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Statistics and Probability

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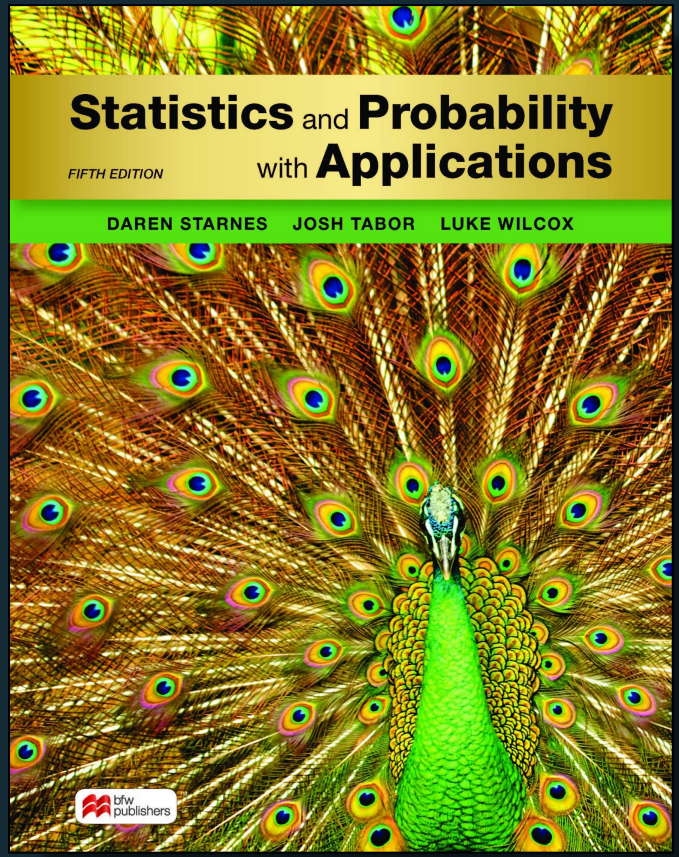
Statistics and Probability with Applications

5th Edition

Daren Starnes
Josh Tabor
Luke Wilcox



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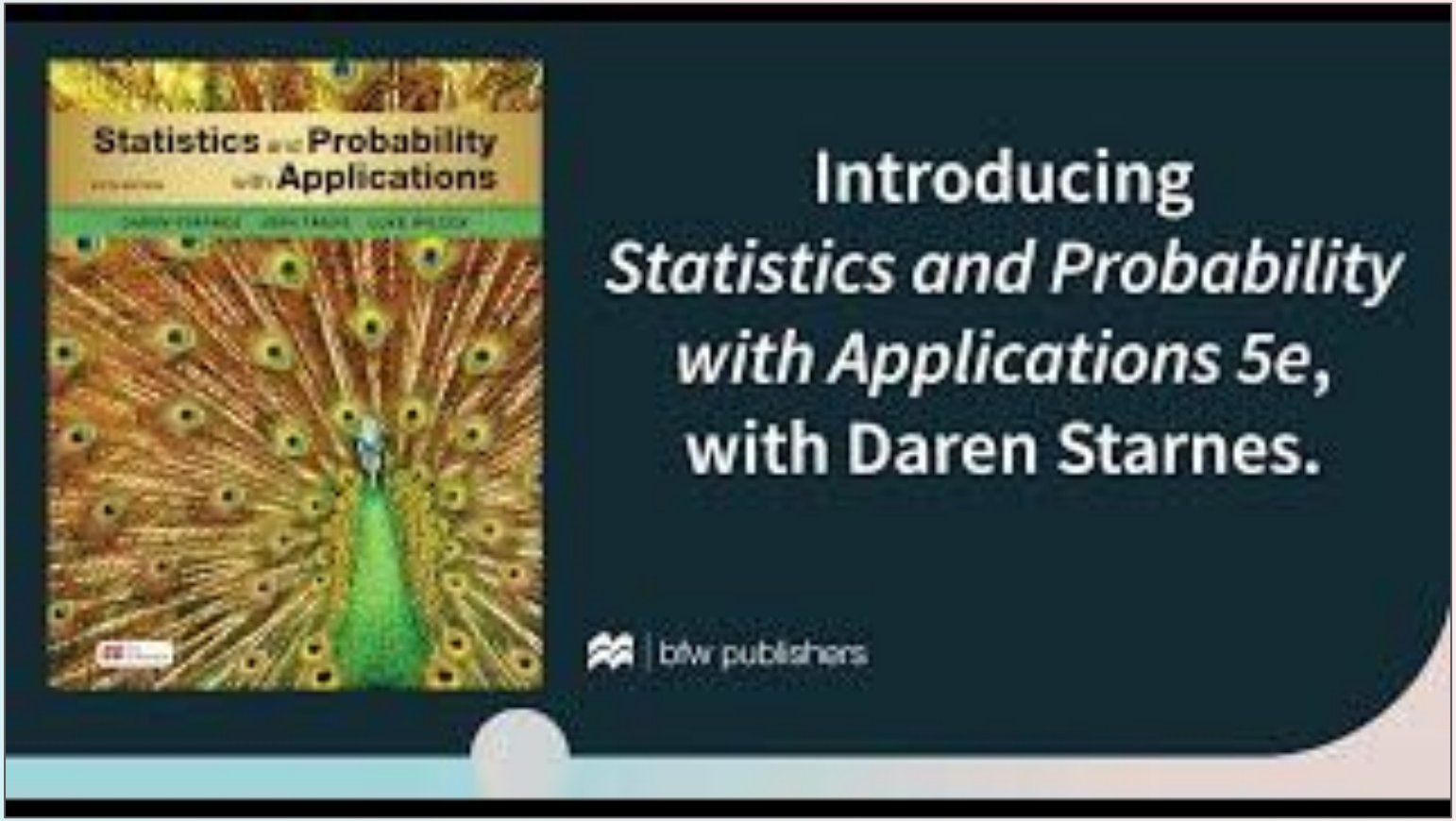
Statistics and Probability with Applications
Introducing
Statistics and Probability with Applications 5e,
with Daren Starnes.
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Student Edition

Structure

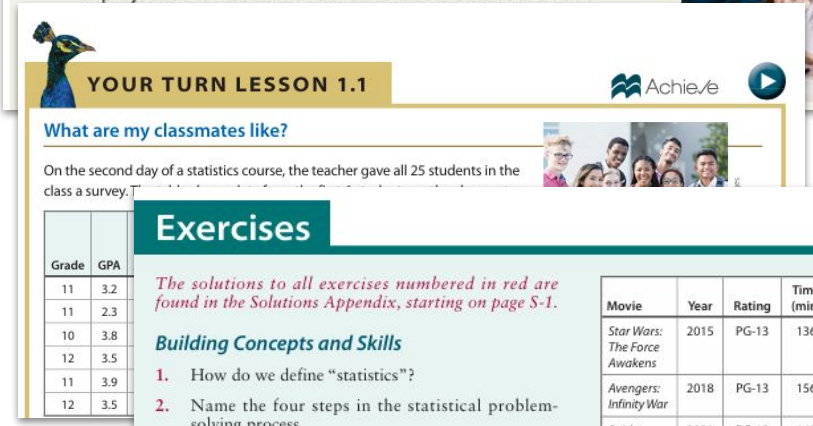
1
Analyzing One-Variable Data

EXAMPLE

So you want to be happy?

Individuals and variables

PROBLEM: The American Statistical Association sponsors a project called Census at School that collects data about



YOUR TURN LESSON 1.1

Achieve

What are my classmates like?

On the second day of a statistics course, the teacher gave all 25 students in the class a survey.

Grade	GPA
11	3.2
11	2.3
10	3.8
12	3.5
11	3.9
12	3.5

Exercises

The solutions to all exercises numbered in red are found in the Solutions Appendix, starting on page S-1.

Building Concepts and Skills

1. How do we define "statistics"?
2. Name the four steps in the statistical problem-solving process.
3. True/False: An individual described in a set of data must be a person.
4. Identify the two types of variables.
5. Give one example of each type of variable.
6. True/False: Any variable that takes number values is a quantitative variable.
7. The distribution of a variable tells us which _____ the variable takes and _____ it takes each value.
8. Explain the difference between a frequency table and a relative frequency table.

Movie	Year	Rating	Time (min)	Genre	Box office ($)
Star Wars: The Force Awakens	2015	PG-13	136	Adventure	2,064,615,817
Avengers: Infinity War	2018	PG-13	156	Action	2,048,359,754
Spider Man: No Way Home	2021	PG-13	148	Action	1,907,836,254
Jurassic World	2015	PG-13	124	Action	1,669,963,641
The Lion King	2019	PG	118	Adventure	1,646,106,779
The Avengers	2012	PG-13	143	Action	1,515,100,211

10. **Tournament time** A high school lacrosse team is planning to go to Buffalo, New York, for a three-day tournament. The tournament's sponsor provides a list of available hotels, along with some information about each hotel. The following table

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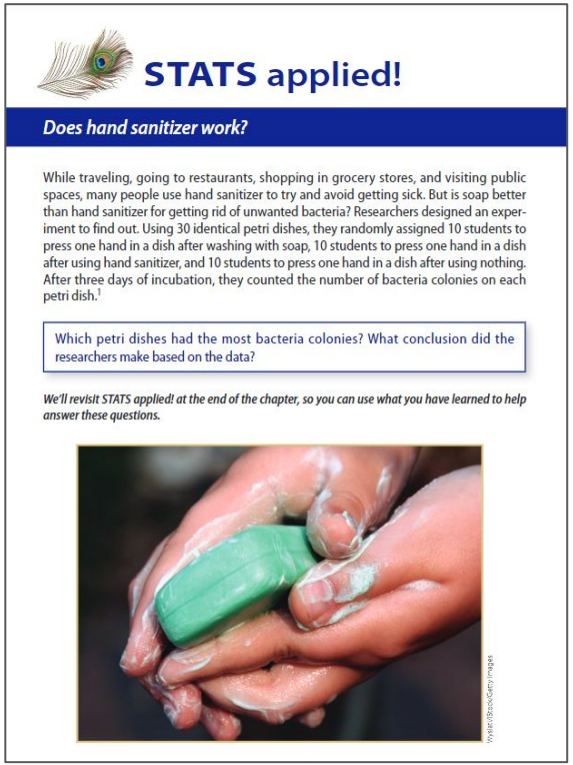
Learning by doing

STATS Applied! Case study helps students make statistics connections in everything from health to video games



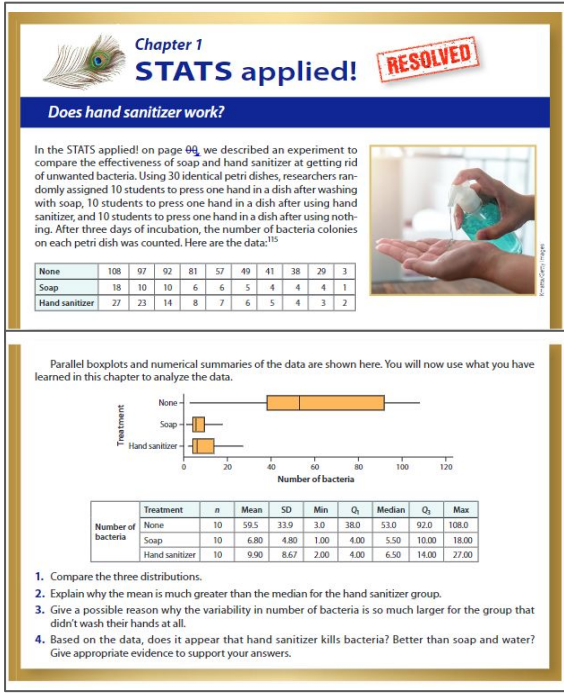
STATS applied!

Does hand sanitizer work?

While traveling, going to restaurants, shopping in grocery stores, and visiting public spaces, many people use hand sanitizer to try and avoid getting sick. But is soap better than hand sanitizer for getting rid of unwanted bacteria? Researchers designed an experiment to find out. Using 30 identical petri dishes, they randomly assigned 10 students to press one hand in a dish after washing with soap, 10 students to press one hand in a dish after using hand sanitizer, and 10 students to press one hand in a dish after using nothing. After three days of incubation, they counted the number of bacteria colonies on each petri dish.[1]

Which petri dishes had the most bacteria colonies? What conclusion did the researchers make based on the data?

We'll revisit STATS applied! at the end of the chapter, so you can use what you have learned to help answer these questions.



Chapter 1

STATS applied!

RESOLVED

Does hand sanitizer work?

In the STATS applied! on page ~~99~~, we described an experiment to compare the effectiveness of soap and hand sanitizer at getting rid of unwanted bacteria. Using 30 identical petri dishes, researchers randomly assigned 10 students to press one hand in a dish after washing with soap, 10 students to press one hand in a dish after using hand sanitizer, and 10 students to press one hand in a dish after using nothing. After three days of incubation, the number of bacteria colonies on each petri dish was counted. Here are the data:[115]

None	108	97	92	81	57	49	41	38	29	3
Soap	18	10	10	6	6	5	4	4	4	1
Hand sanitizer	27	23	14	8	7	6	5	4	3	2

Parallel boxplots and numerical summaries of the data are shown here. You will now use what you have learned in this chapter to analyze the data.

