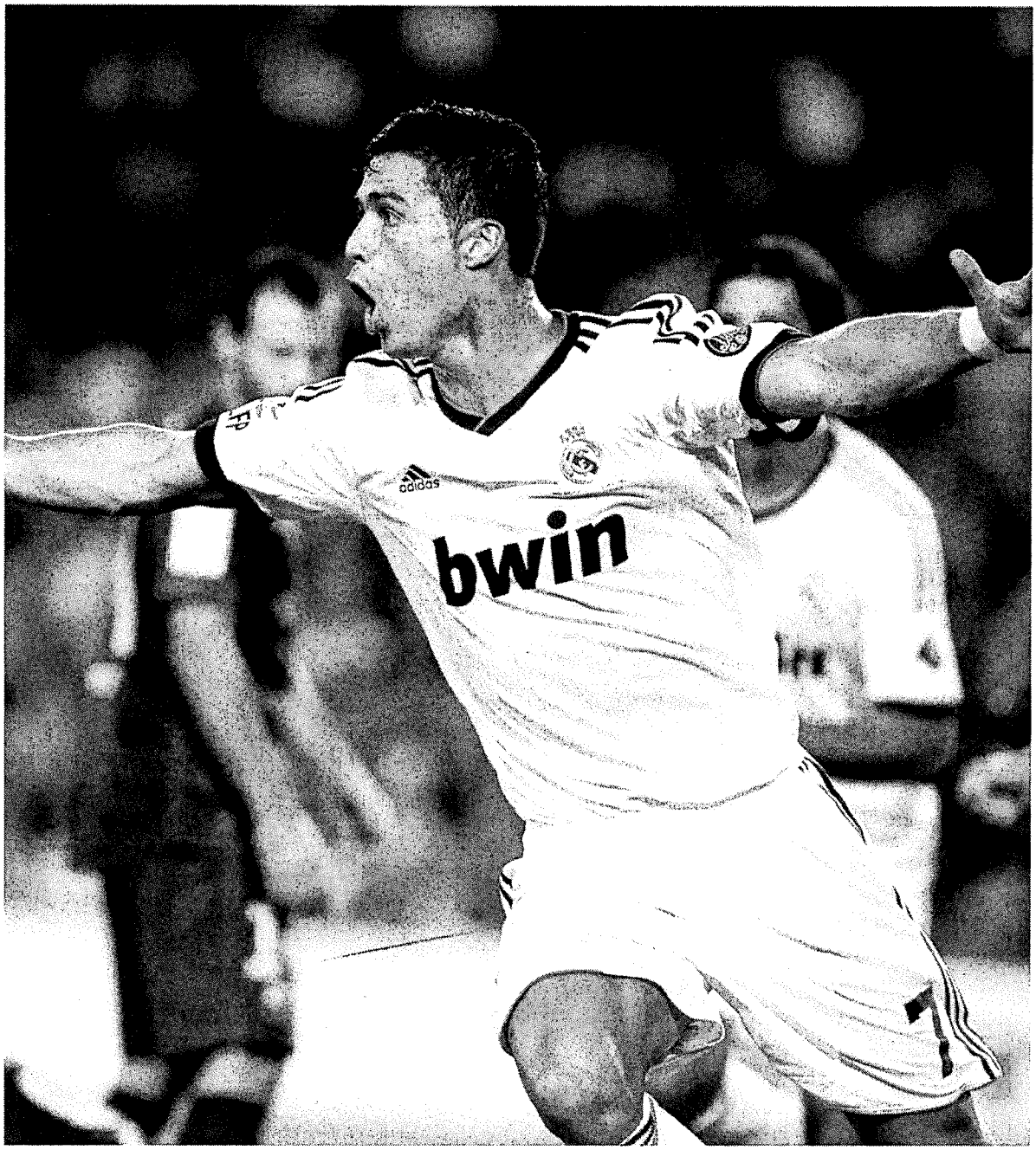
Chapter 7 Business Statistics



Learning Outcomes

7-1 Graphs and Charts

1. Interpret and draw a bar graph.
2. Interpret and draw a line graph.
3. Interpret and draw a circle graph.

7-2 Measures of Central Tendency

1. Find the mean.
2. Find the median.
3. Find the mode.
4. Make and interpret a frequency distribution.
5. Find the mean of grouped data.

7-3 Measures of Dispersion

1. Find the range.
2. Find the standard deviation.

Big Business in the World of Sports

The sports business means many different things to different people. This is truly a global industry, and sports stir up deep passion within spectators and players alike in countries around the world. To athletes, sports may lead to high levels of personal achievement; to professionals, sports can bring fame and fortune. To businesspeople, sports provide a lucrative and continually growing marketplace worthy of immense investment.

When the astonishing variety of sports-related sectors are considered, a significant number of workers in developed nations such as the United States, the United Kingdom, Australia, and Japan rely on the sports industry for their livelihoods. Official U.S. Bureau of Labor Statistics figures state that 240,000 people work as coaches, referees, and related workers, including 11,500 sports competitors that earn an average of $78,260 per year. Another 22,400 work as athletic trainers and over 560,000 people work in fitness and recreation centers. In total, well over 1,000,000 Americans work directly in the spectator sports, amusement, and recreation sectors.

Although not one of the four major sports in the United States, soccer (or "futbol") is one of the most popular sports in the world. Nearly every major country has a professional soccer league, though the average salaries of soccer players vary greatly by country and league. During a recent year, players in the top soccer league in the United States earned an average of $213,048 per season, or $4,097 per week.

The English Premier League (EPL) is arguably the top soccer league in the world. As a testament to the sport's popularity in England, the average EPL player made $3,562,600 per year

or $68,512 per week. The highest division of soccer in Spain, La Liga, is home to some of the world's best soccer players. In a recent year, the average La Liga player made $1,901,008 per season, or an average of $36,558 per week. The three highest-paid La Liga players were Cristiano Ronaldo ($28,500,000 per year), Gareth Bale ($25,700,000 per year), and Lionel Messi ($21,700,000 per year).

Even without the home team involved, the recent World Cup final between Germany and Argentina set a television viewership record in the United States, with an estimated 26.5 million people watching the game. The game had 17.3 million viewers on ABC and another 9.2 million on the Spanish-language Univision. The month-long World Cup also was responsible for an astonishing 3 billion interactions on Facebook and 672 million messages on Twitter, showing that worldwide, soccer is here to stay!

Galileo once said that mathematics is the language of science. In the 21st century, he might have said that mathematics is also the language of business. Through numbers, businesspeople communicate their business history, status, and goals. Statistics, tables, and graphs are three important tools with which to do so.

7-1 Graphs And Charts

Learning Outcomes

1. Interpret and draw a bar graph.
2. Interpret and draw a line graph.
3. Interpret and draw a circle graph.

Scan a newspaper, a magazine, or a business report, and you are likely to see graphs. Graphs do more than present sets of data. They visually represent the relationship between the sets. The relationship between **data sets** might be visualized by a bar graph, a line graph, or a circle graph. By data set we mean a collection of values or measurements that have a common characteristic. Depending on "what you want to see," one of these forms helps you to see the relationship more meaningfully.

In today's fast-paced society, a person is given a limited amount of time to *sell* his or her idea or to *show* his or her data. Graphs and charts tell a story in pictures.

Data set

a collection of values or measurements that have a common characteristic.

1 Interpret and draw a bar graph.

Bar graphs are used to visually represent the relationship between data. As its name implies, a bar graph uses horizontal or vertical bars to show relative quantities. The data are grouped into categories or classes, and each category is represented by a bar. The length of the bars for horizontal bars or the height of the bars for vertical bars shows the number of items in each category. Suppose an instructor wants to see a visual representation of the scores that 25 students made on an exam. **Table 7-1** gives the data in table form. Instead of graphing individual scores, the data are grouped into intervals of scores. **Figure 7-1** shows a bar graph of this data.

Bar graph

a graph that uses horizontal or vertical bars to show how values compare to each other.

Figure 7-1 demonstrates why bar graphs are so useful: We can easily compare the scores for grade intervals at a glance.

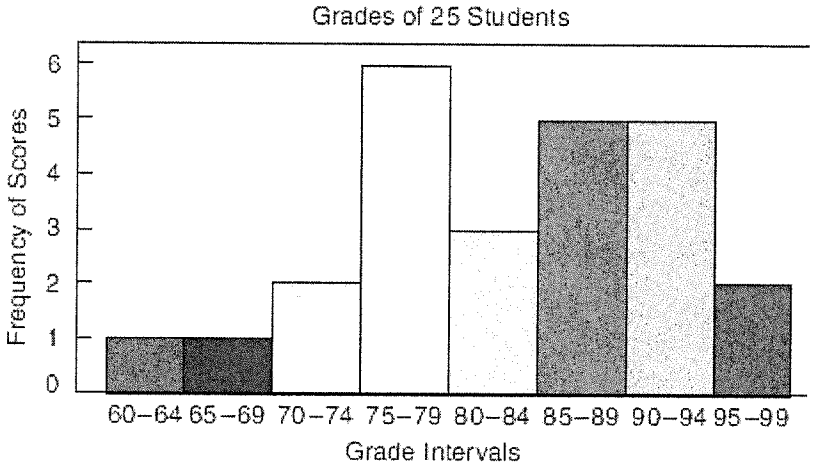


Figure 7-1 Bar Graph of 25 Exam Scores

Table 7-1 Distribution of 25 Exam Scores

Example 1

Answer the questions using the data represented in **Figure 7-1** .

a. Which grade interval(s) had the highest number of scores?
b. Which grade interval(s) had the lowest number of scores?
c. If 90-99 is a grade of A, how many As were there?

a. Which grade interval(s) had the highest number of scores?
The interval 75-79 had the highest number of scores, 6.
b. Which grade interval(s) had the lowest number of scores?
The intervals 60-64 and 65-69 had the lowest number of scores, 1.
c. If 90-99 is a grade of A, how many As were there?
There are 5 scores in the 90-94 interval and 2 scores in the 95-99 interval. **There are 5 + 2 or 7 scores that are As.**

Try Stop & Check 1–3.

A **histogram** is a special type of bar graph that represents the data from a frequency distribution. The procedure for making a frequency distribution is given in Section 7-2. **Figure 7-1** is a histogram. Because there are no gaps in the intervals, the bars in a histogram are drawn with no space between them. In contrast, the bars on a standard bar graph describe categories, and they are drawn with gaps between the bars.

Histogram

a special type of bar graph that represents the data from a frequency distribution.

How To Draw a Bar Graph

1. Write an appropriate title.
2. Make appropriate labels for the bars and scale. The intervals on the scale should be equally spaced and include the smallest and largest values.
3. Draw bars to represent the data. Bars should be of uniform width and should not touch.
4. Make additional notes as appropriate. For example, "Amounts in Thousands of Dollars" allows values such as $30,000 to be represented as 30.

