstrations illustrate the concept that theoretical probabilities are long-run experimental probabilities.			
Simulating probability of rolling a 6	Investigates relationship between theoretical and experimental probabilities of rolling 6 as number of die rolls increases.	Reports and creates frequency histogram for each outcome of each simulated roll of a fair die. Students specify number of rolls; applet calculates and plots proportion of 6s.	**3.1**, 157; **3.2**, 157; **3.3**, 168; **3.4**, 169; **3.5**, 183
Simulating probability of rolling a 3 or 4	Investigates relationship between theoretical and experimental probabilities of rolling 3 or 4 as number of die rolls increases.	Reports outcome of each simulated roll of a fair die; creates frequency histogram for outcomes. Students specify number of rolls; applet calculates and plots proportion of 3s and 4s.	**3.3**, 168; **3.4**, 169
Simulating the probability of heads: fair coin	Investigates relationship between theoretical and experimental probabilities of getting heads as number of fair coin flips increases.	Reports outcome of each fair coin flip and creates a bar graph for outcomes. Students specify number of flips; applet calculates and plots proportion of heads.	**4.2**, 221
Simulating probability of heads: unfair coin ($P(H) = .2$)	Investigates relationship between theoretical and experimental probabilities of getting heads as number of unfair coin flips increases.	Reports outcome of each flip for a coin where heads is less likely to occur than tails and creates a bar graph for outcomes. Students specify number of flips; applet calculates and plots the proportion of heads.	**4.3**, 239
Simulating probability of heads: unfair coin ($P(H) = .8$)	Investigates relationship between theoretical and experimental probabilities of getting heads as number of unfair coin flips increases.	Reports outcome of each flip for a coin where heads is more likely to occur than tails and creates a bar graph for outcomes. Students specify number of flips; applet calculates and plots the proportion of heads.	**4.3**, 239
Simulating the stock market	Theoretical probabilities are long run experimental probabilities.	Simulates stock market fluctuation. Students specify number of days; applet reports whether stock market goes up or down daily and creates a bar graph for outcomes. Calculates and plots proportion of simulated days stock market goes up.	**4.5**, 240
Mean versus median	Investigates how skewedness and outliers affect measures of central tendency.	Students visualize relationship between mean and median by adding and deleting data points; applet automatically updates mean and median.	**2.1**, 89; **2.2**, 89; **2.3**, 89

Applet	Concept Illustrated	Description	Applet Activity
Standard deviation	Investigates how distribution shape and spread affect standard deviation.	Students visualize relationship between mean and standard deviation by adding and deleting data points; applet updates mean and standard deviation.	**2.4,** 96; **2.5,** 97; **2.6,** 97; **2.7,** 119
Confidence intervals for a proportion	Not all confidence intervals contain the population proportion. Investigates the meaning of 95% and 99% confidence.	Simulates selecting 100 random samples from the population and finds the 95% and 99% confidence intervals for each. Students specify population proportion and sample size; applet plots confidence intervals and reports number and proportion containing true proportion.	**7.5,** 369; **7.6,** 370
Confidence intervals for a mean (the impact of confidence level)	Not all confidence intervals contain the population mean. Investigates the meaning of 95% and 99% confidence.	Simulates selecting 100 random samples from population; finds 95% and 99% confidence intervals for each. Students specify sample size, distribution shape, and population mean and standard deviation; applet plots confidence intervals and reports number and proportion containing true mean.	**7.1,** 351; **7.2,** 351
Confidence intervals for a mean (not knowing standard deviation)	Confidence intervals obtained using the sample standard deviation are different from those obtained using the population standard deviation. Investigates effect of not knowing the population standard deviation.	Simulates selecting 100 random samples from the population and finds the 95% z-interval and 95% t-interval for each. Students specify sample size, distribution shape, and population mean and standard deviation; applet plots confidence intervals and reports number and proportion containing true mean.	**7.3,** 361; **7.4,** 361
Hypothesis tests for a proportion	Not all tests of hypotheses lead correctly to either rejecting or failing to reject the null hypothesis. Investigates the relationship between the level of confidence and the probabilities of making Type I and Type II errors.	Simulates selecting 100 random samples from population; calculates and plots z-statistic and P-value for each. Students specify population proportion, sample size, and null and alternative hypotheses; applet reports number and proportion of times null hypothesis is rejected at 0.05 and 0.01 levels.	**8.5,** 433; **8.6,** 434
Hypothesis tests for a mean	Not all tests of hypotheses lead correctly to either rejecting or failing to reject the null hypothesis. Investigates the relationship between the level of confidence and the probabilities of making Type I and Type II errors.	Simulates selecting 100 random samples from population; calculates and plots t statistic and P-value for each. Students specify population distribution shape, mean, and standard deviation; sample size, and null and alternative hypotheses; applet reports number and proportion of times null hypothesis is rejected at both 0.05 and 0.01 levels.	**8.1,** 407; **8.2,** 417; **8.3,** 417; **8.4,** 417
Correlation by eye	Correlation coefficient measures strength of linear relationship between two variables. Teaches user how to assess strength of a linear relationship from a scattergram.	Computes correlation coefficient r for a set of bivariate data plotted on a scattergram. Students add or delete points and guess value of r; applet compares guess to calculated value.	**11.2,** 652
Regression by eye	The least squares regression line has a smaller SSE than any other line that might approximate a set of bivariate data. Teaches students how to approximate the location of a regression line on a scattergram.	Computes least squares regression line for a set of bivariate data plotted on a scattergram. Students add or delete points and guess location of regression line by manipulating a line provided on the scattergram; applet plots least squares line and displays the equations and the SSEs for both lines.	**11.1,** 625

