



USED

3rd Edition

INTRODUCTION TO
**BUSINESS
STATISTICS**

RONALD M. WEIERS

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Introduction to Business Statistics

THIRD EDITION

Ronald M. Weiers

*Eberly College of Business
Indiana University of Pennsylvania*



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To the fond memories of my best friend ever, Mr. Barney Jim, to making some memories with Connor Reilly and Madeleine Marie, and to Peg, Nancy, Pam, Bob, Jen, and Janice with love.

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Preface

Philosophies and Goals of the Text: A Message to the Student

A book is a very special link between author and reader. In a mystery novel, the author presents the reader with a maze of uncertainty, perplexity, and general quicksand. Intellectual smokescreens are set up all the way to the “whodunit” ending. Unfortunately, many business statistics texts seem to be written the same way—except for the “whodunit” section. This text is specifically designed to be different. Its goals are: (1) to be a clear and friendly guide as you learn about business statistics, (2) to avoid quicksand that could inhibit either your interest or your learning, and (3) to earn and retain your trust in our ability to accomplish goals 1 and 2.

Business statistics is not only relevant to your present academic program, it is also relevant to your future personal and professional life. As a citizen, you will be exposed to, and perhaps may even help generate, statistical descriptions and analyses of data that are of vital importance to your local, state, national, and world communities. As a business professional, you will constantly be dealing with statistical measures of performance and success, as well as with employers who will expect you to be able to utilize the latest statistical techniques and computer software tools—including spreadsheet programs like Excel and statistical software packages like MINITAB—in working with these measures.

The chapters that follow are designed to be both informal and informative, as befits an introductory text in business statistics. You will not be expected to have had mathematical training beyond simple algebra, and mathematical symbols and notations will be explained as they become relevant to our discussion. Following an introductory explanation of the purpose and the steps involved in each technique, you will be provided with several down-to-earth examples of its use. Each section has a set of exercises based on the section contents. At the end of each chapter you’ll find a summary of what you’ve read and a listing of equations that have been introduced, as well as chapter exercises, an interesting minicase, and a computer database exercise to help you practice your skills. A self-test is even provided to help you evaluate how well you’ve learned the material.

Features of the Text

Interesting and Relevant Chapter-Opening Vignettes

Each chapter begins with a vignette that’s both interesting and relevant to the material ahead. Topics range from whether people can tell the difference between regular and fat-

free Pringles, to using the consumer price index to time-travel to the prices in days gone by (were they *really* lower?), and even a discussion of an odd little car in which the rear passengers faced to the rear. Some of the opening-vignette titles:

- Fat-Free or Regular Pringles: Can Tasters Tell the Difference? (Chapter 9)
- Synergy, ANOVA, and the Thorndikes (Chapter 11)
- Proportions Testing and the Restroom Police (Chapter 12)
- Time-Series-Based Forecasting and the Zündapp (Chapter 16)
- The CPI Time Machine (Chapter 17)
- A Sample of Sampling By Giving Away Samples (Chapter 21)

Extensive Use of Examples and Analogies

Each chapter is packed with examples to illustrate the techniques being discussed. In addition to describing a technique and presenting a small-scale example of its application, we will typically present one or more Excel and MINITAB printouts showing how the analysis can be handled with a spreadsheet or a statistical software package. This pedagogical strategy is used so the reader will better appreciate what's going on inside the computer when it's applied to problems of a larger scale.

The Use of Real Data

The value of statistical techniques becomes more apparent through the consistent use of real data in the text. Data sets, gathered from such publications as *USA Today*, *Fortune*, *Newsweek*, and *The Wall Street Journal*, are used in more than 400 exercises and examples to make statistics both relevant and interesting for students.

Computer Relevance

The text includes more than 200 computer printouts generated by Excel and MINITAB. For the many who have access to these popular software packages, there is an additional benefit: the disk supplied with the text contains the underlying data files for practically all of the Excel and MINITAB figures and tables in the text. Further, Appendices C (Excel Step-By-Step Guide) and D (MINITAB Step-By-Step Guide) list the detailed steps by which each printout was generated. While an immensely popular and useful spreadsheet program, Excel does not offer all of the techniques for description and analysis that are available in a dedicated statistical software package like MINITAB. On the other hand, Excel's flexibility helps make the MINITAB/Excel combination a useful one for our text—for example, to take Excel beyond its standard capabilities for statistical analysis, we've included 22 Excel worksheet templates that students will find both easy and enjoyable to use. See the "What's New" section of the preface for more information and a listing of the Excel worksheet templates.

