Claims About Two Proportions

ID: 10259

Time required
45 minutes

Activity Overview

In this activity, students test claims about two proportions by calculating test statistics, critical values, and P-values. They will find the P-values by finding the area under the curve of a standard normal distribution in the appropriate tail or tails. Once students are comfortable using the formula for the test statistic, they use the 2-Prop z test command in the Calculator application.

Topic: Hypothesis Testing

- *Calculate proportions*
- *Determine test statistics for comparing two proportions*
- *Find critical values and P-values of a normal distribution*

Teacher Preparation and Notes

- *This activity assumes students are familiar with the concepts used in hypothesis testing.*
- *For each problem, have students check that the binomial distribution can be approximated by the normal distribution by finding* $n_1\hat{p}$, $n_1(1-\hat{p})$, $n_2\hat{p}$, *and* $n_2(1-\hat{p})$. *These values can be estimated using mental math.*
- *Notes for using the TI-Nspire™ Navigator™ System are included throughout the activity. The use of the Navigator System is not necessary for completion of this activity.*
- ***To download the student and solution TI-Nspire documents (.tns files) and student worksheet, go to education.ti.com/exchange and enter "10259" in the keyword search box.***

Associated Materials

- *ClaimTwoProp_Student.doc*
- *ClaimTwoProp.tns*
- *ClaimTwoProp_Soln.tns*

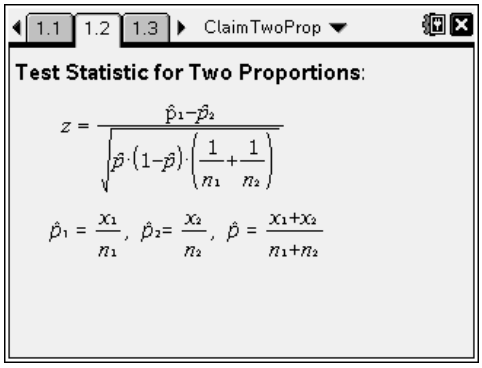
Suggested Related Activities

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

- *Testing Claims About Proportions (TI-Nspire technology) — 10131*
- *Difference Between Two Proportions (TI-Nspire technology) — 10082*
- *Comparing Two Means (TI-84 Plus family) — 10258*

Problem 1 – I Deserve a Raise!

Introduce and discuss the test statistic that is used for testing a claim about two proportions.



The scenario for the problem is given on page 1.3. Students are to test the claim that a greater proportion of women did not receive raises.

The null and alternative hypotheses for this right-tailed test is:

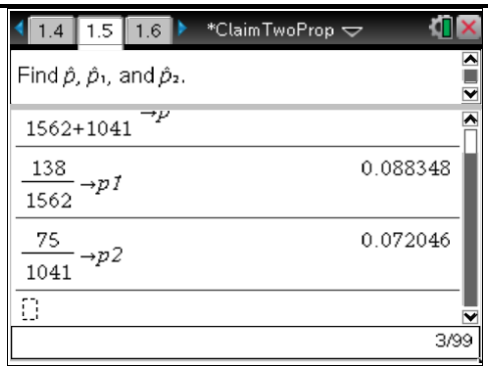
H_0: $p_1 \leq p_2$, H_a: $p_1 > p_2$.

TI-Nspire Navigator Opportunity: *Quick Poll*

See Note 1 at the end of this lesson.

Students are to use the *Calculator* application on page 1.5 to find values they need for calculating the test statistic, z.

They should store each value when calculated by pressing ctrl + var followed by the letter and number.

