Activity

8-4 Modeling With Quadratic Functions

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MODEL & DISCUSS

The graphic shows the heights of a supply package dropped from a helicopter hovering above ground.

A. **Model With Mathematics** Would a linear function be a good model for the data? Explain. MP.4

B. Would a quadratic function be a good model for the data? Explain.

HABITS OF MIND

Reason Compare the rate of change for the function representing the supply-package heights for the interval from 0 to 1 second and for the interval from 3 to 4 seconds. What do these rates of change represent, and what do they reveal about how quickly the supply package is falling over time? MP.2

EXAMPLE 1 **Try It! Use Quadratic Functions to Model Area**

1. Suppose the length of the pool in Example 1 is 3 times the area of the width. How does the function that represents the combined area of the pool and deck change? Explain.

EXAMPLE 2 **Try It! Model Vertical Motion**

2. Find the diver's maximum height above the water if he dives from a 20-ft platform with an initial velocity of 8 ft/s.

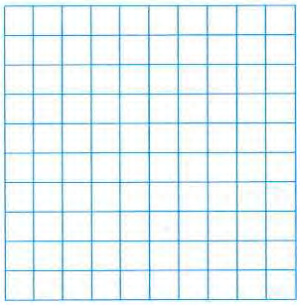
HABITS OF MIND

Communicate Precisely In Example 2, what units are used for the initial height and velocity? How do these units relate to the coefficient of the t^2-term? Suppose the problem expressed the initial height and velocity using meters. What value would be used for the coefficient of the t^2-term? MP.6

EXAMPLE 3 Try It! Assess the Fit of a Function by Analyzing Residuals

3. Make a scatterplot of the data and graph the function $f(x) = -8x^2 + 95x + 745$. Make a residual plot and describe how well the function fits the data.

Price Increase ($)	0	1	2	3	4
Sales ($)	730	850	930	951	1010



EXAMPLE 4 Try It! Fit a Quadratic Function to Data

4. Use the model in Example 4 to determine the predicted revenue after the 6th and 7th price increases. What do you notice?

HABITS OF MIND

Construct Arguments A student thinks that the first list on the graphing calculator screen shown in Step 1 of Example 4 should show the admission prices in dollars: 5, 6, 7, 8, and 9. Explain why these prices are not used for this list. MP.3

Do You UNDERSTAND?

1. **ESSENTIAL QUESTION** What kinds of real-world situations can be modeled by quadratic functions?

2. **Look for Relationships** How is the function $h(t) = -16t^2 + bt + c$ related to vertical motion? MP.7

3. **Vocabulary** What does it mean in a real-world situation when the *initial velocity* is 0?

4. **Error Analysis** Chen uses $h(t) = -16t^2 + 6t + 16$ to determine the height of a ball t seconds after it is thrown at an initial velocity of 16 ft/s from an initial height of 6 ft. Describe the error Chen made. MP.3

Do You KNOW HOW?

Write a vertical motion model in the form $h(t) = -16t^2 + v_0t + h_0$ for each situation presented. For each situation, determine how long, in seconds, it takes the thrown object to reach maximum height.

5. Initial velocity: 32 ft/s; initial height: 20 ft

6. Initial velocity: 120 ft/s; initial height: 50 ft

7. A rectangular patio has a length four times its width. It also has a 3-ft wide brick border around it. Write a quadratic function to determine the area of the patio and border?

8. The data are modeled by $f(x) = -2x^2 + 16.3x + 40.7$. What does the graph of the residuals tell you about the fit of the model?

x	y
1	55.0
2	65.3
3	71.6
4	73.9
5	72.2