



N E I L A . W E I S S

ELEMENTARY STATISTICS

F O U R T H E D I T I O N



Elementary Statistics

FOURTH EDITION

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 **ADDISON-WESLEY**

An imprint of Addison Wesley Longman, Inc.

Reading, Massachusetts • Menlo Park, California • New York • Harlow, England
Don Mills, Ontario • Sydney • Mexico City • Madrid • Amsterdam

Publisher: Greg Tobin
Sponsoring Editor: Jennifer Albanese
Editorial Assistant: Laura Potter
Project Manager: Jennifer Bagdigian
Production Supervisor: Karen Guardino
Text Designer: Cynthia Crampton
Design Supervisor: Barbara T. Atkinson
Cover Designer: Karen Rappaport
Illustrations: Scientific Illustrators, Inc.
Marketing Manager: Brenda Bravener
Marketing Coordinator: Melissa Perrelli
Prepress Buyer: Caroline Fell
Technical Art Consultant: Joseph Vetere
Print Buyer: Evelyn Beaton

Photo Credits: Florence Nightingale, page 56, courtesy of The Bettmann Archive. Adolphe Quetelet, page 123, Copyright Bibliothèque royale Albert I^{er}, Cabinet des Estampes, Bruxelles, J. Odevaëre. John Tukey, page 193, courtesy of John W. Tukey. Adrien Legendre, page 244, courtesy of The Bettmann Archive. Andrei Kolmogorov, page 327, courtesy of The Bettman Archive. Carl Friedrich Gauss, page 372, courtesy of The Bettmann Archive. Pierre-Simon Laplace, page 408, courtesy of The Bettmann Archive. William Gosset, page 454, courtesy of The Granger Collection, New York. Jerzy Neyman, page 528, courtesy of the Department of Statistics, University of California, Berkeley. Gertrude Cox, page 592, courtesy of Research Triangle Institute. Abraham de Moivre, page 638, courtesy of The Granger Collection, New York. Karl Pearson, page 687, courtesy of Brown Brothers. Sir Ronald Fisher, page 719, courtesy of The Bettmann Archive. Sir Francis Galton, page 774, courtesy of Stock Montage.

Library of Congress Cataloging-in-Publication Data

Weiss, N. A. (Neil A.)
Elementary statistics / Neil Weiss; biographies by Carol Weiss. - 4th ed.
p. cm.
Includes index.
ISBN 0-201-33834-3 (book)
ISBN 0-201-59878-7 (book/disk pkg.)
I. Statistics. I. Title.
QA276.12.W445 1999
519.5--dc21

98-20512
CIP

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Preface

Using and understanding statistics or statistical procedures have become required skills in virtually every profession and every academic discipline. The purpose of this book is to help students grasp basic statistical concepts and techniques, and to present real-life opportunities for applying them.

The text is intended for a one-quarter or one-semester course. Instructors can easily fit the text to the pace and depth they prefer. Introductory high-school algebra is a sufficient prerequisite.

New advances in technology and new insights into the practice of teaching statistics have inspired many of the changes in the Fourth Edition of *Elementary Statistics*, leading to more emphasis on conceptual understanding and less emphasis on computation. We have also worked hard to refine and improve the exercise sets, the clarity of the examples and explanations, and the real-world applications.

Highlights of the Approach

Several aspects of the approach used in the Fourth Edition give the text distinction and prominence among basic statistics books. Here are a few of those aspects:

ASA/MAA-guidelines compliant. We have followed ASA/MAA guidelines to stress the interpretation of statistical results, the contemporary applications of statistics, and the importance of critical thinking.

Data analysis and exploration. We agree wholeheartedly with the trend of including more exploratory and confirmatory data analysis in statistics courses and have incorporated an extensive amount into the text and exercises. Recognizing that not all readers will have access to computers, we have provided ample opportunity to analyze and explore data without the use of a computer.

Detailed and careful explanations. We have included every step of explanation we think a typical reader might need. Our guiding principle is to avoid cognitive jumps, making the learning process smooth and enjoyable. We believe detailed and careful explanations result in better understanding.

Emphasis on application. We have concentrated on the application of statistical techniques to the analysis of data. Although statistical theory has been kept to a minimum, we have provided a thorough explanation of the rationale for using each statistical procedure.

Real-world examples. Because we believe that the majority of students learn by example, every concept discussed in the book is illustrated by at least one detailed

example. The examples are, for the most part, based on real-life situations and have been chosen for their interest as well as for their illustrative value.

