BUSINESS
STATISTICS
A FIRST COURSE

Canadian Edition

Norean R. Sharpe
Georgetown University

Richard D. De Veaux
Williams College

Paul F. Velleman
Cornell University

Jonathan Berkowitz
Sauder School of Business
University of British Columbia

PEARSON

To my parents, who taught me the importance of education
—Norean

To my parents
—Dick

To my father, who taught me about ethical business practice by
his constant example as a small businessman and parent
—Paul

To my wife, Heather, who provides the quality in my quantitative life;
and to my sons, Matthew and Joshua, two outliers
*in the best sense of the word*
—Jonathan

MEET THE AUTHORS

As a researcher of statistical problems in business and a professor of Statistics at a business school, **Norean Radke Sharpe** (Ph.D. University of Virginia) understands the challenges and specific needs of the business student. She is currently teaching at the McDonough School of Business at Georgetown University, where she is also Associate Dean and Director of Undergraduate Programs. Prior to joining Georgetown, she taught business statistics and operations research courses to both undergraduate and MBA students for fourteen years at Babson College. Before moving into business education, she taught mathematics for several years at Bowdoin College and conducted research at Yale University. Norean is coauthor of the recent text, *A Casebook for Business Statistics: Laboratories for Decision Making*, and she has authored more than 30 articles—primarily in the areas of statistics education and women in science. Norean currently serves as Associate Editor for the journal *Cases in Business, Industry, and Government Statistics*. Her research focuses on business forecasting and statistics education. She is also co-founder of DOME Foundation, Inc., a nonprofit foundation that works to increase diversity and outreach in mathematics and engineering for the greater Boston area. She has been active in increasing the participation of women and underrepresented students in science and mathematics for several years and has two children of her own.

Richard D. De Veaux (Ph.D. Stanford University) is an internationally known educator, consultant, and lecturer. Dick has taught statistics at a business school (Wharton), an engineering school (Princeton), and

a liberal arts college (Williams). While at Princeton, he won a Lifetime Award for Dedication and Excellence in Teaching. Since 1994, he has been a professor of statistics at Williams College, although he returned to Princeton for the academic year 2006–2007 as the William R. Kenan Jr. Visiting Professor of Distinguished Teaching. Dick holds degrees from Princeton University in Civil Engineering and Mathematics and from Stanford University in Dance Education and Statistics, where he studied with Persi Diaconis. His research focuses on the analysis of large data sets and data mining in science and industry. Dick has won both the Wilcoxon and Shewell awards from the American Society for Quality and is a Fellow of the American Statistical Association. Dick is well known in industry, having consulted for such *Fortune* 500 companies as American Express, Hewlett-Packard, Alcoa, DuPont, Pillsbury, General Electric, and Chemical Bank. He was named the "Statistician of the Year" for 2008 by the Boston Chapter of the American Statistical Association for his contributions to teaching, research, and consulting. In his spare time he is an avid cyclist and swimmer. He also is the founder and bass for the doo-wop group, Diminished Faculty, and is a frequent soloist with various local choirs and orchestras. Dick is the father of four children.

Paul F. Velleman (Ph.D. Princeton University) has an international reputation for innovative statistics education. He designed the Data Desk® software package and is also the author and designer of the award-winning ActivStats® multimedia software, for which he received the EDUCOM Medal for innovative uses of computers in teaching statistics and the

ICTCM Award for Innovation in Using Technology in College Mathematics. He is the founder and CEO of Data Description, Inc. (www.datadesk.com), which supports both of these programs. He also developed the Internet site, *Data and Story Library* (DASL; www.dasl.datadesk.com), which provides data sets for teaching Statistics. Paul coauthored (with David Hoaglin) the book *ABCs of Exploratory Data Analysis*. Paul has taught Statistics at Cornell University on the faculty of the School of Industrial and Labor Relations since 1975. His research often focuses on statistical graphics and data analysis methods. Paul is a Fellow of the American Statistical Association and of the American Association for the Advancement of Science. He is also baritone of the barbershop quartet Alchemy. Paul's experience as a professor, entrepreneur, and business leader brings a unique perspective to the book.

Richard De Veaux and Paul Velleman have authored successful books in the introductory college and AP High School market with David Bock, including *Intro Stats,* Third Edition (Pearson, 2009), *Stats: Modeling the World*, Third Edition (Pearson, 2010), and *Stats: Data and Models*, Second Edition (Pearson, 2008).

For the past 25 years **Jonathan Berkowitz** (Ph.D. University of Toronto) has had a full-time practice as a consulting statistician as president of the aptly named Berkowitz & Associates Consulting Inc. But Jonathan leads a double life, because he is also a full-time instructor with the Sauder School of Business and an Associate Member of the Department of Family Practice (Faculty of Medicine), both at the University of British Columbia.

Jonathan is recognized as an outstanding teacher, having won the Killam Teaching Prize for undergraduate teaching and CGA Graduate Master Teacher Award for MBA teaching, both at the Sauder School, as well as many awards and commendations from students. In addition he teaches short courses and workshops for a number of public and private sector groups. His passion for teaching also extends to younger audiences, regularly performing shows on math magic, word games, and puzzles in school classrooms.

In his consulting life, Jonathan has been involved in a wide range of collaborative and interdisciplinary research in health care and medical research, social science, engineering, biotechnology, transportation, law, management consulting, market research, and accounting. His clients enthusiastically describe him as a "user-friendly" statistician! He has contributed to numerous successful research grant applications, and has co-written many peer-reviewed journal articles and other publications. He has also helped more than 100 graduate students complete their degrees.

While numbers are his vocation, words are his avocation. A passion for puzzles, word games, and puns infiltrates all aspects of his life, including the classroom. He is an active member of the National Puzzlers' League, and for six years was the puzzle composer and editor for the American Statistical Association's *CHANCE* magazine.

Jonathan and his wife have two children, both of whom graduated from Canadian business schools and have careers in quantitative fields, a classic illustration of the power of both nature and nurture.

CONTENTS

Part II   Understanding Data and Distributions   177

Appendixes

Providing Real Business Context

Chapter Openers

Each chapter opens with an interesting business example. The stories of companies such as Mountain Equipment Co-op, Canada Goose, and Rogers Communication enhance and illustrate the message of each chapter, showing students how and why statistical thinking is vital to modern business decision-making. We analyze data from these examples throughout the chapter.

Random Variables and Probability Models

CONNECTIONS: CHAPTER

With the ideas of probability we discussed in Chapter 7 we now have the tools to create specific models that describe where the data came from. In this chapter we will learn about two types of models—discrete and continuous—that correspond to the two types of data we have worked with—categorical and quantitative. The models will be used all the way through the rest of the text; they are the key to understanding and interpreting data. This is also where the famous bell-shaped curve will be introduced.

Manulife Financial

What company could be more Canadian than one whose first president was the first Prime Minister of Canada, Sir John A. Macdonald? The Manufacturers Life Insurance Company was founded in 1887, and a mere ten years later expanded its operations into China and Hong Kong. Manulife now operates in 21 countries, most notably in the United States, through its subsidiary, John Hancock Insurance.

