Lesson H

Problem Solving Skills: Modeling Data

Use after Lesson 13-8

When you want to see the trend in a set of data, you can use linear, quadratic, and exponential functions to model the data points. This process is called **regression.** A graphing calculator can make this process much easier. Here are the steps to follow to generate the equation of a line that will fit the data on a TI-83/84 Plus graphing calculator.

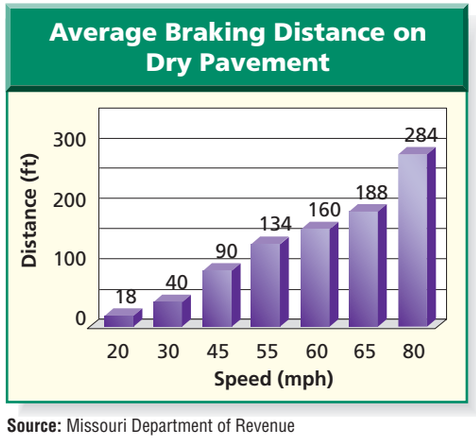
- Press STAT ENTER to enter the data in L1 and L2.
- Press STAT ▶. To fit a linear function to the data, press 4. To fit a quadratic function to the data, press 5. To fit an exponential function to the data, press 0. Then press ENTER.

Problem Solving Strategies

- Guess and check
- Look for a pattern
- Solve a simpler problem
- Make a table, chart or list
- ✔ Use a picture, diagram or model
- Act it out
- Work backwards
- Eliminate possibilities
- Use an equation or formula

PROBLEM

The graph shows the average braking distance on dry pavement for various speeds.



Source: Missouri Department of Revenue

a. Would a line be a good model for these data?

b. Would a curve be a good model for these data? If so, should you use a quadratic function or an exponential function?

c. How might choosing the wrong model affect the predictions you make?

d. Assuming that the trend continues, what would be the braking distance on dry pavement for 90 miles per hour? What about for 10 miles per hour?

Solve the Problem

a. Set the viewing window at x: [0, 100] with xscl 10 and y: [0, 300] with yscl 30. You can graph the data along with a line that fits the data points by pressing STAT ▶ 4 2nd [L1] , 2nd [L2] , VARS ▶ ENTER ENTER ENTER. The equation of the regression line is $y = 4.342777778x - 89.6694444$. Then press GRAPH. You can see that the line misses several of the data points. This is probably not the best model for the data.

b. Follow the same instructions as in step a, but this time, begin with STAT ▶ 5. You can see that the line goes through all of the data points. This is a quadratic model, and it is probably the best model for the data. (You may want to try the exponential model to be sure.)

c. If the wrong model is chosen, any predictions made would most likely be incorrect.

d. Press 2nd [CALC] 1. Enter 90 and press ENTER. Using this function, the distance at 90 miles per hour would be about 360 feet. At 10 miles per hour, it would be about 5 feet.

Try These Exercises

Write a regression equation for each display. Round to the nearest ten-thousandth.

1. $y = ax^2 + bx + c$
$a = 2.153065102$
$b = -.1036982505$
$c = 42.53362581$

2. $y = ax + b$
$a = 1.31$
$b = -2581.6$

3. $y = a*b \hat{} x$
$a = 5.513825879$
$b = 1.012946155$

Practice Exercises

For each set of data, a) make a scatter plot, b) write a regression equation for the curve of best fit, c) state whether it is linear, quadratic, or exponential, and d) make the prediction noted. Round to the nearest ten-thousandth.

4. GOVERNMENT Populations and U.S. Congressional Representation

State	CA	NY	TX	FL	NC	IN	AL
Population (millions)	35.9	19.2	22.5	17.4	8.5	6.2	4.5
Representatives	53	29	32	25	13	9	7

Source: *The World Almanac*

Predict the number of representatives for Oklahoma, with a population of about 3.5 million.

5. POSTAGE The Cost of First-Class Postage in the United States

Year	1978	1981	1985	1988	1991	1995	1999	2001	2002	2006
Cost (dollars)	0.15	0.20	0.22	0.25	0.29	0.32	0.33	0.34	0.37	0.39

Predict the cost of first-class postage in 2010.

6. POPULATION Percent of U.S. Population that is Foreign-Born

Year	1970	1980	1990	2000	2004
Percent	4.7	6.2	8.0	10.4	11.7

Source: *The World Almanac*

Predict the percent of the population that will be foreign-born in 2008.

7. FAMILY The table below shows the numbers of persons aged 18–24 who were living at home or in dormitories.

Year	1960	1970	1980	1985	1990	1995	2000	2004
Persons (thousands)	6,842	10,398	14,278	13,695	12,450	12,545	13,291	14,165

Source: *The World Almanac*

a. Neither linear, quadratic, nor exponential functions are a good fit for these data. Explore the following functional models: cubic, quartic, and logarithmic. Are any of these types of functions a better fit for these data? Explain.

b. About how many people aged 18–24 will be living at home or in dormitories in 2010?

8. WRITING MATH Describe a set of data that can be modeled by each type of function. Use actual sets of data or a thorough description of the data set. Explain why you feel that these functions best model the data.

a. linear
b. quadratic
c. exponential