LESSON 21

Surveys

GOAL Identify biased survey questions and analyze surveys.

Activity

Comparing Survey Questions

1. Give Survey A to half of the students in your class and give Survey B to the other half. Make sure that the students do not read or hear the questions on the other group's survey.

Survey A	Survey B
1. Do you think it is important to get good grades in school?	1. Is getting good grades the most important thing in school?
2. Studies have shown that daily exercise has a positive effect on academic performance. Do you exercise?	2. Studies have shown that daily exercise has no effect on academic performance. Do you exercise?
3. Do you think that students with poor grades should be allowed to participate on school sports teams?	3. Do you think that students with poor grades should be allowed to participate on school sports teams?

2. Compare the questions in Survey A to the questions in Survey B. How are the questions similar? How are the questions different? Explain.
3. Find the percent of students who said "yes" to questions 1, 2, and 3 for both Survey A and Survey B. Describe any differences in the results.
4. In both Survey A and Survey B, suppose question 3 was asked before question 2. Do you think the responses to question 3 would be different? Explain.

When conducting a survey, it is important that the survey questions are carefully written. If a question is poorly written, then the responses of the people surveyed may not accurately reflect their opinions or actions. These types of questions are called **biased questions**. Some characteristics of biased questions are listed below.

- The respondent is encouraged or pressured to answer in a particular way.
- The respondent is not provided enough information to give an accurate opinion.

The order in which the questions are asked may also introduce bias.

EXAMPLE 1 Identifying Biased Survey Questions

Tell whether the survey question may be biased. Explain.

a. "Do you favor the proposal to increase spending on technology in our schools?"

b. "Wearing a seat belt can save a person's life. Should school buses have seat belts?"

c. A dentist asks his patients, "Do you floss every day?"

SOLUTION

a. This question may be biased because it assumes that the respondent is familiar with the proposal. The responses from people who are unfamiliar with the proposal may not accurately reflect their opinions.

b. This question may be biased because a response of "no" implies that the respondent does not care about the safety of students riding school buses. Some respondents may feel pressured to give a response of "yes."

c. This question may be biased because a dentist is asking the question. The responses may not accurately represent the number of patients who floss every day.

CHECK Example 1

Tell whether the survey question may be biased. Explain.

1. A math teacher asks her students, "About how much time do you spend on your homework each week?"

2. "Do you read the school newspaper?"

3. "Do you, like most people your age, enjoy watching music videos?"

Analyzing Surveys In addition to the wording of survey questions, there are other ways to introduce bias in a survey. Consider the following questions before using the results of a survey.

Question	Example
How was the sample chosen?	A random sample is most likely to produce results that are representative of a population.
What was the size of the sample?	Small samples may produce results that are not representative of the population.
Who sponsored the survey?	The results of the survey may benefit the person or business sponsoring the survey.
When was the survey conducted?	The time of day or year could affect the results of the survey.

EXAMPLE 2 Analyzing a Survey

The owner of a health club wants to determine the percent of adults in his area who exercise for at least 20 minutes three times a week. He decides to ask the first 25 adults he sees at a mall on a weekday around 10:00 A.M. His results are shown at the right. Are the results of the survey likely to be representative of the population? Explain.

Do you exercise for at least 20 minutes three times a week?	
Yes	32%
No	68%

SOLUTION

The sample chosen is a convenience sample, which is not likely to be representative of the population. Also, 25 adults make up a small sample for a large population. Finally, the sample underrepresents the adults who are not at the mall on a weekday around 10:00 A.M.

No, the results are not likely to be representative of the population.

Making Predictions A **statistic** is a number that describes a sample. A **parameter** is a number that describes a population. You can use a statistic from a survey to estimate a parameter. In this way, surveys can be used to make predictions about a population.

EXAMPLE 3 Making Predictions

In a survey of 50 students at a high school, 32 students said that they plan to attend the homecoming dance. The school has 720 students. Predict the number of students who plan to attend the homecoming dance.

