

## Problem Set Section 2B

Directions: Answer the following questions about sampling distributions.

1. Describe the process of making a sampling distribution.
2. What can sampling distributions tell us about sampling variability?
3. What is a point estimate? Discuss how point estimates create confusion for people reading articles and scientific reports.
4. Discuss the shape of sampling distributions. When the population is skewed, is the sampling distribution always normal? Why is it important for a sampling distribution to be normal? In the examples in this section, which statistics had a normal sampling distribution? Which statistics had a skewed sampling distribution?
5. Explain how the standard error is calculated. What does the standard error tell us about sample statistics and the population parameter? Why is the standard error only accurate when the sampling distribution is normal?
6. What is the difference between standard error and margin of error? Is the standard error smaller or larger than the margin of error?

(#7-16) For the following problems, copy the indicated census data set from the Math 140 Survey Data Fall 2015 at [www.matt-teachout.org](http://www.matt-teachout.org). We will be assuming this is an unbiased census and therefore know the population mean. Open StatKey at [www.lock5stat.com](http://www.lock5stat.com). Under the “sampling distributions” menu, click on “mean”. You should see “sampling distribution for the mean”. Under “edit data” paste in the indicated data set. Under “choose samples of size n”, put in the indicated sample size. Create a sampling distribution and then answer the following questions.

7. Use StatKey to create a sampling distribution with sample size 10 from the Age in Years census data (Math 140 Survey Data Fall 2015).
  - a) What was the shape and mean average of the population?
  - b) Were all the sample means the same as the population mean?
  - c) Were all the sample means the same as each other?
  - d) How many random samples did you take when you created the sampling distribution?
  - e) What is the shape of the sampling distribution?
  - f) What is the center (mean) of the sampling distribution? Is it relatively close to the population mean?
  - g) What is the standard error? Write a sentence explaining the meaning of the standard error.
8. Use StatKey to create a sampling distribution with sample size 100 from the Age in Years census data (Math 140 Survey Data Fall 2015).
  - a) What was the shape and mean average of the population?
  - b) Were all the sample means the same as the population mean?
  - c) Were all the sample means the same as each other?
  - d) How many random samples did you take when you created the sampling distribution?
  - e) What is the shape of the sampling distribution?
  - f) What is the center (mean) of the sampling distribution? Is it relatively close to the population mean?
  - g) What is the standard error? Write a sentence explaining the meaning of the standard error.
  - h) How does the standard error for sample size 10 compare to the standard error for sample size 100?
  - i) How does the shape of the sampling distribution for sample size 10 compare to the shape of the sampling distribution for sample size 100?
9. Use StatKey to create a sampling distribution with sample size 10 from the sleep hours per night census data (Math 140 Survey Data Fall 2015).
  - a) What was the shape and mean average of the population?
  - b) Were all the sample means the same as the population mean?
  - c) Were all the sample means the same as each other?
  - d) How many random samples did you take when you created the sampling distribution?
  - e) What is the shape of the sampling distribution?



- f) What is the center (mean) of the sampling distribution? Is it relatively close to the population mean?
- g) What is the standard error? Write a sentence explaining the meaning of the standard error.

10. Use StatKey to create a sampling distribution with sample size 25 from the sleep hours per night census data (Math 140 Survey Data Fall 2015).

- a) What was the shape and mean average of the population?
- b) Were all the sample means the same as the population mean?
- c) Were all the sample means the same as each other?
- d) How many random samples did you take when you created the sampling distribution?
- e) What is the shape of the sampling distribution?
- f) What is the center (mean) of the sampling distribution? Is it relatively close to the population mean?
- g) What is the standard error? Write a sentence explaining the meaning of the standard error.
- h) How does the standard error for sample size 10 compare to the standard error for sample size 25?
- i) How does the shape of the sampling distribution for sample size 10 compare to the shape of the sampling distribution for sample size 25?

11. Use StatKey to create a sampling distribution with sample size 10 from the cell phone bill (in dollars per month) census data (Math 140 Survey Data Fall 2015).

- a) What was the shape and mean average of the population?
- b) Were all the sample means the same as the population mean?
- c) Were all the sample means the same as each other?
- d) How many random samples did you take when you created the sampling distribution?
- e) What is the shape of the sampling distribution?
- f) What is the center (mean) of the sampling distribution? Is it relatively close to the population mean?
- g) What is the standard error? Write a sentence explaining the meaning of the standard error.

12. Use StatKey to create a sampling distribution with sample size 100 from the cell phone bill (in dollars per month) census data (Math 140 Survey Data Fall 2015).

- a) What was the shape and mean average of the population?
- b) Were all the sample means the same as the population mean?
- c) Were all the sample means the same as each other?
- d) How many random samples did you take when you created the sampling distribution?
- e) What is the shape of the sampling distribution?
- f) What is the center (mean) of the sampling distribution? Is it relatively close to the population mean?
- g) What is the standard error? Write a sentence explaining the meaning of the standard error.
- h) How does the standard error for sample size 10 compare to the standard error for sample size 100?
- i) How does the shape of the sampling distribution for sample size 10 compare to the shape of the sampling distribution for sample size 100?