Manulife Financial is the largest insurance company in Canada, the second largest in the North Americ... known because of their use of Snoopy... strip "Peanuts"), and the world's fifth lar... capitalization. At the end of 2011, its to... $450 billion and total employees surpas... a financial services provider and holds ... a wholly-owned subsidiary.

Manulife changed from a joint stock... company, privately owned by its policyh... demutualized in 1999 and shares of the ... Financial Corporation began trading on ... Exchange (TSX), New York Stock Excha...

In 2002, China gave approval to Ma... Insurance Co. Ltd. to open a branch off...

LEARNING OBJECTIVES

1. Find the expected value and standard deviation of a random variable or combination of random variables.
2. Use the Binomial and Geometric models to find probabilities.
3. Use the 68–95–99.7 Rule to find probabilities or cutoff values.
4. Use the Normal model to find probabilities, cutoff values, and the mean and standard deviation.
5. Compute and use z-scores for comparisons.
6. Use the Normal model to approximate the Binomial and compute probabilities.

In-Text Examples

Real business examples motivate the discussions, often returning to the chapter-opening company.

99.9%‡
If you are careful to add the percentages in Table 4.2, you will notice the total is 99.99%. Of course the real total has to be 100.00%. The discrepancy is due to individual percentages being rounded. You'll often see this in tables of percents, sometimes with explanatory footnotes.

It is often also very useful to rearrange the order of the categories, and the bars, so that they go from highest to lowest (or lowest to highest). This version is referred to as a Pareto chart, but it is just a variation of the bar chart we have discussed. Here is another look at Figure 4.3, with reordered, and horizontal, bars.

4.3 Charts

The Area Principle

Now that we have a frequency table, we're ready to follow the three rules of data analysis and make a picture of the data. But we can't make just any picture; a bad picture can distort our understanding rather than help it. For example, here's a graph of the frequencies of Table 4.1. What impression do you get of the relative frequencies of visits from each province?

The figure does not accurately represent the information in the table. What's gone wrong? The height of the images in the figure do match the percentages in the table. But our eyes tend to be more impressed by the *area* (or perhaps even the *volume*) than by other aspects of each image, and it's that aspect of the image that we notice.

Since there were nearly three times as many visits from Ontario and BC as from Quebec, the images depicting the number from Ontario and from BC is almost three times higher than the image for Quebec, but it occupies almost nine times the area, since both the height and the width were increased three-fold to keep the image looking proportional. As you can see from the frequency table, that isn't a correct impression.

The best data displays observe a fundamental principle of graphing data called the **area principle**, which says that the area occupied by a part of the graph should correspond to the magnitude of the value it represents.

Applying the Concepts

The Sharpe Edge: PLAN, DO, REPORT

There are three simple steps to doing Statistics right: *Plan, Do,* and *Report.*

We lead students through the process of making business decisions with data. The first step is planning how to tackle a problem, the second is doing the calculations, and the third is reporting the results and conclusions. In each chapter, we apply the new concepts learned in *Guided Example*. Examples are structured to the way statisticians approach and solve problems. These step-by-step examples show students how to produce the kind of solutions and reports that clients expect to see.

PLAN first. Know where you're headed and why. Clearly defining and understanding your objective will save you a lot of work. What do you know? What do you hope to learn? Are the assumptions and conditions satisfied?

DO is the mechanics of calculating statistics. This is what most people think Statistics is about. But the computations don't tell the whole story.

REPORT what you've learned. Until you've explained your results in the context of the business question in your Plan, the job isn't done. We present the report step as a memo to emphasize the decision aspect of each example.

GUIDED EXAMPLE | New York Stock Exchange Trading Volume

Are some months on the NYSE busier than others? Boxplots of the number of shares traded by month are a good way to see such patterns. We're interested not only in the centres, but also in the spreads. Are volumes equally variable from month to month, or are they more spread out in some months?

PLAN

Setup Identify the variables, report the time frame of the data, and state the objective.

We want to compare the daily volume of shares traded from month to month on the NYSE during 2006.

The daily volume is quantitative and measured in number of shares. We can partition the values by month and use side-by-side boxplots to compare the volume across months.

DO

Mechanics Plot the side-by-side boxplots of the data.

REPORT

Conclusion Report what you've learned about the data and any recommended action or analysis.

MEMO:

Re: Research on trading volume of the NYSE

We have examined the daily sales volume on the NYSE (number of shares traded) for each month of 2006. As the attached display shows, sales volume follows a seasonal pattern with lower volume in March and August. The highest median trading activity is found in November. The variability of trading volume also shows a pattern. June and December have higher variability than the rest, and March has noticeably less variability. There were several unusually high-volume days that bear investigation and one extremely low-volume day in November.

Promoting Understanding

What Can Go Wrong?

The most common mistakes for those new to statistical analysis usually involve misusing a method, not miscalculating a statistic. We acknowledge these mistakes with *What Can Go Wrong?*, found at the end of each chapter. Our goal is to arm students with the tools to detect statistical errors and offer practice in debunking misuses of statistics.

Math Box

The mathematical underpinnings of statistical methods and concepts are set apart to avoid interrupting the explanation of the topic at hand. We use these derivations to increase students' understanding of the underlying mathematics, but they can be skipped by less mathematically inclined students.

By Hand

Although we encourage using technology to perform statistical calculations, we recognize the benefits of knowing how to compute by hand. *By Hand* boxes explain formulas and help students through the calculation of a worked example.

WHAT CAN GO WRONG?

- **Don't violate the area principle.** This is probably the most common mistake in a graphical display. Violations of the area principle are often made for the sake of artistic presentation. Earlier we quoted Tufte, who said that "the only worse design than a pie chart is several of them..." Here is another take. The only worse design than a 2-D pie chart is a 3-D pie chart. If you insist on using a pie chart, don't compound the visual perception difficulty by adding irrelevant and misleading perspective. While we're on the subject, don't use 3-D bar chart either (see below). Here, for example, are two versions of the same pie chart for the *Regional Preference* data.
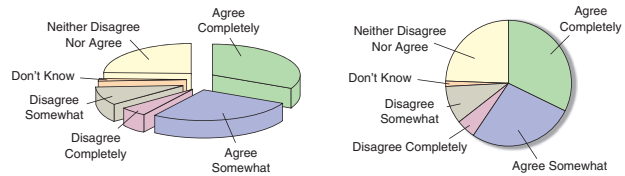
The one on the left looks interesting, doesn't it? But showing the pie three dimensionally on a slant violates the area principle and makes it much more difficult to compare fractions of the whole made up of each category of the response—the principal feature that a pie chart ought to show. Those sections of the pie in the forefront are emphasized. If you want to mislead the viewer, put the "bad news" category in the back and the "good news" category in the front. The viewer sees not only the top of the pie but the side as well.
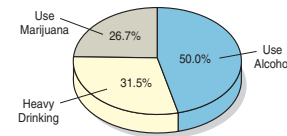
Try adding up the percentages. Or look at the 50% slice. Does it look right? Then think: What are these percentages of? Is there a "whole" that has been sliced up? In a pie chart, the proportions shown by each slice of the pie must add up to 100%, and each individual must fall into only one category. Of course, showing the pie on a slant makes it even harder to detect the error.

MATH BOX

We want to find the mean (expected value) of random variable X, using a geometric method with probability of success p.

