Problem Set Section 2E

Directions: Answer the following questions.

1. What are the assumptions necessary for making a one-population proportion confidence interval?

2. What are the assumptions necessary for making a one-population mean confidence interval?

3. What are the assumptions necessary for making a one-population bootstrap confidence interval?

4. An experiment was conducted to see what percentage of rats would show empathy toward fellow rats in distress. Of the 30 total rats in the study, 23 showed empathy. What was the sample proportion? What are the critical value Z-scores for 99% confidence? If you cannot remember them, open StatKey at www.lock5stat.com. Go to "theoretical distributions" and click on "normal". You can look up the critical value Z-scores. Use the critical values and the given standard error to calculate the margin of error and construct a 99% confidence interval estimate of the population proportion of rats that show empathy. Convert the upper and lower limits of your confidence interval into percentages.

Standard Error ≈ 0.07725

a) Sample Proportion $\hat{p} = \frac{Number\ of\ Success\ (events)}{Total\ Sample\ Size} =$

b) Critical value Z-scores = ±

c) Margin of Error = $Z \times Standard\ Error$ =

d) Confidence Interval Lower Limit = $\hat{p} - (Margin\ of\ Error)$

e) Confidence Interval Upper Limit = $\hat{p} + (Margin\ of\ Error)$

5. Use the following Statcato printout to check your margin of error and confidence interval answers from the rat empathy data in number 4. Now check the assumptions and write sentences to explain the margin of error and confidence interval.

Number of trials	Number of Events	Sample proportion	Margin of Error	99.0%CI
30	23	0.767	0.199	(0.5678, 0.9656)

a) Check each of the assumptions for this problem. Assume the rats were randomly selected. Explain your answers.

b) Write a sentence to explain the margin of error in context.

c) Write a sentence to explain the confidence interval in context.

6. A study was done on the effectiveness of lie detector tests to catch someone that lies. In a random sample of 48 total lies, the machine identified only 31 of them. What was the sample proportion? What are the critical value Z-scores for 95% confidence? If you cannot remember them, open StatKey at www.lock5stat.com. Go to "theoretical distributions" and click on "normal". You can look up the critical value Z-scores. Use the critical values and the given standard error to calculate the margin of error and construct a 95% confidence interval estimate of the population proportion of lies caught be lie detector tests. Convert the upper and lower limits of your confidence interval into percentages.

Standard Error ≈ 0.0689

a) Sample Proportion $\hat{p} = \frac{Number\ of\ Success\ (events)}{Total\ Sample\ Size} =$

b) Critical value Z-scores = ±

c) Margin of Error = $Z \times Standard\ Error =$

d) Confidence Interval Lower Limit = $\hat{p} - (Margin\ of\ Error)$

e) Confidence Interval Upper Limit = $\hat{p} + (Margin\ of\ Error)$

7. Use the following Statcato printout to check your margin of error and confidence interval answers from the lie detector data in number 6. Now check the assumptions and write sentences to explain the margin of error and confidence interval.

Number of trials	Number of Events	Sample proportion	Margin of Error	95.0%CI
48	31	0.646	0.135	(0.5105, 0.7811)

a) Check each of the assumptions for this problem. Explain your answers.

b) Write a sentence to explain the margin of error in context.

c) Write a sentence to explain the confidence interval in context.

8. We want to determine what percentage of cereals the company Quaker makes. A random sample of 24 cereals found that Quaker made four of them. What was the sample proportion? What are the critical value Z-scores for 90% confidence? If you cannot remember them, open StatKey at www.lock5stat.com. Go to "theoretical distributions" and click on "normal". You can look up the critical value Z-scores. Use the critical values and the given standard error to calculate the margin of error and construct a 90% confidence interval estimate of the population proportion of cereals made by Quaker. Convert the upper and lower limits of your confidence interval into percentages.

