

## Hypothesis Testing: vocabulary and concepts

A **hypothesis** is a statement (or claim) about the value of a population parameter in the distribution of some random variable  $X$

The **null hypothesis** (notation:  $H_0$ ) is the main claim that is to be tested. (In science, the null hypothesis is usually chosen as the claim that we would be willing to believe in the absence of proof; in business applications, they sometimes say that the null hypothesis is the one that does not require action if it is true. In other words, the null hypothesis is often the opposite of what we may be hoping to prove.)

An **alternate hypothesis** (or **alternative hypothesis**; notation  $H_a$ ) is a claim that is being tested against the null hypothesis. In the tests we consider in this course, there will only be one alternate hypothesis.

Requirements about these:

- The null hypothesis must have an equals sign in it, for the type of tests we are considering
- The null hypothesis and the alternate hypothesis must be mutually exclusive statements

A **test** or **decision rule** of the null hypothesis is a rule that tells how the sample data will be used to determine whether we will accept the claim of the null hypothesis or not.

There are two outcomes to a hypothesis test:

- We accept the null hypothesis, or
- We reject the null hypothesis (in which case the result is said to be **significant**)

There are two types of errors possible when we perform a hypothesis test:

- We reject the null hypothesis when it is true: this is called an **error of Type I**
- We accept the null hypothesis when it is false: this is called an **error of Type II**

The way we will perform the test is to compute the value of a **test statistic** which is related to the parameter in the test. For example, to test a claim about a population mean  $\mu$ , the test statistic would be the sample mean  $\bar{x}$

The possible values of the test statistic are divided into two mutually exclusive sets, or regions: the region in which we will accept the null hypothesis (**Acceptance region**), and the region in which we will reject the null hypothesis (**Rejection region** or **critical region**). This is our decision rule.

The letter  $\alpha$  denotes the **probability of a Type I error**; it is the probability that the test statistic will fall in the critical region if the null hypothesis is true, so is also called the **size of the critical region**; it is also called the **level of significance** of the test.

The letter  $\beta$  denotes the **probability of making a Type II error**.

There are two types of null and alternate hypotheses discussed in the text: (for simplicity I will assume that knowing the value of the parameter being tested means that we know the distribution of the random variable, in other words, that any other parameters needed for the distribution are already known)

- A **simple hypothesis** specifies the value of the parameter
- A **composite hypothesis** gives a range of possible values for the parameter.