Thorndike Sports Equipment Minicases

The text follows the saga of Grandfather (Luke) and Grandson (Ted) Thorndike as they apply chapter concepts to the varied pursuits of Thorndike Sports Equipment. At the end of each chapter, the reader will have the opportunity to help Luke and Ted apply statistics to their business. In many of the Thorndike adventures, the computer (and the Thorndike

data on the supplied disk) can be a helpful partner. The Thorndikes are also available on videocassette. The actors playing the roles of Luke and Ted are pretty convincing. See the Ancillaries section for more details.

Springdale Shopping Survey Computer Database Exercises

The Springdale Shopping Survey computer database exercises provide the opportunity to apply chapter concepts and the computer to real numbers representing the opinions and behaviors of real people in a real community. The only thing that isn't real is the name of the community. The entire database contains 38 variables for 200 respondents. This database (including shortened versions for those using the student editions of some statistical software packages such as MINITAB) is on the data disk, discussed in the Ancillary Items section.

Unique Chapters

Chapter 18, Total Quality Management, introduces the student to key ideas and methods in this vital field. As in the core chapters, heavy emphasis is given to computer applications in TQM. To make TQM convenient as well as relevant, we've included Excel worksheet templates for some of the more popular statistical process control (SPC) charts. Once the user has entered or pasted the data to be analyzed, Excel automatically does the rest, including generating the SPC chart. They're self-contained, the directions are included, and they're on the disk supplied with the text.

Chapter 20, Business and Survey Research, reinforces the fact that data such as those presented in exercises and examples throughout the book do not simply materialize: They are the result of business research efforts relevant to a real-world business problem or situation. A brief summary of some of the more well-known published and other secondary data sources is provided, along with a discussion of how to go about evaluating the applicability and the quality of such information.

To the knowledge of the author and publisher, this was the first introductory business statistics textbook to include a separate chapter like Chapter 21, Ethics in Statistical Analysis and Reporting. We continue the emphasis on this important topic, even though time constraints for some courses might necessitate that students read it on their own. We think they will.

Organization of the Text

The text can be used in either a one-term or a two-term course. For one-term applications, Chapters 1 through 10 are suggested. For two-term use, it is recommended that the first term include Chapters 1 through 10, and that the second term include Chapters 11 through 17. In either one- or two-term use, the number and variety of chapters allow for instructor flexibility in designing either a course or a sequence of courses that will be of maximum benefit to the student. This flexibility includes the possibility of including one or more of the four remaining chapters, which are in the Special Topics section of the text.

Chapter 1 provides an introductory discussion of business statistics and its relevance to the real world. Chapters 2 and 3 cover visual summarization methods and descriptive

statistics used in presenting statistical information. In Chapters 4 through 6, we discuss the basic notions of probability and go on to introduce the discrete and continuous probability distributions upon which many statistical analyses depend. In Chapters 7 and 8, the philosophies and methods of sampling and generalizing upon sample findings are discussed.

Chapters 9 through 13 focus on the use of sample data to reach conclusions regarding the phenomena that the data represent. In these chapters, the reader will learn how to use statistics in deciding whether to reject statements that have been made concerning these phenomena. In Chapters 14 and 15, methods are introduced that allow us to employ equations in describing how one variable tends to change in response to changes in one or more others.

Chapters 16 and 17 examine time series, forecasting, and index number concepts used in analyzing data that occur over a period of time. Chapter 18 examines total quality management and its utilization of statistics, while Chapter 19 discusses the role of statistics in decision theory. Chapter 20 examines some of the popular approaches by which statistical data are collected or generated. In Chapter 21, statistics and its practitioners are discussed in terms of larger social and ethical implications.

At the end of the text, along with the Excel and MINITAB Step-By-Step Guides, there is a combined index and glossary of key terms, a set of statistical tables, answers to selected exercises, and answers to the self-test questions at the end of each chapter. For convenience, the rear endsheet and the pages immediately preceding it contain the two statistical tables to which the reader will most often be referring: the t -distribution and the standard normal, or z -distribution.

What's New in the Third Edition

Excel Spreadsheet Applications

Excel worksheet applications are now heavily featured and integrated throughout the text, and for good reason. Excel is a popular, powerful, and versatile business tool that interfaces easily with other business software applications, like databases, word processing, presentations, and desktop publishing. It also offers a wide variety of statistical tools and techniques that lend themselves well to the introductory business statistics course. In addition, many students will already have familiarity and confidence with the software as the result of having used it in other business or information systems courses. Conversely, those who are using it for the first time in this course can be assured that their current efforts will pay off in a future course, in the business world, or (most likely) both.

