

TESTING OF HYPOTHESIS

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What is meant by Testing of hypothesis?

Testing of hypothesis is a form of statistical inference that uses data from a sample to draw conclusions about a population parameter or a population probability distribution.

OR

Hypothesis testing can be defined as a statistical tool that is used to identify if the results of an experiment are meaningful or not.

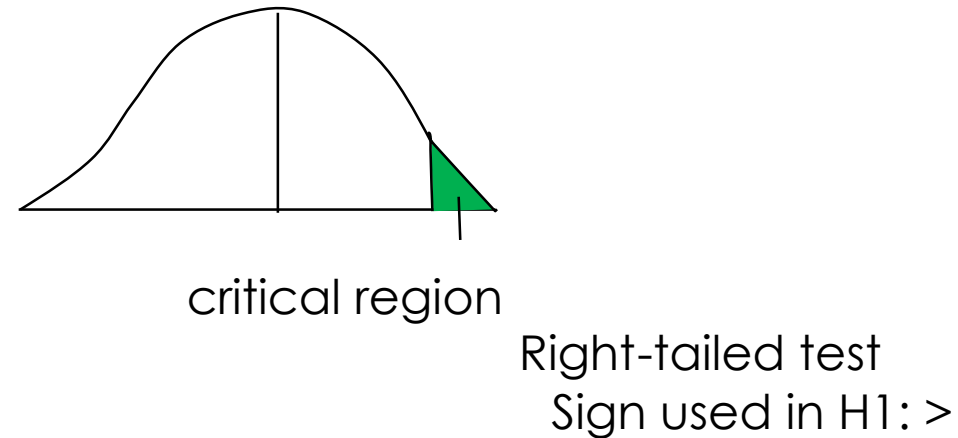
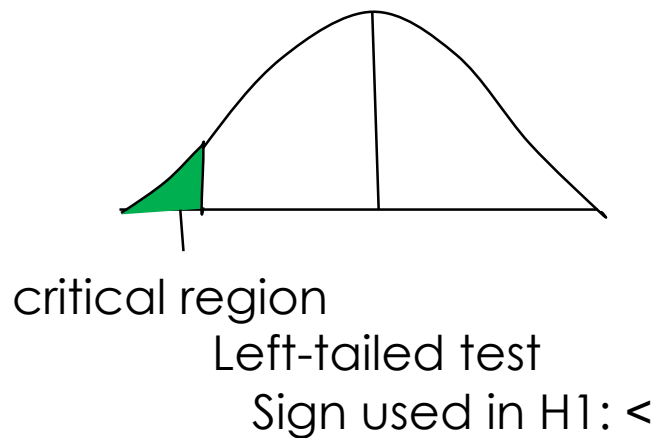
STATISTICAL HYPOTHESIS

- ▶ Hypothesis testing can be defined as a statistical tool that is used to identify if the results of an experiment are meaningful or not.
- ▶ Null hypothesis: A statistical hypothesis that is to be tested. i.e the null hypothesis of a test always predicts no effect or no relationship between variables. It is denoted by H_0 .
- ▶ Alternative hypothesis : The alternative to the null hypothesis. i.e the alternative hypothesis states your research prediction of an effect or relationship. It is denoted by H_1 .

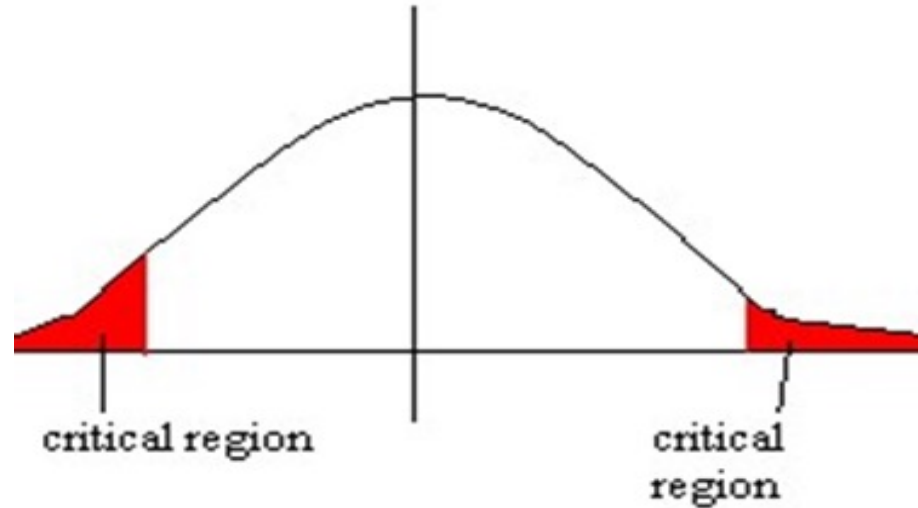
One-tailed or Two-tailed Tests

- In Statistics hypothesis testing, we need to judge whether it is a one-tailed or a two-tailed test so that we can find the critical values in tables such as Standard Normal z Distribution Table and t Distribution Table. And then, by comparing test statistic value with the critical value or whether statistic value falls in the critical region, we make a conclusion either to reject the null hypothesis or to fail to reject the null hypothesis.
- How can we tell whether it is a one-tailed or a two-tailed test? It depends on the original claim in the question. A one-tailed test looks for an “increase” or “decrease” in the parameter whereas a two-tailed test looks for a “change” (could be increase or decrease) in the parameter. Therefore, if we see words such as “increased, greater, larger, improved and so on”, or “decreased, less, smaller and so on” in the original claim of a question ($>$, $<$ are used in H_1), a one-tail test is applied. If words such as “change, the same, different/difference and so on” are used in the claim of the question (\neq is used in H_1), a two-tailed test is applied.

