GLOBAL EDITION

BUSINESS STATISTICS

4E

Norean R. Sharpe • Richard D. De Veaux • Paul F. Velleman

4th Edition
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Business Statistics

Norean R. Sharpe
St. John's University

Richard D. De Veaux
Williams College

Paul F. Velleman
Cornell University

With Contributions by David Bock
and Special Contributor Eric M. Eisenstein

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CHAPTER 8

EXERCISES

SECTION 8.1

1. For the following observational studies, indicate whether they are prospective or retrospective.

a) A tuition center monitored their crash-course tuition program for A levels to estimate the number of students who joined the program will score a greater number of A's on their A level exam.
b) Lazada looked at their customers' feedback on their courier partners to decide whether to continue their contract with them.

2. For the following observational studies, indicate whether they are prospective or retrospective studies.

a) An airline was concerned that new security measures might discourage air travelers. A year after the new security restrictions were put into place, the airlines compared the miles traveled by their frequent fliers before and after the change.
b) Does giving children a flu shot protect parents? Researchers questioned a random sample of families at the end of a flu season. They asked whether the children had been immunized, whether the parents had received flu shots, and who in the family had contracted the flu.

SECTION 8.2

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

a) Sampling error occurs when researchers are observing every individual subject in a population.
b) Randomization in an experiment is where you choose your experimental participants randomly.
c) Sampling error occurs when an analyst does not select a sample that represents the entire population of data, and the results found in the sample do not represent the results that would be obtained from the entire population.
d) By doing randomization, the irrelevant variables will increase biases and interferences.

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

a) To get a representative sample, you must sample a large fraction of the population.
b) Using modern methods, it is best to select a representative subset of a population systematically.
c) A census is the only true representative sample.
d) A random sample of 100 students from a school with 2000 students has the same precision as a random sample of 100 from a school with 20,000 students.

SECTION 8.3

5. An environmental advocacy group is interested in the perceptions of farmers about global climate change. Specifically, they wish to determine the percentage of organic farmers who are concerned that climate change will affect their crop yields. They use an alphabetized list of members of the Northeast Organic Farming Association (www.nofa.org), a nonprofit organization of over 5000 members with chapters in Connecticut, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont. They use Excel to generate a randomly shuffled list of the members. They then select members to contact from this list until they have succeeded in contacting 150 members.

a) What is the population?
b) What is the sampling frame?
c) What is the population parameter of interest?

6. An airline company is interested in the opinions of their frequent flyer customers about their proposed new routes. Specifically they want to know what proportion of them plan to use one of their new hubs in the next six months. They take a random sample of 10,000 from the database of all frequent flyers and send them an e-mail message with a request to fill out a survey in exchange for 1500 miles.

a) What is the population?
b) What is the sampling frame?
c) What is the population parameter of interest?

SECTION 8.4

7. As discussed in the chapter, GfK Roper Consulting conducts a global consumer survey to help multinational companies understand different consumer attitudes throughout the world. In India, the researchers interviewed 1000 people aged 13–65 (www.gfkamerica.com). Their sample is designed so that they get 500 males and 500 females.

a) Are they using a simple random sample? How do you know?
b) What kind of design do you think they are using?

8. An accountant works in a company that has 2,000 employees, and he wants to determine the employees' savings for retirement based on the different categories of age. He groups the employees into four age groups: less than 30 years old, 30 to less than 40 years old, 40 to less than 50 years old, 50 years old and more. Then he identifies the number of employees who belong to each of these age groups and selects a sample of 100 employees.

a) Do you think the accountant was using an SRS? Why?
b) What kind of sampling design do you think he used?

9. The environmental advocacy group from Exercise 5 that was interested in gauging perceptions about climate change among organic farmers has decided to use a different method to sample. Instead of randomly selecting members from a shuffled list, they listed the members in alphabetical order and took every tenth member until they succeeded in contacting 150 members. What kind of sampling method have they used?

