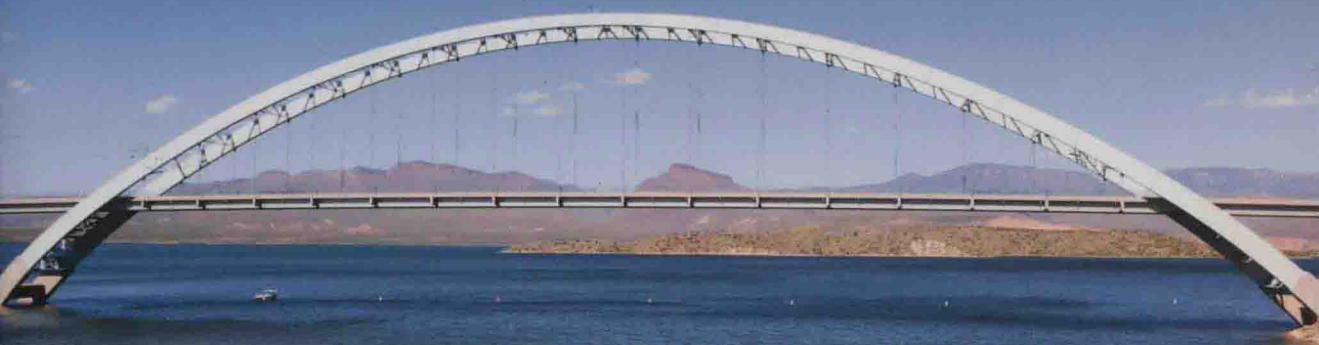
INTRODUCTION TO Statistics

Fundamental Concepts and Procedures of Data Analysis



Howard M. Reid

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INTRODUCTION TO STATISTICS

This book is dedicated to the memory of my father, Malcolm, and my brother, Robert. Both were outgoing, inquisitive, supportive, energetic, intelligent, and hardworking. They were devoted to their families, and each embraced life to the fullest. Tragically, each died much too young. They are greatly missed. And the book is dedicated to my mother, Jeannette, whose love, support, and kindness are a blessing to all who know her.

ABOUT THE AUTHOR

Howard M. Reid is a professor at State University of New York, Buffalo State. He received his doctorate in experimental psychology from the University of Maine and followed it by postdoctoral study in behavior genetics at The Jackson Laboratory. He is currently conducting studies examining perception of art, is directing a variety of undergraduate student research projects, and is chairing the College senate. He has been an active researcher with broad interests, including published work in operant analysis of behavior, animal models of epilepsy, links between ADHD (attention-deficit/hyperactivity disorder) and laterality, as well as construction of a scale measuring student appreciation of the liberal arts. He has also directed numerous undergraduate research projects. He is the recipient of a number of prestigious awards, including the SUNY Chancellor's Awards in Teaching and Faculty Service and the BSC President's Award for Excellence as an Undergraduate Research Mentor.

PREFACE

There are many fine introductory statistics books that have been written for undergraduate students. Yet these students often continue to view statistics courses negatively, and many fear they will be unable to master the basic level of understanding that is essential to progress in their majors. The present text is an attempt to rethink what students need to learn in an introductory statistics course and how best to organize the presentation of this material to assist them in acquiring the competence necessary to succeed in their chosen field of study.

Every book is written from some perspective. This book is written from the perspective that a first course in applied statistics is an introduction to a form of critical thinking as much as it is an introduction to a mathematically based discipline. And this book emphasizes what a student will need to remember in future semesters, even years, rather than focusing on a cursory introduction to numerous techniques, many of which will soon be forgotten. Finally, this book is designed to provide a foundation on which students can build as they take further statistics or methodology courses.

As a consequence, while this book covers many of the same topics as in other texts, the presentation, and in some cases the content, differs in significant ways. First, the text is organized to assist students in understanding the logic of statistical procedures and how they are related to each other. And the material is presented so that students gain confidence in their ability to master this subject. Simple concepts and procedures are presented before difficult ones, and concepts build so that by the end of the book readers have gained a clear comprehension of the goals, basic techniques, and the limitations of statistical analysis. Second, an aim of the text is to have the reader not only be exposed to fundamental concepts such as variability but also come to appreciate that these concepts re-occur in a variety of contexts. Repetition and an emphasis on the use of definitional equations enhance students' gaining a deeper understanding. For instance, the reader repeatedly sees that statistical measures of variability are based on deviations, something that can be lost when computational equations are used. Of course, researchers don't commonly employ definitional equations in statistical calculations. (They no longer turn to computational equations either.) Instead, they turn to statistical packages to conduct analyses of their data. Accordingly, a third major thrust is that this text emphasizes the mastery of SPSS through the use of step-by-step directions and numerous figures, all integrated into the chapters. As a result, students see how mastery of SPSS complements their

learning of statistical procedures. Fourth, a concerted effort has been made to integrate the study of statistics with numerous disciplines as well as by including brief historical sections and incorporating relevant quotations. While it is unlikely that every example will resonate with every reader, the goal is to present statistics in a manner that appeals to students coming to the course with diverse backgrounds and interests.

The result is, I believe, a text that will assist students in being able to understand the proper uses, and limitations, of a set of commonly employed statistical procedures. By incorporating progress checks, lists of assumptions, consequences of violating the assumptions, and referral to an overview table of statistical procedures (Appendix K), I have found that my students are better able to match the correct procedure with a research design. This is often a difficult challenge for students. Consequently, one of the goals while writing this text was to present the material in such a way that students would be better able to correctly identify the appropriate procedure to use, not just be able to calculate an answer when told what test to employ.

The book's organization differs significantly from what is commonly seen in other introductory statistics texts. Instead of the almost universal order of presentation which relegates nonparametric tests, seemingly as an afterthought, to a final chapter, the current book is organized so that the procedures that employ nominal data, and which are also the easiest for students to calculate, are presented before the procedures that employ ordinal or interval and ratio data. The resulting presentation is, by design, somewhat repetitious, but it allows for positive transfer among the commonly used procedures that are reviewed. For instance, important statistical concepts, including significance, effect size, and use of post hoc tests, are introduced with the review of the chi-square test of independence. Students see these concepts again when the procedures that employ interval and ratio data are discussed. The goal is for students to experience important concepts repeatedly and to understand how the different statistical procedures are related.

A final note for instructors:

I am fully aware that this book presents a different approach to teaching introductory statistics. And a new approach can be challenging, particularly for those of us who have always viewed the discipline of statistics from a particular perspective. All I can say is that, for me, this system works. My students are learning more material. They are learning more easily. And they are better prepared and more confident going into my department's subsequent methodology course. I know that no single approach to teaching statistics will work for everyone, but I encourage you to consider the difficulties that many students currently have with mastering this subject and whether they would find the approach taken by this text beneficial.

ACKNOWLEDGMENTS

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