Fundamentals of Social Statistics

Third Edition

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PREFACE

This book represents the collective wisdom of nearly a thousand statistics students whom I have taught. Much like myself when I was an undergraduate, students appreciate engaging, relevant, and concrete examples of statistics that are placed into a meaningful context. Their ability to learn is frequently hampered by computational steps that are omitted, the lack of clear definitions of new concepts, and the failure to include relevant presentations or the logic behind the techniques they are learning. My first encounter with statistics left me confused and floundering. I was unable to express the "faults" I found in the assigned text. This led me to write a text that students could more easily understand.

Students *can* learn statistics and have a satisfying experience at the same time, provided the material is presented appropriately. My students and I have worked hard to see that you will engage in some real problem solving, and not be asked to manipulate numbers within a meaningless context. A primary reason for writing this book was to create a text that is not a burden for students to use, one that could be appreciated even by those students who initially feared statistics. I believe that you will find this text to be very clear and useful.

Student and faculty response to the first and second editions of this textbook has been very satisfying. *Fundamentals of Social Statistics,* is widely used in social and behavioral science departments in the United States and in several English-speaking countries throughout the world. The publication of the third edition of a textbook is a great source of satisfaction to an author. In 1982, I was asked to rewrite Richard P. Runyon and Audrey Haber's best-selling behavioral science textbook, *Fundamentals of Behavioral Statistics;* I never dreamed that 15 years later I would be completing a third edition. I have sought to develop a text that meets the specific needs of those in sociology and in the related fields of criminology, family and urban studies, political science, and social welfare.

The current edition features a broader emphasis on the interpretation of data than the previous editions. The book now incorporates computer analysis from the Statistical Package for the Social Sciences (SPSS) along with a complete explanation of the interpretation and application of data. Case Examples are prominently displayed throughout the text. These examples are excerpted from a rich and varied selection of contemporary research in the social sciences and cover topics such as HIV/AIDS, health, gender, race, welfare, and crime. Statistics are presented as part of the real world, not as figures in a vacuum. The examples and raw data are presented and analyzed using the statistical techniques featured in that particular chapter. The Case Examples bring cohesion to statistical topics that often are perceived as separate and discrete.

Statistics in Action presents recently published material or research, including design, research goals, and raw data. The boxed examples first demonstrate statistical analysis at a level appropriate to student understanding at that point in the book, then offer additional data for analysis followed by solutions. The same studies are often

repeated later in the text with more advance analyses, so students can observe the continuity and connectedness of statistical analysis.

The chapters on contingency tables, probability, and regression have undergone considerable revision; regression now includes a discussion on regression to the mean. The treatment of analysis of variance includes a more complete discussion of the *F*-test, and new sections dealing with hypothesis testing have been added to Chapters 13 and 14. Throughout the book, the examples have been updated and most exercises address current social issues, which provide students with meaningful, real-life knowledge. You also will find that the presentation of complex concepts has been clarified and simplified.

Features of the Book

A number of important features are included in this text. Key terms appear in boldface while terms that require emphasis are in italics. Visual devices—charts, figures, and graphs—help ensure maximum understanding by the student. New equations are discussed fully rather than applied mechanically, and ample examples of equations are provided initially to ensure comprehension.

Each chapter begins with an outline of the contents to provide the student with an overview of the material; each chapter ends with a glossary of key terms and summary. A completely updated student workbook has been designed by Philip Luck to provide a review and feedback for the student. The workbook incorporates study objectives for each chapter; a programmed review of terms, symbols, and concepts; selected computational exercises for application purposes; and sample test questions.

The Appendixes include a review of basic mathematics, a glossary of symbols keyed to the first page on which the symbols appear, a complete set of tables accompanied by explicit directions for their use, a master glossary of key terms and references. Other features of the book are a simplified chronological listing of equations most frequently used (inside the front and back covers), and a comprehensive index.

Acknowledgments

I owe a debt of gratitude to the many students who have participated in the revision of this edition and to the many colleagues who have contributed in ways that will always be appreciated.

Several persons at McGraw-Hill were particularly helpful in supporting me throughout this revision. Philip Butcher and Jill Gordon both encouraged and supported me as sponsoring editors at different phases of the project. Along with Amy Smeltzley, they kept me forging ahead while offering guidance when it was needed. Christina Thornton-Villagomez served as project manager who together with Charles Olson masterfully copyedited the third edition.