	Treatment	*n*	Mean	SD	Min	Q_1	Median	Q_3	Max
Number of bacteria	None	10	59.5	33.9	3.0	38.0	53.0	92.0	108.0
	Soap	10	6.80	4.80	1.00	4.00	5.50	10.00	18.00
	Hand sanitizer	10	9.90	8.67	2.00	4.00	6.50	14.00	27.00

1. Compare the three distributions.
2. Explain why the mean is much greater than the median for the hand sanitizer group.
3. Give a possible reason why the variability in number of bacteria is so much larger for the group that didn't wash their hands at all.
4. Based on the data, does it appear that hand sanitizer kills bacteria? Better than soap and water? Give appropriate evidence to support your answers.

Learning Targets

Lesson 1.2

Displaying Categorical Data

LEARNING TARGETS

- Make and interpret bar charts or pie charts of categorical data.
- Compare distributions of categorical data.
- Identify what makes some graphs of categorical data misleading.

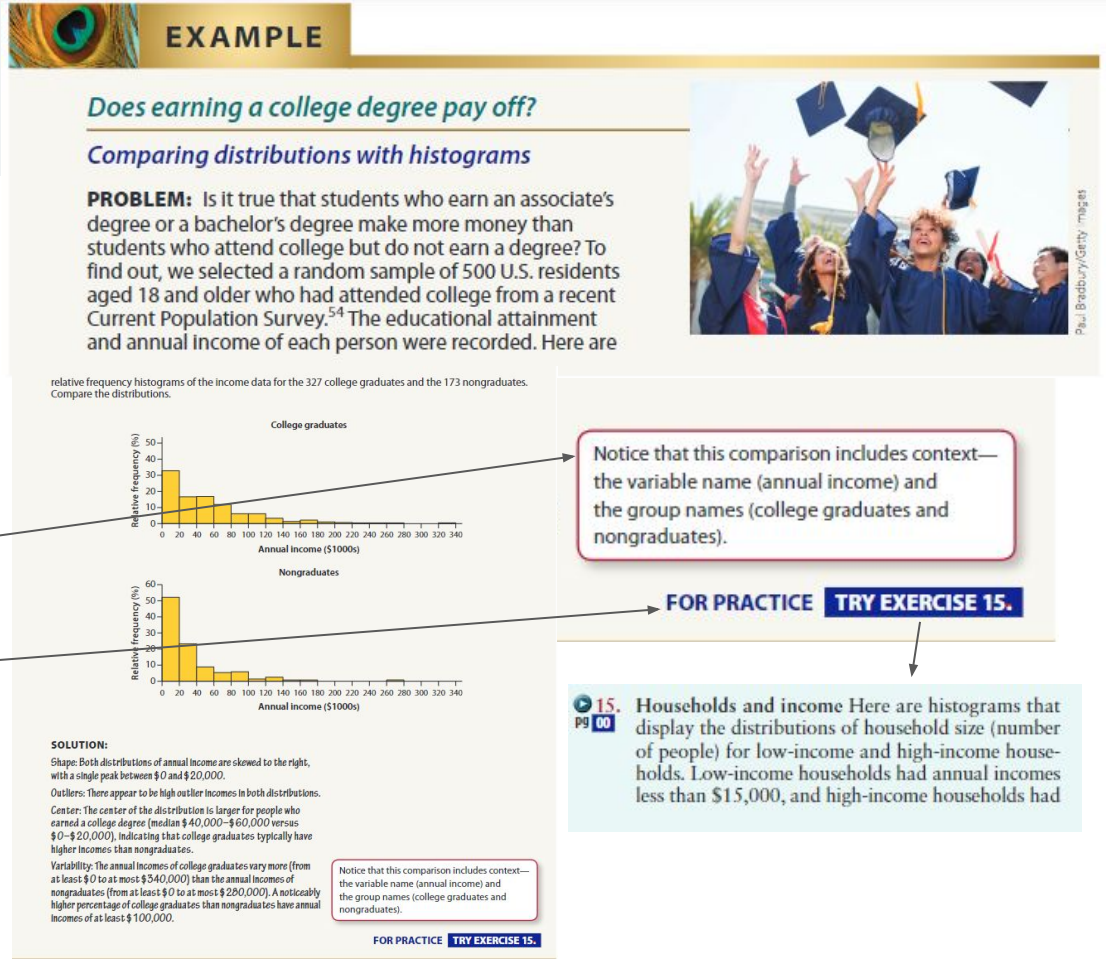
Lesson 1.2

WHAT DID YOU LEARN?

LEARNING TARGET	EXAMPLE	EXERCISES
Make and interpret bar charts or pie charts of categorical data.	p. 14	7–10
Compare distributions of categorical data.	p. 16	11–14
Identify what makes some graphs of categorical data misleading.	p. 18	15–18

Worked examples

- Approx 300 examples
- 20% New & 25% Updated
- Tied to Learning Targets with Model Solutions
- Voice of the Teacher Notes
- For Practice , Try Exercise… offers related Lesson exercise



EXAMPLE

Does earning a college degree pay off?

Comparing distributions with histograms

PROBLEM: Is it true that students who earn an associate's degree or a bachelor's degree make more money than students who attend college but do not earn a degree? To find out, we selected a random sample of 500 U.S. residents aged 18 and older who had attended college from a recent Current Population Survey.[54] The educational attainment and annual income of each person were recorded. Here are

Paul Bradbury/Getty Images

relative frequency histograms of the income data for the 327 college graduates and the 173 nongraduates. Compare the distributions.

College graduates

Relative frequency (%)

Annual income ($1000s)

Nongraduates

Relative frequency (%)

Annual income ($1000s)

SOLUTION:

Shape: Both distributions of annual income are skewed to the right, with a single peak between $0 and $20,000.

Outliers: There appear to be high outlier incomes in both distributions.

Center: The center of the distribution is larger for people who earned a college degree (median $40,000–$60,000 versus $0–$20,000), indicating that college graduates typically have higher incomes than nongraduates.

Variability: The annual incomes of college graduates vary more (from at least $0 to at most $340,000) than the annual incomes of nongraduates (from at least $0 to at most $280,000). A noticeably higher percentage of college graduates than nongraduates have annual incomes of at least $100,000.

Notice that this comparison includes context—the variable name (annual income) and the group names (college graduates and nongraduates).

FOR PRACTICE TRY EXERCISE 15.

Notice that this comparison includes context—the variable name (annual income) and the group names (college graduates and nongraduates).

FOR PRACTICE TRY EXERCISE 15.

15. P9 **Households and income** Here are histograms that display the distributions of household size (number of people) for low-income and high-income households. Low-income households had annual incomes less than $15,000, and high-income households had

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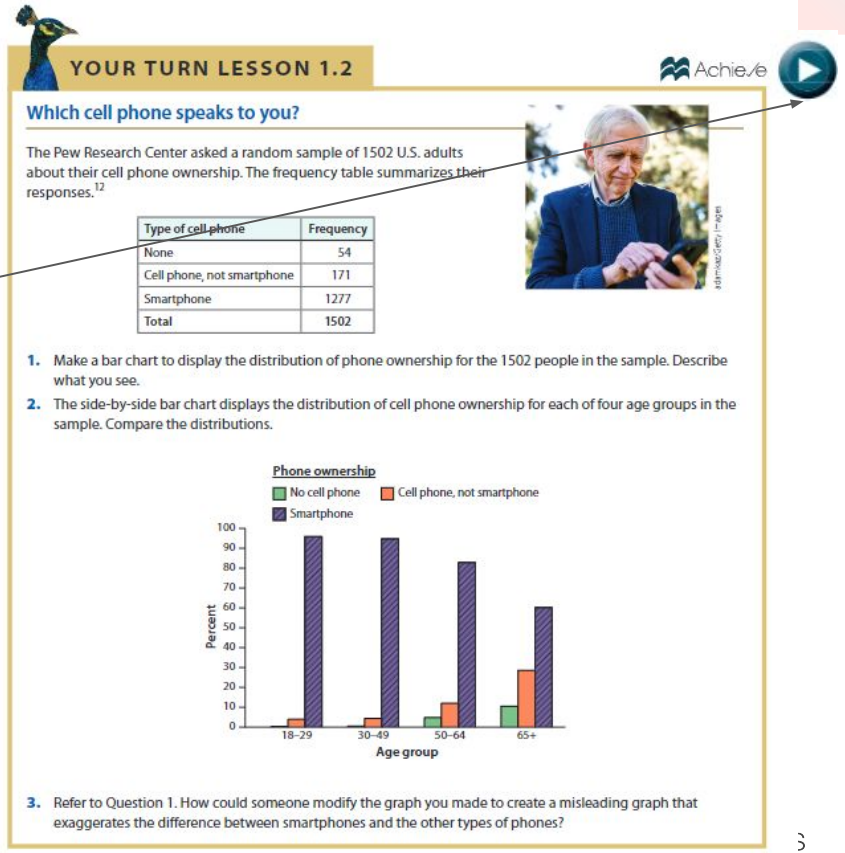
Your Turn Lesson Wrap-Up

- Formerly called “Lesson App”
- 75 total = 1 per lesson
- 13 % new & 50% updated
- **Video walkthroughs for ALL Your Turns in Achieve**



YOUR TURN LESSON 1.2

Achieve

Which cell phone speaks to you?

The Pew Research Center asked a random sample of 1502 U.S. adults about their cell phone ownership. The frequency table summarizes their responses.[12]

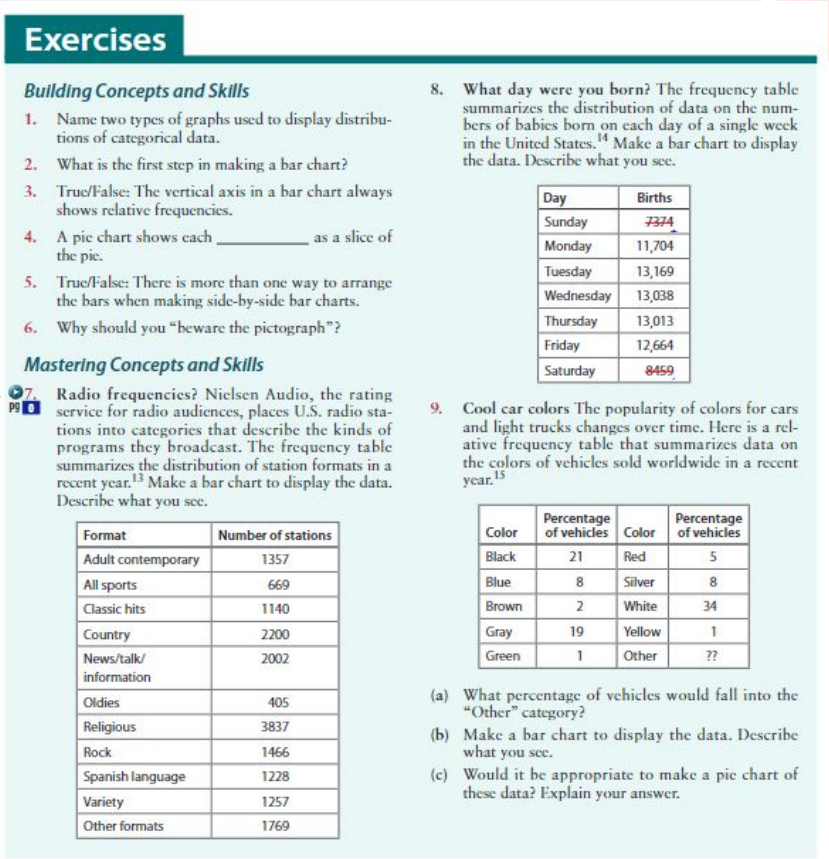
Type of cell phone	Frequency
None	54
Cell phone, not smartphone	171
Smartphone	1277
Total	1502

1. Make a bar chart to display the distribution of phone ownership for the 1502 people in the sample. Describe what you see.
2. The side-by-side bar chart displays the distribution of cell phone ownership for each of four age groups in the sample. Compare the distributions.

3. Refer to Question 1. How could someone modify the graph you made to create a misleading graph that exaggerates the difference between smartphones and the other types of phones?

Practice, Practice, Practice–Lesson Exercises

- Comprehensive – 2000+ exercises
- 21% New & 28% Updated
- Scaffolded question sets
  - Building Concepts and Skills
  - Mastering Concepts and Skills
  - Applying the Concepts
  - Extending the Concepts
  - Recycle and Review
- 200 Video Solutions in Achieve



Exercises

Building Concepts and Skills

1. Name two types of graphs used to display distributions of categorical data.
2. What is the first step in making a bar chart?
3. True/False: The vertical axis in a bar chart always shows relative frequencies.
4. A pie chart shows each _____ as a slice of the pie.
5. True/False: There is more than one way to arrange the bars when making side-by-side bar charts.
6. Why should you "beware the pictograph"?

Mastering Concepts and Skills

7. pg **Radio frequencies?** Nielsen Audio, the rating service for radio audiences, places U.S. radio stations into categories that describe the kinds of programs they broadcast. The frequency table summarizes the distribution of station formats in a recent year.[13] Make a bar chart to display the data. Describe what you see.

Format	Number of stations
Adult contemporary	1357
All sports	669
Classic hits	1140
Country	2200
News/talk/ information	2002
Oldies	405
Religious	3837
Rock	1466
Spanish language	1228
Variety	1257
Other formats	1769

8. **What day were you born?** The frequency table summarizes the distribution of data on the numbers of babies born on each day of a single week in the United States.[14] Make a bar chart to display the data. Describe what you see.

Day	Births
Sunday	~~7374~~
Monday	11,704
Tuesday	13,169
Wednesday	13,038
Thursday	13,013
Friday	12,664
Saturday	~~8459~~

9. **Cool car colors** The popularity of colors for cars and light trucks changes over time. Here is a relative frequency table that summarizes data on the colors of vehicles sold worldwide in a recent year.[15]

Color	Percentage of vehicles	Color	Percentage of vehicles
Black	21	Red	5
Blue	8	Silver	8
Brown	2	White	34
Gray	19	Yellow	1
Green	1	Other	??

