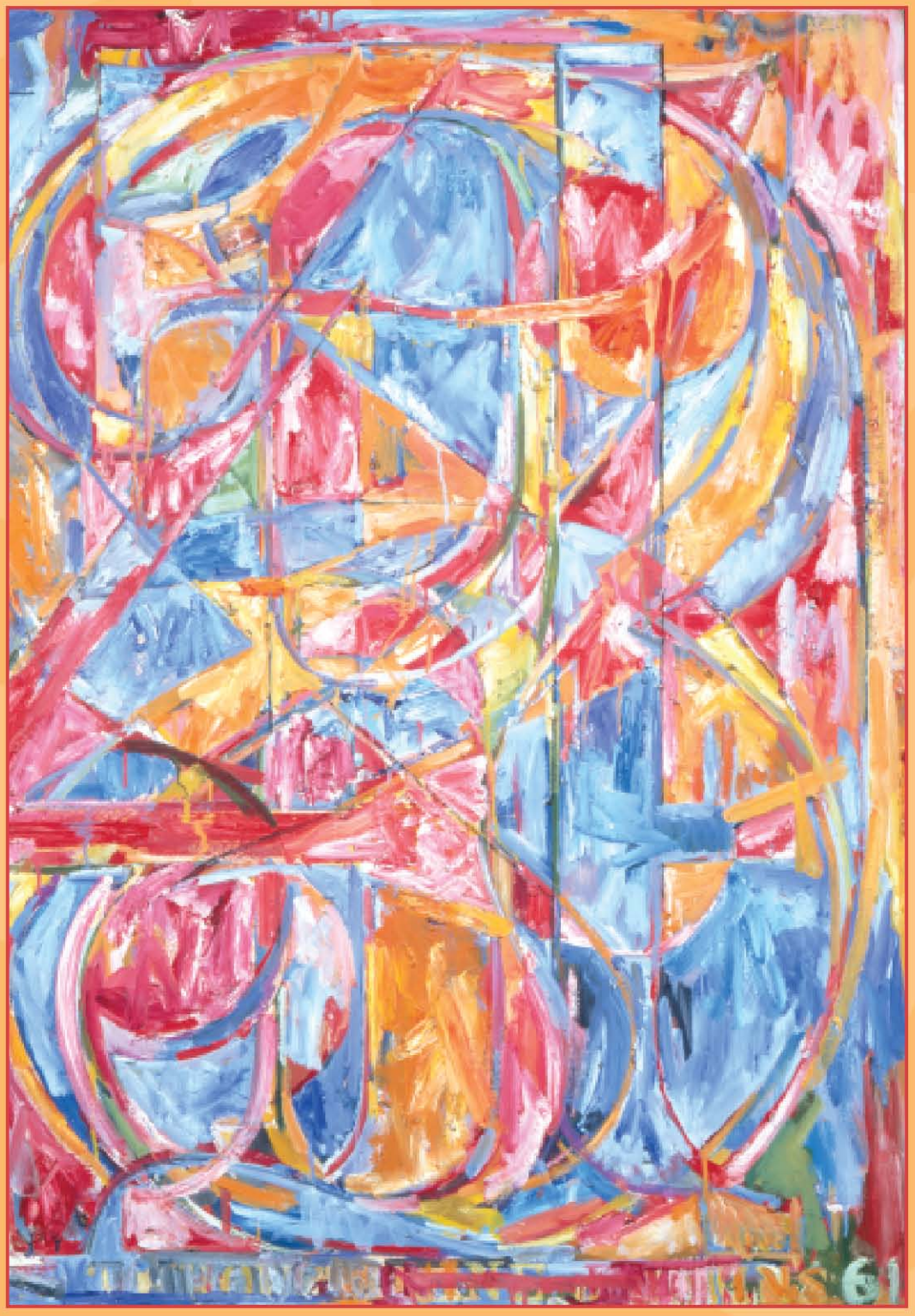
INTRODUCTION TO THE PRACTICE OF STATISTICS



SIXTH EDITION

MOORE
McCABE
CRAIG

Authors' note about the cover

Introduction to the Practice of Statistics emphasizes the use of graphical and numerical summaries to understand data. The front cover shows a painting entitled *0 to 9,* by the American artist Jasper Johns in 1961. In this work, the structure of the painting is determined by number sequence, just as our graphical summaries are determined by the numerical calculations that we perform when we analyze data. Can you find all of the digits in the painting?

