

Time Out to Think

In Example 6, suppose the poll found the candidate had 55% of the vote. Should she be confident of a win?

QUICK QUIZ

Choose the best answer to each of the following questions. Explain your reasoning with one or more complete sentences.

- You conduct a poll in which you randomly select 1000 registered voters from Texas and ask if they approve of the job their governor is doing. The *population* for this study is
 - all registered voters in the state of Texas.
 - the 1000 people that you interview.
 - the governor of Texas.
- Results of the poll described in question 1 would most likely suffer from *bias* if you chose the participants from
 - all registered voters in Texas.
 - all people with a Texas driver's license.
 - people who donated money to the governor's campaign.
- When we say that a sample is *representative* of the population, we mean that
 - the results found for the sample are similar to those we would find for the entire population.
 - the sample is very large.
 - the sample was chosen in the best possible way.
- Consider an experiment designed to test whether cash incentives improve school attendance. The researcher chooses two groups of 100 high school students. She offers one group \$10 for every week of perfect attendance. She tells the other group that they are part of an experiment but does not give them any incentive. The students who do not receive an incentive represent
 - the treatment group.
 - the control group.
 - the observation group.
- The experiment described in question 4 is
 - single-blind.
 - double-blind.
 - not blind.
- The purpose of a *placebo* is
 - to prevent participants from knowing whether they belong to the treatment group or the control group.
 - to distinguish between the cases and the controls in a case-control study.
 - to determine whether diseases can be cured without any treatment.
- If we see a *placebo effect* in an experiment to test a new treatment designed to cure warts, we know that
 - the experiment was not properly double-blind.
 - the experimental groups were too small.
 - the warts of those in the control group were cured.
- An experiment is single-blind if
 - it lacks a treatment group.
 - it lacks a control group.
 - the participants do not know whether they belong to the treatment or the control group.
- Poll X predicts that Powell will receive 49% of the vote, while Poll Y predicts that he will receive 53% of the vote. Both polls have a margin of error of 3 percentage points. What can you conclude?
 - One of the two polls must have been conducted poorly.
 - The two polls are consistent with each other.
 - Powell will receive 51% of the vote.
- A survey reveals that 12% of Americans believe Elvis is still alive, with a margin of error of 4 percentage points. The confidence interval for this poll is
 - from 10% to 14%.
 - from 8% to 16%.
 - from 4% to 20%.

Exercises 5A

REVIEW QUESTIONS

- Why do we say that the term *statistics* has two meanings? Describe both meanings.
- Define the terms *population*, *sample*, *population parameter*, and *sample statistics* as they apply to statistical studies.
- Describe the five basic steps in a statistical study, and give an example of their application.
- Why is it so important that a statistical study use a representative sample? Briefly describe four common sampling methods.

5. What is bias? How can it affect a statistical study? Give examples of several forms of bias.
6. Describe and contrast observational studies and experiments. What do we mean by the treatment group and control group in an experiment? What do we mean by the cases and controls in an observational case-control study?
7. What is a placebo? Describe the placebo effect and how it can make experiments difficult to interpret. How can making an experiment single-blind or double-blind help?
8. What is meant by the margin of error in a survey or opinion poll? How is it used to identify a confidence interval?

DOES IT MAKE SENSE?

Decide whether each of the following statements makes sense (or is clearly true) or does not make sense (or is clearly false). Explain your reasoning.

9. In my experimental study, I used a sample that was larger than the population.
10. I followed all the guidelines for sample selection carefully, yet my sample still did not reflect the characteristics of the population.
11. I wanted to test the effects of vitamin C on colds, so I gave the treatment group vitamin C and gave the control group vitamin D.
12. I don't believe the results of the experiment, because the results were based on interviews but the study was not double-blind.
13. The pre-election poll found that Kennedy would get 58% of the vote, with a margin of error of 4%, but he ended up losing the election.
14. By choosing my sample carefully, I can make a good estimate of the average height of Americans by measuring the heights of only 500 people.

