

## Section 3.5 Exponential and Logarithmic Models

**Objective:** In this lesson you learned how to use exponential growth models, exponential decay models, Gaussian models, logistic models, and logarithmic models to solve real-life problems and how to fit exponential and logarithmic models to sets of data.

Course Number

Instructor

Date

### Important Vocabulary

Define each term or concept.

**Bell-shaped curve**

**Logistic curve**

**Sigmoidal curve**

### I. Introduction (Page 258)

The **exponential growth model** is \_\_\_\_\_.

The **exponential decay model** is \_\_\_\_\_.

The **Gaussian model** is \_\_\_\_\_.

The **logistic growth model** is \_\_\_\_\_.

**Logarithmic models** are \_\_\_\_\_ and

\_\_\_\_\_.

#### *What you should learn*

How to recognize the five most common types of models involving exponential and logarithmic functions

### II. Exponential Growth and Decay (Pages 259–261)

**Example 1:** Suppose a population is growing according to the model  $P = 800e^{0.05t}$ , where  $t$  is given in years.

- What is the initial size of the population?
- How long will it take this population to double?

#### *What you should learn*

How to use exponential growth and decay functions to model and solve real-life problems

To estimate the age of dead organic matter, scientists use the carbon dating model \_\_\_\_\_, which denotes the ratio  $R$  of carbon 14 to carbon 12 present at any time  $t$  (in years).

**Example 2:** The ratio of carbon 14 to carbon 12 in a fossil is  $R = 10^{-16}$ . Find the age of the fossil.

**III. Gaussian Models** (Page 262)

The Gaussian model is commonly used in probability and statistics to represent populations that are \_\_\_\_\_

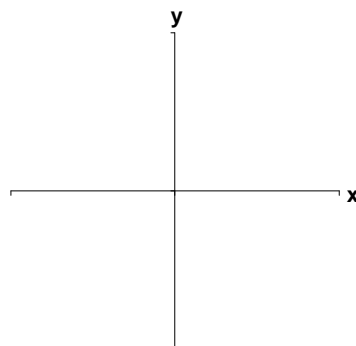
\_\_\_\_\_.

On a bell-shaped curve, the average value for a population is the \_\_\_\_\_ of the curve.

**Example 3:** Draw the basic form of the graph of a Gaussian model.

***What you should learn***

How to use Gaussian functions to model and solve real-life problems

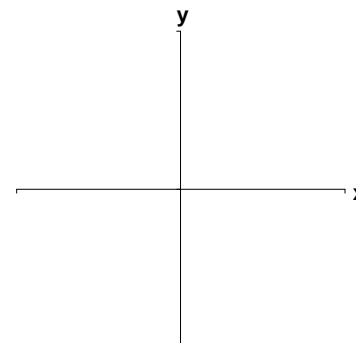
**IV. Logistic Growth Models** (Page 263)

Give an example of a real-life situation that is modeled by a logistic growth model.

**Example 4:** Draw the basic form of the graph of a logistic growth model.

***What you should learn***

How to use logistic growth functions to model and solve real-life problems

**V. Logarithmic Models** (Page 264)

**Example 5:** The number of kitchen widgets  $y$  (in millions) demanded each year is given by the model  $y = 2 + 3 \ln(x + 1)$ , where  $x = 0$  represents the year 2000 and  $x \geq 0$ . Find the year in which the number of kitchen widgets demanded will be 8.6 million.

***What you should learn***

How to use logarithmic functions to model and solve real-life problems

**VI. Fitting Models to Data** (Pages 264–265)

Describe how to use a graphing utility to fit a logarithmic or an exponential model to data.