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Introduction to the Practice of Statistics

SIXTH EDITION

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TO TEACHERS: *About This Book*

Statistics is the science of data. *Introduction to the Practice of Statistics* (*IPS*) is an introductory text based on this principle. We present the most-used methods of basic statistics in a way that emphasizes working with data and mastering statistical reasoning. *IPS* is elementary in mathematical level but conceptually rich in statistical ideas and serious in its aim to help students think about data and use statistical methods with understanding.

Some schematic history will help place *IPS* in the universe of texts for a first course in statistics for students from a variety of disciplines. Traditional texts were almost entirely devoted to methods of inference, with quick coverage of means, medians, and histograms as a preliminary. No doubt this reflected the fact that inference is the only part of statistics that has a mathematical theory behind it. Several innovative books aimed at nontraditional audiences pioneered a broader approach that paid more attention to design of samples and experiments, the messiness of real data, and discussion of real-world statistical studies and controversies. All were written by widely known statisticians whose main business was not writing textbooks. *The Nature of Statistics* (Wallis and Roberts) has passed away, but *Statistics* (Freedman and collaborators) and *Statistics: Concepts and Controversies* (Moore) remain alive and well. None of these books tried to meet the needs of a typical first course because their audiences did not need full coverage of standard statistical methods.

IPS was the first book to successfully combine attention to broader content and reasoning with comprehensive presentation of the most-used statistical methods. It reflects the consensus among statisticians—even stronger now than when the first edition appeared—concerning the content of an introduction to our discipline. This consensus is expressed in a report from the joint curriculum committee of the American Statistical Association and the Mathematical Association of America[1] and in discussions in leading journals.[2] *IPS* has been successful for several reasons:

1. *IPS* examines the nature of modern statistical practice at a level suitable for beginners. Attention to data analysis and data production as well as to probability and inference is "new" only in the world of textbooks. Users of statistical methods have always paid attention to all of these. Contemporary research in statistics, driven by advances in computing, puts more emphasis on sophisticated "looking at data" and on data-analytic ways of thinking. Formal inference remains important and receives careful treatment, but it appears as part of a larger picture.

2. *IPS* has a logical overall progression, so data analysis and data production strengthen the presentation of inference rather than stand apart from it. We stress that data analysis is an essential preliminary to inference because inference requires clean data. The most useful "goodness of fit" procedure, for example, is the normal quantile plot presented in Chapter 1 and used frequently in the inference chapters. We emphasize that when you do formal statistical inference, you are acting as if your data come from properly randomized data production. We use random samples and experimental randomization to motivate the need for probability as a language for inference.