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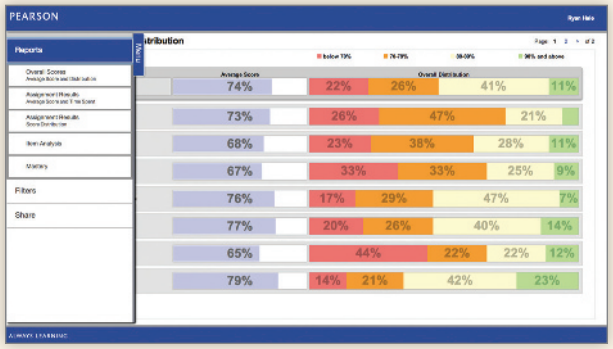

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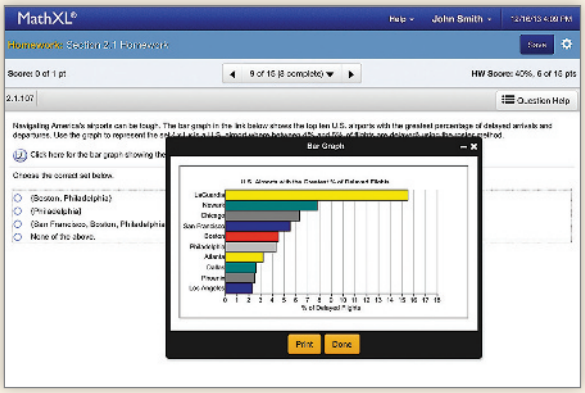

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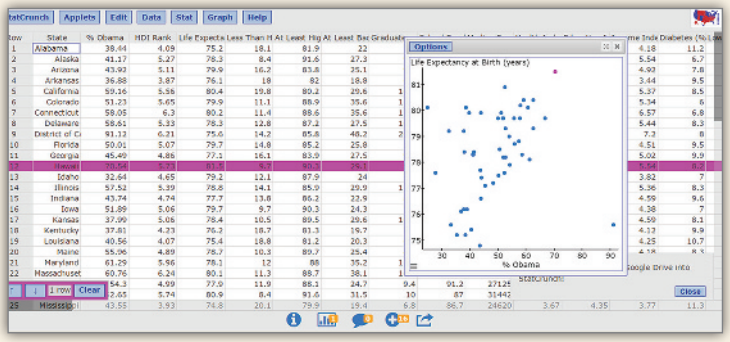

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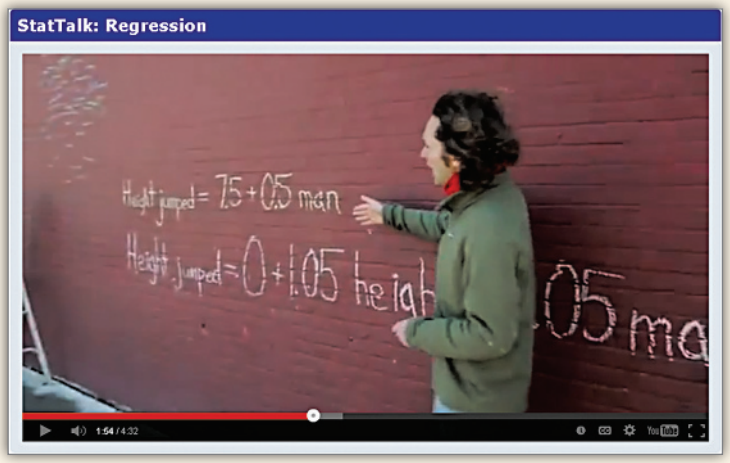

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STATISTICS

THIRTEENTH EDITION

GLOBAL EDITION

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Preface

This 13th edition of *Statistics* is an introductory text emphasizing inference, with extensive coverage of data collection and analysis as needed to evaluate the reported results of statistical studies and make good decisions. As in earlier editions, the text stresses the development of statistical thinking, the assessment of credibility, and the value of the inferences made from data, both by those who consume and those who produce them. It assumes a mathematical background of basic algebra.

