**Essential Question** How can you use data to predict an event?

### 1 ACTIVITY: Representing Data by a Linear Equation

Work with a partner. You have been working on a science project for 8 months. Each month, you have measured the length of a baby alligator.



My Science Project

The table shows your measurements.

September → | April →

| Month, x | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Length (in.), y | 22.0 | 22.5 | 23.5 | 25.0 | 26.0 | 27.5 | 28.5 | 29.5 |

Use the following steps to predict the baby alligator's length next September.

a. Graph the data in the table.

b. Draw the straight line that you think best approximates the points.

c. Write an equation of the line you drew.

d. Use the equation to predict the baby alligator's length next September.
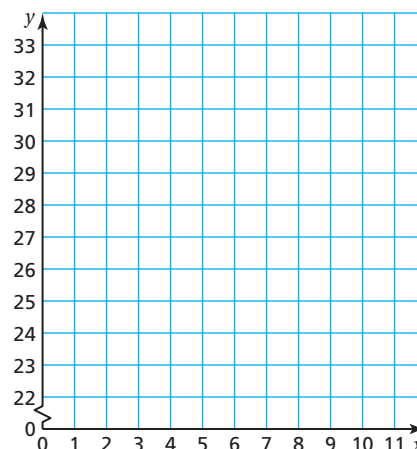
**ACTIVITY: Representing Data by a Linear Equation**

Work with a partner. You are a biologist and are studying bat populations.

You are asked to predict the number of bats that will be living in an abandoned mine in 3 years.

To start, you find the number of bats that have been living in the mine during the past 8 years.

The table shows the results of your research.

7 years ago

this year

| Year, $x$ | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| Bats (thousands), $y$ | 327 | 306 | 299 | 270 | 254 | 232 | 215 | 197 |

Use the following steps to predict the number of bats that will be living in the mine after 3 years.

**a.** Graph the data in the table.

**b.** Draw the straight line that you think best approximates the points.

**c.** Write an equation of the line you drew.

**d.** Use the equation to predict the number of bats in 3 years.
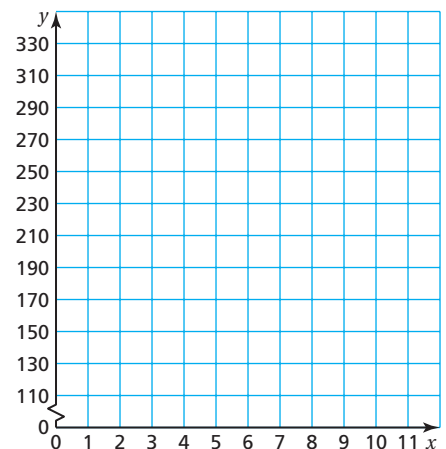


# What Is Your Answer?

**3. IN YOUR OWN WORDS** How can you use data to predict an event?

**4.** Use the Internet or some other reference to find data that appear to have a linear pattern. List the data in a table and graph the data. Use an equation that is based on the data to predict a future event.

**Practice** Use what you learned about scatter plots and lines of best fit to complete Exercise 3 on page 293.

Check It Out
Lesson Tutorials
BigIdeasMath com.

**Key Vocabulary**
scatter plot, *p. 290*
line of best fit, *p. 292*

## Key Idea

**Scatter Plot**

A **scatter plot** is a graph that shows the relationship between two data sets. The two sets of data are graphed as ordered pairs in a coordinate plane.