3. *IPS* presents data analysis as more than a collection of techniques for exploring data. We integrate techniques with discussion of systematic ways of thinking about data. We also work hard to make data-analytic thinking accessible to beginners by presenting a series of simple principles: always plot your data; look for overall patterns and deviations from them; when looking at the overall pattern of a distribution for one variable, consider shape, center, and spread; for relations between two variables, consider form, direction, and strength; always ask whether a relationship between variables is influenced by other variables lurking in the background. Inference is similarly treated as more than a collection of methods. We warn students about pitfalls in clear cautionary discussions—about regression and correlation, experiments, sample surveys, confidence intervals, and significance tests. Our goal throughout *IPS* is to present principles and techniques together in a way that is accessible to beginners and lays a foundation for students who will go on to more advanced study.
4. *IPS* integrates discussion of techniques, reasoning, and practice using real examples to drive the exposition. Students learn the technique of least-squares regression and how to interpret the regression slope. But they also learn the conceptual ties between regression and correlation, the importance of looking for influential observations (always plot your data), and to beware of averaged data and the restricted-range effect.
5. *IPS* is aware of current developments both in statistical science and in teaching statistics. For example, the first edition already favored the version of the two-sample t procedures that does not assume equal population variances and discussed the great difference in robustness between standard tests for means and for variances. In the fourth edition, we introduced the modified ("plus four") confidence intervals for proportions that are shown by both computational studies[3] and theory[4] to be superior to the standard intervals for all but very large samples. Brief optional "Beyond the Basics" sections give quick overviews of topics such as density estimation, scatterplot smoothers, nonlinear regression, and data mining. Chapter 16 on resampling methods offers an extended introduction to one of the most important recent advances in statistical methodology.

The title of the book expresses our intent to introduce readers to statistics as it is used in practice. Statistics in practice is concerned with gaining understanding from data; it focuses on problem solving rather than on methods that may be useful in specific settings. A text cannot fully imitate practice because it must teach specific methods in a logical order and must use data that are not the reader's own. Nonetheless, our interest and experience in applying statistics have influenced the nature of *IPS* in several ways.

Statistical Thinking Statistics is interesting and useful because it provides strategies and tools for using data to gain insight into real problems. As the continuing revolution in computing automates the details of doing calculations and making graphs, an emphasis on statistical concepts and on insight from data becomes both more practical for students and teachers and more important for users who must supply what is not automated. No student should complete a first statistics course, for example, without a firm grasp of the distinction between observational studies and experiments and of why randomized comparative experiments are the gold standard for evidence of causation.

We have seen many statistical mistakes, but few have involved simply getting a calculation wrong. We therefore ask students to learn to explore data, always starting with plots, to think about the context of the data and the design of the study that produced the data, the possible influence of wild observations on conclusions, and the reasoning that lies behind standard methods of inference. Users of statistics who form these habits from the beginning are well prepared to learn and use more advanced methods.

Data Data are numbers with a context, as we say in "To Students: What Is Statistics?" A newborn who weighs 10.3 pounds is a big baby, and the birth weight could not plausibly be 10.3 ounces or 10.3 kilograms. Because context makes numbers meaningful, our examples and exercises use real data with real contexts that we briefly describe. Calculating the mean of five numbers is arithmetic, not statistics. We hope that the presence of background information, even in exercises intended for routine drill, will encourage students to always consider the meaning of their calculations as well as the calculations themselves. Note in this connection that a calculation or a graph or "reject H_0" is rarely a full answer to a statistical problem. We strongly encourage requiring students always to state a brief conclusion in the context of the problem. This helps build data sense as well as the communication skills that employers value.

Mathematics Although statistics is a mathematical science, it is not a field of mathematics and should not be taught as if it were. A fruitful mathematical theory (based on probability, which *is* a field of mathematics) underlies some parts of basic statistics, but by no means all. The distinction between observation and experiment, for example, is a core statistical idea that is ignored by the theory.[5] Mathematically trained teachers, rightly resisting a formula-based approach, sometimes identify conceptual understanding with mathematical understanding. When teaching statistics, we must emphasize statistical ideas and recognize that mathematics is not the only vehicle for conceptual understanding. *IPS* requires only the ability to read and use equations without having each step parsed. We require no algebraic derivations, let alone calculus. Because this is a *statistics* text, it is richer in ideas and requires more thought than the low mathematical level suggests.

Calculators and Computers Statistical calculations and graphics are in practice automated by software. We encourage instructors to use software of their choice or a graphing calculator that includes functions for both data analysis and basic inference. *IPS* includes some topics that reflect the dominance of software in practice, such as normal quantile plots and the version of the two-sample t procedures that does not require equal variances. Several times we display the output of multiple software systems for the same problem. The point is that a student who knows the basics can interpret almost any output. Students like this reassurance, and it helps focus their attention on understanding rather than reading output.