First write the probabilities:

x	1	2	3	4	$\cdots$
$P(X = x)$	p	qp	q^2p	q^3p	$\cdots$

The expected value is: $E(X) = 1p + 2qp + 3q^2p + 4q^3p + \cdots$

Let $p = 1 - q$: $= (1 - q) + 2q(1 - q) + 3q^2(1 - q) + 4q^3(1 - q) + \cdots$

Simplify: $= 1 - q + 2q - 2q^2 + 3q^2 - 3q^3 + 4q^3 - 4q^4 + \cdots$

That's an infinite geometric series, with first term 1 and common ratio q: $= 1 + q + q^2 + q^3 + \cdots$

$= \dfrac{1}{1-q}$

So, finally $E(X) = \dfrac{1}{p}$.

Finding the correlation coefficient by hand

To find the correlation coefficient by hand, we'll use a formula in original units, rather than z-scores. This will save us the work of having to standardize each individual data value first. Start with the summary statistics for both variables: $\bar{x}$, $\bar{y}$, s_x, and s_y. Then find the deviations as we did for the standard deviation, but now in both x and y: $(x - \bar{x})$ and $(y - \bar{y})$. For each data pair, multiply these deviations together: $(x - \bar{x}) \times (y - \bar{y})$. Add the products up for all data pairs. Finally, divide the sum by the product of $(n - 1) \times s_x \times s_y$ to get the correlation coefficient.

Here we go.

Suppose the data pairs are:

x	6	10	14	19	21
y	5	3	7	8	12

Then $\bar{x} = 14$, $\bar{y} = 7$, $s_x = 6.20$, and $s_y = 3.39$

Deviations in x	Deviations in y	Product
$6 - 14 = -8$	$5 - 7 = -2$	$-8 \times -2 = 16$
$10 - 14 = -4$	$3 - 7 = -4$	16
$14 - 14 = 0$	$7 - 7 = 0$	0
$19 - 14 = 5$	$8 - 7 = 1$	5
$21 - 14 = 7$	$12 - 7 = 5$	35

Add up the products: $16 + 16 + 0 + 5 + 35 = 72$
Finally, we divide by $(n - 1) \times s_x \times s_y = (5 - 1) \times 6.20 \times 3.39 = 84.07$
The ratio is the correlation coefficient:

$$r = 72/84.07 = 0.856$$

Integrating Technology

Technology Help

In business, Statistics is practised with computers. We offer specific guidance for Excel®, often with an annotated example to help students get started with the technology of their choice.

TECHNOLOGY HELP: Displaying and Summarizing Quantitative Variables

Almost any program that displays data can make a histogram, but some will do a better job of determining where the bars should start and how they should partition the span of the data (see the art on the next page).

Many statistics packages offer a prepackaged collection of summary measures. The result might look like this:

```
Variable: Weight
N = 234
Mean = 143.3      Median = 139
St. Dev = 11.1    IQR = 14
```

Alternatively, a package might make a table for several variables and summary measures:

Variable	N	mean	median	stdev	IQR
Weight	234	143.3	139	11.1	14
Height	234	68.3	68.1	4.3	5
Score	234	86	88	9	5

It is usually easy to read the results and identify each computed summary. You should be able to read the summary statistics produced by any computer package.

Packages often provide many more summary statistics than you need. Of course, some of these may not be appropriate when the data are skewed or have outliers. It is your responsibility to check a histogram or stem-and-leaf display and decide which summary statistics to use.

It is common for packages to report summary statistics to many decimal places of "accuracy." Of course, it is rare to find data that have such accuracy in the original measurements. The ability to calculate to six or seven digits beyond the decimal point doesn't mean that those digits have any meaning. Generally, it's a good idea to round these values, allowing perhaps one more digit of precision than was given in the original data.

Displays and summaries of quantitative variables are among the simplest things you can do in most statistics packages.

The vertical scale may be counts or proportions. Sometimes it isn't clear which. But the shape of the histogram is the same either way.

Most packages choose the number of bars for you automatically. Often you can adjust that choice.

The axis should be clearly labelled so you can tell what "pile" each bar represents. You should be able to tell the lower and upper bounds of each bar.

28.0 29.0 30.0 31.0 32.0 33.0 34.0 35.0
Run Times
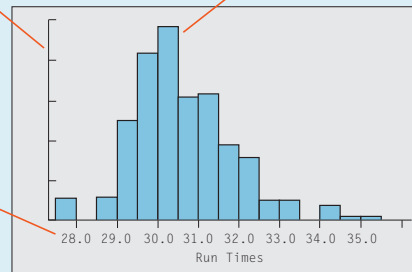
EXCEL

To calculate summaries, Click on an empty cell. Type an equals sign and choose "**Average**" from the popup list of functions that appears to the left of the text editing box. Enter the data range in the box that says "**Number 1**." Click the **OK** button. To compute the standard deviation of a column of data directly, use the **STDEV** from the popup list of functions in the same way.

Comments

Excel's Data Analysis add-in does offer something called a histogram, but it isn't a statistically appropriate histogram. Excel cannot make histograms, boxplots, or dotplots without a third-party add in. Excel's STDEV function should not be used for data values larger in magnitude than 100 000 or for lists of more than a few thousand values. It is fine for smaller data sets.

MINI CASE STUDY PROJECT

Eddie's Hang-Up Display
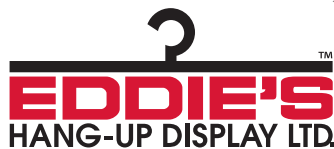
Chances are very high that when you walk into a retail store you notice the merchandise. But do you notice the store fixtures: hangers and size dividers, clothing racks, display cases, signs, tagging and price labels, mannequins, and the myriad of supplies that retailers need to run a business? Eddie's Hang-Up Display Ltd. (www.eddies.com) is one of Canada's leading importers and distributors of store fixtures and retail supplies. They have suppliers in Taiwan, China, Korea, Thailand, Italy, Turkey, France, and the United States. Eddie's has stores in Vancouver and Edmonton and offers over 3000 different display and supply items in addition to custom manufacturing.

Like MEC in the chapter's opening illustration, Eddie's relies on Google Analytics to analyze web traffic and a variety of other data. The Excel spreadsheet **ch04_MCPS_Eddies** has data on *Visits*, *Pages*, and *New Visits* for each of ten regions for March and October 2012. These are two peak months in their business as retailers prepare for spring and Christmas sales periods. The spreadsheet also has 2012 monthly data on these variables for British Columbia and Alberta, where Eddie's has retail stores.

Using Excel or your statistics package, create frequency tables and bar charts of the three variables by region, for each of the two months separately. Next, create a bar chart that compares the two months on the same graph. Then create frequency tables and bar charts to compare data from British Columbia and Alberta across the year. Write a case report summarizing your analysis and results.

Mini Case Study Projects

Each chapter includes one or more *Mini Case Study Projects* that use real data and ask students to investigate a question or make a decision. Students define the objective, plan the process, complete the analysis, and report their conclusion. Data for the *Mini Case Study Projects* are available on MyStatLab, formatted for various technologies. Solutions for the *Mini Case Study Projects* are found in the Instructor's Solutions Manual.