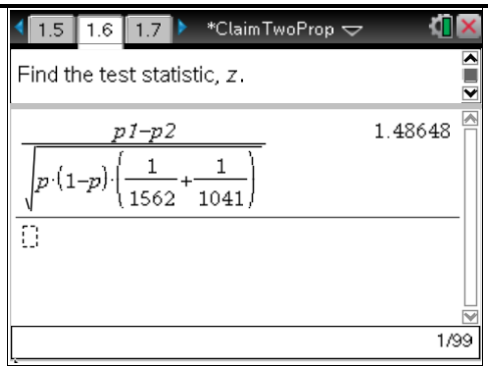


TI-Nspire Navigator Opportunity: *Live Presenter and Quick Poll*

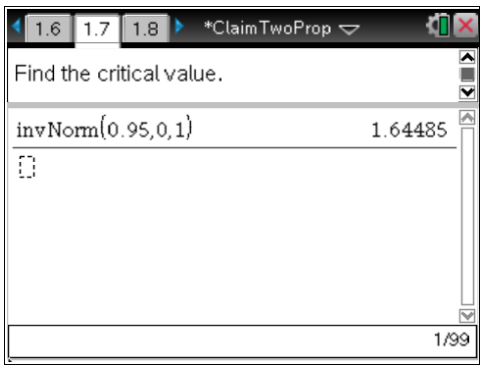
See Note 2 at the end of this lesson.

On page 1.6, students will find the test statistic using the stored values of $\hat{p}$, $\hat{p}_1$, and $\hat{p}_2$.

They should find that it is about 1.48648. Explain to students that we do not know if this is, or is not, in the critical region until we know the critical value.



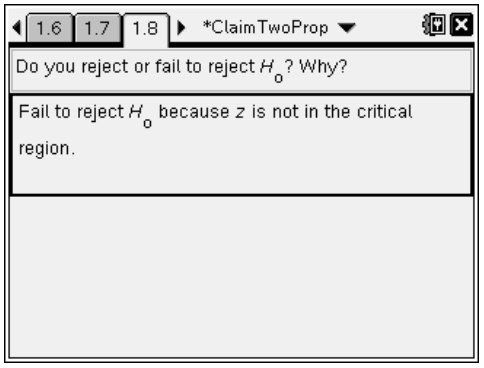
Students are to find the critical value on page 1.7 by using the **invNorm** command (**MENU > Statistics > Distributions > Inverse Normal**, or type **invNorm** directly.



Because this is a right-tailed test, all of the 0.05 is to the right of the critical value.

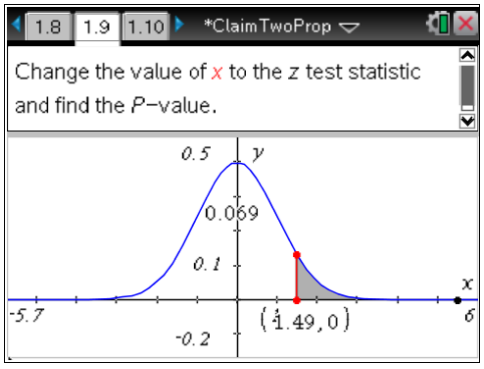
The critical value is 1.64485. Test statistics greater than this value are in the critical region and not likely to occur when the null hypothesis is true.

Ask students what their decision is and why.



The test statistic is not in the critical region. There is not sufficient evidence to reject the null hypothesis, meaning we cannot say that the proportion of women who did not receive raises was less than the proportion of men who did not receive raises.

This decision can also be based on looking at the *P*-value. Instruct students to find the *P*-value by changing the *x*-coordinate of the plotted point to the value of the test statistic and then find the area to the right of this point using the **Integral** command (**MENU > Analyze Graph >Integral**).



The area is greater than 5%. The null hypothesis is only rejected when the *P*-value is less than alpha, 0.05 for this problem.

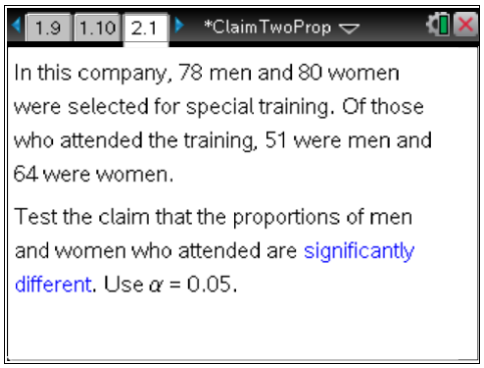
TI-Nspire Navigator Opportunity: *Live Presenter*

See Note 2 at the end of this lesson.