Standard Error ≈ 0.076

a) Sample Proportion $\hat{p} = \frac{Number\ of\ Success\ (events)}{Total\ Sample\ Size} =$

b) Critical value Z-scores = ±

c) Margin of Error = $Z \times Standard\ Error =$

d) Confidence Interval Lower Limit = $\hat{p} - (Margin\ of\ Error)$

e) Confidence Interval Upper Limit = $\hat{p} + (Margin\ of\ Error)$

9. Use the following Statcato printout to check your margin of error and confidence interval answers from the cereal data in number 8. Now check the assumptions and write sentences to explain the margin of error and confidence interval.

Number of trials	Number of Events	Sample proportion	Margin of Error	90.0%CI
24	4	0.167	0.125	(0.0415, 0.2918)

a) Check each of the assumptions for this problem. Assume the cereal data was randomly selected. Explain your answers.

b) Write a sentence to explain the margin of error in context.

c) Write a sentence to explain the confidence interval in context.

10. If a cereal has more than nine grams of sugar per serving, we consider it to have a high sugar content. We want to determine what percentage of cereals have a high sugar content. A random sample of 24 cereals found that 10 of them have a high sugar content. What was the sample proportion? What are the critical value Z-scores for 95% confidence? If you cannot remember them, open StatKey at www.lock5stat.com. Go to "theoretical distributions" and then click on "normal". You can look up the critical value Z-scores. Use the critical values and the given standard error to calculate the margin of error and construct a 95% confidence interval estimate of the population proportion of cereals made by Quaker. Convert the upper and lower limits of your confidence interval into percentages.

Standard Error ≈ 0.1006

a) Sample Proportion $\hat{p} = \frac{Number\ of\ Success\ (events)}{Total\ Sample\ Size} =$

b) Critical value Z-scores = ±

c) Margin of Error = $Z \times Standard\ Error =$

d) Confidence Interval Lower Limit = $\hat{p} - (Margin\ of\ Error)$

e) Confidence Interval Upper Limit = $\hat{p} + (Margin\ of\ Error)$

11. Use the following Statcato printout to check your margin of error and confidence interval answers from the cereal data in number 10. Now check the assumptions and write sentences to explain the margin of error and confidence interval.

Number of trials	Number of Events	Sample proportion	Margin of Error	95.0%CI
24	10	0.417	0.197	(0.2194, 0.6139)

a) Check each of the assumptions for this problem. Assume the cereal data was randomly selected. Explain your answers.

b) Write a sentence to explain the margin of error in context.

c) Write a sentence to explain the confidence interval in context.

12. A random sample of 45 high school students has a skewed left distribution. The sample mean average ACT exam score ($\bar{x}$) was 20.8 with a sample standard deviation of 9.868. What is the degrees of freedom? Open StatKey at www.lock5stat.com. Go to "theoretical distributions" and click on "T". Use the degrees of freedom and StatKey to look up the critical value T-scores for a 90% confidence level. Use the critical values and the given standard error to calculate the margin of error and construct a 90% confidence interval estimate of the population mean average ACT exam.

Standard Error = 1.471 ACT points

a) Degrees of Freedom = $n - 1$ =

b) Critical value T-scores = ±

c) Margin of Error = $T \times Standard\ Error$ =

d) Confidence Interval Lower Limit = $\bar{x} - (Margin\ of\ Error)$

e) Confidence Interval Upper Limit = $\bar{x} + (Margin\ of\ Error)$

13. Use the following Statcato printout to check your margin of error and confidence interval answers from the ACT data in number 12. Now check the assumptions and write sentences to explain the margin of error and confidence interval.

Var	N	Mean	Stdev	Margin of Error	90.0%CI
summary	45.0	20.8	9.868	2.472	(18.3284, 23.2716)

a) Check each of the assumptions for this problem. Explain your answers.

b) Write a sentence to explain the margin of error in context.

c) Write a sentence to explain the confidence interval in context.