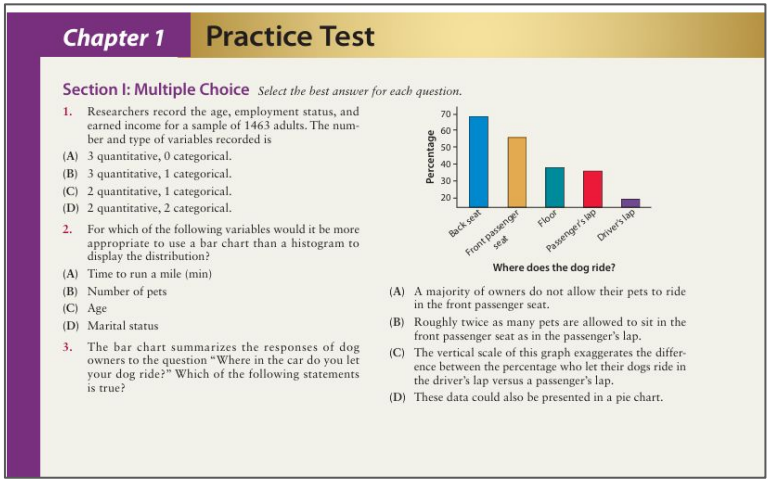
(a) What percentage of vehicles would fall into the "Other" category?

(b) Make a bar chart to display the data. Describe what you see.

(c) Would it be appropriate to make a pie chart of these data? Explain your answer.

More practice and review

- **Chapter Main Points**
- **Chapter Review Exercises**
  - with more **Worked Exercise Videos** and **Solutions!**
- **Practice Test**



Chapter 1 Practice Test

Section I: Multiple Choice *Select the best answer for each question.*

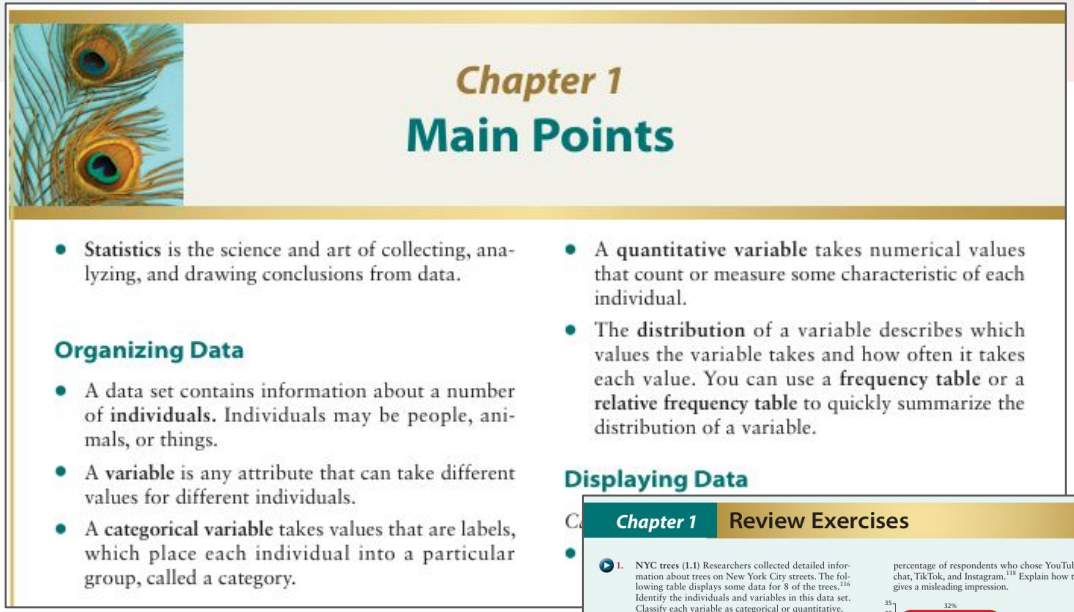
1. Researchers record the age, employment status, and earned income for a sample of 1463 adults. The number and type of variables recorded is
(A) 3 quantitative, 0 categorical.
(B) 3 quantitative, 1 categorical.
(C) 2 quantitative, 1 categorical.
(D) 2 quantitative, 2 categorical.

2. For which of the following variables would it be more appropriate to use a bar chart than a histogram to display the distribution?
(A) Time to run a mile (min)
(B) Number of pets
(C) Age
(D) Marital status

3. The bar chart summarizes the responses of dog owners to the question "Where in the car do you let your dog ride?" Which of the following statements is true?

Where does the dog ride?

(A) A majority of owners do not allow their pets to ride in the front passenger seat.
(B) Roughly twice as many pets are allowed to sit in the front passenger seat as in the passenger's lap.
(C) The vertical scale of this graph exaggerates the difference between the percentage who let their dogs ride in the driver's lap versus a passenger's lap.
(D) These data could also be presented in a pie chart.



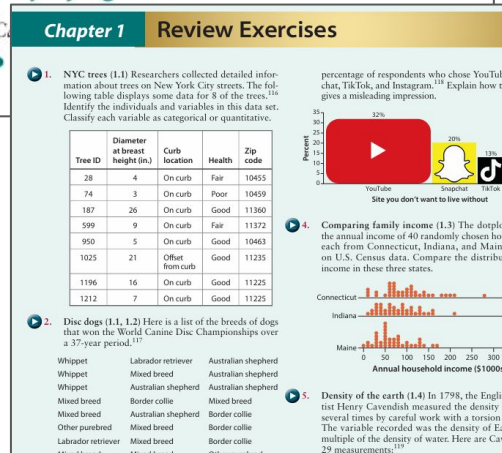
Chapter 1
Main Points

- **Statistics** is the science and art of collecting, analyzing, and drawing conclusions from data.

Organizing Data

- A data set contains information about a number of **individuals.** Individuals may be people, animals, or things.
- A **variable** is any attribute that can take different values for different individuals.
- A **categorical variable** takes values that are labels, which place each individual into a particular group, called a category.
- A **quantitative variable** takes numerical values that count or measure some characteristic of each individual.
- The **distribution** of a variable describes which values the variable takes and how often it takes each value. You can use a **frequency table** or a **relative frequency table** to quickly summarize the distribution of a variable.

Displaying Data



Chapter 1 Review Exercises

1. **NYC trees (1.1)** Researchers collected detailed information about trees on New York City streets. The following table displays some data for 8 of the trees.[116] Identify the individuals and variables in this data set. Classify each variable as categorical or quantitative.

Tree ID	Diameter at breast height (in.)	Curb location	Health	Zip code
28	4	On curb	Fair	10455
74	3	On curb	Poor	10459
187	26	On curb	Good	11360
599	9	On curb	Fair	11372
950	5	On curb	Good	10463
1025	21	Offset from curb	Good	11235
1196	16	On curb	Good	11225
1212	7	On curb	Good	11225

2. **Dog dogs (1.1, 1.2)** Here is a list of the breeds of dogs that won the World Canine Disc Championships over a 37-year period.[117]

Whippet	Labrador retriever	Australian shepherd
Whippet	Mixed breed	Australian shepherd
Whippet	Australian shepherd	Australian shepherd
Mixed breed	Border collie	Mixed breed
Mixed breed	Australian shepherd	Border collie
Other purebred	Mixed breed	Border collie
Labrador retriever	Mixed breed	Border collie

percentage of respondents who chose YouTube, TikTok, and Instagram.[118] Explain how this gives a misleading impression.

4. **Comparing family income (1.3)** The dotplots show the annual income of 40 randomly chosen households each from Connecticut, Indiana, and Maine in 2019, based on U.S. Census data. Compare the distribution of household income in these three states.

5. **Density of the earth (1.4)** In 1798, the English scientist Henry Cavendish measured the density of the earth several times by careful work with a torsion balance. The variable recorded was the density of Earth as a multiple of the density of water. Here are Cavendish's 29 measurements:[119]

Applets and Tech Corners

- **Applets** – available in Achieve
- **Tech Corner Boxes** guide students through using software and calculators to perform simulations, generate graphs, and more
  - Applets
  - TI-83/84

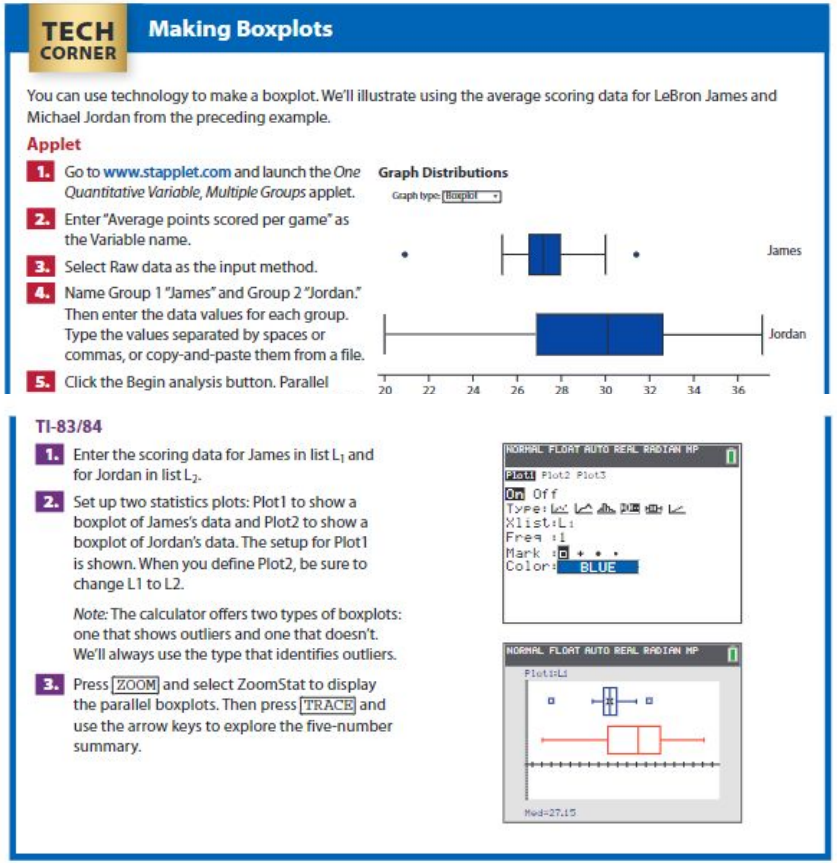
Applets - Data Analysis

- 1 Categorical Variable, Single Group
- 1 Categorical Variable, Multiple Groups
- 2 Categorical Variables
- 1 Quantitative Variable, Single Group (also collaborative)
- 1 Quantitative Variable, Multiple Groups (also collaborative)
- 2 Quantitative Variables (also collaborative)
- Multiple Regression

back to top

Applets - Normal Distributions and Probability

- Normal Distributions
- Discrete Random Variables
- Binomial Distributions
- Counting Methods



TECH CORNER

Making Boxplots

You can use technology to make a boxplot. We'll illustrate using the average scoring data for LeBron James and Michael Jordan from the preceding example.

Applet

1. Go to www.stapplet.com and launch the *One Quantitative Variable, Multiple Groups* applet.
2. Enter "Average points scored per game" as the Variable name.
3. Select Raw data as the input method.
4. Name Group 1 "James" and Group 2 "Jordan." Then enter the data values for each group. Type the values separated by spaces or commas, or copy-and-paste them from a file.
5. Click the Begin analysis button. Parallel

TI-83/84

1. Enter the scoring data for James in list L_1 and for Jordan in list L_2.
2. Set up two statistics plots: Plot1 to show a boxplot of James's data and Plot2 to show a boxplot of Jordan's data. The setup for Plot1 is shown. When you define Plot2, be sure to change L1 to L2.

   Note: The calculator offers two types of boxplots: one that shows outliers and one that doesn't. We'll always use the type that identifies outliers.
3. Press ZOOM and select ZoomStat to display the parallel boxplots. Then press TRACE and use the arrow keys to explore the five-number summary.

shers

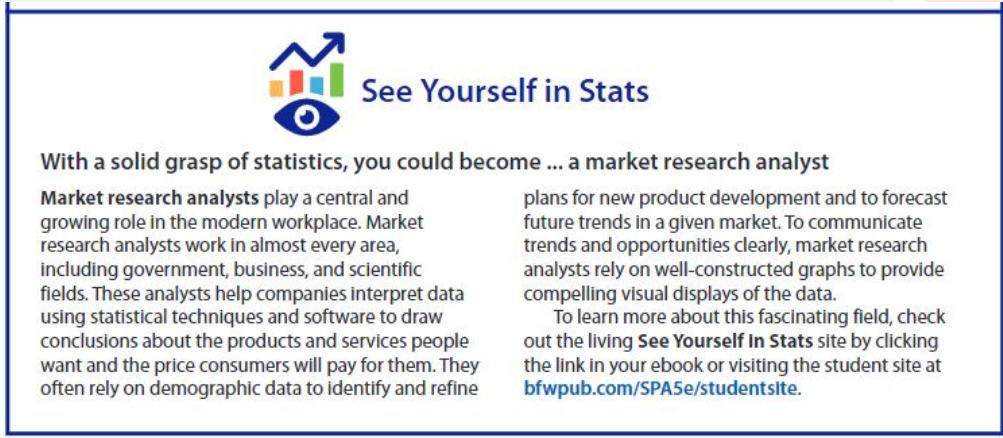
New to the 5th edition

- Revised and updated examples, applications, and data
- Alignment to most national and state math standards
- Updated digital resources in Achieve
- New “See Yourself in Stats” feature
- New Chapter Projects

NEW: See Yourself in Stats!