Judgment Statistics in practice requires judgment. It is easy to list the mathematical assumptions that justify use of a particular procedure, but not so easy to decide when the procedure can be safely used in practice. Because judgment develops through experience, an introductory course should present clear guidelines and not make unreasonable demands on the judgment of

students. We have given guidelines—for example, on using the t procedures for comparing two means but avoiding the F procedures for comparing two variances—that we follow ourselves. Similarly, many exercises require students to use some judgment and (equally important) to explain their choices in words. Many students would prefer to stick to calculating, and many statistics texts allow them to. Requiring more will do them much good in the long run.

Teaching Experiences We have successfully used *IPS* in courses taught to quite diverse student audiences. For general undergraduates from mixed disciplines, we cover Chapters 1 to 8 and Chapter 9, 10, or 12, omitting all optional material. For a quantitatively strong audience—sophomores planning to major in actuarial science or statistics—we move more quickly. We add Chapters 10 and 11 to the core material in Chapters 1 to 8 and include most optional content. We de-emphasize Chapter 4 (probability) because these students will take a probability course later in their program, though we make intensive use of software for simulating probabilities as well as for statistical analysis. The third group we teach contains beginning graduate students in such fields as education, family studies, and retailing. These mature but sometimes quantitatively unprepared students read the entire text (Chapters 11 and 13 lightly), again with reduced emphasis on Chapter 4 and some parts of Chapter 5. In all cases, beginning with data analysis and data production (Part I) helps students overcome their fear of statistics and builds a sound base for studying inference. We find that *IPS* can be flexibly adapted to quite varied audiences by paying attention to our clear designation of some material as optional and by varying the chapters assigned.

The Sixth Edition: *What's New?*

- **Co-author** We are delighted to welcome Professor Bruce Craig to the *Introduction to the Practice of Statistics* author team. Bruce is currently Director of the Statistical Consulting Service at Purdue University and is an outstanding teacher. His vast experience consulting and collaborating with individuals who use statistical methods in their work provides him with perspective on the field of statistics that resonates with the approach of this text.
- **Ethics** Chapter 3 now contains a new section (3.4) on ethics. We believe that this topic is a very important part of the undergraduate curriculum and that a course in statistics is an ideal forum to stimulate thought and discussion about ethical issues.
- **Text Organization** Logistic Regression, previously treated in Chapter 16, now appears in Chapter 14. Similarly, Bootstrap Methods and Permutation Tests has moved to Chapter 16. This change is in line with the increasing importance of logistic regression in statistical practice. In response to suggestions from current *IPS* users, we have moved the material on data analysis for two-way tables from Chapter 9 back to Chapter 2 (Section 2.5). In addition, the large sample confidence procedures are now the featured methods for one and two proportions in Chapter 9, and the plus-four have been moved to Beyond the Basics sections, a more appropriate location. The table of contents follows what we consider to be the best ordering of the topics from a

pedagogical point of view. However, the text chapters are generally written to enable instructors to teach the material in the order they prefer.

- **Design** A new design incorporates colorful, revised figures throughout to aid students' understanding of text material. Photographs related to chapter examples and exercises make connections to real-life applications and provide a visual context for topics.
- **Exercises and Examples** Exercises and examples are labeled to help instructors and students easily identify key topics and application areas. The number of total exercises has increased by 15%. Approximately half the total exercises are new or revised to reflect current data and a variety of topics. *IPS* examples and exercises cover a wide range of application areas. An application index is provided for instructors to easily select and assign content related to specific fields.
- **Use Your Knowledge Exercises** Short exercises designed to reinforce key concepts now appear throughout each chapter. These exercises are listed, with page numbers, at the end of each section for easy reference.

