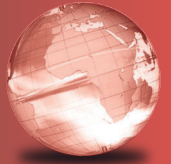# Business Statistics

THIRD EDITION

Sharpe • De Veaux • Velleman

PEARSON

you possibly think of traveling to Miami in the next six months on your way to one of your destinations?"

a) What is the population?
b) What is the sampling frame?
c) Point out any problems you see either with the sampling procedure and/or the survey itself. What are the potential impacts of these problems?

13. An intern is working for Pacific TV (PTV), a small cable and Internet provider, and has proposed some questions that might be used in the survey to assess whether customers are willing to pay $50 for a new service.

Question 1: If PTV offered state-of-the-art, high-speed Internet service for $50 per month, would you subscribe to that service?

Question 2: Would you find $50 per month—less than the cost of a daily cappuccino—an appropriate price for high-speed Internet service?

a) Do you think these are appropriately worded questions? Why or why not?
b) Which one has more neutral wording? Explain.

14. Here are more proposed survey questions for the survey in Exercise 13:

Question 3: Do you find that the slow speed of DSL Internet access reduces your enjoyment of web services?

Question 4: Given the growing importance of high-speed Internet access for your children's education, would you subscribe to such a service if it were offered?

a) Do you think these are appropriately worded questions? Why or why not?
b) Suggest a question with better wording.

SECTION 8.5

15. Indicate whether each statement below is true or false. If false, explain why.

a) A local television news program that asks viewers to call in and give their opinion on an issue typically results in a biased voluntary response sample.
b) Convenience samples are generally representative of the population.
c) Measurement error is the same as sampling error.
d) A pilot test can be useful for identifying poorly worded questions on a survey.

16. Indicate whether each statement below is true or false. If false, explain why.

a) Asking viewers to call into an 800 number is a good way to produce a representative sample.

b) When writing a survey, it's a good idea to include as many questions as possible to ensure efficiency and to lower costs.
c) A recent poll on a website was valid because the sample size was over 1,000,000 respondents.
d) Malls are not necessarily good places to conduct surveys because people who frequent malls may not be representative of the population at large.

17. For your marketing class, you'd like to take a survey from a sample of all the Catholic Church members in your city to assess the market for a DVD about Pope Francis's first year as pope. A list of churches shows 17 Catholic churches within the city limits. Rather than try to obtain a list of all members of all these churches, you decide to pick 3 churches at random. For those churches, you'll ask to get a list of all current members and contact 100 members at random.

a) What kind of design have you used?
b) What could go wrong with the design that you have proposed?

18. PIRSA Fisheries, based in South Australia, plans to study the recreational fishing around Goolwa Beach. To do that, they decide to randomly select five fishing boats at the end of a randomly chosen fishing day and count the numbers and types of all the fish on those boats.

a) What kind of design have they used?
b) What could go wrong with the design that they have proposed?

CHAPTER EXERCISES

19. Software licenses. The website www.gamefaqs.com asked, as their question of the day to which visitors to the site were invited to respond, "*Do you ever read the end-user license agreements when installing software or games?*" Of the 98,574 respondents, 63.47% said they never read those agreements—a fact that software manufacturers might find important.

a) What kind of sample was this?
b) How much confidence would you place in using 63.47% as an estimate of the fraction of people who don't read software licenses?

20. Drugs in baseball. Major League Baseball, responding to concerns about their "brand," tests players to see whether they are using performance-enhancing drugs. Officials select a team at random, and a drug-testing crew shows up unannounced to test all 40 players on the team. Each testing day can be considered a study of drug use in Major League Baseball.

a) What kind of sample is this?
b) Is that choice appropriate?

21. Pew. Pew Research Center publishes polls on issues important in the news and about global life at its website, www.pewinternet.org. At the end of a report about a survey you can find paragraphs such as this one:

Country: Brazil; Sample design: Multi-stage cluster sample stratified by Brazil's five regions and size of municipality; Mode: Face-to-face adults 18 plus; Languages: Portuguese; Fieldwork dates: March 4 – April 21, 2013; Sample size: 960; Margin of Error: ±4.1 percentage points; Representative: Adult population.

a) Explain the multi-stage design applied in terms of regions and municipalities.
b) What sampling frame might have been used?

