Problem Solving with Linear Models

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CHAPTER 1 Problem Solving with Linear Models

Here you'll use some of the linear modeling tools learned in previous Concepts to solve real-world problems.

What if you've plotted some data points, with the $x-$coordinates of the points representing the number of years a teacher has been teaching at a school and the $y-$coordinates representing his salary? Suppose that you've found the line of best fit to be $y = 1500x + 28,000$. If the teacher has been teaching at the school for 8 years, could you use the line of best fit to predict how much his salary will be after he's taught for 12 years? How would you do it? In this Concept, you'll learn how to answer real-world questions like these by using a linear model.

Guidance

Previously we worked on writing equations and determining lines of best fit. When we fit a line to data using interpolation, extrapolation, or linear regression, it is called **linear modeling.**

A **model** is an equation that best describes the data graphed in the scatter plot.

Example A

Dana heard something very interesting at school. Her teacher told her that if you divide the circumference of a circle by its diameter you always get the same number. She tested this statement by measuring the circumference and diameter of several circular objects. The following table shows her results.

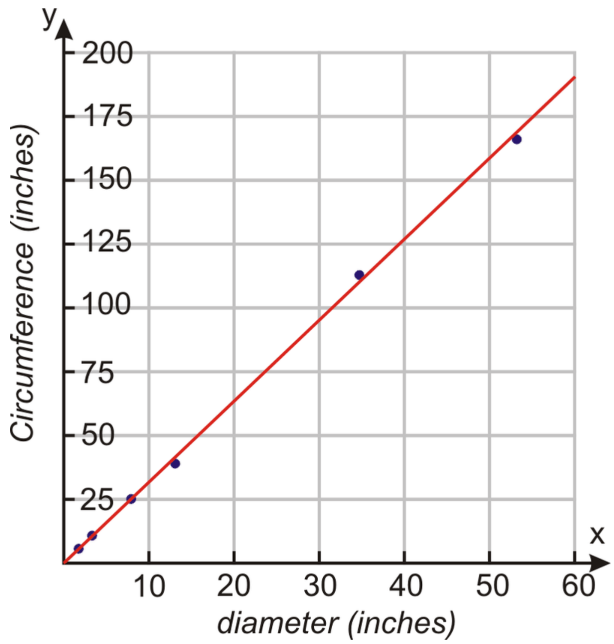
From this data, estimate the circumference of a circle whose diameter is 12 inches.

Solution:

Begin by creating a scatter plot and drawing the line of best fit.

TABLE 1.1: Diameter and Circumference of Various Objects

Object	Diameter (inches)	Circumference (inches)
Table	53	170
Soda can	2.25	7.1
Cocoa tin	4.2	12.6
Plate	8	25.5
Straw	0.25	1.2
Propane tank	13.3	39.6
Hula hoop	34.25	115



Find the equation of the line of best fit.

You should get the equation: y = 3.14x + 0.42

Example B

Using Dana's data from Example A, estimate the circumference of a circle whose diameter is 25 inches.

Solution:

The equation $y = 3.14x + 0.42$ of the relationship between diameter and circumference from Example A applies here.

$$\text{Diameter} = 25 \text{ inches} \Rightarrow y = 3.14(25) + 0.42 = \underline{78.92 \text{ inches}}$$

A circle with a diameter of 25 inches will have a circumference that is approximately 78.92 inches.

Example C

Using Dana's data from Example A, estimate the circumference of a circle whose diameter is 60 inches.

Solution:

The equation $y = 3.14x + 0.42$ of the relationship between diameter and circumference from Example A applies here.

$$\text{Diameter} = 60 \text{ inches} \Rightarrow y = 3.14(60) + 0.42 = \underline{188.82 \text{ inches}}$$

A circle with a diameter of 60 inches will have a circumference that is approximately 188.82 inches.