In the News

1. **Statistics in the News.** Select three news stories from the past week that involve statistics in some way. In each case, write one or two paragraphs describing the role of statistics in the story.

2. **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.)

3. **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.

4. **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?

5. **Poor Sampling.** In a recent newspaper or magazine, find an 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 unrepresentative 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.

6. **Good Sampling.** In a recent newspaper or magazine, find an 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.

7. **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.

**Exercises**

Population and Sample. For the studies described in Exercises 1–6, describe the population, sample, population parameters, and sample statistics.

1. In order to gauge public opinion about the candidates in a recent election for Governor of California, CBS News conducted telephone interviews with 1026 people who were registered to vote in California.

2. Astronomers typically determine the distance to a galaxy (a galaxy is 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.

3. To rate the speed of new computers, Byte magazine editors purchased five new computers and measured the time required by each to run a standard program.

4. The Gallup Organization conducted a poll of 1200 adults to determine how Americans respond to the question “Do you think college coaches use physical force with their athletes?”

5. A nationwide Harris Poll of 1010 adults surveyed by telephone revealed that the professions viewed by the public as most prestigious are doctor, scientist, teacher, and minister/clergy.

6. The American Institute of Education conducts an annual study of attitudes of incoming college students by surveying approximately 261,000 first-year students at 462 colleges and universities. There are approximately 1.6 million first-year college students in this country.

Steps in a Study. Describe how you would apply the five basic steps of a statistical study to the issues in Exercises 7–11.

7. You want to determine the average amount of pizza consumed each year by students at your school.

8. As an airline marketing executive, you want to know if there has been an increase in frustration with air travel among business travelers.

9. You want to know the mean (average) height of adult American women.

10. You want to know the typical percentage of the bill that is left as a tip in restaurants.

11. You want to know how long alkaline batteries last in Kodak cameras.
12. You want to know the percentage of high school students who are vegetarians.

13. **Representative Sample?** You want to determine the mean (average) number of calories eaten daily by girls on high school track teams. Which of the following samples is most likely to be representative, and why? Also explain why each of the other choices is not likely to make a representative sample for this study.
   - The seniors on your high school’s girls’ track team
   - The shot putters and javelin throwers on your high school’s girls’ track team
   - The sprinters on your high school’s girls’ track team
   - The entire girls’ track team at your high school

14. **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

**Identify the Sampling Method.** Exercises 15–20 each describe a sample. Identify the sampling method as simple random sampling, systematic sampling, convenience sampling, or stratified sampling. Briefly explain why you think this sampling method was chosen.

15. An IRS (Internal Revenue Service) auditor randomly selects for audits 30 taxpayers whose gross income is less than $30,000 and 30 taxpayers whose gross income is more than $30,000.

16. *People* magazine chooses its “best-dressed celebrities” by looking at responses from readers who choose to mail in a survey printed in the magazine.

17. A study of sleep habits uses 50 participants whose ages are between 20 and 29, 50 participants whose ages are between 30 and 39, and 50 participants whose ages are between 40 and 49.

18. Every 100th roll of rope that is produced is given a strength test.

19. 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.

20. At a football game, a computer randomly selects 50 ticket numbers; those whose tickets are selected are invited to participate in a contest.

**Type of Study.** For Exercises 21–26, state whether the study is an observational study or an experiment. If it is an experiment, describe the treatment and control groups and discuss whether single- or double-blinding is needed. If it is observational, state whether it is a case-control study and, if it is, distinguish between the cases and the controls.

21. A 1999 Michigan State University study of starting salaries for college graduates found that computer science majors had the highest salaries ($42,500), while communications majors had the lowest ($25,600).

22. 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*, September 1997).

23. A Gallup survey done for CNN/USA Today found that 80% of Americans think we’re less civil than we were ten years ago and 67% think that we are more likely to use vulgar language than we were ten years ago.

24. 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 exercise regularly were found to have a lower incidence of breast cancer (*New England Journal of Medicine*, May 1, 1997).

25. A (hypothetical) study found that tomato plants treated with a new fertilizer had a 23% greater yield than plants with no fertilizer.

