



Activity Overview

In this activity, students are introduced to three real-life scenarios and test a claim about two means for each. The samples are independent (not matched) and large, so the test statistic is z . Students first use the formula to calculate z , then they use the **ShadeNorm** command to calculate the p -value. For the last scenario, they check their test statistic and find the p -value by using the **2-SampZTest** command.

Topic: Hypothesis Testing

- Use the sampling distribution of the difference in the means $\bar{x}_1 - \bar{x}_2$ of two different populations (with unknown standard deviation σ) to test the null hypothesis $H_0: \mu_1 = \mu_2$ against the alternative one-tailed hypothesis $H_a: \mu_1 < \mu_2$, or the two-tailed hypothesis $H_a: \mu_1 \neq \mu_2$.

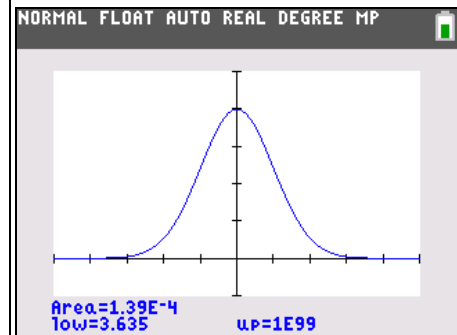
Teacher Preparation and Notes

- This activity is designed to be used for students studying Statistics and Probability
- Students should already be familiar with the concepts used in hypothesis testing. Ideally, students have already tested claims about a single mean.
- For large n , s approximates σ .
- **To download the student worksheet, go to education.ti.com/exchange and enter “10258” 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.

- Hypothesis Testing: Means (TI-84 Plus family) — 10239
- Run Me A Hypothesis Test (TI-84 Plus family with TI Navigator) — 5135
- Claims About Two Proportions (TI-Nspire technology) — 10259



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:

- ComparingTwoMeans_Student.pdf
- ComparingTwoMeans_Student.doc

Click [HERE](#) for Graphing Calculator Tutorials.



Problem 1 – Summer Course: Does it help?

Before beginning, discuss the difference between dependent samples (matched pairs) and independent samples. Remind students that when n is large, the sample standard deviation can be used in place of the population standard deviation.

Students are introduced to the scenario of first quarter scores in school district where some students were in a summer math course and some students were not. They are to determine the null and alternative hypotheses for the claim that students in the program score better.

This right-tailed test has hypotheses, $H_0: \mu_1 = \mu_2$, $H_a: \mu_1 > \mu_2$.

For those who took the summer course:

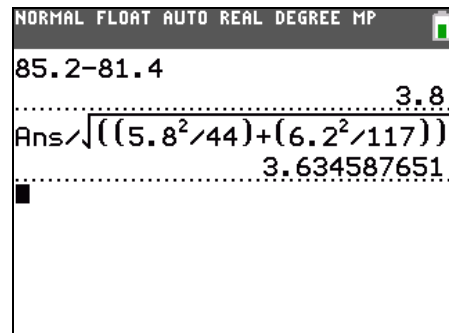
$$\bar{x} = 85.2 \text{ and } \sigma = 5.8.$$

For those who did not take the summer course:

$$\bar{x} = 81.4 \text{ and } \sigma = 6.2$$

Students are to use the formula to calculate the test statistic on the Home screen.

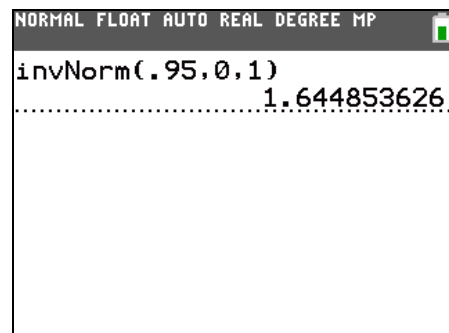
Discuss with students that $\mu_1 - \mu_2 = 0$ because the null hypothesis claims they are equal.



Have students find the critical value for $\alpha = 0.05$. Remind students that this is a right-tailed test, so 5% is above the critical value, 95% is below.

Students can find the critical value by using the **invNorm** command from the DISTR menu.

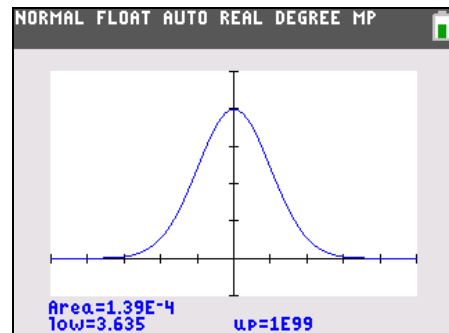
Ask students if they should reject or fail to reject the null hypothesis and why. (Because the test statistic is greater than the critical value, they should reject the null hypothesis.)



Students should make sure that all functions and plots have been turned off.

Before using the **ShadeNorm** command to find the P -value, they will need to use the **ClrDraw** command from the DRAW menu (**2nd** [DRAW]) to erase any existing drawings.

The area is about 0.000139. The value is not doubled because it is a right-tailed test. Because the P -value is less than the significance level of 0.05, it was correct to reject the null hypothesis.





