Chapter 6
Exponential and Logarithmic Functions

Section 6-7
Modeling with Exponential and Logarithmic Functions

Classifying Data

You have analyzed *finite differences* of data with equally-spaced inputs to determine what type of polynomial function can be used to model the data. For exponential data with equally-spaced inputs, the outputs are multiplied by a constant factor. So, consecutive outputs form a constant ratio.

EXAMPLE 1 Classifying Data Sets

Determine the type of function represented by each table.

a.

x	-2	-1	0	1	2	3	4
y	0.5	1	2	4	8	16	32

b.

x	-2	0	2	4	6	8	10
y	2	0	2	8	18	32	50

SOLUTION

a. The inputs are equally spaced. Look for a pattern in the outputs.

x	−2	−1	0	1	2	3	4
y	0.5	1	2	4	8	16	32

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▶ As x increases by 1, y is multiplied by 2. So, the common ratio is 2, and the data in the table represent an exponential function.

b. The inputs are equally spaced. The outputs do not have a common ratio. So, analyze the finite differences.

x	−2	0	2	4	6	8	10
y	2	0	2	8	18	32	50

−2 2 6 10 14 18 first differences

4 4 4 4 4 second differences

▶ The second differences are constant. So, the data in the table represent a quadratic function.

Writing Exponential Functions

You know that two points determine a line. Similarly, two points determine an exponential curve.

EXAMPLE 2 Writing an Exponential Function Using Two Points

Write an exponential function $y = ab^x$ whose graph passes through (1, 6) and (3, 54).

SOLUTION

Data do not always show an *exact* exponential relationship. When the data in a scatter plot show an *approximately* exponential relationship, you can model the data with an exponential function.

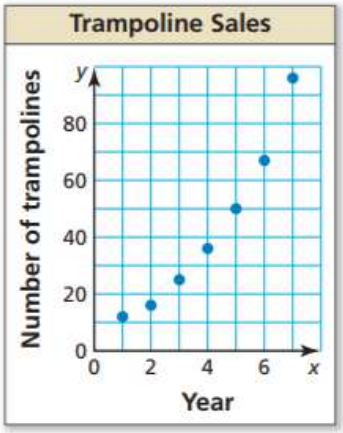
EXAMPLE 3 Finding an Exponential Model

Year, x	Number of trampolines, y
1	12
2	16
3	25
4	36
5	50
6	67
7	96

A store sells trampolines. The table shows the numbers y of trampolines sold during the xth year that the store has been open. Write a function that models the data.

SOLUTION

Step 1 Make a scatter plot of the data. The data appear exponential.



Step 2 Choose any two points to write a model, such as (1, 12) and (4, 36). Substitute the coordinates of these two points into $y = ab^x$.

$$12 = ab^1$$

$$36 = ab^4$$

Solve for a in the first equation to obtain $a = \frac{12}{b}$. Substitute to obtain $b = \sqrt[3]{3} \approx 1.44$ and $a = \frac{12}{\sqrt[3]{3}} \approx 8.32$.

▶ So, an exponential function that models the data is $y = 8.32(1.44)^x$.

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