

10-3

Modeling Data With Lines

Check Skills You'll Need

- Vocabulary Review**
An equation written in the form $y = mx + b$ is in ?

Graph each linear function.

- $y = \frac{2}{3}x + 3$
- $y = 3x - 1$
- $y = -\frac{1}{2}x + 2$
- $y = -x + 4$

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Lesson 4-2

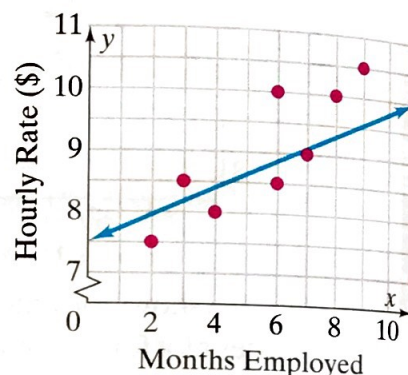
What You'll Learn

To assess the fit of a trend line on a scatter plot and to use trend lines to estimate and make predictions

New Vocabulary trend line

Why Learn This?

When two sets of data have a linear association, such as the data in the scatter plot at the right, you can use a trend line to show the association more clearly. A **trend line** is a line you draw on a graph to approximate the relationship between data sets. If there is no association, you cannot draw a trend line.



You can use a trend line to estimate a value between two given data points. You can also use a trend line to make predictions about data points that do not appear on a scatter plot.

CONTENT STANDARDS

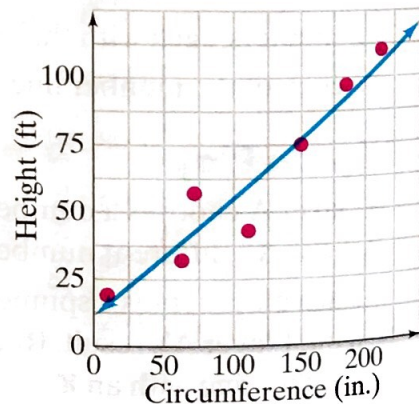
8.SP.2, 8.SP.3

EXAMPLE Drawing Trend Lines

- The table at the left shows the circumference and height of a variety of trees. Use a scatter plot to predict the height of a tree that has a circumference of 175 in.

Height (ft)	Circumference (in.)
19	10
32	63
57	72
43	111
75	150
97	185
110	214

- Step 1** Plot each data pair.
- Step 2** The plotted points go up from left to right. This scatter plot shows a positive, linear association.
- Step 3** Draw a line with positive slope. Make sure there are about as many points above the line as there are below it.
- Step 4** Find 175 on the horizontal axis. Move up to the trend line. Then move left to the vertical axis.



A tree with a circumference of 175 in. should have a height of about 88 ft.

Quick Check

- The table shows the age and height of a sample of girls. Use a scatter plot to predict the height of a girl who is 9 years old.

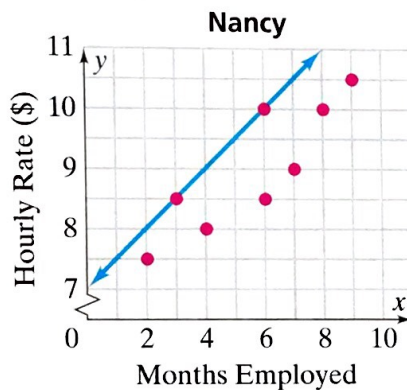
Age and Height of Girls

Age (yr)	2	7	11	13	14	17	15	5	18
Height (in.)	33	45	56	57	61	63	66	43	65

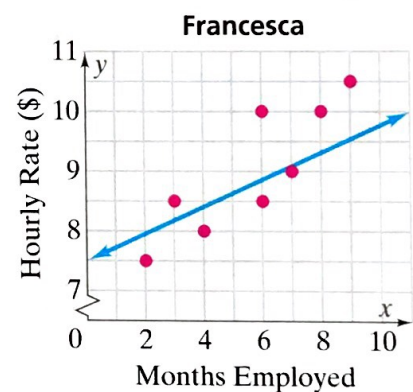
An accurate trend line should fit the data closely. The same number of points should be above the trend line as below it.

EXAMPLE Assessing the Fit of Trend Lines

- In the scatter plots below, Nancy and Francesca each drew a different trend line to approximate the relationship between months employed and hourly rate. Which trend line appears to be the better fit? Explain.



Nancy's trend line passes through two points and has 0 points above it and 6 points below it.

