



Activity

# 8-5

## Linear, Exponential, and Quadratic Models



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### MODEL & DISCUSS

Jacy and Emma use different functions to model the value of a bike  $x$  years after it is purchased. Each function models the data in the table.

Jacy's function:  $f(x) = -14.20x + 500$

Emma's function:  $f(x) = 500(0.85)^x$

Time (yr)	Value (\$)
0	500.00
1	485.20
2	472.13
3	461.00
4	452.10

A. **Make Sense and Persevere** Why did Jacy and Emma not choose a quadratic function to model the data? © MP.1

B. Whose function do you think is a better model? Explain.

C. Do you agree with this statement? Explain why or why not.

To ensure that you are finding the best model for a table of data, you need to find the values of the functions for the same values of  $x$ .

#### HABITS OF MIND

**Communicate Precisely** How is finding the best model for data in a real-world situation similar to finding the best model in a mathematical situation? How is it different? © MP.6

**EXAMPLE 1**  **Try It! Determine Which Function Type Represents Data**

1. Does a linear, quadratic, or exponential function best model the data? Explain.

a.

$x$	0	1	2	3	4
$y$	-2	-5	-14	-29	-50

b.

$x$	-2	-1	0	1	2
$y$	4	12	36	108	324

**EXAMPLE 2**  **Try It! Choose a Function Type for Real-World Data**

2. Determine whether a linear, quadratic, or exponential function best models the data. Then, use regression to find the function that models the data.

$x$	0	1	2	3	4
$y$	100	89.5	78.9	68.4	57.8

**HABITS OF MIND**

**Reason** If a table of data does not have common differences or a common ratio, can you still make predictions about other data points in the data set? Explain. © MP.2

**EXAMPLE 3**  **Try It!** Compare Linear, Exponential, and Quadratic Growth

3. Compare the functions  $f(x) = 3x + 2$ ,  $g(x) = 2x^2 + 3$ , and  $h(x) = 2^x$ . Show that as  $x$  increases,  $h(x)$  will eventually exceed  $f(x)$  and  $g(x)$ .

**HABITS OF MIND**

**Generalize** How can the rate of change help determine the type of function that best fits the data? © MP.8



## Do You UNDERSTAND?

1. **ESSENTIAL QUESTION** How can you determine whether a linear, exponential, or quadratic function best models data?

2. **Reason** The growth of a function is less from  $x = 1$  to  $x = 4$  than from  $x = 5$  to  $x = 8$ . What type of function could it be? Explain. © MP.2

3. **Error Analysis** Kiyo used a quadratic function to model data with constant first differences. Explain the error Kiyo made. © MP.3

## Do You KNOW HOW?

Determine whether the data are best modeled by a linear, quadratic, or exponential function.

4.

$x$	0	1	2	3	4
$y$	-2	1	10	25	46

5.

$x$	-2	-1	0	1	2
$y$	2	7	12	17	22

6. A company's profit from a certain product is represented by  $P(x) = -5x^2 + 1,125x - 5,000$ , where  $x$  is the price of the product. Compare the growth in profits from  $x = 120$  to  $x = 140$  and from  $x = 140$  to  $x = 160$ . What do you notice?

