

Fourth  
Edition

# Data Analysis and Decision Making



Albright | Winston | Zappe

4TH  
EDITION

# Data Analysis and Decision Making

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S. Christian Albright, Wayne L. Winston,  
Christopher J. Zappe

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**To my wonderful family**

*To my wonderful wife Mary—my best friend and constant companion; to Sam, Lindsay, and Teddy, our new and adorable grandson; and to Bryn, our wild and crazy Welsh corgi, who can't wait for Teddy to be able to play ball with her!*      S.C.A.

**To my wonderful family**      W.L.W.

**To my wonderful family**

*Jeannie, Matthew, and Jack. And to my late sister, Jenny, and son, Jake, who live eternally in our loving memories.*      C.J.Z.



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# Preface

With today's technology, companies are able to collect tremendous amounts of data with relative ease. Indeed, many companies now have more data than they can handle. However, the data are usually meaningless until they are analyzed for trends, patterns, relationships, and other useful information. This book illustrates in a practical way a variety of methods, from simple to complex, to help you analyze data sets and uncover important information. In many business contexts, data analysis is only the first step in the solution of a problem. Acting on the solution and the information it provides to make good decisions is a critical next step. Therefore, there is a heavy emphasis throughout this book on analytical methods that are useful in decision making. Again, the methods vary considerably, but the objective is always the same—to equip you with decision-making tools that you can *apply* in your business careers.

We recognize that the majority of students in this type of course are *not* majoring in a quantitative area. They are typically business majors in finance, marketing, operations management, or some other business discipline who will need to analyze data and make quantitative-based decisions in their jobs. We offer a hands-on, example-based approach and introduce fundamental concepts as they are needed. Our vehicle is spreadsheet software—specifically, Microsoft Excel. This is a package that most students already know and will undoubtedly use in their careers. Our MBA students at Indiana University are so turned on by the required course that is based on this book that *almost all* of them (mostly finance and marketing majors) take at least one of our follow-up elective courses in spreadsheet modeling. We are convinced that students see value in quantitative analysis when the course is taught in a practical and example-based approach.

## Rationale for writing this book

*Data Analysis and Decision Making* is different from the many fine textbooks written for statistics and management science. Our rationale for writing this book is based on three fundamental objectives.

### 1. Integrated coverage and applications.

The book provides a unified approach to business-related problems by integrating methods and applications that have been traditionally taught in separate courses, specifically statistics and management science.

### 2. Practical in approach.

The book emphasizes realistic business examples and the processes managers actually use to analyze business problems. The emphasis is *not* on abstract theory or computational methods.

### 3. Spreadsheet-based.

The book provides students with the skills to analyze business problems with tools they have access to and will use in their careers. To this end, we have adopted Excel and commercial spreadsheet add-ins.

## Integrated coverage and applications

In the past, many business schools, including ours at Indiana University, have offered a required statistics course, a required decision-making course, and a required management science course—or some subset of these. One current trend, however, is to have only one required course that covers the basics of statistics, some regression analysis, some decision making under uncertainty, some linear programming, some simulation, and possibly others. Essentially, we faculty in the quantitative area get one opportunity to teach all business students, so we attempt to cover a *variety* of useful quantitative methods. We are not necessarily arguing that this trend is ideal, but rather that it is a reflection of the reality at our university and, we suspect, at many others. After several years of teaching this course, we have found it to be a great opportunity to attract students to the subject and more advanced study.

The book is also integrative in another important aspect. It not only integrates a number of analytical methods, but it also applies them to a wide variety of business problems—that is, it analyzes realistic examples from many business disciplines. We include examples, problems, and cases that deal with portfolio

optimization, workforce scheduling, market share analysis, capital budgeting, new product analysis, and many others.

## Practical in approach

We want this book to be very example-based and practical. We strongly believe that students learn best by working through examples, and they appreciate the material most when the examples are realistic and interesting. Therefore, our approach in the book differs in two important ways from many competitors. First, there is just enough conceptual development to give students an understanding and appreciation for the issues raised in the examples. We often introduce important concepts, such as multicollinearity in regression, in the context of examples, rather than discussing them in the abstract. Our experience is that students gain greater intuition and understanding of the concepts and applications through this approach.

Second, we place virtually no emphasis on hand calculations. We believe it is more important for students to understand why they are conducting an analysis and what it means than to emphasize the tedious calculations associated with many analytical techniques. Therefore, we illustrate how powerful software can be used to create graphical and numerical outputs in a matter of seconds, freeing the rest of the time for in-depth interpretation of the output, sensitivity analysis, and alternative modeling approaches. In our own courses, we move directly into a discussion of examples, where we focus almost exclusively on interpretation and modeling issues and let the software perform the number crunching.