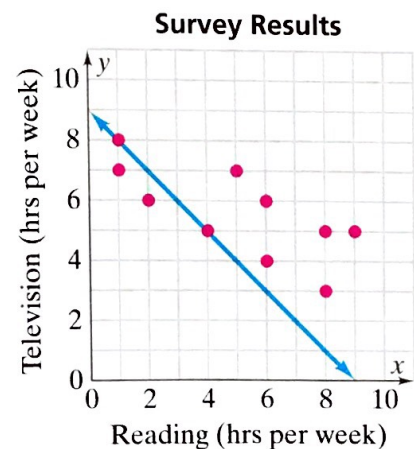


Francesca's trend line has 4 points above it and about 4 points below it.

Francesca's trend line has about the same number of points above it as below it. So Francesca's trend line appears to be a better fit.

Quick Check

- The scatter plot shows the results of a survey about the relationship between the number of hours spent reading and the number of hours spent watching television. Draw a trend line that fits the data better than the one shown.



You can also use an equation of a trend line to predict an unknown value.

EXAMPLE Using an Equation of a Trend Line

Test Prep Tip

It is possible that none of the points in the scatter plot will actually be on the line of best fit.

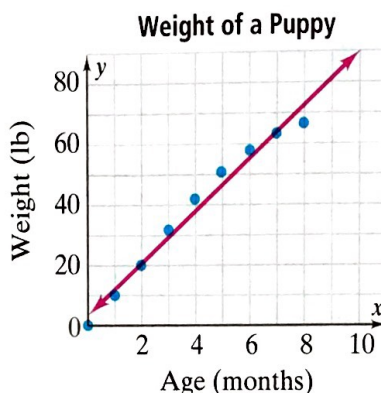
- 3 Multiple Choice** Make a scatter plot of the data at the right. What is the approximate weight of a 10-month-old puppy?

- (A) 0.8 lb (C) 80 lb
(B) 8.5 lb (D) 88 lb

Weight of a Puppy

Age (months)	Weight (lb)
0	0.8
1	9.2
2	19.9
3	31.3
4	41.8
5	50.6
6	57.4
7	62.6
8	66.4

- Step 1** Make a scatter plot and draw a trend line. Estimate the coordinates of two points on the line.



Two points on the trend line are (2, 19.9) and (7, 62.6).

- Step 2** Use two points to find the slope of the trend line.

$$m = \frac{62.6 - 19.9}{7 - 2} = \frac{42.7}{5} \approx 8.5$$

- Step 3** Use (2, 19.9) and the slope to estimate the y-intercept of the trend line.

A change in x of -2 corresponds to a change in y of $-2(8.5) = -17$.
Add: $19.9 + (-17) = 2.9$. So the y-intercept is (0, 2.9).

- Step 4** Substitute the slope and y-intercept into the slope-intercept form.

$$y = mx + b \quad \leftarrow \text{Use slope-intercept form.}$$

$$y = 8.5x + 2.9 \quad \leftarrow \text{Substitute 8.5 for } m \text{ and 2.9 for } b.$$

- Step 5** Use the equation of the trend line to predict the weight of a 10-month-old puppy.

$$y = 8.5(10) + 2.9 = 87.9$$

The weight of a 10-month-old puppy is about 88 lb. The correct answer is D.

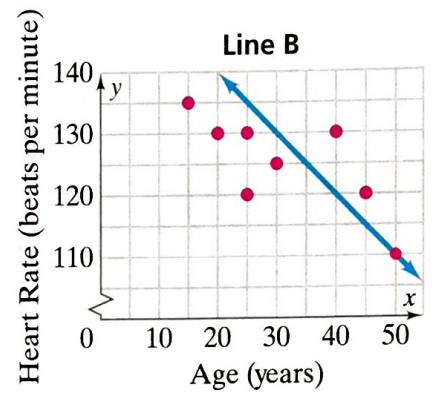
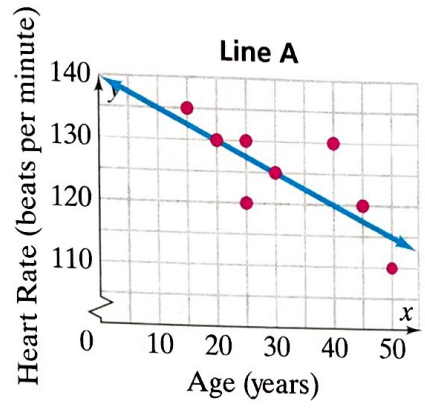
Quick Check

3. a. What is the approximate weight of a 12-month-old puppy?
b. What does the slope of the trend line in Example 3 mean? What does the y-intercept of the trend line mean?

Check Your Understanding

- Reasoning** Given a scatter plot for a set of data, how can you draw an accurate trend line?

The scatter plots below display the same data about the ages of eight health club members and their heart rates during exercise.



- Which trend line appears to be a better fit for the data?

Homework Exercises

For more exercises, see Extra Skills and Word Problems.