Checking Understanding

Just Checking

Once or twice per chapter, *Just Checking* asks students to stop and think about what they've read. These questions are designed to check student understanding and involve little calculation. Answers are provided at the end of the chapter so students can easily check their work.

What Have We Learned?

These chapter-ending summaries highlight the concepts introduced in the chapter, define new terms, and list the skills presented in the chapter. If students understand all these parts, they're probably ready for the exam.

WHAT HAVE WE LEARNED?

We've learned that data are information in a context.

- The W's help nail down the context: *Who*, *What*, *Why*, *Where*, *When*.
- We must know at least the *Who*, *What*, and *Why* to be able to say anything useful based on the data. The *Who* are the *cases*. The *What* are the *variables*. A variable gives information about each of the cases. The *Why* helps us decide which way to treat the variables.

We treat variables in two basic ways, as *categorical* or *quantitative*.

- Categorical variables identify a category for each case. Usually we think about the counts of cases that fall in each category. (An exception is an identifier variable that just names each case.)
- Quantitative variables record measurements or amounts of something.
- Sometimes we treat a variable as categorical or quantitative depending on what we want to learn from it, which means some variables can't be pigeonholed as one type or the other. That's an early hint that in Statistics we can't always pin things down precisely.

Terms

Case	A case is an individual about whom or which
Categorical variable	A variable that names categories (whether w categorical.
Context	The context ideally tells *Who* was measured were collected, *Where* the data were collect performed.
Cross-sectional data	Data taken from situations that vary over ti instant are said to be a cross-section of the t
Data	Systematically recorded information, whet context.
Data table	An arrangement of data in which each row represents a variable.
Experiment	A study in which the researcher *manipulates* factor on the response.
Experimental unit	An individual in a study for which or for wh experimental units are usually called subject
Identifier variable	A categorical variable that records a unique value for each case, used to name or identify it.
Nominal variable	The term "nominal" can be applied to data whose values are used only to name categories.

Skills

PLAN
- Recognize when a variable is categorical and choose an appropriate display for it.
- Understand how to examine the association between categorical variables by comparing conditional and marginal percentages.

DO
- Summarize the distribution of a categorical variable with a frequency table.
- Display the distribution of a categorical variable with a bar chart.
- Construct and examine a contingency table.
- Construct and examine displays of the conditional distributions of one variable for two or more groups.
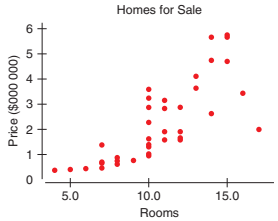
REPORT
- Describe the distribution of a categorical variable in terms of its possible values and relative frequencies.
- Describe any anomalies or extraordinary features revealed by the display of a variable.
- Describe and discuss patterns found in a contingency table and associated displays of conditional distributions.

Tackling Problems
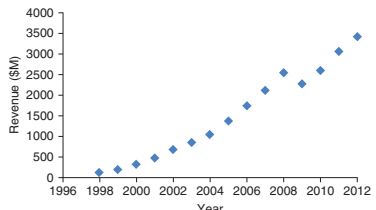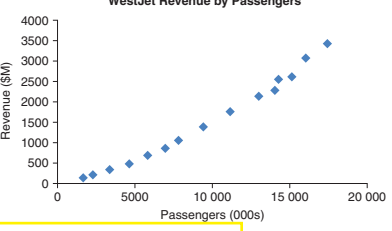
Exercises

We have worked hard to ensure that the exercises contain relevant and modern questions with real data. The exercises generally start with a straightforward application of the ideas, then tackle larger problems. Many break a problem into several parts to help guide the student through the logic of a complete analysis. Finally, there are exercises that ask students to synthesize and incorporate their ideas with less guidance. Data sets for exercises marked with **T** can be found on MyStatLab.

EXERCISES

Homes for Sale

a) Is there an association?
b) Check the assumptions and conditions for correlation.
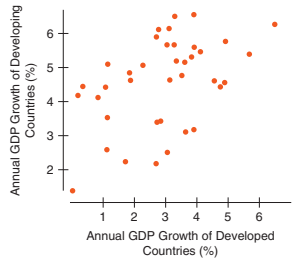
T 22. WestJet. WestJet is Canada's second largest Canadian air carrier, and the ninth-largest in North America by passengers carried (over 17 million in 2012). Founded in 1996, WestJet is a public company with over 9000 employees, non-unionized, and not part of any airline alliance. Here are two scatterplots of data from 1998–2012. The first shows the growth in annual revenue over time. The second shows the relationship between annual revenue and number of passengers (called "segment guests"). Describe the relationships seen in the two scatterplots. Are they linear? Are there any unusual features or data points? **LO❶**

WestJet Revenue Growth

WestJet Revenue by Passengers

for 180 countries as grouped by the World Bank. Each point represents one of the years from 1970 to 2007. The output of a regression analysis follows. **LO❷**

Dependent variable: GDP Growth Developing Countries
R^2 = 20.81%
s = 1.244
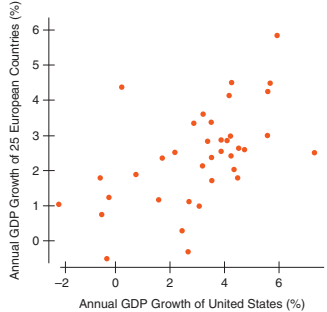
Variable	Coefficient
Intercept	3.46
GDP Growth Developed Countries	0.433

a) Check the assumptions and conditions for the linear model.
b) Explain the meaning of R^2 in this context.
c) What are the cases in this model?

T 24. European GDP growth. Is economic growth in Europe related to growth in the United States? Here's a scatterplot of the average growth in 25 European countries (in % of Gross Domestic Product) vs. the growth in the United States. Each point represents one of years from 1970 to 2007. **LO❷**

Dependent variable: 25 European Countries GDP Growth
R^2 = 29.65%
s = 1.156

n the developing world d countries? Here's a Domestic Product) of of developed countries

Ethics in Action

Our ethics vignettes in each chapter illustrate some of the judgments needed in statistical analysis, identify possible errors, link the issues to the ASA's Ethical Guidelines, and then propose ethically and statistically sound alternatives.

THE CANADIAN EDITION OF *BUSINESS STATISTICS*

This book recognizes both the changing curriculum and the changing pedagogy for teaching introductory Statistics. It focuses on application, streamlines and reorganizes topics, sheds unneeded theoretical details, and recognizes learning styles of the current generation of students, making it an attractive choice for single-term courses at Canadian business schools.

The Canadian edition uses illustrative case studies and chapter exercises that focus on business and management of Canadian companies, large and small. The writing has Canadian style, perspective, and sensibility, not just changes to spelling and metric measurements. The book recognizes that Canada has public policy, governmental structure and mandate (federal, provincial, and municipal), economic systems (banking and finance), social services, health care, sports, and entertainment that are different from those of the United States. While the book is indeed Canadian, it also shows how Statistics has no geographical borders and is a vital part of building and enhancing the global community.

Most chapter-opening examples reflect a Canadian situation that is then used within the chapter to illustrate new concepts. Throughout the chapters, exercises use Canadian sources and examples, as do most *Mini Case Study Projects*.

