APPLIED STATISTICS

FOURTH EDITION

NETER WASSERMAN WHITMORE

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Applied Statistics

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To Dottie, Cathy, and Lonnie

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Preface

To Our Readers:

Applied Statistics, Fourth Edition, is written for students in basic statistics courses in business, economics, and other social sciences, as well as for people already engaged in these fields who desire an introduction to statistical methods and their application. Our aim is to offer you a balanced presentation of fundamental statistical concepts and methods, along with practical advice on their effective application to real-world problems. The conceptual foundation of each subject is developed carefully up to that level needed for prudent and beneficial use of statistical methods in practice.

Features of Applied Statistics

Clear Explanations. The book is written so that the explanations of important principles and concepts are clear and always contain illustrations by one or more examples drawn from real life. In addition, many case applications are presented so that you can understand statistical concepts and methods in the context of actual use.

Broad Coverage. The topical coverage of the text is broad, but it is in no sense a miscellany of statistical tools. Topics have been selected on the basis of two criteria: (1) their importance in actual applications of statistics, and (2) their contribution to the development and understanding of material presented subsequently in the book.

Clear Structure. Units, chapters, and sections have been organized and sequenced in a way that always keeps the main track of the subject clear to you. Technical notes and secondary observations are presented in *Comments* sections. Topics that are not essential to the main development of statistical ideas are presented in *Optional Topic* sections at the ends of chapters and can be omitted without loss of continuity. Important definitions and formulas are set out in a distinctive manner to aid you in learning and to facilitate ready reference.

Wide Use of Computer Output and Plots. Statistical packages play a major supporting role in applications of statistics and will be encountered by everyone, not just by statistical specialists. We have therefore integrated statistical computer output and plots into the text presentation in every subject area in a routine and natural manner, employing them just as they would be used in practice.

No Advanced Mathematics. We believe that fundamental statistical ideas can be conveyed with only a modest use of mathematics and that this approach in an introductory text leads to a fuller appreciation of statistics than a more mathematical approach. Use of this

book therefore requires only knowledge of college-entrance algebra but not calculus. Mathematical demonstrations are included where they make a significant contribution to your understanding of the subject, but all such demonstrations are segregated so that they do not interfere with the main presentation. Occasionally, a mathematical demonstration that requires calculus is presented in an optional section. These sections are marked "calculus needed" and may be omitted without loss of continuity.

Numerous Problems, Exercises, and Studies. Large numbers of questions and problems are given at the ends of chapters to assist your understanding of concepts and to enable you to obtain experience in applying statistical techniques in practical situations and in interpreting results of statistical investigations. The *Problems* sections contain basic problems and drill questions. The *Exercises* sections present questions dealing with more technical concepts, as well as extensions of ideas developed in the chapters. Finally the *Studies* sections contain major comprehensive problems and case studies. Numerical answers for selected problems (identified by an asterisk in the margin) are given at the end of the book to facilitate immediate checking by you.

A computer will facilitate the working out of many of the problems, exercises, and studies. Those problems for which use of a computer is essential are marked by the logo of a computer. Most of the larger data sets in problems, tables, and figures are contained in files on a computer disk that is available with the text. These data sets are identified by the logo of a floppy disk when first introduced in problems, tables, and figures.

Student Supplements

The following student supplements, specifically keyed to the Fourth Edition of *Applied Statistics,* are available to you.

1. *Study Guide* (prepared by William Sanders, Clarion University). The *Study Guide* is a self-learning study manual to help you in understanding the concepts and techniques presented in the text. It incorporates principles of programmed learning so that correct understanding is immediately reinforced as you work through self-contained units at your own speed. The *Study Guide* emphasizes understanding and calculations are kept to a minimum. Full verbal answers and step-by-step numerical answers are given to enable you to better understand concepts and techniques and to identify causes of any mistakes. The *Study Guide* also contains detailed answers for the starred problems in the the text.

2. *Software Workbooks for Statistical Packages.* Software workbooks have been prepared for the Minitab and MYSTAT statistical software systems for use with this text. Each manual introduces you to the software and assists you in using the system for statistical computations and analysis with this text. The two manuals are:

   Minitab for ***Applied Statistics*** (prepared by Warren Dixon, State University of New York at Plattsburg)

   Business MYSTAT with QCTOOLS for ***Applied Statistics*** (prepared by Kaye A. de Ruiz, Air Force Academy)

Appendix E of this textbook contains a brief technical manual for Business MYSTAT and QCTOOLS that is a handy reference for these systems.

3. *Data Disk.* Each software workbook contains a data disk for your use. Files of the larger data sets in the tables, figures, and problems, as well as the four large data sets in Appendix D, have been assembled in ASCII format on the disk. You can import these data files readily into Minitab, MYSTAT, and most other statistical packages.

A Final Word

You are about to embark on a journey that will show you how statistical thinking plays an important role in everyday life and how statistical concepts and methods are used in business, economics, and the other social sciences. Read the Introduction first and see how the CEO Compensation case and the Space Shuttle Challenger case illustrate the importance of statistical thinking. Then proceed into the chapters that follow. We are confident that you will enjoy and benefit from the journey.

Acknowledgments

We are greatly indebted to many individuals and organizations who have helped us in the preparation of this book. Our sincere thanks go to all who have provided us with case materials and illustrations that demonstrate the usefulness of statistical methods in business, economics, and the other social sciences. Many persons, including colleagues and reviewers, have made helpful suggestions and otherwise assisted us in this and previous editions, for which we are most grateful. We particularly wish to thank for their help Robert F. Berner, Murray J. Cote, R. V. Erickson, John E. Floyd, Diwakar Gupta, Derek Hart, Edgar Hickman, Shu-Ping Hodgson, Burt S. Holland, Oswald Honkalehto, H. K. Hsieh, Allan Humphrey, Raj Jaganathan, William Meeker, Robert Norland, Jr., Eddy Patuwo, Thomas Pray, Thomas Rothrock, Barbara Rufle, J. Michael Ryan, Al Schainblatt, Kenneth C. Schneider, Randolph Shen, Brian Smith, Ehsan S. Soofi, Erland Sorensen, Albert Teitlebaum, Stephen Vardeman, Dean Wichern, and Morty Yalovsky.

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