Type I & Type II Errors

The Null Hypothesis basically says there is no difference between groups.

H_O: ***There is no difference between male and female scores on the GRE exam nationwide.***

H_1: There is a difference between male and female scores on the GRE exam nationwide.

We sample 1000 students' scores at ASU to test our hypothesis.

H_O: ***There is no difference between male and female scores on the GRE exam nationwide.***

Assume: null is false – females score higher than males

Case 3: *Our sample shows that females have higher scores, hence we reject the null.*

3. Null is false, we reject it --- **Correct Decision**

Case 4: Our sample shows that males and females have equal scores, hence we fail to reject the null.

4. Null is false, we fail to reject it --- **Type II Error (β)**

Type I Error (α) occurs when we reject the null, but the null is true.

Type II Error (β) occurs when we fail to reject the null, but the null is, in fact, false.

When we correctly reject a false null hypothesis, this is known as power.

Power is symbolized by $\mathbf{1 - \beta}$

The more power a study has, the less likely it is that we will make a Type II error.

Increase the sample size to reduce the possibility of making a Type II error.

H_O: ***There is no difference between male and female scores on the GRE exam at ASU.***

2,001 students took the GRE at ASU and females scored higher than males (hence the null is false).

Sample consists of 10 males and 10 females from this class and their scores are equal, hence we fail to reject the null (committed Type II error.)

Sample consists of 1,000 males and 1,000 females from around campus and find that females scored higher, hence we reject the null (and have the correct answer.)

Sample Size has increased the Power of our study.
Statistically speaking, size does matter.

Type I Error (α) occurs when we reject the null, but the null is true.

Alpha level – **Level of Significance** – *Probability of Type I Error*

α *(also p): The probability with which we are comfortable making a Type I error.*

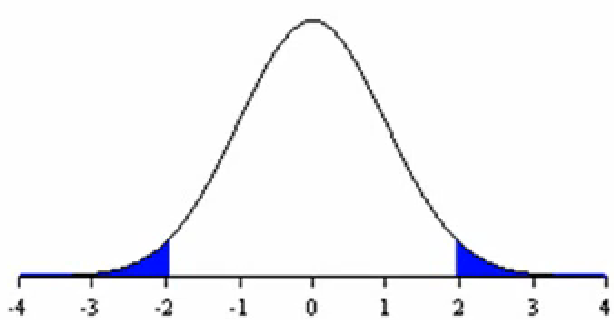
Conventionally, α is set at 0.05

Means we are willing to tolerate a 5-in-100 chance of making a Type I error

So, if we took 20 samples from our population, statistically, we should get the correct answer 19 times.

The alpha level defines the **critical region**, or ***region of rejection***, in a hypothetical distribution of sample statistics.

$\alpha = .05$



Shaded area = **critical region** (< -1.96 & > +1.96)

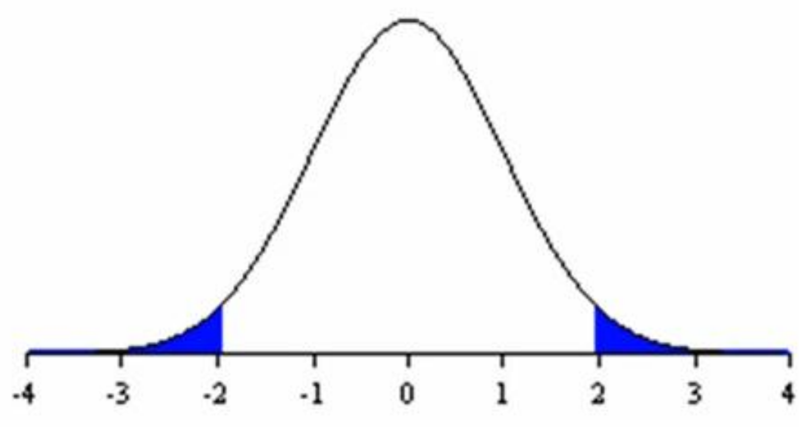
ABC Light Bulb Company claims that their bulbs burn for 1000 hours, with a standard deviation of 200 hours. To test their claim you buy 16 bulbs and observe how many hours each bulb stays lit. The mean number of hours in your sample is 980 hours. Is their claim justified?

Null: There is no significant difference between the claimed mean and the sample mean.

Given: population (claimed) mean =1000
sample mean = 980
population std dev = 200
sample size = 16

Z = (sample mean – pop mean)/(pop std dev/sq rt(sample size))
= (980 – 1000)/(200/sq rt(16))
= -20 / 50
= -0.4

Z = -0.4



α=.05

Since **-0.4** <u>does not</u> fall in the **critical region**, we fail to reject the null, therefore we have no evidence to conclude ABC's claim was incorrect