10.6 Samples and Populations

Essential Question How can you determine whether a sample accurately represents a population?

A **population** is an entire group of people or objects. A **sample** is a part of the population. You can use a sample to make an *inference*, or conclusion, about a population.

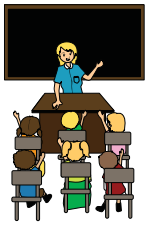
Identify a population.		Select a sample.		Interpret the data in the sample.		Make an inference about the population.
Population	→	Sample	→	Interpretation	→	Inference

1 ACTIVITY: Identifying Populations and Samples

Work with a partner. Identify the population and the sample.

a.

The students in a school



The students in a math class

b.

The grizzly bears with GPS collars in a park

The grizzly bears in a park

c.

150 quarters

All quarters in circulation

d.

All books in a library

10 fiction books in a library

Probability and Statistics

In this lesson, you will

- determine when samples are representative of populations.
- use data from random samples to make predictions about populations.

2 ACTIVITY: Identifying Random Samples

Work with a partner. When a sample is selected at random, each member of the population is equally likely to be selected. You want to know the favorite extracurricular activity of students at your school. Determine whether each method will result in a random sample. Explain your reasoning.

a. You ask members of the school band.

b. You publish a survey in the school newspaper.

c. You ask every eighth student who enters the school in the morning.

d. You ask students in your class.

There are many different ways to select a sample from a population. To make valid inferences about a population, you must choose a random sample very carefully so that it accurately represents the population.

3 ACTIVITY: Identifying Representative Samples

Work with a partner. A new power plant is being built outside a town. In each situation below, residents of the town are asked how they feel about the new power plant. Determine whether each conclusion is valid. Explain your reasoning.

a. A local radio show takes calls from 500 residents. The table shows the results. The radio station concludes that most of the residents of the town oppose the new power plant.

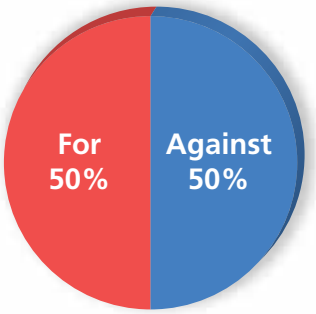
New Power Plant	
For	70
Against	425
Don't know	5

Math Practice

Understand Quantities

Can the size of a sample affect the validity of a conclusion about a population?

New Power Plant



b. A news reporter randomly surveys 2 residents outside a supermarket. The graph shows the results. The reporter concludes that the residents of the town are evenly divided on the new power plant.

c. You randomly survey 250 residents at a shopping mall. The table shows the results. You conclude that there are about twice as many residents of the town against the new power plant than for the new power plant.

New Power Plant	
For	32%
Against	62%
Don't know	6%

What Is Your Answer?

4. **IN YOUR OWN WORDS** How can you determine whether a sample accurately represents a population?

5. **RESEARCH** Choose a topic that you would like to ask people's opinions about, and then write a survey question. How would you choose people to survey so that your sample is random? How many people would you survey? Conduct your survey and display your results. Would you change any part of your survey to make it more accurate? Explain.

6. Does increasing the size of a sample necessarily make the sample representative of a population? Give an example to support your explanation.

Practice Use what you learned about populations and samples to complete Exercises 3 and 4 on page 444.

10.6 Lesson

Check It Out
Lesson Tutorials
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Key Vocabulary
population, *p. 440*
sample, *p. 440*
unbiased sample, *p. 442*
biased sample, *p. 442*

An **unbiased sample** is representative of a population. It is selected at random and is large enough to provide accurate data.

A **biased sample** is not representative of a population. One or more parts of the population are favored over others.

EXAMPLE 1 Identifying an Unbiased Sample

You want to estimate the number of students in a high school who ride the school bus. Which sample is unbiased?

(A) 4 students in the hallway
(B) all students in the marching band
(C) 50 seniors at random
(D) 100 students at random during lunch

Choice A is not large enough to provide accurate data.

Choice B is not selected at random.

Choice C is not representative of the population because seniors are more likely to drive to school than other students.

Choice D is representative of the population, selected at random, and large enough to provide accurate data.

So, the correct answer is (D).

On Your Own

Now You're Ready
Exercises 5–7

1. **WHAT IF?** You want to estimate the number of seniors in a high school who ride the school bus. Which sample is unbiased? Explain.
2. You want to estimate the number of eighth-grade students in your school who consider it relaxing to listen to music. You randomly survey 15 members of the band. Your friend surveys every fifth student whose name appears on an alphabetical list of eighth graders. Which sample is unbiased? Explain.

The results of an unbiased sample are proportional to the results of the population. So, you can use unbiased samples to make predictions about the population.

Biased samples are not representative of the population. So, you should not use them to make predictions about the population because the predictions may not be valid.

EXAMPLE 2 Determining Whether Conclusions Are Valid

You want to know how the residents of your town feel about adding a new stop sign. Determine whether each conclusion is valid.

a. You survey the 20 residents who live closest to the new sign. Fifteen support the sign, and five do not. So, you conclude that 75% of the residents of your town support the new sign.

The sample is not representative of the population because residents who live close to the sign are more likely to support it.

So, the sample is biased, and the conclusion is not valid.

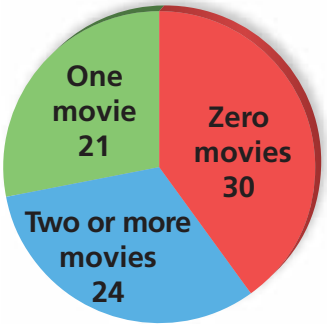
b. You survey 100 residents at random. Forty support the new sign, and sixty do not. So, you conclude that 40% of the residents of your town support the new sign.