BASIC SKILLS & CONCEPTS

15–20: **Population and Sample.** For the following studies, describe the population, sample, population parameters, and sample statistics.

15. In order to gauge public opinion on how to handle Iran's growing nuclear program, the Pew Research Center surveyed 1001 Americans by telephone.
16. Astronomers typically determine the distance to a galaxy (a huge collection of billions of stars) by measuring the distances to just a few stars within it and taking the mean (average) of these distance measurements.
17. An AP/CBS telephone poll of 998 randomly selected Americans revealed that 6 in 10 people believe there has been progress in finding a cure for cancer in the last 30 years.
18. A Gallup poll of 1051 American adults shows that 32% of Americans say they have been spending less in recent months and 27% say they are saving more now and intend to make this their new, normal pattern in the years ahead.
19. In a *USA Today*/Gallup poll of 1027 Americans surveyed by cell phones and land lines, 62% of those who responded said that there should be an investigation of anti-terror tactics used during the Bush administration.

20. The Higher Education Research Institute conducts an annual study of attitudes of incoming college students by surveying approximately 241,000 first-year students at 340 colleges and universities. There are approximately 1.4 million first-year college students in this country.

21–26: **Steps in a Study.** Describe how you would apply the five basic steps of a statistical study to the following issues.

21. You want to determine the average number of hours per week that ninth-graders spend on cell phones.
22. A supermarket manager wants to determine whether the variety of products in her store meets customers' needs.
23. You want to know the percentage of male college students in America who play chess at least once per week.
24. You want to know the typical percentage of the bill that is left as a tip in restaurants.
25. You want to know the average time to failure of batteries in a particular model of laptop computer.
26. You want to know the percentage of high school students who are vegetarians.
27. **Representative Sample?** You want to determine the average percentage of classes skipped by first-year students at a small college during a particular semester. Determine, with an explanation, which of the following samples are likely to be representative and which are not likely to be representative.
 - 100 first-year students who belong to a sorority or fraternity
 - 100 first-year students who play a varsity sport
 - The first 100 first-year students whom you meet at the student union
 - 100 first-year students taking honors humanities courses
28. **Representative Sample?** You want to determine the typical dietary habits of students at a college. Which of the following would make the best sample, and why? Also explain why each of the other choices would *not* make a good sample for this study.
 - Students in a single dormitory
 - Students majoring in public health
 - Students who participate in intercollegiate sports
 - Students enrolled in a required mathematics class
- 29–34: **Identify the Sampling Method.** Identify the sampling method (simple random sampling, systematic sampling, convenience sampling, or stratified sampling) in the following studies.
 29. An IRS (Internal Revenue Service) auditor randomly selects for audits 30 taxpayers in each of the filing status categories: single, head of household, married filing jointly, and married filing separately.
 30. *People* magazine chooses its "25 most beautiful women" by looking at responses from readers who voluntarily mail in a survey printed in the magazine.
 31. A study of the use of antidepressants selects 50 participants between the ages of 20 and 29, 50 participants between the ages of 30 and 39, and 50 participants between the ages of 40 and 49.