14. A random sample of body temperatures in degrees Fahrenheit was taken from 50 randomly selected adults. The sample mean temperature of 98.26 °Fand a standard deviation of 0.765 °F. What is the degrees of freedom? Open StatKey at www.lock5stat.com. Go to "theoretical distributions" and click on "T". Use the degrees of freedom and StatKey to look up the critical value T-scores for a 95% confidence level. Use the critical values and the given standard error to calculate the margin of error and construct a 95% confidence interval estimate of the population mean average body temperature.

Standard Error = 0.1082 °F

a) Degrees of Freedom = $n - 1$ =

b) Critical value T-scores = ±

c) Margin of Error = $T \times Standard\ Error$ =

d) Confidence Interval Lower Limit = $\bar{x} - (Margin\ of\ Error)$

e) Confidence Interval Upper Limit = $\bar{x} + (Margin\ of\ Error)$

15. Use the following Statcato printout to check your margin of error and confidence interval answers from the temperature data in number 14. Now check the assumptions and write sentences to explain the margin of error and confidence interval. A histogram of the data has been created with Statcato.

Var	N	Mean	Stdev	Margin of Error	95.0%CI
summary	50.0	98.26	0.765	0.217	(98.0426, 98.4774)
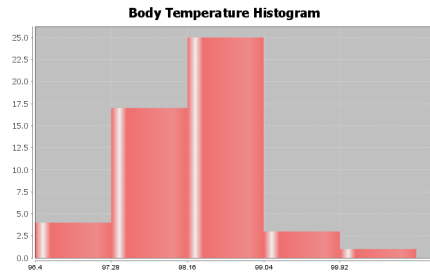
Body Temperature Histogram

a) Check each of the assumptions for this problem. Explain your answers.

b) Write a sentence to explain the margin of error in context.

c) Write a sentence to explain the confidence interval in context.

16. A random sample of cereal sugar content (grams per serving) was taken from 24 cereals. The sample mean average amount of sugar was of 7.208 grams per serving and a standard deviation of 4.634 grams per serving. What is the degrees of freedom? Open StatKey at www.lock5stat.com. Go to "theoretical distributions" and click on "T". Use the degrees of freedom and StatKey to look up the critical value T-scores for a 99% confidence level.   Use the critical values and the given standard error to calculate the margin of error and construct a 99% confidence interval estimate of the population mean average amount of sugar in cereals.

Standard Error = 0.9459 grams

a) Degrees of Freedom = $n - 1$ =

b) Critical value T-scores = $\pm$

c) Margin of Error = $T \times Standard\ Error$ =

d) Confidence Interval Lower Limit = $\bar{x} - (Margin\ of\ Error)$

e) Confidence Interval Upper Limit = $\bar{x} + (Margin\ of\ Error)$

17. Use the following Statcato printout to check your margin of error and confidence interval answers from the sugar in cereals data in number 16. Now check the assumptions and write sentences to explain the margin of error and confidence interval. A histogram of the data has been created with Statcato.

Var	N	Mean	Stdev	Margin of Error	99.0%CI
Sugar (grams per serving)	24.0	7.208	4.634	2.656	(4.5527, 9.8639)
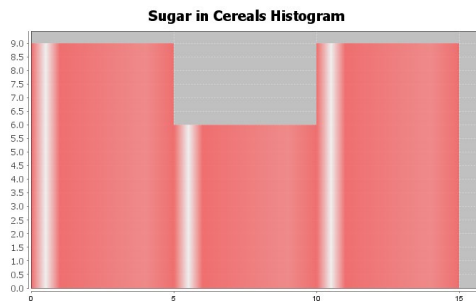
Sugar in Cereals Histogram

a) Check each of the assumptions for this problem. Explain your answers.

b) Write a sentence to explain the margin of error in context.

c) Write a sentence to explain the confidence interval in context.