Real-world exercises. Most exercises in the book are based on information found in newspapers, magazines, statistical abstracts, and journal articles; sources are explicitly cited. The exercises are designed not only to help the reader learn the material but also to show that statistics is a lively and relevant discipline. Answers to selected exercises are included in Appendix B.

Technology. We have chosen Release 12 of Minitab® to illustrate the use of statistical software, but the text has been written so that the instructor is free to select other packages, such as SAS® or SPSS®. Additionally, Excel® and TI-83® manuals have been prepared to accompany the book. The examples and exercises have been carefully correlated to these technologies by using icons to represent

Minitab , Excel , and the TI-83 .

All computer and calculator material is *optional*, but recommended.

Minitab sections are integrated as optional subsections occurring immediately following the particular statistical concept under consideration. In each subsection we explain how Minitab can be used to solve problems that were solved by hand earlier in the section. Each solution consists of introducing the required menu instructions, displaying the computer output, and interpreting the results.

Most exercise sets contain a group of exercises using technology. Three types of technology exercises have been included.

1. The first type asks the reader to interpret computer printouts; no knowledge of or access to statistical software is necessary for these exercises.
2. The second type asks the reader to use Minitab or some other statistical software or calculator to solve exercises that were presented previously for hand solution. All basic Minitab instructions required for these technology exercises will have been covered in the text, with more detailed instructions contained in the *Minitab Manual*. Excel and TI-83 instructions are discussed in the *Excel Manual* and *TI-83 Manual*, respectively.
3. The third type asks the reader to use statistical software or a calculator to perform a simulation. These exercises are designed to provide concrete illustrations of some of the more complex concepts (e.g., sampling distributions) and to show the reader how a computer or statistical calculator can be used to reveal statistical facts.

New Content and Technology Support

Content changes have been made throughout the Fourth Edition and new ancillaries provide even greater technology support. Here are some highlights:

Early coverage of regression/correlation. The material on descriptive methods in regression and correlation has been moved to Chapter 4 to allow for early coverage. The placement is flexible; the chapter can also be postponed until later in the course. (See page 195.)

Option for brief probability coverage. The probability required for statistical inference, presented in Chapter 5, can now be covered in two or three class periods. Further probability is available at the instructor's option. (See page 247.)

One-way ANOVA. One-way analysis of variance, discussed in Chapter 13, is new to this edition. (See page 689.)

Optional linear models modules. Three new optional chapter-length modules that contain additional material on linear models are available for customizing your course. Contact your Addison Wesley Longman representative for details.

- *Multiple Regression Analysis*
- *Model Building in Regression*
- *Design of Experiments and Analysis of Variance*

Minitab for Windows® 95/NT™. We feature the Professional version of Minitab for Windows 95/NT, the latest version of Minitab for PCs. Aside from worksheet size, only minor differences exist between the Professional version and *The Student Edition of MINITAB for Windows 95/NT*. The Fourth Edition of *Elementary Statistics* and *The Student Edition of MINITAB for Windows 95/NT* are available packaged together at a special discount to students. Contact your Addison Wesley Longman representative for details.

TI-83® and Excel® support. The integration of technology has been expanded in the Fourth Edition to include support for using the TI-83 graphing calculator and Excel spreadsheet. Exercises and examples in the book are keyed to the *TI-83 Manual* and *Excel Manual*. We also continue to offer a dedicated *Minitab Manual*. The three icons



have been used throughout the book to denote technology integration supplemented by the manuals.

New Features

We've also made changes to improve how the book supports effective teaching and learning. Some of the most significant new features include:

All-new design. We have redesigned the text for improved readability.

Case studies. Each chapter begins with a classic or contemporary case study that highlights the real-world relevance of the material under consideration. At the

end of the chapter, the case study is reviewed and discussed in light of the chapter's major points and then problems are presented for the students to solve.

New concept and technology exercises. The exercise sets have been extensively updated and revised, including hundreds of new concept exercises and many new technology exercises. Each section exercise set is now divided into the following three categories:

- *Statistical Concepts and Skills.* These exercises help the students master the skills and concepts explicitly discussed in the section. (See page 134.)
- *Extending the Concepts and Skills.* These exercises invite the students to extend their skills by examining material not necessarily covered in the text. (See page 135.)
- *Using Technology.* These exercises provide the students with an opportunity to interpret and apply the computing and statistical capabilities of Minitab, Excel, and the TI-83 calculator to conduct data analyses and simulations. Three types of technology exercises have been included in most exercise sets: interpretation of computer output, use of Minitab or some other statistical software to solve exercises that were presented previously for hand solution, and use of statistical software to perform a simulation. (See page 137.)