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Exercises	See Example
3-4	1
5-6	2
7	3

Make a scatter plot for each set of data. If possible, draw a trend line and describe the trend.

- Life Expectancy**

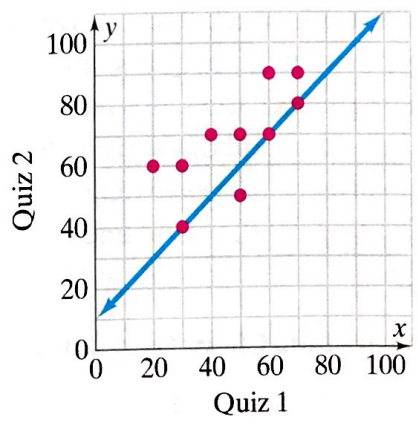
Current Age (yr)	10	15	20	25	30	35	40	45
Life Expectancy (yr)	67.4	62.5	57.7	53.0	48.2	43.5	38.8	34.3

- Farm Sizes in the United States**

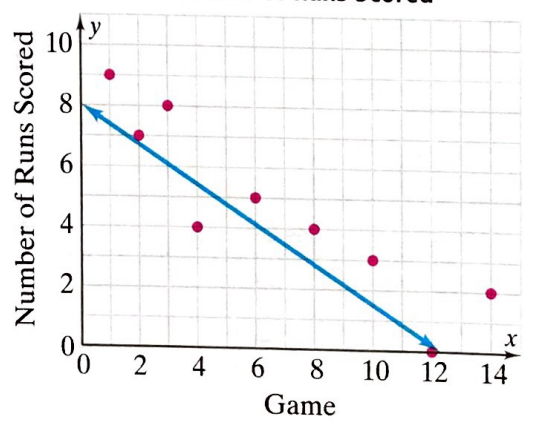
Number of Farms (millions)	6.30	6.10	5.39	3.96	2.95	2.44	2.15	2.17
Average Size (acres)	157	175	216	297	373	426	460	434

For each scatter plot, find a better trend line than the one shown.

- Quiz Scores**



- Number of Runs Scored**



7. Use the data below. Make a scatter plot of the data. Draw a trend line. What is the approximate length of a 12-month-old baby boy?

Length of a Baby Boy

Age (mo)	0	1	2	3	4	5	6	8	9
Length (in.)	20	21.5	23.5	25.5	25.5	27	28	27.5	30.5



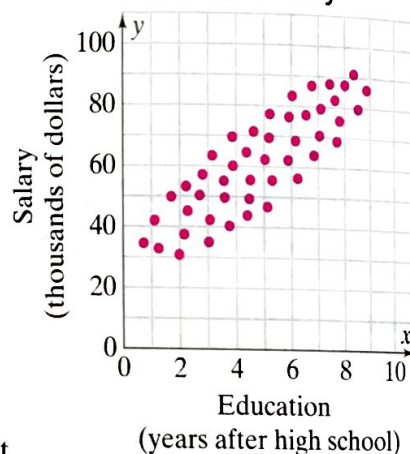
8. **Guided Problem Solving** Use the data below. What is the approximate temperature of the cup of hot tea after 30 minutes?

Temperature of Hot Tea Over Time

Time (min)	0	2	4	6	8	10	15	20	25
Temperature (°C)	81	75	67	62	59.5	57	55	50.5	48

- How can you use a scatter plot to find a trend line?
 - How can you use a trend line to make a prediction?
9. **Writing in Math** The scatter plot shows the relationship between a person's education and yearly salary.
- Describe how you would draw a trend line to model the data in the scatter plot.
 - Write an equation of the trend line. Explain what the slope and y -intercept represent.
10. **Challenge** Mr. Li fills his car with gas. The farther he drives, the less gas his car has. Would it be reasonable to use this negative association to predict the amount of gasoline in Mr. Li's tank after he has driven 500 miles? Explain.

Post-High School Education and Salary



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Test Prep and Mixed Review

Practice

Multiple Choice

11. The equation $y = 100x + 75$ represents an equation of a trend line that relates the amount y , in dollars, that computer repairmen in one town charge for x hours of work. Which statement is NOT true?
- The amount that a computer repairman charges and the number of hours he works have a positive association.
 - As the number of hours of work increases, the amount the repairman charges also increases.
 - The y -intercept of the trend line represents how much a repairman charges to diagnose the problem.
 - The slope of the trend line represents how much the repairman charges to repair one computer.

Solve each equation. Check the solution.

12. $2 + 16x = -6 + 10x$ 13. $9y = 11(y + 8)$ 14. $8 - 4(p - 3) = 16p$

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Exercises	See Lesson
12-14	2-4