26. A survey of 275,811 first-year college students revealed that 32.4% of these students had an A average in high school (*Higher Education Research Institute*, 1998).

**Which Type of Study?** For each of the questions in Exercises 27–32, what type of statistical study is most likely to lead to an answer? Why?

27. What is the average income of public school teachers?

28. Can listening to jazz music while studying improve students’ grades?

29. Are high levels of artificial flavoring harmful to humans when eaten in foods?

30. Does playing soccer help swimmers improve their times?
31. Does an aspirin a day reduce the incidence of heart attacks?

32. Does a self-proclaimed mind-reader really have supernatural abilities?

**Experiment Results.** Consider an experiment designed to determine the effectiveness of a new drug. The drug is given to participants in the treatment group, while participants in the control group receive a placebo. For each set of results described in Exercises 33–36, discuss whether there appears to be evidence that the treatment is effective.

33. 60% of those in the treatment group showed improvement; 20% of those in the placebo group showed improvement.

34. 40% of those in the treatment group showed improvement; 40% of those in the placebo group showed improvement.

35. 90% of those in the treatment group showed improvement; 50% of those in the placebo group showed improvement.

36. 30% of those in the treatment group showed improvement; 40% of those in the placebo group showed improvement.

**Margin of Error.** Each of Exercises 37–40 states both a sample statistic and a margin of error. Find the confidence interval in each case, and answer any additional questions asked. Be sure to explain your answers clearly.

37. A poll is conducted the day before a state election for 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?

38. A poll is conducted the day before an election for U.S. Representative. There are only two candidates running. The poll shows that 48.5% of the voters surveyed favor the Democratic candidate, with a margin of error of 2.0 percentage points. Based on this poll, should the Democratic candidate expect to lose the election? Why or why not?

39. The U.S. Labor Department reports that the January unemployment rate was 4.2% and the February unemployment rate was 4.3%. The margin of error for each report is 0.2 percentage point. Can we conclude that unemployment increased from January to February?

40. 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?

41. In a TIME/CNN poll, 748 adults were asked whether they believed their children would have a higher standard of living than they have; 63% of those polled said "yes." The margin of error was 3.6 percentage points.

42. A Yankelovich poll determined that 70% of 4000 people surveyed agreed with the statement "People have to realize that they can only count on their own skills and abilities if they're going to win in this world." The margin of error in the poll was 1.6 percentage points.

43. Based on its survey of 60,000 households (see Example 2), the U.S. Labor Department reported an unemployment rate of 4.2% in September 1999. The margin of error for the report was 0.2 percentage point.

44. 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
2. Market researchers conduct a survey at a supermarket on a weekday between 10:00 a.m. and noon to determine what fraction of customers uses coupons.

3. An exit poll designed to predict the winner of a local election uses interviews with everyone who votes between 7:00 and 7:30 a.m.

4. An exit poll designed to predict the winner of a national election uses interviews with randomly selected voters in New York.

5. In order to determine the opinions of people in the 18- to 24-year age group on capital punishment, researchers survey a random sample of 500 Marines in this age group.

6. A college mails survey forms to all current seniors, asking for the students' choice of their all-time best and worst professor. Students are asked to return the survey in the campus mail.

7. Monsanto conducts a study to determine whether its new, genetically engineered soybean poses any threat to the environment.

8. Scientists working for Greenpeace (which opposes genetically engineered crops) conduct a study to determine whether Monsanto's new, genetically engineered soybean poses any threat to the environment.

9. It's All in the Wording. In 1998, Princeton Survey Research Associates did a study for Newsweek magazine illustrating the effects of wording in a survey. Two questions were asked:
   - Do you personally believe that abortion is wrong?
   - Whatever your own personal view of abortion, do you favor or oppose a woman in this country having the choice to have an abortion with the advice of her doctor?

To the first question, 57% of the respondents replied yes, while 36% responded no. In response to the second question, 69% of the respondents favored the choice, while 24% opposed the choice. Discuss why the two questions produced seemingly contradictory results. How could the results of the questions be used selectively by various groups?

