

7.1.1: Exercises

1. In 2022, the average student loan debt for federal loans was \$37,358. A student at UCLA wants to know if the average student loan debt for federal loans at his institution is more than \$37,358. He randomly surveyed 120 UCLA students with federal loan debt and found the average was \$39,532 with a standard deviation of \$8,067.

a. In this study, what is the sample?

b. In this study, what is the sample statistic?

c. In this study, what is the population?

d. In this study, what is the population parameter that the sample statistic is estimating?

2. Go to the website: <http://www.rossmanchance.com/applets/OneSample.html?population=model>

a. By selecting “Show Sampling Options,” you can simulate random sampling of the population. The sample means of these simulated samples will be displayed in the “Statistics” plot. Follow the directions below to use the simulation:

- Select “Show Sampling Options”
- Set the Number of Samples to 1000
- Set the Sample size (n) to 10
- Click “Draw Samples” to plot the distribution of sample means in the plot on the right. The middle plot displays the most recent sample created by the simulation.
 - Write the mean, standard deviation, and shape of the distribution of sample means (the plot on the right).

- Set the Sample size (n) to 20
- Click “Draw Samples” to plot the distribution of sample means in the plot on the right. The middle plot displays the most recent sample created by the simulation.
 - Write the mean, standard deviation, and shape of the distribution of sample means (the plot on the right).

- Set the Sample size (n) to 30
- Click “Draw Samples” to plot the distribution of sample means in the plot on the right. The middle plot displays the most recent sample created by the simulation.
 - Write the mean, standard deviation, and shape of the distribution of sample means (the plot on the right).

- As the sample size increases, how does the mean, standard deviation (called the standard error when working with a sampling distribution), and shape of the distribution of sample means change?

b. Now we will analyze the sampling distribution of sample means when samples are taken from a **skewed population**:

- Change the drop-down next to “Population Shape” from “Normal” to “Skewed Right” and click the “Set Population” button below
- Set the Sample size (n) to 10
- Click “Draw Samples” to plot the distribution of sample means in the plot on the right. The middle plot displays the most recent sample created by the simulation.
 - Write the mean, standard deviation, and shape of the distribution of sample means (the plot on the right).

- Set the Sample size (n) to 20
- Click “Draw Samples” to plot the distribution of sample means in the plot on the right. The middle plot displays the most recent sample created by the simulation.
 - Write the mean, standard deviation, and shape of the distribution of sample means (the plot on the right).

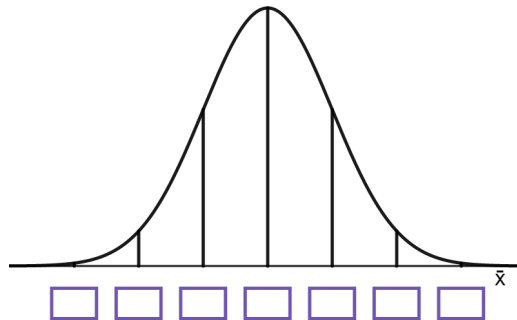
- Set the Sample size (n) to 40
- Click “Draw Samples” to plot the distribution of sample means in the plot on the right. The middle plot displays the most recent sample created by the simulation.
 - Write the mean, standard deviation, and shape of the distribution of sample means (the plot on the right).

- As the sample size increases, how does the mean, standard deviation (called the standard error when working with a sampling distribution), and shape of the distribution of sample means change?

3. The average time it takes corn to germinate is 8 days with a standard deviation of 2.5 days. Germination depends on soil temperature and moisture conditions. A farmer has a variety of corn plots and wants to know about the quality of the soil by measuring the average germination for various plots. She plants 40 corn seeds in each plot.

- a. Find the mean and standard error (rounded to three decimal places) of the sampling distribution of sample means.
- b. A sampling distribution is a description of all possible values of a statistic. What does this sampling distribution represent?
- c. Is this sampling distribution approximately normal? Explain why or why not.

- d. The boxes under the normal distribution below are one standard error apart, with the center box located under the mean. Use the mean and standard error you calculated in a. to label the horizontal axis.



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- e. Use the empirical rule to find the interval centered at that contains approximately 95% of all sample means.
- f. What sample means would you consider unusual?
- g. In one plot of corn, the average germination time was 9 days. Calculate the Z-score for this sample mean. Round to two decimal places.
- h. The farmer can conclude that the soil needs improvement if germination takes too long. What is the probability of observing a plot in which seeds take an average of 9 or more days to germinate?

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