***What you should learn***

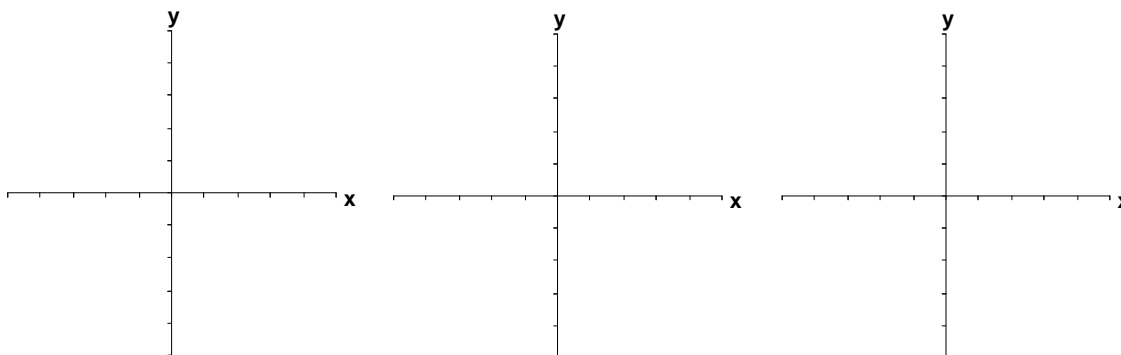
How to fit exponential and logarithmic models to sets of data

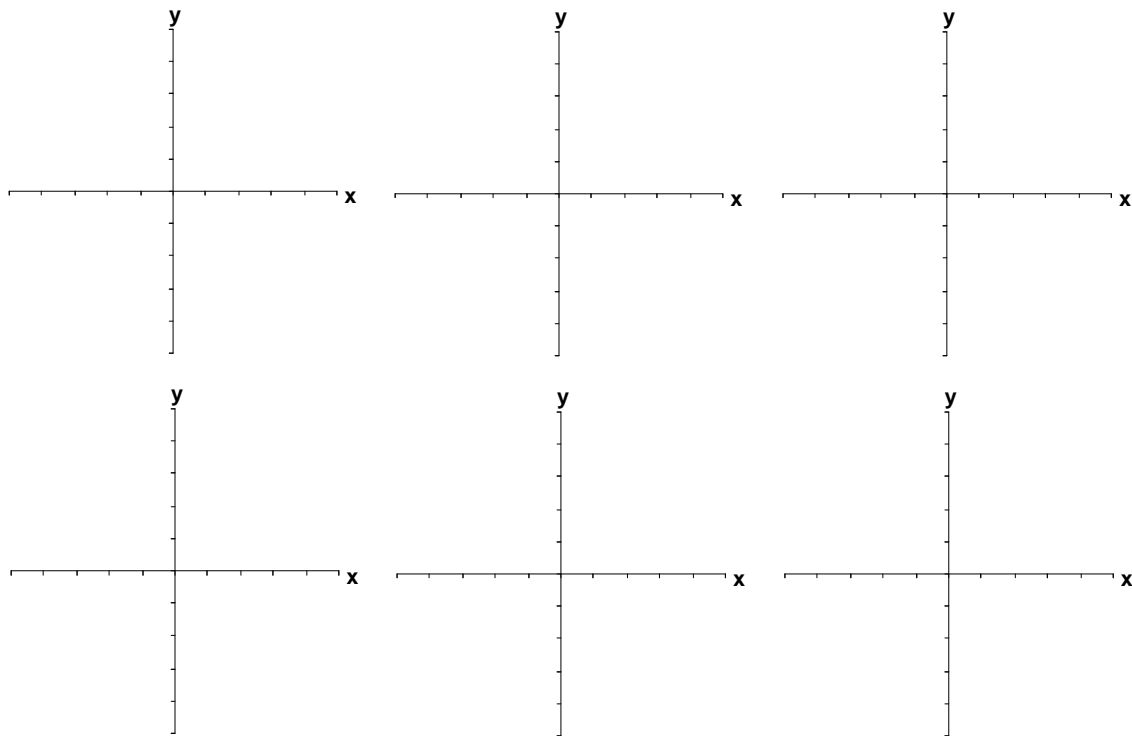
An exponential model of the form  $y = ab^x$  can be changed to an equivalent exponential model of the form  $y = ae^{cx}$  by letting  $c = \underline{\hspace{2cm}}$  in the second model.

**Example 6:** Rewrite the exponential function  $f(x) = 0.2(4)^x$  as a natural logarithmic function.

**Example 7:** Find an appropriate model, either logarithmic or exponential, for the data in the following table.

$x$	1	3	5	7	9
$y$	1.120	2.195	4.303	8.433	16.529



**Additional notes****Homework Assignment**

Page(s)

Exercises