The Canadian edition has two new features on the chapter opener, to help map the chapter content: Learning Objectives, which are then tied to the end-of-chapter exercises, and a Connections box that situates the content within the text as a whole. New and expanded topics, new sidebars, and added warnings in *What Can Go Wrong* features throughout the chapters provide further clarity and context for students.

Chapter 16, Statistical Modelling and the World of Business Statistics, is a brand-new capstone chapter. It provides both a framework for the inference methods developed in Chapters 9 through 15 and a method for choosing an appropriate procedure for a given data analysis situation.

Here are some highlights of what else is new in the Canadian edition:

- **Chapter 1** encourages students' interest in and understanding of the discipline through the revised chapter opener and a brand-new Section 1.1, The Role of Statistics in the World. This chapter also includes new material to explain and expand on the concept of variation.

- **Chapter 2** expands Section 2.2, Types of Variables (and Types of Data), to include topics such as "imaginary" units or underlying measurement scale, the creation of quantitative variables as summed ordinal scales, and string variables. The new Section 2.3, Data Quality, categorizes data as "good" versus "bad" and explores various aspects of data quality.

- **Chapter 3** provides additional explanations of *population*, *parameter*, *sample*, *statistic*, and *sampling frame* and sidebar discussions that help contextualize the concept of polls and surveys.

- **Chapter 4** introduces alternatives and variations on bar charts—dot plot, Pareto chart—and segmented bar charts as an alternative to pie charts.

- **Chapter 5** has new historical notes on the term *histogram*, the origins of stem-and-leaf displays, and the use of x-bar notation; an added explanation of harmonic and geometric means, with illustrative examples; and the probability explanation of the $n - 1$ denominator of sample standard deviation.

- **Chapter 6** has a new discussion on regression to the mean, with graphical illustration.

- **Chapter 7** features expanded commentary about and illustrations of Bayes' Rule. The new Section 7.10, Fun with Probability!, describes three famous probability puzzles.

- **Chapter 8** has a new subsection on dependent random variables, in light of their importance in finance and portfolio diversification.

- **Chapter 9** includes stronger ties to material in previous and later chapters, to help students draw on what they have already learned.

- **Chapter 10** has a full illustration of the correspondence between the logic of hypothesis testing and proof by contradiction, as well as new explanations of concepts such as statistical versus practical significance and how the two error-type probabilities are inversely related.

- **Chapter 11** includes feature boxes that connect statistics to students' everyday life, including a *Just Checking* feature on the Canadian census administered by Statistics Canada and an *Ethics in Action* box that addresses wait times for elective medical treatment in Canada.

- **Chapter 12** has a new subsection about how the paired t-test works, as well as a new Section 12.9, Comparing Two Proportions, with an illustrative example on Facebook usage by teenagers.

- **Chapter 13** combines the two sections on the chi-square test of homogeneity and the chi-square test of independence into a single section, Chi-Square Tests of Two-Way Tables, showing how the two-proportion z-test can be recast as a two-way table and then extended to more rows and more columns.

- **Chapter 14** has two new sections: Section 14.10, A Hypothesis Test for Correlation, and Section 14.11, ANOVA and the F-statistic.

- **Chapter 15** has two new sections: Section 15.6, Building, Comparing, and Using Models, and Section 15.7, Extending Multiple Regression.

- **Chapter 16,** the new capstone chapter, synthesizes key material from earlier chapters. It also provides a brief description of several business statistics methods beyond the scope of this text and concludes with comments on the future of business statistics and big data.

We set out to write a book for business students that answers the simple question: "How can I make better decisions?" As entrepreneurs and consultants, we know that statistics are essential to survive and thrive in today's competitive environment. As educators, we've seen a disconnect between the way Statistics is taught to business students and the way it is used in making business decisions. In *Business Statistics: A First Course*, we try to close the gap between theory and practice by presenting statistical methods so they are both relevant and interesting to students.

The data that inform a business decision have a story to tell, and the role of statistics is to help us hear that story clearly. Like other textbooks, *Business Statistics: A First Course* teaches how to select and perform inferential tests and highlights definitions and formulas. But, unlike other textbooks, *Business Statistics: A First Course* also teaches the "why" and insists that results be reported in the context of business decisions. Students will come away knowing how to use statistics to make better business decisions and how to effectively communicate both their analysis and recommendations.

Business Statistics: A First Course is written with the understanding that today Statistics is practised with technology. This insight informs everything from our choice of forms for equations to our extensive use of real data. But more important, understanding the value of technology allows us to focus on teaching statistical thinking rather than calculation. The questions that motivate each of our hundreds of examples are not "how do you find the answer?" but "how do you think about the answer, and how does it help you make a better decision?"

Our focus on statistical thinking ties the chapters of the book together. An introductory business statistics course covers an overwhelming number of new terms, concepts, and methods. But they have a central core: how we can understand more about the world and make better decisions by understanding what the data tell us. From this perspective, students can see that the many ways to draw inferences from data are several applications of the same core concepts.

Our Goal: Read This Book!

The best textbook in the world is of little value if students don't read it. Here are some of the ways we made *Business Statistics: A First Course* more approachable:

- **Readability.** You'll see immediately that this book doesn't read like other Statistics texts. We strive for a conversational, approachable style, and we introduce anecdotes to maintain interest. In class tests, instructors report their amazement that students are voluntarily reading ahead of their assignments. Students write to tell us (to their amazement) that they actually enjoyed the book.

- **Focus on assumptions and conditions.** More than any other textbook, *Business Statistics: A First Course* emphasizes the need to verify assumptions to use statistical procedures. We reiterate this focus throughout the examples and exercises. We make every effort to provide students with templates that reinforce the practice of checking these assumptions and conditions, rather than rushing through the computations of a real-life problem.

- **Emphasis on graphing and exploring data.** Our consistent emphasis on the importance of displaying data is evident through all chapters. Examples always include data displays and often illustrate the value of examining data visually,

and the exercises reinforce this. When we graph data, we are able to see structures, or patterns, that we can't see otherwise. These patterns often raise new questions and guide our statistical analysis and case analysis process. Emphasizing graphics throughout the book helps students see that the structures we look for in graphs help illuminate sophisticated concepts.

- *Consistency.* We work hard to avoid the "do as we say, not as we do" trap. Having taught the importance of plotting data and checking assumptions and conditions, we are careful to model that behaviour throughout the book. (Check the exercises in the chapter on multiple regression and you'll find us still requiring and demonstrating the plots and checks that were introduced in the early chapters.) This consistency helps reinforce these fundamental principles.

- *The need to read.* Students who plan just to skim the book may find that important concepts, definitions, and sample solutions are not always set aside in boxes. This book needs to be read, so we've tried to make the reading experience enjoyable.

Coverage

The topics covered in a Business Statistics course are generally consistent and mandated by our students' needs in their studies and in their future professions. But the *order* of these topics and the relative emphasis given to each is not well established. In *Business Statistics: A First Course*, you may encounter some topics sooner or later than you expected. Although we have written many chapters specifically so they can be taught in a different order, we urge you to consider the order we have chosen.