Problem 2 – Special Training

Introduce the scenario on page 2.1 and then have students write null and alternative hypotheses for this two-tailed test.

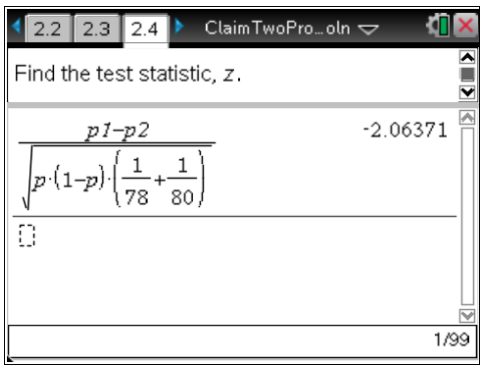
H_0: $p_1 = p_2$, H_a: $p_1 \neq p_2$.



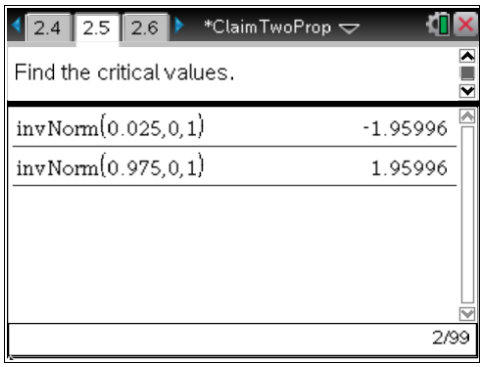
Students are to find the values of $\hat{p}$, $\hat{p}_1$, and $\hat{p}_2$ on page 2.3. Because this is a new problem, students can use the same variables to store the values as they did in the previously.

$\hat{p}$ = 0.728, $\hat{p}_1$ = 0.654, $\hat{p}_2$ = 0.8

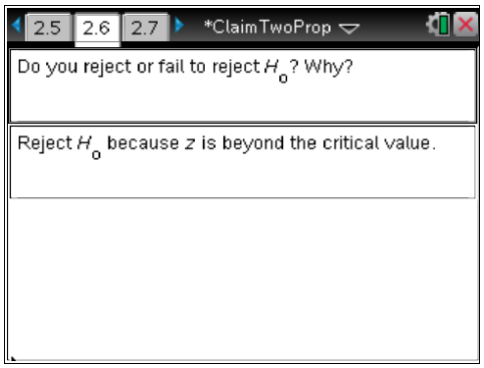
Then students are to find the test statistic on page 2.4.



When determining the critical values, remind students that this is a two-tailed test, so 2.5% of the area under the curve is in each tail.

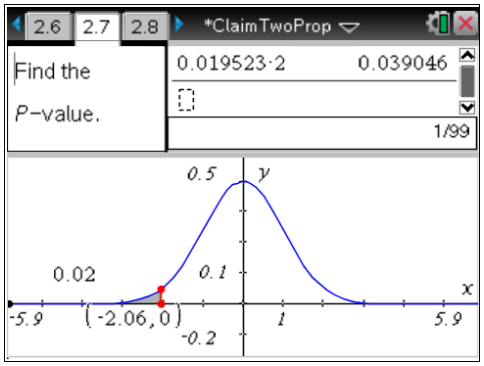


Have students discuss their decision. They should reject the null hypothesis because the test statistic is in a critical region. The data suggests that there may be a difference in the proportions of men and women who went to the training.



Before advancing to page 2.7, ask students what they know must be true about the *P*-value. (It is less than 0.05.)

Then, have students use page 2.7 to calculate the *P*-value by finding the area in one tail and doubling it in the *Calculator* application or *Scratchpad*. The *P*-value is about 0.039.

