About the Mathematics

This activity involves investigating whether a difference really seems to exist between two sample means.

This activity will give students the following opportunities:

- Generate an observed difference for the lifetime of two kinds of compact fluorescent light bulbs (the context could easily be changed).
- Check that the assumptions concerning the samples are met (large population relative to the sample, independence, differences are normally distributed).
- Generate a simulated sampling distribution for the difference of the means.
- Compare the observed difference to the simulated sampling distribution to decide how likely it would be to see a difference as large or greater than the observed difference.
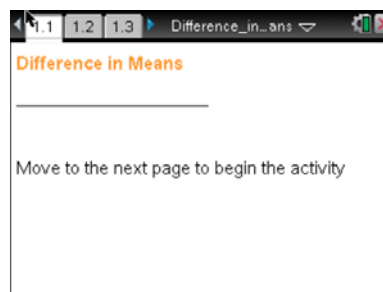
Math Objectives

- Students will use a simulated sampling distribution to estimate the probability of an outcome.
- Students will find and interpret an estimated probability that the difference between two means is greater than or equal to an observed difference.
- Students will reason abstractly and quantitatively (CCSS Mathematical Practices).

TI-Nspire™ Technology Skills:
- Open a document
- Move between Pages
- Click on a minimized slider

Lesson Materials:
Difference_in_Means.tns

Visit www.mathnspired.com for lesson updates.

The Problem Situation

Beginning in 2011, the United States government 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. One type of bulb claims a mean lifetime of 22 years with a standard deviation of 7.5 years. The other has a mean lifetime of 19 years, with a standard deviation of 6.5 years. (Note that the average is based on using the bulb three hours a day).

**Question:** On average, are the lifetimes of these two brands of bulbs really different?

Using the Document

Page 2.2: Generate a Sample

The arrow on Page 2.2 generates a random sample of 100 bulbs from each of the two brands and computes the difference of the means.

Students should notice that the random samples are mound-shaped and relatively symmetric, suggesting that the assumption of nearly normal is satisfied. The two samples were independent and randomly selected.Students should record the observed difference for later use.
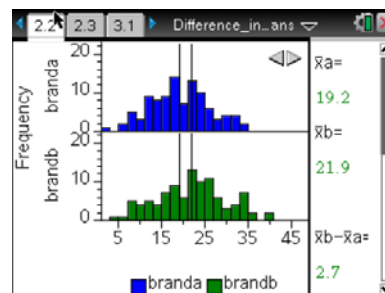
Page 3.1: Difference in Means

To examine the question of whether the mean lifetimes for the two brands seem to be different, students will generate a simulated sampling distribution of sample means where the mean difference is 0. The arrow in the upper left corner on Page 3.1 will generate the difference in the means for two random samples, one at a time and then in sets of ten.
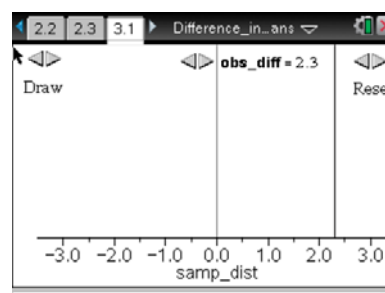
Students should use the arrow in the middle to set the difference in the means of the two samples they observed on Page 2.2; a vertical line representing that observed difference is displayed on the dotplot of the simulated sample differences.

By looking at the plot, students can estimate the probability their observed difference in the mean lifetimes of the bulbs would occur by chance.

Reset clears the screen and allows students to simulate another set of 100 differences in sample means to see if their estimate is consistent.

Possible Applications

This activity can be used informally to introduce students to the concept of the difference between two sample means and the underlying thinking about reasoning from what would be likely if the variability in the differences was due to chance. The context can also be set up as a formal hypothesis test, with $H_0 : \mu_1 - \mu_2 = 0; \quad H_A : \mu_1 - \mu_2 \neq 0$ and using the language associated with *p*-values.

Related Activities

- Statistics Nspired *What is a p-value?*
- Statistics Nspired *Difference in Proportions*