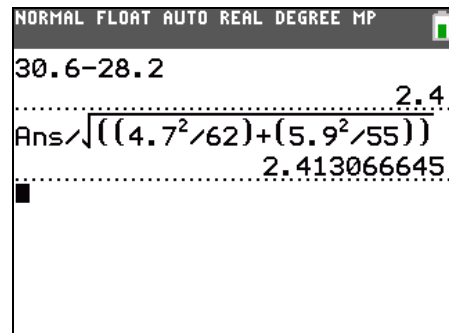
Problem 2 – Boys and Girls: Did they work the same number of hours?

Students are to test the claim that the boys and girls in the senior class worked the same amount of hours.

The hypotheses are $H_0: \mu_1 = \mu_2$, $H_a: \mu_1 \neq \mu_2$.

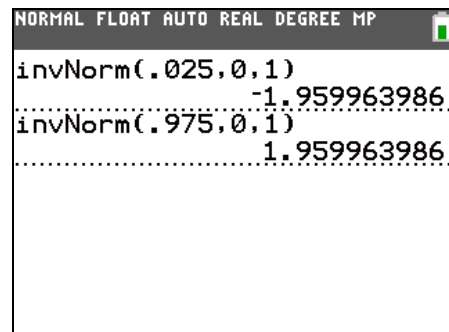
Have students calculate the test statistic. Because n is large, the sample standard deviation is a good estimate of the population standard deviation.

Once again $\mu_1 - \mu_2 = 0$ because the null hypothesis claims they are equal.



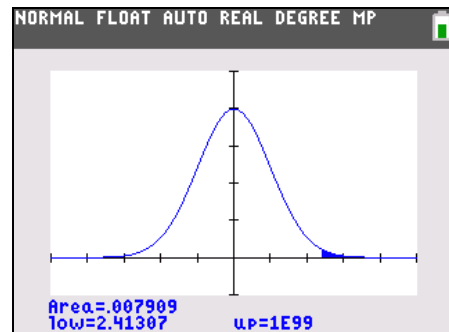
Have students find the critical values for $\alpha = 0.05$. Remind students that this is a two-tailed test and the 5% critical region is divided between the two tails.

Ask students if they should accept or reject the null hypothesis and why. (Because the test statistic is greater than the critical value, they should reject the null hypothesis.)



Now, students are to find the P -value using the **ShadeNorm** command.

The area is about 0.007909. This value needs to be doubled because it is a two-tailed test. The P -value is 0.015818 and because it is less than the significance level of 0.05, it was correct to reject the null hypothesis.

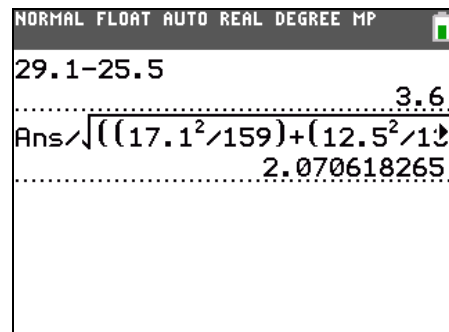


Problem 3 – Morning Rush: Does the east side have longer commutes?

Students are to test the claim that the commutes on the east side are longer than the west side.

The hypotheses are $H_0: \mu_1 = \mu_2$, $H_a: \mu_1 > \mu_2$.

Have students work through Questions 14–18 independently. Walk around and help students as needed during this time. Review the results and clarify and misunderstandings.



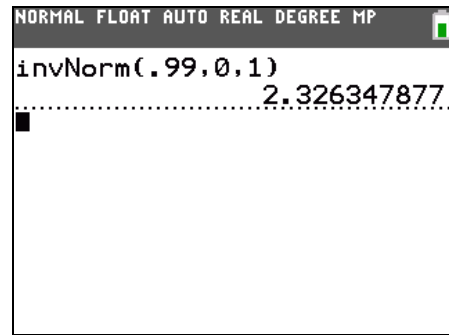


Have students find the critical values for $\alpha = 0.05$. This is a right-tailed test, so 1% is above the critical value, 99% is below.

Ask students if they should accept or reject the null hypothesis and why. (Because the test statistic is less than the critical value, they should fail to reject the null hypothesis.)

Now, students are to find the P -value using the **2-SampZTest** command.

The area is about 0.019197. Because it is greater than the significance level of 0.01, it was correct to reject the null hypothesis.



Student Worksheet Solutions

1. $H_0: \mu_1 = \mu_2, H_a: \mu_1 > \mu_2$
2. about 3.635
3. about 1.645
4. Reject, the test statistic is greater than the critical value; it is in the critical region.
5. about 0.000139
6. about 0.000139
7. is
8. $H_0: \mu_1 = \mu_2, H_a: \mu_1 \neq \mu_2$
9. about 2.413
10. about -1.96 and 1.96
11. Reject, the test statistic is greater than the positive critical value; it is in the critical region.
12. is
13. about 0.0158
14. $H_0: \mu_1 = \mu_2, H_a: \mu_1 > \mu_2$
15. about 2.071
16. about 2.326
17. Fail to reject, the test statistic is less than the critical value; it is not in the critical region.
18. is not
19. It must be greater than 0.01 because we failed to reject the null hypothesis.
20. about 0.019