

Testing Claims About Proportions

ID: 10131

Time required

40 minutes

Activity Overview

In this activity, students find z-scores and critical values to test claims about proportions. To verify the results, they find P-values by either finding the area under the curve with the **Integral** tool, or by using the **1-Prop z Test** command in the Calculator application.

Topic: Hypothesis Testing

- Use the sampling distribution of a proportion \hat{p} to test the null hypothesis $H_0: p = p_0$ against the alternative one-tailed hypothesis $H_a: p < p_0$ or the two-tailed hypothesis $H_a: p \neq p_0$.

Teacher Preparation and Notes

- This activity is intended to be mainly teacher-led, with breaks for individual student work. Use the following pages to present the material to the class and encourage discussion. Students will follow along using their handhelds.
- This activity assumes knowledge of binomial experiments and the requirements for a binomial experiment.
- Students should already be familiar with the basic concepts behind hypothesis testing.
- Depending on the time available in class, Problems 1 and 2 can be done in class and Problem 3 can be done for homework.
- 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 “10131” in the keyword search box.**

Associated Materials

- Testing_Claims_Proportion_Student.doc
- Testing_Claims_Proportion.tns
- Testing_Claims_Proportion_Soln.tns

Suggested Related Activities

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

- Estimating a Population Proportion (TI-Nspire technology) — 9986
- Claims About Two Proportions (TI-Nspire technology) — 10259
- Difference Between Two Proportions (TI-Nspire technology) — 10082
- Candy Pieces (TI-Nspire technology) — 9997

Problem 1 – Lefties

Discuss how hypothesis testing can be used to test claims about proportions, and that the test statistic is z , given that the requirements for a binomial experiment are met.

On page 1.3, students are told to test the claim that 10% of Americans are left-handed. Confirm with students that z can be used as the test statistic.

Explain to students that testing at $\alpha = 0.05$ means testing at a 95% confidence level.

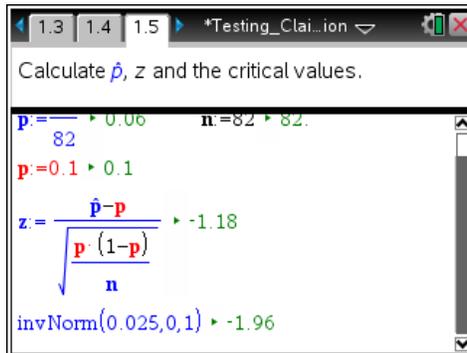
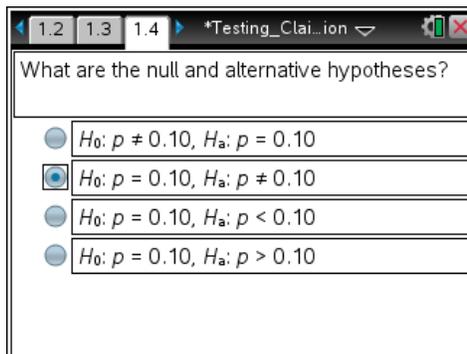
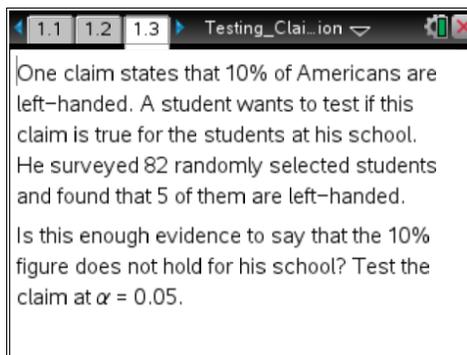
On page 1.4, students are to select the null and alternative hypotheses. This is a two-tailed test.

Students are directed to use the math box on page 1.5 to calculate the sample proportion. To use the math box, students are to enter the values given in the problem and press **enter**. The sample proportion is $\frac{x}{n}$, where x is the number of successes, in this case, left-handed students.

Ask students if they think 6% is far enough away from 10% to reject the claim.

To activate the other math boxes, have the students click inside the math box and press **enter**.

