



Problem 1 – Introducing Type I and Type II errors

In the past, you have learned to test a null hypothesis (H_0) against an alternative hypothesis (H_1). Each test has a confidence level that is associated with it. Yet, regardless of how well you construct and carry out the test, there is a chance for error. There are two classifications of errors:

Type I error: Reject H_0 when H_0 is true.
Type II error: Fail to reject H_0 when H_1 is true.

Complete the chart with the labels *Type I Error*, *Type II Error*, and *Correct decision*:

	H_0 true	H_1 true
Reject H_0		
Fail to reject H_0		

Let's look at a scenario together. A person goes to the doctor and they are either sick or not, with influenza. The doctor tests for the virus. The test comes back either positive or negative. There are four things that could happen:

- The person has the flu and the test comes back positive (Correct decision)
- The person does not have the flu and the test comes back positive (Type II error)
- The person has the flu and the test comes back negative (Type I error)
- The person does not have flu and the test comes back negative (Correct decision)

Decide the type of error, if any, associated with each of the following scenarios. Check with your neighbor to see if he/she agrees.

1. A parent believes her child has strep throat. The child does have strep but the test at the doctor's comes back negative.
A) Type I error **B)** Type II error **C)** No error, correct decision.

2. A coach believes that the athletes on the team are doing drugs. An athlete who has never used any drugs tests positive for drug use.
A) Type I error **B)** Type II error **C)** No error, correct decision.

3. A can of cola advertises a mean weight of 12 oz. A sample of 100 cans taken from a batch has a mean weight of 12.5 oz. This is outside of the confidence interval, so the entire batch is rejected. It is later found that the true mean weight of the batch is within the interval.
A) Type I error **B)** Type II error **C)** No error, correct decision.



4. A teacher gives a test to 5 sections of Statistics. She makes the hypothesis that all classes will have the same mean. Upon analysis, she finds that all of the means fall within a 95% confidence interval of the population.
 A) Type I error B) Type II error C) No error, correct decision.

5. True or False: With a Type I error, you reject the null hypothesis when it is true.

6. If the null hypothesis is false, what kind of error can you make?
 A) Type I error B) Type II error C) Both type I and II D) You can't make an error.

Open **Pic1**. The graph shows a representation of type I errors, type II errors, and power. The vertically striped area represents the power. The checked area represents type I errors and the black area represents type II errors. Use the graph to answer Question 7.

7. The power of a test is ...
 A) the same as a type I error B) the same as a type II error
 C) 1 – type II error D) 1 – type I error

Problem 2 – Calculating the probability of errors

In this problem you will calculate the probability of different types of errors occurring.

α = probability of a type I error
 = the significance level used for testing

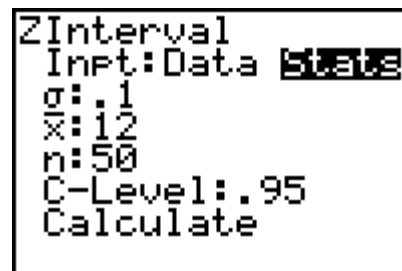
β = probability of a type II error

power = probability that a test will reject the null hypothesis when it is, in fact, false
 = $1 - \beta$

Situation: A sample of 50-12 oz. cans of cola has a mean of 12.05 oz. The weights are known to be normally distributed with a standard deviation is 0.1 oz. You test the hypothesis that the mean is 12 oz at a significance level of 5%.

$$H_0: \mu = 12 \quad H_1: \mu \neq 12$$

8. Find the interval that contains the values of sample proportions (\bar{x}) that do not lead to a rejection of H_0 .
 (Use the **ZInterval** command by pressing **[STAT]** and arrow to the **TESTS** menu.)





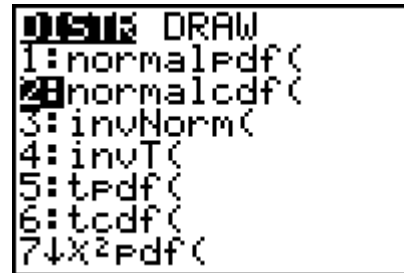
What! A Mistake!

9. On the Home screen, use the sample mean to standardize each endpoint.

(Use the formula $\frac{x - \bar{x}}{\sigma / \sqrt{n}}$.)

10. Using the standardized values, find the probability that the z-value will lie in the interval. This is β . (Use the **normalcdf** command by pressing **2nd** [DISTR].)

What is the probability of a type II error?



11. What is the power?

12. What is the probability of a type I error?