SOLUTION

Let x be the number of students who plan to attend the dance.

$$\frac{\text{Students in sample planning to attend}}{\text{Students in sample}} = \frac{\text{Students in school planning to attend}}{\text{Students in school}}$$

$$\frac{32}{50} = \frac{x}{720} \quad \textit{Substitute.}$$

$$32 \cdot 720 = 50x \quad \textit{Cross products property}$$

$$460.8 = x \quad \textit{Solve for x.}$$

You can predict that about 461 students plan to attend the dance.

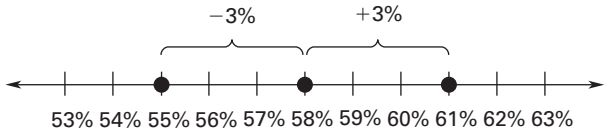
CHECK Examples 2 and 3

4. A restaurant owner wants to know how often families in his area go out for dinner. He decides to ask 25 families who dine at his restaurant on Tuesday night. Are his results likely to be representative of the population? Explain.

5. In a random sample of emergency calls to a police station, 11 of the 25 calls were for actual emergencies. Suppose a city receives 175 emergency calls in one day. Predict the number of calls that will be for actual emergencies.

Margin of Error A polling organization surveys 1000 voters in a city to find out who they plan to vote for in an upcoming mayoral election. The organization reports that 58% of city residents plan to vote for Smith, and that the survey has a *margin of error* of ±3%. The margin of error expresses the amount of error in the survey results due to the nature of random sampling.

The **margin of error** of a random sample defines an interval, centered on the sample percent, in which the population percent is most likely to lie. In the above example, the margin of error of ±3% means that the percent of voters in the population who plan to vote for Smith is likely to lie within 3 percentage points of 58%. That is, it is likely that between 55% and 61% of city voters plan to vote for Smith.



EXAMPLE 4 Interpreting a Margin of Error

Students at a high school will vote on a proposal to start the school day later. According to a survey of a random sample of students, 54% of the students agree with the proposal and 46% of the students disagree with the proposal. The survey's margin of error is ±5%. Does the survey clearly project the outcome of the voting?

SOLUTION

Use the margin of error to find an interval in which the actual percent of students who agree with the proposal is likely to lie.

$54\% \pm 5\%$ represents the interval $54\% - 5\% = 49\%$ to $54\% + 5\% = 59\%$.

Use the margin of error to find an interval in which the actual percent of students who disagree with the proposal is likely to lie.

$46\% \pm 5\%$ represents the interval $46\% - 5\% = 41\%$ to $46\% + 5\% = 51\%$.

You can conclude that between 49% and 59% of all students agree with the proposal and between 41% and 51% of all students disagree with the proposal. Because the intervals overlap, the survey does not clearly project the outcome of the voting.

CHECK Example 4

6. A survey of a random sample of voters shows that 38% of voters plan to vote for Gonzalez, 31% of voters plan to vote for Chang, and 31% plan to vote for Harris. The survey has a margin of error of ±3%. Does the survey clearly project the outcome of the voting? Explain.

EXERCISES

Tell whether the survey question may be biased. Explain.

1. A survey in a local newspaper asks, "Do you agree with the budget cuts proposed by the mayor?"
2. "Would you rather read a boring book or watch an exciting movie?"
3. "Global warming is increasingly responsible for unusual weather patterns. Do you favor government spending to reduce global warming?"
4. "Do you have a dog?"
5. A piano teacher asks a sample of her students, "Do you practice piano everyday?"
6. A person conducting a taste test asks, "Do you like the refreshing taste of sample A or the flat taste of sample B?"

In Exercises 7 and 8, use the following information.

The editor of a school newspaper wants to survey students about which one of the following methods of communication they prefer: talking on the telephone, writing e-mail, or using instant messaging applications.