10. Tax or Spend? A Gallup poll in March 1999 asked the following two questions:
   - Do you favor a tax cut or "increased spending on other government programs"? Result: 75% for tax cut.
   - Do you favor a tax cut or "spending to fund new retirement savings accounts, as well as increased spending on education, defense, Medicare and other programs"? Result: 60% for the spending.

Discuss why the two questions produced seemingly contradictory results. How could the results of the questions be used selectively by various groups?

Stat-Bytes. Politicians must make their political statement (often called sound-bytes) very short because the attention span of listeners is so short. A similar effect occurs in reporting statistical news. Major statistical studies are often reduced to one or two sentences. The summaries of statistical reports in Exercises 11-16 are taken from various news sources. Discuss what crucial information is missing and what more you would want to know before you acted on the report.

11. USA Today (April 28, 1999) reports on a Harris poll claiming that the percentage of adults with a "great deal of confidence" in military leaders stands at 54% (up from 37% in 1997).

12. CNN reports on a Zagat Survey of America's Top Restaurants which found that "only nine restaurants achieved a rare 29 out of a possible 30 rating and none of those restaurants are in the Big Apple."

13. A University of Michigan study concluded that drunken driving by high school seniors had declined. The report was based on two studies. In 1984, 31.2% of high school seniors reported driving after drinking sometime during the previous two weeks. By 1997, only 18.3% of high school seniors reported driving after drinking sometime during the previous two weeks.

14. An estimated 2% of Americans deceased last year paid estate taxes, while 60% of Americans favor repealing estate taxes.

15. The size of network TV audiences has decreased by 24% since 1991, while the annual advertising revenue of the networks increased by 42%.

16. Thirty percent of newborns in India would qualify for intensive care if they were born in the United States.

Accurate Headlines? Exercises 17-19 give a headline and a brief description of the statistical news story that accompanied the headline. In each case, discuss whether the headline accurately represents the story.
SUMMARY  Eight Guidelines for Evaluating a Statistical Study

1. Identify the goal of the study, the population being considered, and the type of study used.
2. Consider the source, particularly with regard to whether the researchers may be biased.
3. Look for bias that may prevent the sample from being representative of the population.
4. Look for problems in defining or measuring the variables of interest, which can make it difficult to interpret results.
5. Watch out for confounding variables that can invalidate the conclusions of a study.
6. Consider the setting and the wording of questions in any survey, looking for anything that might tend to produce inaccurate or dishonest responses.
7. Check that results are presented fairly in graphs and concluding statements, since both researchers and media often create misleading graphics or jump to conclusions that the results do not support.
8. Stand back and consider the conclusions. Did the study achieve its goals? Do the conclusions make sense? Do the results have any practical significance?

Review Questions

1. Briefly describe each of the eight guidelines for evaluating statistical studies. Give an example to which each guideline applies.
2. Describe and contrast selection bias and participation bias in sampling. Give an example of each.
3. What do we mean by the variables of interest in a study?
4. What are confounding variables, and what problems can they cause?

In the News

1. Applying the Guidelines. Find a recent newspaper article or television report about a statistical study on a topic that you find interesting. Write a short report applying each of the eight guidelines given in this section. (Some of the guidelines may not apply to the particular study you are analyzing; in that case, explain why the guideline is not applicable.)
2. Believable Results. Find a recent news report about a statistical study whose results you believe are meaningful and important. In one page or less, summarize the study and explain why you find it believable.
3. Unbelievable Results. Find a recent news report about a statistical study whose results you don’t believe are meaningful or important. In one page or less, summarize the study and why you don’t believe its claims.
4. Legal Experts. Find a news report concerning a major ongoing trial. Find out whether any of the “expert witnesses” are being paid by either side. Based on what you learn, describe whether you think the experts are giving biased testimony.
5. Biased Questioning? Find a recent news report of responses to a single question in an opinion poll. State the exact words of the question and the results of the poll. Analyze the question and the reported results for potential biases. At the end of your analysis, state whether you believe the results, and defend your opinion.

Exercises

Bias. Exercises 1–8 present situations in which bias may be an issue. Describe one potential source of bias in the situation, and briefly discuss whether the bias should affect your view of the situation.

1. A film critic on ABC gives her opinion of the latest movie from Disney, which happens to own ABC.