



**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. He tested for the virus. It 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)

Discuss the type of error, if any, associated with each scenario. 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.
  
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.
  
3. A can of cola advertises a mean weight of 12 oz. A sample of 100 cans has a mean weight of 12.5 oz. This is outside of the confidence interval, so the cola cans are rejected. It is later found that the true mean weight is within the interval.



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.
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?

**Problem 2 – Calculating the probability of errors**

$\alpha$  = probability of a type I error  
= the significance level used for testing

$\beta$  = 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 follow distribution with a standard deviation is 0.1 oz. You test the hypothesis that the mean is 12 oz at a significance level of 5%.

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

**Step 1:** Find the interval that contains the values of sample proportions ( $\bar{x}$ ) that do not lead to a rejection of  $H_0$ . (Use the **z Interval** command.)

**Step 2:** Use the sample mean and standardize each endpoint. (Use the formula  $\frac{x - \bar{x}}{\sigma / \sqrt{n}}$ )

**Step 3:** Using the standardized values, find the probability that the z-value will lie in the interval. This is  $\beta$ . (Use the **normCdf** command.)

7. What is the probability of a type II error?
8. What is the power?
9. What is the probability of a type I error?