STATISTICS *for the* *Behavioral Sciences*

THIRD EDITION

B. Michael Thorne ▪ J. Martin Giesen

STATISTICS FOR THE BEHAVIORAL SCIENCES

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Statistics for the Behavioral Sciences

To Wanda, my wife and friend,
and to my children, Dean and Erin.
B.M.T.

To my parents, teachers, friends,
and students who have helped me learn.
J.M.G.

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Preface

In this edition, we had four goals: First, we sought to preserve and improve the features of previous editions that, based on our experience and feedback, have been beneficial to new learners of statistics. Second, we strove for clear and enhanced conceptual presentations. Third, we included additions and adjustments that recognize advances and changes in statistics for the behavioral sciences. Finally, we tried to do all these things without losing sight of our overall goal: a simplified textbook that maintains essential content.

Special Features and Enhancements

This edition contains a number of special features, enhancements, and additions that set it apart both from its competition and from previous editions.

Getting Started Right—How to Think About Learning Statistics and How to Avoid Being Anxious About the Subject. Like the second edition, this edition uses *the metaphor of learning a second language* to introduce students to statistics. Just like learning Spanish or French, learning statistics requires developing a new vocabulary and discovering how to combine terms and phrases into longer and more useful "sentences." Like language students, students of statistics often find they are already familiar with many of the basic concepts and simply have to learn new "words" for them. Also like language students, statistics students find they benefit from immersion in the new subject and from regular practice.

Another similarity is that students often enter their first statistics course with some fear and anxiety, worrying that they may not have the necessary background for success. Many students are traumatized by textbooks that introduce too many statistical concepts and formulas too quickly. In this book, we show that statistics can be approached and appreciated on different levels. We aim for comprehension on two levels: (1) the practical level, involving the ability to use statistical tests and methods in applied settings, and (2) the intuitive level, involving a feel for the principles underlying statistical procedures. Again, our goal has been to write a simplified text without sacrificing essential content. At all times, we have kept in mind the student with less mathematics training. In fact, the statistical procedures in this book require little more than addition, subtraction, multiplication,

division, and some elementary high-school algebra. Almost all students, well prepared in math or less well prepared, can succeed on the levels at which this book is aimed. Just as students *can* learn a second language with good instruction and regular practice, students *can* learn statistics.

Practice Using Statistical Tests and Immediate Feedback Exercises: Checking Your Progress. Our emphasis has been on teaching students to use statistical tests and procedures. To this end, almost all newly introduced techniques are illustrated with two completely solved examples. Sections labeled "Checking Your Progress" do what the name implies—allow students to check their ability to use the technique they've just read about. Additional exercises at the end of each chapter further strengthen the students' computational skills; the exercise sets have been substantially increased for this edition.

Engaging Illustrations of Chapter Concepts and Tips to Avoid Common Errors. Many chapters begin with a brief vignette that illustrates the chapter's material, engages the students, and alleviates anxiety. Beginning with Chapter 5, most chapters also have a section called "Troubleshooting Your Computations." These sections identify some of the common errors that can result if the chapter techniques are misapplied and show students what to do about them. Frequently, the troubleshooting sections help students recognize an obviously incorrect answer and provide suggestions about finding and correcting the problem.

Summaries of Major Sections on Descriptive and Inferential Statistics and Help Choosing the Right Test. Following a short introductory chapter, the text is divided into two parts. In Part I, Descriptive Statistics, Chapters 2–6 cover basic measurement concepts and statistical vocabulary, the frequency distribution, graphing, measures of central tendency, and measures of dispersion and standard scores. There is a **brief summary** of Part I following Chapter 6. It is highlighted by a bleed tab to make it easy to locate.

In Part II, Inferential Statistics, Chapters 7–15 cover probability, the normal distribution, confidence intervals and hypothesis testing, significance testing with two sample means, one-way analysis of variance with post hoc comparisons, two-way analysis of variance, correlation and regression, and several popular nonparametric inferential tests (i.e., chi square, Mann–Whitney U, Wilcoxon T, and Kruskal–Wallis H). There is a **brief summary** of inferential techniques after Chapter 15. This summary is followed by a decision tree in a section called "Choosing the Correct Inferential Test," which is new to this edition. Bleed tabs on both the summary and the decision tree make them easy to locate as well.

New Arrangement of Topics, Changes in Emphasis, and Introduction to Bayesian Statistics. Also new to this edition is the arrangement of some of the chapters (e.g., the correlation and regression chapter has been moved from the end of Part I—Descriptive Statistics—to the end of parametric inferential tests) and the extensive revision of others. As an example of revision involving several chapters, the grouped frequency distribution has been de-emphasized and boxed in the chapters containing it (i.e., Chapters 3–6), reflecting its infrequent application in the behavioral sciences. The probability chapter now initiates the survey of inferential statistics, as befits the importance of probability theory for the inferential tests. The chapter also has been expanded from its coverage in the second edition,

with the addition of various ways of thinking about probability (e.g., subjectively, theoretically, empirically) and an introduction to Bayesian statistics. The probability chapter now ends with a brief look at the binomial distribution, which ties in well with the following chapter on the normal probability distribution.

