

**Statistical Reasoning
Hypothesis Tests**

Name: _____

Date: _____

Class: _____

Interpreting Hypothesis Tests

Two possible Hypothesis Test decisions: Reject H_0 or Fail to Reject H_0

- **Fail to reject the null hypothesis**— Failure to reject the null hypothesis means that any observed difference between the claimed value (H_0) and the sample value (H_a) is not significant. Clarification— That is NOT saying the true population value is the claimed value—just that there is Not enough evidence to reject H_0 .
 - o Legal analogy: In the court system you never hear the jury declare someone innocent, you only hear them conclude that someone isn't guilty.
 - o You can't prove someone is innocent, you just don't have enough evidence to prove that they're guilty.
- **Reject the null hypothesis**— Rejecting the null hypothesis means the difference between the claimed value (H_0) and the sample value (H_a) is significant. That is to say, the true population value is not equal to the claimed value because the sample value is different enough from the claimed value that the difference is unlikely based on random sampling alone.

Actually, there are 4 possible decisions—two H_0 decisions two kinds of error

Possibilities

True state of the world

H_0 Decisions

	H_0 is True	H_0 is False H_a is True
Reject H_0	Type I error $P(\text{Type I}) = \alpha$	Correct $P(\text{correct}) = 1 - \beta$
Fail to Reject H_0	Correct $P(\text{correct}) = 1 - \alpha$	Type II error $P(\text{Type II}) = \beta$



Different types of errors can have dramatically different consequences. For example...

Compare rejecting a perfectly good parachute and refusing to jump (type I)

vs.

Failing to reject a defective parachute and jumping out of a plane with it (type II).

What are the consequences of each?

- **Type I error:** is rejecting H_0 when H_0 is true.
(This is not a miscalculation or procedural error but a rare event that happens by chance.)
 - For example: A conclusion to an HIV test where the null hypothesis claims that there is no disease. If the test shows that an individual has HIV when they really do not this is a Type I error.
 - The probability of rejecting the null hypothesis when it is true is called the significance level or α (alpha).
- **Type II error:** is Failing to reject H_0 when H_0 is false.
 - For example: A conclusion to an HIV where the null hypothesis claims there is no disease. If the test shows that an individual does not have HIV when they really DO! this is a Type II error.
 - β (beta) is used to represent the probability of a type II error. (

α , β , and sample size n are all related.

- For any fixed α , an increase in the sample size n will cause a decrease in β .
- For any fixed sample size n , a decrease in α will cause an increase in β .
- To decrease both α and β , _____.

To know what to do, consider the ramifi ramifications involved in making each type of error. Consider the following example:

M&M's have a mean weight of .916 g while Bufferin tablets have a mean weight of 325 mg of aspirin.

If the M&M's weights are too large, Mars could lose money but customers will likely not complain. If the weights are too small, unless it was WAY off, customers would probably not notice.

However, if Bufferin tablets' weights are off in either direction, the company could face consumer lawsuits or FDA action. Bristol-Myers, the company that makes Bufferin, is thus likely to use a smaller significance level and a larger sample size n to do its testing because of the more serious consequences.