Example 2

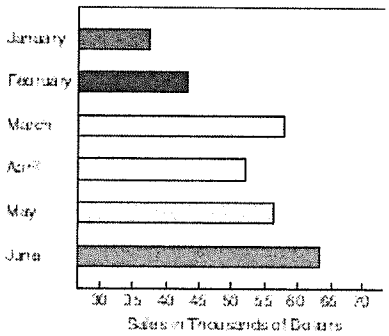
The investors of Corky's Barbecue Restaurant have asked to see a semiannual report of sales. The data show Corky's Barbecue Restaurant sales during January through June. Draw a bar graph that represents the data.

The title of the graph is "Corky's Barbecue Restaurant Sales, January –June."

The smallest value is $37,734 and the largest value is $63,784. Therefore, the graph should show values from $30,000 to $70,000. To avoid using very large numbers, indicate on the graph that the numbers represent dollars in thousands. Therefore, 65 on the graph would represent $65,000. The bars can be either horizontal or vertical. In **Figure 7-2** we make the bars horizontal. Months are labeled along the vertical line, and the dollar scale is labeled along the horizontal line. For each month, the length of the bar corresponds to the sales for the month.

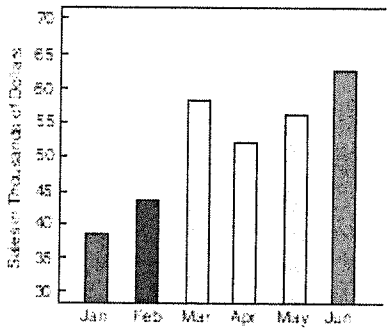
Figure 7-3 interchanges the labeling of the scales, and the bars are drawn vertically.

Try Stop & Check 4–5.



Corky's Barbecue Restaurant
Sales, January–June

Figure 7-2 Horizontal Bar Graph Showing Corky's Barbecue Restaurant Sales, January–June



Corky's Barbecue Restaurant
Sales, January–June

Figure 7-3 Vertical Bar Graph Showing Corky's Barbecue Restaurant Sales, January–June

Bar graphs may illustrate relationships among more than one variable. A **standard bar graph** illustrates the change in magnitude of just one variable. **Figure 7-2** is a standard horizontal bar graph. **Figure 7-3** shows the same data as a standard vertical bar graph.

Standard bar graph
bar graph with just one variable.

In many instances it is important for a business to see how data compares from one time period to another. For example, The 7th Inning wants to compare annual sales by department for the past four years. Look at the data that is shown in **Table 7-2** .

Table 7-2 The 7th Inning Annual Sales

A **comparative bar graph** is used to illustrate two or more related variables. The bars representing each variable are shaded or colored differently so that visual comparisons can be made more easily. **Figure 7-4** shows a comparative bar graph for the annual sales for The 7th Inning from 2014 through 2017.

Comparative bar graph

bar graph with two or more variables.

Component bar graph

bar graph with each bar having more than one component.

A **component bar graph** is used to show that each bar is the total of various components. The components are stacked immediately on top of each other and shaded or colored differently. **Figure 7-5** is a component bar graph that shows the total annual sales for The 7th Inning as well as the sales by department.

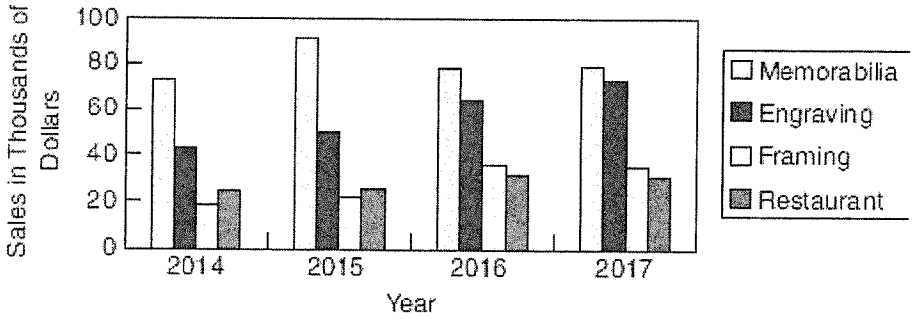


Figure 7-4 Comparative bar graph showing The 7th Inning Sales by Department

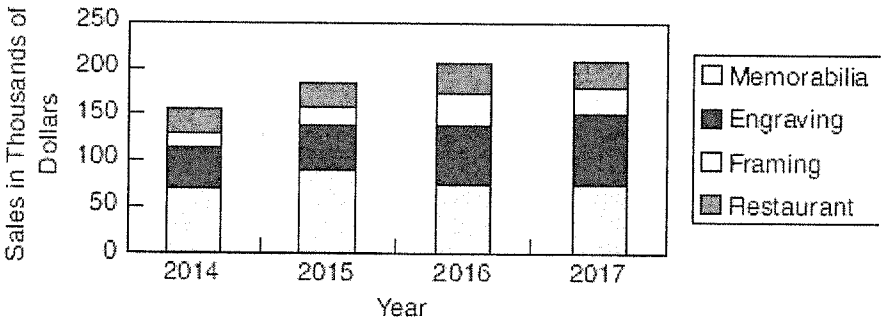


Figure 7-5 Component bar graph showing The 7th Inning Annual Sales

Stop & Check

Fifty business students were given a project to complete. The bar graph in ***Figure 7-6*** *shows the number of days it took the students to complete the assignment. See* ***Example 1*** .

1. How many students took 4 days to complete the assignment?
2. How many students completed the project in 3 days or less?
3. What percent of students completed the project in 3 days or less?

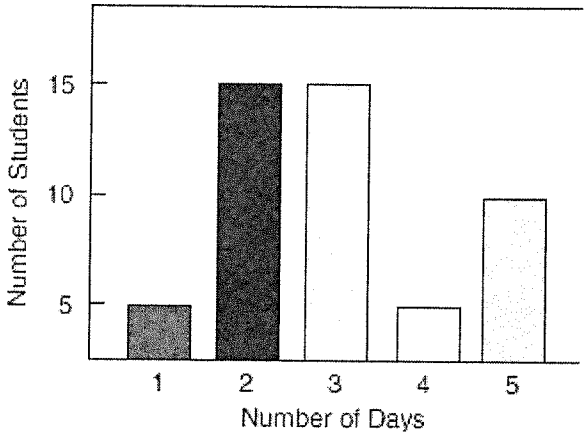


Figure 7-6

See ***Example 2*** .

4. The staff at Tulsa Community College have accumulated the following number of vacation days: 11 have accumulated 0-19 days; 12 have accumulated 20-39 days; 5 have accumulated 40-59 days; 5 have accumulated 60-79 days; and 3 have accumulated 80-99 days. Make a histogram to illustrate these data.
5. From the graph, identify the number of vacation days (interval) that 12 staff members have.

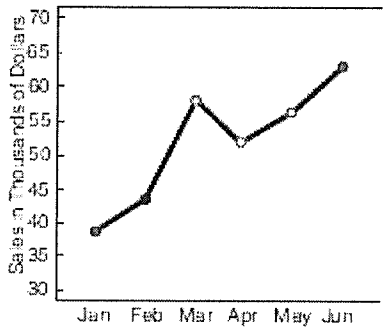
2 Interpret and draw a line graph.

Line graphs are very similar to vertical bar graphs. The difference is that a line graph uses a single dot to represent height, rather than a whole bar. When the dots are in place, they are connected by a line. Line graphs make even more apparent the rising and falling trends of the data. **Figure 7-7** is a line graph representing the data given in Example 2 for the January to June sales for Corky's Barbecue Restaurant.

Line graph

line segments that connect points on a graph to show the rising and falling trends of a data set.

Line graphs may have enough points that connecting them yields a curve rather than angles. **Figure 7-8** shows such a line graph, relating the time film is developed to the degree of contrast achieved in the developed film. To read the graph, we locate a specific degree of contrast on the vertical scale, and then move horizontally until we intersect the curve. From that point, we move down to locate the corresponding number of minutes on the horizontal scale.



Corky's Barbecue Restaurant
Sales, January–June

Figure 7-7 Line Graph Showing Corky's Barbecue Restaurant Sales, January–June

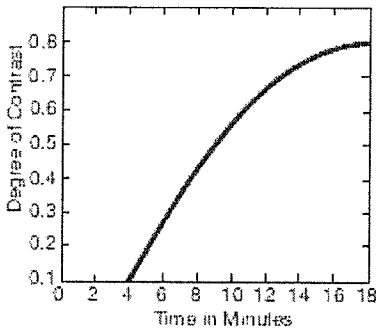


Figure 7-8 Developing Time Required for Degree of Contrast

Example 3

Use **Figure 7-9** to answer the following questions:

a. If the film is to be developed to a contrast of 0.5, how long must it be developed?
b. If the film is developed for 13 minutes, what is its degree of contrast?

a. Find 0.5 on the vertical scale, and then move horizontally until you intersect the curve. From the point of intersection, move down to locate the corresponding number of minutes on the horizontal scale. **Figure 7-9 shows the minutes are 9.**
b. Find 13 minutes on the horizontal scale, and move up until you intersect the curve. From the point of intersection, move across to locate the corresponding degree of contrast. **Figure 7-9 shows the degree of contrast is 0.7.**

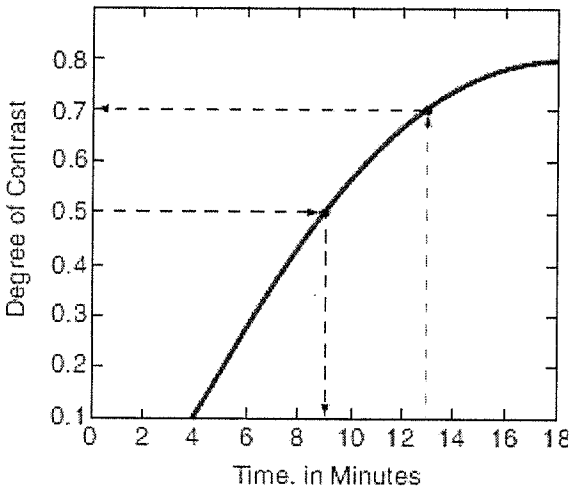


Figure 7-9 Reading a Line Graph

Try Stop & Check 1–2.

As in drawing bar graphs, drawing line graphs often means using approximations of the given data.

How To Draw a line graph

1. Write an appropriate title.
2. Make and label appropriate horizontal and vertical scales, each with equally spaced intervals. Often, the horizontal scale represents time.
3. Use points to locate data on the graph.
4. Connect data points with line segments or a smooth curve.

Table 7-3 neighborhood Grocery Daily sales for Week Beginning Monday, June 21

Example 4 Draw a line graph to represent the data in Table 7-3 .

The smallest and largest values in the table are $1,237 and $1,984, respectively, so the graph may go from $1,000 to $2,000 in $100 increments. Do not label every increment. This would crowd the side of the graph and make it difficult to read. The purpose of any graph is to give information that is quick and easy to understand and interpret.