A Step-By-Step Approach to Hypothesis Testing and Added Emphasis on Writing Good Conclusions. In this edition, Chapter 9—devoted to confidence intervals and a first look at hypothesis testing (the one-sample *t* test)—introduces a verbal, problem context-oriented interpretation of confidence intervals. The chapter also introduces a seven-step procedure for testing the null hypothesis. The final step emphasizes the importance of writing good conclusions following the American Psychological Association style manual guidelines. Examples provide model conclusions that fully explain results in the research context of the problem. The seven-step procedure with model conclusions is employed throughout the remainder of the text to guide students through the hypothesis-testing process, which is often perceived as counterintuitive. Conclusion writing—an emphasis frequently requested by our colleagues—is reinforced by end-of-chapter exercises.

New Topics and Controversies. Chapter 9 now ends with a brief, intuitive look at meta-analysis and an equally brief examination of the current debate on the value of hypothesis testing ("Should Hypothesis Testing Be Abandoned?").

Relating Procedures and Increasing Understanding by Using "Key Concepts." In many places in this edition, the discussion has been made more sophisticated without losing sight of the simplicity for which previous editions were known. For example, the key deviation of the score minus the mean $(X - \overline{X})$ is identified in the chapter on measures of dispersion. This key deviation is carried through and expanded in the coverage of analysis of variance. The key deviation concept is extended to regression as the deviation of a score from its predicted value. The idea of a pooled or common variance has been added to the chapter devoted to the two-sample *t* test, and this concept carries through to mean square within groups in analysis of variance. In the correlation and regression chapter, there is a section on "Correlation, Variance, and Covariance" that ties the formula for the Pearson *r* to the familiar concept of variance and introduces variance's relative—the covariance.

Integrated Testing Procedures for ANOVA and a Simplified Consistent Method for Post Hoc Testing. In this edition, the post hoc tests following ANOVA are included in the ANOVA chapter rather than being consigned to the succeeding chapter. Also, the order of presentation of the post hoc tests has been reversed, with the Fisher LSD presented before the Tukey HSD and in greater detail. Finally, the equation for computing LSD and the procedures for reporting the results of the analysis have been modified to make them parallel to the comparable HSD discussion.

Showing Relationships Between Procedures and Research Questions—Introducing the General Linear Model. The correlation chapter now mentions correlation coefficients other than the Pearson *r* and the Spearman r_S—specifically, the point biserial correlation and the phi coefficient. The chapter closes with a brief discussion of how the inferential techniques covered can be subsumed and related to one another under the general linear model.

Helpful Appendixes. Five appendixes at the end of the book provide important resources for students. Appendix 1 is a brief math–algebra review for students who need to refresh their math skills. Appendix 2 is a glossary of statistical terms. Appendix 3 contains the symbols and the most important computational formulas in the book, organized by chapter. Appendix 4 contains the tables needed for the inferential tests, and Appendix 5 provides answers to the odd-numbered exercises at the end of each chapter.

Additional Helpful Materials Complete the Package

Also available with the text are an *Instructor's Manual,* a *Study Guide With Computer Exercises,* and a *Solutions Manual.* The *Instructor's Manual* contains answers to all the even-numbered exercises in the text, a sample syllabus with formulas, and a test bank of problems the instructor can use either for in-class exercises or for constructing tests.

Keyed to the textbook, each chapter of the *Study Guide With Computer Exercises* includes a comprehensive chapter review, a listing of all chapter formulas, terms to identify, fill-in-the-blank exercises, additional problems to work, and a self-test to enable students to check their mastery of concepts and techniques. For instructors who have the resources available and want to introduce computer use to students, the *Study Guide* includes selected, guided exercises for computer solutions using SPSS for Windows in chapters in which such solutions are appropriate. A special appendix is included in the *Study Guide* that provides a quick and concise introduction to using SPSS for Windows. If an instructor wants to place more emphasis on computer use in his or her course, we recommend consideration of *Ready, Set, Go! A Student Guide to SPSS for Windows* by Thomas Pavkov and Kent Pierce. This practical user's manual for SPSS for Windows focuses on the types of problems covered in the text and study guide.

The answers to all *Study Guide* problems are provided. The *Solutions Manual* contains complete calculations from formula to final answer for every problem in the text, including the "Checking Your Progress" exercises, and for all problems from the *Study Guide.*

Let Us Hear From You. We want your teaching experience using *Statistics for the Behavioral Sciences* to be as successful as possible. If you have comments, questions, or suggestions, please contact us by e-mail (bmt2@ra.msstate.edu).

We would like to thank the reviewers of this book: Nancy Anderson, Liberty University; Xuanning Fu, Brigham Young University, Hawaii; Paul C. Price, California State University, Fresno; Sarah C. Sitton, St. Edward's University; and Todd D. Zakrajsek, Southern Oregon State University.

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