13. Use StatKey to create a sampling distribution with sample size 10 from the travel time to get to school in minutes (Math 140 Survey Data Fall 2015).

- a) What was the shape and mean average of the population?
- b) Were all the sample means the same as the population mean?
- c) Were all the sample means the same as each other?
- d) How many random samples did you take when you created the sampling distribution?
- e) What is the shape of the sampling distribution?
- f) What is the center (mean) of the sampling distribution? Is it relatively close to the population mean?
- g) What is the standard error? Write a sentence explaining the meaning of the standard error.

14. Use StatKey to create a sampling distribution with sample size 40 from the travel time to get to school in minutes (Math 140 Survey Data Fall 2015).

- a) What was the shape and mean average of the population?
- b) Were all the sample means the same as the population mean?
- c) Were all the sample means the same as each other?



- d) How many random samples did you take when you created the sampling distribution?
- e) What is the shape of the sampling distribution?
- f) What is the center (mean) of the sampling distribution? Is it relatively close to the population mean?
- g) What is the standard error? Write a sentence explaining the meaning of the standard error.
- h) How does the standard error for sample size 10 compare to the standard error for sample size 40?
- i) How does the shape of the sampling distribution for sample size 10 compare to the shape of the sampling distribution for sample size 40?

15. Use StatKey to create a sampling distribution with sample size 10 from the work hours per week for COC college students (Math 140 Survey Data Fall 2015).

- a) What was the shape and mean average of the population?
- b) Were all the sample means the same as the population mean?
- c) Were all the sample means the same as each other?
- d) How many random samples did you take when you created the sampling distribution?
- e) What is the shape of the sampling distribution?
- f) What is the center (mean) of the sampling distribution? Is it relatively close to the population mean?
- g) What is the standard error? Write a sentence explaining the meaning of the standard error.

16. Use StatKey to create a sampling distribution with sample size 40 from the work hours per week for COC college students (Math 140 Survey Data Fall 2015).

- a) What was the shape and mean average of the population?
- b) Were all the sample means the same as the population mean?
- c) Were all the sample means the same as each other?
- d) How many random samples did you take when you created the sampling distribution?
- e) What is the shape of the sampling distribution?
- f) What is the center (mean) of the sampling distribution? Is it relatively close to the population mean?
- g) What is the standard error? Write a sentence explaining the meaning of the standard error.
- h) How does the standard error for sample size 10 compare to the standard error for sample size 40?
- i) How does the shape of the sampling distribution for sample size 10 compare to the shape of the sampling distribution for sample size 40?

(#17-26) The following population proportions come from the Math 140 Survey Data Fall 2015 at [www.matt-teachout.org](http://www.matt-teachout.org). We will be assuming this is an unbiased census and therefore know the population proportion (%). Open StatKey at [www.lock5stat.com](http://www.lock5stat.com). Under the “sampling distributions” menu, click on “proportion”. You should see “sampling distribution for a proportion”. Under “edit proportion”, enter the given population proportion. Create a sampling distribution and then answer the following questions.

17. A census of COC statistics students in the fall 2015 semester indicated that the population proportion of statistics students with brown hair is 0.537. Use this population proportion to create a sampling distribution with sample size 10 with StatKey.

- a) Were all the sample proportions the same as the population proportion?
- b) Were all the sample proportions the same as each other?
- c) How many random samples did you take when you created the sampling distribution?
- d) What is the shape of the sampling distribution?
- e) What is the center (mean) of all the sample proportions in the sampling distribution? Is it relatively close to the population proportion ( $\pi$ )?
- f) What is the standard error? Write a sentence explaining the meaning of the standard error.

18. A census of COC statistics students in the fall 2015 semester indicated that the population proportion of statistics students with brown hair is 0.537. Use this population proportion to create a sampling distribution with sample size 100 with StatKey.

- a) Were all the sample proportions the same as the population proportion?
- b) Were all the sample proportions the same as each other?
- c) How many random samples did you take when you created the sampling distribution?
- d) What is the shape of the sampling distribution?



- e) What is the center (mean) of all the sample proportions in the sampling distribution? Is it relatively close to the population proportion ( $\pi$ )?
- f) What is the standard error? Write a sentence explaining the meaning of the standard error.
- g) How does the standard error for sample size 10 compare to the standard error for sample size 100?
- h) How does the shape of the sampling distribution for sample size 10 compare to the shape of the sampling distribution for sample size 100?

19. A census of COC statistics students in the fall 2015 semester indicated that the population proportion of statistics students that smoke cigarettes is 0.091. Use this population proportion to create a sampling distribution with sample size 10 with StatKey.