Charles Janet of Georgia State University provided a comprehensive review of earlier drafts. His assistance was invaluable and his keen eye and insight are much

appreciated. Several other reviewers read all or part of the manuscript and offered important suggestions: Glenn Deane, State University of New York, Albany; Robin Franck, Southwestern College; Duane R. Monette, Northern Michigan University; and J. D. Robson, University of Arkansas at Little Rock. Thanks also must go to Dawn Baunach of Georgia State University and Edward Bell of Brescia College for their welcome suggestions.

Finally, my daughters Kristin and Shelley have been influential from the first edition to the present. My greatest supporters were undoubtedly Mam, Pap, and Andy Sheldon. Most important, Claire Sterk got me started, kept me going, and was with me as a pal and scholar from beginning to end.

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PART I

Introduction

CHAPTER 1

The Definition of Statistical Analysis

1.1 WHAT IS STATISTICS?

Think for a moment of the thousands of incredibly complex things you do during the course of a day. You are absolutely unique. No one else possesses your physical features, your intellectual makeup, your personality characteristics, and your value system. Yet, like billions of others of your species, you are among the most finely tuned and enormously sophisticated statistical instruments ever devised by natural forces. Every moment of your life provides testimony to your ability to receive and process a variety of information and then to use this information instantly to determine possible courses of action.

To illustrate, imagine you are driving in heavy traffic. You are continuously observing the road conditions, noting the speed of cars in front of you compared to your own speed, the position and rate of approach of vehicles to your rear, and the presence of automobiles in the oncoming lane. If you are an alert driver, you are constantly summarizing this information—usually without words or even awareness.

Imagine next that, without warning, the driver of the car in front of you suddenly jams on the brakes. In an instant you must act upon this prior information. You must brake the car, turn left, turn right, or pray. Your brain instantly considers alternative courses of action: If you jam on the brakes, what is the possibility that you will stop in time? Is the car behind you far enough away to avoid a rear-end collision? Can you

avoid an accident by turning into the left lane or onto the right shoulder? Most of the time your decision is correct. Consequently, most of us live to a ripe old age.

In this situation, as in many others during the course of a lifetime, you have accurately assessed the possibilities and taken the right course of action. And you make such decisions thousands of times each and every day of your life. For this reason, you should regard yourself as a mechanism for making statistical decisions. In this sense you are already a statistician.

In daily living, our statistical functioning is usually informal and loosely structured. Consider the times you have contemplated the *likelihood* of someone you are attracted to, but do not know well, rejecting your invitation to have lunch. We *behave* statistically, although we may be totally unaware of the formal laws of probability, which will be presented in Chapter 12.

In this course, we will attempt to provide you with some of the procedures for collecting and analyzing data, and making decisions or inferences based on these analyses. Since we will frequently be building upon your prior experiences, you will often feel that you have made a similar analysis before: "Why, I have been calculating averages almost all my life—whenever I determine my test average in a course or the mileage my car gets," and "I compute range whenever I figure how much my time varies on my favorite two-mile jog." If you constantly draw upon your previous knowledge and relate course materials to what is familiar in daily life, statistics need not, and should not, be the bugaboo it is often painted to be.

What, then, is statistics all about? To many people, statistics is merely a collection of numerical facts that are expressed in terms of a summarizing statement such as: "Seven out of 10 doctors prescribe the pain reliever that is contained in Product X," or "During his current hitting streak, Ken Griffey, Jr., hit safely in 20 of his last 45 times at bat," or "During the Fourth of July weekend, 1986, more than 6 million New Yorkers and visitors participated in the centennial celebration of the unveiling of the Statue of Liberty."

However, this is not the way statistics is defined by scientists. Rather, **statistics** is a method for dealing with data and involves the organization and analysis of numerical facts or observations that are collected in accordance with a systematic plan. The plan for collecting data is called the **research design.** Broadly speaking, the design of a particular study is structured to provide answers to specific questions.

The material presented in Box 1.1 allows us to answer the following questions: Are smaller percentages of American children living in traditional families today than in the past? What percent of all children now live in traditional families? Is there a difference by race of the child? Ask yourself, are any trends apparent from reviewing the data? What might be some possible explanations for the trends and racial differences that are evident in Box 1.1?

A distinction may be made between the two functions of the statistical method: descriptive statistical techniques and inferential or inductive statistical techniques.

The major purpose of **descriptive statistics** is to present information in a convenient, usable, and understandable form. The statistical information presented in Figure 1.1 and the text of Box 1.1 are examples of statistics used for descriptive purposes. **Inferential or inductive statistics,** on the other hand, is concerned with making inferences about populations that are based on samples taken from those populations.