



# Difference Between Two Proportions

## Student Activity

Name \_\_\_\_\_

Class \_\_\_\_\_

Proportions from two independent populations can be compared. Subscripts 1 and 2 are used in the notation to distinguish between them.

$$x_1, n_1, p_1 \quad \text{and} \quad x_2, n_2, p_2$$

A confidence interval for the difference between two population proportions is

$$(p_1 - p_2) - E < p_1 - p_2 < (p_1 - p_2) + E, \text{ where the margin of error is } E = z_{\frac{\alpha}{2}} \cdot \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$$

### Problem 1 – Estimating a Confidence Interval

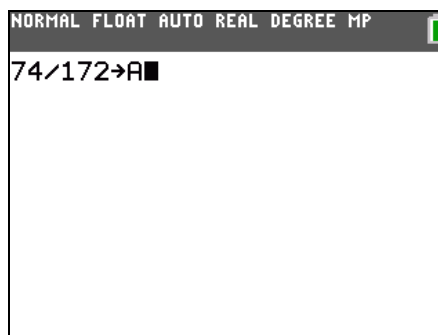
Customers randomly selected at a grocery store included 172 women and 445 men. Of the women, 74 used coupons, as did 12 of the men.

*What is the difference between the proportion of women and the proportion of men that use coupons at this store?*

Calculate the two proportions and then find the difference between them.

Store  $p_1$  as **A**,  $p_2$  as **B**, and  $p_1 - p_2$  as **D**.

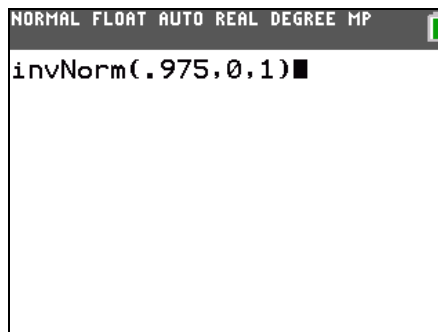
To store a value, press **[STO]** and then enter the letter.



Find the Margin of Error at the 95% level and store it as **E**.

First use the **invNorm** command to find the z-score. This command is found in the DISTR menu (**[2nd]** **[DISTR]**).

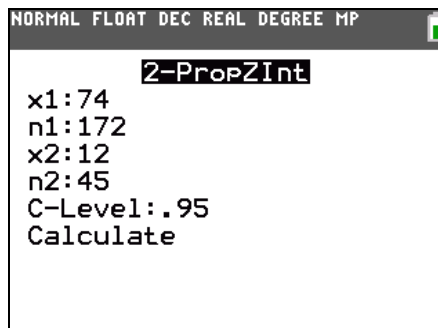
Use the margin or error and the difference of the proportions to find the 95% confidence interval.



- State the confidence interval in a sentence.
- Now find a 90% confidence interval for the same proportions.

Check your answers using the **2-PropZInt** command.

Press **[STAT]**, arrow over to the TESTS menu and then scroll down to select the command.





### Problem 2 – Practice Problems

A principal reported that the same percent of juniors and seniors felt that the homecoming should have been postponed due to rain. A student checks this claim by randomly surveying 85 juniors and 57 seniors. Respectively, 66 and 40 of those students said homecoming should have been postponed.

- Find the 95% confidence interval for the difference between the proportions.
- What do you think of the principal's claim?

In an experiment for a new drug, 217 patients took the drug and 58 of those reported headaches, while 174 patients took the placebo and 66 of those reported headaches.

- Find the 95% confidence interval for the difference between the proportions, where  $p_1$  is the proportion for the placebo and  $p_2$  is for the drug.
- Is there reason to believe a side effect of the new drug may be headaches?

### Problem 3 – Sample Size

The required sample size to find the difference between two population proportions is given by using the formula at the right. When an estimate of a sample proportion is unknown, 0.5 is used.

$$n = \frac{0.5}{\left(\frac{E}{z_{\frac{\alpha}{2}}}\right)^2}$$

Suppose you want to know the difference in proportion of men and women that shop for new cars online

- Find the required sample size of each sample. You want a 95% confidence level and a margin of error of no more than 4%.
- Find the required sample size when the margin of error is changed to 2%.

### Problem 4 – Extension

Use  $E = z_{\frac{\alpha}{2}} \cdot \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$  to derive the formula for sample size  $n$ .

Begin by replacing  $n_1$  and  $n_2$  with  $n$ .