- **Look Back** At key points in the text Look Back margin notes direct the reader to the first explanation of a topic, providing page numbers for easy reference.

In addition to the new Sixth Edition enhancements, *IPS* has retained the successful pedagogical features from previous editions:

- **Caution** Warnings in the text, signaled by a caution icon, help students avoid common errors and misconceptions.

- **Challenge Exercises** More challenging exercises are signaled with an icon. Challenge exercises are varied: some are mathematical, some require open-ended investigation, and so on.

- **Applets** Applet icons are used throughout the text to signal where related, interactive statistical applets can be found on the text Web site (www.whfreeman.com/ips6e) and CD-ROM.
- **Statistics in Practice** Formerly found at the opening of each chapter, these accounts by professionals who use statistics on the job are now located on the *IPS* Web site and CD-ROM.
- **CrunchIt! Statistical Software** Developed by Webster West of Texas A&M University, CrunchIt! is an easy-to-use program for students and offers capabilities well beyond those needed for a first course. CrunchIt! output, along with other statistical software output, is integrated throughout the text. Access to CrunchIt! is available online through an access-code–protected Web site. Access codes are available in every new copy of *IPS* 6e or can be purchased online.

Acknowledgments

We are pleased that the first five editions of *Introduction to the Practice of Statistics* have helped move the teaching of introductory statistics in a direction supported by most statisticians. We are grateful to the many colleagues and students who have provided helpful comments, and we hope that they will

find this new edition another step forward. In particular, we would like to thank the following colleagues who offered specific comments on the new edition:

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Media and Supplements

For Students

NEW! STATS PORTAL

portals.bfwpub.com/ips6e (Access code required. Available packaged with *Introduction to the Practice of Statistics*, Sixth Edition, or for purchase online.) StatsPortal is the digital gateway to *IPS* 6e, designed to enrich the course and enhance students' study skills through a collection of Web-based tools. StatsPortal integrates a rich suite of diagnostic, assessment, tutorial, and enrichment features, enabling students to master statistics at their own pace. It is organized around three main teaching and learning components:

- **Interactive eBook** offers a complete and customizable online version of the text, fully integrated with all the media resources available with *IPS* 6e. The eBook allows students to quickly search the text, highlight key areas, and add notes about what they're reading. Similarly, instructors can customize the eBook to add, hide, and reorder content, add their own material, and highlight key text for students.
- **Resources** organizes all the resources for *IPS* 6e into one location for students' ease of use. These resources include the following:
  - **StatTutor Tutorials** offer over 150 audio-multimedia tutorials tied directly to the textbook, including videos, applets, and animations.
  - **Statistical Applets** are 16 interactive applets to help students master key statistical concepts.
  - **CrunchIt! Statistical Software** allows users to analyze data from any Internet location. Designed with the novice user in mind, the software is not only easily accessible but also easy to use. CrunchIt! offers all the basic statistical routines covered in the introductory statistics courses. **CrunchIt!** statistical software is available via an access-code protected Web site. Access codes are available in every new copy of *IPS* 6e or can be purchased online.
  - **Stats@Work Simulations** put students in the role of statistical consultants, helping them better understand statistics interactively within the context of real-life scenarios. Students are asked to interpret and analyze data presented to them in report form, as well as to interpret current event news stories. All tutorials are graded and offer helpful hints and feedback.
  - **EESEE Case Studies** developed by The Ohio State University Statistics Department provide students with a wide variety of timely, real examples with real data. Each case study is built around several thought-provoking questions that make students think carefully about the statistical issues raised by the stories. **EESEE** case studies are available via an access-code-protected Web site. Access codes are available in every new copy of *IPS* 6e or can be purchased online.

