



STATISTICS

Concepts and Controversies

David S. Moore / William I. Notz

Ninth Edition

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NINTH EDITION

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Macmillan Learning
New York

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Project Editor: Edward Dionne, MPS North America LLC
Illustrations: Network Graphics, MPS North America LLC
Production Manager: Susan Wein
Composition: MPS North America LLC
Printing and Binding: LSC Communications
Cover Illustration: Tuna, 2009 64 × 115"; made from nineteen watercolor paintings by Sarah Waller. Depicts 20,500 tuna, the average number of tuna fished from the world's oceans every fifteen minutes. Copyright Christopher Jordan Studio.

Library of Congress Control Number: 2016944972

Instructor Complimentary Copy:

ISBN-13: 978-1-4641-9314-9

ISBN-10: 1-4641-9314-2

Student Edition Paperback:

ISBN-13: 978-1-4641-9293-7

ISBN-10: 1-4641-9293-6

Student Edition Loose-leaf:

ISBN-13: 978-1-4641-9300-2

ISBN-10: 1-4641-9300-2

© 2017, 2014, 2009, 2006 by W. H. Freeman and Company

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Printed in the United States of America

First printing

W. H. Freeman and Company
One New York Plaza
Suite 4500
New York, NY 10004-1562
www.macmillanlearning.com

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TO THE TEACHER

Statistics as a Liberal Discipline

Statistics: Concepts and Controversies (SCC) is a book on statistics as a liberal discipline—that is, as part of the general education of “nonmathematical” students. The book grew out of one of the author’s experiences in developing and teaching a course for freshmen and sophomores from Purdue University’s School of Liberal Arts. We are pleased that other teachers have found *SCC* useful for unusually diverse audiences, extending as far as students of philosophy and medicine. This ninth edition is a revision of the text with several new features. It retains, however, the goals of the original: to present statistics not as a technical tool but as part of the intellectual culture that educated people share.

Statistics among the liberal arts

Statistics has a widespread reputation as the least liberal of subjects. When statistics is praised, it is most often for its usefulness. Health professionals need statistics to read accounts of medical research; managers need statistics because efficient crunching of numbers will find its way to the bottom line; citizens need statistics to understand opinion polls and government statistics such as the unemployment rate and the Consumer Price Index. Because data and chance are omnipresent, our propaganda line goes like this: everyone will find statistics useful, and perhaps even profitable.

This is true. We would even argue that for most students, the conceptual and verbal approach in *SCC* is better preparation for future encounters with statistical studies than the usual methods-oriented introduction. The joint curriculum committee of the American Statistical Association and the Mathematical Association of America recommends that any first course in statistics “emphasize the elements of statistical thinking” and feature “more data and concepts, fewer recipes and derivations.” *SCC* does this, with the flavor appropriate to a liberal education: more concepts, more thinking, only simple data, fewer recipes,

and no formal derivations.

There is, however, another justification for learning about statistical ideas: statistics belongs among the liberal arts. A liberal education emphasizes fundamental intellectual skills—that is, general methods of inquiry that apply in a wide variety of settings. The traditional liberal arts present such methods: literary and historical studies, the political and social analysis of human societies, the probing of nature by experimental science, the power of abstraction and deduction in mathematics. The case that statistics belongs among the liberal arts rests on the fact that reasoning from uncertain empirical data is a similarly general intellectual method. *Data* and *chance*, the topics of this book, are pervasive aspects of our experience. Though we employ the tools of mathematics to work with data and chance, the mathematics implements ideas that are not strictly mathematical. In fact, psychologists argue convincingly that mastering formal mathematics does little to improve our ability to reason effectively about data and chance in everyday life.

SCC is shaped, as far as the limitations of the authors and the intended readers allow, by the view that statistics is an independent and fundamental intellectual method. The focus is on statistical thinking, on what others might call *quantitative literacy* or *numeracy*.