## Spreadsheet-based teaching

We are strongly committed to teaching spreadsheet-based, example-driven courses, regardless of whether the basic area is data analysis or management science. We have found tremendous enthusiasm for this approach, both from students and from faculty around the world who have used our books. Students learn and remember more, and they appreciate the material more. In addition, instructors typically enjoy teaching more, and they usually receive immediate reinforcement through better teaching evaluations. We were among the first to move to spreadsheet-based teaching almost two decades ago, and we have never regretted the move.

## What we hope to accomplish in this book

Condensing the ideas in the above paragraphs, we hope to:

- Reverse negative student attitudes about statistics and quantitative methods by making these topics real, accessible, and interesting;
- Give students lots of hands-on experience with real problems and challenge them to develop their intuition, logic, and problem-solving skills;
- Expose students to real problems in many business disciplines and show them how these problems can be analyzed with quantitative methods;
- Develop spreadsheet skills, including experience with powerful spreadsheet add-ins, that add immediate value in students' other courses and their future careers.

## New in the fourth edition

There are two major changes in this edition.

- We have completely rewritten and reorganized Chapters 2 and 3. Chapter 2 now focuses on the description of one variable at a time, and Chapter 3 focuses on relationships between variables. We believe this reorganization is more logical. In addition, both of these chapters have more coverage of categorical variables, and they have new examples with more interesting data sets.
- We have made major changes in the problems, particularly in Chapters 2 and 3. Many of the problems in previous editions were either uninteresting or outdated, so in most cases we deleted or updated such problems, and we added a number of brand-new problems. We also created a file, essentially a database of problems, that is available to instructors. This file, **Problem Database.xlsx**, indicates the context of each of the problems, and it also shows the correspondence between problems in this edition and problems in the previous edition.

Besides these two major changes, there are a number of smaller changes, including the following:

- Due to the length of the book, we decided to delete the old Chapter 4 (Getting the Right

Data) from the printed book and make it available online as Chapter 17. This chapter, now called “Importing Data into Excel,” has been completely rewritten, and its section on Excel tables is now in Chapter 2. (The old Chapters 5–17 were renumbered 4–16.)

- The book is still based on Excel 2007, but where it applies, notes about changes in Excel 2010 have been added. Specifically, there is a small section on the new slicers for pivot tables, and there are several mentions of the new statistical functions (although the old functions still work).
- Each chapter now has 10–20 “Conceptual Questions” in the end-of-chapter section. There were a few “Conceptual Exercises” in some chapters in previous editions, but the new versions are more numerous, consistent, and relevant.
- The first two linear programming (LP) examples in Chapter 13 (the old Chapter 14) have been replaced by two product mix models, where the second is an extension of the first. Our thinking was that the previous diet-themed model was overly complex as a first LP example.
- Several of the chapter-opening vignettes have been replaced by newer and more interesting ones.
- There are now many short “fundamental insights” throughout the chapters. We hope these allow the students to step back from the details and see the really important ideas.

## Software

This book is based entirely on Microsoft Excel, the spreadsheet package that has become the standard analytical tool in business. Excel is an extremely powerful package, and one of our goals is to convert *casual* users into *power* users who can take full advantage of its features. If we accomplish no more than this, we will be providing a valuable skill for the business world. However, Excel has some limitations. Therefore, this book includes several Excel add-ins that greatly enhance Excel’s capabilities. As a group, these add-ins comprise what is arguably the most impressive assortment of spreadsheet-based software accompanying any book on the market.

**DecisionTools® add-in.** The textbook Web site for *Data Analysis and Decision Making* provides a link to the powerful DecisionTools® Suite by Palisade Corporation. This suite includes seven separate add-ins, the first three of which we use extensively:

- **@RISK**, an add-in for simulation
- **StatTools**, an add-in for statistical data analysis
- **PrecisionTree**, a graphical-based add-in for creating and analyzing decision trees
- **TopRank**, an add-in for performing what-if analyses
- **RISKOptimizer**, an add-in for performing optimization on simulation models
- **NeuralTools®**, an add-in for finding complex, nonlinear relationships
- **Evolver™**, an add-in for performing optimization on complex “nonsmooth” models

Online access to the DecisionTools® Suite, available with new copies of the book, is an academic version, slightly scaled down from the professional version that sells for hundreds of dollars and is used by many leading companies. It functions for two years when properly installed, and it puts only modest limitations on the size of data sets or models that can be analyzed. (Visit [www.kelley.iu.edu/albrightbooks](http://www.kelley.iu.edu/albrightbooks) for specific details on these limitations.) We use @RISK and PrecisionTree extensively in the chapters on simulation and decision making under uncertainty, and we use StatTools throughout all of the data analysis chapters.