- **Podcast Chapter Summary** provides students with an audio version of chapter summaries to download and review on an mp3 player.
- **Data Sets** are available in ASCII, Excel, JMP, Minitab, TI, SPSS, and S-Plus formats.
- **Online Tutoring with SMARTHINKING** is available for homework help from specially trained, professional educators.
- **Student Study Guide with Selected Solutions** includes explanations of crucial concepts and detailed solutions to key text problems with step-by-step models of important statistical techniques.
- **Statistical Software Manuals** for TI-83/84, Minitab, Excel, JMP, and SPSS provide instruction, examples, and exercises using specific statistical software packages.
- **Interactive Table Reader** allows students to use statistical tables interactively to seek the information they need.

Resources (instructors only)

- **Instructor's Guide with Full Solutions** includes worked-out solutions to all exercises, teaching suggestions, and chapter comments.
- **Test Bank** contains complete solutions for textbook exercises.
- **Lecture PowerPoint slides** offer a detailed lecture presentation of statistical concepts covered in each chapter of *IPS*.

- **Assignments** organizes assignments and guides instructors through an easy-to-create assignment process providing access to questions from the Test Bank, Web Quizzes, and Exercises from *IPS* 6e. The Assignment Center enables instructors to create their own assignments from a variety of question types for self-graded assignments. This powerful assignment manager allows instructors to select their preferred policies in regard to scheduling, maximum attempts, time limitations, feedback, and more!

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Printed Study Guide prepared by Michael A. Fligner of The Ohio State University offers students explanations of crucial concepts in each section of *IPS*, plus detailed solutions to key text problems and stepped-through models of important statistical techniques. ISBN 1-4292-1473-2

For Instructors

The **Instructor's Web site** www.whfreeman.com/ips6e requires user registration as an instructor and features all the student Web materials plus:

- **Instructor version of EESEE** (Electronic Encyclopedia of Statistical Examples and Exercises), with solutions to the exercises in the student version and **CrunchIt!** statistical software.
- **Instructor's Guide,** including full solutions to all exercises in .pdf format.
- **PowerPoint slides** containing all textbook figures and tables.
- **Lecture PowerPoint slides** offering a detailed lecture presentation of statistical concepts covered in each chapter of *IPS*.
- **Full answers to the Supplementary Exercises** on the student Web site.

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- Instructor's Guide with full solutions
- PowerPoint files and lecture slides
- Test bank files

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TO STUDENTS: *What Is Statistics?*

Statistics is the science of collecting, organizing, and interpreting numerical facts, which we call *data*. We are bombarded by data in our everyday lives. The news mentions imported car sales, the latest poll of the president's popularity, and the average high temperature for today's date. Advertisements claim that data show the superiority of the advertiser's product. All sides in public debates about economics, education, and social policy argue from data. A knowledge of statistics helps separate sense from nonsense in the flood of data.

The study and collection of data are also important in the work of many professions, so training in the science of statistics is valuable preparation for a variety of careers. Each month, for example, government statistical offices release the latest numerical information on unemployment and inflation. Economists and financial advisors, as well as policymakers in government and business, study these data in order to make informed decisions. Doctors must understand the origin and trustworthiness of the data that appear in medical journals. Politicians rely on data from polls of public opinion. Business decisions are based on market research data that reveal consumer tastes. Engineers gather data on the quality and reliability of manufactured products. Most areas of academic study make use of numbers, and therefore also make use of the methods of statistics.

Understanding from Data

The goal of statistics is to gain understanding from data. To gain understanding, we often operate on a set of numbers—we average or graph them, for example. But we must do more, because data are not just numbers; they are numbers that have some context that helps us understand them.

You read that low birth weight is a major reason why infant mortality in the United States is higher than in most other advanced nations. The report goes on to say that 7.8% of children born in the United States have low birth weight, and that 13.4% of black infants have low birth weight.[1] To make sense of these numbers you must know what counts as low birth weight (less than 2500 grams, or 5.5 pounds) and have some feeling for the weights of babies. You probably recognize that 5.5 pounds is small, that 7.5 pounds (3400 grams) is about average, and that 10 pounds (4500 grams) is a big baby.

