10.1 Analyze Surveys and Samples

Before You found experimental probabilities.

Now You will identify populations and sampling methods.

Why? So you can analyze surveys of sports fans, as in Ex. 15.

Key Vocabulary
- **survey**
- **population**
- **sample**
- **biased sample**
- **biased question**

COMMON CORE

CC.9-12.S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.*

A **survey** is a study of one or more characteristics of a group. The entire group you want information about is called a **population** . A survey of an entire population is called a *census*. When it is difficult to perform a census, you can survey a **sample** , which is a part of the population.

KEY CONCEPT *For Your Notebook*

Sampling Methods

In a **random sample**, every member of the population has an equal chance of being selected.

In a **stratified random sample**, the population is divided into distinct groups. Members are selected at random from each group.

In a **systematic sample**, a rule is used to select members of the population.

In a **convenience sample**, only members of the population who are easily accessible are selected.

In a **self-selected sample**, members of the population select themselves by volunteering.

EXAMPLE 1 Classify a sampling method

EMPLOYEE SAFETY The owners of a company with several factories conduct a survey to determine whether employees are informed about safety regulations. At each factory, 50 employees are chosen at random to complete the survey. Identify the population and classify the sampling method.

Solution

The population is all company employees. Because the population is divided into distinct groups (individual factories), with employees chosen at random from each group, the sample is a stratified random sample.

✓ GUIDED PRACTICE for Example 1

1. **WHAT IF?** In Example 1, suppose the owners survey each employee whose last name begins with M. Classify the sampling method.

BIASED SAMPLES A sample chosen for a survey should be representative of the population. A **biased sample** is a sample that is not representative. In a biased sample, parts of the population may be over-represented or under-represented.

Random samples and stratified random samples (as in Example 1) are the most likely types of samples to be representative. A systematic sample may be representative if the rule used to choose individuals is not biased.

EXAMPLE 2 Identify a potentially biased sample

In Example 1, suppose the owners question 50 workers chosen at random from one factory. Is the method likely to result in a biased sample?

Solution

Workers at other factories may hold significantly different opinions, so the method may result in a biased sample.

BIASED QUESTIONS A question that encourages a particular response is a **biased question**. Survey questions should be worded to avoid bias.

EXAMPLE 3 Identify potentially biased questions

Tell whether the question is potentially biased. Explain your answer. If the question is potentially biased, rewrite it so that it is not.

a. Don't you agree that the voting age should be lowered to 16 because many 16-year-olds are responsible and informed?

b. Do you think the city should risk an increase in pollution by allowing expansion of the Northern Industrial Park?

Solution

a. This question is biased because it suggests that lowering the voting age is a good thing to do. An unbiased question is "Do you think the voting age should be lowered to 16?"

b. This question is biased because it suggests that the proposed expansion will be bad for the environment. An unbiased question is "Do you think the city should allow expansion of the Northern Industrial Park?"

✓ GUIDED PRACTICE for Examples 2 and 3

2. SOCCER In a survey about Americans' interest in soccer, the first 25 people admitted to a high school soccer game were asked, "How interested are you in the world's most popular sport, soccer?"

a. Is the sampling method likely to result in a biased sample? *Explain*.

b. Is the question potentially biased? *Explain* your answer. If the question is potentially biased, rewrite it so that it is not.

10.1 EXERCISES

HOMEWORK KEY

◯ = See **WORKED-OUT SOLUTIONS** Exs. 3 and 15

★ = **STANDARDIZED TEST PRACTICE** Exs. 2, 6, and 17

SKILL PRACTICE

1. **VOCABULARY** Copy and complete: In a(n) __?__ sample, participants are chosen using a rule.

2. ★ **WRITING** *Describe* the difference between a census and a sample.

POPULATIONS AND SAMPLES **In Exercises 3–5, identify the population and classify the sampling method.**

EXAMPLE 1 for Exs. 3–6

3. **RESTAURANT SERVICE** A restaurant manager wants to evaluate the restaurant's quality of service. Diners are given mail-in comment cards.

4. **EXTRACURRICULAR ACTIVITIES** Your school wants to know if students are satisfied with the school's extracurricular activities. In each grade, every tenth student on an alphabetized list is surveyed.

5. **CUSTOMER SATISFACTION** An airline wants to gather information on passenger satisfaction during a flight. A computer randomly selects 30 passengers to complete a survey.

6. ★ **MULTIPLE CHOICE** Scientists wanted to gather information about the birds in a particular region. They chose observation sites and asked bird watchers at those sites to record the number and types of birds they saw in 3 minutes. What population was being studied?

   (A) Birds (B) Sites (C) Scientists (D) Bird watchers

EXAMPLE 2 for Exs. 7–8

BIASED SAMPLES **Tell whether the sampling method used is likely to result in a biased sample. *Explain*.**

7. **NEIGHBORHOOD WATCH** A family wants to gather information from other residents on their street about forming a neighborhood watch. They survey every third house on both sides of the street.

8. **NURSE SURVEY** The American Nurses Association wanted to gather information about the working environment for nurses in hospitals. A survey for nurses was posted on the association's website.

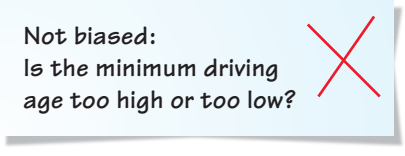
EXAMPLE 3 for Exs. 9–11

BIASED QUESTIONS **In Exercises 9 and 10, tell whether the question is potentially biased. *Explain* your answer.**

9. Do you support the incumbent's tax plan or the challenger's tax plan?

10. Do you prefer the ease of shopping online or the fun of going to a mall?

11. **ERROR ANALYSIS** *Describe* and correct the error in revising the survey question "Don't you think the minimum driving age should be lower?" so that it is not biased.



12. **CHALLENGE** Two toothpaste manufacturers each claim that 4 out of every 5 dentists use their brand exclusively. Both manufacturers can support their claims with survey results. *Explain* how this is possible.

PROBLEM SOLVING

EXAMPLES 2 and 3 for Exs. 13–16

Explain **why the question is biased. Then rewrite it so that it is not.**

13. Don't you agree that the school needs a new athletic field more than a new science lab?

14. Would you pay even higher concert ticket prices to finance a new arena?

15. **BASEBALL** Each baseball season, Major League Baseball (MLB) fans cast ballots to choose players for the MLB All-Star Game. Do the ballots cast necessarily represent the opinions of all baseball fans? *Explain*.

16. **WATER SAMPLING** Scientists designed a project in which students performed tests on local water sources each day. Students from 18 countries participated in the project. The results of the survey were used to assess the quality of the world's fresh water. Is the sample likely to be biased? *Explain*.

17. ★ **SHORT RESPONSE** You plan to report on the academic performance of students in your school for your school newspaper. *Describe* how you could choose a representative sample. Then write an unbiased question you could use to collect information on how many hours each day a student studies. *Explain* why your question is unbiased.

18. **CHALLENGE** The results of two five-year studies of a possible link between exercise and decreased risk of heart attack in men appear in a newspaper. The studies involve two different groups of 1000 men over the age of 40 who have never had a heart attack. In the *randomized experiment*, half of the 1000 men are chosen at random to take part in a supervised exercise program, while the other half continue their usual routines. In the *observational study*, the men are divided into two groups, those who exercise regularly and those who do not, and their health status is observed. Which study's results would you expect to be more reliable? *Explain*.