The text incorporates the following features, developed from the American Statistical Association's (ASA) Guidelines for Assessment and Instruction in Statistics Education (GAISE) Project:

- Emphasize statistical literacy and develop statistical thinking
- Use real data in applications
- Use technology for developing conceptual understanding and analyzing data
- Foster active learning in the classroom
- Stress conceptual understanding rather than mere knowledge of procedures
- Emphasize intuitive concepts of probability

A briefer version of the book, *A First Course in Statistics*, is available for single semester courses that include minimal coverage of regression analysis, analysis of variance, and categorical data analysis.

New in the 13th Edition

- **Over 2,000 exercises, with revisions and updates to 25%.** Many new and updated exercises, based on contemporary studies and real data, have been added. Most of these exercises foster and promote critical thinking skills.
- **Updated technology.** All printouts from statistical software (SAS, SPSS, MINITAB, and the TI-83/Tl-84 Plus Graphing Calculator) and corresponding instructions for use have been revised to reflect the latest versions of the software.
- **New Statistics in Action Cases.** Six of the 14 Statistics in Action cases are new or updated, each based on real data from a recent study.
- **Continued emphasis on Ethics.** Where appropriate, boxes have been added emphasizing the importance of ethical behavior when collecting, analyzing, and interpreting data with statistics.
- **Data Informed Development.** The authors analyzed aggregated student usage and performance data from Pearson MyLab Statistics for the previous edition of this text. The results of this analysis helped improve the quality and quantity of exercises that matter most to instructors and students.

Content-Specific Changes to This Edition

- **Chapter 1 (Statistics, Data, and Statistical Thinking).** Material on all basic sampling concepts (e.g., random sampling and sample survey designs) has been streamlined and moved to Section 1.5 (Collecting Data: Sampling and Related Issues).
- **Chapter 2 (Methods for Describing Sets of Data).** The section on summation notation has been moved to the appendix (Appendix A). Also, recent examples of misleading graphics have been added to Section 2.9 (Distorting the Truth with Descriptive Statistics).

- **Chapter 4 (Discrete Random Variables) and Chapter 5 (Continuous Random Variables).** Use of technology for computing probabilities of random variables with known probability distributions (e.g., binomial, Poisson, normal, and exponential distributions) has been incorporated into the relevant sections of these chapters. This reduces the use of tables of probabilities for these distributions.
- **Chapter 6 (Sampling Distributions).** In addition to the sampling distribution of the sample mean, we now cover (in new Section 6.4) the sampling distribution of a sample proportion.
- **Chapter 8 (Inferences Based on a Single Sample: Tests of Hypothesis).** The section on *p*-values in hypothesis testing (Section 8.3) has been moved up to emphasize the importance of their use in real-life studies. Throughout the remainder of the text, conclusions from a test of hypothesis are based on *p*-values.

Hallmark Strengths

We have maintained the pedagogical features of *Statistics* that we believe make it unique among introductory statistics texts. These features, which assist the student in achieving an overview of statistics and an understanding of its relevance in both the business world and everyday life, are as follows:

- **Use of Examples as a Teaching Device**—Almost all new ideas are introduced and illustrated by data-based applications and examples. We believe that students better understand definitions, generalizations, and theoretical concepts *after* seeing an application. All examples have three components: (1) "Problem," (2) "Solution," and (3) "Look Back" (or "Look Ahead"). This step-by-step process provides students with a defined structure by which to approach problems and enhances their problem-solving skills. The "Look Back" feature often gives helpful hints to solving the problem and/or provides a further reflection or insight into the concept or procedure that is covered.
- **Now Work**—A "Now Work" exercise suggestion follows each example. The Now Work exercise (marked with the icon NW in the exercise sets) is similar in style and concept to the text example. This provides the students with an opportunity to immediately test and confirm their understanding.
- **Statistics in Action**—Each chapter begins with a case study based on an actual contemporary, controversial, or high-profile issue. Relevant research questions and data from the study are presented and the proper analysis demonstrated in short "Statistics in Action Revisited" sections throughout the chapter. These motivate students to critically evaluate the findings and think through the statistical issues involved.
- **Applet Exercises**—The text is accompanied by applets (short computer programs) available at www.pearsonglobaleditions.com/mcclave and within Pearson MyLab Statistics. These point-and-click applets allow students to easily run simulations that visually demonstrate some of the more difficult statistical concepts (e.g., sampling distributions and confidence intervals). Each chapter contains several optional applet exercises in the exercise sets. They are denoted with the following icon: D.
- **Real Data-Based Exercises**—The text includes more than 2,000 exercises based on applications in a variety of disciplines and research areas. All the applied exercises employ the use of current real data extracted from current publications (e.g., newspapers, magazines, current journals, and the Internet). Some students have difficulty learning the mechanics of statistical techniques when all problems are couched in terms of realistic applications. For this reason, all exercise sections are divided into four parts:

