Chapter 1

Section 1.1: Statistics Today

No exercises.

Section 1.2: Populations, Samples, Probability, and Statistics

1.1 True

1.2 False

1.3 True

1.4 (a) Population (b) Sample (c) Variable

1.5 Answers may vary.
(a) Consider a random sample of 100 Americans. Probability question: How likely would it be to observe that fewer than 50 of the sampled Americans have a social media profile? Statistics question: Within the sample of 100 Americans, only 50 report having a social media profile. What does this result suggest about the reported national percentage of social media users?

(b) Consider a random sample of 50 people. Probability question: What is the probability that exactly 21 of the selected individuals use the same password for everything?
Statistics question: We observe that 21 of the selected 50 use the same password for everything. Does this suggest that the true percentage of people who use the same password for everything is actually different than 36%?

(c) Probability question: Suppose you walk through a parking lot in Norway. What is the probability that none of the first 16 cars you observe is a plug-in electric vehicle?
Statistics question: Suppose you take a random sample of 35 cars in Denmark and 19 of them are plug-in electric vehicles. Does this sample provide evidence to suggest that Denmark has a higher percentage of electric cars than Norway does?

(d) Probability question: Suppose that 3 people in your neighborhood suffer snow shoveling injuries this winter. What is the likelihood that all 3 injuries are categorized as pulled muscles? Statistics question: Suppose an insurance agency sees an atypically large number of snow shoveling related insurance claims this winter, all from the same neighborhood. If the company observes that 6 of the 10 claims are not categorized as pulled muscles, does it have evidence to suggest that these claims may be fraudulent?

1.6 (a) Descriptive statistics

(b) Inferential statistics

(c) Inferential statistics

(d) Inferential statistics

(e) Descriptive statistics

(f) Descriptive statistics

1.7 (a) Descriptive statistics

(b) Inferential statistics

(c) Descriptive statistics

(d) Inferential statistics

(e) Descriptive statistics

(f) Descriptive statistics

1.8 Population: All patients undergoing open-heart surgery in the last year. Sample: 30 selected patients undergoing open-heart surgery. Variable: Length of stay (days) of the selected patients.

1.9 Population: All T-shirt buyers. Sample: 50 surveyed consumers. Variable: Tag preference (whether each buyer will cut off the T-shirt tag).

1.10 Population: All employees at Citigroup Inc. in New York. Sample: The 35 employees selected and questioned.

1.11 Population: All adult residents in Arizona. Sample: 500 selected Arizona residents.

1.12 Population: All Nationwide Insurance claims from southwest Florida as a result of the hurricane. Sample: 80 selected claims from affected families.

1.13 (a) Population: All people who bought a dining room table in the last month. Sample: 5 selected buyers. Probability question.

(b) Population: All people who shop at this Walgreens. Sample: 25 selected shoppers. Statistics question.

(c) Population: All people who have used or will use this water slide. Sample: 50 selected riders. Probability question.

(d) Population: All automatic doors in public buildings in Henderson, Nevada. Sample: 100 randomly selected doors. Statistics question.

(e) Population: All travelers entering LAX airport. Sample: 1000 selected travelers. Statistics question.

(f) Population: All people who sold a home in the past year. Sample: 35 selected sellers. Probability question.

(g) Populations: All for-profit nursing homes and all Medicare nursing homes. Samples: The several nursing homes of each type that were selected. Statistics question.

1.14 (a) Population: All shark attacks. (b) Sample: 1000 shark attacks (observed records). (c) Variable: Victim group of attack.

1.15 Population: All pumpkin seeds. Sample: 50 selected seeds. Variable: Amount of zinc the seed contains.

1.16 Population: All patients with hepatitis C. Sample: 40 selected patients. Variable: Daily liver enzyme level.

1.17 (a) Population: All Bounty paper towels. (b) Sample: The single sheet tested from each of the 35 selected rolls. (c) Variable: Amount of absorption for each paper towel.

1.18 Population: All search and rescue missions from 2018. Sample: 100 randomly selected missions. Variable: Elapsed time from call to contact for each mission.

1.19 (a) Population: All traditionally produced cheddar cheese. Sample: 20 selected cheddar cheeses from around the world.
(b) Probability problem: How likely is it that only 3 of the selected 20 cheeses were aged for fewer than 2 years? Statistics problem: If only 3 of the selected 20 cheeses were aged for fewer than 2 years, does this provide evidence to suggest that less than 75% of cheddar cheeses are aged for fewer than 2 years?