Comprehensive end-of-chapter exercises. We have expanded the review tests at the end of each chapter to include concept questions, basic-skill problems, and exercises using technology. These provide a comprehensive collection of problems for reviewing the chapter. (See pages 632–635.) Answers to the review tests are given in Appendix B.

Internet projects with dedicated Web site. Each chapter now presents an Internet project. These projects, which are keyed to the text,

- engage the students in active and collaborative learning through simulations, demonstrations, and other activities as a supplement to the book,
- guide the students through applications using Internet links to access real data and other information provided by the vast resources of the World Wide Web.

The Internet projects (see page 54) can be completed individually or in a collaborative learning environment and are featured on our dedicated Web site. The URL for the Web site can be found on the back cover of the book.

DataDisk CD. This CD-ROM contains all data sets used in examples, exercises, and case studies. It also includes the *Focus Database*, a database that was obtained by randomly selecting 500 Arizona State University sophomores. Seven variables are considered for each student: sex, high-school GPA, SAT math score, cumulative GPA, SAT verbal score, age, and total hours completed. Compatible with PC and Macintosh, DataDisk CD is packaged with every copy of the book.

Minitab Quick Reference. For quick access and reference to the Minitab menu instructions discussed in this book, we have provided a Minitab Quick Reference (MQR) for Minitab for Windows 95/NT. Located inside the front cover of the book, the MQR includes the procedures, their menu instructions, and page-number references for more details.

Continuing Features

Following are some features of the Fourth Edition retained from previous editions.

Data sets. In most examples and exercises, we have presented raw data in addition to summary statistics. This gives a more realistic view of statistics and provides an opportunity for the problems to be solved by computer or statistical calculator, if so desired. Hundreds of new data sets have been included and most of those from previous editions have been updated.

Procedure boxes. To help the reader learn statistical procedures, we have developed easy-to-follow, step-by-step methods for carrying out those procedures. For ease in locating, each procedure is displayed with a color background. A unique feature of this book is that each step in the procedure is presented again within the example that illustrates the procedure. This serves a twofold purpose: it shows how the procedure is applied and helps the reader master the steps in the procedure.

Procedure index. Given the numerous statistical procedures, it is sometimes difficult to find a specific one, especially when the book is being used for reference purposes. Consequently, we have included a procedure index. Located inside the back cover of the book, the procedure index provides a quick and easy way to find the required procedure for performing any particular statistical analysis.

Computer simulations. We have incorporated many computer simulations in both the text and the exercises. These serve as pedagogical aids for understanding complex concepts such as sampling distributions. Readers can benefit from this material even if they do not have access to a computer.

General objectives and chapter outlines. Included at the beginning of each chapter is a general description of the chapter and an explanation of how the chapter relates to the text as a whole. As a further aid, a chapter outline lists the sections in the chapter.

Biographical sketches. Each chapter ends with a brief biography of a famous statistician. Besides being of general interest, these biographies help the reader obtain a perspective on how the science of statistics developed.

Chapter reviews. The end-of-chapter material begins with a chapter review. The review includes (1) chapter objectives, (2) a list of key terms with page references, and (3) a review test. These pedagogical aids provide the students with an organized method for reviewing and studying.

Database exercises. Following each chapter review, a section entitled “Using the Focus Database” asks the students to conduct various statistical analyses on the Focus Database, which is contained in the Focus folder of DataDisk CD. These exercises are optional and are to be done by computer.

Formula/Table card. A detachable formula/table card (FTC) is provided with the book. This card contains all of the formulas and many of the tables that appear in the text. The FTC is helpful for quick-reference purposes; many instructors also find it convenient for use with examinations.

