$$0.5240 < \mu < 0.7624$$

or

$$(0.5240, 0.7624)$$

We are 99% confident that the mean amount of water used per household for brushing teeth is between 0.5240 and 0.7624 gallons per day.

8.3 Section Exercises

Note: *For all exercises in this section, you may assume that the requirements mentioned in this section are met; namely, the population standard deviation is unknown, all samples are simple random samples, and either the sample size is at least 30 or the population distribution is approximately normal.*

Confidence Intervals for Population Means (σ Unknown)

Construct a confidence interval for the population mean at the given level of confidence using the information provided. Assume sample data are simple random samples.

1. $n = 14, \quad \bar{x} = 95.0, \quad s = 4.8, \quad$ level of confidence is 95%

2. $n = 25, \quad \bar{x} = 56, \quad s = 8, \quad$ level of confidence is 90%

3. $n = 8, \quad \bar{x} = 7.0, \quad s = 1.2, \quad$ level of confidence is 99%

4. $n = 13, \quad \bar{x} = 1.97, \quad s = 0.03, \quad$ level of confidence is 98%

5. $c = 0.98$

192	465	321	299	516	256	339	311	407

6. $c = 0.95$

Stem-and-Leaf Plot

Stem	Leaves
2	2 3 3 8 9 9
3	0 1 1 4
4	5 6 7 7 8 8

Key: 2 | 2 = 22

7. Level of confidence is 90%

11	47	95	54	33	64	4	8	57	9	80	32	19
8	90	3	49	4	44	79	80	48	16	64	55	68
31	7	15	21	52	6	78	109	40	50	12	29	22

8. Level of confidence is 80%

Ages of Participants in a Study

Age	Frequency
16	9
17	15
18	16
19	5
20	3

Margins of Error of Confidence Intervals for Population Means (σ Unknown)

Calculate each specified margin of error.

9. The mean distance commuters drove to work each day was estimated to be 40.8 miles from a sample of 45 commuters. The sample standard deviation was 5.8 miles. Calculate the margin of error for a 95% confidence interval.

10. The mean amount of money spent per week on gas by a sample of 25 drivers was found to be \$57.00 with a standard deviation of \$2.36. Calculate the margin of error for a 90% confidence interval. Assume that the population distribution is approximately normal.

Confidence Intervals for Population Means (σ Unknown)

Construct and interpret each specified confidence interval.

11. Wildlife conservationists studying grizzly bears in the United States found that the mean weight of 25 adult male grizzly bears was 600 pounds with a standard deviation of 90 pounds. Construct and interpret a 98% confidence interval for the mean weight of all adult male grizzly bears in the United States. Assume that the weights of all adult male grizzly bears in the United States are normally distributed.

12. The mean length of 12 newly hatched iguanas is 7.00 inches with a standard deviation of 0.75 inches. Construct and interpret a 90% confidence interval for the mean length of all newly hatched iguanas. Assume that the lengths of all newly hatched iguanas are normally distributed.

13. Suppose that you sample 59 high school baseball pitchers in one county and find that they have a mean fastball pitching speed of 80.00 miles per hour (mph) with a standard deviation of 4.98 mph. Find a 95% confidence interval for the mean fastball pitching speed of all high school baseball pitchers in the county. Interpret the interval.

14. Given the following data, construct and interpret a 99% confidence interval for the mean face value of an individual life insurance policy.

Face Values of Individual Life Insurance Policies

Stem	Leaves
15	0 0 0 0 0 0 1 2 2 3 3 4 5 8 9 9
16	0 0 0 2 3 3 3 3 5 5 8 8 8
17	1 1 2 2 2 3 4 5 5 5 6
18	2 2 3 5 5
19	0 0 5 5 5 6
20	0 0 0 0 0 2 2

Key: 15 | 0 = \$150,000

15. The attendance records for a random sample of 28 men's basketball games at one university revealed that the mean number of fans at each game was 4125.0 with a standard deviation of 741.0. To predict ticket sales for next year, the athletic office needs a confidence interval for attendance at these games. Using a confidence level of 95%, construct and interpret a confidence interval for the mean number of fans at men's basketball games at this university. Assume that the population distribution is approximately normal.

16. Suppose you are thinking about getting a puppy and want to know the amount of time people spend caring for puppies. You survey 31 puppy owners and find that the mean amount of time they spend caring for their puppies is 108.0 minutes per day. If the standard deviation is 17.0 minutes, construct a 98% confidence interval for the mean amount of time puppy owners spend on their puppies per day. Interpret the interval.

17. A company that manufactures gas fireplaces wishes to estimate the average amount of heat produced by its newest model. A sample of 35 fireplaces produced an average of 22,770 BTUs of heat with a standard deviation of 320 BTUs. Create a 90% confidence interval for the average amount of heat produced by all of the newest model fireplaces manufactured by this company.

18. A fitness publication wishes to determine the average number of calories contained in a fast food combo meal. A sample of 46 combo meals is selected at random from a variety of fast food restaurants. The average number of calories contained in the sample meals was 860 with a standard deviation of 110 calories. Construct a 99% confidence interval for the average number of calories in all fast food combo meals.

19. As part of a fuel efficiency study, a large school district wishes to estimate the average weekly mileage for its school buses. A sample of 18 buses is selected at random and the mileages are recorded for that week. The same mean was found to be 215 with a standard deviation of 31 miles. Construct a 99% confidence interval for the average weekly mileage for all school buses in the school district. Assume that the population distribution is approximately normal.

20. The following is a random sample of the annual salaries of high school counselors in the United States. Assuming that the distribution of salaries is approximately normal, construct a 90% confidence interval for the mean salary of high school counselors across the United States. Interpret the interval.

$51,050 $38,740 $65,360 $42,640 $55,340 $32,980 $49,540

Respond thoughtfully to the following exercises.

21. Suppose you were told that the confidence interval for a population mean is $(16.30, 19.70)$. Is it possible for you to determine what the margin of error, E, is? If so, what is it?

22. Suppose you are told that a 95% confidence interval for the mean monthly household electric bill in the county where you live is $(205.56, 253.90)$. Is it possible for you to determine how many electric bills were sampled to construct the interval?

23. You are presented with the following reports estimating the mean increase in monthly household spending on gasoline over the past six months. Determine which report you find most convincing and explain your reasoning.

i. Based on a simple random sample of 15 households, we are 98% confident that the mean increase in monthly household spending on gasoline over the past six months is between \$43.65 and \$58.93.

ii. Based on a simple random sample of 52 households, we are 95% confident that the mean increase in monthly household spending on gasoline over the past six months is between \$48.82 and \$52.10.

24. If you were presented with a margin of error of 15,642, would you believe that the margin of error was reported correctly?

Discussion Questions

Discuss each question with your classmates. Focus on the relationships between the parameters in each question.

25. Lisa sets out to survey 500 people; however, only 387 responses were received.

a. How will this decrease in her sample size affect the margin of error for her confidence interval for a population mean?

b. How will this decrease in her sample size affect the width of her confidence interval for a population mean?

26. How will increasing the level of confidence without changing the sample size affect the width of a confidence interval for a population mean?

27. How will increasing the level of confidence without changing the sample size affect the margin of error for a confidence interval for a population mean?

28. Which level of confidence will produce a wider confidence interval for a population mean: a 95% level of confidence or a 99% level of confidence?

29. If you decrease the sample size while keeping the margin of error for a confidence interval for a population mean constant, what effect will this have on the level of confidence?

30. How will the width of a confidence interval for a population mean change if you increase the sample size and keep the same level of confidence?