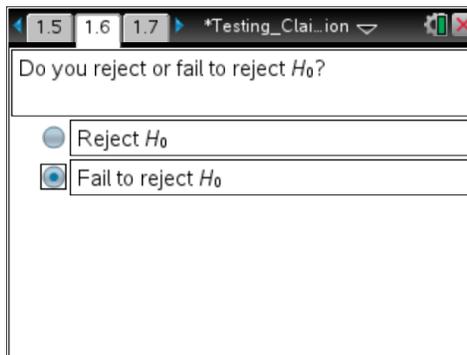
Note: Because this is a two-tailed test, the inverse Normal command uses $0.05/2$ (0.25). Because the normal distribution is symmetric, they can just find the left critical value and use its opposite for the right critical value.



TI-Nspire Navigator Opportunity: *Live Presenter* and *Class Capture*
See Note 1 at the end of this lesson.

Discuss with students if they should reject or fail to reject the 10% claim for the students at this school.

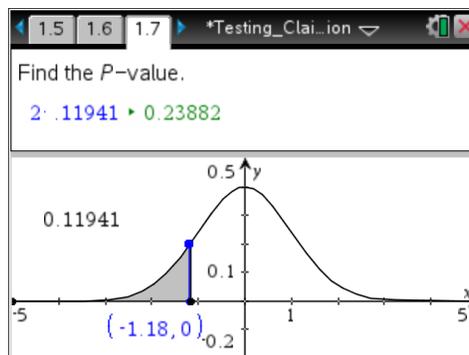
The test statistic is not in either critical region, so we fail to reject it.



TI-Nspire Navigator Opportunity: Quick Poll
See Note 2 at the end of this lesson.

Instruct students to find the P -value by using the **Integral** tool on the next page. Have them change the x -value of the plotted point to that of the test statistic and then use the **Integral** tool (**MENU > Analyze Graph > Integral**) to find the area under the curve beyond that point. This is about 11.94%.

Because the test is two-tailed, this value is doubled to find the P -value. Students can perform this calculation in the math box in the *Notes* application at the top of the page. The P -value is about 23.9%, much greater than 5%, so it was correct to fail to reject the null hypothesis.



Problem 2 – Loaded Cube?

Students are introduced to the loaded number cube scenario on page 2.1. Confirm that the requirements for a binomial experiment are met.

A number cube is suspected of being "loaded," that is, it seems more sixes come up than any other number.

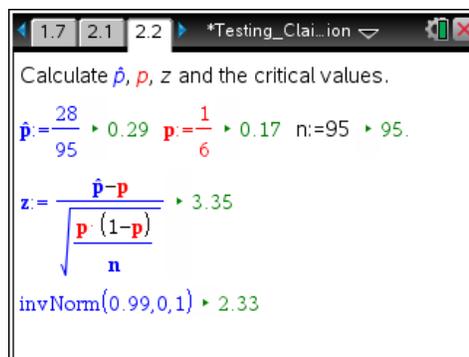
If a six comes up on 28 out of 95 rolls, test the claim that the proportion of sixes is greater than what it should be. Test the claim at $\alpha = 0.01$.

TI-Nspire Navigator Opportunity: Class Capture
See Note 3 at the end of this lesson.

On page 2.2, have students find decimal approximations for both p , the claimed population proportion, \hat{p} , the sample proportion, the test statistic and the critical value. Because this is a right-tailed test, all of the 0.01 is to the right of the critical value.

Students are to determine their null and alternative hypotheses on the next page. This is a right-tailed test.

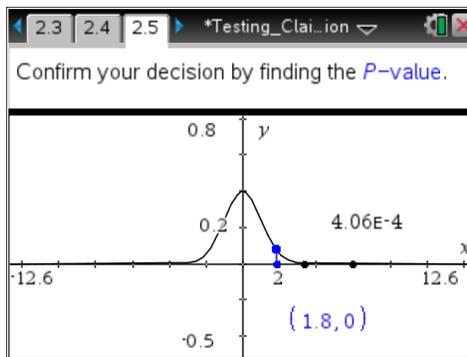
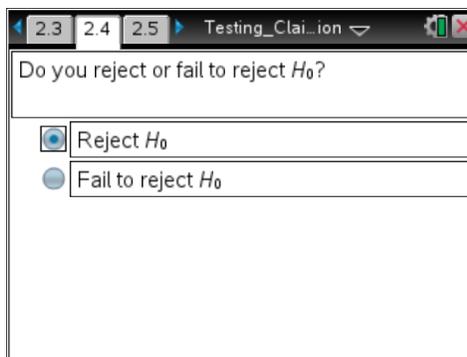
$H_0: p = 0.1\bar{6}$, $H_a: p > 0.1\bar{6}$



Discuss with students if they should reject or fail to reject the claim that sixes come up more than they should.