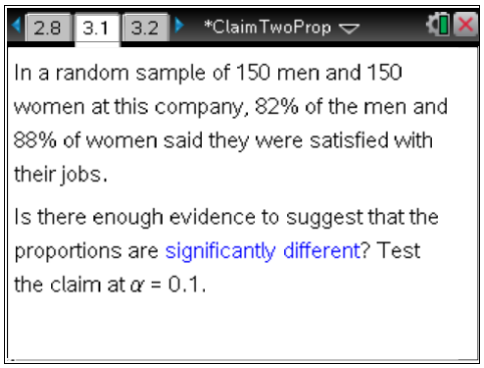


Problem 3 – Job Satisfaction

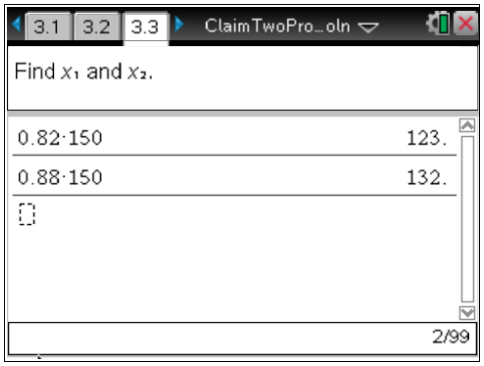
Introduce the scenario on page 3.1. Point out that this time; the significance level is at 10%, or 0.10.

Have students write null and alternative hypotheses for this two-tailed test.

H_0: $p_1 = p_2$, H_a: $p_1 \neq p_2$

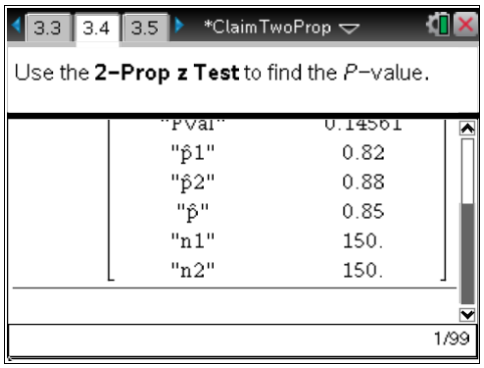


The scenario gives each proportion, but not the number of successes, that is, the number of men and women satisfied with their jobs. Because they will not be calculating the test statistic in this problem, students need to multiply to find x_1 and x_2.

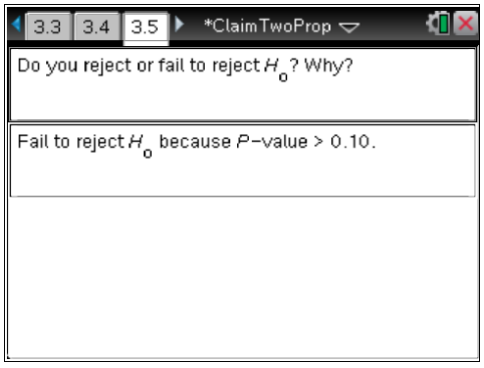


In the *Calculator* application on page 3.4 or *Scratchpad*, students are to press **MENU > Statistics > Stat Tests > 2-Prop z Test**. Tell them to fill the cells with the problem data, choose the two-tailed alternative hypothesis, and press OK.

Students will see that the *P*-value is about 0.146.



Have students discuss their decision. They should fail to reject the null hypothesis because the *P*-value is not less than 0.10. There is not enough evidence to suggest that the proportion of men satisfied with their job differs significantly from the proportion of women satisfied with their job.



TI-Nspire Navigator Opportunities

Note 1

Problem 1, *Quick Poll,*

Consider sending a *Quick Poll* on page 1.4 to check that students are setting the problem up correctly. For those who have it wrong, go back to problem set-up on 1.3 and identify the various parts.

Note 2

Problem 1, *Live Presenter, Quick Poll*

Consider using *Live Presenter* to demonstrate how to store calculated values as variables. Also send *Quick Polls* for the questions on pages 1.5 and 1.6.

Note 3

Problem 1, *Live Presenter*

Consider using *Live Presenter* to demonstrate how to enter the *z*-statistic into the graph as well as how to use the integral tool in finding the *p*-value. Once these are both done, use the final display to discuss why we fail to reject the H_0.