The horizontal side of the graph will show the days of the week, and the vertical side will show the daily sales. Plot each day's sales by placing a dot directly above the appropriate day of the week across from the approximate value. For example, the sales for Monday totaled $1,567. Place the dot above Monday between $1,500 and $1,600. After each amount has been plotted, connect the dots with straight lines.

Figure 7-10 shows the resulting graph.

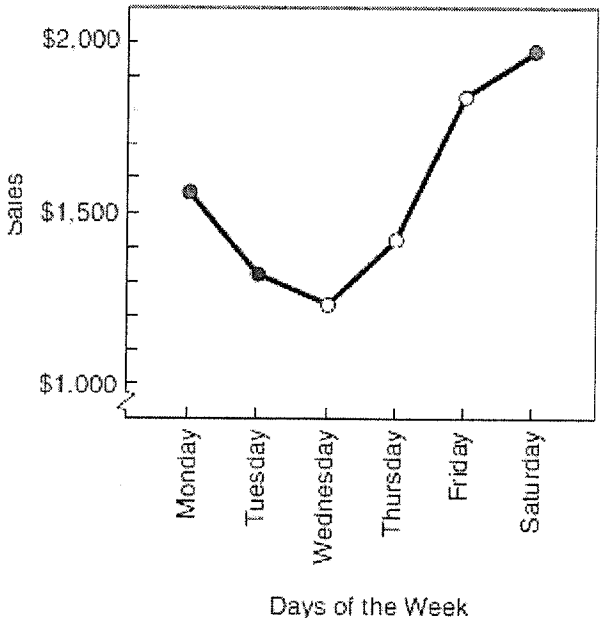


Figure 7-10 Neighborhood Grocery Daily Sales for Week Beginning Monday, June 21

Try Stop & Check 3–5.

Did You Know?

A line graph may show data that is always increasing or is always decreasing or that fluctuates. Fluctuate means sometimes increasing and sometimes decreasing. The line graph in **Figure 7-10** is a fluctuating graph.

Stop & Check

See **Example 3** .

1. Is the graph in **Figure 7-11** increasing, decreasing, or fluctuating?
2. Find the monthly average number of CDs sold by House of Music for the 6-month period January–June.

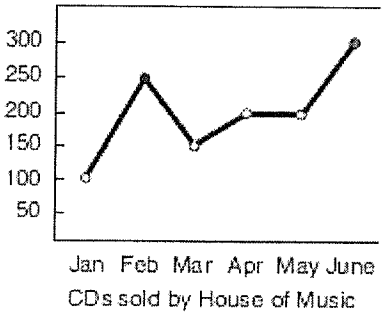


Figure 7-11

*See **Example 4*** .

3. Draw a line graph to represent the data in **Table 7-4** .

Table 7-4 Personal Income for Quarters 2014: II-2015: III Millions of Dollars, seasonally adjusted at annual rate

Source: Bureau of Economic Analysis, an agency of the U.S. Department of Commerce

4. Is the graph in Exercise 3 increasing, decreasing, or fluctuating?
5. Which month showed the highest personal income?

3 Interpret and draw a circle graph.

A **circle graph** is a circle divided into sections to give a visual picture of *how some whole quantity* (represented by the whole circle) *is being divided.* Each section represents a portion of the total amount. **Figure 7-12** shows a circle graph illustrating how different portions of a family's total take-home income are spent on nine categories of expenses: food, housing, contributions, savings, clothing, insurance, education, personal items, and miscellaneous items.

Circle graph

a circle that is divided into parts to show how a whole quantity is being divided.

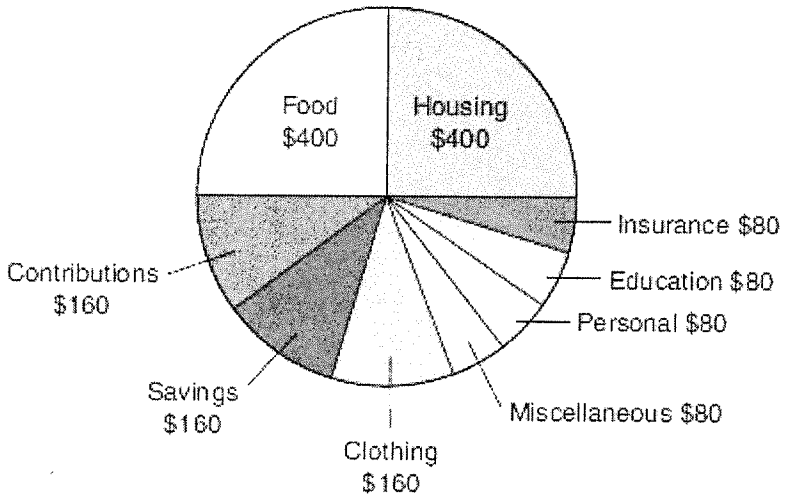


Figure 7-12 Distribution of Family Monthly Take-Home Pay

Circle graphs are relatively easy to read, and they make it easy to visually compare categories. Constructing a circle graph requires that you make several calculations and use a measuring device called a **protractor** that measures angles. Each value in the data set should be represented as a fraction of the sum of all the values. We calculate these fractions, then

calculate the number of degrees needed for each sector, and then draw the graph.

Protractor

a measuring device that measures angles.

Sector

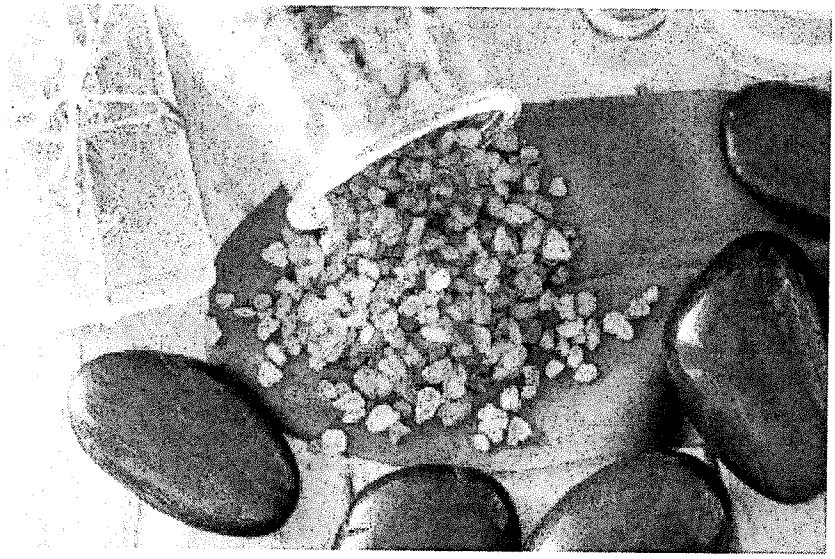
portion or wedge of a circle identified by two lines from the center to the outer edge of the circle.

Compass

a tool for drawing circles.

How To Draw A Circle Graph

1. Write an appropriate title.
2. Find the sum of the values in the data set.
3. Represent each value as a fractional or decimal part of the sum of values. Total of all parts equal 1.
4. For each fraction or decimal, find the number of degrees in the **sector** of the circle to be represented by the fraction or decimal: Multiply the fraction or decimal by 360 degrees. The sum of the degrees for all sectors should be 360 degrees.
5. Use a **compass** (a tool for drawing circles) to draw a circle. Indicate the center of the circle and a starting point on the circle.
6. For each degree value, draw a sector: Use a protractor (a measuring instrument for angles) to measure the number of degrees for the sector of the circle that represents the value. Where the first sector ends, the next sector begins. The last sector should end at the starting point.
7. Label each sector of the circle and make additional explanatory notes as necessary.



Example 5

Construct a circle graph showing the budgeted operating expenses for one month for Silver's Spa: salary, $25,000; rent, $8,500; depreciation, $2,500; miscellaneous, $2,000; taxes and insurance, $10,000; utilities, $2,000; advertising, $3,000. The title of the graph is "Silver's Spa Monthly Budgeted Operating Expenses."

Because several calculations are required, it is helpful to organize the calculation results in a chart (**Table 7-5**).

Table 7-5 silver's spa Monthly Budgeted Operating Expenses

Decimal equivalents can be used instead of fractions of total expenses. The sum of the fractions or decimal equivalents is 1. To the nearest thousandth, the decimal equivalents are 0.472, 0.160, 0.047, 0.038, 0.189, 0.038, and 0.057. The sum is 1.001. Rounding causes the sum to be slightly more than 1, just as the sum of the degrees is slightly more than 360°.

Use a compass to draw a circle. Measure the sectors of the circle with a protractor, using the calculations you just made. The finished circle graph is shown in **Figure 7-13**

Did You Know?

Computer software such as *Microsoft Word* and *Excel* has built-in features that can be used to construct many different types of graphs, called *charts*. Data are organized in a table format and the software builds the chart and guides you through the process of giving the chart a title, labeling the scales or *axes*, and identifying other information about the data through *legends* and *notes*.

Knowing how a graph is constructed helps in reading the graph and analyzing the data of the graph. In reality, you will probably use computer software in making graphs for business presentations.

In *Word*, you will find the graphing options under the *Insert* tab, *Illustrations*, and *Chart*. In *Excel*, the graphing options are under the *Insert* tab and *Charts*. Some of the types of graphing options included are *Column* (vertical bar graph), *Line, Pie* (circle graph), and *Bar* (horizontal bar graph). Selecting one of these options will give you several pictorial choices including options for comparative and component graphs. You will make a selection based on the characteristics of the data you wish to display.

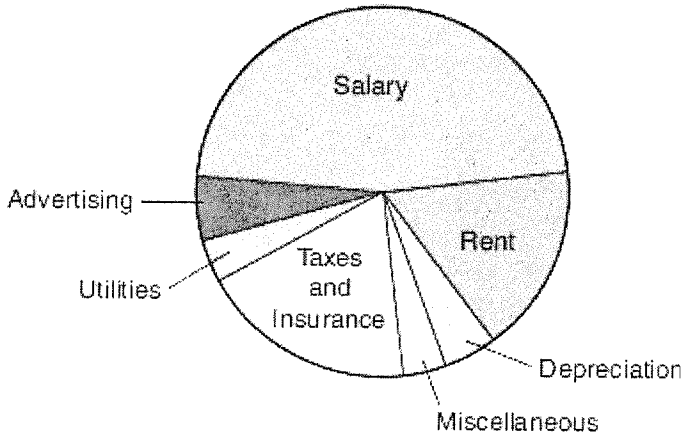


Figure 7-13 Monthly Budgeted Operating Expenses for Silver's Spa

Try Stop & Check 1–4.

Stop & Check

Use **Table 7-6** for Exercises 1-4. See **Example 5** .

1. Construct a circle graph showing the distribution of market share using data in **Table 7-6** .

Table 7-6 Percent Dollar Market Share of Comics and Magazine Sales for September (Rounded to the Nearest Whole Percent)

2. What percent of market share is held by the largest three companies?

3. If the total market had $80,000,000 in comics and magazine sales for September, what were the sales for Marvel Comics?

