Lesson 5: Using Linear Models
Algebra 2 A Unit 2: Functions, Equations, and Graphs

Objectives: Write linear equations that model real-world data; Make predictions from linear models
Materials: *Course Materials are not available as of this time as this User has not been assigned to any Courses. Please check back once the User has been placed into a Course.*

Linear Models

How do you choose a career? There are so many career options—how do you know which one is right for you? Factors such as personal interests, where you want to live, the amount of money you want to make, and hiring outlook can help you narrow down the choices. Suppose you want to determine what kind of salary you can expect to make as a physical therapist. How can a graph help you predict the salary of a physical therapist by the time you get certified? What other information can you learn from a graph? In this lesson, you will learn how to use a linear model to explore real-world data.

Objectives

- Write linear equations that model real-world data
- Make predictions from linear models

Key Words

- correlation
- correlation coefficient
- line of best fit
- scatter plot

Linear Regression

A popular method used to analyze data is to draw and interpret a scatter plot.

Click on the links below to watch the "Introduction: Shark Attacks and Beach Attendance" and "Example 1: Correlations and Scatterplots -- Weather" Discovery Education™ *streaming* movies. After watching the movies, answer the questions below:

1. What is correlation?
2. Does correlation imply causation? Explain.
3. What is a scatter plot?
4. What will a scatter plot look like if there is
    - a positive correlation?
    - a negative correlation?
    - no correlation?
5. What is a correlation coefficient?

Introduction: Shark Attacks and Beach Attendance

Example 1: Correlations and Scatterplots—Weather

Click on the Show Answer button below to check your answers.

Show Answer

1. A correlation is an association between two variables.
2. A correlation does not imply causation. Two variable quantities may correlate, but that does not necessarily mean that one causes the other. There could be a third variable involved or it could just be a coincidence. However, causation does imply a correlation.
3. A scatter plot is a graph in which data points for two variables are plotted in a coordinate plane.
4. A scatter plot shows
    a. a positive correlation when the data points follow the pattern of a line with a positive slope.
    b. a negative correlation when the data points follow the pattern of a line with a negative slope.
    c. no correlation when the data points do not follow a pattern.
5. The correlation coefficient is represented with the variable r, where $-1 \leq r \leq 1$. The closer r is to 1 or –1, the stronger the correlation.

A scatter plot can help determine a correlation between two variables and find a linear equation that can be used to make predictions. This line is referred to as the line of best fit, or trend line. To learn more, complete problems 1–3 from the PowerAlgebra website. Each problem below includes step-by-step instructions.

Problem 1

Problem 2

Problem 3

Click on the link below to complete a chart to help you organize your notes on linear

model concepts. Use pp. 92–95 in *Algebra 2* as a reference. Be sure to include the completed graphic organizer in your math binder.

Using Linear Models Graphic Organizer

Click on the link below to access and complete the 2-5 Think About a Plan worksheet to learn how to apply the concepts from this lesson. When you are finished, click on the link below to check your answers.

2-5 Think About a Plan

Tip: Accuracy is important when creating a scatter plot to ensure a good visualization of the correlation. You should also have a straightedge handy, such as a ruler, for drawing a line of best fit.

Click on the link below to access a piece of graph paper to use when creating a scatter plot.

Graph Paper

Complete the following activities.

1. To practice using a scatter plot to analyze real-world data, click on the link below to complete the Height 'n' Hand Relationships activity from the National Library of Virtual Manipulative website. Use friends and family to collect data for the activity. Try to get measurements for at least 5 people.

   Height 'n' Hand Relationships

2. To practice concepts from this lesson, complete problems 7–17 odd on pp. 96–97 in *Algebra 2*. You can find the answers to these exercises in the back of your textbook in the Selected Answers section.
3. Continue working on the portfolio and participating in the discussion.

Tip: Please return to Unit 2, Lesson 1, page 4 to access the discussion link in order to add your comments.

Click on the link below to access the online textbook.

Algebra 2

Tip: Click on the link below to access a piece of graph paper to use when creating a scatter plot.

Graph Paper

Complete the following review activities.

In this lesson, you learned how to use a scatter plot and linear regression to model real-world data and make predictions. The activities that follow will help you review the concepts from this lesson.

1. Click on the link below to complete the Lesson Check on p. 96 in *Algebra 2*.

2. Complete the questions below in the writing journal section of your math binder.

    a. What is the purpose of a scatter plot?
    b. What is a line of best fit?
    c. What does the correlation coefficient tell you?