7. Describe a sampling method that can be used so that the sample will best represent the population.
8. Write a question to ask the members of the sample. The question should be carefully written so that it is not biased.

In Exercises 9–12, tell whether the results of the survey are likely to be representative of the population. Explain.

9. The manager of a fast-food restaurant wants to determine the popularity of the restaurant's French fries. He surveys 10 people who are waiting in line at the restaurant at noon every day for one month. The results show that 85% of the sample prefer the restaurant's French fries to those of their competitors.
10. A writer for a travel magazine wants to learn tourists' opinions about the nightlife in a city. She decides to visit some of the tourist attractions in the city on a Thursday morning. She plans to ask the first 50 tourists she meets for their opinions.
11. The owner of a lawn care company wants to know if his clients are satisfied with the company's service. He decides to ask a sample of 15 clients, randomly chosen from a list of his 32 clients, for their opinions of the company's service.
12. Your class officers are planning a dance, and they want to know if they should hire a disc jockey or a live band. They decide to ask 10 students randomly chosen from the 24 students on the student council.

13. Find the results of a survey published in a newspaper or magazine. Do you think that the results are representative of the population? Explain.

In Exercises 14–16, use the following information.

A quality control inspector finds the number of defective items in a random sample of a product. Then the inspector predicts the number of defective items in a larger group, or lot, of the product.

14. A quality control inspector randomly chooses 25 tennis balls from a lot of 500 tennis balls. She finds the water repellent on 2 of the 25 tennis balls to be defective. Estimate the number of tennis balls in the entire lot with defective water repellent.

15. Out of a sample of 40 bottles of shampoo, 1 bottle had a label that was applied upside down. It was later discovered that 15 bottles in the entire lot had labels that were applied upside down. Estimate the number of bottles of shampoo in the lot.

16. A manufacturer of compact discs will not sell a lot if 3% or more of the discs in the lot are defective. A quality control inspector finds 2 defective discs in a sample of 50 discs. The sample was randomly chosen from a lot of 1000 discs. Will the manufacturer sell this lot? Explain.

In Exercises 17 and 18, use the following information.

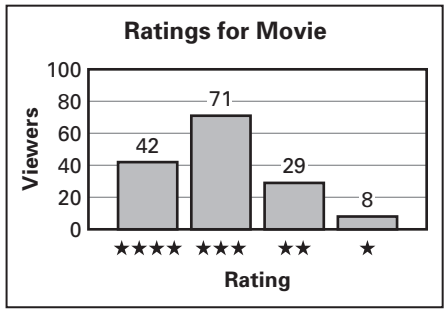
After a movie screening, the 150 viewers were asked to give the movie a rating. They were asked to choose the rating that corresponds with what they would tell their friends about the movie. The results are shown at the right.

★★★★ Excellent; you must see this movie.

★★★ Good; this movie is worth the cost of the ticket.

★★ Average; you should wait until it comes out on DVD.

★ Bad; you shouldn't even rent this movie.



17. Suppose that 800,000 people go to see this movie on the day it opens. Estimate the number of people who will tell their friends that the movie is so bad that they shouldn't even rent it.

18. Suppose that 182,000 people who saw the movie on a Friday night rated the movie as excellent. Estimate the number of people who saw the movie that night.

In Exercises 19–21, use the following information.

A reporter for a school newspaper surveys a random sample of students to find out who they plan to vote for in an upcoming election for student body president. The survey's results are shown below.

19. According to the survey, in what interval is the percent of students who plan to vote for Wilson likely to lie? In what interval is the percent of students who plan to vote for Stevens likely to lie?

20. The reporter states that the election is currently a statistical tie. Explain what the reporter means by this.

Survey Results

Wilson	53%
Stevens	47%

Margin of error: ±4%

21. Suppose 600 students vote in the election. According to the survey, what is the greatest number of votes Wilson is likely to receive? What is the least number of votes Wilson is likely to receive?