**EXAMPLE  1  Interpreting a Scatter Plot**

**Restaurant Sandwiches**
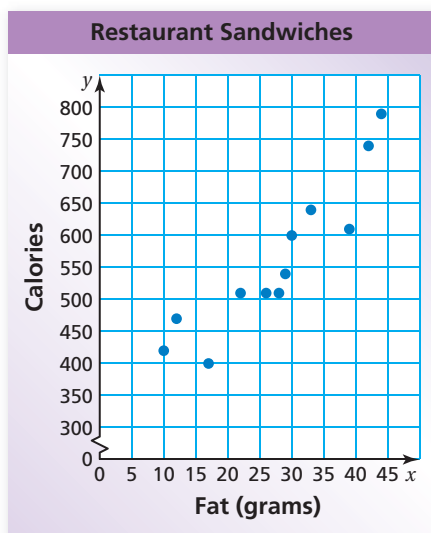
**The scatter plot at the left shows the total fat (in grams) and the total calories in 12 restaurant sandwiches.**

**a.** How many calories are in the sandwich that contains 17 grams of fat?

Draw a horizontal line from the point that has an $x$-value of 17. It crosses the $y$-axis at 400.

∴ So, the sandwich has 400 calories.

**Restaurant Sandwiches**

**b.** How many grams of fat are in the sandwich that contains 600 calories?

Draw a vertical line from the point that has a $y$-value of 600. It crosses the $x$-axis at 30.

∴ So, the sandwich has 30 grams of fat.
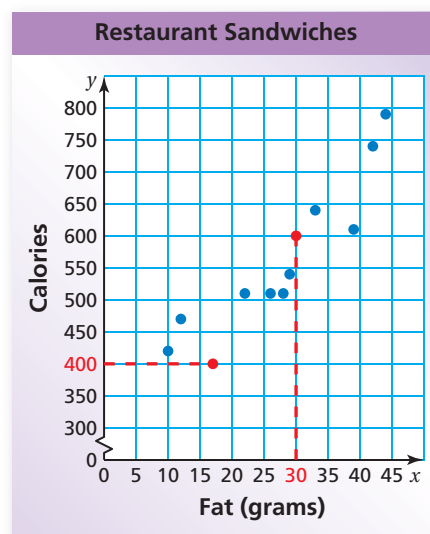
**c.** What tends to happen to the number of calories as the number of grams of fat increases?

Looking at the graph, the plotted points go up from left to right.

∴ So, as the number of grams of fat increases, the number of calories increases.

## On Your Own

Now You're Ready
Exercises 4 and 5

**1.** **WHAT IF?** A sandwich has 650 calories. Based on the scatter plot in Example 1, how many grams of fat would you expect the sandwich to have? Explain your reasoning.
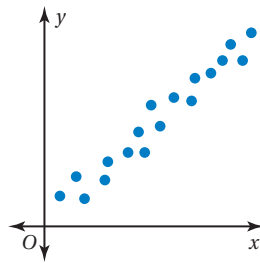
Multi-Language Glossary at BigIdeasMath com.

A scatter plot can show that a relationship exists between two data sets.
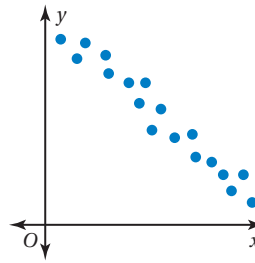
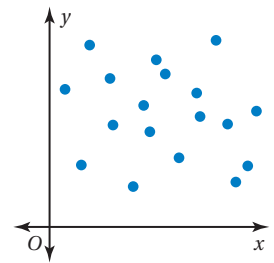**Positive Relationship**   **Negative Relationship**   **No Relationship**



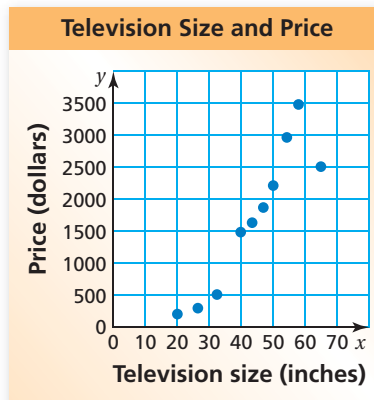As $x$ increases, $y$ increases.

As $x$ increases, $y$ decreases.

The points show no pattern.