10. The airline company from Exercise 6, interested in the opinions of their frequent flyer customers about their proposed new routes, has decided that different types of customers might have different opinions. Of their customers, 50% are silver-level, 30% are blue, and 20% are red. They first compile separate lists of silver, blue, and red members and then randomly select 5000 silver members, 3000 blue members, and 2000 red members to e-mail. What kind of sampling method have they used?

For Exercises 11 and 12, identify the following if possible. (If not, say why.)

a) The population
b) The population parameter of interest
c) The sampling frame
d) The sample
e) Any potential sources of bias you can detect and any problems you see in generalizing to the population of interest

11. An online store is interested to know its customers' purchase satisfaction level. After an order has been delivered, the store e-mails its customer a set of survey questions. There are about 75% of their customers who respond to the e-mail and 80% who show that they are satisfied with their purchase.

12. A food tasting was conducted at a hypermarket. A promoter distributed free food samples for the customers to taste at the hypermarket and asked the customers whether they liked or disliked the taste of the food sample distributed.

SECTION 8.5

13. An intern for the environmental group in Exercise 5 has decided to make the survey process simpler by calling 150 of the members who attended the recent symposium on coping with climate change that was recently held in Burlington, VT. He has all the phone numbers, so it will be easy to contact them. He will start calling members from the top of the list, which was generated as the members enrolled for the symposium. He has written a script to read to them that follows,

"As we learned in Burlington, climate change is a serious problem for farmers. Given the evidence of impact on crops, do you agree that the government should be doing more to fight global warming?"

a) What is the population of interest?
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?

14. The airline company in Exercise 6 has realized that some of its customers don't have e-mail or don't read it regularly. They decide to restrict the mailing only to customers who have recently registered for a "Win a trip to Miami" contest, figuring that those with Internet access are more likely to read and to respond to their e-mail. They send an e-mail with the following message:

"Did you know that National Airlines has just spent over $3 million refurbishing our brand new hub in Miami? By answering the following question, you may be eligible to win $1000 worth of coupons that can be spent in any of the fabulous restaurants or shops in the Miami airport. Might 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?

15. 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.

16. Here are more proposed survey questions for the survey in Exercise 15:

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 8.6

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

a) A radio show would like to know its audiences' opinion on a topic. So they open a few hotlines for their audience to respond. More than 20,000 people respond and 75% of them gave positive views. Though the response rate is high, audiences' opinions result in voluntary response bias.
b) While conducting a convenience sampling, we must know the sampling probability in selecting a group of individuals as sample.
c) A measurement error is the error that occurs between a measured value and its predicted value.
d) Pilot test is necessary and useful in providing the groundwork in a research project. It is also one of the essential stages in a research project to minimize the investment in time and resources.

18. 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.

19. A researcher has been working on a survey involving university students' in his city buying luxury products for themselves. A list shows that there are 20 universities in his city. The researcher decides to pick two universities at random and tries to obtain a list of all students studying at these universities. He then contacts 500 students at random.

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

20. A company is looking into the average number of sick leaves each employee has applied for per year. The company has five departments with different number of employees in which the company estimates that the number of sick leaves applied by each department is largely associated with the number of employees in that department. The company randomly samples three departments, then samples 50 employees with probabilities proportional to the number of employees in each of the selected department to run their analysis.

a) What kind of design is used?
b) What could go wrong with the design proposed?

CHAPTER EXERCISES

21. 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?

22. Fertilizer overuse. The Agricultural Bureau conducts a test in a farming village on the overuse of inorganic fertilizers. Officials select 10 farms at random from the village, and sample the soil and plants from the farms that are then sent for nutrient testing.

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

23. Pew. Pew Research Center publishes polls on important issues in news and about global life at its website, www.pewglobal.org. In a survey summary, you can find the information as below:

Country: Turkey; Sample design: Multistage, area probability design. Primary sampling units (PSUs) are household blocks stratified by region (NUTS2) and urbanity. The number of PSUs selected is 100. Individuals within households are selected using computer randomization based on all 18+ people living in the household. Up to three attempts are made to complete the interview with the selected respondent.; Mode: Face-to-face; Languages: Turkish; Fieldwork dates: July 11–August 7, 2019; Sample size: 1,046; Margin of Error: 4.5 percentage points; Representative: Adult population 18 plus. (https://pewrsr.ch/3h3PjZH)

a) Explain the multistage design applied in terms of regions and municipalities.
b) What sampling frame might have been used? Does this seem representative of the population?

