Difference Between Two Proportions

TIMATH.COM: STATISTICS

TEACHER NOTES

ID: 10081

Activity Overview

In this activity, students use confidence intervals to estimate the difference of two population proportions. First they find the intervals by calculating the critical value and the margin of error. Then, they use the **2-prop z Interval** command. Students find confidence intervals for differences in proportions in real-life situations and use them to make judgments about certain claims. Last, they determine required sample size, *n*, when given a confidence interval and margin of error.

Topic: Sampling Distributions

- Use the fact that the sampling distribution of the difference $p_1 - p_2$ (where p_1 and p_2 are the proportions of some attribute in two different populations) is approximately a normal distribution with mean $p_1 - p_2$ and standard deviation $\sqrt{\frac{p_1(1-p_1)}{n_1} + \frac{p_2(1-p_2)}{n_2}}$ to calculate a confidence interval for $p_1 - p_2$

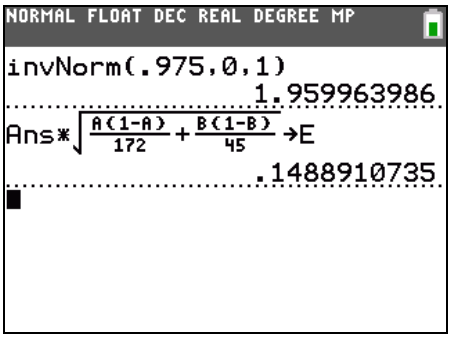
Teacher Preparation and Notes

- Students should already be familiar with estimating a confidence interval for a single population proportion and determining the sample size that is required for a given confidence interval and margin of error.
- Using a confidence interval to make a decision, as done in Problem 2, is a precursor to hypothesis testing.
- Information for an optional extension is provided at the end of this activity. Have students disregard that portion of the student worksheet if you choose not to have them complete it.
- **To download the student worksheet, go to education.ti.com/exchange and enter "10081" in the keyword search box.**

Suggested Related Activities

To download any activity listed, go to education.ti.com/exchange and enter the number in the keyword search box.

- Introduction to the Central Limit Theorem (TI-84 Plus family) — 9891
- To Toss or To Simulate? (TI-84 Plus family) — 11610



This activity utilizes MathPrint™ functionality and includes screen captures taken from the TI-84 Plus C Silver Edition. It is also appropriate for use with the TI-83 Plus, TI-84 Plus, and TI-84 Plus Silver Edition but slight variances may be found within the directions.

Compatible Devices:

- TI-84 Plus Family
- TI-84 Plus C Silver Edition

Associated Materials:

- DifferenceBetweenTwoPorportions_Student.pdf
- DifferenceBetweenTwoProportions_Student.doc

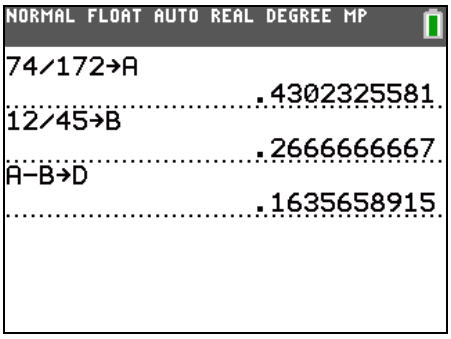
Click HERE for Graphing Calculator Tutorials.

Problem 1 – Estimating a Confidence Interval

To begin the activity, explain to students that they can estimate the true difference between two population proportions and that subscripts will be used to differentiate between the two populations.

Then introduce the formulas for the margin of error and confidence interval.

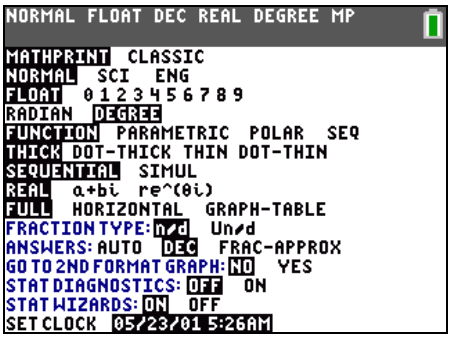
The scenario describes the numbers of men and women that used coupons at a grocery store. Students use the TI-84 to find each sample proportion and the difference between the sample proportions.