There are over 80 Excel printouts in the text. With the underlying data (on the disk supplied with the text) and Appendix C (Excel Step-By-Step Guide), students can gain familiarity with both Excel and the relevant statistical tools by recreating practically any Excel figure or table in the text.

The Excel Worksheet Templates

Excel's inherent flexibility can be taken advantage of by using the 22 Excel worksheet templates on the disk supplied with the text. These are applicable to many of the chapters in the text, directions for their use are self-contained, and many of them perform analyses

that are not standard components of Excel. Besides extending the statistical capabilities of Excel, these worksheet templates and Excel's active-linking feature enable us to carry out fascinating and informative "what-if?" scenarios that enliven and reinforce important concepts developed in the text. In the next section, we'll use a walk-through example to show how easy the worksheet templates are to use, then we'll look at an example of the "what-if?" possibilities they offer.

Excel Worksheet Templates Supplied with the Text

<i>Application</i>	<i>File Name</i>
Hypergeometric Probabilities	tmhyper.xls
z -Interval for the Mean, Sigma Known or Assumed	tmzint.xls
t -Interval for the Mean, Sigma Unknown	tmtint.xls
Confidence Interval for a Proportion	tmpint.xls
Sample Size for Estimating a Population Mean	tmnformu.xls
Sample Size for Estimating a Population Proportion	tmnforpi.xls
z -Test of a Mean, Sigma Known or Assumed	tmztest.xls
t -Test of a Mean, Sigma Unknown	tmttest.xls
z -Test of a Sample Proportion	tmptest.xls
z -Test Comparing Two Sample Proportions	tm2ptest.xls
Chi-Square Goodness-of-Fit Test	tmchifit.xls
Chi-Square Test for Independence of Variables	tmchivar.xls
Chi-Square Test Comparing Sample Proportions	tmchipro.xls
Wilcoxon Signed Rank Test for One Sample	tmwilrs1.xls
Wilcoxon Rank Sum Test for Independent Samples	tmwilrs2.xls
Sign Test for Single Sample or Paired Samples	tmsign.xls
Runs Test for Randomness	tmruns.xls
Quarterly Data and Deseasonalized Series	tmquarts.xls
Monthly Data and Deseasonalized Series	tmmonths.xls
Mean and Range Charts	tmspcmr.xls
p -Chart for Proportion Defective	tmspcpch.xls
c -Chart for Number of Defects	tmspccch.xls

A Walk-Through Using an Excel Worksheet Template

Each of the Excel worksheet templates contains instructions for its use. A Typical worksheet template application is shown below. It pertains to the c -chart for number of defects, one of several statistical process control charts discussed in Chapter 18, Total Quality Management. The journey from raw data to finished graph is swift:

Number of flaws
in 20 samples:

1-5: 3 4 6 6 4
6-10: 7 9 8 3 6
10-15: 10 5 7 8 3
16-20: 3 1 4 6 3

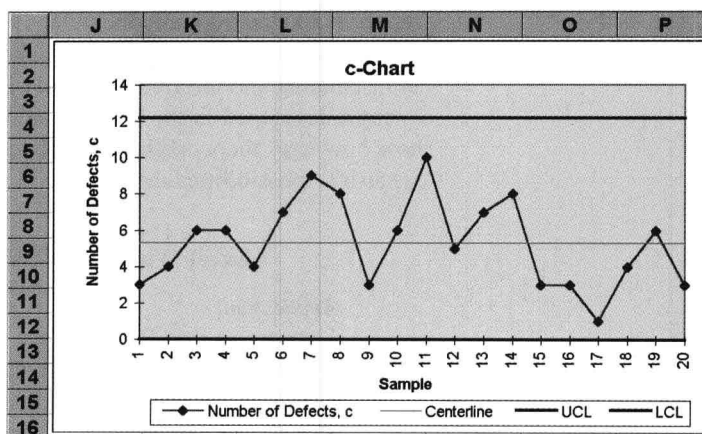
The Data.

+

1. Beginning with row 78 (associated with sample 60) and working upward, select row button(s) and delete entirely all unnecessary rows.
2. Enter or paste sample data in the remaining rows of column B.