Another part of the context is the source of the data. How do we know that 7.8% of American babies have low birth weight or that the average weight of newborns is about 3400 grams? The data come from the National Center for Health Statistics, a government office to which the states report information from all birth certificates issued each month. These are the most complete data available about births in the United States.

When you do statistical problems—even straightforward textbook problems—don't just graph or calculate. Think about the context and state your conclusions in the specific setting of the problem. As you are learning how to do statistical calculations and graphs, remember that the goal of statistics is not calculation for its own sake but gaining understanding from numbers. The

calculations and graphs can be automated by a calculator or software, but you must supply the understanding. This book presents only the most common specific procedures for statistical analysis. A thorough grasp of the principles of statistics will enable you to quickly learn more advanced methods as needed. Always keep in mind, however, that a fancy computer analysis carried out without attention to basic principles will often produce elaborate nonsense. As you read, seek to understand the principles, as well as the necessary details of methods and recipes.

The Rise of Statistics

Historically, the ideas and methods of statistics developed gradually as society grew interested in collecting and using data for a variety of applications. The earliest origins of statistics lie in the desire of rulers to count the number of inhabitants or measure the value of taxable land in their domains. As the physical sciences developed in the seventeenth and eighteenth centuries, the importance of careful measurements of weights, distances, and other physical quantities grew. Astronomers and surveyors striving for exactness had to deal with variation in their measurements. Many measurements should be better than a single measurement, even though they vary among themselves. How can we best combine many varying observations? Statistical methods that are still important were invented to analyze scientific measurements.

By the nineteenth century, the agricultural, life, and behavioral sciences also began to rely on data to answer fundamental questions. How are the heights of parents and children related? Does a new variety of wheat produce higher yields than the old, and under what conditions of rainfall and fertilizer? Can a person's mental ability and behavior be measured just as we measure height and reaction time? Effective methods for dealing with such questions developed slowly and with much debate.[2]

As methods for producing and understanding data grew in number and sophistication, the new discipline of statistics took shape in the twentieth century. Ideas and techniques that originated in the collection of government data, in the study of astronomical or biological measurements, and in the attempt to understand heredity or intelligence came together to form a unified "science of data." That science of data—statistics—is the topic of this text.

The Organization of This Book

Part I of this book, called "Looking at Data," concerns data analysis and data production. The first two chapters deal with statistical methods for organizing and describing data. These chapters progress from simpler to more complex data. Chapter 1 examines data on a single variable; Chapter 2 is devoted to relationships among two or more variables. You will learn both how to examine data produced by others and how to organize and summarize your own data. These summaries will be first graphical, then numerical, and then, when appropriate, in the form of a mathematical model that gives a compact description of the overall pattern of the data. Chapter 3 outlines arrangements (called "designs") for producing data that answer specific questions. The principles presented in this chapter will help you to design proper samples and experiments and to evaluate such investigations in your field of study.

Part II, consisting of Chapters 4 to 8, introduces statistical inference—formal methods for drawing conclusions from properly produced data. Statistical inference uses the language of probability to describe how reliable its conclusions are, so some basic facts about probability are needed to understand inference. Probability is the subject of Chapters 4 and 5. Chapter 6, perhaps the most important chapter in the text, introduces the reasoning of statistical inference. Effective inference is based on good procedures for producing data (Chapter 3), careful examination of the data (Chapters 1 and 2), and an understanding of the nature of statistical inference as discussed in Chapter 6. Chapters 7 and 8 describe some of the most common specific methods of inference for drawing conclusions about means and proportions from one and two samples.

The five shorter chapters in Part III introduce somewhat more advanced methods of inference, dealing with relations in categorical data, regression and correlation, and analysis of variance. Supplement chapters, available on the book-companion CD and Web site, present additional statistical topics.