    Click on the Show Answer button below to check your answers.

    Show Answer

    Answers:

    a. A scatter plot can show a relationship between two variables.
    b. For two variables that have a linear association, the line of best fit is the line on the scatter plot that best approximates the linear relationship. The equation of the line of best fit can be used to make predictions.
    c. The correlation coefficient indicates the strength of the relationship between the two variables.

3. Recall the physical therapist scenario from the beginning of this lesson. Suppose you want to determine what kind of salary you can expect to make as a physical therapist. How can a graph help you predict the salary of a physical therapist by the time you are certified? What other information can you learn from a graph?

    Click on the Show Answer button below to check your answer.

    Show Answer

    Answer:
    You could create a scatter plot of the yearly average salary for a physical therapist for the past 10 years in the area in which you plan to work. The scatter plot will show if the data has a linear relationship. You could use the correlation coefficient to determine the strength of the correlation. Once a linear relationship has been determined, the equation of the line of best fit could be used to make a prediction regarding future salaries of physical therapists.

Click on the link below to access the online textbook.

Algebra 2

Tip: Click on the link below to access a piece of graph paper to use when creating a scatter plot.

Graph Paper

Lesson Answers

Click on the link below to check your answers to the 2-5 Think About a Plan worksheet.

2-5 Think About a Plan Answers

Using Linear Models

Aaron Doyle may not take this assessment.

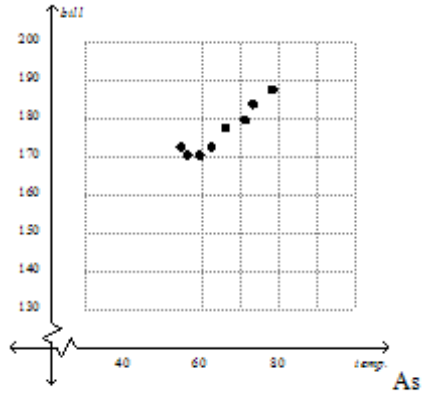
Multiple Choice

1.

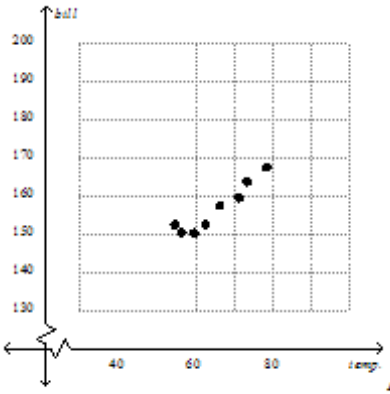
The table lists average monthly temperatures and electricity cost for a Texas home in 2008. The table displays the values rounded to the nearest whole number. Make a scatter plot. How would you describe the correlation?

Month	Average Temp (°F)	Electricity Bill ($)
January	57	150
February	55	152
March	60	150
April	63	152
May	67	157
June	72	159
July	74	163
August	79	167

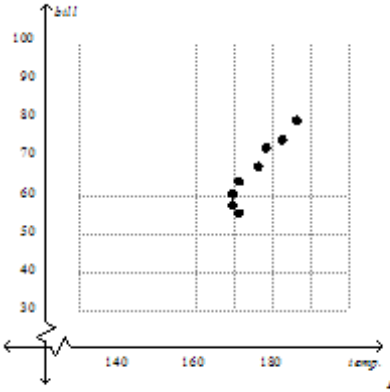
(1 point)



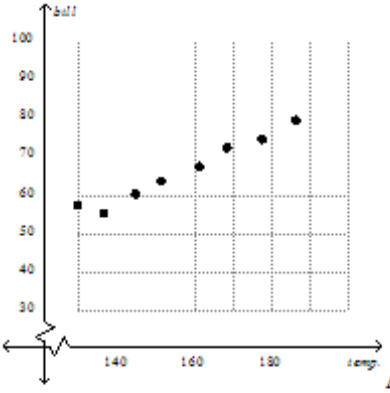
○ As temperature increases, the electricity cost increases; there is a negative correlation.

○ 

As temperature increases, the electricity cost increases; there is a positive correlation.

○ 

As temperature increases, the electricity cost decreases; there is a positive correlation.

○ 

As temperature increases, the cost of electricity decreases; there is a negative correlation.

2.

You research the average cost of a gallon of gas over several years to look for trends. The table shows the data that you have collected. What is the equation of the line of best fit? How much would you expect to pay for gasoline in 2029?