32. Every 100th computer chip that is produced is given a reliability test.
33. A computer randomly selects 400 names from a list of all registered voters. Those selected are surveyed to predict who will win the election for mayor.
34. A taste test for chips and salsa is conducted at the entrance to a supermarket.
- 35–40: Type of Study.** Determine whether the following studies are observational studies or experiments. If the study is an experiment, identify the control and treatment groups, and discuss whether single- or double-blinding is necessary. If the study is observational, state whether it is a case-control study, and if so, identify the cases and controls.
35. A study at the University of Southern California separated 108 volunteers into groups, based on psychological tests designed to determine how often they lied and cheated. Those with a tendency to lie had different brain structures than those who did not lie (*British Journal of Psychiatry*).
36. A National Cancer Institute study of 716 melanoma patients and 1014 cancer-free patients matched by age, sex, and race found that those having a single large mole had twice the risk of melanoma. Having 10 or more moles was associated with a 12 times greater risk of melanoma (*Journal of the American Medical Association*).
37. In a study done at Boston University, researchers took snapshots of 4000 white adults every four years for 30 years and determined that 9 of 10 men and 7 of 10 women will eventually become overweight (*Annals of Internal Medicine*).
38. A breast cancer study began by asking 25,624 women questions about how they spent their leisure time. The health of these women was tracked over the next 15 years. Those women who said they exercised regularly were found to have lower incidence of breast cancer (*New England Journal of Medicine*).
39. A double-blind drug versus placebo study of 103 patients suffering from tinnitus (the perception of ringing in the ears) demonstrated the effectiveness of ginkgo biloba extract. The ginkgo treatment improved the condition of all the tinnitus patients (*Annals of Otology, Rhinology, and Laryngology*).
40. Using a survey of 35,000 Americans, the Pew Forum on Religion and Public Life determined that between 47 and 59 percent of adults switch their religious affiliation at least once in their lives.
- 41–46: What Type of Study?** What type of statistical study is most likely to lead to an answer to the following questions?
41. Is magnet therapy a more effective way to treat headaches than aspirin or doing nothing at all?
42. Which of eight airlines has the lowest percentage of delayed flights?
43. Which National Football League team has the linemen with the greatest average weight?
44. Which of the leading brands of insect repellent provides the best protection from mosquitoes?
45. Does taking a multivitamin a day reduce the incidence of strokes?
46. Are the Sunday horoscopes in a local newspaper more accurate than the weekday horoscopes?
- 47–50: Margin of Error.** The following summaries of statistical studies give a sample statistic and a margin of error. Find the confidence interval and answer any additional questions.
47. A poll is conducted the day before an election for state senator. There are only two candidates running. The poll shows that 53% of the voters surveyed favor the Republican candidate, with a margin of error of ± 2.5 percentage points. Should the Republican plan a victory party? Why or why not?
48. In an NBC News/*Wall Street Journal* poll of 500 adults nationwide, 53% of those surveyed answered yes to the question, "Do you favor a law to ban the sale of assault weapons and semiautomatic rifles?" The margin of error was ± 4.4 percentage points. Would you claim that a majority of American support such a law?
49. A national survey by the Pew Research Center for the People and the Press of 1521 respondents reached on land lines and cell phones found that the percentage of adults who favor legalized abortion has dropped from 54% a year ago to 46%. The study claimed that the error attributable to sampling is ± 3 percentage points. Would you claim that a majority of American oppose legalized abortion?
50. In a survey of 1002 people, 701 (which is 70%) said that they voted in the most recent presidential election (based on data from ICR Research Group). The margin of error for the survey was ± 3 percentage points. However, actual voting records show that only 61% of all eligible voters actually did vote. Does this necessarily imply that people lied when they answered the survey?

FURTHER APPLICATIONS

51–54: Experimental Results. Consider the following results of experiments designed to measure the efficacy of a new drug. The new drug was given to participants in the treatment group, while a placebo was given to those in the control group. Discuss whether there is evidence that the treatment is effective.

51. 70% of those in the treatment group showed improvement; 30% of those in the placebo group showed improvement.
52. 45% of those in the treatment group showed improvement; 45% of those in the placebo group showed improvement.
53. 90% of those in the treatment group showed improvement; 50% of those in the placebo group showed improvement.
54. 25% of those in the treatment group showed improvement; 50% of those in the placebo group showed improvement.

55–60: Real Studies. Consider the following statistical studies.

- Identify the population and the population parameter of interest.
 - Describe the sample and sample statistic for the study.
 - Identify the type of study.
 - Discuss what additional facts you would like to know before you believed the study or acted on the results of the study.
55. A study done at the Center for AIDS and STD at the University of Washington tracked the survival rates of 17,517 asymptomatic

North American patients with HIV who started drug therapy at different points in the progression of the infection. It was discovered that asymptomatic patients who postponed antiretroviral treatment until their disease was more advanced faced a higher risk of dying than those who had initiated drug treatment earlier (*New England Journal of Medicine*).