The sample is representative of the population, selected at random, and large enough to provide accurate data.

So, the sample is unbiased, and the conclusion is valid.

EXAMPLE 3 Making Predictions

Movies per Week



You ask 75 randomly chosen students how many movies they watch each week. There are 1200 students in the school. Predict the number n of students in the school who watch one movie each week.

The sample is representative of the population, selected at random, and large enough to provide accurate data. So, the sample is unbiased, and you can use it to make a prediction about the population.

Write and solve a proportion to find n.

Sample **Population**

$$\frac{\text{students in survey (one movie)}}{\text{number of students in survey}} = \frac{\text{students in school (one movie)}}{\text{number of students in school}}$$

$$\frac{21}{75} = \frac{n}{1200} \qquad \text{Substitute.}$$

$$336 = n \qquad \text{Solve for } n.$$

So, about 336 students in the school watch one movie each week.

On Your Own

Now You're Ready
Exercises 8, 9, and 12

3. In Example 2, each of 25 randomly chosen firefighters supports the new sign. So, you conclude that 100% of the residents of your town support the new sign. Is the conclusion valid? Explain.

4. In Example 3, predict the number of students in the school who watch two or more movies each week.

10.6 Exercises

Check It Out
Help with Homework
BigIdeasMath.com

Vocabulary and Concept Check

1. **VOCABULARY** Why would you survey a sample instead of a population?
2. **CRITICAL THINKING** What should you consider when conducting a survey?

Practice and Problem Solving

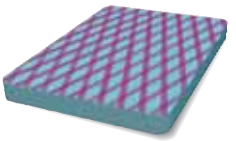
Identify the population and the sample.

3. Residents of New Jersey

Residents of Ocean County

4.

4 cards



All cards in a deck

Determine whether the sample is *biased* or *unbiased*. Explain.

1

5. You want to estimate the number of students in your school who play a musical instrument. You survey the first 15 students who arrive at a band class.

6. You want to estimate the number of books students in your school read over the summer. You survey every fourth student who enters the school.
7. You want to estimate the number of people in a town who think that a park needs to be remodeled. You survey every 10th person who enters the park.

Determine whether the conclusion is valid. Explain.

2

8. You want to determine the number of students in your school who have visited a science museum. You survey 50 students at random. Twenty have visited a science museum, and thirty have not. So, you conclude that 40% of the students in your school have visited a science museum.
9. You want to know how the residents of your town feel about building a new baseball stadium. You randomly survey 100 people who enter the current stadium. Eighty support building a new stadium, and twenty do not. So, you conclude that 80% of the residents of your town support building a new baseball stadium.

Which sample is better for making a prediction? Explain.

10.

Predict the number of students in a school who like gym class.	
Sample A	A random sample of 8 students from the yearbook
Sample B	A random sample of 80 students from the yearbook

11.

Predict the number of defective pencils produced per day.	
Sample A	A random sample of 500 pencils from 20 machines
Sample B	A random sample of 500 pencils from 1 machine

3 **12. FOOD** You ask 125 randomly chosen students to name their favorite food. There are 1500 students in the school. Predict the number of students in the school whose favorite food is pizza.

Favorite Food	
Pizza	58
Hamburger	36
Pasta	14
Other	17

Determine whether you would survey the population or a sample. Explain.

13. You want to know the average height of seventh graders in the United States.

14. You want to know the favorite types of music of students in your homeroom.

15. You want to know the number of students in your state who have summer jobs.

Theater Ticket Sales	
Adults	Students
522	210

16. THEATER You su0.rvey 72 randomly chosen students about whether they are going to attend the school play. Twelve say yes. Predict the number of students who attend the school.

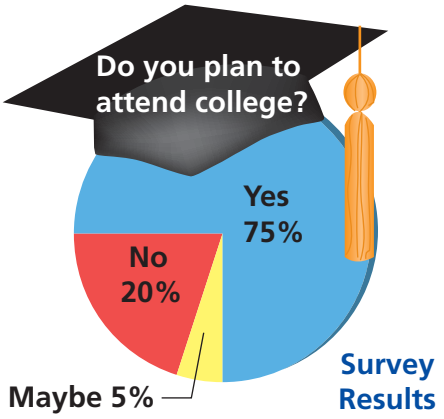
17. CRITICAL THINKING Explain why 200 people with email addresses may not be a random sample. When might it be a random sample?

18. LOGIC A person surveys residents of a town to determine whether a skateboarding ban should be overturned.

a. Describe how the person could conduct the survey so that the sample is biased toward overturning the ban.

b. Describe how the person could conduct the survey so that the sample is biased toward keeping the ban.

19. Reasoning A guidance counselor surveys a random sample of 60 out of 900 high school students. Using the survey results, the counselor predicts that approximately 720 students plan to attend college. Do you agree with her prediction? Explain.



Fair Game Review *What you learned in previous grades & lessons*

Write and solve a proportion to answer the question. *(Section 6.3)*

20. What percent of 60 is 18?

21. 70% of what number is 98?

22. 30 is 15% of what number?

23. What number is 0.6% of 500?

24. MULTIPLE CHOICE What is the volume of the pyramid? *(Section 9.5)*

Ⓐ 40 cm^3 Ⓑ 50 cm^3

Ⓒ 100 cm^3 Ⓓ 120 cm^3