See Yourself in Stats feature in each chapter profiling a pertinent career option with links in Achieve to more information on career path, job opps, etc.

1. Market Research Analyst
2. Game Designer
3. Environmental Scientist
4. Pollster
5. Sports Analyst
6. Actuary
7. Operations Research Analyst
8. Medical Researcher
9. Biomedical Engineer
10. Data Scientist
11. Econometrician

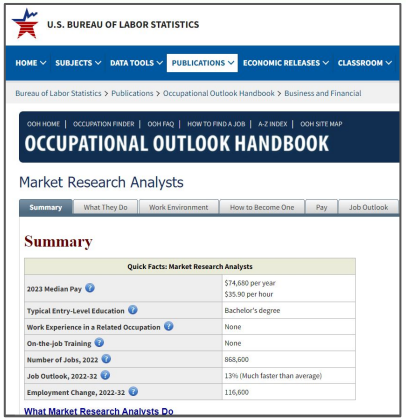


See Yourself in Stats

With a solid grasp of statistics, you could become ... a market research analyst

Market research analysts play a central and growing role in the modern workplace. Market research analysts work in almost every area, including government, business, and scientific fields. These analysts help companies interpret data using statistical techniques and software to draw conclusions about the products and services people want and the price consumers will pay for them. They often rely on demographic data to identify and refine plans for new product development and to forecast future trends in a given market. To communicate trends and opportunities clearly, market research analysts rely on well-constructed graphs to provide compelling visual displays of the data.

To learn more about this fascinating field, check out the living **See Yourself In Stats** site by clicking the link in your ebook or visiting the student site at bfwpub.com/SPA5e/studentsite.



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Bureau of Labor Statistics > Publications > Occupational Outlook Handbook > Business and Financial

OCCUPATIONAL OUTLOOK HANDBOOK

Market Research Analysts

Summary | What They Do | Work Environment | How to Become One | Pay | Job Outlook

Summary

Quick Facts: Market Research Analysts	
2023 Median Pay	$74,680 per year $35.90 per hour
Typical Entry-Level Education	Bachelor's degree
Work Experience in a Related Occupation	None
On-the-job Training	None
Number of Jobs, 2022	868,600
Job Outlook, 2022-32	13% (Much faster than average)
Employment Change, 2022-32	116,600

What Market Research Analysts Do

Home / Money / Careers / Best Jobs / Market Research Analyst

Market Research Analyst Overview

Overall Score 5.7 / 10

#7 in Best Business Jobs | #27 in 100 Best Jobs

Overview | Salary | Reviews and Advice | Job Openings

What is a Market Research Analyst?

Market research analysts study data and market conditions to help companies determine their target demographics and how much consumers are willing to pay for a product.

"Market research uses data to create insights that lead society and businesses to make important decisions," Melanie Courtright, CEO of the Insights Association, a professional organization for the insights and analytics industry, wrote in an email. "A market research analyst is heavily involved in all phases of market research projects designed to deliver those insights."

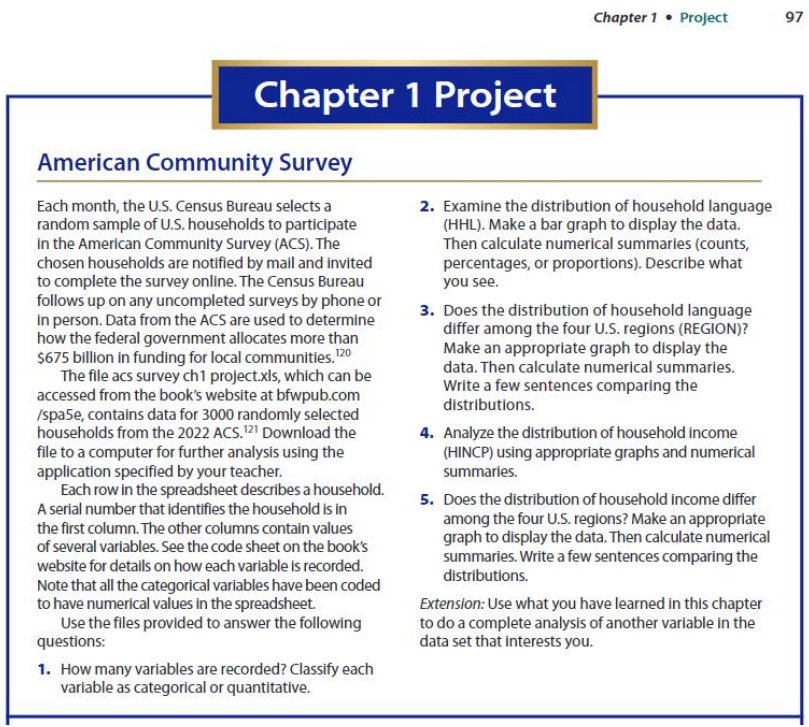
Median Salary
$68,230

Unemployment Rate
3.2%

Duties may include:

NEW: Chapter Level Projects

- **7 Chapter Ending Projects -** Working with and interpreting larger data sets related to real world situations including:
  - Ch 1 - Survey about household language, income, region, etc.
  - Ch 3 - Water quality monitoring in Lake Champlain re: dissolved O2 levels
  - Ch 8 - National Public Opinion Reference Survey
  - Ch 11 - Design a Study & Poster Presentation



Chapter 1 Project

American Community Survey

Each month, the U.S. Census Bureau selects a random sample of U.S. households to participate in the American Community Survey (ACS). The chosen households are notified by mail and invited to complete the survey online. The Census Bureau follows up on any uncompleted surveys by phone or in person. Data from the ACS are used to determine how the federal government allocates more than $675 billion in funding for local communities.[120]

The file acs survey ch1 project.xls, which can be accessed from the book's website at bfwpub.com/spa5e, contains data for 3000 randomly selected households from the 2022 ACS.[121] Download the file to a computer for further analysis using the application specified by your teacher.

Each row in the spreadsheet describes a household. A serial number that identifies the household is in the first column. The other columns contain values of several variables. See the code sheet on the book's website for details on how each variable is recorded. Note that all the categorical variables have been coded to have numerical values in the spreadsheet.

Use the files provided to answer the following questions:

1. How many variables are recorded? Classify each variable as categorical or quantitative.
2. Examine the distribution of household language (HHL). Make a bar graph to display the data. Then calculate numerical summaries (counts, percentages, or proportions). Describe what you see.
3. Does the distribution of household language differ among the four U.S. regions (REGION)? Make an appropriate graph to display the data. Then calculate numerical summaries. Write a few sentences comparing the distributions.
4. Analyze the distribution of household income (HINCP) using appropriate graphs and numerical summaries.
5. Does the distribution of household income differ among the four U.S. regions? Make an appropriate graph to display the data. Then calculate numerical summaries. Write a few sentences comparing the distributions.

Extension: Use what you have learned in this chapter to do a complete analysis of another variable in the data set that interests you.

Aligned to State and National Standards.

Updated Alignment

- Comprehensive alignment with most standards

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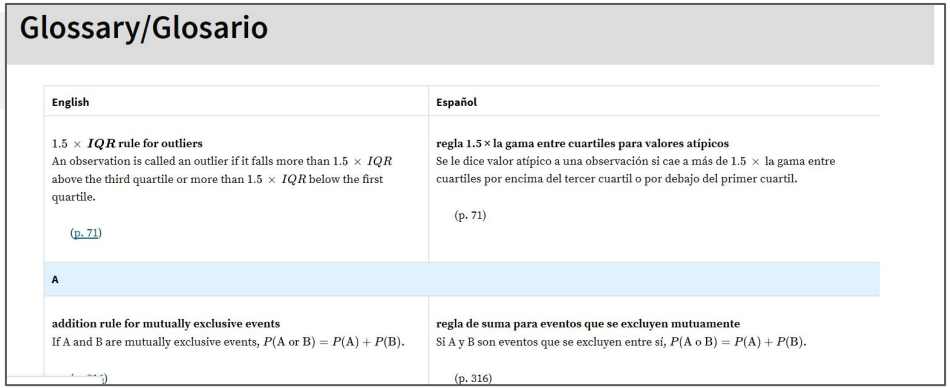
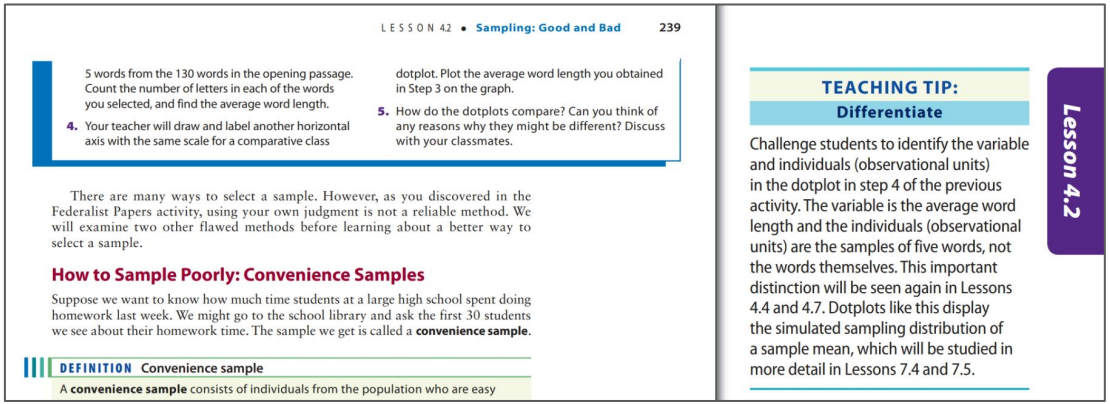
ELL/ESE support

- English/Spanish glossary (side-by-side)
- English/Spanish flashcards – Achieve
- Read-aloud ebook feature – Achieve
- Differentiation notes – teacher's edition
- Variety of activities – teacher's edition





Teacher Resources

bfw publishers

Teacher Resource Package

Complimentary with a class set purchase!

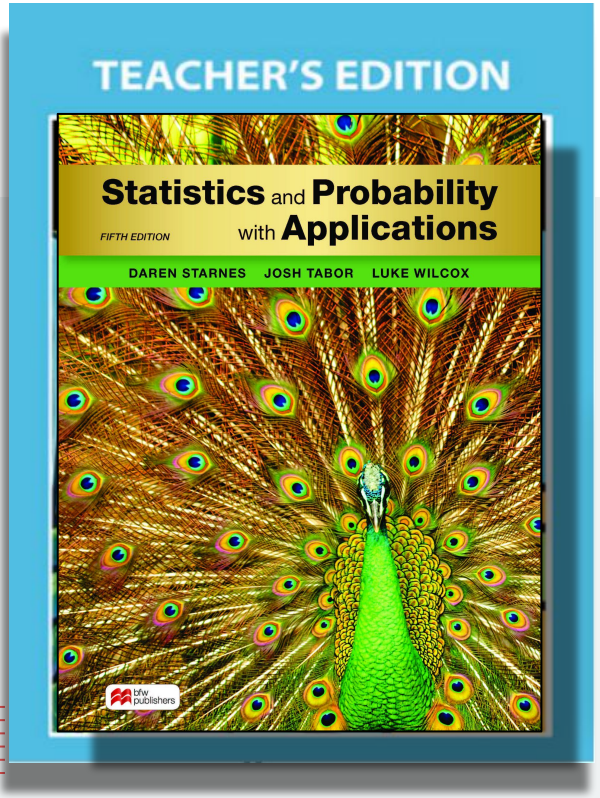
Teacher's Edition - print & ebook

Teacher Resources

Digital Test Bank

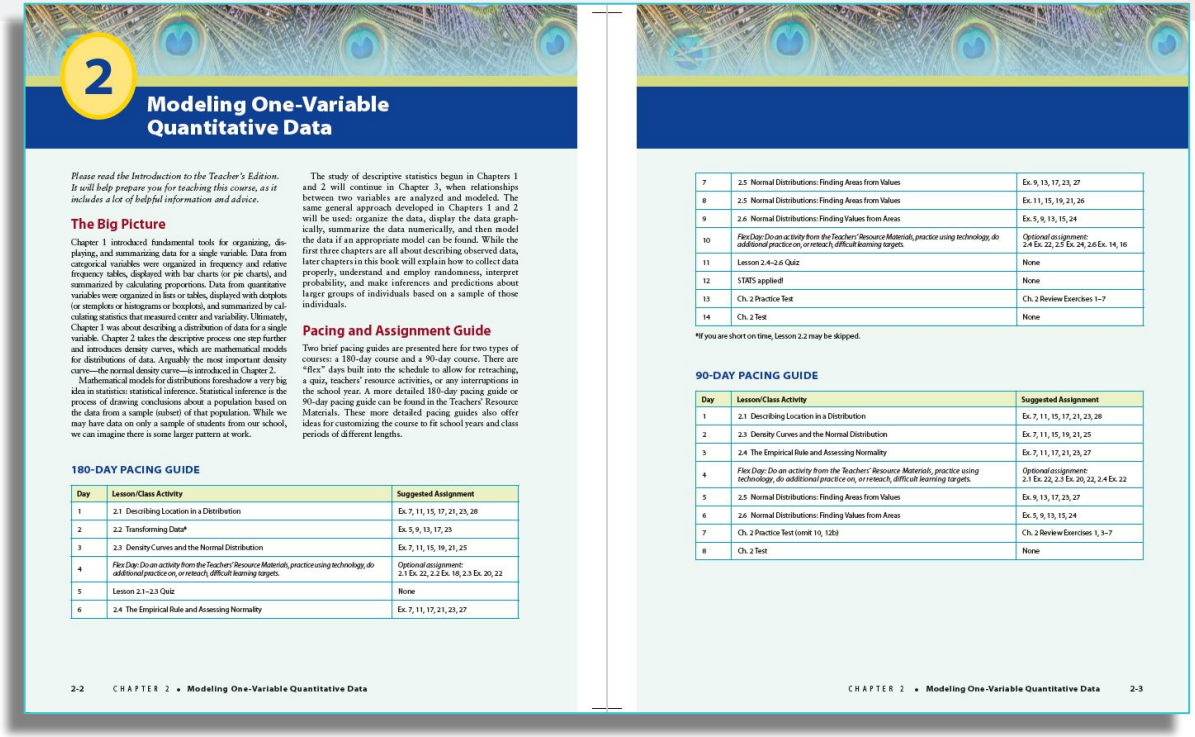
bedford, freeman & worth
publishers

Teacher's Edition



Teacher's Edition–planning pages

- Big Picture chapter overview
- Pacing and Assignment Guides
- Promoting Good Habits and Skills
- Lesson-by-Lesson Content Overview
- Chapter Resources list



2

Modeling One-Variable Quantitative Data

Please read the Introduction to the Teacher's Edition. It will help prepare you for teaching this course, as it includes a lot of helpful information and advice.