Organization and Chapter-by-Chapter Changes

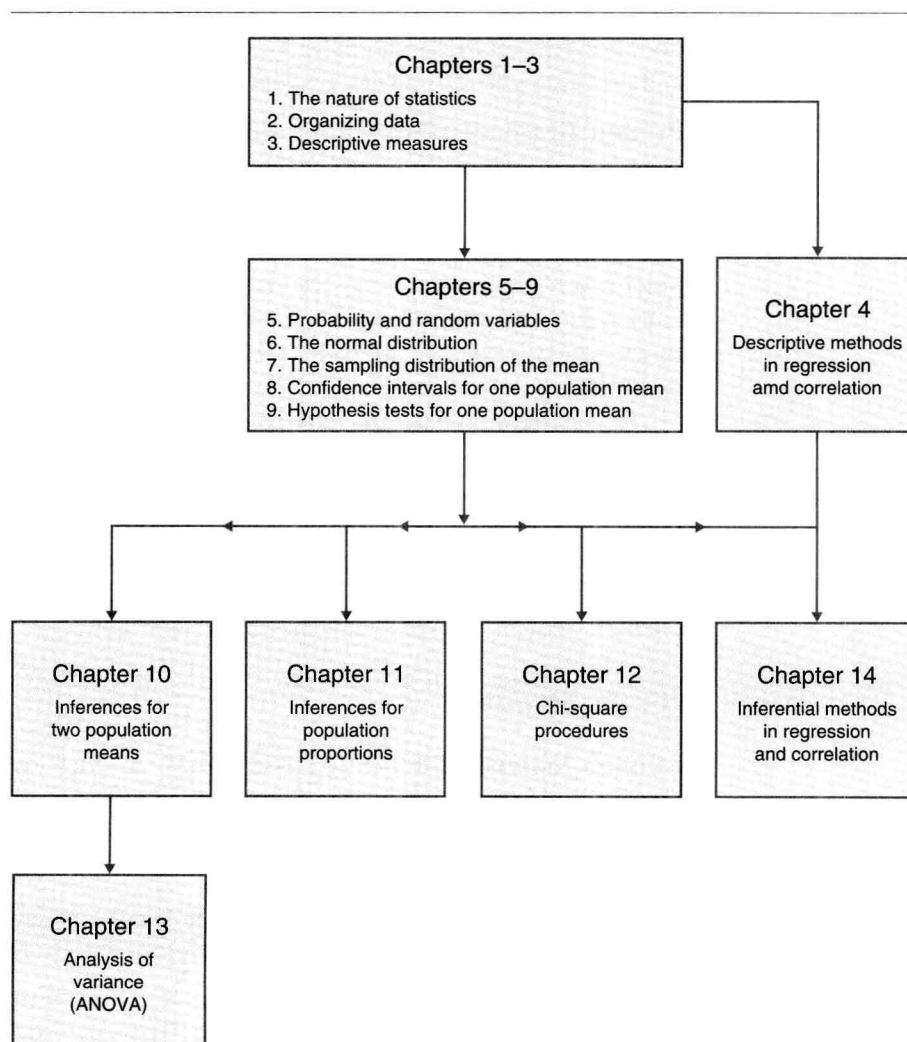
The text offers a great deal of flexibility in choosing material to cover.

- Chapter 1 presents the nature of statistics, sampling designs, and—new to this edition—an introduction to experimental design. (The new optional modular chapter *Design of Experiments and Analysis of Variance* provides a more comprehensive treatment.) Also new to Chapter 1 is a presentation of the basics of Minitab for Windows 95/NT needed for subsequent use of the software.
- Chapters 2 and 3 provide the fundamentals of descriptive statistics. The discussion of descriptive measures is now more concise for quicker coverage.
- Chapter 4 now gives an early treatment of regression and correlation, relying on intuitive and graphical presentation of important concepts. Chapter 5 examines probability and optional material on discrete random variables; in this edition only the first three sections of Chapter 5 are prerequisite to coverage of inferential statistics.
- In Chapter 6 we provide a concise discussion of the normal distribution. Chapter 7 introduces the concept of sampling distributions and presents an improved and simplified introduction to the sampling distribution of the mean.
- Chapters 8 and 9 now give an easily accessible introduction to confidence intervals and hypothesis tests for one population mean by using the terminology of variables and avoiding formal probability. We consider Chapters 1–9 the core of an elementary statistics course.
- Chapter 10 presents inferences for two population means and now contains a detailed discussion of the meaning of independent samples, including graphics for quick assimilation. In Chapter 11 we discuss inferences for one and two population proportions.
- New to Chapter 12, which examines the chi-square goodness-of-fit test and the chi-square independence test, is a section on grouping bivariate data into contingency tables and an improved presentation of association.
- Chapter 13 is new to this edition. It presents one-way analysis-of-variance (ANOVA) by using the language of variables to simplify and unify assumptions. Other types of ANOVA, including two-way ANOVA and randomized

block design, are discussed in the optional module *Design of Experiments and Analysis of Variance*.