What Lies Ahead

Introduction to the Practice of Statistics is full of data from many different areas of life and study. Many exercises ask you to express briefly some understanding gained from the data. In practice, you would know much more about the background of the data you work with and about the questions you hope the data will answer. No textbook can be fully realistic. But it is important to form the habit of asking, "What do the data tell me?" rather than just concentrating on making graphs and doing calculations.

You should have some help in automating many of the graphs and calculations. You should certainly have a calculator with basic statistical functions. Look for key words such as "two-variable statistics" or "regression" when you shop for a calculator. More advanced (and more expensive) calculators will do much more, including some statistical graphs. You may be asked to use software as well. There are many kinds of statistical software, from spreadsheets to large programs for advanced users of statistics. The kind of computing available to learners varies a great deal from place to place—but the big ideas of statistics don't depend on any particular level of access to computing.

Because graphing and calculating are automated in statistical practice, the most important assets you can gain from the study of statistics are an understanding of the big ideas and the beginnings of good judgment in working with data. Ideas and judgment can't (at least yet) be automated. They guide you in telling the computer what to do and in interpreting its output. This book tries to explain the most important ideas of statistics, not just teach methods. Some examples of big ideas that you will meet are "always plot your data," "randomized comparative experiments," and "statistical significance."

You learn statistics by doing statistical problems. Practice, practice, practice. Be prepared to work problems. The basic principle of learning is persistence. Being organized and persistent is more helpful in reading this book than knowing lots of math. The main ideas of statistics, like the main ideas of any important subject, took a long time to discover and take some time to master. The gain will be worth the pain.

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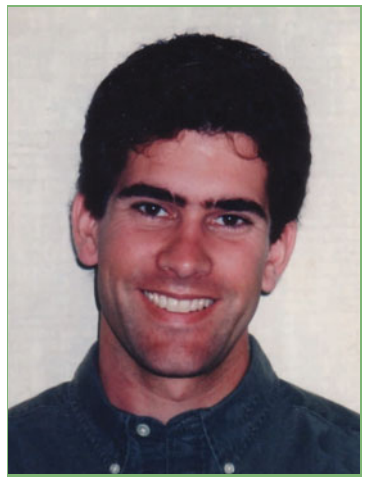
Professor McCabe's research interests have focused on applications of statistics. Much of his recent work has been focused on problems in nutrition, including nutrient requirements, calcium metabolism, and bone health. He is author or coauthor of over 150 publications in many different journals.



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Professor Craig's research interests focus on the development of novel statistical methodology to address research questions in the life sciences. Areas of current interest are protein structure determination, diagnostic testing, and animal abundance estimation. In 2005, he was named Purdue University Faculty Scholar.

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CHAPTER

1

Looking at Data—Distributions

Students planning a referendum on college fees. See Example 1.1.

Introduction

Statistics is the science of learning from data. Data are numerical facts. Here is an example of a situation where students used the results of a referendum to convince their university Board of Trustees to make a decision.

1.1 Displaying Distributions with Graphs

1.2 Describing Distributions with Numbers

1.3 Density Curves and Normal Distributions

EXAMPLE

1.1 Students vote for service learning scholarships. According to the National Service-Learning Clearinghouse: "Service-learning is a teaching and learning strategy that integrates meaningful community service with instruction and reflection to enrich the learning experience, teach civic responsibility, and strengthen communities."[1] University of Illinois at Urbana–Champaign students decided that they wanted to become involved in this national movement. They proposed a $15.00 per semester Legacy of Service and Learning Scholarship fee. Each year, $10.00 would be invested in an endowment and $5.00 would be used to fund current-use scholarships. In a referendum, students voted 3785 to 2977 in favor of the proposal. On April 11, 2006, the university Board of Trustees approved the proposal. Approximately $370,000 in current-use scholarship funds will be generated each year, and with the endowment, it is expected that in 20 years there will be more than a million dollars per year for these scholarships.