We've been guided in the order of topics by the fundamental principle that this should be a coherent course in which concepts and methods fit together to give students a new understanding of how reasoning with data can uncover new and important truths. We have tried to ensure that each new topic fits into the growing structure of understanding that we hope students will build. For example, we teach inference concepts with proportions first and then with means. Students have a wider experience with proportions, seeing them in polls and advertising. And by starting with proportions, we can teach inference with the Normal model and then introduce inference for means with the Student's t-distribution.

We introduce the concepts of association, correlation, and regression early in *Business Statistics: A First Course*. Our experience in the classroom shows that introducing students to these fundamental ideas early motivates them at the beginning of the course. Later in the semester, when we discuss inference, students recall what they have learned and find it natural and relatively easy to build on the fundamental concepts they experienced by exploring data with these methods. In an introductory course, the relative emphasis placed on topics requires planning by the instructor. Introductory Business Statistics courses often have limited time, so it can be hard to get to the important topics of multiple regression and model building with enough time to treat them thoroughly. We've been guided in our choice of what to emphasize by the GAISE (Guidelines for Assessment and Instruction in Statistics Education) Report,[1] which resulted from extensive experience in how students best learn statistics. Those recommendations, which received wide support and adoption across North America (Statistical Society of Canada and American Statistical Association), urge (among other detailed suggestions) that Statistics education should:

1. Emphasize statistical literacy and develop statistical thinking;
2. Use real data;
3. Stress conceptual understanding rather than mere knowledge of procedures;

---

[1] www.amstat.org/education/gaise

4. Foster active learning;

5. Use technology for developing conceptual understanding and analyzing data; and

6. Make assessment a part of the learning process.

In this sense, this book is thoroughly modern. But to be effective, a course must fit comfortably with the instructor's preferences. There are several equally effective pathways through this material depending on the emphasis a particular instructor wants to make. We describe some alternative orders that also work comfortably with these materials.

Flexible Syllabus. *Business Statistics: A First Course* follows the GAISE Guidelines. The committee that developed these guidelines was made up of innovative educators in Statistics education, including one of the authors of this textbook (Velleman). Those guidelines call for presenting students with real data early and throughout the course and emphasizing real-world decisions and understanding as the final step of any statistical analysis. Following that advice, we have placed an introductory (exploratory, non-inference) section on regression early in the text (Chapter 6).

However, we are acutely aware of the challenge that Statistics instructors face in covering essential material in a limited period of time. For that reason we offer suggested modifications that may better fit your teaching style and requirements:

- Chapter 3 (Surveys and Sampling) can be taught just before Chapter 7 (Randomness and Probability), where it would provide motivation for randomness.

- Chapter 6 (Correlation and Linear Regression [without inference]) can be taught just before Chapter 14 (Inference for Regression), where it would form a larger lesson on regression analysis through inference and can be followed immediately by Chapter 15's discussion of multiple regression.

- Chapter 7 (Randomness and Probability) can be excluded if probability is taught in a separate course (e.g. quantitative decision-making), or for a more data-focused course.

- We introduce inference with proportions. We find this works better for students (who know about polls and margins of error in that context), and makes the presentation simpler. If you prefer to introduce inference with means, you can teach Chapter 11 (Confidence Intervals and Hypothesis Tests for Means) before Chapter 10 (Testing Hypotheses about Proportions). Note, however, that we teach inference for means without the assumption that the population standard deviation is known, and thus emphasize Student's t. That reflects the almost universal practice in real business analyses and in all statistics software. It also frees students of any concern about how big a sample should be before "switching" from t to Normal—with modern technology, there is no need to switch. And no statistics package or regression analysis does switch.

- Chapters 12 (Comparing Two Groups) and 13 (Inference for Counts: Chi-Square Tests) are omitted by some instructors.

- Chapter 15 introduces multiple regression, which can also be omitted.

- Chapter 16 is designed to be a capstone chapter, by summarizing inference in the framework of statistical modelling. For courses that do not cover regression models, this chapter is optional.

Features

A textbook isn't just words on a page: it is many features that come together to form a big picture. The features in *Business Statistics: A First Course* provide a real-world context for concepts, help students apply these concepts, promote problem-solving, and

integrate technology—all of which help students understand and see the big picture of Business Statistics.

Motivating Examples. Each chapter opens with a motivating example, often taken from the authors' consulting experiences. These companies—such as Angus Reid, Mountain Equipment Co-op, Manulife Financial, and Canada Goose—enhance and illustrate the story of each chapter and show students how and why statistical thinking is so vital to modern business decision-making. We analyze the data from those companies throughout the chapter.

LEARNING OBJECTIVES

Learning Objectives. Each chapter begins with a list of learning objectives. These are brief but clear statements about what students are expected to know and be able to demonstrate by the end of chapter (or the end of the course). These will also help instructors with course planning and classroom delivery. Each end-of-chapter exercise references one or more learning objectives to guide students' assessment of their progress with the material.

CONNECTIONS

Connections. Although the authors (and, we hope, the instructors) know how the chapters of a textbook are related to each other and understand the logic behind the sequencing, it may not be clear to students until they reach the end of the book. The Connections boxes explain how the current chapter is related to the previous chapter(s), and why its position in the sequence is appropriate.

PLAN

DO

REPORT

Step-by-Step Guided Examples. The ability to clearly communicate statistical results is crucial to helping Statistics contribute to business decision-making. To that end, some examples in each chapter are presented as *Guided Examples*. A good solution is modelled in the right column while commentary appears in the left column. The overall analysis follows our innovative **Plan, Do, Report** template. That template begins each analysis with a clear question about a decision and ends with a report that answers that question. To emphasize the decision aspect of each example, we present the **Report** step as a business memo that summarizes the results in the context of the example and states a recommendation if the data are able to support one. In addition, whenever possible we include limitations of the analysis or models in the concluding memo.

MINI CASE STUDY PROJECTS

Mini Case Study Projects. Each chapter includes one or two *Mini Case Study Projects* that use real data and ask students to investigate a question or make a decision. Students define the objective, plan the process, complete the analysis, and report a conclusion. Data for the *Mini Case Study Projects* are available on MyStatLab.

What Can Go Wrong? Each chapter contains an innovative section called *What Can Go Wrong?* that highlights the most common statistical errors and the misconceptions people have about Statistics. The most common mistakes for the new user of statistical methods involve misusing a method, not miscalculating a statistic. Most of the mistakes we discuss have been experienced by the authors in a business context rather than a classroom situation. One of our goals is to arm students with the tools to detect statistical errors and to offer practice in recognizing when Statistics is misused, whether intentional or not. In this spirit, some of our exercises probe the understanding of such errors.

By Hand. Even though we encourage the use of technology to calculate statistical quantities, we realize the pedagogical benefits of doing a calculation by hand. The *By Hand* boxes break apart the calculation of some of the simpler formulas and help the student through the calculation of a worked example.

REALITY CHECK

Reality Check. We regularly remind students that Statistics is about understanding the world and making decisions with data. Results that make no sense are probably

wrong, no matter how carefully we think we did the calculations. Mistakes are often easy to spot with a little thought, so we ask students to stop for a reality check before interpreting results.