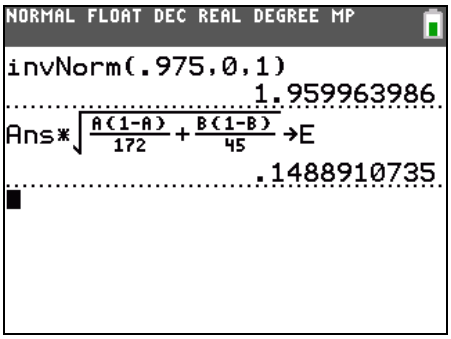
Since p_1, p_2, and the difference will be used in later calculations, students should store these values.

Note: To enter a fraction, students can press [ALPHA] [F1] and select **n/d**. Enter the value of the numerator, press [▼] to move to the denominator, and enter the value of the denominator. Then press [▶] to move out of the fraction templat

To use the fraction template in this activity, students need to change the format of the answers to decimals. To do this, press [MODE] and press [ENTER] on **DEC** next to **ANSWERS**.



Students can then find the margin of error. They will first need to use the **invNorm** command to calculate the *z*-score. The margin of error is about 14.89%.



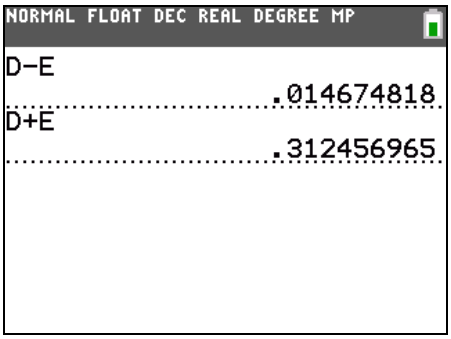
Students should also store this value.

Note: When entering the formula on the Home screen and students press [2nd] [√], the cursor will move under the square root bracket. Repeat the steps from Page 1 to enter the fractions.

Students will need to press [▶] twice to get out from the fraction template and the square root.

Students are to construct the confidence interval by subtracting from and adding to the difference of the sample proportions.

Have students state their result in a sentence: *We are 95% certain that the difference in proportion of men and women who use coupons at that store is between 1.5% and 31.2%*.



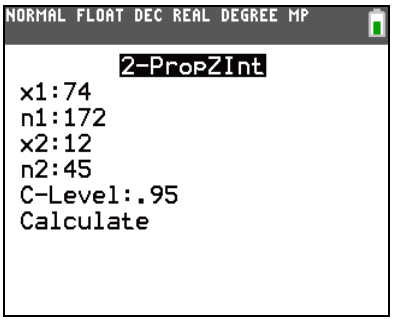
Now students will repeat the process to construct the 90% confidence interval. The 90% confidence interval is from 3.9% to 28.9%.

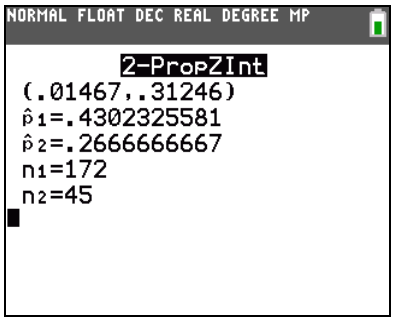
In a sentence: *We are 90% certain that the difference in proportion of men and women who use coupons at that store is between 3.9% and 28.9%*.