1.20 (a) Population: All American adults. Sample: 500 sampled adults.
(b) Probability problem: What is the probability that more than 60% of the sample of Americans read a printed book in the past year? Statistics question: If fewer than 60% of the sample have read a printed book in the past year, do the sample data provide evidence to doubt the Pew researcher's claim?

1.21 (a) All computer systems of U.S. government agencies. (b) The computer systems of 100 U.S. government agencies. (c) Whether the computer systems contained a trace of the Kaspersky software. (d) Probability question: What is the likelihood that at most 20 of the selected 100 agencies' systems have traces of the Kaspersky software? Statistics question: Suppose the sample indicates that 20 of the selected systems contain traces of the Kaspersky software. Do these findings suggest that the true proportion of government agencies with traces is higher than 15%?

1.22 Population: All nursing homes in Canada. Sample: 80 selected nursing homes.
Variable: Number of patient falls recorded within each nursing home during the last year.

Section 1.3: Experiments and Random Samples

1.23 True

1.24 False

1.25 False

1.26 True

1.27 False

1.28 (a) Biased (b) Nonresponse bias
(c) Self-selection bias

1.29 Claim, experiment, likelihood, conclusion

1.30 The researchers could have gotten a very lucky result even though the claim is true, or the more plausible outcome is that the claim is not the truth about the population.

1.31 (a) Observational study (b) The sample is all student responses that the volunteers were able to collect that evening. (c) This is not a random sample. The dormitory selected was close to the proposed site, and students living in that dormitory may have a different opinion than those living in a dormitory farther from the site. Additionally, only students in their rooms at the time the volunteers walked through were able to participate, leaving out students at the library studying for their statistics exam.

1.32 (a) Observational study (b) All volunteer firefighters in the 25 largest companies. (c) This is not a random sample because the largest volunteer fire companies were selected rather than a random sample of all volunteer companies. These 25 selected companies may not represent the population of volunteer firefighters.

1.33 (a) Population: All 4-oz packages of Reese's Pieces produced by the Hershey Company. Sample: Packages selected by the inspection team. (b) This is a random sample. The inspection team has selected packages from various locations within the plant, ensuring that all packages have the same chance of being selected and measured.

1.34 Assign each shipped product an ID number and use a random number generator to produce 50 unique values. Those 50 values then correspond to the 50 product IDs in your sample.

1.35 (a) Observational study (b) Population: All Lyft drivers. Sample: 25 selected Atlanta drivers. (c) This is not a random sample because drivers were only selected from Atlanta. Perhaps this city has drivers who travel an oddly large number of miles in a typical 8-hr shift compared to Lyft drivers in the rest of the country.

1.36 (a) Population: All male users of disposable razors. Sample: 100 men who bought disposable razors. (b) This is not a random sample because only men who were already purchasing a disposable razor were eligible to participate in the study. These men may be predisposed to react a certain way to certain brands of razors.

1.37 Obtain a list of customers who have recently purchased the TV, and place each of their names on an equal-sized slip of paper. Put the slips into a hat and after mixing well, select a group of 25 customer names to then call and survey.

1.38 Obtain a list of all challenges made over the course of a season and label each one with an ID number. Using a random number generator, produce 15 unique numbers that correspond to a set of 15 challenges, which can then be reviewed.

1.39 (a) Experiment (b) Tumor count for each rodent

1.40 (a) Obtain a list of the serial numbers of the fire extinguishers in Transport Canada's Gulf Stream Coach RVs. Using a random number generator, produce a list of 35 unique serial numbers to be tested and inspected by the company. (b) Observational study.

1.41 (a) Experiment. (b) Lifetime of each rose blossom. (c) Assign each of the 50 roses an ID number. Using a random number generator, produce 25 unique ID numbers that correspond to the roses in the "treated" group. The rest of the roses will be placed in the "untreated" group.

1.42 (a) Experiment (b) Car preference of the blindfolded rider (c) It is important to randomize the order of the rides for each passenger. Perhaps riders are predisposed to prefer the second ride they go on, regardless of which car they are in. By randomizing which type of car will be used for which ride, there should be roughly an equal number of trials in which the electric car was used for the first versus second ride.

1.43 (a) Population: All floor tiles of this particular type. Sample: The 25 tiles that were ordered and tested. (b) This is not a random sample. One method for obtaining a random sample of tiles would be to visit the factory production line and, using a random number generator, select one of the 4,000 tiles produced each hour throughout the work day. The collection of selected tiles will then make up your sample.