The Big Picture

Chapter 1 introduced fundamental tools for organizing, displaying, and summarizing data for a single variable. Data from categorical variables were organized in frequency and relative frequency tables, displayed with bar charts (or pie charts), and summarized by calculating proportions. Data from quantitative variables were organized in lists or tables, displayed with dotplots (or stemplots or histograms or boxplots), and summarized by calculating statistics that measured center and variability. Ultimately, Chapter 1 was about describing a distribution of data for a single variable. Chapter 2 takes the descriptive process one step further and introduces density curves, which are mathematical models for distributions of data. Arguably the most important density curve—the normal density curve—is introduced in Chapter 2.

Mathematical models for distributions foreshadow a very big idea in statistics: statistical inference. Statistical inference is the process of drawing conclusions about a population based on the data from a sample (subset) of that population. While we may have data on only a sample of students from our school, we can imagine there is some larger pattern at work.

The study of descriptive statistics begun in Chapters 1 and 2 will continue in Chapter 3, when relationships between two variables are analyzed and modeled. The same general approach developed in Chapters 1 and 2 will be used: organize the data, display the data graphically, summarize the data numerically, and then model the data if an appropriate model can be found. While the first three chapters are all about describing observed data, later chapters in this book will explain how to collect data properly, understand and employ randomness, interpret probability, and make inferences and predictions about larger groups of individuals based on a sample of those individuals.

Pacing and Assignment Guide

Two brief pacing guides are presented here for two types of courses: a 180-day course and a 90-day course. There are "flex" days built into the schedule to allow for retreaching, a quiz, teachers' resource activities, or any interruptions in the school year. A more detailed 180-day pacing guide or 90-day pacing guide can be found in the Teachers' Resource Materials. These more detailed pacing guides also offer ideas for customizing the course to fit school years and class periods of different lengths.

180-DAY PACING GUIDE

Day	Lesson/Class Activity	Suggested Assignment
1	2.1 Describing Location in a Distribution	Ex. 7, 11, 15, 17, 21, 23, 28
2	2.2 Transforming Data*	Ex. 5, 9, 13, 17, 23
3	2.3 Density Curves and the Normal Distribution	Ex. 7, 11, 15, 19, 21, 25
4	*Flex Day: Do an activity from the Teachers' Resource Materials, practice using technology, do additional practice on, or reteach, difficult learning targets.*	*Optional assignment:* 2.1 Ex. 22, 2.2 Ex. 18, 2.3 Ex. 20, 22
5	Lesson 2.1–2.3 Quiz	None
6	2.4 The Empirical Rule and Assessing Normality	Ex. 7, 11, 17, 21, 23, 27
7	2.5 Normal Distributions: Finding Areas from Values	Ex. 9, 13, 17, 23, 27
8	2.5 Normal Distributions: Finding Areas from Values	Ex. 11, 15, 19, 21, 26
9	2.6 Normal Distributions: Finding Values from Areas	Ex. 5, 9, 13, 15, 24
10	*Flex Day: Do an activity from the Teachers' Resource Materials, practice using technology, do additional practice on, or reteach, difficult learning targets.*	*Optional assignment:* 2.4 Ex. 22, 2.5 Ex. 24, 2.6 Ex. 14, 16
11	Lesson 2.4–2.6 Quiz	None
12	STATS applied!	None
13	Ch. 2 Practice Test	Ch. 2 Review Exercises 1–7
14	Ch. 2 Test	None

*If you are short on time, Lesson 2.2 may be skipped.

90-DAY PACING GUIDE

Day	Lesson/Class Activity	Suggested Assignment
1	2.1 Describing Location in a Distribution	Ex. 7, 11, 15, 17, 21, 23, 28
2	2.3 Density Curves and the Normal Distribution	Ex. 7, 11, 15, 19, 21, 25
3	2.4 The Empirical Rule and Assessing Normality	Ex. 7, 11, 17, 21, 23, 27
4	*Flex Day: Do an activity from the Teachers' Resource Materials, practice using technology, do additional practice on, or reteach, difficult learning targets.*	*Optional assignment:* 2.1 Ex. 22, 2.3 Ex. 20, 22, 2.4 Ex. 22
5	2.5 Normal Distributions: Finding Areas from Values	Ex. 9, 13, 17, 23, 27
6	2.6 Normal Distributions: Finding Values from Areas	Ex. 5, 9, 13, 15, 24
7	Ch. 2 Practice Test (omit 10, 12b)	Ch. 2 Review Exercises 1, 3–7
8	Ch. 2 Test	None

Teacher's Edition–wraparound features

PD LESSON OVERVIEW VIDEO

Watch the Lesson 2.4–2.6 overview video for guidance from the authors on teaching the content in these lessons. Find it by clicking on the link in the TE-book or by logging into the teachers' resources on our digital platform.

TEACHING TIP

StatsMedic.com

StatsMedic has three blog posts titled "Why Do We Standardize Normal Distributions?," "Why Bother with *z*-scores and Table A?," and "Interpret the *z*-score (Like It's Your Job)" that are relevant to the content in this lesson. Check it out at **statsmedic.com/blog.**

TEACHING TIP

Students are unlikely to have prior experience with *z*-scores and their interpretation. Work through a few examples with them. As you talk with students, alternate the terms *z*-score and standardized score to get them accustomed to both.

COMMON ERROR

The term "curve" is sometimes strange for students, particularly when the first density curve they see is "straight." Remind them that in mathematics, curve is a general term for any graph. Later in this lesson, they'll see some density curves that are . . . curved.

TRM LESSON 2.4–2.6 QUIZ

You can find a prepared quiz for Less 2.4–2.6 by clicking on the link in the TE-book or by logging into the teach resources on our digital platform.

FYI

There is a function that defines a normal curve with mean μ and standard deviation σ. It is $f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2}$. We don't recommend sharing this with students unless they're very, very curious about it.

ALTERNATE EXAMPLE

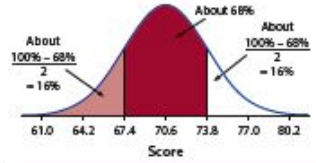
What Is Lexi Thompson's score?

Using the empirical rule in reverse

PROBLEM: Golfer Lexi Thompson is one of the top golfers on the LPGA tour. The distribution of scores for each of the more than 700 rounds over her LPGA career is approximately normal with a mean of about $\mu = 70.6$ strokes and a standard deviation of about $\sigma = 3.2$ strokes. What score is at the 16th percentile of the distribution? Justify your answer.

SOLUTION:

About 68% of all scores are between 67.4 and 73.8. That means about 100% – 68% = 32% are either less than 67.4 or greater than 73.8. Because normal distributions are symmetric, about 32%/2 = 16% or 0.16 of Lexi Thompson's scores are less than 67.4. So, a score of 67.4 is at about the 16th percentile of the distribution.



BELL RINGER

According to the Centers for Disease Control and Prevention, American females aged 20 and over have a mean height of 64 inches. Suppose that the standard deviation of their heights is 2.5 inches. How tall would a woman be who is exactly 1 standard deviation tall than average? 2 standard deviations taller? 3 standard deviations taller? 1 standard deviation *shorter* than averag 2 standard deviations *shorter*? 3 standa deviations *shorter*?

TEACHING TIP:
Differentiate

Here is a short algebraic justification that multiplying every value in a distribution by a real number b multiplies the mean by b. If you have students who want to use their algebraic skills in statistics, give them the first line or two and see if they can complete it.

For a set of values $x_1, x_2, x_3, \ldots, x_n$,

let $\bar{x} = \frac{x_1 + x_2 + x_3 + \cdots + x_n}{n}$

New mean $= \frac{(x_1 \cdot b) + (x_2 \cdot b) + (x_3 \cdot b) + \cdots + (x_n \cdot b)}{n}$

$= \frac{b \cdot (x_1 + x_2 + x_3 + \cdots + x_n)}{n}$

$= b \cdot \frac{(x_1 + x_2 + x_3 + \cdots + x_n)}{n}$

$= b \cdot \bar{x}$

ACTIVITY OVERVIEW

Time: 8–10 min

Materials: One Internet-connected device for each student or group of students.

Teaching Advice: This activity is not long, but it is very instructive. The main point of this activity is to convince students that all normal distributions have certain properties in common. Specifically, this activity reveals the empirical (68–95–99.7) rule for normal distributions. Allow students to discover this rule with as little input from you as possible. Make sure students have correct boundary values in Step 4: 85 and 115, 70 and 130, 55 and 145, respectively:

- Step 4→ 5.29 and 8.39, 3.74 and 9.94, 2.19 and 11.49 respectively

Answers:

1. About 68%
2. About 95%
3. About 99.7%
4. About 68%, 95%, and 99.7%, respectively
5. About 68%, 95%, and 99.7%, respectively
6. 68%, 95%, and 99.7%

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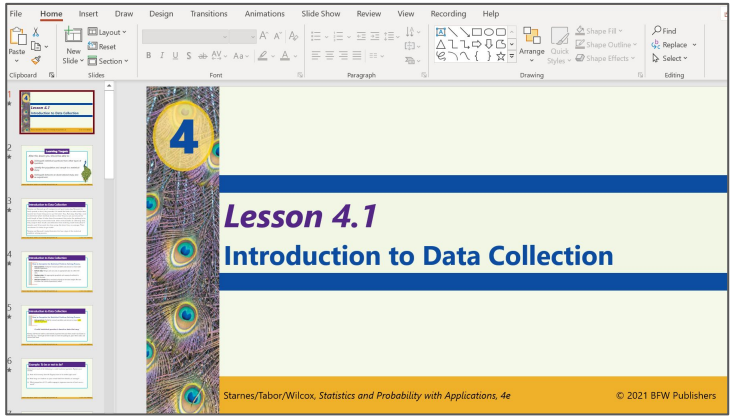
Teacher Resources and Test bank

Teacher Resources

- Lecture presentation slides for each lesson
- Worksheets, activities, and handouts
- Prepared quizzes and tests
- Professional development videos
- Additional resources



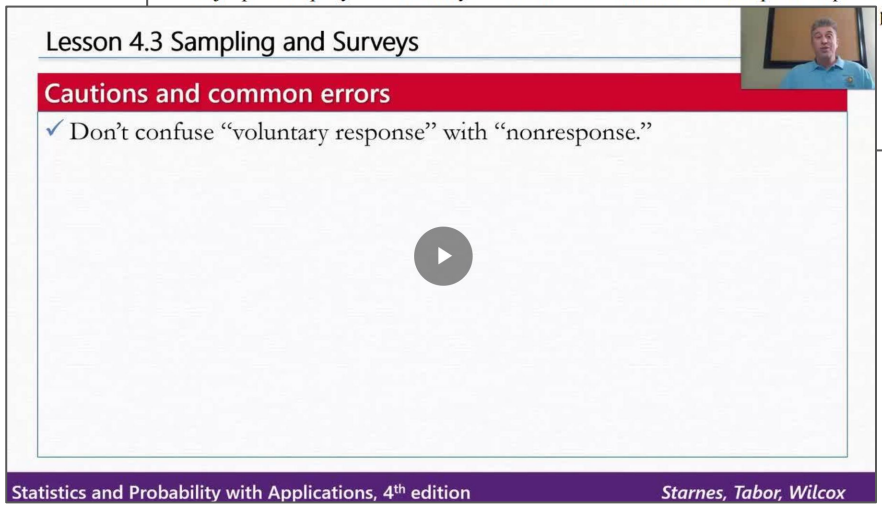
Chapter 4 Test Name:

Part I: Multiple-Choice. Circle the letter corresponding to the best answer choice.

1. What is the purpose of the random assignment of treatments to subjects in an experiment?
   (A) To create roughly equivalent groups before treatments are administered.
   (B) To prevent certain groups in the population from being systematically excluded from the experiment.
   (C) To reduce bias in the selection of the subjects to be included in the experiment.
   (D) To eliminate the need for blinding in an experiment.

2. A random number generator is used to select 12 students from a large statistics class to rate a statistics video. The 12 students selected are
   (A) the population.
   (B) a simple random sample of the class.
   (C) a convenience sample.
   (D) a voluntary response sample.