56. A Fox News poll of 900 registered voters found that 19% of Americans “regift” (give gifts that they received as gifts). Women (21%) are more likely to regift than men (16%) and the results are nearly independent of income. The margin of error was ± 3 percentage points.
57. One hundred people in the 60–70 and 71–82 age categories were given cognitive tests. It was discovered that those participants who were given a suggestion that their age might affect their performance on the test actually did worse on the test (*Experimental Aging Research*).
58. The Pew Research Center asked 1546 adult Americans whether humans would land on Mars within the next 50 years; 76% of these people said either “definitely yes” or “probably yes.” The margin of error for the poll was ± 2.5 percentage points.
59. A survey of 16,000 adolescents and a review of smoking laws in 36 states showed that rigorous enforcement of laws on tobacco sales led to a 20.8% decrease in the rate at which 10th-graders became regular smokers (*BMC Public Health*).
60. In a CBS/*New York Times* telephone poll, 973 adult Americans responded to the following question.

As you may know, for the past seven years the United States has been holding a number of suspected terrorists at a US military prison in Guantanamo Bay, Cuba. Based on what you have heard or read, do you think the US should continue to operate the prison, or do you think the US should close the prison and transfer the prisoners somewhere else?

Forty-seven percent said the prison should continue to operate, 44% said the prison should be closed, and 9% said they had no opinion.

WEB PROJECTS

61. **Current Nielsen Ratings.** Find the Nielsen ratings for the past week. What were the three most popular television shows? Explain both the rating and the share for each show.
62. **Attitude Update.** The Pew Research Center for the People and the Press studies public attitudes toward the press, politics, and public policy issues. Go to the center’s Web site and find the latest survey about attitudes. Write a one-page summary of what Pew surveyed, how it conducted the survey, and what it found.
63. **Labor Statistics.** Use the Bureau of Labor Statistics Web page to learn about its monthly survey. Choose one aspect of the survey, such as how the sample is chosen or how it is used to compare unemployment rates over time. Write a short summary of what you learn.
64. **Professional Polling.** Visit the Web site of a national polling organization and report on a recent poll. Write a short

description of the poll and its results, commenting on features such as sampling technique, sample size, and margin of error.

IN YOUR WORLD

65. **Statistics in the News.** Select three news stories from the past week that involve statistics in some way. For each case, write one or two paragraphs describing the role of statistics in the story.
66. **Statistics in Your Major.** Write two to three paragraphs describing the ways in which you think the science of statistics is important in your major field of study. (If you have not chosen a major, answer this question for a major that you are considering.)
67. **Statistics in Sports.** Choose a sport and describe three different statistics commonly tracked by participants in or spectators of the sport. In each case, briefly describe the importance of the statistic to the sport.
68. **Sample and Population.** Find a report in today’s news concerning any type of statistical study. What is the population being studied? What is the sample? Why do you think the sample was chosen as it was?
69. **Poor Sampling.** Find a news article about a study that attempts to describe some characteristic of a population, but that you believe involved poor sampling (for example, a sample that was too small or not representative of the population under study). Describe the population, the sample, and what you think was wrong with the sample. Briefly discuss how you think the poor sampling affected the study results.
70. **Good Sampling.** Find a recent news article that describes a statistical study in which the sample was well chosen. Describe the population, the sample, and why you think the sample was a good one.
71. **Margin of Error.** Find a report of a recent survey or poll. Interpret the sample statistic and margin of error quoted for the survey or poll.

TECHNOLOGY EXERCISES

72. **Generating Random Numbers.** Use a calculator or Excel to generate the following sets of random numbers. (Answers are not unique!)
 - a. Ten random numbers between 0 and 1
 - b. Ten random numbers between 0 and 10
 - c. Ten random numbers between 1 and 2
 - d. Ten random numbers between 10 and 20
73. **Average Random Numbers.**
 - a. Generate ten random numbers between 0 and 1. What is the average of the numbers (divide the sum of the numbers by 10)?
 - b. Repeat part a. What is the average?
 - c. Without carrying out the calculation, what number do you think the average of 1000 random numbers between 0 and 1 is near?