4. What was Image Comics' sales for September if the total market was $80,000,000?

7-1 Section Exercises

Applications

Use **Figure 7-14** for Exercises 1 through 3. See **Example 1** .

1. Which quarter had the highest dollar volume?
2. What percent of the yearly sales were the sales for October-December?
3. What was the percent of increase in sales from the first to the second quarter?

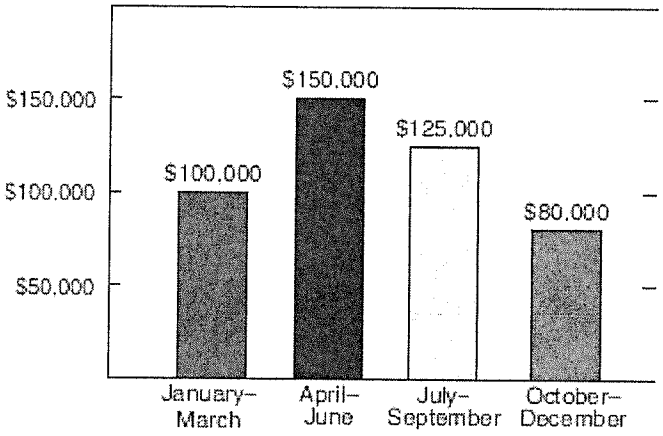


Figure 7-14 Quarterly Dollar Volume of Batesville Tire Company

4. Draw a bar graph comparing the quarterly sales of the Oxford Company: January-March, $280,000; April-June, $310,000; July-September, $250,000; October-December, $400,000. *See **Example 2*** .

*Use **Table 7-7** for Exercises 5 through 8.*

Table 7-7 Sales by Each Salesperson at Happy's Gift Shoppe

5. Construct a bar graph showing total sales by salesperson for Happy's Gift Shoppe in **Table 7-7** . *See **Example 2*** .

6. Which salesperson made the most sales for the week? Which salesperson made the second highest amount in sales? *See **Example 1*** .
7. What day had the lowest amount in sales? What day of the week had the highest amount in sales? *See **Example 3*** .
8. Construct a line graph showing total sales by the days of the week for Happy's Gift Shoppe in **Table 7-7** . *See **Example 4*** .

*Use **Figure 7-15** for Exercises 9 through 12. See **Example 3** .*

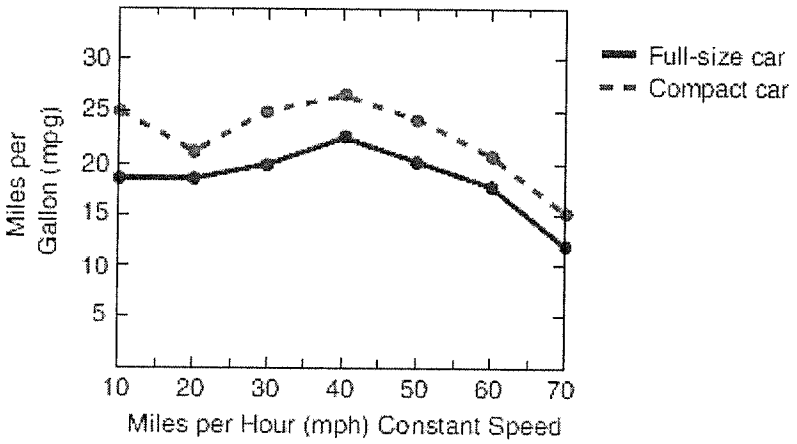


Figure 7-15 Automobile Gasoline Mileage Comparisons

9. What speed gave the highest gasoline mileage for both types of automobiles?
10. What speed gave the lowest gasoline mileage for both types of automobiles?
11. At what speed did the first noticeable decrease in gasoline mileage occur? Which car showed this decrease?
12. Identify factors other than gasoline mileage that should be considered when deciding which type of car to purchase, full size or compact.

*Use **Figure 7-16** for Exercises 13 through 16. Round to the nearest tenth of a percent.*

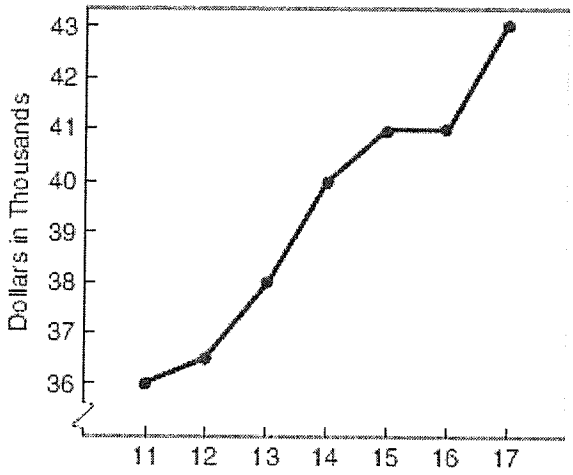


Figure 7-16 Dale Crosby's Salary History

13. Calculate the amount and percent of increase in Dale's salary from 2014 to 2015.
14. What is the percent of increase in Dale's salary from 2012 to 2013?
15. If the cost-of-living increase was 10% from 2011 to 2016, determine if Dale's salary for this period of time kept pace with inflation.
16. Calculate the amount and percent of increase in Dale's salary from 2016 to 2017.

See **Example 5** .

17. Match the dollar values with the names in the circle graph of **Figure 7-17** by visually selecting the largest portion on the graph, then the next largest, and so on: $192, $144, $96, $72, $72.

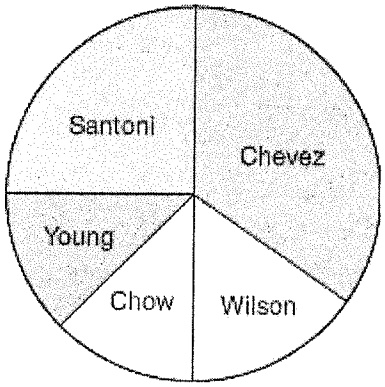


Figure 7-17 Daily Sales by Salesperson

*Use **Figure 7-18** for Exercises 19 through 21.*

18. The family budget is illustrated in **Figure 7-18** . What is the total take-home pay and what percent is allocated for transportation?

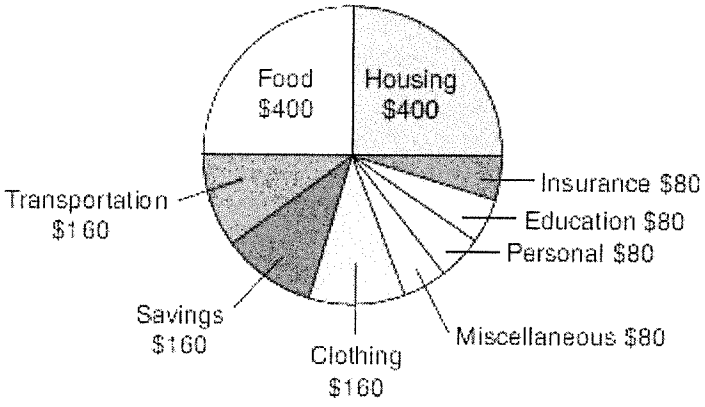


Figure 7-18 Distribution of Family Monthly Take-Home Pay

19. What percent of the take-home pay is allocated for food?
20. What percent of take-home pay is spent for education?

21. What percent of take-home pay is spent for education when education, savings, and miscellaneous funds are combined to be used for education?

7-2 Measures of Central Tendency

Learning Outcomes

1. Find the mean.
2. Find the median.
3. Find the mode.
4. Make and interpret a frequency distribution.
5. Find the mean of grouped data.

All through the year, a business records its daily sales. At the end of the year, 365 values—one for each day—are on record. These values are a data set. With this data set, and using the correct *statistical* methods, we may calculate manageable and meaningful information; this information is called **statistics** . By using the statistics, we should be able to reconstruct—well enough—the original data set or make predictions about a future data set.

Statistic

a standardized, meaningful measure of a set of data that reveals a certain feature or characteristic of the data.

Mean

the arithmetic average of a set of data or the sum of the values divided by the number of values.

1 Find the mean.

One common statistic we may calculate for a data set is its mean. The **mean** is the statistical term for the ordinary arithmetic average. To find the mean, or arithmetic average, we divide the sum of the values by the total number of values.

How To Find the mean of a data set

Example 1

Find the mean used car price for the prices in **Table 7-8** . Round to the nearest ten dollars.

First find the sum of the values.

Rounded to the nearest 10 dollars, the mean price is $8,950.

Try Stop & Check 1–6.

Table 7-8 Prices of Used Automobiles Sold in Tyreville on May 1–2

Stop & Check

See **Example 1** .

1. Find the mean salary to the nearest dollar: $37,500; $32,000; $28,800; $35,750; $29,500; $47,300.
2. Find the mean number of hours for the life of a lightbulb to the nearest whole hour: 2,400; 2,100; 1,800; 2,800; 3,450.
3. Find the mean number of days a patient stays in the hospital rounded to the nearest whole day: 2 days; 15 days; 7 days; 3 days; 1 day; 3 days; 5 days; 2 days; 4 days; 1 day; 2 days; 6 days; 4 days; 2 days.
4. Find the mean number of CDs purchased per month by a group of college students: 12, 7, 5, 2, 1, 8, 0, 3, 1, 2, 7, 5, 30, 5, 2.
5. Manchester City professional soccer team pays its players the highest wages of all teams in the English Premier League (EPL). Find the mean for the wages paid in a recent year by soccer teams in the EPL in millions of British pounds rounded to the nearest tenth of a million pounds: £242; £190; £187; £162; £140; £112; £74; £68; £55; £66; £70; £55; £48; £53; £68; £62; £52
6. Weekly wages for Manchester City soccer team's highest-paid players in a recent year were: £200,000; £120,000; £75,000; £220,000; £140,000; £75,000; £94,000; £80,000; £80,000; £80,000; £90,000; £90,000; £135,000; £100,000; £75,000. Find the mean for the weekly wages.

2 Find the median.

A second kind of average is a statistic called the **median** . To find the median of a data set, we arrange the values in order from the smallest to the largest or from the largest to the smallest and select the value in the middle.

Median

the middle value of a data set when the values are arranged in order of size.

How To Find the median of a data set

Example 2 Find the median price of the used cars in Table 7-8 .

Stop & Check

See **Example 2** .

1. ind the median salary: $37,500; $32,000; $28,800; $35,750; $29,500; $47,300.
2. Find the median number of hours for the life of a lightbulb: 2,400; 2,100; 1,800; 2,800; 3,450.
3. Find the median number of days a patient stays in the hospital: 2 days; 15 days; 7 days; 3 days; 1 day; 3 days; 5 days; 2 days; 4 days; 1 day; 2 days; 6 days; 4 days; 2 days.
4. Find the median number of CDs purchased per month by college students: 12, 7, 5, 2, 1, 8, 0, 3, 1, 2, 7, 5, 30, 5, 2.
5. Manchester City professional soccer team pays its players the highest wages of all teams in the English Premier League (EPL). Find the median for the wages paid in a recent year by soccer teams in the EPL in millions of British pounds: £242; £190; £187; £162; £140; £112; £74; £68; £55; £66; £70; £55; £48; £53; £68; £62; £52
6. Weekly wages for Manchester City soccer team's highest-paid players in a recent year were: £200,000; £120,000; £75,000; £220,000; £140,000; £75,000; £94,000; £80,000; £80,000; £80,000; £90,000; £90,000; £135,000; £100,000; £75,000. Find the median for the weekly wages.

