

Comparing Two Means

ID: 12626

Time required

20 minutes

Activity Overview

In this activity, students will test hypotheses concerning means of two populations. They calculate the test statistic and the critical values and then graph the critical region and plot the value of the test statistic.

Topic: Statistical Inference

- Difference of two means
- Hypothesis testing
- Two sample t-distribution

Teacher Preparation and Notes

- This activity can be used as a stand-alone lesson on hypothesis testing for two means. A homework data set is included that requires students to first test for normalcy, a review topic, and then test the hypothesis.
- Students can enter their responses directly in the TI-Nspire document or write on the accompanying worksheet. For self-check questions, students can then press **menu** and select **Check Answer** (or **ctrl** + **▲**). If desired, by using the TI-Nspire Teacher Edition software, teachers can change these self-check questions to exam mode so students cannot check their answers. To change the question mode, move to any question. Then, in the Document Tools, click the Teacher Tool Palette and select Question Properties. Change the Document Type from Self-Check to Exam.
- To download the student TI-Nspire document (.tns files) and student worksheet, go to education.ti.com/exchange and enter "12626" in the keyword search box.

Associated Materials

- Comparing_Two_Means_Student.doc
- Comparing_Two_Means.tns

Suggested Related Activities

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

- Hypothesis Testing: Means (TI-Nspire technology) — 10240
- Claims About Two Proportions (TI-Nspire technology) — 10259
- Goodness-Of-Fit (TI-Nspire technology) — 10286
- One and Two Sample t-Distributions (TI-84 Plus family with TI-Navigator) — 1967
- Comparing Two Means (TI-84 Plus family) — 10258

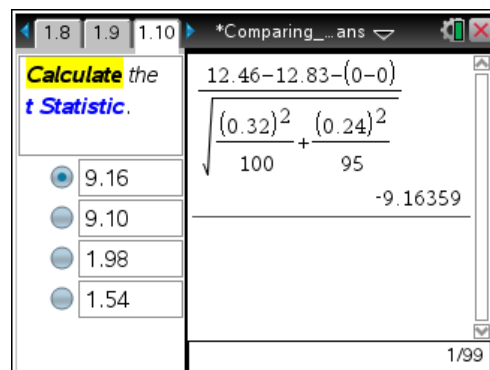
Background

Students are introduced to the conditions for comparing two means using the *t* distribution. Then they are given the formula for computing the test statistic. It may be helpful to students to practice determining the degrees of freedom.

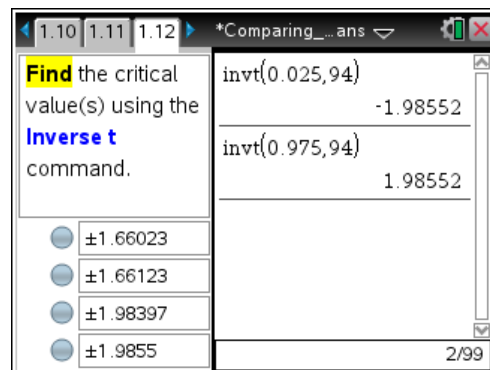
Problem 1 – Testing Volumes of Cans

The TI-Nspire document leads students through the steps for inference testing of two means. Self-check questions are included to help students go through each step, pausing to check their work. Remind students that the steps are the same as for other inference testing.

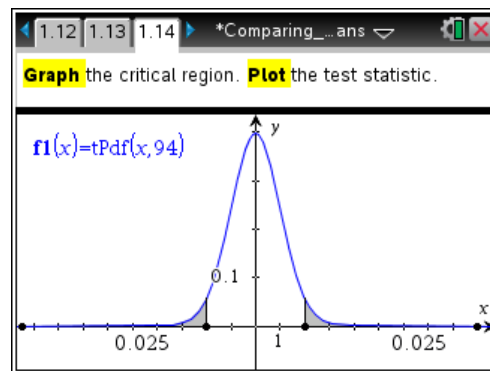
After determining the claim and the null and alternative hypotheses, students will calculate the test statistic. On page 1.10, they are to use the formula given on the worksheet and on page 1.4. Explain to students that it does not matter which sample is denoted as 1 and which is denoted as 2. Either choice will lead to the same conclusion.