The test statistic is in the critical region, so we reject the null hypothesis. Sixes are coming up more than expected.

Students are to find the P -value on the next page. The area is about 0.000405. The value is not doubled because it is a one-tailed test. Because it is less than the significance level of 0.01, it was correct to reject the null hypothesis.



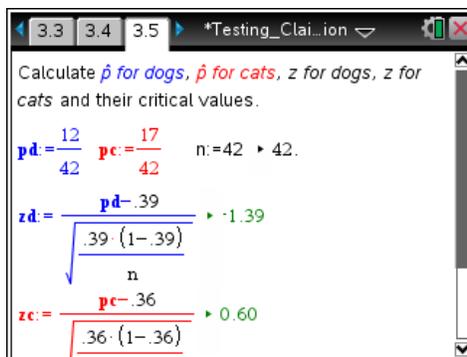
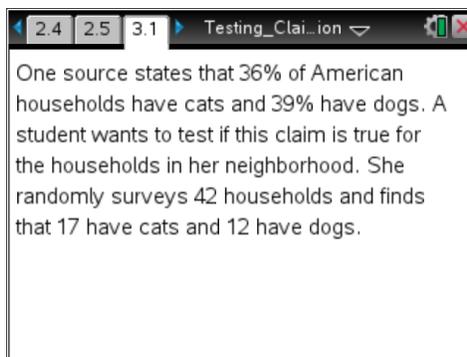
Problem 3 – Cats and Dogs

For the scenario described on page 3.1, students should work independently to write the null and alternative hypotheses.

For cats: $H_0: p = 0.36$, $H_a: p \neq 0.36$

For dogs: $H_0: p = 0.39$, $H_a: p \neq 0.39$

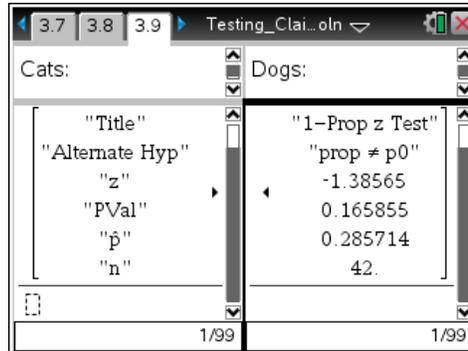
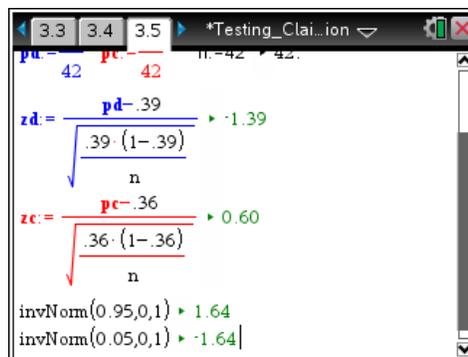
Students are to use page 3.5 to determine the sample proportions, z-scores, and critical values. Remind students that to activate math boxes, they need to click inside the math box and then press the **enter** button.



Discuss with students if they should reject or fail to reject the claims about the proportions for cats and dogs in this neighborhood at $\alpha = 0.10$.

Neither test statistic is beyond a critical value. There is not enough evidence to reject either claim.

On page 3.9, students are to use the **1-Prop z Test** command (**MENU > Statistics > Stat Tests**) to find the *P*-values for each test. The *P*-values are about 0.55 (cats) and 0.17 (dogs), both above 0.10, the significance level.



TI-Nspire™ Navigator™ Opportunities

Note 1

Question 1, *Live Presenter* and *Class Capture*

Use Live Presenter to help students see how easy it is to use the math boxes. Have students click in the math box and press **[enter]**. Use Class Capture to ensure everyone is doing this correctly. This is very important as the other problems in this activity utilize math boxes.

Note 2

Question 1, *Quick Poll*

Send students a Quick Poll asking if they reject or fail to reject the null hypothesis. For those answering incorrectly (reject) go back to the pages 1.4 and 1.5 with them and have the class discuss what those pages mean.

Note 3

Question 3, *Class Capture*

Use Class Capture for the duration of the activity to monitor student progress and to assist, as needed.