3. A survey consisted of a random sample of 3800 U.S. adults. The adults were asked, "Should we have a third major political party in this country in addition to the Democratic and Republican parties?" In this sample, population to which



Assessment

- More than 1,700 questions, coded by Learning Target, Lesson, Chapter, level of difficulty
- The platform is fully customizable, allowing you to enter your own questions and edit existing questions
- To discourage cheating, the test bank can scramble answers and change the order of questions
- Can easily export into most common LMSs
- Our BFW Test Generator is cloud-based and does not require installati
- Works seamlessly on a Mac or PC

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Achieve

is

Online Courseware

E-book

Resources

Assignments

Reports & Insights

Homework with Targeted Feedback

Adaptive Quizzing

Summative Quizzes

Gradebook

Coming Fall 2025 – Respondus Lockdown Browser!!

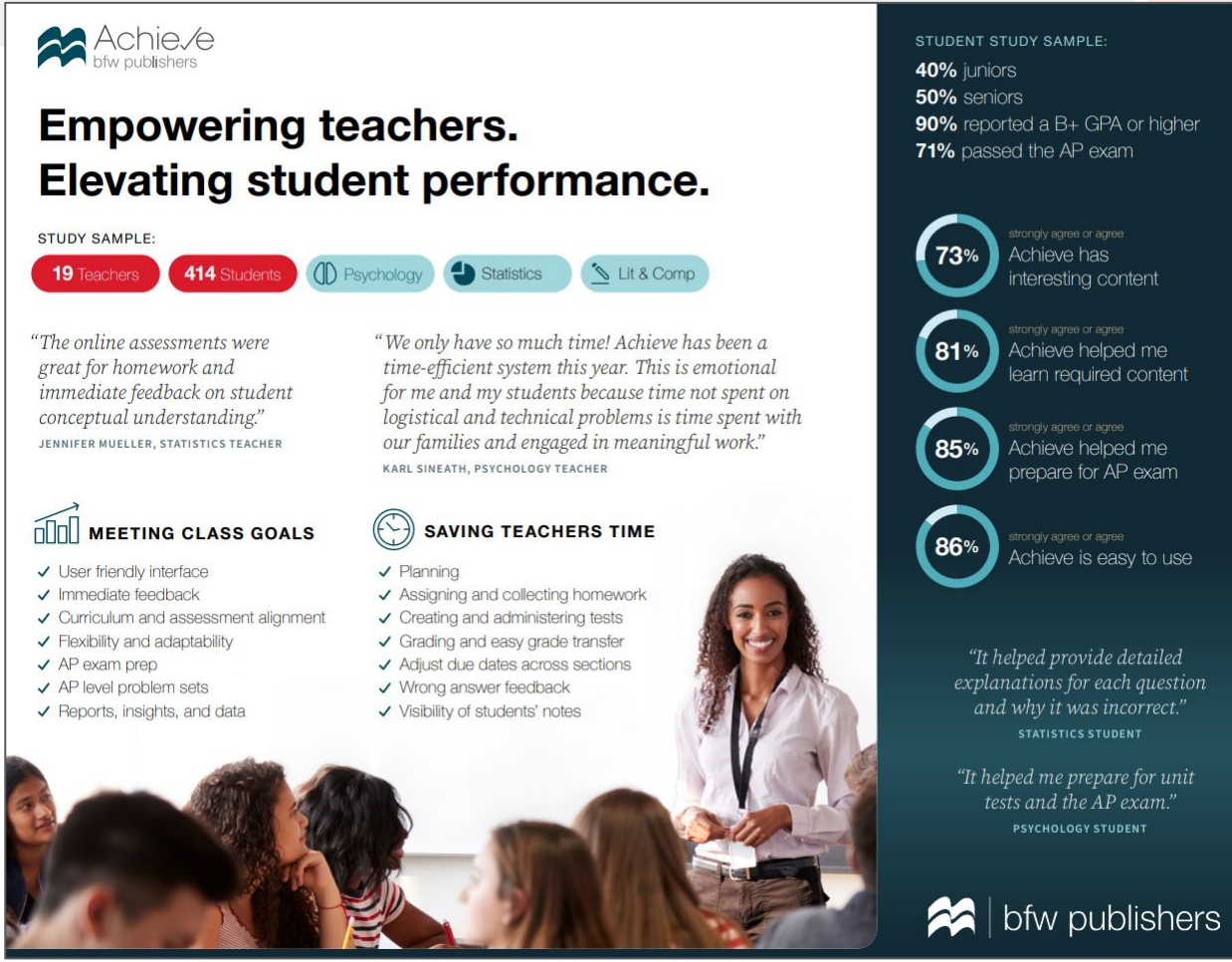
Our research on Achieve

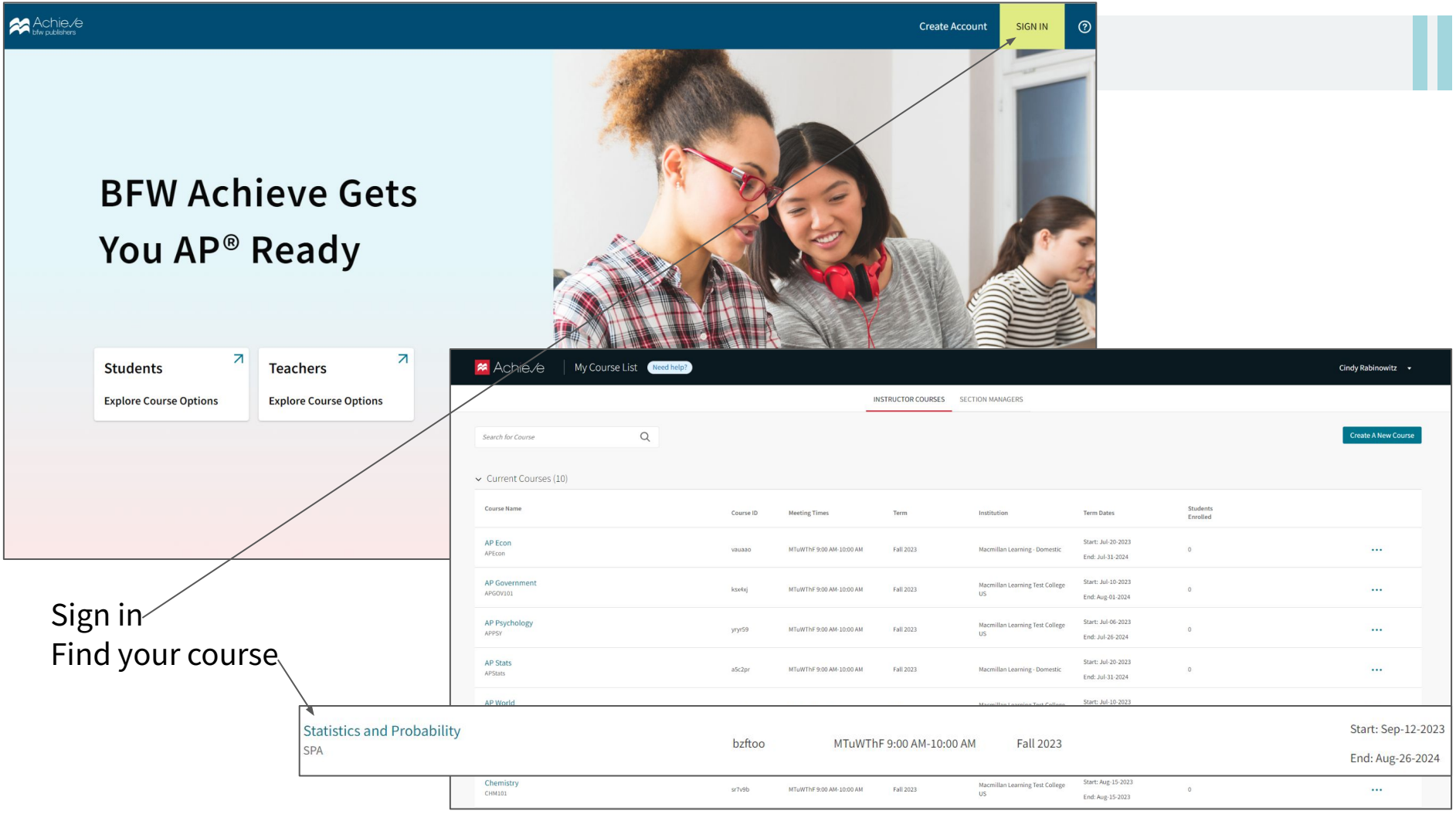
Saves teachers time

- planning
- assigning/collecting HW
- grading, etc.

Meets class goals

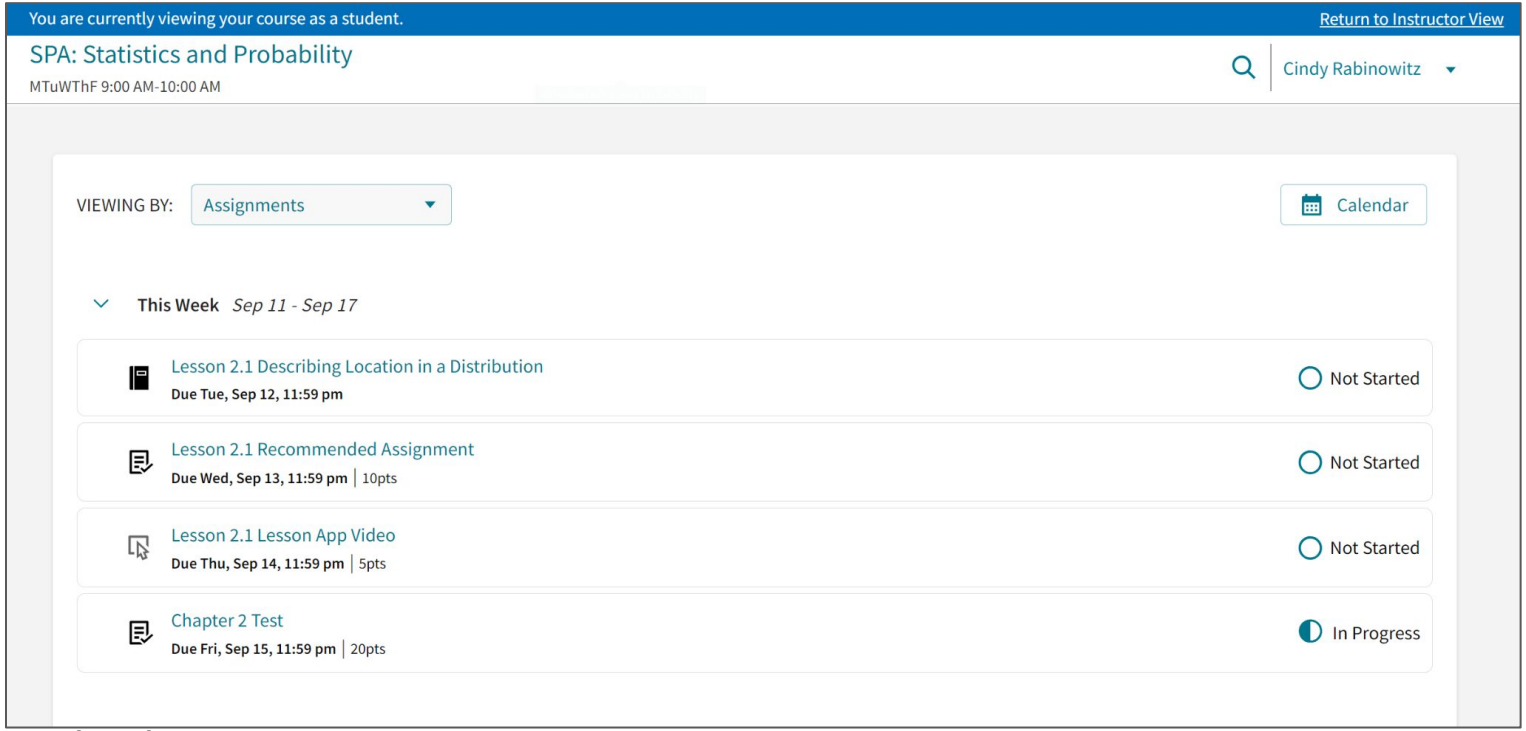
- alignment
- exam prep
- differentiation
- insights/reports/data





Sign in

Find your course



Ebook
Homework
Videos
Summative assessment

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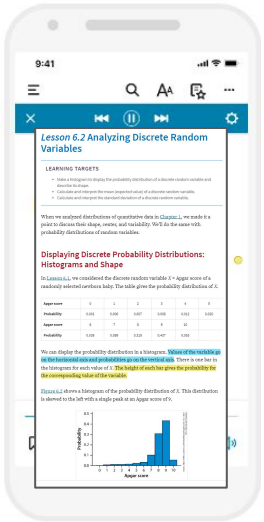
Ebook:

Read aloud
Highlights
Notes
Accessibility
Downloadable



Lesson 6.2 Analyzing Discrete Random Variables

LEARNING TARGETS

- Make a histogram to display the probability distribution of a discrete random variable and describe its shape.
- Calculate and interpret the mean (expected value) of a discrete random variable.
- Calculate and interpret the standard deviation of a discrete random variable.

When we analyzed distributions of quantitative data in Chapter 1, we made it a point to discuss their shape, center, and variability. We'll do the same with probability distributions of random variables.