Notation Alert. Throughout this book, we emphasize the importance of clear communication. Proper notation is part of the vocabulary of Statistics, but it can be daunting. Students who know that in Algebra *n* can stand for any variable may be surprised to learn that in Statistics *n* is always the sample size. Statisticians dedicate many letters and symbols for specific meanings (*b*, *e*, *n*, *p*, *q*, *r*, *s*, *t*, and *z*, along with many Greek letters all carry special connotations). Students learn more effectively when they are clear about the letters and symbols statisticians use.

Just Checking. To help students check their understanding of material they've just read, we ask questions at points throughout the chapter. These questions are a quick check and most involve little calculation. The answers are at the end of the exercise sets in each chapter so students can easily check themselves to be sure they understand the key ideas. The questions can also be used to motivate class discussion.

MATH BOX

Math Boxes. In many chapters, we present the mathematical underpinnings of the statistical methods and concepts. Different students learn in different ways, and even the same student can understand the material by more than one path. By setting these proofs, derivations, and justifications apart from the narrative, we allow the student to continue to follow the logical development of the topic at hand, yet also make available the underlying mathematics for greater depth.

WHAT HAVE WE LEARNED?

What Have We Learned? These chapter-ending summaries highlight new concepts, define new terms introduced in the chapter, and list the skills that the student should have acquired. Students can think of these as study guides. If they understand the concepts in the summary, know the terms, and have the skills, they're probably ready for the exam.

ETHICS IN ACTION

Ethics in Action. Students are often surprised to learn that Statistics is not just plugging numbers into formulas. Most statistical analyses require a fair amount of judgment. The best guidance for these judgments is that we make an honest and ethical attempt to learn the truth. Anything less than that can lead to poor and even dangerous decisions. The *Ethics in Action* vignettes in each chapter illustrate some of the judgments needed in statistical analyses, identify possible errors, link the issues to widely accepted ethical guidelines in Statistics, and then propose ethically and statistically sound alternative approaches.

Exercises. We've worked hard to ensure that exercises contain relevant, modern, and real-world questions. Many come from news stories; some come from recent research articles. Whenever possible, the data are on MyStatLab (always in a variety of formats) so students can explore them further. Sometimes, because of the size of the data set, the data are only available electronically. Throughout the book, we pair the exercises so that each odd-numbered exercise (with answer in the back of the book) is followed by an even-numbered exercise on the same Statistics topic. Exercises are roughly ordered within each chapter by both topic and by level of difficulty.

Data Sources. Most of the data used in examples and exercises are from real-world sources, and we list many sources in this edition. Whenever we can, we include references to the internet data sources used, often in the form of URLs. As internet users (and thus, our students) know well, URLs can "break" as websites evolve. To minimize the impact of such changes, we point as high in the address tree as is practical. Moreover, the data themselves often change as more recent values become

available. The data we use are usually on MyStatLab. If you seek the data—or an updated version of the data—on the internet, we try to direct you to a good starting point.

TECHNOLOGY HELP

Technology Help. In business, Statistics is practised with computers, but not with a single software platform. Instead of emphasizing a particular statistics program, at the end of each chapter, we summarize what students can find in the most common packages, often with annotated output. We then offer specific guidance for one of the most common packages, Excel®, to help students get started with the software of their choice.

Supplements

Technology Resources

MyStatLab™ Online Course (access code required). MyStatLab is a course management system that delivers **proven results** in helping individual students succeed.

- MyStatLab can be successfully implemented in any environment—lab-based, hybrid, fully online, traditional—and demonstrates the quantifiable difference that integrated usage has on student retention, subsequent success, and overall achievement.

- MyStatLab's comprehensive online gradebook automatically tracks students' results on tests, quizzes, and homework, and in the study plan. Instructors can use the gradebook to provide positive feedback or intervene if students have trouble. Gradebook data can be easily exported to a variety of spreadsheet programs, such as Microsoft Excel. You can determine which points of data you want to export, and then analyze the results to determine success.

MyStatLab provides **engaging experiences** that personalize, stimulate, and measure learning for each student. In addition to the following resources, each course includes a full interactive online version of the accompanying textbook.

- **Data Sets:** Data sets are available on MyStatLab and are formatted for use with Excel® and other statistics software.

- **Tutorial Exercises with Multimedia Learning Aids:** The homework and practice exercises in MyStatLab align with the exercises in the textbook, and they regenerate algorithmically to give students unlimited opportunity for practice and mastery. Exercises offer immediate helpful feedback, guided solutions, sample problems, animations, videos, and eText clips for extra help at point-of-use.

- **StatTalk Videos:** *24 Conceptual Videos to Help You Actually Understand Statistics.* Fun-loving statistician Andrew Vickers takes to the streets of Brooklyn, New York, to demonstrate important statistical concepts through interesting stories and real-life events. These fun and engaging videos will help students actually understand statistical concepts. Available with an instructor's user guide and assessment questions.

- **Business Insight Videos:** Concept videos feature Deckers, Southwest Airlines, Starwood, and other companies and focus on statistical concepts as they pertain to the real world.

- **Getting Ready for Statistics:** A library of questions now appears within each MyStatLab course to offer the developmental math topics students need for the course. These can be assigned as a prerequisite to other assignments, if desired.

- **Conceptual Question Library:** In addition to algorithmically regenerated questions that are aligned with the textbook, there is a library of 1000 Conceptual Questions available in the assessment manager that requires students to apply their statistical understanding.

- **StatCrunch™:** MyStatLab integrates the web-based statistical software StatCrunch within the online assessment platform so that students can easily analyze data sets from exercises and the text. In addition, MyStatLab includes access to **www.StatCrunch.com**, a website where users can access more than 15 000 shared data sets, conduct online surveys, perform complex analyses using the powerful statistical software, and generate compelling reports.

- **Statistical Software Support:** Knowing that students often use external statistical software, we make it easy to copy our data sets into software such as StatCrunch, Minitab, Excel, and more. Students have access to a variety of support tools—Technology Tutorial Videos, Technology Study Cards, and Technology Manuals for select titles—to learn how to effectively use statistical software.

- **Pearson eText:** Pearson eText gives students access to the text whenever and wherever they have access to the Internet. eText pages look exactly like the printed text, offering powerful new functionality for students and instructors. Users can create notes, highlight text in different colours, create bookmarks, zoom, click hyperlinked words and phrases to view definitions, and view in single-page or two-page view. Pearson eText allows for quick navigation to key parts of the eText using a table of contents and provides full-text search. The eText may also offer links to associated media files, enabling users to access videos, animations, or other activities as they read the text.

MathXL® for Statistics Online Course (access code required). MathXL® is the homework and assessment engine that runs MyStatLab. (MyStatLab is MathXL plus a learning management system.) With MathXL for Statistics, instructors can

- Create, edit, and assign online homework and tests using algorithmically generated exercises correlated at the objective level to the textbook.
- Create and assign their own online exercises and import TestGen tests for added flexibility.
- Maintain records of all student work, tracked in MathXL's online gradebook.

With MathXL for Statistics, students can

- Take chapter tests in MathXL and receive personalized study plans and/or personalized homework assignments based on their test results.
- Use the study plan and/or the homework to link directly to tutorial exercises for the objectives they need to study.
- Access supplemental animations and video clips directly from selected exercises.

Knowing that students often use external statistical software, we make it easy to copy our data sets, both from the eText and the MyStatLab questions, into software like StatCrunch™, Minitab®, Excel®, and more.