22. Defining the survey. At its website (www.gallup.com) the Gallup World Poll reports results of surveys conducted in various places around the world. At the end of one of these reports about the reliability of electric power in Africa, they describe their methods, including explanations such as the following:

Results are based on face-to-face interviews with 1,000 adults, aged 15 and older, conducted in 2010 in Botswana, Burkina Faso, Cameroon, Central African Republic, Chad, Ghana, Kenya, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, South Africa, Tanzania, Uganda, and Zimbabwe. For results based on the total sample of national adults, one can say with 95% confidence that the maximum margin of sampling error ranges from ± 3.4 percentage points to ± 4.0 percentage points. The margin of error reflects the influence of data weighting. In addition to sampling error, question wording and practical difficulties in conducting surveys can introduce error or bias into the findings of public opinion polls.[4]

a) Gallup is interested in the opinions of Africans. What kind of survey design are they using?
b) Some of the countries surveyed have large populations. (South Africa is estimated to have over 50 million people.) Some are quite small. (Zimbabwe has fewer than 13,000,000 people.) Nonetheless, Gallup sampled 1000 adults in each country. How does this affect the precision of its estimates for these countries?

23–30. Survey details. *For the following reports about statistical studies, identify the following items (if possible). If you can't tell, then say so—this often happens when we read about a survey.*

a) The population
b) The population parameter of interest
c) The sampling frame
d) The sample
e) The sampling method, including whether or not randomization was employed
f) Any potential sources of bias you can detect and any problems you see in generalizing to the population of interest

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23. Global Views on Morality. The 2013 *Pew Research Center's Global Attitudes Project* asked 1000 adult respondents in 40 countries what they thought about eight moral issues, such as premarital sex and alcohol use.

24. Global warming. The Gallup Poll interviewed 1022 randomly selected U.S. adults aged 18 and older, March 7–10, 2013. Gallup reports that when asked whether respondents thought that global warming was due primarily to human activities, 57% of respondents said it was.

25. At the bar. Researchers waited outside a bar they had randomly selected from a list of such establishments. They stopped every tenth person who came out of the bar and asked whether he or she thought drinking and driving was a serious problem.

26. Election poll. Hoping to learn what issues may resonate with voters in the coming election, the campaign director for a mayoral candidate selects one block at random from each of the city's election districts. Staff members go there and interview all the residents they can find.

27. Toxic waste. The Environmental Protection Agency took soil samples at 16 locations near a former industrial waste dump and checked each for evidence of toxic chemicals. They found no elevated levels of any harmful substances.

28. Housing discrimination. Inspectors send trained "renters" of various races and ethnic backgrounds, and of both sexes to inquire about renting randomly assigned advertised apartments. They look for evidence that landlords deny access illegally based on race, sex, or ethnic background.

29. Quality control. A company packaging snack foods maintains quality control by randomly selecting 10 cases from each day's production and weighing the bags. Then they open one bag from each case and inspect the contents.

30. Contaminated milk. Dairy inspectors visit farms unannounced and take samples of the milk to test for contamination. If the milk is found to contain dirt, antibiotics, or other foreign matter, the milk will be destroyed and the farm is considered to be contaminated pending further testing.

31. Bradley effect. The Bradley effect theory posits that inaccurate polls are skewed by the phenomenon of voters giving inaccurate polling responses because they fear that, by stating their true preference, they will open themselves to criticism of racial or ethnic motivation. Members of the public may feel under pressure to provide an answer that is deemed to be more publicly acceptable, or 'politically correct', but they vote according to their true preference. Is the Bradley effect an example of bias, or of sampling error?

32. Indian polls. In the 2014 elections in India, no less than eleven opinion poll agencies have been seen, whose surveys are published and broadcast by leading magazines and

news channels. However, predictions of polling agencies demonstrate considerable variability. Is this more likely to be a result of bias, or sampling error? Explain.