**SolverTable add-in.** We also include SolverTable, a supplement to Excel’s built-in Solver for optimization. If you have ever had difficulty understanding Solver’s sensitivity reports, you will appreciate SolverTable. It works like Excel’s data tables, except that for each input (or pair of inputs), the add-in runs Solver and reports the *optimal* output values. SolverTable is used extensively in the optimization chapters. The version of SolverTable included in this book has been revised for Excel 2007. (Although SolverTable is available on this textbook’s Web site, it is also available for free from the first author’s Web site, [www.kelley.iu.edu/albrightbooks](http://www.kelley.iu.edu/albrightbooks).)

## Possible sequences of topics

Although we use the book for our own required one-semester course, there is admittedly more material

than can be covered adequately in one semester. We have tried to make the book as modular as possible, allowing an instructor to cover, say, simulation before optimization or vice versa, or to omit either of these topics. The one exception is statistics. Due to the natural progression of statistical topics, the basic topics in the early chapters should be covered before the more advanced topics (regression and time series analysis) in the later chapters. With this in mind, there are several possible ways to cover the topics.

- For a one-semester required course, with no statistics prerequisite (or where MBA students have forgotten whatever statistics they learned years ago): If data analysis is the primary focus of the course, then Chapters 2–5, 7–11, and possibly the online Chapter 17 (all statistics and probability topics) should be covered. Depending on the time remaining, any of the topics in Chapters 6 (decision making under uncertainty), 12 (time series analysis), 13–14 (optimization), or 15–16 (simulation) can be covered in practically any order.
- For a one-semester required course, with a statistics prerequisite: Assuming that students know the basic elements of statistics (up through hypothesis testing, say), the material in Chapters 2–5 and 7–9 can be reviewed quickly, primarily to illustrate how Excel and add-ins can be used to do the number crunching. Then the instructor can choose among any of the topics in Chapters 6, 10–11, 12, 13–14, or 15–16 (in practically any order) to fill the remainder of the course.
- For a two-semester required sequence: Given the luxury of spreading the topics over two semesters, the entire book can be covered. The statistics topics in Chapters 2–5 and 7–9 should be covered in order before other statistical topics (regression and time series analysis), but the remaining chapters can be covered in practically any order.

## Custom publishing

If you want to use only a subset of the text, or add chapters from the authors' other texts or your own materials, you can do so through Cengage Learning Custom Publishing. Contact your local Cengage Learning representative for more details.

## Student ancillaries

### Textbook Web Site

Every new student edition of this book comes with an Instant Access Code (bound inside the book). The code provides access to the *Data Analysis and Decision Making, 4e* textbook Web site that links to all of the following files and tools:

- DecisionTools® Suite software by Palisade Corporation (described earlier)
- Excel files for the examples in the chapters (usually two versions of each—a template, or data-only version, and a finished version)
- Data files required for the problems and cases
- **Excel Tutorial.xlsx**, which contains a useful tutorial for getting up to speed in Excel 2007

Students who do not have a new book can purchase access to the textbook Web site at [www.CengageBrain.com](http://www.CengageBrain.com).

### Student Solutions

Student Solutions to many of the odd-numbered problems (indicated in the text with a colored box on the problem number) are available in Excel format. Students can purchase access to Student Solutions files on [www.CengageBrain.com](http://www.CengageBrain.com). (ISBN-10: 1-111-52905-1; ISBN-13: 978-1-111-52905-5).

## Instructor ancillaries

Adopting instructors can obtain the *Instructors' Resource CD* (IRCD) from your regional Cengage Learning Sales Representative. The IRCD includes:

- **Problem Database.xlsx** file (contains information about all problems in the book and the correspondence between them and those in the previous edition)
- Example files for all examples in the book, including annotated versions with additional explanations and a few extra examples that extend the examples in the book
- Solution files (in Excel format) for all of the problems and cases in the book and solution shells (templates) for selected problems in the modeling chapters
- PowerPoint® presentation files for all of the examples in the book

- Test Bank in Word format and now also in ExamView® Testing Software (new to this edition).

The book's password-protected instructor Web site, [www.cengage.com/decisionsciences/albright](http://www.cengage.com/decisionsciences/albright), includes the above items (Test Bank in Word format only), as well as software updates, errata, additional problems and solutions, and additional resources for both students and faculty. The first author also maintains his own Web site at [www.kelley.iu.edu/albrightbooks](http://www.kelley.iu.edu/albrightbooks).

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