5.7 Predicting with Linear Models

Goals • Determine whether a linear model is appropriate.
 • Use a linear model to make a real-life prediction.

VOCABULARY

Linear interpolation Linear interpolation is a method of
estimating the coordinates of a point that lies between two
given data points.

Linear extrapolation Linear extrapolation is a method of
estimating the coordinates of a point that lies to the right or
left of all of the given data points.

WRITING A LINEAR MODEL

Step 1 Make a scatter plot of the data.

Step 2 Draw a line that best fits the points.

Step 3 Find two points on the best-fitting line. Use these points to
find the slope of the line .

Step 4 Estimate the *y*-intercept of the line.

Step 5 Use the slope and the *y*-intercept to write an equation
of the line.

Example 1   *Writing a Linear Model*

Internet The scatter plot at the right shows the hours per person per year that Americans use the Internet. Write a linear model for the data.

Internet Usage

Hours per person per year

Years since 1996
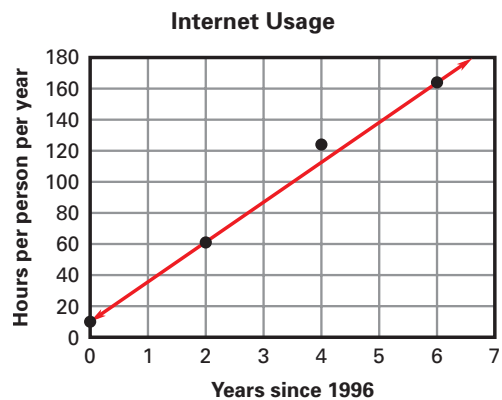
Solution

Draw a line that best fits the points. The line does not need to pass through any of the data points.

Find two points on the line such as (0, 10) and (6, 164). Use these points to find the slope of the line.

$$m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{164 - 10}{6 - 0} \approx 26$$

Using a *y*-intercept of $b = \underline{\,10\,}$ and a slope of $m = \underline{\,26\,}$, you can write an equation of the line.

$y = \underline{\,mx + b\,}$ **Write slope-intercept form.**

$y = \underline{\,26x + 10\,}$ **Substitute for *m* and *b*.**

Answer A linear model for the hours per person per year that Americans use the Internet is $y = \underline{\,26x + 10\,}$.

✔ *Checkpoint* **Complete the following exercise.**

1. In Example 1, suppose the line passes through the points (0, 10) and (3, 97). Write a linear model for the data.

$y = 29x + 10$

Example 2 *Linear Interpolation and Linear Extrapolation*

Use the linear model you found in Example 1 to estimate the Internet usage (in hours per person per year) in 2012. Tell whether you need to use *linear interpolation* or *linear extrapolation*.

Solution

Because 2012 is to the right of all of the given data, you will use <u>linear extrapolation</u>. You can estimate the Internet usage in 2012 by substituting $x =$ <u>16</u> into the linear model from Example 1.

$y =$ <u>$26x + 10$</u>   Write linear model.

$=$ <u>$26(16) + 10$</u>   Substitute for *x*.

$=$ <u>426</u>   Simplify.

Answer The model estimates that the Internet usage in 2012 will be about <u>426</u> hours per person per year.

✔ *Checkpoint* **Use the linear model you found in Example 1 to estimate the Internet usage (in hours per person per year) in the given year. Tell whether you need to use *linear interpolation* or *linear extrapolation*.**

2. 2014	**3.** 1997
linear extrapolation; 478 hours per person per year	linear interpolation; 36 hours per person per year