33. Cable company market research. A local cable TV company, Pacific TV (PTV), with customers in 15 towns is considering offering high-speed Internet service on its cable lines. Before launching the new service they want to find out whether customers would pay the $75 per month that they plan to charge. An intern has prepared several alternative plans for assessing customer demand. For each, indicate what kind of sampling strategy is involved and what (if any) biases might result.

a) Put a big ad in the newspaper asking people to log their opinions on the PTV website.
b) Randomly select one of the towns and contact every cable subscriber by phone.
c) Send a survey to each customer and ask them to fill it out and return it.
d) Randomly select 20 customers from each town. Send them a survey, and follow up with a phone call if they do not return the survey within a week.

34. Cable company market research, part 2. Four new sampling strategies have been proposed to help PTV determine whether enough cable subscribers are likely to purchase high-speed Internet service. For each, indicate what kind of sampling strategy is involved and what (if any) biases might result.

a) Run a poll on the local TV news, asking people to dial one of two phone numbers to indicate whether they would be interested.
b) Hold a meeting in each of the 15 towns, and tally the opinions expressed by those who attend the meetings.
c) Randomly select one street in each town and contact each of the households on that street.
d) Go through the company's customer records, selecting every 40th subscriber. Send employees to those homes to interview the people chosen.

35. Amusement park riders. An amusement park has opened a new roller coaster. It is so popular that people are waiting for up to three hours for a two-minute ride. Concerned about how patrons (who paid a large amount to enter the park and ride on the rides) feel about this, they survey every tenth person in line for the roller coaster, starting from a randomly selected individual.

a) What kind of sample is this?
b) Is it likely to be representative?
c) What is the sampling frame?

36. Playground. Some people have been complaining that the children's playground at a municipal park is too small and is in need of repair. Managers of the park decide to survey city residents to see if they believe the playground should be rebuilt. They hand out questionnaires to parents who bring children to the park. Describe possible biases in this sample.

37. Another ride. The survey of patrons waiting in line for the roller coaster in Exercise 35 asks whether they think it is worthwhile to wait a long time for the ride and whether they'd like the amusement park to install still more roller coasters. What biases might cause a problem for this survey?

38. Playground bias. The survey described in Exercise 36 asked,

Many people believe this playground is too small and in need of repair. Do you think the playground should be repaired and expanded even if that means imposing an entrance fee to the park?

Describe two ways this question may lead to response bias.

39. (Possibly) Biased questions. Examine each of the following questions for possible bias. If you think the question is biased, indicate how and propose a better question.

a) Should companies that pollute the environment be compelled to pay the costs of cleanup?
b) Should a company enforce a strict dress code?

40. More possibly biased questions. Examine each of the following questions for possible bias. If you think the question is biased, indicate how and propose a better question.

a) Do you think that price or quality is more important in selecting a tablet computer?
b) Given humanity's great tradition of exploration, do you favor continued funding for space flights?

41. Phone surveys. Anytime we conduct a survey, we must take care to avoid undercoverage. Suppose we plan to select 500 names from the city phone book, call their homes between noon and 4 p.m., and interview whoever answers, anticipating contacts with at least 200 people.

a) Why is it difficult to use a simple random sample here?
b) Describe a more convenient, but still random, sampling strategy.
c) What kinds of households are likely to be included in the eventual sample of opinion? Who will be excluded?
d) Suppose, instead, that we continue calling each number, perhaps in the morning or evening, until an adult is contacted and interviewed. How does this improve the sampling design?
e) Random-digit dialing machines can generate the phone calls for us. How would this improve our design? Is anyone still excluded?

42. Cell phone survey. What about drawing a random sample only from cell phone exchanges? Discuss the advantages and disadvantages of such a sampling method compared with surveying randomly generated telephone numbers from non–cell phone exchanges. Do you think these

advantages and disadvantages have changed over time? How do you expect they'll change in the future?

43. Change. How much change do you have on you right now? Go ahead, count it.

a) How much change do you have?
b) Suppose you check on your change every day for a week as you head for lunch and average the results. What parameter would this average estimate?
c) Suppose you ask 10 friends to average *their* change every day for a week, and you average those 10 measurements. What is the population now? What parameter would this average estimate?
d) Do you think these 10 average change amounts are likely to be representative of the population of change amounts in your class? In your college? In the country? Why or why not?