3 Find the mode.

Mode: the value or values that occur most frequently in a data set.

A third kind of average is the **mode** . The mode is the value or values that occur most frequently in a data set. If no value occurs most frequently, then there is no mode for that data set. In **Table 7-8** there are two cars priced at $9,600. The mode for that set of prices is $9,600.

Mode

the value or values that occur most frequently in a data set.

How To Find the mode(s) of a data set

Example 3

Find the mode(s) for this set of test grades in a business class: 76, 83, 94, 76, 53, 83, 74, 76, 97, 83, 65, 77, 76, 83.

The grade of 76 occurs four times. The grade of 83 also occurs four times. All other grades occur only once. Therefore, both 76 and 83 occur the same number of times and are modes.

Both 76 and 83 are modes for this set of test grades.

Try Stop & Check 1–4.

The mean, median, and mode may each be called an *average*. These statistics are **measures of central tendency** . They indicate how data group toward the center. Taken together, the mean, median, and mode describe the tendencies of a data set to cluster between the smallest and largest values. Sometimes it is useful to know all three of these statistical averages, since each represents a different way of describing the data set. It is like looking at the same thing from three different points of view.

Measures of central tendency

statistical measurements such as the mean, median, or mode that indicate how data group toward the center.

Looking at just one statistic for a set of numbers often distorts the total picture. It is advisable to find the mean, median, and mode of a data set and then analyze the results.

Did You Know?

Computer software like *Microsoft Excel* has built-in functions for finding most statistical measures. These functions can be found under the *Formulas* tab. Under the *Formulas* tab, select *More Functions* then *Statistical.* An alphabetical list of the available functions is listed, sometimes in abbreviated form. By moving the mouse over a function, an explanation of the function and a help option will appear. In this listing you will find *AVERAGE* (for the mean), *MEDIAN*, and *MODE.*

Example 4

A real estate agent told a prospective buyer that the average cost of a home in Tyreville was $171,000 during the past three months. The agent based this statement on this list of selling prices: $270,000, $250,000, $150,000, $150,000, $150,000, $150,000, $149,000, $145,000, $125,000.

Which statistic—the mean, the median, or the mode—gives the most realistic picture of how much a home in Tyreville is likely to cost?

Solution

The values are listed in order from largest to smallest, and the middle value is $150,000.

Median = middle value = $150,000

Mode = most frequent amount = $150,000

The mean is $171,000. The median is $150,000. The mode is $150,000.

Conclusion

Because two values are significantly different from the other values, the mean is probably not the most useful statistic.

The median and mode give a more realistic picture of how much a home is likely to cost— about $150,000.

Try Stop & Check 5–6.

Stop & Check

See **Example 3** .

1. From **Table 7-9** find the mode score for vacation days.
2. State sales tax rates are given in **Table 7-10** . What is the mode?

Table 7-9 Number of Vacation Days Accumulated by Staff at Tulsa Community College

Table 7-10 State Sales Tax Rates

Compiled by Federation of Tax Administrators from various sources.

3. Michelle Baragona recorded the test scores on a biology exam. Find the mode score: 98, 92, 76, 48, 97, 83, 42, 86, 79, 100.
4. What is the mode score for number of points scored by players in the season-opening basketball game?

See **Example 4** .

5. What is the mean (to the nearest tenth), median, and mode weight of soccer players? 148, 172, 158, 160, 170, 158, 170, 165, 162, 173, 155, 161
6. Write a statement about the data set in Exercise 5 based on your findings.

4 Make and interpret a frequency distribution.

In Section 7-1, Graphs and Charts, we constructed graphs of data that were already organized in categories. Now, examine some processes for organizing data. **Table 7-1** shows the result of organizing 25 exam scores. Let's look at the individual scores that were used to build this table.

It is difficult to make sense of all these numbers as they appear here. But the instructor can arrange the scores into several smaller groups, called **class intervals** . The word *class* means a special category.
These scores can be grouped into class intervals of 5, such as 60-64, 65-69, 70-74, 75-79, 80-84, 85-89, 90-94, and 95-99. Each class interval has an odd number of scores.

The instructor can now **tally** the number of scores that fall into each class interval to get a **class frequency** , the number of scores in each class interval.

A compilation of class intervals, tallies, and class frequencies is called a **grouped frequency distribution** .

Class intervals

special categories for grouping the values in a data set.

Tally

a mark that is used to count data in class intervals.

Class frequency

the number of tallies or values in a class interval.

Grouped frequency distribution

a compilation of class intervals, tallies, and class frequencies of a data set.

How To Make a frequency distribution

1. Identify appropriate intervals for the data.
2. Tally the data for the intervals.
3. Count the tallies in each interval.

Example 5

Make a grouped frequency distribution of the 25 math exam scores given in **Table 7-1** on page 228. Prepare a table with a title and class intervals and tally the data to determine the class frequencies (**Table 7-11**). Examine the grouped frequency distribution in **Table 7-11** to answer questions *a–e.*

(d) Were the students prepared for the test or was the test too difficult?
The relatively high number of 90's (7) compared to the relatively low number of 60's
(2) suggests that in general, most students were prepared for the test.

(e) What is the ratio of As (90's) to Fs (60's)?

$$\frac{7 \text{ As}}{2 \text{ Fs}} = \frac{7}{2}$$

The ratio is $\frac{7}{2}$

Try Stop & Check 1–5.

Table 7-11 Frequency Distribution of 25 Exam Scores

Did You Know?

In *Excel* there is a function for finding a frequency distribution. It is found by making the following selections: *Formulas, More Functions, Statistical, FREQUENCY.*

Sometimes you want more information about how data are distributed. For instance, you may want to know how each class interval of a frequency distribution relates to the whole set of data. This information is called a relative frequency distribution. A **relative frequency distribution** is a distribution that shows the percent that each class interval of a frequency distribution is of the whole.

Relative frequency distribution

a distribution that shows the percent that each class interval of a frequency distribution is of the whole.

How To Make a relative frequency distribution

1. Make the frequency distribution.
2. Calculate the percent that the frequency of each class interval is of the total number of data items in the set. These percents make up the relative frequency distribution.

$$\text{Relative frequency of a class interval} = \frac{\text{class interval frequency}}{\text{total number in the data set}} \times 100\%$$

Example 6 Make a relative frequency distribution of the data in **Table 7-11**.

Class Interval	Class Frequency	Calculations	Relative Frequency
60–64	1	$\frac{1}{25}(100\%) = \frac{100\%}{25} = 4\%$	4%
65–69	1	$\frac{1}{25}(100\%) = \frac{100\%}{25} = 4\%$	4%
70–74	2	$\frac{2}{25}(100\%) = \frac{200\%}{25} = 8\%$	8%
75–79	6	$\frac{6}{25}(100\%) = \frac{600\%}{25} = 24\%$	24%
80–84	3	$\frac{3}{25}(100\%) = \frac{300\%}{25} = 12\%$	12%
85–89	5	$\frac{5}{25}(100\%) = \frac{500\%}{25} = 20\%$	20%
90–94	5	$\frac{5}{25}(100\%) = \frac{500\%}{25} = 20\%$	20%
95–99	2	$\frac{2}{25}(100\%) = \frac{200\%}{25} = 8\%$	8%

Stop & Check

See **Example 5** .

1. Make a frequency distribution for the number of vacation days accumulated by staff at Tulsa Community College (**Table 7-9** , page 241). Use intervals 0-19, 20-39, 40-59, 60-79, and 80-99.

Use the frequency distribution from Exercise 1 to answer questions 2-5.

2. How many staff have more than 39 vacation days?
3. How many staff have fewer than 40 vacation days?
4. What percent of the staff have 80 or more vacation days? Round to the nearest tenth of a percent.
5. What percent of the staff have 20 to 59 vacation days? Round to the nearest tenth of a percent.
6. Make a relative frequency distribution of the data in **Table 7-9** on page 241. Round percents to the nearest tenth of a percent. *See* **Example 6** .

5 Find the mean of grouped data.

When data are grouped, it may be desirable to find the mean of the grouped data. To do this, we extend our frequency distribution.

How To Find the mean of grouped data

1. Make a frequency distribution.
2. Find the midpoint of each class interval by averaging the beginning and ending points.

$$\text{Midpoint} = \frac{\text{beginning point} + \text{ending point}}{2}$$

3. For each interval in step 1, find the product of the midpoint of the interval and the frequency.
4. Find the sum of the class frequencies.
5. Find the sum of the products from step 3.
6. Divide the sum of the products (from step 5) by the sum of the class frequencies (from step 4).

$$\text{Mean of grouped data} = \frac{\text{sum of the products of the midpoints and the class frequenc}}{\text{sum of the class frequencies}}$$

Example 7

Find the grouped mean of the scores in **Table 7-11** on p. 242. Find the midpoint of each class interval:

$$\begin{aligned}\text{Mean of grouped data} &= \frac{\text{sum of the products of the midpoints and the class frequencies}}{\text{sum of the class frequencies}} \\ &= \frac{2{,}070}{25} \\ &= 82.8\end{aligned}$$

The grouped mean of the scores is 82.8.

Try Stop & Check 1–3.

Tip Is the Mean of Grouped Data Exact?

No. The mean of grouped data is based on the assumption that all the data in an interval have a mean that is exactly equal to the midpoint of the interval. Because this is usually not the case, the mean of grouped data is a reasonable approximation for the mean of the data set.

Stop & Check

See **Example 7** .

1. Find the grouped mean of the data in Exercise 4 on page 230. Round to tenths.
2. Use the grouped frequency distribution in **Table 7-12** to find the grouped mean. Round to hundredths.

   Table 7-12 Frequency Distribution of 75 scores

3. Find the grouped mean to the nearest whole number of the data in the frequency distribution in **Table 7-13** . Round to hundredths.

   Table 7-13 Frequency Distribution of credit-Hour Loads

7-2 Section Exercises

Skill Builders

See **Example 1** .

1. Find the mean for the scores: 3,850; 5,300; 8,550; 4,300; 5,350.
2. Find the mean for the amounts: 92, 68, 72, 83, 72, 95, 88, 76, 72, 89, 89, 96, 74, 72. Round to the nearest whole number.
3. Find the mean for the amounts: $17,485; $14,978; $13,592; $14,500; $18,540; $14,978. Round to the nearest dollar.

See **Example 2** .

