

## Hypothesis Testing: Basic Concepts

In the field of statistics, a *hypothesis* is a claim about some aspect of a population. A *hypothesis test* allows us to test the claim about the population and find out how likely it is to be true.

The hypothesis test consists of several components; two statements, the null hypothesis and the alternative hypothesis, the test statistic and the critical value, which in turn give us the P-value and the rejection region ( $\alpha$ ), respectively.

The null hypothesis, denoted as  $H_0$  is the statement that the value of the parameter is, in fact, equal to the claimed value. We assume that the null hypothesis is true until we prove that it is not.

The alternative hypothesis, denoted as  $H_1$  is the statement that the value of the parameter differs in some way from the null hypothesis. The alternative hypothesis can use the symbols  $<$ ,  $>$ , or  $\neq$ .

The test statistic is the tool we use to decide whether or not to reject the null hypothesis. It is obtained by taking the observed value (the sample statistic) and converting it into a standard score under the assumption that the null hypothesis is true.

The P-value for any given hypothesis test is the probability of getting a sample statistic at least as extreme as the observed value. That is to say, it is the area to the left or right of the test statistic.

The critical value is the standard score that separates the rejection region ( $\alpha$ ) from the rest of a given curve.

### Types of Errors:

- A Type I Error is incorrectly rejecting a true null hypothesis (false negative).
- A Type II Error is incorrectly failing to reject an untrue null hypothesis (false positive).

		<u><math>H_0</math> is actually true</u>	<u><math>H_0</math> is actually false</u>
<u>Decision</u>	Reject $H_0$	Type I Error $P(\text{Type I Error}) = \alpha$	Correct Decision
	Fail to Reject $H_0$	Correct Decision	Type II Error $P(\text{Type II Error}) = \beta$