**The instructions in
Excel worksheet
template tmspcch.xls.**

=



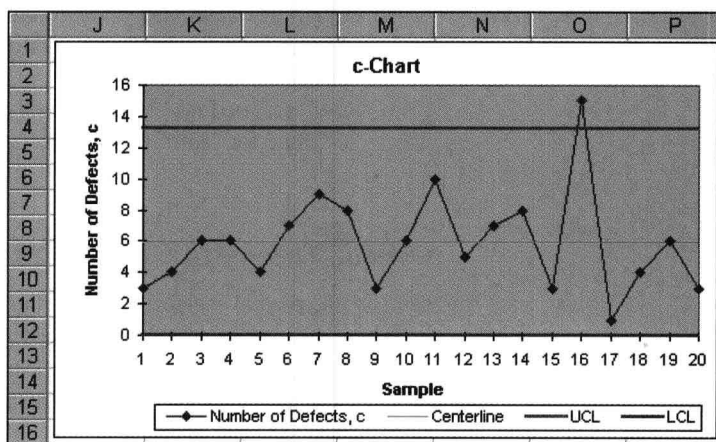
Instant c-chart. This is the one in Figure 18.12.

Playing “What-If?” with the Excel Worksheet Templates

The Excel worksheet templates allow students and instructors to change one or more values in the data, then immediately see how this affects a key outcome, such as the appearance of a statistical process control chart, a quarterly seasonal index and seasonally adjusted series, or the p -Value for a hypothesis test. This is an unparalleled way to enjoy statistics and to reinforce the concepts presented in the textbook. An example:

Instead of having just 3 flaws, **what if** the item in sample 16 showed a whopping 15 flaws? Would this sample have exceeded the upper control limit (UCL) and been “flagged”?

Just enter 15 in cell B34 to find out the answer. It’s “Yes.”

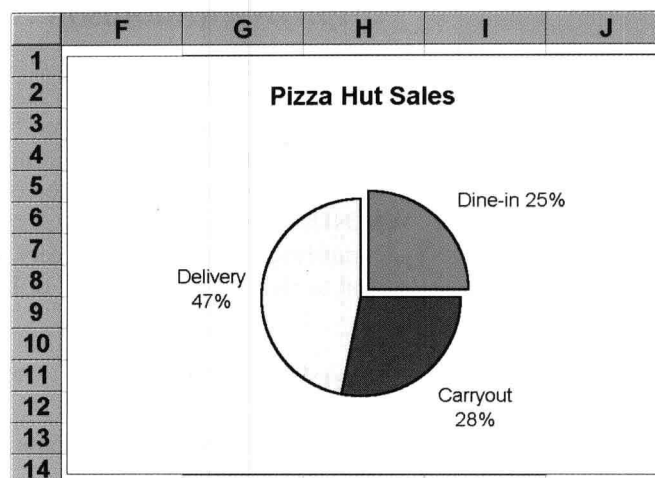


The Excel Step-By-Step Guide (Appendix C)

In Appendix C, we’ve provided detailed instructions for generating practically every one of the over 70 Excel printouts shown in figures and tables throughout the text. For example, this is how Appendix C lists the steps for generating Figure 2.7:

Figure 2.7 (pie chart)

1. Enter Dine-in, Carryout, and Delivery labels to A4:A6. Enter percentages 25%, 28%, and 47% to B4:B6.
2. Click on A4 and drag to B6 to select cells A4:B6.
3. Click on ChartWizard toolbar button and the pointer becomes a combination “+” sign and chart symbol, then place the “+” sign over F1 and click.
4. If the range is what you specified, click Next.
5. Select Pie as the chart type and click Next.
6. Select Pie chart format 3 and click Next.
7. Select Columns, Use First 1 Column(s) for Pie Slice Labels.
8. Select Use First 0 Row(s) for Chart Title and click Next.
9. Select Yes to include a Legend.
10. Enter chart title and click Finish.
11. Click on the chart and drag the borders to expand it vertically and horizontally. [data in c02f07 portion of exlftdat.xls]



The MINITAB Step-By-Step Guide (Appendix D)

With this edition, MINITAB is now sharing the computer stage with Excel, but we still feature more than 130 MINITAB printouts throughout the text, 95 of them in figures and tables. MINITAB is a dedicated statistical software package and is capable of nearly all of the statistical description and analysis analysis methods described in the text, plus a whole lot more. In Appendix D, the MINITAB Step-By-Step Guide, detailed steps are listed for generating just about every MINITAB figure and table in the text. Here's how Appendix D describes the procedure for Table 14.3:

Table 14.3 (simple linear regression), with x data in c1, y data in c2, and with c3 containing the x values for which we wish to obtain confidence and prediction intervals:

1. Choose Stat > Regression > Regression.
2. Enter c2 in Response dialog box and c1 in Predictors dialog box.
3. Select Options.
4. Enter c3 in Prediction Intervals for New Observations dialog box.
5. Click OK.
6. Click OK. [data in c14t03 portion of miftdat3.mtw]

