LESSON 21

Surveys

Key Concept

Given any large population, it is usually impractical to conduct a census of the population. Instead, statisticians often rely on surveying a sample of the population. If the sample is well chosen and the survey is free of bias, the results of the survey can be used to make a prediction about the population. In this lesson, students learn how to analyze a survey, how to use a survey to make a prediction, and how to interpret the margin of error of a survey.

Activity

- **Materials** paper, pencil
- **Goal** Half of the students in the class take a survey while the other students take a similar survey in which the questions are worded differently. Students compare the questions and the results of the two surveys.
- **Teaching Strategy** If possible, make enough copies of each survey for half the class. Hand students one of the surveys as they enter the room and ask them to write their responses on the survey. Then have volunteers tally the responses to each survey and share the results with the class.
- **Key Discovery** The way a question is worded can affect the results of a survey. The order in which the questions are asked can also affect the results of a survey.

Key Question: Example 1

How could you change the survey question in part b so that it is not biased?

Delete the first sentence and simply ask, "Should school buses have seat belts?"

Key Question: Example 2

What would be a better way for the owner of the health club to choose the sample?

Choose a random sample of names from a list of adults who live in the area (such as a list of drivers from the Department of Motor Vehicles, a phone book, and so on).

Key Question: Example 3

How can you use estimation to check that your answer is reasonable?

About $\frac{2}{3}$ of the students surveyed said they would attend the dance. Two-thirds of the entire population of 720 is 480. Since 461 is close to 480, the answer is reasonable.

Avoiding Common Errors

Example 3 Some students may use the correct values in the proportion but set up the proportion incorrectly. Tell students they can use a table like the one below to help them organize the given information and write an appropriate proportion.

	Sample	Population
Number attending dance	32	x
Total number	50	720

The corresponding proportion is $\frac{32}{50} = \frac{x}{720}$.

Key Question: Example 4

If the survey's margin of error were $\pm 3\%$, would the survey clearly project the outcome of the voting? Explain.

Yes; in this case, the percent of students who agree with the proposal lies between 51% and 57% and the percent of students who disagree with the proposal lies between 43% and 49%. Because the intervals do not overlap, the survey clearly projects that the proposal will pass.

Closing the Lesson

Have students answer the following question: What are some key elements in designing an effective survey?

The survey's questions should be unbiased; a random sample should be used; the sample should be large enough to be representative of the population.

Homework Help

Example 1: Exs. 1–6, 8

Example 2: Exs. 7, 9–13

Example 3: Exs. 14–18

Example 4: Exs. 19–21

Homework Check

To quickly check student understanding of key concepts, go over the following exercises: 3, 11, 14, 19, 20.

ANSWERS

Activity Answers

1. Check students' work.
2. *Sample answer:* In both surveys, question 1 asks about the importance of good grades, but in Survey B the question asks if good grades are the *most* important thing. In both surveys, question 2 asks students if they exercise, but in Survey A the question begins by stating that exercise has a positive effect on academic performance while in Survey B the question begins by stating that exercise has no effect on academic performance. Question 3 is the same in both surveys.
3. Answers will vary.
4. *Sample answer:* Yes; asking question 3 before question 2 might yield less biased results since question 2 provides information about the effect of exercise on academic performance and this might influence students' responses on question 3.

Check Answers

1. This question may be biased because a teacher is asking the question. The responses may not accurately represent the number of hours that students spend on homework.
2. The survey question is not biased. The respondent can answer without influence.
3. This question may be biased because a response of "no" implies that the student is not like most students of the same age. Some respondents might feel pressured to say "yes."
4. No; the sample chosen is a convenience sample, which is not likely to be representative of the population.
5. 77 calls
6. Yes; the survey clearly projects that Gonzalez will win because 35% to 41% of voters are likely to vote for Gonzalez and this is greater than the range for Chang and Harris (28% to 34%).

Exercise Answers

1. This question may be biased because it assumes that the respondent is familiar with the proposed budget cuts. The responses from people who are unfamiliar with the proposed budget cuts may not accurately reflect their opinions.
2. This question may be biased because the respondent is encouraged to respond in a particular way based on the description of the choices.
3. This question may be biased because a response of "no" implies that the respondent is not concerned with global warming. Some respondents might feel pressured to say "yes."
4. The survey question is not biased. The respondent can answer without influence.
5. This question may be biased because the piano teacher is asking the question. Some students might feel pressured to answer "yes."
6. This question may be biased because the respondent is encouraged to choose sample A based on the descriptions of the samples.
7. Answers will vary.
8. *Sample answer:* Which one of the following methods of communication do you prefer: talking on the telephone, writing e-mail, or using instant messaging applications?
9. No; the sample includes only customers of the manager's restaurant. So, customers of competitors' restaurants are underrepresented.
10. No; some of the tourists who experience the nightlife in a city are not likely to be visiting tourist attractions the next morning.
11. Yes; a random sample of the clients is most likely to produce results that are representative of the population.
12. No; the sample should include the general population of the school, not just the students on the student council.
13. Answers will vary.
14. 40 tennis balls
15. 600 bottles
16. No; about 4% of the discs are defective.
17. About 42,667 people.
18. 650,000 people
19. 49% to 57%; 43% to 51%
20. There is overlap in the intervals that describe the likely percent of voters for Wilson and the likely percent of voters for Stevens. Therefore, the survey does not clearly project who will win the election.
21. 342; 294