About the Mathematics

This activity investigates generating a confidence interval for the mean of a random sample of size 100 from an unknown population.

This activity will give students the following opportunities:

1. Generate a random sample from an unknown population and record the mean.
2. Examine simulated sampling distributions of means for samples drawn from known populations and decide whether the observed mean seems likely to have come from this population; if so, a point is marked on a number line representing a likely population mean.
3. Repeat the sampling process for a sequence of known means until an interval of 'yeses'—a confidence interval—is marked on the number line.

The approach to confidence intervals in this activity is intended to develop the conceptual understanding of a confidence interval for means. The activity provides a foundation for the formula usually used to calculate the confidence interval for a mean.
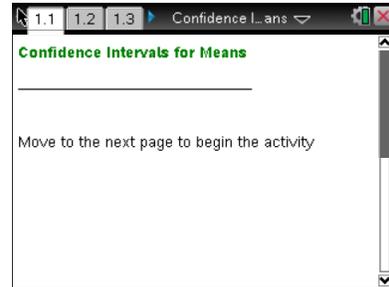
TI-Nspire™ Technology Skills:
- Open a document
- Move between Pages
- Click on a minimized slider

Lesson Materials:
Confidence_Intevals_for_Means.tns

Visit www.mathnspired.com for lesson updates.

Math Objectives

- Students will interpret a confidence interval for a population mean as an estimated range of values that is likely to contain the actual population mean.
- Students will recognize that a confidence interval is calculated from a set of sample data for samples selected from known populations.
- Students will recognize that a confidence interval for a population parameter from an unknown population is based on knowing how statistics from samples drawn from known populations behave.
- Students will reason abstractly and concretely (CCSS Mathematical Practices).
- Students will use appropriate tools strategically (CCSS Mathematical Practices).

The Problem Situation

Beginning in 2011, the United States government has mandated a change in the kind of light bulbs sold in the United States, trying to encourage people to switch to more energy efficient bulbs. An article suggests that the new flourescent light bulbs have a mean lifetime of approximately 22 years with a standard deviation of about 7.5 years based on being lit for three hours a day. This leads to the question: Given the mean we observed from the random sample, 22 years, what does this tell us about the mean of the population from which the sample was drawn?

This activity allows students to investigate the behavior of means of samples drawn from populations in which the population mean is known. Once they have a sense of the variability in the simulated sampling distributions of sample means when the mean of the population is known, they can begin to observe which of those sampling distributions might be likely to contain their observed mean.

Using the Document

Page 2.1: Simulating a Distribution of Sample Means for a Known Population

The top left arrow on Page 2.1 allows the students to choose a population mean. The bottom left arrow simulates 200 samples of size 100 from the population and displays the sampling distribution of the sample means for those samples.
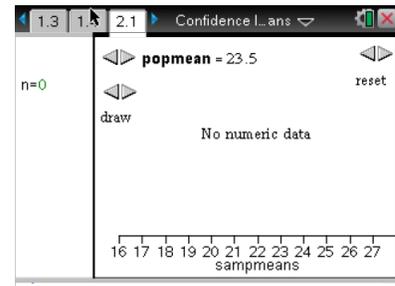
The top right arrow will clear the existing distribution. Students can make and check conjectures about how the sampling disribution might change for a given population mean by choosing 200 new samples. They can also investigate whether the new sampling distribution would lead to the same conclusion about how likely it seems the observed mean of 22 years could come from a sample from that population.

After students have experimented with simulated sampling distributions from populations with several different known population means, they should move to Page 3.1.

Page 3.1: Organizing Likely Populations

The top left arrow allows students to systematically change the given population mean and displays a simulated sampling distribution for that mean. The top right arrow can be used to set the observed mean, in this case, to 22. The dotplot displays a vertical line through 22.
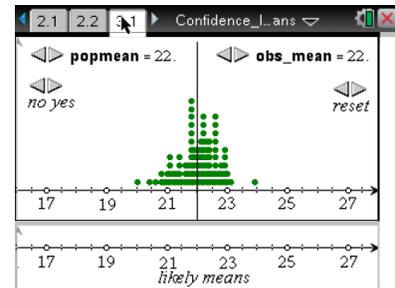
When the student thinks the sampling distribution might plausibly include the sample population mean, the student clicks the yes arrow to place a point on the number line (*likely means*) in the bottom screen. Students should record the values for which they marked yes, so they can retrieve the actual maximum and minimum values when they look at the set of values they have marked as 'yes'. (Note the horizontal axis is marked in intervals of 0.5.)

The bottom right arrow will generate a new simulated distribution for that same population mean, allowing students to observe whether the first simulated sampling distribution was really typical of those from the given population. In actuality, the observed mean is based on one unique sample, and other samples are not involved. However, the arrow on the top right does allow the student to change the value of the observed mean for use in other contexts.

By systematicaly moving through the given populations, students generate an interval of possible population mean lifetimes on the horizontal axis. This interval is a *confidence interval,* an interval of an estimated range of values that is likely to contain the unknown population mean lifetime.

Note that this activity does not specify what is meant by "typical" but allows students to make a decision informally from the visual representation of the sampling distribution and where the observed mean falls relative to the means of other samples from that population. Developing the concept of confidence *level* is explored in the activity *Confidence Levels for Means*.

Possible Applications

The Statistics Nspired activity *Confidence Intervals for Proportions* might give suggestions for questions to ask or ways to manage student interaction with the .tns file. The file can also be used for other contexts.