- Chapter 14 examines inferential methods in regression and correlation. Multiple regression and model building are now covered in the optional modular chapters *Multiple Regression Analysis* and *Model Building in Regression*, which also include topics such as transformations and polynomial models.

The flowchart below summarizes the preceding discussion and shows the interdependence among chapters. In the flowchart, the prerequisites for a given chapter consist of all chapters having a path leading to that chapter.



Supplements and Other Support

The following supplements have been prepared to accompany the Fourth Edition of *Elementary Statistics*.

For the Instructor

Instructor's Solutions Manual (ISBN 0-201-59892-2). This supplement, by David Lund of the University of Wisconsin at Eau Claire, contains detailed, worked-out solutions to all section exercises, review-test problems, Focus Database exercises, and case studies in the text.

PowerPoint Presentation Slides CD (ISBN 0-201-88323-6). New to this edition, PowerPoint Presentation Slides CD contains many of the text's figures, tables, and procedure boxes and are available to aid in classroom instruction.

Printed Test Bank (ISBN 0-201-88325-2). This supplement provides several printed examinations for each chapter of the text.

TestGen-EQ with QuizMaster. Available for Windows (ISBN 0-201-39864-8) and Macintosh (ISBN 0-201-39865-5) operating systems, TestGen-EQ is a computerized test generator with algorithmically defined problems organized specifically for the Fourth Edition. The user-friendly graphical interface enables instructors to select, view, edit, and add test items, and then print tests in a variety of fonts and forms.

Seven question types are available; search and sort features allow the instructor to quickly locate questions and arrange them in a preferred order. The built-in question editor gives the user the power to create graphs, import graphics, insert mathematical symbols, templates, and variable numbers or text. Instructors can also create practice tests for posting to a Web site by using the "Export to HTML" feature. Tests created with TestGen-EQ can be used with QuizMaster-EQ, which enables students to take exams on a computer network.

For the Student

Minitab Manual (ISBN 0-201-88324-4). Written by Peter W. Zehna of the Naval Postgraduate School, the *Minitab Manual* is keyed to the book and provides detailed Minitab instructions to complement those given in the book.

TI-83 Manual (ISBN 0-201-39863-X). This new step-by-step guide, written by Ellen Fischer of Georgia Southern University, presents instructions for using the TI-83 calculator to solve selected examples and exercises found in the book.

Excel Manual (ISBN 0-201-43449-0). Correlated to exercises and examples in the book, this new manual by Peter W. Zehna provides step-by-step instruction in Excel.

Student's Solutions Manual (ISBN 0-201-43714-7). Also prepared by David Lund, this manual includes detailed solutions to all odd-numbered section exercises and all review-test problems in the text.

DataDisk CD. Included with every copy of the book, DataDisk is now on CD-ROM, compatible for the PC and Macintosh. This disk contains text (ASCII) files for the Focus Database and data sets appearing in all the exercises, examples, and case studies. It also contains the Minitab macros discussed and applied in the text. The convenience of the CD-ROM allows for easy storage, analysis, and access to these data sets without having to enter them manually.

The Student Edition of MINITAB® for Windows® 95/NT™. This release of the *Student Edition*, Release 12 for Windows 95/NT (ISBN 0-201-39715-3), allows for 5000 data points. It has improved graphing capabilities and has increased its functionality to include multiple regression and more. Also provided with the software are data sets drawn from business, the social sciences, and the physical sciences. In addition to the software, case studies and 16 tutorial sessions are featured in a tutorial manual written by John McKenzie of Babson College with Robert Goldman of Simmons College.

Modular Chapters. Three optional modular chapters written by Dennis Young of Arizona State University can be custom bound into the text or purchased separately. Modules include *Multiple Regression Analysis* (ISBN 0-201-43710-4), *Model Building in Regression* (ISBN 0-201-43711-2), and *Design of Experiments and Analysis of Variance* (ISBN 0-201-43715-5).

Web site and Internet Projects. The Web site supporting the Fourth Edition of *Elementary Statistics* includes downloadable practice tests, data sets, and formula/table card. It also provides access to the Internet projects, prepared by Tim Arnold of SAS Institute, Inc. The URL can be found on the back cover of the book.

