CHALLENGE AND EXTEND

44a. The mean, median, and standard deviation grow by a factor of 5.
mean: 20; median: 15; standard deviation: $1.6 \cdot 5 = 8$

b. The mean and median increase by 5, while the standard deviation remains the same.
mean: 9; median: 8; standard deviation: 1.6

45. A deck of 1 card:

Cards in Same Position	1
Probability	1

Expected value = 1

A deck of 2 cards:

Cards in Same Position	2	0
Probability	$\frac{1}{2}$	$\frac{1}{2}$

Expected value = 1

A deck of 3 cards:

Cards in Same Position	3	1	0
Probability	$\frac{1}{6}$	$\frac{1}{2}$	$\frac{1}{3}$

Expected value = 1

A deck of 4 cards:

Cards in Same Position	4	2	1	0
Probability	$\frac{1}{24}$	$\frac{1}{4}$	$\frac{1}{3}$	$\frac{3}{8}$

Expected value = 1

Following the pattern, the expected number of cards that will be in the same position after a deck of cards is shuffled is 1.

8-2 DATA GATHERING

CHECK IT OUT!

1. There are the same number of perch and walleye in the lake, or a 1:1 ratio. This is not an accurate estimate according to additional research.

2. biased; people visiting a news site online are more likely to be interested in news and subscribe to a daily newspaper. This may not be representative of the entire population.

3. No, this does not include a large part of the population who do not eat out. People in a restaurant on a Tuesday night are much more likely to eat out often.

4. $\frac{\text{emergencies}}{\text{total calls}} = \frac{\text{emergencies}}{\text{total calls}}$

$\frac{11}{25} = \frac{x}{175}$

$25x = 11 \cdot 175$

$x = 77$

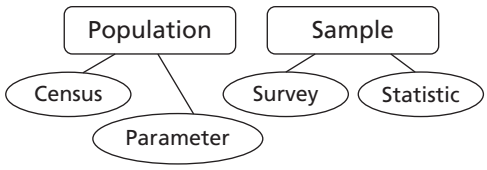
5. No, he is not justified in his evaluation because the sample size was too small. He has a 24% chance of not opening a prize in five boxes.

THINK AND DISCUSS

1. Every individual is surveyed in a census, so no group can be over- or underrepresented.

2. Possible answer: If the parameter is the number of people in the school who will vote for one candidate for school president over another, then it can be estimated by a statistic, or the number of students in a sample that say they will vote for that candidate over the other.

3.



EXERCISES

GUIDED PRACTICE

1. biased

2. parameter

3. Yes; a student that has not gone home from school by 5:00 PM is probably at the school for an extracurricular activity such as a sport.

4. Yes; the sample is a convenience sample that underrepresents people who may not be up so early on a Saturday morning. The baked goods may not be as good later in the day, when they are not as fresh.

5. No; the sample chosen is a convenience sample, which is not likely to be representative of the population. The sample overrepresents students who get to school early in the morning, and who are more likely to have time to eat breakfast at school and make the issue a priority.

6. Yes; the sample chosen is a random sample, so it is likely to be representative of the population.

7. No; the sample is not likely to be representative of the population because it underrepresents students who do not purchase food frequently in the cafeteria, perhaps because of the lack of variety.

8. $\frac{\text{prefer amusement park}}{\text{sophomores}} = \frac{\text{prefer amusement park}}{\text{sophomores}}$

$\frac{8}{20} = \frac{x}{150}$

$20x = 8 \cdot 150$

$x = 60$ sophomores

9. $\frac{\text{satisfied employees}}{\text{total employees}} = \frac{\text{satisfied employees}}{\text{total employees}}$

$\frac{25}{30} = \frac{x}{210}$

$30x = 25 \cdot 210$

$x = 175$ employees

10. The station manager made a good decision. He announced the poll over the air so the people who responded were already listeners, and they are likely to hear the other announcement about the concert as well. If such a high percentage like the band, they are likely to attend the concert.