4. Find the median for the scores: 3,850; 5,300; 8,550; 4,300; 5,350.
5. Find the median for the scores: 92, 68, 72, 83, 72, 95, 88, 76, 72, 89, 89, 96, 74, 72.
6. Find the median for the amounts: $17,485; $14,978; $13,592; $14,500; $18,540; $14,978.

See **Example 3** .

7. Find the mode for the scores: 3,850; 5,300; 8,550; 4,300; 5,350.
8. Find the mode for the scores: 92, 68, 72, 83, 72, 95, 88, 76, 72, 89, 89, 96, 74, 72.
9. Find the mode for the amounts: $17,485; $14,978; $13,592; $14,500; $18,540; $14,978.

Applications

See **Example 4** .

10. Weekly expenses of students taking a business mathematics class are shown in **Table 7-14** .
    a. Find the mean rounded to the nearest whole number.
    b. Find the median.
    c. Find the mode.
    d. Write a statement about the data set based on your findings.

Table 7-14 Weekly Expenses of Students

11. Salaries for the research and development department of Richman Chemical are given as $48,397; $27,982; $42,591; $19,522; $32,400; and $37,582.
    a. Find the mean rounded to the nearest dollar.
    b. Find the median.
    c. Find the mode.
    d. Write a statement about the data set based on your findings.

12. Sales in thousands of dollars for men's suits at a Macy's department store for a 12-month period were $127; $215; $135; $842; $687; $512; $687; $742; $984; $752; $984; $1,992.
    a. Find the mean rounded to the nearest whole thousand.
    b. Find the median.
    c. Find the mode.
    d. Write a statement about the data set based on your findings.

13. Accountants often use the median when studying salaries for various jobs. What is the median of the following salary list: $32,084; $21,983; $27,596; $43,702; $38,840; $25,997?

14. Weather forecasters sometimes give the average (mean) temperature for a particular city. The following temperatures were recorded as highs on June 30 of the last 10 years in a certain city: 89°, 88°, 90°, 92°, 95°, 89°, 93°, 98°, 93°, 97°. What is the mean high temperature for June 30 for the last 10 years?

*See **Example 5** .*

15. The following grades were earned by students on a midterm business math exam:
    Make a frequency distribution of the data using the intervals 60–69, 70–79, 80–89, and 90–99.
16. What percent of the students in Exercise 15 earned a grade that was below 80?

See **Example 6** .

17. The 7th Inning wants to group a collection of autographed photos by price ranges. Make a relative frequency distribution of the prices using the intervals \$0–\$9.99, \$10–\$19.99, \$20–\$29.99, \$30–\$39.99, and \$40–\$49.99.
18. In Exercise 17, what percent to the nearest whole percent of the collection is priced below \$20?
19. In Exercise 17, what percent of the collection is priced \$40 or over?
20. Use the given hourly rates (rounded to the nearest whole dollar) for 35 support employees in a private college to complete the frequency distribution and find the grouped mean rounded to the nearest cent.
    *See **Example 7** .*

7-3 Measures of Dispersion

Learning Outcomes

1. Find the range.
2. Find the standard deviation.

The mean, the median, and the mode are measures of central tendency. Another group of statistical measures is **measures of variation or dispersion** . The variation or dispersion of a set of data may also be referred to as the **spread** .

Measures of variation or dispersion

statistical measurements such as the range and standard deviation that indicate how data are dispersed or spread.

Spread

the variation or dispersion of a set of data.

Range

the difference between the highest and lowest values in a data set.

1 Find the range.

One measure of dispersion of a set of data is the **range** . The range is the difference between the highest value and the lowest value in a set of data.

How To Find the range

1. Find the highest and lowest values.
2. Find the difference between the highest and lowest values.

Range = highest value − lowest value

Example 1

Find the range for the data in **Table 7-8** in the example on page 238 for prices of used automobiles sold over the weekend.

The high value is $15,450. The low value is $6,100.

Range = $15,450 — $6,100 = **$9,350.**

Try Stop & Check 1–6.

Tip Use More Than One Statistical Measure

A common mistake when making conclusions or inferences from statistical measures is to examine only one statistic, such as the range. To obtain a complete picture of the data requires looking at more than one statistic.

Did You Know?

In *Excel* there is no function for finding the range, but you can use the functions *MAX* and *MIN* to identify the highest and lowest values in a set of data.

It is found by making the following selections: *Formulas, More Functions, Statistical,* then *MAX* or *MIN.*

Stop & Check

See **Example 1** .

1. Find the range for salary: $37,500; $32,000; $28,800; $35,750; $29,500; $47,300.
2. Find the range for the number of hours for the life of a lightbulb: 2,400; 2,100; 1,800; 2,800; 3,450.
3. Find the range for the number of days a patient stays in the hospital: 2 days; 15 days; 7 days; 3 days; 1 day; 3 days; 5 days; 2 days; 4 days; 1 day; 2 days; 6 days; 4 days; 2 days.
4. Find the range for the number of CDs purchased per month by college students: 12, 7, 5, 2, 1, 8, 0, 3, 1, 2, 7, 5, 30, 5, 2.
5. Manchester City professional soccer team pays its players the highest wages of all teams in the English Premier League (EPL). Find the range for the wages paid in a recent year by soccer teams in the EPL in millions of British pounds: £242; £190; £187; £162; £140; £112; £74; £68; £55; £66; £70; £55; £48; £53; £68; £62; £52
6. Weekly wages for Manchester City soccer team's highest-paid players in a recent year were: £200,000; £120,000; £75,000; £220,000; £140,000; £75,000; £94,000; £80,000; £80,000; £80,000; £90,000; £90,000; £135,000; £100,000; £75,000. Find the range for the weekly wages.

2 Find the standard deviation.

Although the range gives us some information about dispersion, it does not tell us whether the highest or lowest values are typical values or extreme outliers. An **outlier** is a data point that is outside the overall pattern of the distribution of the data. We can get a clearer picture of the data set by examining how much each data point *differs* or *deviates* from the mean.

The **deviation from the mean** of a data value is the difference between the value and the mean.

Outlier

a data point that is outside the overall pattern of the distribution of the data.

Deviation from the mean

the difference between a value of a data set and the mean.

How To Find the deviation from the mean

When the value is smaller than the mean, the difference is represented by a *negative* number, indicating the value is *below* or less than the mean. When the value is larger than the mean, the difference is represented by a positive number, indicating the value is *above* or greater than the mean. In the example in the How To feature, only one value is below the mean, and its deviation is −4.5. Three values are above the mean, and the sum of these deviations is 0.5 + 2.5 + 1.5 = 4.5. Note that *the sum of all deviations from the mean is zero.* This is true for all sets of data.

Example 2

Find the deviations from the mean for the set of data 45, 63, 87, and 91. Show that the sum of the deviations from the mean is zero.

$$\text{Mean} = \frac{\text{Sum of values}}{\text{Number of values}} = \frac{45 + 63 + 87 + 91}{4} = \frac{286}{4} = 71.5$$

To find the deviation from the mean, subtract the mean from each value. We arrange these values in a table.

The sum of deviations are found as follows:

Try Stop & Check 1–2.

Opposites

a positive and negative number that represent the same distance from 0 but in opposite directions.

We have not gained any statistical insight or new information by analyzing the sum of the deviations from the mean or even by analyzing the average of the deviations.

$$\text{Average deviation} = \frac{\text{sum of deviations}}{\text{number of values}} = \frac{0}{n} = 0$$

To compensate for this situation, we use a statistical measure called the **standard deviation** , which uses the square of each deviation from the mean. The square of a negative value is always positive. The squared deviations are averaged (mean), and the result is called the **variance** .

The square root of the variance is taken so that the result can be interpreted within the context of the problem. Various formulas exist for finding the standard deviation of a set of values, but we will use only one formula, the formula for a sample of data or a small data set. This formula averages the

values by dividing by 1 less than the number of values (n — 1). Several calculations are necessary and are best organized in a table.

Standard deviation

a statistical measurement that shows how data are spread above and below the mean. The standard deviation can be represented by *s*.

Variance

a statistical measurement that is the average of the squared deviations of data from the mean. The square root of the variance is the standard deviation. The variance can be represented by v or s^2.

How To Find the standard deviation of a sample of a set of data

Do You Know

To square a number is to multiply the number times itself. For example, to square 7 we multiply 7(7) = 49.

The square root of a number is the factor that was multiplied by itself to result in the number. For example, 7 is the square root of 49. The symbol $\sqrt{\ }$ is used to indicate square root.

$$\sqrt{49} = 7$$

Example 3

Find the standard deviation to the nearest hundredth for the values 45, 63, 87, and 91.

From Example 2, the mean is 71.5 and the number of values is 4.

$$\text{Variance} = \frac{\text{sum of squared deviations}}{n-1} = \frac{1,395}{4-1} = \frac{1,395}{3} = 465$$

$$\text{Standard deviation} = \text{square root of variance} = \sqrt{465}$$
$$= 21.56385865 \text{ or } 21.56 \text{ rounded}$$

Try Stop & Check 3–5.

Tip Multiplying Negative Numbers

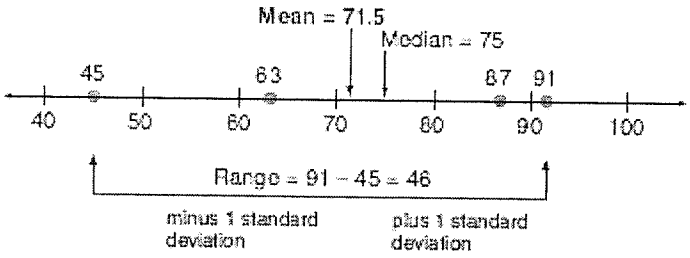
When multiplying two negative numbers, the product is positive.

$(-26.5)(-26.5) = 702.25$

$(-8.5)(-8.5) = 72.25$

A small standard deviation indicates that the mean is a typical value in the data set. A large standard deviation indicates that the mean is not typical, and other statistical measures should be examined to better understand the characteristics of the data set.

Examine the various statistics for the data set on a number line (**Figure 7-19**). We can confirm visually that the dispersion of the data is broad and the mean is not a typical value in the data set.



$$\text{Median} = \frac{63 + 87}{2} = \frac{150}{2} = 75$$

Mean − 1 standard deviation = $71.5 - 21.6 = 49.9$

Mean + 1 standard deviation = $71.5 + 21.6 = 93.1$.

Figure 7-19 Dispersion of Data Using a Number Line

Did You Know?

In *Excel* there is a function for finding the standard deviation of a set of data. It is found by making the following selections: *Formulas, More Functions, Statistical, STDEV.S.*

Normal distribution

if the graph of a data set forms a bell-shaped curve with the mean at the peak, the data set is said to have a normal distribution.

Symmetrical

a graph is symmetrical if it is folded at a middle point and the two halves match.

Another interpretation of the standard deviation is in its relationship to the **normal distribution** . Many data sets are normally distributed, and the graph of a normal distribution is a bellshaped curve, as in **Figure 7-20** . The curve is **symmetrical** ; that is, if folded at the highest point of the curve, the two halves would match. The mean of the data set is at the highest point or fold line. Then, half the data (50%) are to the left or *below* the mean and half the data (50%) are to the right or *above* the mean. Other characteristics of the normal distribution are:

68.3% of the data are within 1 standard deviation of the mean.