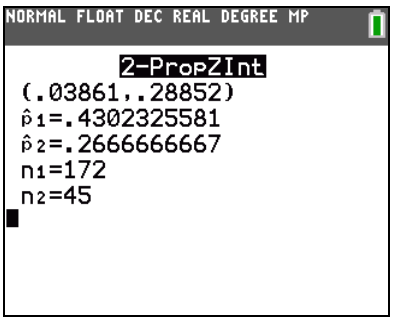
Here, $p_1 > p_2$ making $p_1 - p_2$ positive. You can have students see what the interval would be if the smaller proportion (for men) were used for p_1; (the same, after the order is switched and the absolute value taken).

For simplicity, you may wish for students to always make p_1 the greater sample proportion.

Let students check their answers using the **2-PropZInt** command and entering the required information.



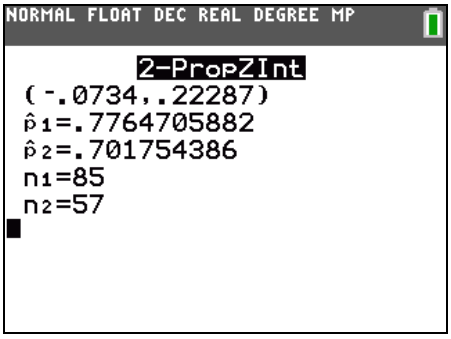




Problem 2 – Practice Problems

Ask students what $p_1 - p_2$ would be if the two proportions were equal or close to equal (0 or close to 0).

Once students have read the scenario, they are to find the confidence interval on the next page using the **2-PropZInt** command or step by step as done in Problem 1.

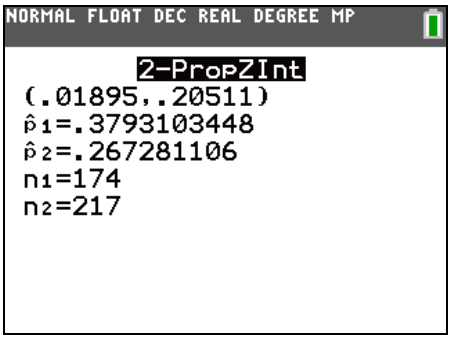


Ask what the value of $p_1 - p_2$ is (about 7.5%). The value is p Diff from the list generated. Ask what the margin of error is (ME is about 14.8%). Discuss why the lower bound is negative.

Students should discuss what they think about the principal's claim and the reasoning behind their statements. There is no reason to believe the principal's claim is incorrect.

Students are to repeat this process for the next scenario. Remind them that in an experiment where patients are given either the drug or a placebo, the patients do not know which group they belong to.

This time, 0%, or no difference, is not in the confidence interval, so there is reason to believe that the true proportions are different. Since the first proportion was larger, and this was the group that received the drug, it would appear that the drug may cause headaches.

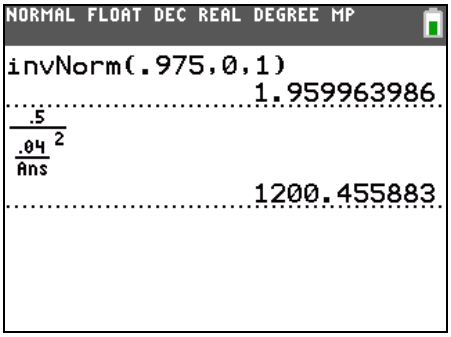


Problem 3 – Sample Size

Introduce the formula for determining required sample size for a given confidence level and margin of error.

Students are to find the sample size needed (1201 men and 1201 women would need to be surveyed).

If the margin of error were reduced to 2%, the number that would need to be surveyed is 4802 men and 4802 women. This is about four times as many of each.



Note: Students can set up a fraction within a fraction. Select the first fraction from the F1 menu. Type **.5** in the top. Then move to the bottom and select **n/d** for another fraction. Enter **.04** in the top and **Ans** in the bottom. Then press ▶ to move out of the bottom fraction, followed by x^2. No parentheses are needed.

Problem 4 – Extension

Have students use algebra to derive the formula used in Problem 3 from the formula for the margin of error by replacing both n_1 and n_2 with n.

If needed, remind or tell students that when an estimate of a sample proportion is unknown, that 0.5 is used.