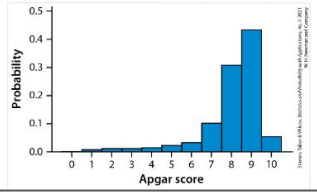
Displaying Discrete Probability Distributions: Histograms and Shape

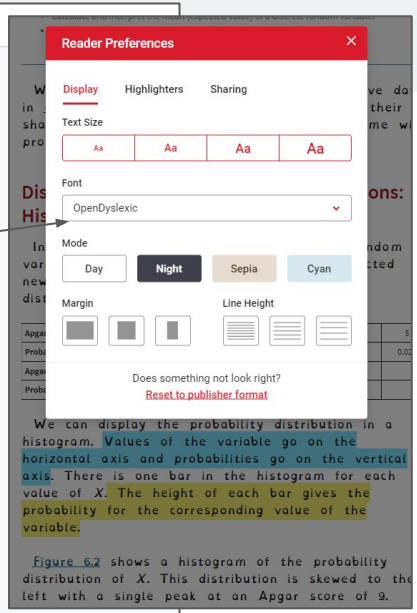
In Lesson 6.1, we considered the discrete random variable X = Apgar score of a randomly selected newborn baby. The table gives the probability distribution of X.

Apgar score	0	1	2	3	4	5
Probability	0.001	0.006	0.007	0.008	0.012	0.020
Apgar score	6	7	8	9	10	
Probability	0.038	0.099	0.319	0.437	0.053	

We can display the probability distribution in a histogram. Values of the variable go on the horizontal axis and probabilities go on the vertical axis. There is one bar in the histogram for each value of X. The height of each bar gives the probability for the corresponding value of the variable.

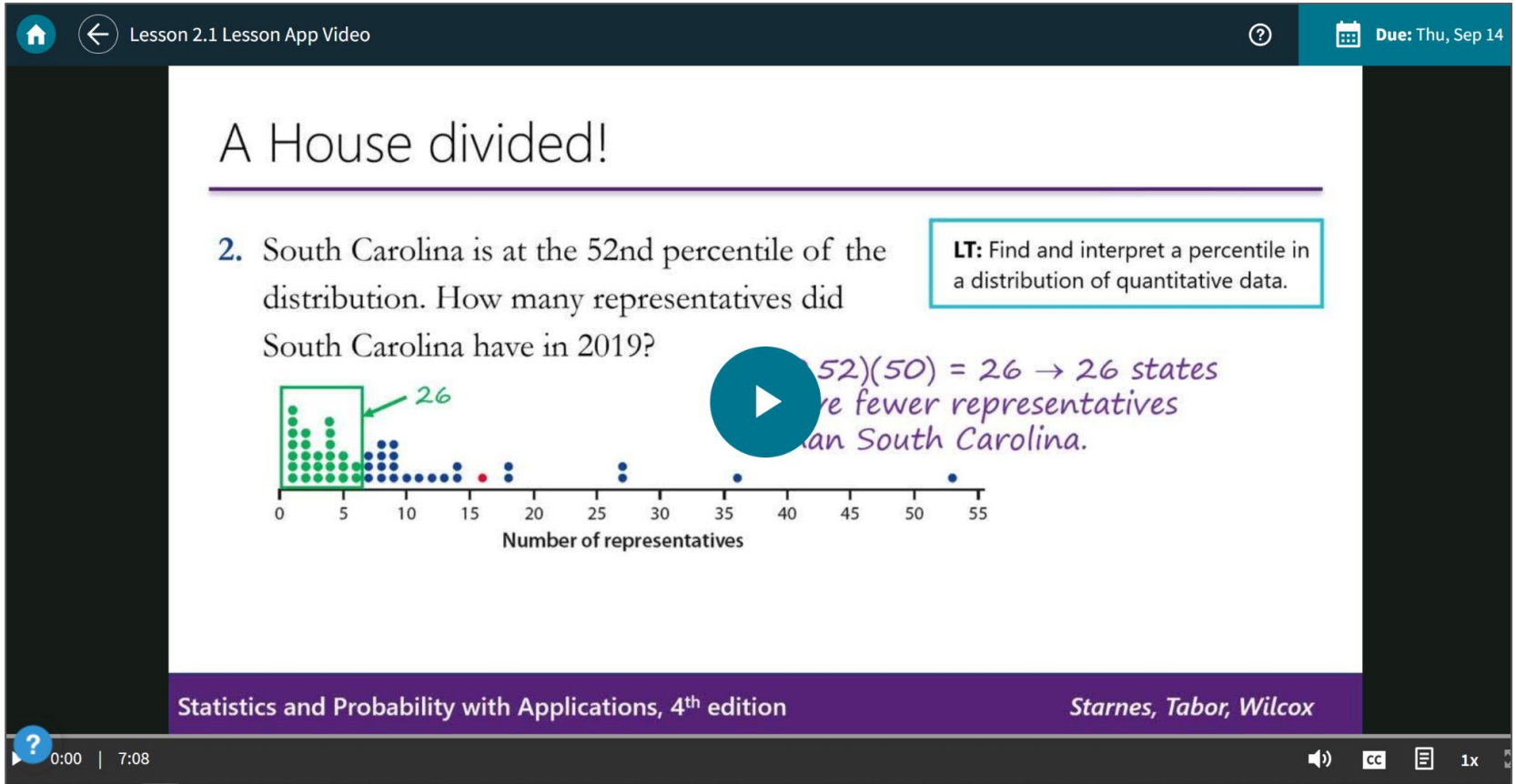
Figure 6.2 shows a histogram of the probability distribution of X. This distribution is skewed to the left with a single peak at an Apgar score of 9.



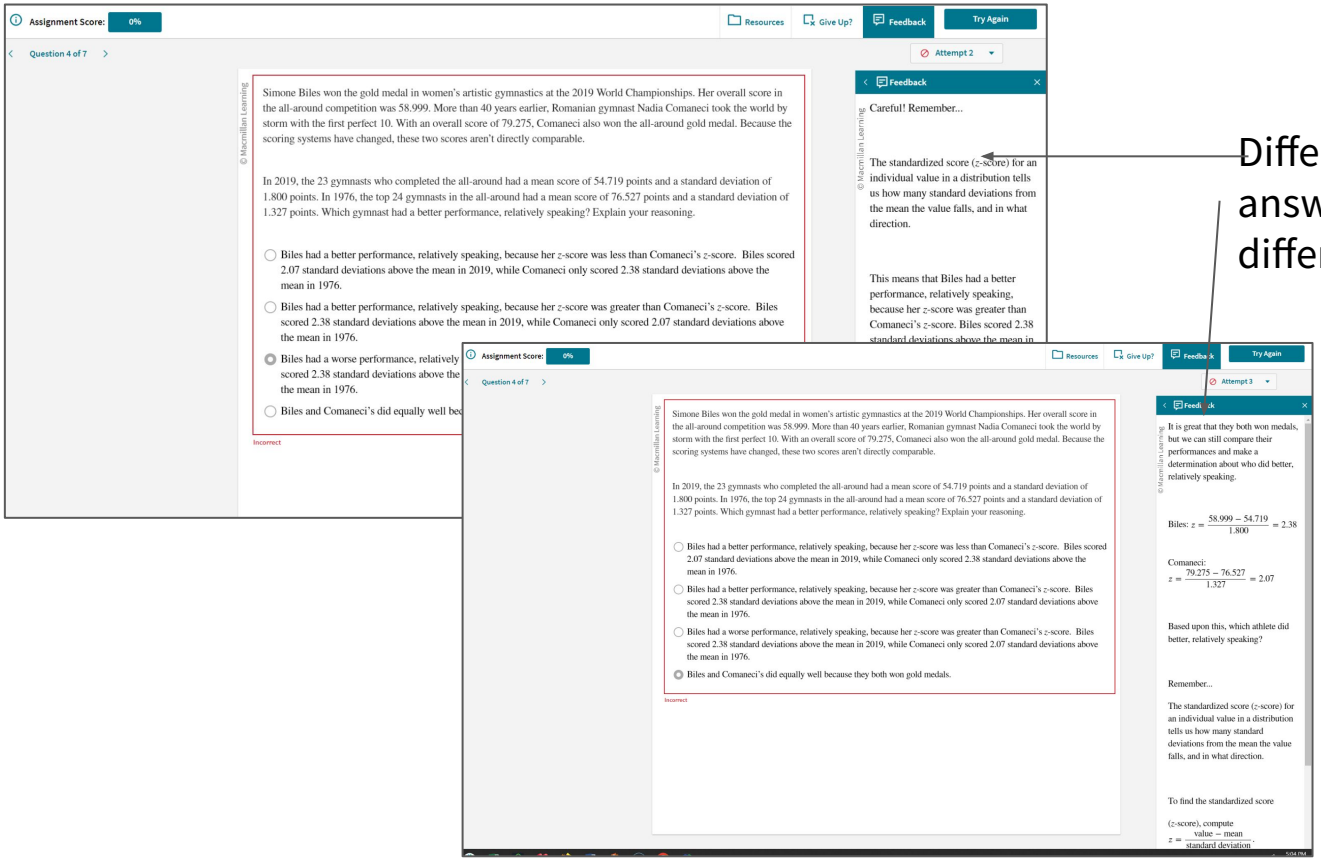


9/12/2023
Important for exam.

Videos


Lesson 2.1 Lesson App Video
Due: Thu, Sep 14
A House divided!
2. South Carolina is at the 52nd percentile of the distribution. How many representatives did South Carolina have in 2019?
LT: Find and interpret a percentile in a distribution of quantitative data.
52)(50) = 26 → 26 states
e fewer representatives
an South Carolina.
26
0 5 10 15 20 25 30 35 40 45 50 55
Number of representatives
Statistics and Probability with Applications, 4th edition
Starnes, Tabor, Wilcox
0:00 | 7:08
CC
1x

Pre-made homework with error-specific feedback



Different wrong answer- different feedback

Summative Assessment

11 of 13 Questions

Completed 0 out of 13

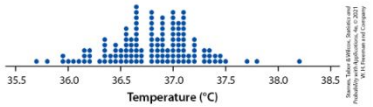
Submit All

1 Question
2 Question
3 Question
4 Question
5 Question
6 Question
7 Question
8 Question
9 Question
10 Question
11 Question
12 Question
13 Question

Question 11 of 13

For more than a century, doctors have been telling patients that a normal body temperature is 98.6°F (37.0 degrees Celsius). This value dates back to a study done by Carl Wunderlich in the mid-1800s. More recently, researchers conducted a study to determine whether the "accepted" value for normal body temperature is accurate. They collected body temperatures (in degrees Celsius) from 130 healthy individuals. A dotplot and numerical summaries of the data are given.

n	Mean	SD	Min	Q_1	Med	Q_3	Max
130	36.805	0.407	35.722	36.556	36.833	37.056	38.222



(a) Find the 10th percentile of the distribution of body temperature. [ ] °C. (Round to the nearest tenth)

(b) Michael's temperature was 37.5°C. Calculate and interpret Michael's standardized score (z-score).

- $z = -1.71$. Michael's temperature is 1.71 degrees below the mean temperature.
- $z = -1.71$. Michael's temperature is 1.71 standard deviations below the mean temperature.
- $z = 1.71$. Michael's temperature is 1.71 degrees above the mean temperature.
- $z = 1.71$. Michael's temperature is 1.71 standard deviations above the mean temperature.

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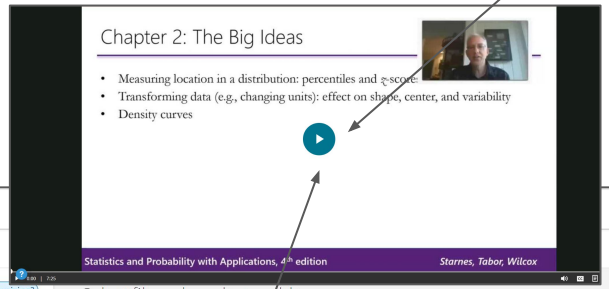
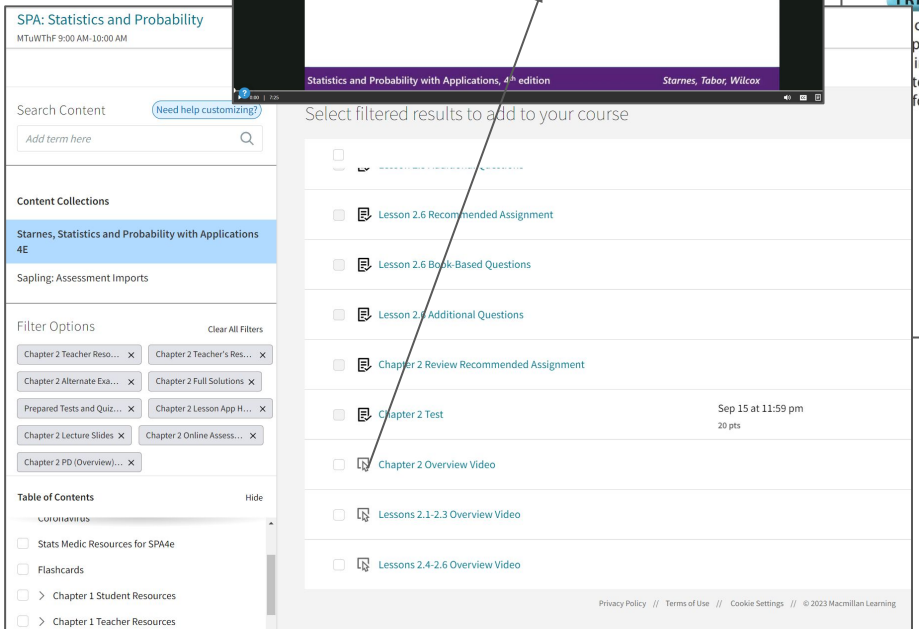
high school publishers

Teacher ebook
Teacher resources





PD CHAPTER OVERVIEW VIDEO
Watch the Chapter 2 overview video for guidance from the authors on teaching the content in this chapter. Find it by clicking on the link in the TE-book or by logging into the teachers' resources on our digital platform.