95.4% of the data are within 2 standard deviations of the mean.

99.7% of the data are within 3 standard deviations of the mean.

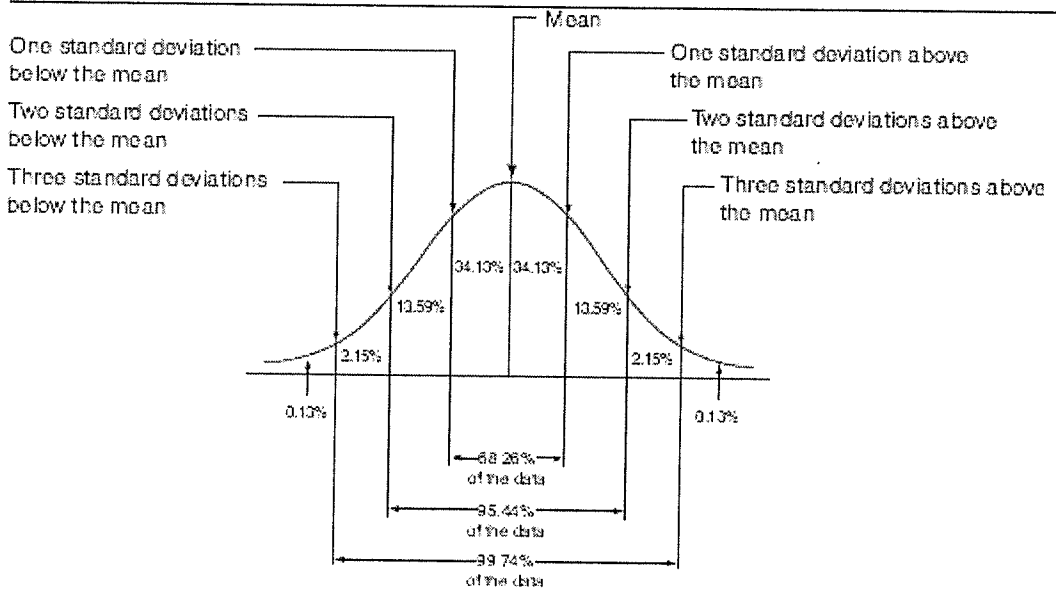


Figure 7-20 The Normal Distribution

Example 4

An Auto Zone Duralast Gold automobile battery has an expected mean life of 46 months with a standard deviation of 4 months. In an order of 100 batteries, how many do you expect to last 54 months or longer? Round to the nearest battery.

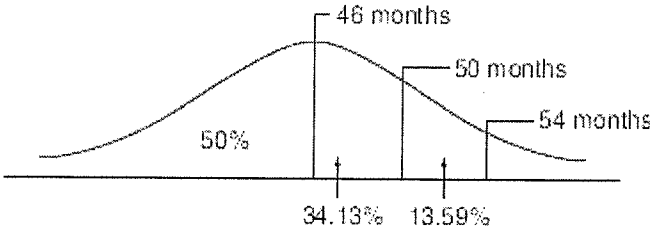


Figure 7-21 Mean Life for Automotive Batteries

97.72% of the batteries should last *less* than 54 months.

100% - 97.72% = 2.28% **Complement of 97.72%**

2.28% of the batteries should last 54 months or longer.

Number of batteries expected to last 54 months or longer

= 2.28%(100 batteries) = 0.0228(100) = 2.28 batteries

2 batteries (rounded) of the 100 batteries should last 54 months or longer.

Try Stop & Check 6.

Stop & Check

1. Find the deviations from the mean for the set of data: 72, 75, 68, 73, 69. *See **Example 2*** .
2. Show that the sum of the deviations from the mean in Exercise 1 is 0. *See **Example 2*** .

7-3 Section Exercises

Skill Builders

Use the sample ACT test scores 24, 30, 17, 22, 22 for Exercises 1 through 7.

See **Example 1** .

1. Find the range.

See **Example 2** .

2. Find the mean.
3. Find the deviations from the mean.

See **Example 3** .

4. Find the sum of squares of the deviations from the mean.
5. Find the variance.
6. Find the standard deviation.

See **Example 4** .

7. In a set of 100 ACT scores that are normally distributed and with a mean of 23 and standard deviation of 4.69, (a) how many scores are expected to be lower than 18.31 (one standard deviation below the mean)? (b) How many of the 100 scores are expected to be below 32.38 (two standard deviations above the mean)?

Applications

The data shows the total number of employee medical leave days taken for on-the-job accidents in the first six months of the year: 12, 6, 15, 9, 18, 12. Use the data for Exercises 8 through 14.

8. Find the range of days taken for medical leave for each month. *See **Example 1*** .
9. Find the mean number of days taken for medical leave each month. *See **Example 2*** .

10.

Find the deviations from the mean. *See **Example 2*** .

11. Find the sum of squares of the deviations from the mean. *See **Example 3*** .
12. Find the variance. *See **Example 3*** .
13. Find the standard deviation. *See **Example 3*** .
14. In a set of 36 months of data for medical leave that has a mean of 12 days per month and a standard deviation of 4.24, how many months are expected to have fewer than 16.24 days per month reported medical leave (one standard deviation above the mean)? *See **Example 4*** .

Chapter 7 Summary

Chapter 7 Exercise Set

*Use **Table 7-16** for Exercises 1 through 5.*

Table 7-16 Class Enrollment by Period and Days of the First Week for the Second Semester

1. Which period on Monday had the highest enrollment?
2. Which period had the highest average (mean) enrollment?
3. Which period had the lowest average (mean) enrollment?
4. Draw a bar graph representing the mean enrollment for each period.
5. Identify enrollment trends for the 10 periods from the bar graph in Exercise 4.

*Use **Table 7-17** for Exercises 6 through 9.*

Table 7-17 Sales for The Family Store, 2017-2018

6. What is the least value for 2017 sales? For 2018 sales?
7. What is the greatest value for 2017 sales? For 2018 sales?
8. Using the values in **Table 7-17** , which of the following interval sizes would be more appropriate in making a bar graph? Why?
    a. $1,000 intervals ($60,000, $61,000, $62,000, . . .)
    b. $10,000 intervals ($60,000, $70,000, $80,000, . . .)

9. Draw a comparative bar graph to show both the 2017 and 2018 values for The Family Store (see **Table 7-17**). Be sure to include a title, explanation of the scales, and any additional information needed.

*Use **Figure 7-25** for Exercises 10 through 13.*

10. What expenditure is expected to be the same next year as this year?

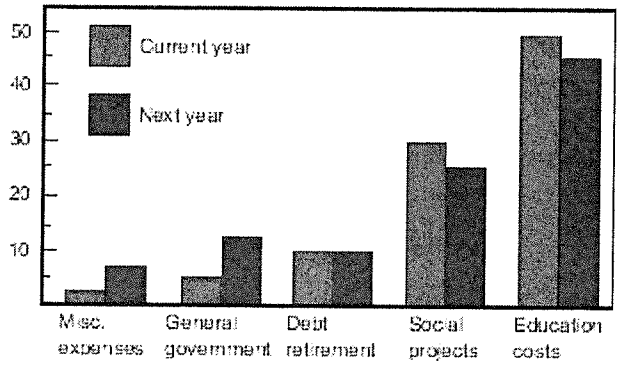


Figure 7-25 Distribution of Tax Dollars

11. What two expenditures are expected to increase next year?
12. What two expenditures are expected to decrease next year?
13. What expenditure was greatest both years?

*Use **Figure 7-26** for Exercises 14 and 15.*

14. What three-month period maintained a fairly constant sales record?
15. What month showed a dramatic drop in sales?

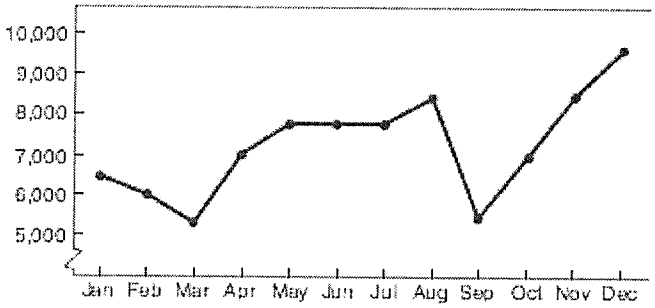


Figure 7-26 Monthly Sales for 7th Inning Sports Memorabilia

Use the following information for Exercises 16 through 20. The temperatures were recorded at two-hour intervals on June 24.

16. What is the smallest value?
17. What is the greatest value?
18. Which interval size is most appropriate when making a line graph for the data? Why?
    a. 1°
    b. 5°
    c. 50°
    d. 100°

19. Draw a line graph representing the data. Be sure to include the title, explanation of the scales, and any additional information needed.
20. Which of the following terms would describe the line graph in Exercise 19?
    a. Continually increasing
    b. Continually decreasing
    c. Fluctuating

*Use **Figure 7-27** for Exercises 21 through 24.*

21. What percent of the gross pay is federal income tax? (Round to tenths.)
22. What percent of the gross pay goes into savings? (Round to tenths.)
23. What are the total deductions for this payroll check?
24. What percent of the gross pay is the take-home pay? (Round to tenths.)

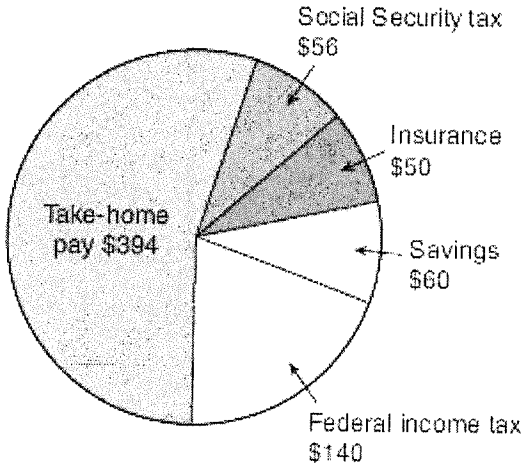


Figure 7-27 Distribution of Gross Pay ($700)

*Use **Figure 7-28** for Exercises 25 through 27.*

25. What percent of the overall cost does the lot represent? (Round to the nearest tenth.)
26. What is the cost of the lot with landscaping? What percent of the total cost does this represent? Round to the nearest tenth.
27. What is the cost of the house with furnishings? What percent of the total cost does this represent? Round to the nearest tenth.