44. Fuel economy. Occasionally, when I fill my car with gas, I figure out how many miles per gallon my car got. I wrote down those results after six fill-ups in the past few months. Overall, it appears my car gets 28.8 miles per gallon.

a) What statistic have I calculated?
b) What is the parameter I'm trying to estimate?
c) How might my results be biased?
d) When the Environmental Protection Agency (EPA) checks a car like mine to predict its fuel economy, what parameter is it trying to estimate?

45. Accounting. Between quarterly audits, a company likes to check on its accounting procedures to address any problems before they become serious. The accounting staff processes payments on about 120 orders each day. The next day, the supervisor rechecks 10 of the transactions to be sure they were processed properly.

a) Propose a sampling strategy for the supervisor.
b) How would you modify that strategy if the company makes both wholesale and retail sales, requiring different bookkeeping procedures?

46. Happy workers? A manufacturing company employs 14 project managers, 48 foremen, and 377 laborers. In an effort to keep informed about any possible sources of employee discontent, management wants to conduct job satisfaction interviews with a simple random sample of employees every month.

a) Do you see any danger of bias in the company's plan? Explain.
b) How might you select a simple random sample?
c) Why do you think a simple random sample might not provide the best estimate of the parameters the company wants to estimate?
d) Propose a better sampling strategy.

e) Listed below are the last names of the project managers. Use random numbers to select two people to be interviewed. Be sure to explain your method carefully.

Barrett	Bowman	Chen
DeLara	DeRoos	Grigorov
Maceli	Mulvaney	Pagliarulo
Rosica	Smithson	Tadros
Williams	Yamamoto	

47. Quality control. Sammy's Salsa, a small local company, produces 20 cases of salsa a day. Each case contains 12 jars and is imprinted with a code indicating the date and batch number. To help maintain consistency, at the end of each day, Sammy selects three bottles of salsa, weighs the contents, and tastes the product. Help Sammy select the sample jars. Today's cases are coded 07N61 through 07N80.

a) Carefully explain your sampling strategy.
b) Show how to use random numbers to pick the three jars for testing.
c) Did you use a simple random sample? Explain.

48. Fish quality. Concerned about reports of discolored scales on fish caught downstream from a newly sited chemical plant, scientists set up a field station in a shoreline public park. For one week they asked fishermen there to bring any fish they caught to the field station for a brief inspection. At the end of the week, the scientists said that 18% of the 234 fish that were submitted for inspection displayed the discoloration. From this information, can the researchers estimate what proportion of fish in the river have discolored scales? Explain.

49. Sampling methods. Consider each of these situations. Do you think the proposed sampling method is appropriate? Explain.

a) We want to know what percentage of local doctors accept Medicaid patients. We call the offices of 50 doctors randomly selected from local Yellow Pages listings.
b) We want to know what percentage of local businesses anticipate hiring additional employees in the upcoming month. We randomly select a page in the Yellow Pages and call every business listed there.

50. More sampling methods. Consider each of these situations. Do you think the proposed sampling method is appropriate? Explain.

a) We want to know if business leaders in the community support the development of an "incubator" site at a vacant lot on the edge of town. We spend a day phoning local businesses in the phone book to ask whether they'd sign a petition.
b) We want to know if travelers at the local airport are satisfied with the food available there. We go to the airport on a busy day and interview every tenth person in line in the food court.

JUST CHECKING ANSWERS

1 a) It can be hard to reach all members of a population, and it can take so long that circumstances change, affecting the responses. A well-designed sample is often a better choice.

   b) This sample is probably biased—people who didn't like the food at the restaurant might not choose to eat there.

   c) No, only the sample size matters, not the fraction of the overall population.

   d) Students who frequent this website might be more enthusiastic about Statistics than the overall population of Statistics students. A large sample cannot compensate for bias.

   e) It's the population "parameter." "Statistics" describe samples.

2 a) systematic

   b) stratified

   c) simple

   d) cluster