## EXAMPLE 2 Identifying a Relationship

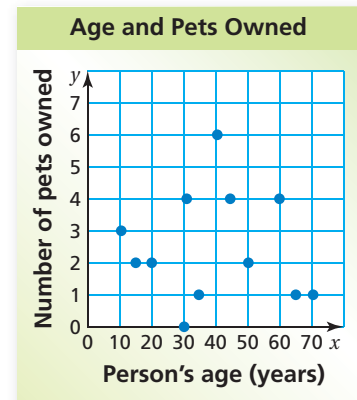**Tell whether the data show a *positive*, a *negative*, or *no* relationship.**

**a.** Television size and price

**b.** Age and number of pets owned



**Television Size and Price**

**Age and Pets Owned**

As the size of the television increases, the price increases.

The number of pets owned does not depend on a person's age.

∴ So, the scatter plot shows a positive relationship.

∴ So, the scatter plot shows no relationship.

## On Your Own


*Now You're Ready*
Exercises 6–8

**Make a scatter plot of the data. Tell whether the data show a *positive*, a *negative*, or *no* relationship.**

**2.**

| Study Time (min), x | 30 | 20 | 60 | 90 | 45 | 10 | 30 | 75 | 120 | 80 |
|---|---|---|---|---|---|---|---|---|---|---|
| Test Score, y | 87 | 74 | 92 | 97 | 85 | 62 | 83 | 90 | 95 | 91 |

**3.**

| Age of a Car (years), x | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Value (thousands), y | $24 | $21 | $19 | $18 | $15 | $12 | $8 | $7 |

A **line of best fit** is a line drawn on a scatter plot that is close to most of the data points. It can be used to estimate data on a graph.

## EXAMPLE 3 Finding a Line of Best Fit

| Week, x | Sales (millions), y |
|---------|---------------------|
| 1 | $19 |
| 2 | $15 |
| 3 | $13 |
| 4 | $11 |
| 5 | $10 |
| 6 | $8 |
| 7 | $7 |
| 8 | $5 |

The table shows the weekly sales of a DVD and the number of weeks since its release. **(a)** Make a scatter plot of the data. **(b)** Draw a line of best fit. **(c)** Write an equation of the line of best fit. **(d)** Predict the sales in week 9.

**a.** Plot the points in a coordinate plane. The scatter plot shows a negative relationship.

**b.** Draw a line that is close to the data points. Try to have as many points above the line as below it.


DVD Sales

**c.** The line passes through (5, 10) and (6, 8).

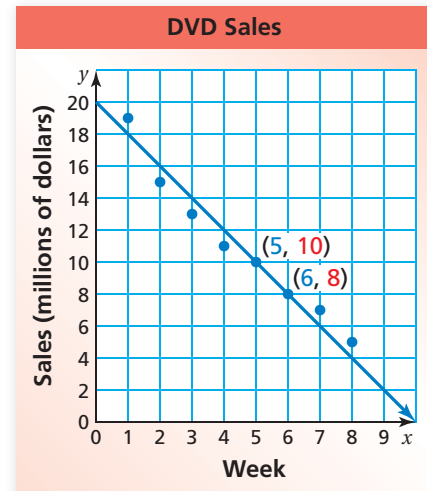$$\text{slope} = \frac{\text{rise}}{\text{run}} = \frac{-2}{1} = -2$$

Because the line crosses the y-axis at (0, 20), the y-intercept is 20.

So, the equation of the line of best fit is $y = -2x + 20$.

**d.** To predict the sales for week 9, substitute 9 for x in the equation of the line of best fit.

$y = -2x + 20$      Line of best fit

$= -2(9) + 20$      Substitute 9 for x.

$= 2$      Evaluate.

The sales in week 9 should be about $2 million.

**Study Tip**

A line of best fit does not need to pass through any of the data points.

### On Your Own

**Now You're Ready**
Exercise 11

4. The table shows the number of people who have attended a neighborhood festival over an 8-year period.

| Year, x | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---------|---|---|---|---|---|---|---|---|
| Attendance, y | 420 | 500 | 650 | 900 | 1100 | 1500 | 1750 | 2400 |

    **a.** Make a scatter plot of the data.

    **b.** Draw a line of best fit.

    **c.** Write an equation of the line of best fit.

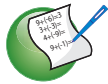    **d.** Predict the number of people who will attend the festival in year 10.