The nature of this book

There are books on statistical theory and books on statistical methods. This is neither. It is a book on statistical ideas and statistical reasoning and on their relevance to public policy and to the human sciences from medicine to sociology. We have included many elementary graphical and numerical techniques to give flesh to the ideas and muscle to the reasoning. Students learn to think about data by working with data. We have not, however, allowed technique to dominate concepts. Our intention is to teach verbally rather than algebraically, to invite discussion and even argument rather than mere computation, though some computation remains essential. The coverage is considerably broader than one might traditionally cover in a one-term course, as the table of contents reveals. In the spirit of general education, we have preferred breadth to detail.

Despite its informal nature, *SCC* is a textbook. It is organized for systematic study and has abundant exercises, many of which ask students to offer a discussion or make a judgment. Even those admirable individuals who seek pleasure in uncompelled reading should look at the

exercises as well as the text. Teachers should be aware that the book is more serious than its low mathematical level suggests. The emphasis on ideas and reasoning asks more of the reader than many recipe-laden methods texts.

New in this edition

We welcome three new contributors to this edition of *SCC*. Professors Jackie Miller (University of Michigan), Leslie Hendrix (University of South Carolina), and Michelle Everson (The Ohio State University) assisted with [Chapters 3, 4, 8, 9, 10, 11, 13, 21, 22, 23](#), and [24](#). They bring a fresh perspective to *SCC* while being sensitive to the fundamental nature of the book.

This new version of a classic text fits the current teaching environment while continuing to present statistics to “nonmathematical” readers as an aid to clear thinking in personal and professional life. The following new features and enhancements build on *SCC*’s strong pedagogical foundation:

- **Content**
 - Several users have encouraged us to emphasize the use of technology for selecting an SRS rather than a table of random digits. Thus, in [Chapter 2](#), we first discuss selecting an SRS using technology. The subsequent discussion of selecting an SRS using a table of random digits is presented as an option for students who do not have access to technology.
 - We have added a web exercise to [Chapter 7](#) (Data Ethics) that raises the issue of experiments on animals.
 - We have added a section on big data in [Chapter 15](#). We discuss big data in the context of prediction and address the perception that big data, by virtue of being big, is free from pitfalls that plague traditional smaller data.
 - We have added an optional section on inference as decision in [Chapter 23](#). This includes a discussion of Type I and II errors. This material appeared in the first edition of *SCC* but was eliminated in subsequent editions. We restore that discussion here.
- **Check the Basics exercises.** Each chapter ends with a series of straightforward multiple-choice problems that test students’

understanding of basic concepts. If students have difficulty with these problems, we recommend they review the basic concepts in the chapter before tackling the chapter exercises.

- **LaunchPad Online Resources.** At the end of each chapter, we provide a list of resources available in LaunchPad that provide additional discussion of topics in the chapter.
- **Examples and exercises.** More than one-third of the examples and exercises are revised to reflect current data and a variety of topics. They cover a wide range of application areas, adding interest and relevance for students. New example and exercise topics include Facebook and grades, low-fat foods and obesity, and texting.
- **Design.** The contemporary design incorporates colorful figures to aid students' understanding of text material. Sleek marginal notes invite students to explore "Statistics in Your World." Exploring the Web exercises are labeled with a QR code icon, bringing students directly to the book's website for updated links and sources.

In addition to the new ninth edition enhancements, *SCC* has retained the successful pedagogical features from previous editions:



- **Applets.** An applet icon signals where related, interactive statistical applets can be found on the book's website.
- **Case Studies.** Beginning each chapter, Case Studies engage students in real-life scenarios related to the chapter concepts. The **Case Study Evaluated** section at the end of each chapter revisits the chapter-opening Case Study with follow-up questions, asking students to evaluate what they have learned from the chapter and to apply their knowledge to the Case Study.
- **Statistical Controversies.** These boxed features explore controversial topics and relate them to the chapter material. There is a follow-up discussion and a proposed resolution to each of these topics in the back of the text, in the Resolving the Controversy section.
- **Chapter summaries.** The Statistics in Summary sections at the end of each chapter consist of two sections. One, titled Chapter Specifics, summarizes the material presented in the chapter. The second section,

titled Link It, relates the chapter content to material in previous and upcoming chapters. The goal of this format is to help students understand how individual chapters relate to each other and to the overall practice of statistics.



