



## Math Objectives

- Students will recognize that elements of a sample from a normal population will vary symmetrically around the mean of the population, with values near the mean occurring more frequently than those further from the mean.
- Students will recognize that as sample size increases, variability (spread) in the sampling distribution of sample means decreases.

## Vocabulary

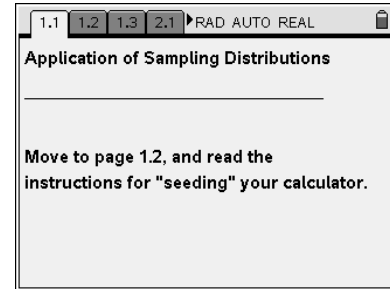
- histogram
- mean
- normal distribution
- population
- sample
- sample mean
- sampling distribution
- standard deviation

## About the Lesson

- This lesson involves examining samples from a normal population and observing the distribution of the means of those samples.
- As a result, students will understand that the sample mean varies from sample to sample, having its own distribution.
- Students will estimate descriptive measures for the sampling distribution and use those measures to approximate the simulated sampling distribution by selecting the mean and standard deviation for overlaying a normal curve.
- As a result, students will understand that the standard deviation becomes smaller as the sample size increases.

## TI-Nspire™ Navigator™ System

- Send the .tns file to students.
- Use Screen Capture to display multiple distributions.
- Use Quick Poll to compare student sample means.



## TI-Nspire™ Technology Skills:

- Download a TI-Nspire document
- Open a document
- Move between pages
- Operate a minimized slider

## Tech Tips:

- Make sure the font size on your TI-Nspire handhelds is set to Medium.

## Lesson Materials:

### *Student Activity*

Application\_of\_Sampling\_Distributions\_Student.pdf

Application\_of\_Sampling\_Distributions\_Student.doc

### *TI-Nspire document*

Application\_of\_Sampling\_Distributions.tns

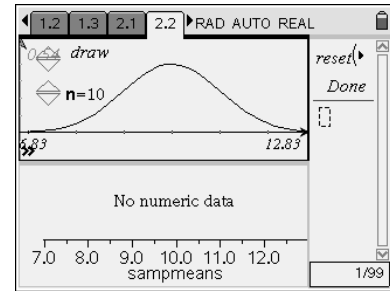


### Discussion Points and Possible Answers

**Tech Tip:** Page 1.2 gives instructions on how to seed the random number generator on the TI-Nspire. Page 1.3 is a *Calculator* page for the seeding process. Ensuring that students carry out this step will prevent students from generating identical data. (Syntax: RandSeed #, where # is a number unique to each student.)

#### Move to page 2.2.

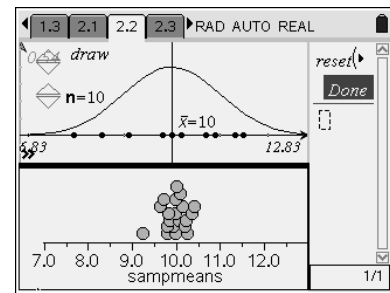
1. Move to page 2.2. Click the up arrow (▲) for **draw** once. What is shown in the top graph? How does it relate to the scenario?



**Sample Answer:** The 10 dots on the x-axis are the 10 boxes of crackers that were sampled. The line is the mean weight of the 10 boxes. The mean,  $\bar{x} = 10.1$ , of this sample is 10.1 ounces.

**Teacher Tip:** The elements that make up the sample come from the population. Thus, the population's characteristics should be reflected in the distribution of those sample elements. The values of individual elements in the samples should fall approximately symmetrically around 10, with a mean near 10. It will be rare to find values as large as 13 or as small as 7, but values as extreme as 8 or 12 should occur occasionally. Discuss these ideas after students have completed Question 2.

2. Click the up arrow 19 more times. Observe the bottom graph.
  - a. How are the sample means distributed?



**Sample Answer:** The dots are accumulating on either side of 10, roughly symmetrically. It looks as though the center of this set of dots might be 10, and the spread is noticeably smaller than that of any of the individual samples themselves.

- b. If you were the president of the company, would you be happy with this distribution? Explain your answer.

**Sample Answer:** Yes. Most of the means are at 10, with the rest falling very close to 10. This means that most of the boxes should have been packaged correctly with 10 ounces.

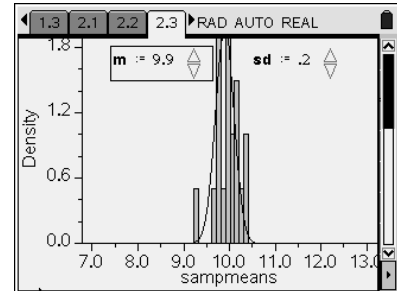


**Teacher Tip:** To help with the understanding of the next several questions, have students click on the leftmost and the rightmost dot in the bottom graph. This will give students the range of the sample means when  $n = 10$ . They should repeat this exercise for Question 4 parts a, b, and c when  $n = 15, 20,$  and  $25$ .

Move to page 2.3.

- Use the sliders to fit the curve to the histogram. Record  $m$ , the mean, and  $sd$ , the standard deviation.

**Sample Answer:**  $m = 9.9$  and  $sd = 0.2$



**Teacher Tip:** If students are having trouble fitting the curve to the histogram because the histogram does not follow the bell shape, have them go back to page 2.2 and generate 10–30 more draws.

- Move back to page 2.2. Press  $\text{2nd} \rightarrow \text{enter}$  in the *Calculator* application to reset the data. Increase  $n$  to 15. Press the up arrow for **draw** 20 times. Go to page 2.3 and match the curve to the histogram. Record  $m$  and  $sd$ .

**Answer:** The mean should be around 10, and the standard deviation should be less than in Question 3.

- Repeat part a using  $n = 20$ .

**Answer:** The mean should be around 10, and the standard deviation should be less than in part a.

- Repeat part a using  $n = 25$ .

**Answer:** The mean should be around 10, and the standard deviation should be less than in part b.

- How did the distribution of the sample means change as you increased  $n$ , the sample size? Explain in terms of the scenario.

**Sample Answer:** More of the sample means fall near 10, and the standard deviation decreases. This means that the mean weights of the sampled boxes fall closer to 10, the desired weight.



- e. As president of the company, if you were presenting data to stockholders, which set of data that you generated in Question 2 and Question 4 parts a, b, and c would you use? Why?

**Sample Answer:** I would use the data from Question 4, part c when  $n = 25$  because the sample means have less variability, which means that they fall closer to how much the boxes should be weighing. The stockholders would want to see that they boxes are being packaged correctly.

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### Wrap Up

Upon completion of the lesson, the teacher should ensure that students understand:

- Elements sampled from a normal population vary according to that normal distribution.
- Means of different samples of a fixed size from a given population vary, but differently than the individual elements from the population.
- The simulated sampling distribution of sample means looks approximately normally distributed.
- As sample size increases, variability in the sampling distribution of sample means decreases.