11. The chef did not make a good decision. If there are about 1200 customers a week, then there is an average of one-seventh of that, about 171, a night. There were only 110 customers that night, so it was a slow night and therefore a relatively small sample that was not representative of all customers. Also, more customers may have ordered the dish because it was offered at a discounted price and not necessarily because it sounded good to them.

PRACTICE AND PROBLEM SOLVING

12. 250 computers; 25 randomly chosen computers

13. 281 employees; 70 randomly chosen employees

14. customers during the one-day sale; 50 randomly chosen customers

15. all of the junk mail that the family receives; the junk mail received during one week

16. Yes; a convenience sample is not likely to be representative of the population.

17. No; a random sample is likely to be representative of the population.

18. Yes; the friends of the members of the drama club are more likely to pay more for a ticket because they know someone involved in the production.

19. Yes; the sample is not likely to be representative of the population because only people with a strong feeling one way or the other will choose to respond to the survey.

20. No; some of the tourists who experience the nightlife in a city are not likely to be visiting tourist attractions the next morning.

21. Possible answer: One method that could result in a biased sample is to survey only students in line waiting to purchase food. If there aren't many vegetarian items on the menu already, vegetarians are more likely to bring their lunch from home and be underrepresented in the sample. One method that would not be likely to result in a biased sample is to survey every tenth student entering the cafeteria.

22. No; not everyone in the student body will attend the football game.

23. Yes; this method is not likely to under- or overrepresent any group because a wide range of spectators will be surveyed.

24. No; this method does not represent all of the people who could purchase baked goods or raffle tickets.

25. No; this method overrepresents people who are likely to enjoy bake sales.

26. Possible answer: The method is inefficient because some students surveyed will not have seen the production. Also, the students surveyed will be more likely to respond positively, whether they enjoyed the production or not, because they have to respond directly to the dancers from the production.

27. $$\frac{\text{students surveyed who attended}}{\text{total students surveyed}} = \frac{\text{students who attended}}{\text{total students}}$$
$$\frac{25}{100} = \frac{x}{800}$$
$$100x = 25 \cdot 800$$
$$x = 200 \text{ students}$$

28. $$\frac{\text{students surveyed who rode bus}}{\text{total students surveyed}} = \frac{\text{students who rode bus}}{\text{total students}}$$
$$\frac{78}{100} = \frac{x}{800}$$
$$100x = 78 \cdot 800$$
$$x = 624 \text{ students}$$

29. $$\frac{\text{students surveyed who took art}}{\text{total students surveyed}} = \frac{\text{students who took art}}{\text{total students}}$$
$$\frac{82}{100} = \frac{x}{800}$$
$$100x = 82 \cdot 800$$
$$x = 656 \text{ students}$$

30. $$\frac{\text{students surveyed who are members of club}}{\text{total students surveyed}} = \frac{\text{students who are members of club}}{\text{total students}}$$
$$\frac{64}{100} = \frac{x}{800}$$
$$100x = 64 \cdot 800$$
$$x = 512 \text{ students}$$

31. $$\frac{\text{students surveyed who played a sport}}{\text{total students surveyed}} = \frac{\text{students who played a sport}}{\text{total students}}$$
$$\frac{65}{100} = \frac{x}{800}$$
$$100x = 65 \cdot 800$$
$$x = 520 \text{ students}$$

32. Approximately one-third of the approximately 900 students lived in walking distance to the school. This is about 300 students.

33. Possible answer: No, this was not a good decision because the sample is biased. The sample contains only dog owners, who are more likely to favor an off-leash area. The town could make a better decision if they used a different surveying method. For instance, ask every twenty-fifth person who enters the park each evening for a week.

TEST PREP

34. $$\frac{\text{students surveyed who planned to attend}}{\text{total students surveyed}} = \frac{\text{students who planned to attend}}{\text{total students}}$$
$$\frac{25}{80} = \frac{x}{550}$$
$$80x = 25 \cdot 550$$
$$x \approx 172 \text{ students}$$

Answer choice C is correct.