18. A random sample of cereal carbohydrate content (grams per serving) was taken from 24 cereals. The sample mean average amount of carbs was of 15.043 grams per serving and a standard deviation of 3.596 grams per serving. What is the degrees of freedom? Open StatKey at www.lock5stat.com. Go to "theoretical distributions" and click on "T". Use the degrees of freedom and StatKey to look up the critical value T-scores for a 99% confidence level.   Use the critical values and the given standard error to calculate the margin of error and construct a 99% confidence interval estimate of the population mean average amount of sugar in cereals.

Standard Error = 0.734 grams

a) Degrees of Freedom = $n - 1$ =

b) Critical value T-scores = $\pm$

c) Margin of Error = $T \times Standard\ Error$ =

d) Confidence Interval Lower Limit = $\bar{x} - (Margin\ of\ Error)$

e) Confidence Interval Upper Limit = $\bar{x} + (Margin\ of\ Error)$

19. Use the following Statcato printout to check your margin of error and confidence interval answers from the carbohydrates in cereals data in number 18. Now check the assumptions and write sentences to explain the margin of error and confidence interval. A histogram of the data has been created with Statcato.

Var	N	Mean	Stdev	Margin of Error	99.0%CI
summary	24.0	15.043	3.596	2.061	(12.9824, 17.1036)
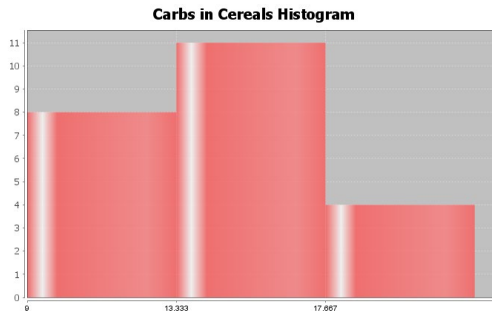
Carbs in Cereals Histogram

a) Check each of the assumptions for this problem. Explain your answers.

b) Write a sentence to explain the margin of error in context.

c) Write a sentence to explain the confidence interval in context.

One-Population Bootstrap Confidence Interval Practice Problems

20. An experiment was conducted to see what percentage of rats would show empathy toward fellow rats in distress. Of the 30 total rats in the study, 23 showed empathy. Go to www.lock5stat.com and click on the "StatKey" tab. Under the "Bootstrap Confidence Intervals" menu, click on "CI for Single Proportion". Click on "Edit Data" and enter 23 for the "count" and 30 for the "sample size". Click on "Generate 1000 Samples" a few times to create the bootstrap sampling distribution for the proportion. Use the bootstrap distribution to find a 99% confidence interval for the population proportion.

a) Does this data meet the assumptions for a bootstrap confidence interval? Explain your answer.

b) How many bootstrap samples did you take?

c) What is the shape of the bootstrap distribution?

d) Write the upper and lower limits of the bootstrap confidence interval. Compare the upper and lower limits of the bootstrap confidence interval to the ones found by the traditional formula with Statcato in #5. Are the close?

e) Write a sentence to explain the bootstrap confidence interval estimate of the population proportion.

21. A study was done on the effectiveness of lie detector tests to catch someone that lies. In a random sample of 48 total lies, the machine identified only 31 of them. Go to www.lock5stat.com and click on the "StatKey" tab. Under the "Bootstrap Confidence Intervals" menu, click on "CI for Single Proportion". Click on "Edit Data" and enter 31 for the "count" and 48 for the "sample size". Click on "Generate 1000 Samples" a few times to create the bootstrap sampling distribution for the proportion. Use the bootstrap distribution to find a 95% confidence interval for the population proportion.

a) Does this data meet the assumptions for a bootstrap confidence interval? Explain your answer.

b) How many bootstrap samples did you take?

c) What is the shape of the bootstrap distribution?

d) Write the upper and lower limits of the bootstrap confidence interval. Compare the upper and lower limits of the bootstrap confidence interval to the ones found by the traditional formula with Statcato in #7. Are the close?

e) Write a sentence to explain the bootstrap confidence interval estimate of the population proportion.