- **In the News exercises.** From popular news media outlets, these exercises use current events and cite recent data sources.
- **Now It's Your Turn exercises.** These appear after a worked example, allowing students to test their understanding. Full solutions to these exercises are provided in the back of the text.



- **Exploring the Web exercises.** QR codes at the end of each chapter point students to these exercises, located on the book's website, that direct students to the web to investigate topics and think critically about statistical data and concepts.
- **Technology output screenshots.** Most statistical analyses rely heavily on statistical software. In this book, we specifically discuss the use of JMP 12 in some parts. Other software for conducting statistical analysis includes CrunchIt!, Minitab, SPSS, and a TI-83/-84 calculator. As specialized statistical packages, JMP, Minitab, and SPSS are the most popular software choices both in industry and in colleges and schools of business. As an all-purpose spreadsheet program, Excel provides a limited set of statistical analysis options in comparison. However, given its pervasiveness and wide acceptance in industry and the computer world at large, we believe it is important to give Excel proper attention. It should be noted that for users who want more statistical capabilities but want to work in an Excel environment, there are a number of commercially available add-on packages (if you have JMP, for instance, it can be invoked from within Excel). TI-83/-84 calculators are generally sufficient for an introductory course, although most statistical analysis is beyond the capabilities of even the best calculator, so those seeking to continue their learning of statistics should consider learning one of the

specialized statistical packages. Even though basic guidance for JMP is provided in parts of this book, it should be emphasized that *SCC* is not bound to any program. Computer output from statistical packages is very similar, so you can feel quite comfortable using any one of these packages.

Media and Supplements



LaunchPad, our online course space, combines an interactive e-Book with high-quality multimedia content and ready-made assessment options, including LearningCurve adaptive quizzing and coded machine-gradable exercises from the textbook. Content is easy to assign or adapt with your own material, such as readings, videos, quizzes, discussion groups, and more. LaunchPad also provides access to a Gradebook that offers a window into your students' performance—either individually or as a whole. Use LaunchPad on its own or integrate it with your school's learning management system so your class is always on the same page. To learn more about LaunchPad for *Statistics: Concepts and Controversies, Ninth Edition*, or to request access, go to launchpadworks.com.

Assets integrated into LaunchPad include:

Interactive e-Book. Every LaunchPad e-Book comes with powerful study tools for students, video and multimedia content, and easy customization for instructors. Students can search, highlight, and bookmark, making it easier to study and access key content. And teachers can ensure that their classes get just the book they want to deliver: they can customize and rearrange chapters; add and share notes and discussions; and link to quizzes, activities, and other resources.



LearningCurve provides students and instructors with powerful adaptive quizzing, a game-like format, direct links to the e-Book, and instant feedback. The quizzing system features questions tailored specifically to the text and adapts to students' responses, providing material at different difficulty levels and topics based on student performance.



JMP Student Edition (developed by SAS) is easy to learn and contains all the capabilities required for introductory statistics. JMP is the leading commercial data analysis software of choice for scientists, engineers, and analysts at companies throughout the world (for Windows and Mac). Register inside LaunchPad at no additional cost.

CRUNCH IT!

CrunchIt![®] is a Web-based statistical program that allows users to perform all the statistical operations and graphing needed for an introductory statistics course and more. It saves users time by automatically loading data from *Statistics: Concepts and Controversies*, Ninth Edition, and it provides the flexibility to edit and import additional data.

StatBoards Videos are brief whiteboard videos that illustrate difficult topics through additional examples, written and explained by a select group of statistics educators.