24. 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

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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.[5]

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?

25–32. 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

25. Sweden and climate change 2019. In April 2019, as part of the Eurobarometer survey on climate change, over 27,000 respondents from different social and demographic groups in the 28 member states of the European Union were interviewed and asked what they consider to be the single most serious problem facing the world. The issues included poverty, climate change, the economic situation, the increasing global population, and others.

26. Global warming. The Gallup Poll interviewed 1,022 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.

27. 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.

28. 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.

29. 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.

30. 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.

31. 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.

32. 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.

33. 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 expose 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?

34. Polls in India. In the 2019 elections in India, no less than 11 opinion poll agencies came into focus, whose surveys were published and broadcast by leading magazines and news channels. However, predictions of polling agencies demonstrated considerable variability. Do you think that it is more likely to be a result of bias or sampling error? Explain.

35. Soft drinks. The soft drinks industry is a highly competitive industry and spends millions of dollars each year in product promotion. A soft drink company would like to conduct a campaign that may increase customers' engagement and give them a chance to voice their opinions. The company discovered the advantages of influencer marketing, which is a valuable way to spread their brand messages to consumers. The typical soft drink consumers tend to be young people with disposable incomes and who spend much of their time on social media. For each of the following, indicate what kind of sampling strategy is involved, and what (if any) biases might result.

a) Conduct an Instagram campaign that focuses on the number of Instagram tags.
b) Randomly select a mall to conduct the campaign.
c) A survey form is attached with each purchase. Customers need to fill up the form and return it.
d) Randomly select 20 customers from few different restaurants in which the restaurants will help in conducting the campaign.

36. Soft drinks, part 2. Four new sampling strategies have been proposed to help the soft drink company to get customers' opinions on soft drinks. For each, indicate what kind of sampling strategy is involved, and what (if any) biases might result.

a) Run a poll on the local live TV show, asking people to dial one of two phone numbers to give their opinions and prizes are giving out.
b) A group of promoters are randomly sent to 30 shopping malls to interview the customers to get their opinions.
c) Randomly select one commercial street in different towns and interview the people living on that street.
d) Go through a retail shop, and select every 10th person who purchases a soft drink. Simple questionnaires to be asked by standby promoters in the retail shop to get opinions on the soft drink they have chosen and award the participants with free gifts as incentives.

37. 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?

38. 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.

39. Another ride. The survey of patrons waiting in line for the roller coaster in Exercise 37 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?

40. Playground bias. The survey described in Exercise 38 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.

41. (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?

42. 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?

43. Internet surveys. Anytime we conduct a survey, we must take care to avoid undercoverage. Suppose, we plan to select 1,000 e-mails from a list of Internet subscribers, e-mail them a set of survey questions to answer within three days and ensure to get at least 400 responds.

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 Internet subscribers are likely to be included in the eventual sample of opinion? Who will be excluded?
d) If we continue sending e-mails about three times a day to each Internet subscriber who did not respond, will this improve the sampling design?
e) A random selection from a group of e-mail database. How would this improve our design? Is anyone still excluded?

44. Face-to-Face interview. What about drawing a random sample from a face-to-face interview? Discuss the advantages and disadvantages of such a sampling method compared to other kinds of interviews. Do you think these advantages and disadvantages have changed over time? How do you expect they will change in the future?

45. 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?

46. Battery usage. Often after I charge my laptop battery, I can figure out how long it will last. My laptop battery has a capacity of 62WHr. While my laptop draws about 12.4 watts on charge, on average my battery can last for about five hours.

a) What statistic have I calculated?
b) What is the parameter I am trying to estimate?
c) Are my results biased?
d) When a computer expert checks the lifetime of a brand-new laptop battery after being fully charged, what parameter are they trying to estimate?

47. 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?

48. 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	

49. 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.

50. 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.

51. 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.

52. 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