## ✓ Vocabulary and Concept Check

1. **VOCABULARY** What type of data are needed to make a scatter plot? Explain.

2. **WRITING** Explain why a line of best fit is helpful when analyzing data.

## Practice and Problem Solving

3. **BLUEBERRIES** The table shows the weights $y$ of $x$ pints of blueberries.

| Number of Pints, $x$ | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Weight (pounds), $y$ | 0 | 0.8 | 1.50 | 2.20 | 3.0 | 3.75 |

   a. Graph the data in the table.

   b. Draw the straight line that you think best approximates the points.

   c. Write an equation of the line you drew.

   d. Use the equation to predict the weight of 10 pints of blueberries.

   e. Blueberries cost $2.25 per pound. How much do 10 pints of blueberries cost?

4. **SUVS** The scatter plot shows the number of sport utility vehicles sold in a city from 2005 to 2010.

   a. In what year were 1000 SUVs sold?

   b. About how many SUVs were sold in 2009?

   c. Describe the relationship shown by the data.



**SUV Sales**
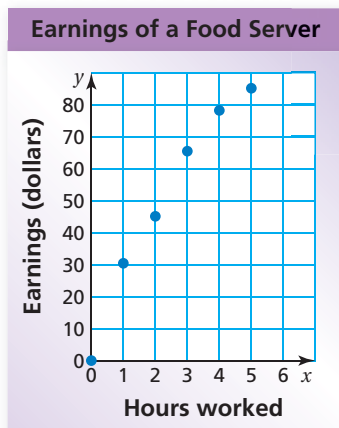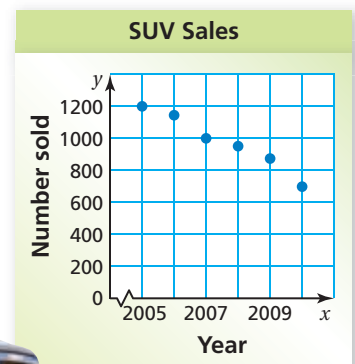
5. **EARNINGS** The scatter plot shows the total earnings (wages and tips) of a food server during 1 day.

   a. About how many hours must the server work to earn $70?

   b. About how much did the server earn for 5 hours of work?

   c. Describe the relationship shown by the data.



**Earnings of a Food Server**

**Tell whether the data show a *positive*, a *negative*, or *no* relationship.**

**②** **6.**



**7.**



**8.**
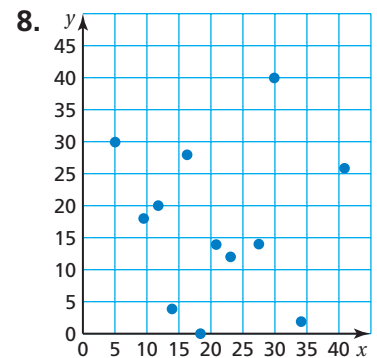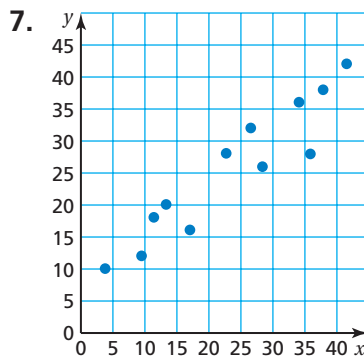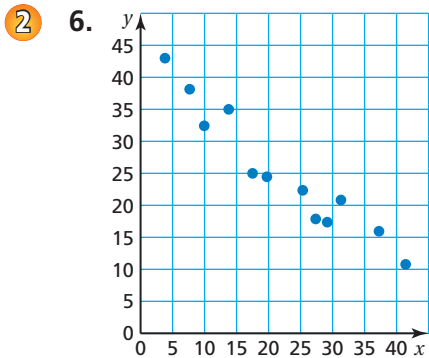