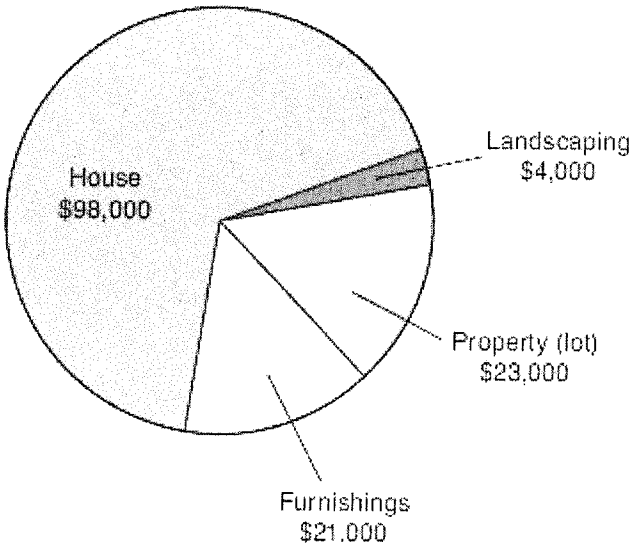


Figure 7-28 Distribution of Costs for an $146,000 Home

Use ***Table 7-18*** *for Exercises 28 through 31.*

Table 7-18 Automobile Dealership's New and Repeat Business

28. What was the total number of cars sold?
29. How many degrees should be used to represent the new car business on a circle (to the nearest whole degree)?
30. How many degrees should be used to represent the repeat business on the circle graph (to the nearest whole degree)?
31. Construct a circle graph for the data in **Table 7-18** . Label the parts of the graph as "New" and "Repeat." Be sure to include a title and any additional information needed.

Use the test scores of 33 students taking Business 205 to complete the frequency distribution and find the grouped mean rounded to the nearest whole number.

•

Use the frequency distribution for Exercise 32 to make a relative frequency distribution. Round to the nearest tenth of a percent.

•

Use the test scores of 24 students taking Marketing 235 to complete the frequency distribution and find the grouped mean rounded to the nearest whole number:

•

Use the frequency distribution for Exercise 34 to make a relative frequency distribution. Round to the nearest tenth of a percent.

Find the range, mean, median, and mode for the following. Round to the nearest hundredth if necessary.

36. Sandwiches

    $0.95 $1.65

    $1.27 $1.97

    $1.65 $1.15

37. New car mileages

    17 mi/gal

    16 mi/gal

    25 mi/gal

    22 mi/gal

    30 mi/gal

38. During the past year, Piazza's Clothiers sold a certain sweater at different prices: $42.95, $36.50, $40.75, $38.25, and $43.25. Find the range, mean, median, and mode of the selling prices. Write a statement about the data set based on your findings.

39. Find the range, mean, median, and mode of the hourly pay rates for the employees. Write a statement about the data set based on your findings.

*Use **Table 7-19** for Exercises 40 and 41.*

First Semester Fall			Second Semester Spring			Third Semester Fall			Fourth Semester Spring		
Course	Cr. Hr.	Gr.	Course	Cr. Hr.	Gr.	Course	Cr. Hr.	Gr.	Course	Cr. Hr.	Gr.
BUS MATH	4	90	SOC	3	92	FUNS	4	88	CAL I	4	89
ACC I	4	89	PSYC	3	91	ACC II	4	89	ACC IV	4	90
ENG I	3	91	ENG II	3	90	ENG III	3	95	ENG IV	3	96
HISTORY	3	92	ACC II	4	88	PURCH	3	96	ADV	3	93
ECON	5	85	ECON II	4	86	MGMT I	5	84	MGMT II	5	83

Table 7-19

40. Give the range and mode of grades for each semester.

41. Give the range and mode of grades for the entire two-year program.

Find the range, mean, median, and mode for the following. Round to the nearest hundredth if necessary.

42. Credit hours
43. Test scores
44. Find the range, mean, median, and mode of the weights of the metal castings after being milled. Write a statement about the data set based on your findings.
45. Find the mean, median, and mode for the data set: 90, 89, 82, 87, 93, 92, 98, 79, 81, 80.
46. Find the range for the data set: 90, 89, 82, 87, 93, 92, 98, 79, 81, 80.
47. EXCEL Find the mean, variance, and standard deviation for the scores:82, 60, 78, 81, 65, 72, 72, 78. Show that the sum of the deviations is zero.

Chapter 7 Practice Test

Katz Florist recorded the sales for a six-month period for fresh and silk flowers in ***Table 7-20*** *. Use the table for Exercises 1 through 4.*

1. What is the smallest value of fresh flowers? Of silk flowers?
2. What is the greatest value of fresh flowers? Of silk flowers?

Table 7-20 Sales for Katz Florist, January–June

3. What interval size would be most appropriate when making a bar graph? Why?
4. Construct a bar graph for the sales at Katz Florist.
    a. $100
    b. $1,000
    c. $5,000
    d. $10,000

Use the following data for Exercises 5 and 6. The totals of the number of laser printers sold in the years 2008 through 2013 by Smart Brothers Computer Store are as follows:

5. What is the smallest value? The greatest value?
6. Draw a line graph representing the data. Use an interval of 250. Be sure to include a title and explanation of the scales.

The costs of producing a piece of luggage at ACME Luggage Company are labor, $45; materials, $40; overhead, $35. Use this information for Exercises 7 through 12.

7. What is the total cost of producing a piece of luggage?
8. What percent of the total cost is attributed to labor?
9. What percent of the total cost is attributed to materials?
10. What percent of the total cost is attributed to overhead?

11. Compute the number of degrees for labor, materials, and overhead needed for a circle graph. Round to whole degrees.
12. Construct a circle graph for the cost of producing a piece of luggage.

Chapter 7 Critical Thinking

1. What type of information does a circle graph show?
2. Give a situation in which it would be appropriate to organize the data in a circle graph.
3. What type of information does a bar graph show?
4. Give a situation in which it would be appropriate to organize the data in a bar graph.
5. What type of information does a line graph show?
6. Give a situation in which it would be appropriate to organize the data in a line graph.
7. Explain the differences among the three types of averages: the mean, the median, and the mode.
8. What can we say about the mean for a data set with a large range?
9. What can we say about the mean for a data set with a small range?
10. What components of a graph enable us to analyze and interpret the data given in the graph?
11. A sales representative has a sales goal of $15,000 per month. Her results for the first six months of the year for January-June are as follows: $28,500, $19,000, $14,500, $11,500, $11,500, and $5,000. Which of the following would have the most relevance when analyzing her sales results, the mode, median, or mean? Do the results create any cause for concern?

Challenge Problem

1. EXCEL Have the computers made a mistake? You have been attending Northeastern State College (which follows a percentage grading system) for two years. You have received good grades, but after four semesters you have not made the dean's list, which requires an overall average of 90% for all accumulated credits or 90% for any given semester. Your grade reports are shown in **Table 7-22** .

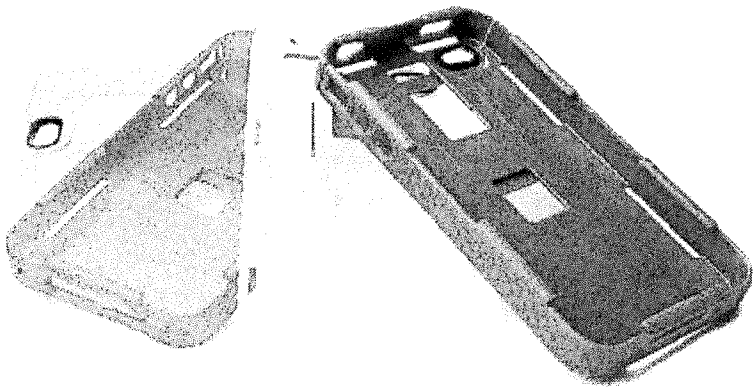
First Semester Fall			Second Semester Spring			Third Semester Fall			Fourth Semester Spring		
Course	Cr. Hr.	Gr.	Course	Cr. Hr.	Gr.	Course	Cr. Hr.	Gr.	Course	Cr. Hr.	Gr.
BUS MATH	4	90	SOC	3	92	FUNS	4	88	CAL I	4	89
ACC I	4	89	PSYC	3	91	ACC II	4	89	ACC IV	4	90
ENG I	3	91	ENG II	3	90	ENG III	3	95	ENG IV	3	96
HISTORY	3	92	ACC II	4	88	PURCH	3	96	ADV	3	93
ECON	5	85	ECON II	4	86	MGMT I	5	84	MGMT II	5	83

Table 7-22

Case Studies

7-1 Progeny Plastics Inc.

A small plastics manufacturing company specializes in making accessories for cell phones, particularly plastic covers. The company currently utilizes a single shift of production workers, and in total employs 13 people with the following annual salaries:



1. Calculate the mean, median, and mode for the salaries rounded up to the nearest thousand.
2. The statistic most often used to describe company salaries is the median or the mean. For this company, does the mean give an accurate description of the salaries? Why or why not?
3. Progeny decides to add a second shift of six more assembly line workers at $27,600 each, along with one additional production supervisor at $48,400. Calculate the mean, median, and mode including the seven additional salaries rounded up to the nearest thousand.
4. Which statistic would this company's labor union representative be most likely to cite during contract negotiations and why? Which statistic would the company president most likely report at the annual shareholders' meeting and why?
5. Name another situation in which it would be beneficial to report the highest average salary, and name another situation where it would be beneficial to use the lowest average salary.

7-2 Ink Hombre: Tattoos and Piercing

At 42 years of age, Enrique Chavez was starting to think more and more about retirement. After 17 years of running one of the Bay Area's most popular tattoo parlors, Ink Hombre, he decided to take on a partner—his 21-year-old bilingual niece Diana. Her words still echoed in his head— the same words she repeated every time someone left his shop to go elsewhere: *"Tío, debe ofrecer la perforación del cuerpo:* You should offer body piercing." She would go on to say, "Piercing gives people the opportunity to express their identity, just like a tattoo." She was right, of course. After she got her piercing certification, Diana came to work with Enrique full-time. But she didn't come cheaply. Between her salary and benefits, she was costing the business $1,000 per month! Enrique kept very detailed records, and her first month's sales were a bit disappointing. Piercings were offered as Category I, II, or III, and cost $35, $55, and $75 for stainless steel jewelry, respectively, and $55, $85, and

$120 for gold. Diana sold five Category I, two Category II, and three Category III in stainless, and one each of categories I, II, and III in gold.

1. Find the mean, median, and mode for Diana's first month of sales.
2. Given the total sales value for Diana's first month, how long will it take for her to break even with her salary and benefits, assuming a 10 percent increase in sales value each month? Is the increase more likely to come from increased number of sales or a higher average sales value?
3. Diana's second month results show that she made six sales at $35, two at $55, three at $75, three at $85, and two at $120. Calculate the standard deviation for this data set. Does your answer for the standard deviation indicate that this is a normal distribution? If not, what are the implications?

4. Month 3 was a breakthrough for Diana, as she made seven sales at $35, four at $55, five at $75, two at $85, and three at $120. Enrique also saw a marked increase in his tattoo business due to direct referrals from Diana, and he decided to pay Diana a 15% referral fee. If Enrique had new tattoo business of $1,200 from Diana's referrals, what were her total earnings for the month?