On page 1.12, students are to use the **Inverse t** command (menu) > **Statistics** > **Distributions** > **Inverse t**) to find the critical values. They should be able to determine that the area will be 0.025 (or 0.975) since the significance level is 0.05 and it is two-tailed. Also, students should determine that the degrees of freedom is 94 since it is the minimum of $n_1 - 1$ and $n_2 - 1$.



Students are given general directions in the .tns document to graph the critical region. On page 1.14, students need to graph $f_1(x) = tPdf(x, 94)$ and choose an appropriate window.

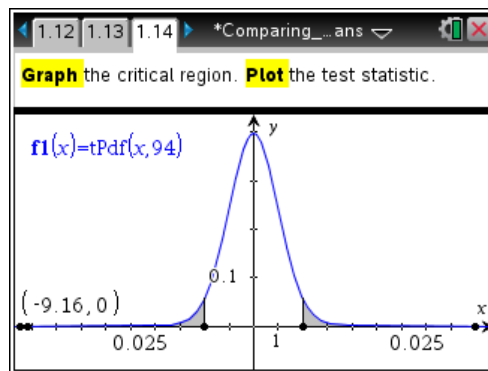


To shade the region, choose the **Integral** tool (menu) > **Analyze Graph** > **Integral**). Then enter the x-minimum for the lower bound and -1.9855 for the upper bound. If students enter a value smaller than the x-minimum, the window will resize.

Repeat for the right tail using 1.9855 and the x-maximum. The numbers that appear should confirm to students that there is an area of 0.025 in each tail.

To plot the test statistic, students can use the **Point On** and **Coordinates and Equations** tools. Place a point on the x-axis and then edit the x-coordinate to the value of test statistic.

Since the test statistic is in the critical region, students should reject the null hypothesis and conclude that there is evidence to suggest that the volumes of the cans of soda are significantly different.



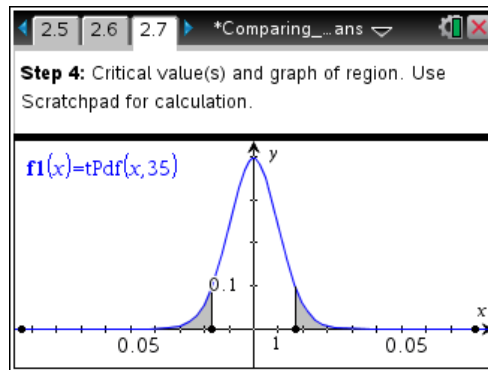
Problem 2 – Homework

The spreadsheet on page 2.2 contains a simple random sample of basketball players from East and West divisions. The field goal percentage for each player is given. Students are asked to determine if the mean field goal percentages for the East and West divisions are not significantly different.

Since both sample sizes are greater than 30, the conditions for the test are met. Students could also graph each sample as a histogram to check for normalcy.

To determine the mean and standard deviation for each sample, students can use the **One-Variable Statistics** command or the **mean** and **stDevSamp** commands.

	east	west
1	43.5	40.4
2	41.9	49.7
3	46.7	43.5
4	48.7	53.9
5	44	55.8
6	46.5	57.2



Solutions – Student worksheet

Problem 1

$$1. \begin{aligned} H_0 : \mu_1 &= \mu_2 \\ H_1 : \mu_1 &\neq \mu_2 \end{aligned}$$

$$2. t = \frac{12.83 - 12.46}{\sqrt{\frac{0.24^2}{95} + \frac{0.32^2}{100}}} = 9.16$$

- Two-tailed since alternative hypothesis is \neq .
- Critical values = ± 1.9855
- The null hypothesis should be rejected because the test statistic is within the shaded region.
- The samples of cola and diet cola force us to reject the claim that the volumes of the two sodas are not significantly different.

Problem 2 Claim: Means are not significantly different ($\mu_1 = \mu_2$).

$$\begin{aligned} H_0 : \mu_1 &= \mu_2 \\ H_1 : \mu_1 &\neq \mu_2 \end{aligned}$$

$$\text{Test statistic: } t = \frac{47.008 - 46.755}{\sqrt{\frac{4.21^2}{36} + \frac{4.03^2}{40}}} = 0.2669$$

Critical values: ± 1.68957

Since the test statistic is not in the critical region, the null hypothesis should be accepted.

Conclusion: There is enough evidence to support the claim that there is not a significant difference between the mean field goal percentage of the East and West divisions.