Year	1970	1975	1980	1985	1990	1995	2000	2005	2010
Average cost for one gallon	$ 1.75	$1.89	$1.62	$1.52	$1.33	$1.24	$1.56	$2.64	$3.17

(1 point)

- ○ $y = 0.538x + 1.36$; \$33.10
- ○ $y = 0.289x + 1.75$; \$18.80
- ○ $y = 0.052x + 1.75$; \$4.82
- ○ $y = 0.025x + 1.36$; \$2.84

3.

A 5-mile cab ride costs \$7.20. A 9-mile cab ride costs \$11.60. Find a linear equation that models a relationship between cost c and distance d.

(1 point)

- ○ $c = 1.44d + 4.40$
- ○ $d = 1.10c + 4.40$
- ○ $c = 1.29d + 1.70$
- ○ $c = 1.10d + 1.70$

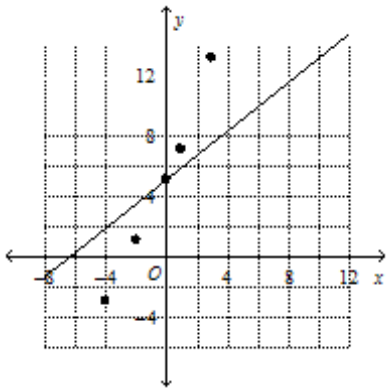
4.

Graph the set of data. Draw a trend line and write its equation.

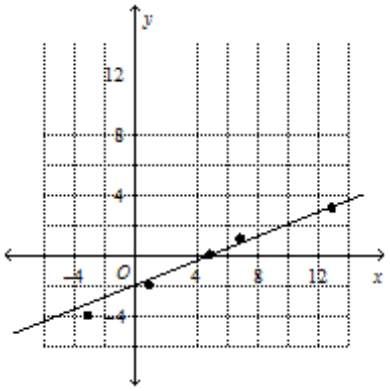
{(1,7), (–2, 1), (3, 13), (–4, –3), (0, 5)}

(1 point)

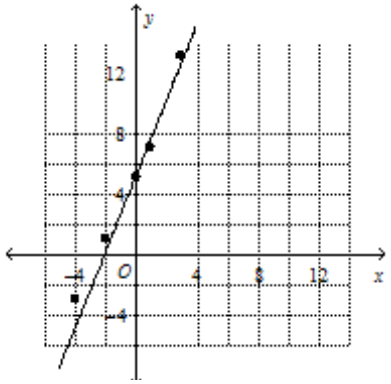
- ○ $y = 0.9x + 8.6$



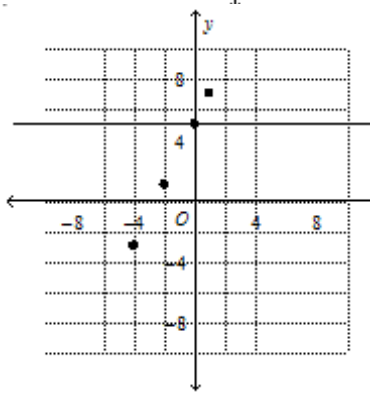
○ $y = \frac{2}{5}x - 2$



○ $y = \frac{5}{2}x + 5$



○ $y = 5$



5.

You research the average cost of whole milk for several recent years to look for trends. The table shows your data. What is the equation for a line of best fit? How much would you expect to pay for a gallon of whole milk in the year 2023?

Year	1998	2000	2002	2004	2006	2008
Average cost for one gallon ($)	$2.54	$2.76	$2.94	$2.91	$3.19	$3.72

(1 point)

○ $y = 2.54x + 0.098$; $4.98
○ $y = 0.102x + 2.499$; $5.06
○ $y = 2.54x + 0.098$; $6.36

○ $y = 0.098x + 2.54$; $4.98

Review Activities 2 and 3

Answers:
2. Linear Models journal entry:

a. A scatter plot can show a relationship between two variables.
b. For two variables that have a linear association, the line of best fit is the line on the scatter plot that best approximates the linear relationship. The equation of the line of best fit can be used to make predictions.
c. The correlation coefficient indicates the strength of the relationship between the two variables.

3. You could create a scatter plot of the yearly average salary for a physical therapist for the past 10 years in the area in which you plan to work. The scatter plot will show if the data has a linear relationship. You could use the correlation coefficient to determine the strength of the correlation. Once a linear relationship has been determined, the equation of the line of best fit could be used to make a prediction regarding future salaries of physical therapists.