22. We want to determine what percentage of cereals the company Quaker makes. A random sample of 24 cereals found that Quaker made four of them. Go to www.lock5stat.com and click on the "StatKey" tab. Under the "Bootstrap Confidence Intervals" menu, click on "CI for Single Proportion". Click on "Edit Data" and enter 4 for the "count" and 24 for the "sample size". Click on "Generate 1000 Samples" a few times to create the bootstrap sampling distribution for the proportion. Use the bootstrap distribution to find a 90% confidence interval for the population proportion.

a) Does this data meet the assumptions for a bootstrap confidence interval? Explain your answer.

b) How many bootstrap samples did you take?

c) What is the shape of the bootstrap distribution?

d) Write the upper and lower limits of the bootstrap confidence interval. Compare the upper and lower limits of the bootstrap confidence interval to the ones found by the traditional formula with Statcato in #9. Are the close?

e) Write a sentence to explain the bootstrap confidence interval estimate of the population proportion.

23. If a cereal has more than 9 grams of sugar per serving, we consider it to have a high sugar content. We want to determine what percentage of cereals have a high sugar content. A random sample of 24 cereals found that 10 of them have a high sugar content. Go to www.lock5stat.com and click on the "StatKey" tab. Under the "Bootstrap Confidence Intervals" menu, click on "CI for Single Proportion". Click on "Edit Data" and enter 10 for the "count" and 24 for the "sample size". Click on "Generate 1000 Samples" a few times to create the bootstrap sampling distribution for the proportion. Use the bootstrap distribution to find a 95% confidence interval for the population proportion.

a) Does this data meet the assumptions for a bootstrap confidence interval? Explain your answer.

b) How many bootstrap samples did you take?

c) What is the shape of the bootstrap distribution?

d) Write the upper and lower limits of the bootstrap confidence interval. Compare the upper and lower limits of the bootstrap confidence interval to the ones found by the traditional formula with Statcato in #11. Are the close?

e) Write a sentence to explain the bootstrap confidence interval estimate of the population proportion.

24. Go to www.matt-teachout.org, click on "Statistics" and then "Data Sets". Open the "cereal data" in excel. Copy the column of data labeled "sugar (grams per serving)". Go to www.lock5stat.com and click on the "StatKey" tab. Under the "Bootstrap Confidence Intervals" menu, click on "CI for Single Mean, Median, St.Dev." Click on "Bootstrap Dot plot of Mean". Now click on "Edit Data" and paste the sugar data into StatKey. Click on "Generate 1000 Samples" a few times to create the bootstrap sampling distribution for the mean. Use the bootstrap distribution to find a 99% confidence interval for the population mean.

a) Does this data meet the assumptions for a bootstrap confidence interval? Assume the data was collected randomly. Explain your answer.

b) How many bootstrap samples did you take?

c) What is the shape of the bootstrap distribution for the mean?

d) Write the upper and lower limits of the bootstrap confidence interval for the population mean. Compare the upper and lower limits of the bootstrap confidence interval to the ones found by the traditional formula with Statcato in #17. Are the close?

e) Write a sentence to explain the bootstrap confidence interval estimate of the population mean.

We can also use bootstrapping to estimate the population median average amount of sugar in cereals. Click on "Bootstrap Dot plot of Median". Use the bootstrap distribution to find a 99% confidence interval for the population median.

f) What is the shape of the bootstrap distribution for the median?

g) Write the upper and lower limits of the bootstrap confidence interval for the population median.

h) Write a sentence to explain the bootstrap confidence interval estimate of the population median.

