12 - 10

Sampling and Error

Main Ideas

- Determine whether a sample is unbiased.
- · Find margins of sampling error.

New Vocabulary

unbiased sample margin of sampling error

GET READY for the Lesson

A survey was

conducted asking

on back-to-school

When polling organizations want

portion of the

population.



Bias To be sure that survey results are representative of the population, polling organizations need to make sure that they poll a random or **unbiased sample** of the population.

EXAMPLE Biased and Unbiased Samples

State whether each method would produce a random sample. Explain.

a. asking every tenth person coming out of a gym how many times a week they exercise to determine how often city residents exercise

This would not result in a random sample because the people surveyed probably exercise more often than the average person.

b. surveying people going into an Italian restaurant to find out people's favorite type of food

This would probably not result in a random sample because the people surveyed would probably be more likely than others to prefer Italian food.

HECK Your Progress

1. asking every player at a golf course what sport they prefer to watch on TV

Margin of Error The margin of sampling error (ME) gives a limit on the difference between how a sample responds and how the total population would respond.

Study Tip

Random Sample

A sample of size *n* is random when every possible sample of size *n* has an equal chance of being selected.



Extra Examples at algebra2.com

KEY CONCEPT

Margin of Sampling Error

If the percent of people in a sample responding in a certain way is p and the size of the sample is n, then 95% of the time, the percent of the population responding in that same way will be between p - ME and p + ME, where

$$ME = 2\sqrt{\frac{p(1-p)}{n}}$$

That is, the probability is 0.95 that $p \pm ME$ will contain the true population results.

EXAMPLE Find a Margin of Error

In a survey of 1000 randomly selected adults, 37% answered "yes" to a particular question. What is the margin of error?

$$ME = 2\sqrt{\frac{p(1-p)}{n}}$$
Formula for margin of sampling error
$$= 2\sqrt{\frac{0.37(1-0.37)}{1000}}$$
 $p = 37\%$ or 0.37, $n = 1000$
$$\approx 0.030535$$
Use a calculator.

The margin of error is about 3%. This means that there is a 95% chance that the percent of people in the whole population who would answer "yes" is between 37 - 3 or 34% and 37 + 3 or 40%.

CHECK Your Progress

2. In a survey of 625 randomly selected teens, 78% said that they purchase music. What is the margin of error in this survey?

EXAMPLE Analyze a Margin of Error

HEALTH In a recent Gallup Poll, 25% of the people surveyed said they had smoked cigarettes in the past week. The margin of error was 3%. How many people were surveyed?

 $ME = 2\sqrt{\frac{p(1-p)}{n}}$ Formula for margin of sampling error $0.03 = 2\sqrt{\frac{0.25(1-0.25)}{n}}$ ME = 0.03, p = 0.25 $0.015 = \sqrt{\frac{0.25(0.75)}{n}}$ Divide each side by 2. $0.000225 = \frac{0.25(0.75)}{n}$ Square each side. $n = \frac{0.25(0.75)}{0.000225}$ Multiply by n and divide by 0.000225. $n \approx 833.33$ About 833 people were surveyed.

CHECK Your Progress

3. In a recent survey, 15% of the people surveyed said they had missed a class or a meeting because they overslept. The margin of error was 4%. How many people were surveyed?

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Real-World Link

The percent of smokers in the United States population declined from 38.7% in 1985 to 23.3% in 2000. New therapies, like the nicotine patch, are helping more people to quit.

Source: U.S. Department of Health and Human Services

Your Understanding

Example 1 (p. 741)	 Determine whether each situation would produce a random sample. Write <i>yes</i> or <i>no</i> and explain your answer. 1. the government sending a tax survey to everyone whose social security number ends in a particular digit 2. surveying college students in the honors program to determine the average time students at the college study each day 		
Example 2 (p. 742)	For Exercises 3–5, find the margin of sampling error to the nearest percent. 3. $p = 72\%$, $n = 100$ 4. $p = 31\%$, $n = 500$		
	5. In a survey of 350 randomly selected homeowners, 54% stated that they are planning a major home improvement project in the next six months.		
Example 3 (p. 742)	MEDIA For Exercises 6 and 7, use the following information.A survey found that 57% of consumers said they will not have any debt from holiday spending. Suppose the survey had a margin of error of 3%.6. What does the 3% indicate about the results?7. How many people were surveyed?		
Exercises			
HOMEWORK HELP For See Exercises Examples 8–11 1	 Determine whether each situation would produce a random sample. Write <i>yes</i> or <i>no</i> and explain your answer. 8. pointing with your pencil at a class list with your eyes closed as a way to find a sample of students in your class 		

- **9.** putting the names of all seniors in a hat, then drawing names from the hat to select a sample of seniors
- **10.** asking every twentieth person on a list of registered voters to determine which political candidate is favored
- **11.** finding the heights of all the boys on the varsity basketball team to determine the average height of all the boys in your school

For Exercises 12–21, find the margin of sampling error to the nearest percent.

12. $p = 81\%$, $n = 100$	13. <i>p</i> = 16%, <i>n</i> = 400	14. <i>p</i> = 54%, <i>n</i> = 500
15. $p = 48\%$, $n = 1000$	16. <i>p</i> = 33%, <i>n</i> = 1000	17. <i>p</i> = 67%, <i>n</i> = 1500

- **18.** A poll asked people to name the most serious problem facing the country. Forty-six percent of the 800 randomly selected people said crime.
- **19.** In a recent survey, 431 full-time employees were asked if the Internet has made them more or less productive at work. 27% said it made them more productive.
- **20.** Three hundred sixty-seven of 425 high school students said pizza was their favorite food in the school cafeteria.
- **21.** Nine hundred thirty-four of 2150 subscribers to a particular newspaper said their favorite sport was football.
- **22. SHOPPING** According to a recent poll, 33% of shoppers planned to spend \$1000 or more during a holiday season. The margin of error was 3%. How many people were surveyed?
- **23. ELECTION PREDICTION** One hundred people were asked whether they would vote for Candidate A or Candidate B in an upcoming election. How many said "Candidate A" if the margin of error was 9.6%?



12 - 21

2, 3



A student guesses at all 5 questions on a true-false quiz. Find each probability. (Lesson 12-8)

31. *P*(all 5 correct)

32. *P*(exactly 4 correct) **33.** *P*(at least 3 correct)

A set of 250 data values is normally distributed with a mean of 50 and a standard deviation of 5.5. (Lesson 12-7)

34. What percent of the data lies between 39 and 61?

35. What is the probability that a data value selected at random is greater than 39?

Cross-Curricular Project

Algebra and Social Studies

Math from the Past It is time to complete your project. Use the information and data you have gathered about the history of mathematics to prepare a presentation or web page. Be sure to include transparencies and a sample mathematics problem or idea in the presentation.

Math Cross-Curricular Project at algebra2.com