  Learning the Mechanics. Designed as straightforward applications of new concepts, these exercises allow students to test their abilities to comprehend a mathematical concept or a definition.

Applying the Concepts—Basic. Based on applications taken from a wide variety of journals, newspapers, and other sources, these short exercises help students to begin developing the skills necessary to diagnose and analyze real-world problems.

Applying the Concepts—Intermediate. Based on more detailed real-world applications, these exercises require students to apply their knowledge of the technique presented in the section.

Applying the Concepts—Advanced. These more difficult real-data exercises require students to use their critical thinking skills.

- **Critical Thinking Challenges**—Placed at the end of the "Supplementary Exercises" sections only, students are asked to apply their critical thinking skills to solve one or two challenging real-life problems. These exercises expose students to real-world problems with solutions that are derived from careful, logical thought and selection of the appropriate statistical analysis tool.
- **Exploring Data with Statistical Computer Software and the Graphing Calculator**—Each statistical analysis method presented is demonstrated using output from three leading Windows-based statistical software packages: SAS, SPSS, and MINITAB. Students are exposed early and often to computer printouts they will encounter in today's high-tech world.
- **"Using Technology" Tutorials**—MINITAB software tutorials appear at the end of each chapter and include point-and-click instructions (with screen shots). These tutorials are easily located and show students how to best use and maximize MINITAB statistical software. In addition, output and keystroke instructions for the TI-83/Tl-84 Plus Graphing Calculator are presented.
- **Profiles of Statisticians in History (Biography)**—Brief descriptions of famous statisticians and their achievements are presented in side boxes. With these profiles, students will develop an appreciation of the statistician's efforts and the discipline of statistics as a whole.
- **Data and Applets**—The Web site www.pearsonglobaleditions.com/mcclave has files for all the data sets marked with the data set icon D in the text. These include data sets for text examples, exercises, Statistics in Action, and Real-World cases. This site also contains the applets that are used to illustrate statistical concepts.

Flexibility in Coverage

The text is written to allow the instructor flexibility in coverage of topics. Suggestions for two topics, probability and regression, are given below.

- **Probability and Counting Rules**—One of the most troublesome aspects of an introductory statistics course is the study of probability. Probability poses a challenge for instructors because they must decide on the level of presentation, and students find it a difficult subject to comprehend. We believe that one cause for these problems is the mixture of probability and counting rules that occurs in most introductory texts. Consequently, we have included the counting rules (with examples) in an optional section (Section 3.7) of Chapter 3. Thus, the instructor can control the level of probability coverage.
- **Multiple Regression and Model Building**—This topic represents one of the most useful statistical tools for the solution of applied problems. Although an entire text could be devoted to regression modeling, we feel that we have presented coverage that is understandable, usable, and much more comprehensive than the presentations in other introductory statistics texts. We devote two full chapters to discussing the major types of inferences that can be derived from a regression analysis, showing how these results appear in the output from statistical software, and, most important, selecting multiple regression models to be used in an analysis. Thus,

the instructor has the choice of one-chapter coverage of simple linear regression (Chapter 11), a two-chapter treatment of simple and multiple regression (excluding the sections on model building in Chapter 12), or complete coverage of regression analysis, including model building and regression diagnostics. This extensive coverage of such useful statistical tools will provide added evidence to the student of the relevance of statistics to real-world problems.

- **Role of Calculus in Footnotes**—Although the text is designed for students with a non-calculus background, footnotes explain the role of calculus in various derivations. Footnotes are also used to inform the student about some of the theory underlying certain methods of analysis. These footnotes allow additional flexibility in the mathematical and theoretical level at which the material is presented.

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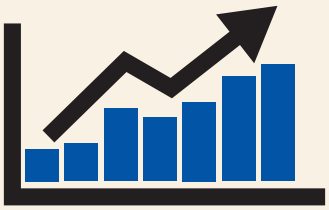

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- **Chapter 14:** Nonparametric Statistics

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