35. Answer choice F, which is a random sample with a larger sample than answer choice G. A random sample is likely to be representative of the population.

CHALLENGE AND EXTEND

36a. By choosing 25 students from each class, the freshmen are overrepresented and the sophomores and the juniors are underrepresented.

b. Possible answer : Choose 19 freshmen, 27 sophomores, 29 juniors, and 25 seniors for the sample.

37. 100 students chosen from 504 students. In this sample, about 1 in every 5 students is surveyed, where the other method results in about 1 in every 7 students surveyed. The greater fraction of students surveyed, the more accurate the results are likely to be.

38. $$\frac{\text{students surveyed who did community service}}{\text{total students surveyed}} = \frac{\text{students who did community service}}{\text{total students}}$$

$$\frac{x}{20} = \frac{646}{760}$$
$$760x = 20 \cdot 646$$
$$x = 17 \text{ students}$$

39. $$\frac{\text{defective discs}}{\text{total discs}} = \frac{\text{defective discs}}{\text{total discs}}$$

$$\frac{2}{50} = \frac{x}{1000}$$
$$50x = 2 \cdot 1000$$
$$x = 40 \text{ defective discs}$$

This represents 4% that are defective. The manufacturer will not sell this lot.

40. Answers will vary.

8-3 SURVEYS, EXPERIMENTS, AND OBSERVATIONAL STUDIES

CHECK IT OUT!

1. It is an observational study because an observation is being conducted without controlling the environment in any way.

2. The treatment in this study is website users using the old and new websites to make purchases. The treatment group is 48 users of the website using the new website to make purchases. The control group is 48 users of the website using the old website to make purchases.

3. The treatment (consuming 1000 milligrams of vitamin C each day as a dietary supplement) is both practical and ethical because it is not known to have any negative effects. Perform an experiment. Randomly choose one group of people to take the vitamin C supplements. Randomly choose another group of people to not take the vitamin C supplements. Monitor the cholesterol levels in both groups at regular intervals.

4. In method A, the researcher gives each group a treatment, so the method is an experiment.
In method B, the researcher asks questions about exercise habits. This method is a survey.
In method C, the researcher observes people who do and do not exercise and monitor their health, but does not impose a treatment. This is an observational study.
Method B is least reliable, because there is no basis for comparison. Method C has a comparison group, but the members are self-selected, which could lead to bias. In method A, the members of each group are randomly selected, which makes the two groups theoretically similar except for the variable, exercise. This method is the most reliable.

THINK AND DISCUSS

1. In an experiment, a treatment is imposed, so the individual or the environment of the individual is affected by the study. This is not the case in an observational study.

2. Possible answer: It would not be ethical to test the effects of exposure to a certain cleaning chemical on people's respiratory health.

3.

Experiment: A baker testing a new brand of yeast bakes 10 loaves with the old brand and 10 with the new brand.	
Control group: 10 loaves with old brand of yeast	**Treatment Group:** 10 loaves with new brand of yeast

EXCERCISES

GUIDED PRACTICE

1. experiment

2. randomized comparative experiment

3. The caretaker applies a treatment (giving half the elephants the new food) to some of the individuals (elephants). The situation is an example of an experiment.

4. The school board gathers data without controlling the individuals or applying a treatment. The situation is an example of an observational study.

5. The treatment in this study is drinking no more soft drinks. The treatment group consists of the fifty students who stopped drinking soft drinks, and the control group consists of the fifty students who continued to drink soft drinks.

6. The treatment in this study is reintroducing the weeds. The treatment group consists of the fish in the lake with the weeds, and the control group consists of the fish in the lake without the weeds.

7. The treatment (exposing pets to second-hand smoke) may affect the pets' health, so it is not ethical to assign individuals to a treatment group. Perform an observational study; Possible answer: Randomly choose one group of pets who are already exposed to second-hand smoke. Randomly choose another group of pets that is not exposed to second-hand smoke. Monitor the health of the pets in both groups at regular intervals.