1.44 (a) Observational study (b) Proportion of white feathers, proportion of down, and proportion of other components within each comforter (c) For the eight companies that this bed-and-bath company is interested in sampling, use a random number generator to select two unique comforters from production within each company. The selected comforters will then make up the sample.

1.45 (a) Observational study (b) Weight of each seat cushion (c) Assign a random sample of new seat cushions and a random sample of old seat cushions to one of two rail cars randomly. After the rail cars travel the same route, measure the energy efficiency of the cars and compare the two measurements.

1.46 (a) Observational study (b) The size of each wine glass (in milliliters). (c) Use a random number generator to produce 40 unique serial numbers that correspond to the selected wine glasses.

Chapter 1 Exercises

1.47 (a) Descriptive statistics
(b) Descriptive statistics
(c) Inferential statistics
(d) Inferential statistics
(e) Descriptive statistics

1.48 (a) Descriptive statistics
(b) Inferential statistics
(c) Descriptive statistics
(d) Inferential statistics
(e) Inferential statistics

1.49 (a) Descriptive statistics
(b) Inferential statistics
(c) Inferential statistics
(d) Descriptive statistics
(e) Inferential statistics

1.50 Population: All teenagers. Sample: The sample of teenagers. Variable: Whether or not each teenager can cook.

1.51 Population: All adults. Sample: 400 sampled adults.

1.52 Population: All people who play contact sports. Sample: 1000 people who play contact sports. Variable: The change in brain stucture and function for each individual.

1.53 (a) Observational study
(b) One thousand people in British Columbia who were called.
(c) This is not a random sample. Only individuals from British Columbia were selected. Their opinions may not fully represent all citizens of Canada.

1.54 (a) Observational study
(b) The sample is made up of every third person getting off the train.
(c) No. Not every group has the same chance of being selected. Perhaps the representative could have selected passenger's train tickets from a hat when choosing passengers to interview.

1.55 (a) Experimental study
(b) Time until ice forms on the plane wings
(c) All ten planes can be assigned an ID number from 1-10. A random number generator can be used to selected 5 IDs for the new chemical group, while the remaining 5 will make up the old chemical group.

1.56 (a) All apartments in Vancouver
(b) 500 apartments selected
(c) Whether each apartment is vacant or occupied
(d) Probability question: If 5% of apartments are vacant, what is the probability that none of the next 15 apartments observed are vacant?
Statistics question: Suppose that only 3 of the next 50 apartments sampled are found to be vacant. Does this provide evidence to suggest that less than 5% of apartments in Vancouver are vacant?

1.57 (a) Observational study
(b) The pressure at each section
(c) This is not a random sample. Use a random number generator to select 12 numbers between 0 and 31, representing the miles in the tunnel. Then, take 5 equally spaced pressure measurements along the mile of tunnel that has been selected.

1.58 (a) Observational study
(b) Whether or not the selected chocolate bar contains almond pieces
(c) Yes. Because researchers will sample from several stores, they will likely get a representative group of candy bars. Perhaps, the sample would be better if bars were selected from grocery stores across the country.

1.59 Population: Residents in high tax states
Sample: 1000 residents from high tax states
Variable: Whether the resident plans to move out of state due to the new tax code

1.60 (a) Experimental study
(b) Time to fill each order

1.61 (a) Observational study
(b) Operating pressure of PyroLance tools
(c) Probably not. It is unlikely that California fire companies are representative of all fire companies. Perhaps, the company that produces this product should select several product serial numbers and follow up with the fire companies who own those tools to measure operating pressure.

1.62 (a) Population: All fish in Lake Winnebago
Sample: 100 fish from the lake
Variable: Whether there is evidence of microbeads in each fish
(b) Probability question: If 25% of the fish in Lake Winnebago contain microbeads, what is the probability that a sample of 35 will contain fewer than 6 fish with evidence of microbeads?
Statistics question: If a sample of 35 fish results in 6 that show evidence of microbeads, is there evidence to suggest that the region's sustainability campaign has successfully lowered the presence of microbeads in lake fish from last year's 25%?
(c) Observational study. Researchers should make sure to collect fish from several different parts of the lake, at several different depths, at several different times of the day to ensure a representative sample.
(d) Claim: A certain percentage (at or below an acceptable level) of fish in Lake Winnebago contain evidence of microbeads.
Experiment: 100 fish are selected from the lake and examined for evidence of microbeads.
Likelihood: A large number of sampled fish exhibit evidence of microbeads. This is very rare if plastic levels in the lake are actually at or below what is acceptable.
Conclusion: There is likely a health risk to the public and a warning should be issued.