Regression Analysis					
The regression equation is					
PRODRATE = 19.2 + 3.00 DEXSCORE					
Predictor	Coef	StDev	T	P	
Constant	19.200	7.669	2.50	0.087	
DEXSCORE	3.0000	0.5407	5.55	0.012	
S = 2.757 R-Sq = 91.1% R-Sq(adj) = 88.2%					
Analysis of Variance					
Source	DF	SS	MS	F	P
Regression	1	234.00	234.00	30.79	0.012
Error	3	22.80	7.60		
Total	4	256.80			

Your Text's Very Own Web Site — <http://www.thomson.com.duxbury.html>

The web site can be accessed through the address above. Once you reach the text's web site, be sure to bookmark it to facilitate your next visit. You'll find it to be more than a go-through-the-motions site, and you can expect some serious entertainment, information, and support. Among other things, you will find worked-out demonstration problems to accompany and reinforce key concepts, tips on using the latest versions of Excel and MINITAB with the text, recent data that are pertinent to topics in the text, and some commentary — sometimes cheery, sometimes dreary — about current happenings relevant to the study and practice of business statistics. Visit often.

Ancillary Items

To further enhance the usefulness of the text, a complete package of ancillary items has been assembled:

Instructor's Resource Manual (Weiers) Suggested syllabi, supplementary teaching aids, ideas for projects and assignments, and additional discussion and examples.

Complete Solutions Manual (Weiers) Full solutions for all chapter and computer database exercises, as well as exercises contained in the Thorndike Sports Equipment minicases.

Thorndike Sports Equipment Video Cases (based on minicases by Weiers) The chapter minicases with Luke and Ted Thorndike continue at a higher level of existence — on videocassette. The crusty critter and his grandson are played by two talented actors. Many of their statistical adventures in the text are dramatized in this entertaining and informative video series.

Powerpoint Presentation Disk (Chaffe-Stengel and Stengel) Suitable for incorporation into lecture presentations, with learning objectives for each chapter, examples, key terms, and key figures and tables within the text, this ancillary is included with the *Instructor's Resource Manual*.

Test Bank (Alice E. Fugate) There are over 1100 test questions, with about 100 for each of the core chapters in the text. The questions include true-false, multiple-choice, and problems similar to those at the ends of the chapters. Questions are classified according to level of difficulty and are referenced to a specific page in the text.

Computerized Testing Program for Windows With customized and on-line testing, automated grading, and grade book features.

Data Disk (Taiani and Weiers) The disk supplied with the text contains the 22 Excel worksheet templates, along with data files for the following: Excel and MINITAB text figures and tables, Springdale Shopping Survey computer database exercises, Thorndike Sports Equipment minicases, and exercises with larger data sets.

As a unique feature, the appendix table of random digits is also provided in electronic form as a computer database to facilitate computer analysis and to demonstrate chapter principles. Databases are provided in Excel, MINITAB, and ASCII formats. For those using student editions of packages like MINITAB, shortened versions of the computer databases are provided in MINITAB and ASCII formats. The readme.txt file on the data disk contains the latest available information pertaining to the data diskette and the use of its data files.

Also Available From the Publisher

Student Solutions Manual (Weiers) With full solutions to selected odd-numbered exercises in the text.

Study Guide (Chaffe-Stengel and Stengel) With chapter summaries, detailed annotated solutions to major types of problems, supplementary exercise sets, and more.

Ready Notes (Chaffe-Stengel and Stengel) Chapter-by-chapter Powerpoint presentation slides in “class notes” format assist student note-taking and provide a valuable review resource.

StatConcepts: A Visual Tour of Statistical Ideas (Newton and Harvill) Interactive and highly visual, this software for Windows provides stimulating animation of 28 key statistical concepts.

Data Analysis with Microsoft Excel, Windows 95 Edition (Berk and Carey) Detailed guidebook covers Excel’s standard capabilities and expands them with StatPlus add-ins for use in business statistics courses. This edition is appropriate for both Office 95 and Office 97 versions of Excel.

Data Analysis Using Microsoft Excel, Windows 95 Edition (Middleton) This guidebook covers Excel’s built-in capabilities and shows how to work around Excel’s statistical capabilities.

Minitab, Student Version for Windows (Minitab, Inc.) The student version of this popular statistical software package. *Available at a discount when bundled the text.*

JMP IN 3.2 (SAS Institute) State-of-the-art statistical software for data discovery, for Windows and Macintosh.

StataQuest Text Companion (Stata Corporation) Powerful, low-cost software featuring high-resolution graphics and a spreadsheet-like data entry system.

Just the Basics Please: A Quick Review of Math for Introductory Statistics (Schiffler and Adams) Self-paced and inexpensive guidebook that covers essential statistics concepts.

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Ronald M. Weiers, Ph.D.

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