Statistics in Action

UNDERSTANDING A WORLD OF DATA

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About the Authors

Ann E. Watkins is Professor of Mathematics at California State University, Northridge. She received her Ph.D. in education from the University of California, Los Angeles. She is a former president of the Mathematical Association of America and a Fellow of the American Statistical Association. Dr. Watkins has served as co-editor of the *College Mathematics Journal*, as a member of the Board of Editors of the *American Mathematical Monthly*, and as Chair of the Advanced Placement Statistics Development Committee. She was selected as the 1994–1995 CSUN Outstanding Professor and won the 1997 CSUN Award for the Advancement of Teaching Effectiveness. Before moving to CSUN in 1990, she taught for the Los Angeles Unified School District and at Pierce College in Los Angeles. In addition to numerous journal articles, she is the co-author of books based on work produced by the Activity-Based Statistics Project (co-authored by Watkins and Scheaffer and now published by Key College Publishing), the Quantitative Literacy Project, and the Core-Plus Mathematics Project.

Richard L. Scheaffer is Professor Emeritus of Statistics at the University of Florida. He received his Ph.D. in statistics from Florida State University. He then joined the faculty of the University of Florida and served as chairman of the Department of Statistics for 12 years. Dr. Scheaffer's research interests are in the areas of sampling and applied probability, especially in their applications to industrial processes. He has published numerous papers and is co-author of four college-level textbooks. In recent years, much of his effort has been directed toward statistics education throughout the school and college curriculum. He was one of the developers of the Quantitative Literacy Project in the United States. As a developer on this project, Dr. Scheaffer helped form the basis of the data analysis emphasis in mathematics curriculum standards recommended by the National Council of Teachers of Mathematics. Dr. Scheaffer also directed the task force that developed the Advanced Placement Statistics Program and served as its first Chief Faculty Consultant. He continues to work on educational projects at the elementary, secondary, and college levels. Dr. Scheaffer is Fellow and past president of the American Statistical Association, from whom he received a Founders Award.

George W. Cobb is the Robert L. Rooke Professor of Statistics at Mt. Holyoke College, where he served a three-year term as Dean of Studies. He received his Ph.D. in statistics from Harvard University. In addition to his fundamental contributions to the emerging science of confectionery ballistics (the statistics of firing gummy bears from a launcher), he is an expert in statistics education with a significant publication record in this field. He chaired the joint committee on undergraduate statistics of the Mathematical Association of America and the American Statistical Association. He also led the STATS project of the Mathematical Association of America, which helped professors of mathematics learn to teach statistics. He is the author of *Introduction to Design and Analysis of Experiments,* published by Key College Publishing. Dr. Cobb served on the National Research Council's Committee on Applied and Theoretical Statistics. Over the past two decades, he has frequently served as an expert witness in lawsuits involving alleged employment discrimination. Dr. Cobb is a Fellow of the American Statistical Association.

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A Note to Students from the Authors

Whether you talk about income, prices of goods and services, sports, health, politics, or the weather, data enter the conversation. In fact, in this age of information technology, data come at you at such a rapid rate that you can catch only a glimpse of the masses of numbers. The only way to cope intelligently with this quantitative world and make informed decisions is to gain an understanding of the basic concepts of statistics and practice what you have learned with real data.

What's in This Book

This book is designed for an introductory statistics course—either an introductory college course or its high school equivalent, Advanced Placement Statistics—and includes all of the standard topics for that course. Beginning in Chapter 1 with a court case about age discrimination, you will be immersed in real problems that can be solved only with statistical methods. You will learn to

- explore, summarize, and display data
- design surveys and experiments
- use probability to understand random behavior
- make inferences about populations by looking at samples from those populations
- make inferences about the effect of treatments from designed experiments

How This Book Is Different

Statistical work is more active than it was a generation ago. Computers and graphing calculators have automated the graphical exploration of data, and in the process have made the practice of statistics a more visual enterprise. Statistical techniques are also changing as simulations allow statisticians (and you) to shift the emphasis from following recipes for calculations to paying more attention to statistical concepts. Your instructor has selected this book for you because he or she

- wants you to learn this modern, data-analytic approach to statistics
- encourages you to be an active participant in the classroom
- wants you to see real data (If you have only pretend data, you can only pretend to analyze it.)
- believes that statistical analyses must be tailored to the data
- uses graphing calculators or statistical software for data analysis and for simulations

Throughout this textbook you will see many graphical displays, lots of real data, activities that introduce each major topic, computer printouts, questions for you to discuss with your class, and practice problems so you can be sure you understand the basics before you move on. These features grow out of the vigorous changes that

have been reshaping the practice of statistics and the teaching of statistics over the last quarter century.

The most basic question to ask about any data set is, "Where did the data come from?" Good data for statistical analysis must come from a good plan for data collection. Thus, *Statistics in Action* gives an honest and thorough treatment to the design and analysis of both experiments and surveys.

What You Should Know Before You Start

You will be using this book in an introductory statistics course; thus, you aren't required to know anything yet about statistics. You may find that your perseverance in trying to understand what you read will contribute more to your success in statistics than your skill with algebra. However, basic topics from algebra, such as the equation for a line, slope, exponential equations, and the idea of a logarithm, will come up throughout the book. Be prepared to review those as you go along, if the need arises.

Acknowledgments

This book is a product of what we have learned from the statisticians and teachers who have been actively involved in helping the introductory statistics course evolve into one that emphasizes activity-based learning of statistical concepts while reflecting modern statistical practice. This book is written in the spirit of the recommendations from the MAA's STATS project and Focus Group on Statistics, the ASA's Quantitative Literacy projects, and the College Board's AP Statistics course. We hope that it adequately reflects the wisdom and experience of those with whom we have worked and who have inspired and taught us.

It has been an awesome experience to work with the Key Curriculum staff and field-test teachers, who always put the interests of students and teachers first. Their commitment to excellence has motivated us to do better than we ever could have done on our own. Steve, Casey, Mary Jo, Anna, Dudley, Bill, and the rest of the staff have been professional and astute throughout. Our deepest gratitude goes to Cindy Clements, our editor, who has been a joy to work with. (Not all authors say that—and mean it—about their editors.) Cindy was an outstanding statistics and calculus teacher before coming to Key. She brings an extraordinary intellectual curiosity and talent for teaching and for statistics to her current position. Her organizational skills, experience in the classroom, and insight have improved every chapter of this text.

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