

**11.1****Using Normal Distributions**

For use with Exploration 11.1

**Essential Question** In a normal distribution, about what percent of the data lies within one, two, and three standard deviations of the mean?

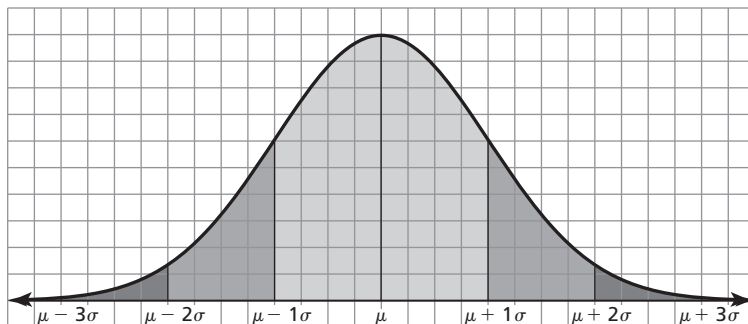
Recall that the standard deviation  $\sigma$  of a numerical data set is given by

$$\sigma = \sqrt{\frac{(x_1 - \mu)^2 + (x_2 - \mu)^2 + \cdots + (x_n - \mu)^2}{n}}$$

where  $n$  is the number of values in the data set and  $\mu$  is the mean of the data set.

**1 EXPLORATION: Analyzing a Normal Distribution**

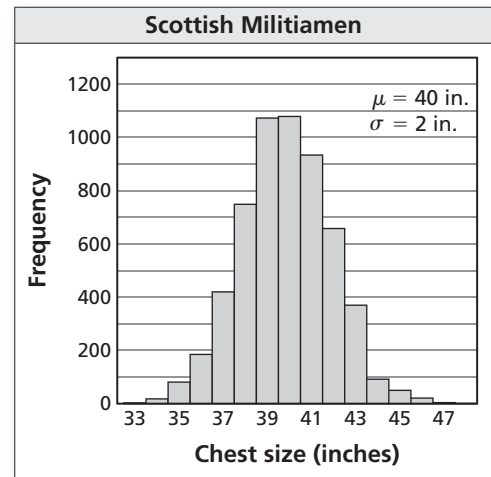
**Work with a partner.** In many naturally occurring data sets, the histogram of the data is bell-shaped. In statistics, such data sets are said to have a *normal distribution*. For the normal distribution shown below, estimate the percent of the data that lies within one, two, and three standard deviations of the mean. Each square on the grid represents 1%.



**11.1 Using Normal Distributions (continued)****2 EXPLORATION: Analyzing a Data Set**

**Work with a partner.** A famous data set was collected in Scotland in the mid-1800s. It contains the chest sizes (in inches) of 5738 men in the Scottish Militia. Do the data fit a normal distribution? Explain.

Chest size	Number of men
33	3
34	18
35	81
36	185
37	420
38	749
39	1073
40	1079
41	934
42	658
43	370
44	92
45	50
46	21
47	4
48	1

**Communicate Your Answer**

- In a normal distribution, about what percent of the data lies within one, two, and three standard deviations of the mean?
- Use the Internet or some other reference to find another data set that is normally distributed. Display your data in a histogram.

# 11.1

## Notetaking with Vocabulary

For use after Lesson 11.1

In your own words, write the meaning of each vocabulary term.

normal distribution

normal curve

standard normal distribution

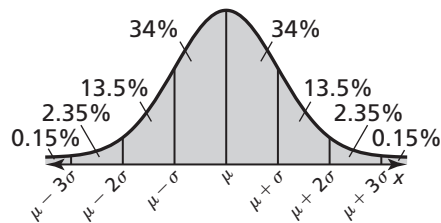
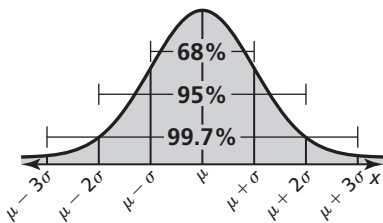
z-score

### Core Concepts

#### Areas Under a Normal Curve

A normal distribution with mean  $\mu$  and standard deviation  $\sigma$  has these properties.

- The total area under the related normal curve is 1.
- About 68% of the area lies within 1 standard deviation of the mean.
- About 95% of the area lies within 2 standard deviations of the mean.
- About 99.7% of the area lies within 3 standard deviations of the mean.



Notes:

**11.1** Notetaking with Vocabulary (continued)**Extra Practice**

In Exercises 1–6, a normal distribution has mean  $\mu$  and standard deviation  $\sigma$ . Find the indicated probability for a randomly selected  $x$ -value from the distribution.

1.  $P(x \leq \mu - 2\sigma)$

2.  $P(x \geq \mu - 3\sigma)$

3.  $P(x \leq \mu + 2\sigma)$

4.  $P(x \geq \mu + 3\sigma)$

5.  $P(\mu - \sigma \leq x \leq \mu + 3\sigma)$

6.  $P(\mu - 2\sigma \leq x \leq \mu + \sigma)$

7. The scores for a math course test are normally distributed with a mean of 61 and a standard deviation of 11. The test scores range from 0 to 100.

a. About what percent of the students taking the test have scores between 72 and 83?

b. About what percent of the students taking the test have scores less than 50?

**11.1** Notetaking with Vocabulary (continued)

8. The temperatures of a city are normally distributed over the course of a year. The mean temperature is  $55.2^{\circ}\text{F}$  and the standard deviation is  $6.3^{\circ}\text{F}$ . A day is randomly chosen.
- What is the probability that the chosen day is  $45^{\circ}\text{F}$  or cooler?
  - What is the probability that the chosen day is cooler than  $32.5^{\circ}\text{F}$ ?
  - What is the probability that the chosen day is between  $32.5^{\circ}\text{F}$  and  $45^{\circ}\text{F}$ ?
  - What is the probability that the chosen day is  $60^{\circ}\text{F}$  or warmer?

In Exercises 9 and 10, determine whether the histogram has a normal distribution.