25. Go to www.matt-teachout.org, click on "Statistics" and then "Data Sets". Open the "cereal data" in excel. Copy the column of data labeled "carbs (grams per serving)". Go to www.lock5stat.com and click on the "StatKey" tab. Under the "Bootstrap Confidence Intervals" menu, click on "CI for Single Mean, Median, St.Dev." Click on "Bootstrap Dot plot of Mean". Now click on "Edit Data" and paste the carb data into StatKey. Click on "Generate 1000 Samples" a few times to create the bootstrap sampling distribution for the mean. Use the bootstrap distribution to find a 95% confidence interval for the population mean.

a) Does this data meet the assumptions for a bootstrap confidence interval? Assume the data was collected randomly. Explain your answer.

b) How many bootstrap samples did you take?

c) What is the shape of the bootstrap distribution for the mean?

d) Write the upper and lower limits of the bootstrap confidence interval for the population mean. Compare the upper and lower limits of the bootstrap confidence interval to the ones found by the traditional formula with Statcato in #19. Are the close?

e) Write a sentence to explain the bootstrap confidence interval estimate of the population mean.

We can also use bootstrapping to estimate the population median average amount of carbohydrates in cereals. Click on "Bootstrap Dot plot of Median". Use the bootstrap distribution to find a 95% confidence interval for the population median.

f) What is the shape of the bootstrap distribution for the median?

g) Write the upper and lower limits of the bootstrap confidence interval for the population median.

h) Write a sentence to explain the bootstrap confidence interval estimate of the population median.

26. Go to www.matt-teachout.org, click on "Statistics" and then "Data Sets". Open the "bear data" in excel. Copy the column of data labeled "weight in pounds". Go to www.lock5stat.com and click on the "StatKey" tab. Under the "Bootstrap Confidence Intervals" menu, click on "CI for Single Mean, Median, St.Dev." Click on "Bootstrap Dot plot of Mean". Now click on "Edit Data" and paste the bear weight data into StatKey. Click on "Generate 1000 Samples" a few times to create the bootstrap sampling distribution for the mean. Use the bootstrap distribution to find a 90% confidence interval for the population mean average weight of bears.

a) Does this data meet the assumptions for a bootstrap confidence interval? Assume the data was collected randomly. Explain your answer.

b) How many bootstrap samples did you take?

c) What is the shape of the bootstrap distribution for the mean?

d) Write the upper and lower limits of the bootstrap confidence interval for the population mean.

e) Write a sentence to explain the bootstrap confidence interval estimate of the population mean.

We can also use bootstrapping to estimate the population median average weight of bears. Click on "Bootstrap Dot plot of Median". Use the bootstrap distribution to find a 90% confidence interval for the population median.

f) What is the shape of the bootstrap distribution for the median?

g) Write the upper and lower limits of the bootstrap confidence interval for the population median.

h) Write a sentence to explain the bootstrap confidence interval estimate of the population median.

27. Go to www.matt-teachout.org, click on "Statistics" and then "Data Sets". Open the "bear data" in excel. Copy the column of data labeled "length in inches". Do not click on "head length" by mistake. We want the overall length of the bears. Go to www.lock5stat.com and click on the "StatKey" tab. Under the "Bootstrap Confidence Intervals" menu, click on "CI for Single Mean, Median, St.Dev." Click on "Bootstrap Dot plot of Mean". Now click on "Edit Data" and paste the bear length data into StatKey. Click on "Generate 1000 Samples" a few times to create the bootstrap sampling distribution for the mean. Use the bootstrap distribution to find a 99% confidence interval for the population mean average length of bears.

a) Does this data meet the assumptions for a bootstrap confidence interval? Assume the data was collected randomly. Explain your answer.

b) How many bootstrap samples did you take?

c) What is the shape of the bootstrap distribution for the mean?

d) Write the upper and lower limits of the bootstrap confidence interval for the population mean.

e) Write a sentence to explain the bootstrap confidence interval estimate of the population mean.

We can also use bootstrapping to estimate the population median average length of bears. Click on "Bootstrap Dot plot of Median". Use the bootstrap distribution to find a 99% confidence interval for the population median.

f) What is the shape of the bootstrap distribution for the median?

g) Write the upper and lower limits of the bootstrap confidence interval for the population median.

h) Write a sentence to explain the bootstrap confidence interval estimate of the population median.