Stepped Tutorials are centered on algorithmically-generated quizzing with step-by-step feedback to help students work their way toward the correct solution. These exercise tutorials (two to three per chapter) are easily assignable and assessable.

Statistical Video Series consists of StatClips, StatClips Examples, and Statistically Speaking “Snapshots.” View animated lecture videos, whiteboard lessons, and documentary-style footage that illustrate key statistical concepts and help students visualize statistics in real-world scenarios.

Video Technology Manuals, available for TI-83/84 calculators, Minitab, Excel, JMP, SPSS, R, Rcmdr, and CrunchIt![®], provide brief instructions for using specific statistical software.

StatTutor Tutorials offer multimedia tutorials that explore important concepts and procedures in a presentation that combines video, audio, and interactive features. The newly revised format includes built-in, assignable assessments and a bright new interface.

Statistical Applets give students hands-on opportunities to familiarize themselves with important statistical concepts and procedures, in an interactive setting that allows them to manipulate variables and see the results graphically. Icons in the textbook indicate when an applet is available for the material being covered. Applets are assessable and assignable in LaunchPad.

Stats@Work Simulations put students in the role of the statistical consultant, helping them better understand statistics interactively within the context of real-life scenarios.

EESEE Case Studies (*Electronic Encyclopedia of Statistical Examples and Exercises*), developed by The Ohio State University Statistics Department, teach students to apply their statistical skills by exploring actual case studies using real data.



SolutionMaster offers an easy-to-use Web-based version of the instructor's solutions, allowing instructors to generate a solution file for any set of homework exercises.

Data files are available in JMP, ASCII, Excel, TI, Minitab, SPSS (an IBM Company) ^{*}, R, and CSV formats.

Lab and Activities Manual by Dennis Pearl, The Ohio State University. This manual provides a variety of projects and exercises to help students develop a fuller appreciation of statistical concepts. It features computer lab and hands-on activities illustrating key concepts in the text as well as additional end-of-chapter-type problems and activities. Additionally, there are exercises based on the statistical applets and EESEE Case Studies (both accessed through LaunchPad).

Instructor's Guide with Solutions includes teaching suggestions, chapter comments, and detailed solutions to all exercises and is available electronically in LaunchPad.

Test Bank offers hundreds of multiple-choice questions and is available in LaunchPad.

Lecture Slides offer a customizable, detailed lecture presentation of

statistical concepts covered in each chapter of *SCC*. **Image Slides** contain all textbook figures and tables. Lecture slides and images slides are available in LaunchPad.

Additional Resources Available with Statistics: *Concepts and Controversies*, Ninth Edition

Special Software Package A student version of JMP is available for packaging with the printed text. JMP is also available inside LaunchPad at no additional cost.



i-clicker is a two-way radio-frequency classroom response solution developed by educators for educators. Each step of i-clicker's development has been informed by teaching and learning.

Acknowledgments

A very special thank you to Jackie Miller, University of Michigan; Leslie Hendrix, University of South Carolina; and Michelle Everson, The Ohio State University for their invaluable contributions to this edition. Thanks also to Michelle Everson for carefully accuracy checking the book.

Thank you to the instructors who authored and accuracy reviewed supplements for the book: Michelle Duda at Columbus State Community College for authoring solutions and Karen Brady at Columbus State Community College for accuracy reviewing the solutions; Mark A. Gebert at University of Kentucky–Lexington for authoring the test bank and Soma Roy at California Polytechnic State University–San Luis Obispo for accuracy reviewing the test bank; and Leslie Hendrix for authoring the lecture slides and i-clicker slides.

The staff of W. H. Freeman, especially Karen Carson, Jorge Amaral, Catriona Kaplan, Victoria Garvey, Blake Logan, and Susan Wein, have done their usual excellent job in editing, designing, and producing the book. Special thanks also to Edward Dionne.

We are grateful to the many colleagues who commented on successive drafts of the manuscript for this edition (listed below). We are also grateful to those who reviewed previous editions (a full list is available at www.macmillanlearning.com/scc9e).

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