What! A Mistake!

ID: 12677

Time required
20 minutes

Activity Overview

In this activity, students will learn about Type I and Type II errors. Then, for a given scenario, students will calculate the probabilities of errors and the power of the test.

Topic: Statistical Inference

- *Hypothesis testing*
- *Type I and II errors*

Teacher Preparation and Notes

- *This can be used as a stand alone lesson on Type I and Type II errors. Multiple choice questions allow students to check their understanding of the concepts. The AP exam does not require students to calculate the probability of the errors; however the second problem discusses the calculation of Type I and Type II errors and the power of the test.*
- *Students should have previously completed work on hypothesis testing to complete the extension. Knowledge of using the calculator to find probabilities and z-intervals is important. This problem serves as excellent review of previously learned concepts.*
- *Students can record their responses on the accompanying worksheet.*
- ***To download the student worksheet, go to education.ti.com/exchange and enter "12677" in the keyword search box.***

Associated Materials

- *TypesOfErrors_Student.doc*
- *Pic1.8xi (PIC file)*

Suggested Related Activities

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

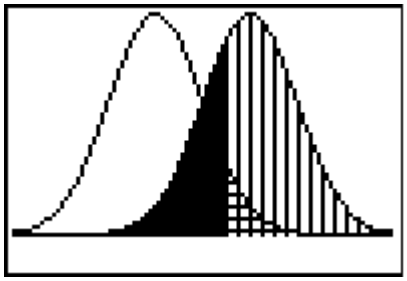
- *Type I and Type II Errors (TI-84 Plus family with TI-Navigator) — 1977*
- *Means With Confidence (TI-84 Plus family) — 12370*
- *Estimating a Population Proportion (TI-Nspire technology) — 9985*
- *How Fast is Your Racer (TI-84 Plus) — 8385*

Problem 1 – Introducing Type I and Type II errors

Students are introduced to type I and type II errors. They are led through a practical example and then given questions to check their ability to differentiate between the types of errors. Students will complete a table similar to the one on the right.

	H_0 true	H_1 true
Reject H_0	Type I Error	Correct decision
Fail to reject H_0	Correct decision	Type II Error

The picture **Pic1** shows a representation of Type I and Type II errors and Power (discussed later). Students should load the picture on their handhelds by pressing [2nd] [DRAW], arrow to the STO menu and choose **RecallPic**. Press [VARS], choose **Picture** and then choose **Pic1**.



The vertically striped area represents the power. The checked area represents type I errors and the black area represents type II errors.

Problem 2 – Calculating the probability of errors

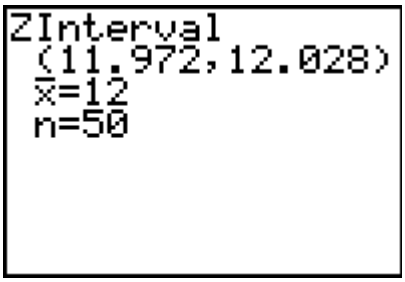
Students learn to calculate type I and type II errors. They are introduced to the concept of power. Explain to students that the significance level of any test is the probability of rejecting the null hypothesis when it is in fact true. Thus, the probability of a type I error occurring is the significance level.

Calculating type II errors is more difficult to calculate because it requires estimating the distribution of the alternative hypothesis, which is usually unknown.

Additional Properties:

- Type I (α) and Type II (β) errors are inversely related: as one increases the other decreases.
- Type I errors are generally set by the statistician since they are the significance level of the test.
- High power is desirable. Increasing the sample size always increases the power.
- Power is equivalent to 1-β.

In Question 8, students will find the interval that contains that contains the values of sample proportions ($\bar{x}$) that do not lead to a rejection of H_0. They can use the **ZInterval** command by pressing [STAT], choosing **ZInterval** from the **TESTS** menu.

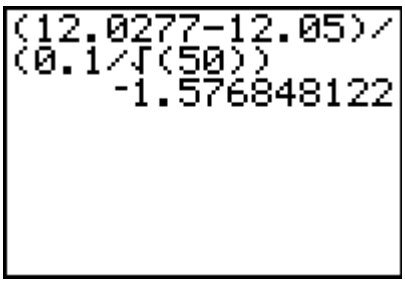


Inpt: Stats σ: 0.1 $\bar{x}$: 12 n: 50 C-Level: 0.95

These values can also be found with the formula $\mu \pm z_{\alpha/2}\frac{\sigma}{\sqrt{n}}$.

In Question 9, students will standardize the endpoints of the interval with the formula given on the worksheet.

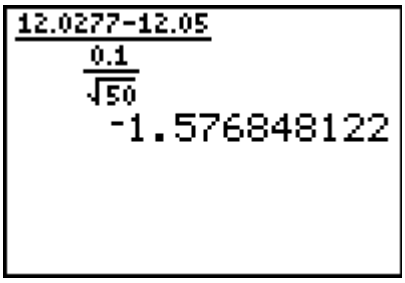
They should find the standard values to be –5.494 and –1.577.



If using Mathprint OS:

Students can use the fraction template and square root template to calculate the standard values. To do this, press [ALPHA] [F1] and select **n/d**. Then enter the value of the numerator, press [▼] to move to the bottom of the fraction, enter the value of the denominator.

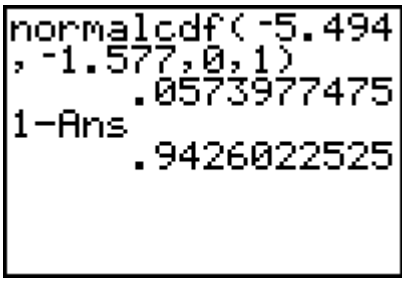
Press [2nd] [√], enter the value of the radicand and press [▶] to move out from under the radical symbol.



In Question 10, students use the **normalcdf** command (press [2nd] [DISTR] and choose **normalcdf(**) to find the probability that the *z*-value will lie in the interval. This is the probability of a type II error.

From the type II error, students can calculate the power. From the given situation students should know that the probability of a type I error is 0.05 or 5%.

Discuss with students what implications the probabilities have on the test.



Solutions – student worksheet

1. Type I error
2. Type II error
3. Type I error
4. No error, correct decision
5. True
6. Type II
7. 1 – type II error
8. (11.972, 12.028)
9. –5.494 and –1.577
10. 0.057398
11. 0.942602
12. 0.05