TRM CHAPTER 2 LECTURE PRESENTATION SLIDES
You can find Microsoft PowerPoint lecture presentations by clicking on the link in the TE-book or by logging into the teachers' resources on our digital platform.

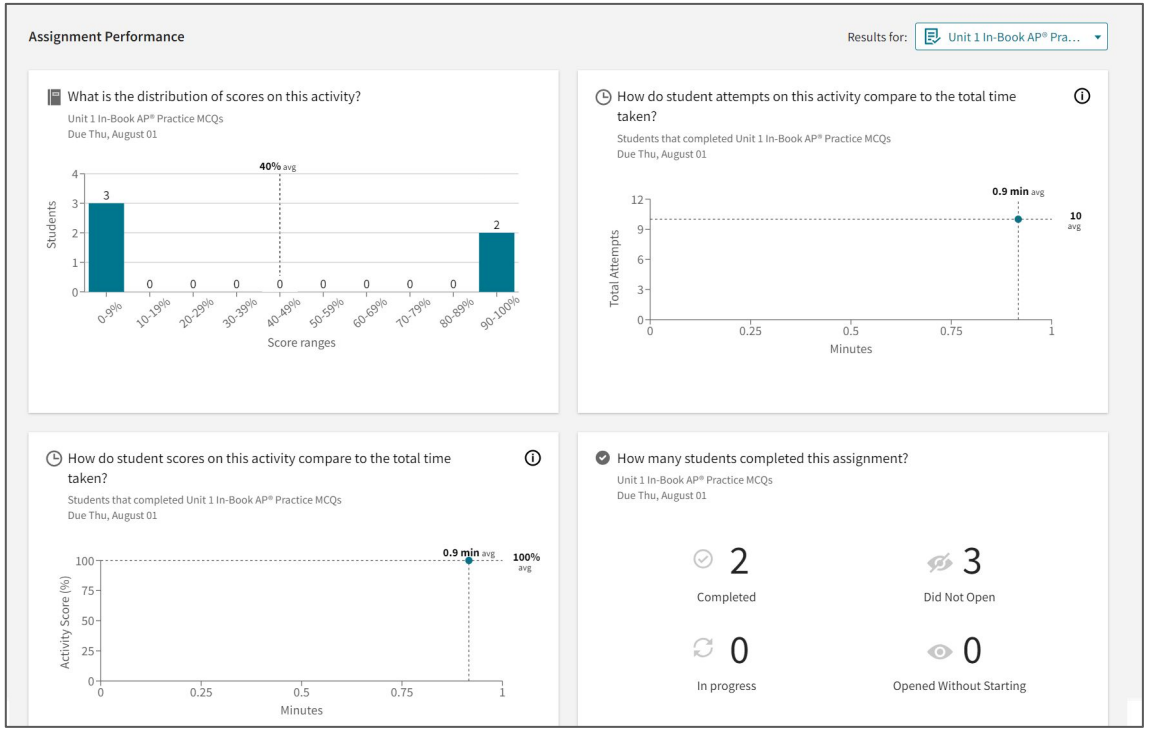
TRM CHAPTER 2 DATA FILES
can find data files for many
pter 2 data sets by clicking on the
in the TE-book or by logging into
teachers' resources on our digital
form.

Modeling One-Variable Quantitative Data

Reports and Insights

Use this information to assess students' progress so you can adjust accordingly

- Top assignments to review
- How often are students logging in?
- What's the distribution of scores on an activity?
- How do students scores on an activity compare to time taken?
- How many students completed an assignment?
- Performance by unit, learning objective, and student



Goal Setting and Reflections Survey

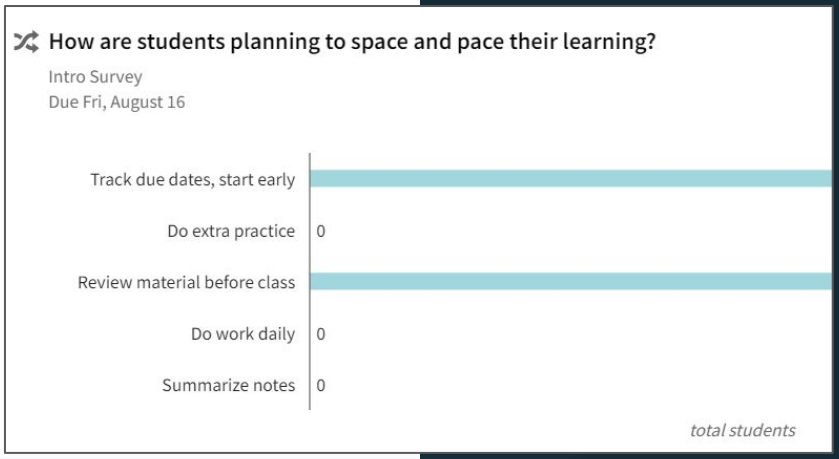
bfw publishers

Goal-Setting and Reflections Surveys

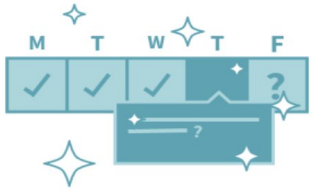
In recent weeks…

How often did you give yourself enough time to complete assignments on time or start early?

- ○ 5 - Always
- ○ 4 - Often
- ○ 3 - Sometimes
- ○ 2 - Rarely
- ○ 1 - Never



Teacher view



Category 1: Space it out!

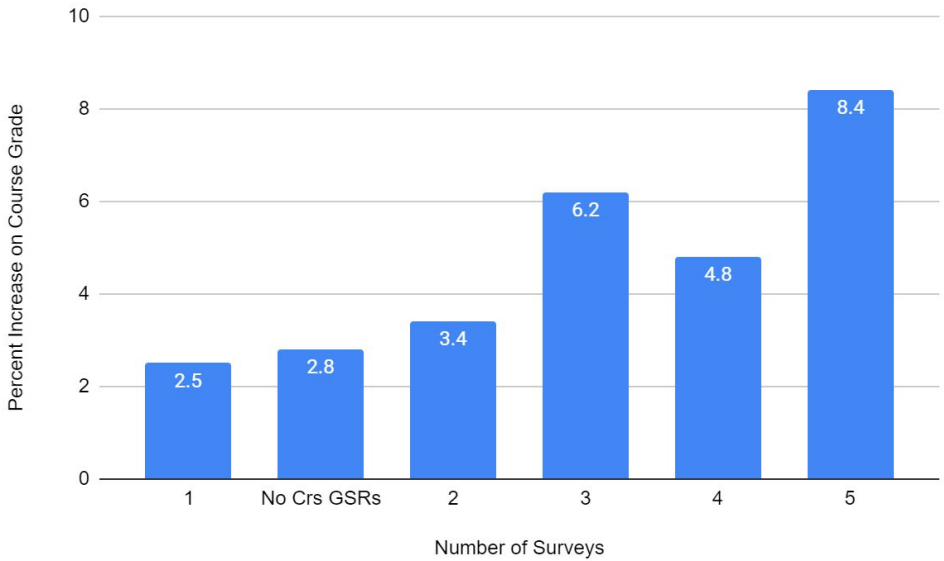
Learning happens over time, not all at once.

Research has shown memory benefits from spacing studying/review sessions over time rather than trying to "cram" right before a test. Our Brains take time to consolidate information into long-term memory. Therefore, we're better able to recall information and concepts if we learn them in multiple, spread-out sessions.

Teacher slides

Research suggests…

Completing just 3 surveys increased course grades by 6.2%. We saw an increase of 8.4% when 5 surveys were completed (n=2,529 students).



Students found the Goal Setting & Reflection Surveys valuable for their learning.

Survey Item	*Agree/Strongly Agree*
The surveys helped me improve as a student this semester.	**75%**
The surveys were a valuable use of my time.	**62%**
The surveys helped me think about my goals/learning habits in and outside of class.	**80%**
The surveys helped me learn something new about how I can manage my time, studying, or learning.	**79%**

Study included college students taking intro-level chemistry, biochem, bio, calc, precalc, econ, & English classes

bfw publishers

Empowering teachers.

19 Teachers | Psychology | Statistics | Lit & Comp

"The online assessments were great for homework and immediate feedback on student conceptual understanding."

JENNIFER MUELLER, STATISTICS TEACHER

"We only have so much time! Achieve has been a time-efficient system this year. This is emotional for me and my students because time not spent on logistical and technical problems is time spent with our families and engaged in meaningful work."

KARL SINEATH, PSYCHOLOGY TEACHER

Saving Teachers Time

- ✓ Planning
- ✓ Assigning and collecting homework
- ✓ Creating and administering tests
- ✓ Grading and easy grade transfer
- ✓ Adjust due dates across sections
- ✓ Wrong answer feedback
- ✓ Visibility of students' notes

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Elevating student performance

414 Students | Psychology | Statistics | Lit & Comp

Meeting Class Goals

- ✓ User friendly interface
- ✓ Immediate feedback
- ✓ Curriculum and assessment alignment
- ✓ Flexibility and adaptability
- ✓ AP exam prep
- ✓ AP level problem sets
- ✓ Reports, insights, and data

"The online assessments were great for homework and immediate feedback on student conceptual understanding. It helped provide detailed explanations for each question and why it was incorrect."

STATISTICS STUDENT

"It helped me prepare for unit tests and the AP exam."

PSYCHOLOGY STUDENT

STUDENT STUDY SAMPLE:

40% juniors
50% seniors
90% reported a B+ GPA or higher
71% passed the AP exam

strongly agree or agree
Achieve has interesting content

strongly agree or agree
Achieve helped me learn required content

strongly agree or agree
Achieve helped me prepare for AP exam

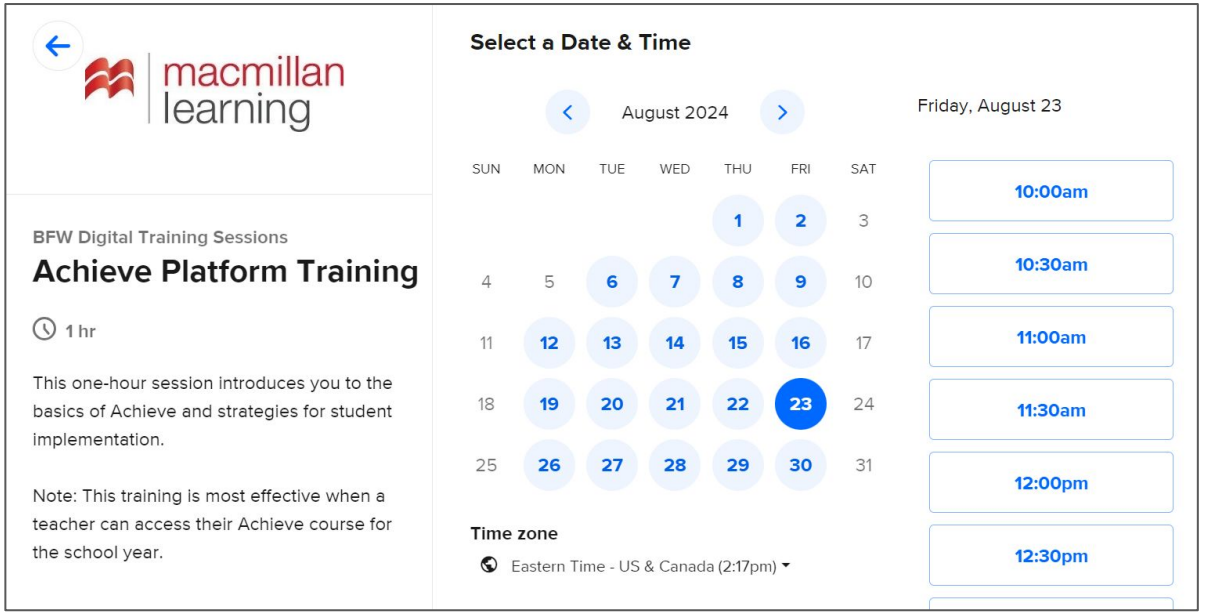
strongly agree or agree
Achieve is easy to use

bfw publishers

Training

Implementation Training

- Live Training
- Independent study/Asynchronous training
- Live Online 1:1 Digital Training
  - Achieve
  - Test bank
  - LMS



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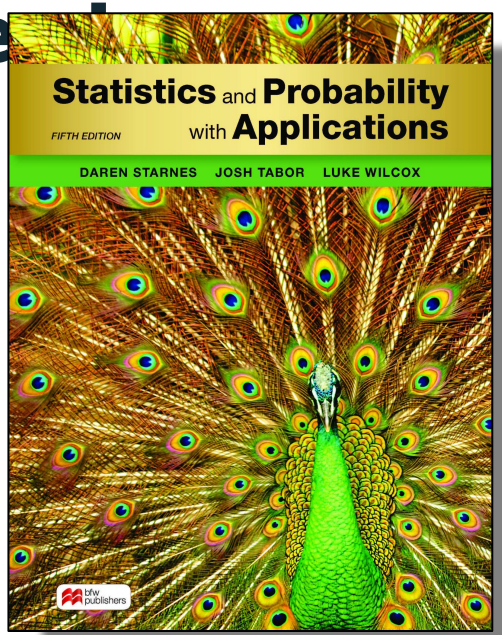

- Authorship
- Teacher Resources
- Bite-sized lessons
- Applications/activities
- Range of exercises
- Achieve

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