**9.** **HONEYBEES** The table shows the number of honeybee colonies in the United States from 2003 to 2006. What type of relationship do the data show?

| Year, x | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|
| Honeybee Colonies (millions), y | 2.599 | 2.556 | 2.413 | 2.392 |

**10.** **OPEN-ENDED** Describe a set of real-life data that has a positive relationship.

**③** **11.** **VACATION** The table shows the distance you travel over a 6-hour period.

  **a.** Make a scatter plot of the data.

  **b.** Draw a line of best fit.

  **c.** Write an equation of the line of best fit.
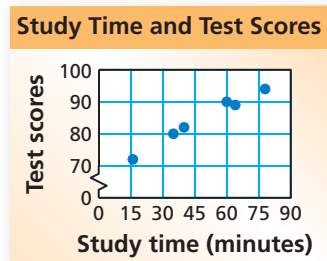
  **d.** Predict the distance you will travel in 7 hours.

| Hours, x | Distance (miles), y |
|---|---|
| 1 | 62 |
| 2 | 123 |
| 3 | 188 |
| 4 | 228 |
| 5 | 280 |
| 6 | 344 |

**12.** **ERROR ANALYSIS** Describe and correct the error in drawing the line of best fit.
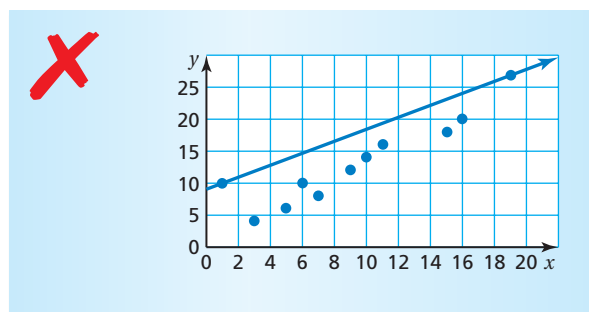


**13.** **TEST SCORES** The scatter plot shows the relationship between the number of minutes spent studying and the test scores for a science class.

  **a.** What type of relationship does the data show?

  **b.** Interpret the relationship.



Study Time and Test Scores

294   Chapter 7   Data Analysis and Displays

**14. REASONING** A data set has no relationship. Is it possible to find the line of best fit for the data? Explain.

**15. PROJECT** Use a ruler or a yardstick to find the height and arm span of three people.

   **a.** Make a scatter plot using the data you collected. Then draw the line of best fit for the data.

   **b.** Use your height and the line of best fit to predict your arm span.

   **c.** Measure your arm span. Compare the result with your prediction in part (b).

   **d.** Is there a relationship between a person's height $x$ and arm span $y$? Explain.

**16.** **Critical Thinking** The table shows the price of admission to a local theater and the yearly attendance for several years.

| Price of Admission (dollars), $x$ | Yearly Attendance, $y$ |
|---|---|
| 19.50 | 50,000 |
| 21.95 | 48,000 |
| 23.95 | 47,500 |
| 24.00 | 40,000 |
| 24.50 | 45,000 |
| 25.00 | 43,500 |

   **a.** Identify the outlier.

   **b.** How does the outlier affect the line of best fit? Explain.

   **c.** Make a scatter plot of the data and draw the line of best fit.

   **d.** Use the line of best fit to predict the attendance when the admission cost is $27.

## Fair Game Review What you learned in previous grades & lessons

**Use a graph to solve the equation. Check your solution.**

**17.** $5x = 2x + 6$

**18.** $7x + 3 = 9x - 13$

**19.** $\dfrac{2}{3}x = -\dfrac{1}{3}x - 4$

**20. MULTIPLE CHOICE** The circle graph shows the super powers chosen by a class. What percent of the students want strength as their super power? *Ž*

   **Ⓐ** 10.5%       **Ⓑ** 12.5%

   **Ⓒ** 15%         **Ⓓ** 25%

**Super Powers**

Speed $2x$

Invisibility 22.5%

Fly 40%

Strength $x$