ActivStats™ 2.0 (ISBN 0-201-31068-6). Developed by Paul Velleman and Data Description, Inc., *ActivStats 2.0* presents a complete introductory statistics course on CD-ROM using a full range of multimedia. Integrating video, simulation, animation, narration, text, interactive experiments, World Wide Web access, and Data Desk, a fully functioning statistics package, this product brings each student into a rich learning environment. Also included are exercises for reinforcement of key concepts, an index, and a glossary. *ActivStats 2.0* is PC and Macintosh compatible.

Acknowledgments

It is our pleasure to thank the following reviewers, whose comments and suggestions resulted in significant improvements to this edition.

Beth Chance
University of the Pacific
Carol DeVille
Louisiana Tech University
Dennis M. O'Brien
University of Wisconsin, La Crosse
Dwight M. Olson
John Carroll University
Steven E. Rigdon
Southern Illinois University,
Edwardsville

George W. Schultz
St. Petersburg Jr. College
Cid Srinivasan
University of Kentucky, Lexington
W. Ed Stephens
McNeese State University
Kathy Taylor
Clackamas Community College

We would also like to thank the following reviewers who provided comments and suggestions for previous editions of *Elementary Statistics*:

Scott Balcomb
St. Joseph's College
David Lund
University of Wisconsin, Eau Claire
Donald Mason
Elmhurst College
Theodore Moore
Mohawk Valley Community College

Reed Parr
Salt Lake Community College
Bryan Stewart
Tarrant County Junior College
Lav Vrdoljak
Barry University
Ruth Yaras
Metropolitan State College of Denver

Our thanks as well to Professor Michael Driscoll for his help in selecting the statisticians for the biographical sketches; and Professors Charles Kaufman, Sharon Lohr, Kathy Prewitt, Walter Reid, and Bill Steed with whom we have had several illuminating discussions. Thanks also to Professors Matthew Hassett and Ronald Jacobowitz for their many helpful comments and suggestions.

To Professor Larry Griffey, we express our appreciation for his formula/table card. We are grateful to Professor Peter Zehna for preparing the *Minitab Manual* and *Excel Manual* and to Professor Ellen Fischer for the *TI-83 Manual*. Our thanks go as well to Dean David Lund for writing the *Instructor's Solutions Manual* and *Student's Solutions Manual*. Many thanks to Professor Dennis Young for his linear models modules and to Tim Arnold for his Internet projects. In addition, we extend our appreciation to Phyllis Barnidge and Joe Fred Gonzalez, Jr., for providing the answers to the exercises that appear in the back of the book.

We are grateful to Dr. William Feldman and Mr. Frank Crosswhite for supplying the data from their study on the Golden Torch Cactus; to Professor Thomas A. Ryan, Jr., for his correspondence concerning the correlation test for normality; and

to Dr. George McManus and Mr. Gregory Weiss for supplying the data from their study of zooplankton nutrition in the Gulf of Mexico.

We also extend our appreciation to Professor John Tukey for taking the time to provide us with autobiographical information and a photo of himself; to Alison Stern-Dunyak of the American Statistical Association for supplying biographical information on Gertrude Cox; to Maureen Quinn of The Gallup Organization for providing the information used in the case study of Chapter 12; and to all the people at Minitab for their excellent Author Assistance Program and technical support. Our appreciation also goes to Howard Blaut and Rick Hanna for providing data on real estate; to Jeffrey Jirele for supplying data on automobile insurance; and to Mary Neary for furnishing the Focus database.

Many thanks to our text designer Cynthia Crampton for an outstanding design. We are also grateful to our fine proofreaders Trent Buskirk, Jenny Bagdigian, Elka Block, and Gregory Weiss. Our appreciation goes as well to our macro writer Don DeLand, to Berthold Horn and Louis Vosloo at Y&Y, Inc., and to George and Brian Morris of Scientific Illustrators.

Without the help of many people at Addison Wesley Longman, this book and its numerous ancillaries would not have been possible; to all of them go our heartfelt thanks. We would, however, like to give special thanks to the following people at Addison Wesley Longman: Greg Tobin, Jennifer Albanese, Brenda Bravener, Karen Guardino, Jenny Bagdigian, Kim Ellwood, Laura Potter, Melissa Perrelli, Caroline Fell, Joseph Vetere, Barbara Atkinson, Karen Scott, and Alex Levering.

Finally, we would like to express our appreciation to Carol Weiss. Apart from writing the text, she was involved in every aspect of development and production. Moreover, Carol researched and wrote the biographies and took on the task of typesetter using the \TeX typesetting system.

Tempe, Arizona

N.A.W.

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