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Study Guide and Intervention

Modeling Quadratic Functions

Example 1 **Write a function rule.**

Write an equation for the function. Use your model to predict the fuel economy at 80 miles per hour.

10-MILE PER HOUR INTERVAL, x	MILES PER HOUR	GASOLINE USAGE IN MILES PER GALLON, $f(x)$
0	20	24.5
1	30	28.0
2	40	30.0
3	50	30.2
4	60	28.8
5	70	25.8

Solution

Step 1 **Determine the finite differences in x-values and the second finite differences in the values of f(x).**

	10-MILE PER HOUR INTERVAL, x	MILES PER HOUR	GASOLINE USAGE IN MILES PER GALLON, $f(x)$		
	0	20	24.5		
$\Delta x = 1 - 0 = 1$	1	30	28.0	3.5	
$\Delta x = 2 - 1 = 1$	2	40	30.0	2.0	-1.5
$\Delta x = 3 - 2 = 1$	3	50	30.2	0.2	-1.8
$\Delta x = 4 - 3 = 1$	4	60	28.8	-1.4	-1.6
$\Delta x = 5 - 4 = 1$	5	70	25.8	-3.0	-1.6

Step 2 **Calculate the average of the second finite differences and use this value to determine *a* in the quadratic function model, $f(x) = ax^2 + bx + c$.**

$$2a = \frac{-1.5 - 1.8 - 1.6 - 1.6}{4} = -1.625$$

So $a = -.8125$

Step 3 **Calculate the value of *b*.**

The difference between the values of f(x) for x = 0 and 1 is (a + b)

a + b = 3.5
(-.8125) + b = 3.5
b = 3.5 + .8125
b = 4.3125

Step 4 **Determine the value of c.**

The value of f(0) = c
f(0) = 24.5
c = 24.5

Step 5 **Substitute the values of a, b, and c into the general form to determine the function model.**

$f(x) = -.8125x^2 + 4.3125x + 24.5$

Exercises

For questions 1-3, use finite differences to determine if the data sets represent linear, exponential, quadratic, or other type of function.

1.

x	$y = f(x)$
1	7
2	16
3	27
4	40
5	55

2.

x	$y = f(x)$
1	-13
2	-28
3	-45
4	-64
5	-85

3.

x	$y = f(x)$
1	-4
2	-6
3	-6
4	-4
5	0

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Study Guide and Intervention

Writing Quadratic Functions (cont.)

Exercises

For questions 4-6, use the data set to generate a quadratic function that best models the data.

4.

x	$y = f(x)$
1	3
2	12
3	27
4	48
5	75

5.

x	$y = f(x)$
1	-12
2	-20
3	-24
4	-24
5	-20

6.

x	$y = f(x)$
1	1
2	-8
3	-23
4	-44
5	-71

For questions 7 and 8, use the following information.

SPEED OF A VEHICLE IN MILES PER HOURS, x	DISTANCE OF THE SKID IN FEET, $f(x)$
30	37.5
36	54
42	73.5
48	96
54	121.5
60	150

7. Use the table of data to determine the length of a skid mark of a vehicle that was traveling at a speed of 72 miles when it applied brakes.

8. Use the table of data to determine how fast a vehicle was traveling if the length of the skid mark was 24 feet.

For questions 9 and 10, use the following information.

TIME IN SECONDS, x	DISTANCE FROM THE GROUND IN METERS, $f(x)$
0	0
1	30
2	50
3	60
4	60
5	50

9. Use the data in the table to generate a quadratic function that models the data.

10. Use the data in the table to find the height of the ball after 7 seconds.