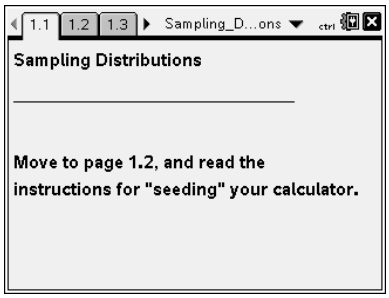
Sampling Distributions
Student Activity

Name _____
Class _____

Open the TI-Nspire document *Sampling_Distributions*.



What is a sampling distribution of a statistic? A **sampling distribution** is the distribution of values of a given statistic based on all possible samples of a given size from a given population. In this activity, you will explore and describe the sampling distribution of the sample mean by creating and observing the means of a number of different samples from a given population.

Move to page 1.2.

Press ctrl ▶ and ctrl ◀ to navigate through the lesson.

This activity involves generating a number of random samples from a population. In order to avoid having your results be identical to another student in the room, it is necessary to "seed" the random number generator. Read the instructions on page 1.2 for seeding your random number generator.

Move to page 2.1.

1. The graph on this page shows a normal distribution with mean 0 and standard deviation 1, representing a population of values. Recall the empirical rule and your knowledge of normal distributions. Predict what you expect as the shape, center, and spread of the distribution of values randomly selected from this population.

2. Each time you click the up arrow (▲) on the slider labeled "draw," you will generate a random sample of size 10 from the given population. The members of your sample will be displayed as dots on the *x*-axis. Click to select your first sample. Even though you have selected only 10 values from the population, do they seem to support your predictions in Question 1? Look particularly at the center and spread of the values selected in your sample. Explain.

3. In addition to the 10 dots that make up your sample, a vertical line is displayed on your plot. What do you think it represents? Explain your reasoning.

4. Think about the variability among the dots that make up your sample and the variability among the vertical $\bar{x}$ lines for several different samples.
   a. Use *draw* to select another sample (still of size 10). Record the value of $\bar{x}$ and write a short description of how the individual dots of your sample are distributed (look back at Question 2).

   b. Repeat part a four more times. Then describe how the $\bar{x}$ lines vary compared to how the individual dots of the samples vary.

   c. Predict the center, spread, and shape of the distribution that would be formed by all $\bar{x}$ values from a large number of samples. Explain.

Move to page 3.1.

5. The top screen on page 3.1 shows the same population that you dealt with in Questions 1–4. A new dot plot has been added in the lower screen.
   a. Click *draw* a few times and describe what seems to be happening in the lower dot plot.

   b. What variable do you think is being plotted in the dot plot?

6. Click *draw* 10 or 15 times to generate more dots in the dot plot. Does the dot plot seem to confirm the predictions you made in Question 4 about the center, spread, and shape of the distributions of the $\bar{x}$ values from a large number of samples? Explain.

7. You know several measures of spread. Think of one of those measures.
   a. Without doing any actual calculations, estimate the values of that measure of spread, first for the set of individual values in your samples themselves, and then for the set of dots in the dot plot of the lower screen on page 3.1.

   b. How do these two numbers (measures of spread) compare? Explain any differences you see.

Move to page 3.2.

8. The top screen on page 3.2 is an exact copy of the lower screen on page 3.1, with which you have been working. The lower screen displays the same data ($\bar{x}$ values from your samples) in a histogram. Comment on which display seems best for seeing the overall shape of the distribution. Explain your reasoning.

Return to page 3.1.

9. Click *draw* many more times (for about a total of 100).
   a. Does the dot plot seem to confirm your earlier predictions about the distribution of sample means? Explain why your prediction seems reasonable.

   b. In Question 7 you estimated a measure of spread for the sampling distribution of sample means and compared the variability among sample means to the variability within the population itself. Revise that estimate and comparison based on this larger simulation.

Return to page 3.2.

10. a. Which graph type seems most appropriate for this larger simulation? Explain.

    b. Describe the shape of the distribution of sample means. Estimate the mean and standard deviation of this distribution.

Move to page 3.3.

The plot on page 3.3 is an exact copy of the histogram you examined on page 3.2 but has an "adjustable" normal curve in the window. You control the appearance of that curve by clicking on the up arrows (▲) to select your choices for mean and standard deviation.

11. Use the up arrows (▲) to set the mean and standard deviation to match the estimates you made in Question 10. Then re-adjust the values if necessary so that they seem to fit your histogram as well as possible. Record your final values for mean and standard deviation. Comment on the accuracy of your predictions.

Move to page 4.1.

12. On page 4.1, you can take samples of sizes other than 10 by changing the value of *n*. Repeat the "sample-size-10" explorations you carried out in Questions 9–11, this time using a different sample size. Comment on how changing the sample size affects the center, spread, and shape of the distribution of $\bar{x}$. Be as specific as possible, indicating what happens when the sample size increases and what happens when the sample size decreases.

    Note: Type **reset()** in the right-hand panel of this page to erase an exploration using one sample size in order to begin another exploration with another sample size.

13. Write a brief description to explain what you learned about a sampling distribution of a sample statistic for someone who did not do this activity.