MathXL for Statistics is available to qualified adopters. For more information, visit our website at **www.mathxl.com**, or contact your Pearson representative.

StatCrunch. StatCrunch is powerful web-based statistical software that allows users to perform complex analyses, share data sets, and generate compelling reports of their data. The vibrant online community offers more than 15 000 data sets for students to analyze.

- **Collect.** Users can upload their own data to StatCrunch or search a large library of publicly shared data sets, spanning almost any topic of interest. Also, an online survey tool allows users to quickly collect data via web-based surveys.
- **Crunch.** A full range of numerical and graphical methods allow users to analyze and gain insights from any data set. Interactive graphics help users understand statistical concepts, and are available for export to enrich reports with visual representations of data.
- **Communicate.** Reporting options help users create a wide variety of visually appealing representations of their data.

Full access to StatCrunch is available with a MyStatLab kit, and StatCrunch is available by itself to qualified adopters. StatCrunch Mobile is now available to access from your mobile device. For more information, visit our website at **www.StatCrunch.com**, or contact your Pearson representative.

Additional Student Supplement

CourseSmart for Students. CourseSmart goes beyond traditional expectations—providing instant, online access to the textbooks and course materials you need at significant savings over the price of a printed text. With instant access from any computer and the ability to search your text, you'll find the content you need quickly, no matter where you are. And with online tools like highlighting and note-taking, you can save time and study efficiently. See all the benefits at www.coursesmart.com/students.

Instructor Supplements

Instructor's Solutions Manual. This manual contains solutions for all end-of-chapter exercises as well as the Mini Case Study Projects. Available within MyStatLab or at http://www.pearsoncanada.ca/highered.

Instructor's Resource Guide. This guide contains chapter-by-chapter comments on the major concepts, tips on presenting topics (and what to avoid), teaching examples, suggested assignments, basic exercises, and web links and lists of other resources. Available within MyStatLab or at http://www.pearsoncanada.ca/highered.

Business Insight Video Guide to accompany *Statistics*. Written to accompany the Business Insight Videos, this guide includes a summary of the video, video-specific questions and answers that can be used for assessment or classroom discussion, a correlation to relevant chapters in *Statistics*, concept-centred teaching points, and useful web links. The Video Guide is available for download from MyStatLab or at http://www.pearsoncanada.ca/highered.

PowerPoint® Lecture Slides. The PowerPoint® package provides an outline to use in a lecture setting, presenting definitions, key concepts, and figures from the text. These slides are available within MyStatLab or at http://www.pearsoncanada.ca/highered.

TestGen® (www.pearsoned.com/testgen). TestGen software enables instructors to build, edit, print, and administer tests using a computerized bank of questions developed to cover all the objectives of the text. TestGen is algorithmically based, allowing instructors to create multiple but equivalent versions of the same question or test with the click of a button. Instructors can also modify test bank questions or add new questions. The software and testbank are available for download from Pearson Canada's online catalogue.

Test Item File. All the test questions from the TestGen testbank are also available in Microsoft Word format, available within MyStatLab or at www.pearsoncanada.ca/highered.

Image Library. An image library with electronic copies of key figures and tables from the text is available within MyStatLab or at www.pearsoncanada.ca/highered.

CourseSmart for Instructors. CourseSmart goes beyond traditional expectations—providing instant, online access to the textbooks and course materials you need at a lower cost for students. And even as students save money, you can save time and hassle with a digital eTextbook that allows you to search for the most relevant content at the very moment you need it.

Whether it's evaluating textbooks or creating lecture notes to help students with difficult concepts, CourseSmart can make life a little easier. See how when you visit www.coursesmart.com/instructors.

Pearson Custom Library. For enrollments of at least 25 students, you can create your own textbook by choosing the chapters that best suit your own course needs. To begin building your custom text, visit www.pearsoncustomlibrary.com. You may also work with a dedicated Pearson Custom editor to create your ideal text—publishing your own original content or mixing and matching Pearson content. Contact your local Pearson sales representative to get started.

Learning Solutions Managers. Pearson's Learning Solutions Managers work with faculty and campus course designers to ensure that Pearson technology products, assessment tools, and online course materials are tailored to meet your specific needs. This highly qualified team is dedicated to helping schools take full advantage of a wide range of educational resources, by assisting in the integration of a variety of instructional materials and media formats. Your local Pearson sales representative can provide you with more details on this service program.

Acknowledgments

Many people have contributed to this book from the first day of its conception to its publication. This book would not have been possible without the many contributions of David Bock, our co-author on several of our other textbooks. Many of the explanations and exercises in this book benefit from Dave's pedagogical flair and expertise. We are honoured to have him as a colleague and friend.

Business Statistics: A First Course would have never seen the light of day without the assistance of the incredible team at Pearson. We'd also like to thank our accuracy checkers whose monumental task was to make sure we said what we thought we were saying; the individuals who joined us for a weekend to discuss business statistics education, emerging trends, technology, and business ethics; and those who provided feedback through focus groups, class tests, and reviews.

Finally, we want to thank our families. This has been a long project, and it has required many nights and weekends. Our families have sacrificed so that we could write the book we envisioned.

Norean Sharpe
Richard De Veaux
Paul Velleman

My sincere thanks to Mark Wexler for his guidance and suggestions on how to successfully undertake a textbook writing project, and to Sam Shamash for his list of suggested suitable companies to profile.

Special thanks to Stephen Gaerber, Neil Cumming, Rob Philipp, and Kit Chansavang for providing interesting and illuminating data sets for chapter openers or exercises.

Thanks to Jan Wallace and Alex Micu for their early assistance and helping me get my first chapter written.

And most importantly, from a very proud father, thanks to Joshua Berkowitz and Matthew Berkowitz, who enthusiastically undertook internet research to suggest appropriate case studies and exercises, and to find relevant data sets.

Thanks to the amazing team at Pearson, in particular, Megan Farrell, Acquisitions Editor; Darryl Kamo and Lori McLellan, Developmental Editors; and Cat Haggert, Copy Editor.

The following reviewers (plus other who choose to remain anonymous) provided feedback on either the U.S. edition or the manuscript for the Canadian edition:

Peter Au, George Brown College
Charles A. Backman, Grande Prairie Regional College
Fouzia Baki, McMaster University
Walid Belassi, Athabasca University
Clare Chua, Ryerson University
Laurel A. Donaldson, Douglas College
Torben Drewes, Trent University
Bruno Fullone, George Brown College
Scott Hadley, Sheridan Institute of Technology and Advanced Learning
Darryl Hammond, Red River College of Applied Arts, Science and Technology
Ali R. Hassanlou, Kwantlen Polytechnic University
Dave Kennedy, Lethbridge College
Dennis Kira, Concordia University
Linda Lakats, York University
Lisa MacKay, SAIT Polytechnic
Colin F. Mang, Nipissing University
John Mayer, SAIT Polytechnic
Ron McCarron, Cape Breton University
Hassan Qudrat-Ullah, York University
Gerhard Trippen, University of Toronto Mississauga
Thomas Varghese, Northern Alberta Institute of Technology

Their comments helped to shape this edition of the book.

Jonathan Berkowitz