- a) Were all the sample proportions the same as the population proportion?
- b) Were all the sample proportions the same as each other?
- c) How many random samples did you take when you created the sampling distribution?
- d) What is the shape of the sampling distribution?
- e) What is the center (mean) of all the sample proportions in the sampling distribution? Is it relatively close to the population proportion ( $\pi$ )?
- f) What is the standard error? Write a sentence explaining the meaning of the standard error.

20. A census of COC statistics students in the fall 2015 semester indicated that the population proportion of statistics students that smoke cigarettes is 0.091. Use this population proportion to create a sampling distribution with sample size 100 with StatKey.

- a) Were all the sample proportions the same as the population proportion?
- b) Were all the sample proportions the same as each other?
- c) How many random samples did you take when you created the sampling distribution?
- d) What is the shape of the sampling distribution?
- e) What is the center (mean) of all the sample proportions in the sampling distribution? Is it relatively close to the population proportion ( $\pi$ )?
- f) What is the standard error? Write a sentence explaining the meaning of the standard error.
- g) How does the standard error for sample size 10 compare to the standard error for sample size 100?
- h) How does the shape of the sampling distribution for sample size 10 compare to the shape of the sampling distribution for sample size 100?

21. Approximately 60% of college students in the U.S. were able to finish their bachelor's degree in six years. Use this population proportion to create a sampling distribution with sample size 10 with StatKey.

- a) Were all the sample proportions the same as the population proportion?
- b) Were all the sample proportions the same as each other?
- c) How many random samples did you take when you created the sampling distribution?
- d) What is the shape of the sampling distribution?
- e) What is the center (mean) of all the sample proportions in the sampling distribution? Is it relatively close to the population proportion ( $\pi$ )?
- f) What is the standard error? Write a sentence explaining the meaning of the standard error.

22. Approximately 60% of college students in the U.S. were able to finish their bachelor's degree in six years. Use this population proportion to create a sampling distribution with sample size 100 with StatKey.

- a) Were all the sample proportions the same as the population proportion?
- b) Were all the sample proportions the same as each other?
- c) How many random samples did you take when you created the sampling distribution?
- d) What is the shape of the sampling distribution?
- e) What is the center (mean) of all the sample proportions in the sampling distribution? Is it relatively close to the population proportion ( $\pi$ )?
- f) What is the standard error? Write a sentence explaining the meaning of the standard error.
- g) How does the standard error for sample size 10 compare to the standard error for sample size 100?
- h) How does the shape of the sampling distribution for sample size 10 compare to the shape of the sampling distribution for sample size 100?



23. Approximately 9.4% of all adults in the U.S. have diabetes. Use this population proportion to create a sampling distribution with sample size 10 with StatKey.

- a) Were all the sample proportions the same as the population proportion?
- b) Were all the sample proportions the same as each other?
- c) How many random samples did you take when you created the sampling distribution?
- d) What is the shape of the sampling distribution?
- e) What is the center (mean) of all the sample proportions in the sampling distribution? Is it relatively close to the population proportion ( $\pi$ )?
- f) What is the standard error? Write a sentence explaining the meaning of the standard error.

24. Approximately 9.4% of all adults in the U.S. have diabetes. Use this population proportion to create a sampling distribution with sample size 100 with StatKey.

- a) Were all the sample proportions the same as the population proportion?
- b) Were all the sample proportions the same as each other?
- c) How many random samples did you take when you created the sampling distribution?
- d) What is the shape of the sampling distribution?
- e) What is the center (mean) of all the sample proportions in the sampling distribution? Is it relatively close to the population proportion ( $\pi$ )?
- f) What is the standard error? Write a sentence explaining the meaning of the standard error.
- g) How does the standard error for sample size 10 compare to the standard error for sample size 100?
- h) How does the shape of the sampling distribution for sample size 10 compare to the shape of the sampling distribution for sample size 100?

25. Approximately 90% of all lung cancer cases are caused by cigarette smoking. Use this population proportion to create a sampling distribution with sample size 10 with StatKey.

- a) Were all the sample proportions the same as the population proportion?
- b) Were all the sample proportions the same as each other?
- c) How many random samples did you take when you created the sampling distribution?
- d) What is the shape of the sampling distribution?
- e) What is the center (mean) of all the sample proportions in the sampling distribution? Is it relatively close to the population proportion ( $\pi$ )?
- f) What is the standard error? Write a sentence explaining the meaning of the standard error.

26. Approximately 90% of all lung cancer cases are caused by cigarette smoking. Use this population proportion to create a sampling distribution with sample size 100 with StatKey.

- a) Were all the sample proportions the same as the population proportion?
- b) Were all the sample proportions the same as each other?
- c) How many random samples did you take when you created the sampling distribution?
- d) What is the shape of the sampling distribution?
- e) What is the center (mean) of all the sample proportions in the sampling distribution? Is it relatively close to the population proportion ( $\pi$ )?
- f) What is the standard error? Write a sentence explaining the meaning of the standard error.
- g) How does the standard error for sample size 10 compare to the standard error for sample size 100?
- h) How does the shape of the sampling distribution for sample size 10 compare to the shape of the sampling distribution for sample size 100?