In a one-tailed test, the critical region has just one part (the green area below). It can be a left-tailed test or a right-tailed test. Left-tailed test: The critical region is in the extreme left region (tail) under the curve. Right-tailed test: The critical region is in the extreme right region (tail) under the curve.



In two-tailed test, the critical region has two parts (the red areas below) which are in the two extreme gerions (tails) under the curve.



Two-tailed test
Sign used in H_1 : \neq

TYPE I AND TYPE II ERROR

- ▶ Statistical hypothesis testing implies that no test is ever 100% certain: that's because we rely on probabilities to experiment. When online marketers and scientists run hypothesis tests, they're both looking for statistically relevant results. This means that the results of their tests have to be true within a range of probabilities (typically 95%). Even though hypothesis tests are meant to be reliable, there are two types of errors that can still occur. These errors are known as type 1 and type 2 errors. Let's dive in and understand what type 1 and type 2 errors are and the difference between the two.

Measured or
Perceived

False

Correct 😊	Type 1 error False Positive
Type 2 error False Negative	Correct 😊

Understanding Type I Errors

Type 1 errors - often assimilated with false positives - happen in hypothesis testing when the null hypothesis is true but rejected. The null hypothesis is a general statement or default position that there is no relationship between two measured phenomena.

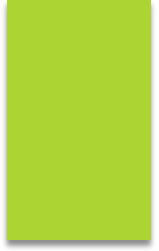
Simply put, type 1 errors are "false positives" — they happen when the tester validates a statistically significant difference even though there isn't one.

Type 1 error

False Positive

Type 2 error

False Negative



Understanding Type II Errors

In the same way that type 1 errors are commonly referred to as "false positives", type 2 errors are referred to as "false negatives".

Type 2 errors happen when you inaccurately assume that no winner has been declared between a control version and a variation although there actually is a winner.

In more statistically accurate terms, type 2 errors happen when the null hypothesis is false and you subsequently fail to reject it.

CRITICAL REGION

- ▶ While deciding whether H_0 is true or false , entire sample is divided into two non-overlapping regions.
- ▶ One of the regions is acceptance region of H_0 and the other is rejection region of H_0 .

TEST AND TEST STATISTIC

- ▶ A rule which leads to the decision of acceptance of H_0 or rejection of H_0 is called a test.
- ▶ A function of sample observations which is used to test H_0 is called as test statistic.

LEVEL OF SIGNIFICANCE

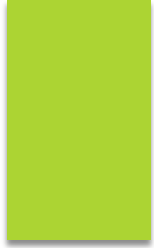
- ▶ A Probability of rejecting H_0 when it is true is called as Level of Significance.
- ▶ It is denoted by α .
- ▶ Level of Significance can be interpreted as proportion of cases in which H_0 is rejected though it is true.
- ▶ It is the probability of committing Type I error.
- ▶ Level of Significance cannot be made 0. However we can fix it in advance as 0.01 (1%) or 0.05 (5%) .
- ▶ In most cases it is taken as 5%.

P-value

- ▶ A p-value is a statistical measurement used to validate a hypothesis against observed data.
- ▶ A p-value measures the probability of obtaining the observed results, assuming that the null hypothesis is true.
- ▶ The lower the p-value, the greater the statistical significance of the observed difference.

What Are The Steps For Hypothesis Testing?

- First we state the null hypothesis H_0 .
- What is the null hypothesis?.
- This states that in the general population there is no change, no difference, or no relationship.
- Basically it says the opposite of what we are hoping to show.

- 
- **Then we state the alternative hypothesis.**
 - **What is the alternative hypothesis?**
 - **This states that there is a change, a difference, or a relationship for the general population.**
 - **This is where we state what we believe (hypothesize) to be true**

WHY DO WE DO THIS?

- ▶ There is no way to PROVE a hypothesis. You can only support a hypothesis, or reject it. If you support it 100,000 times, and then on the 100,001st time you reject it, the hypothesis is not true.
- ▶ So, we seek to reject the null, and thus, conversely we support the alternative.

ADVANTAGES

- The most significant benefit of hypothesis testing is it allows you to evaluate the strength of your claim or assumption before implementing it in your data set.
- Also, hypothesis testing is the only valid method to prove that something “is or is not”.

DISADVANTAGES

- This basic approach has a number of shortcomings.
- First, for many of the weapon systems,
 - (1) the tests may be costly,
 - (2) they may damage the environment, and
 - (3) they may be dangerous. These considerations often make it impossible to collect samples of even moderate size.

TESTING OF HYPOTHESIS IN MS EXCEL

- Height (in inches) of Male and Female in US .

Males	Females
73	60
62	66
68	56
60	64
67	64
67	56
63	61
77	59
80	63
66	55

Step 1: Writing the Hypothesis

Ho: Mean height of Males is equal to mean height of Females

H1: Mean height of Males is not equal to mean height of Females

Step 2: Method Two sample t-test

p-value 0.012963805 alpha=0.05

- P-value is calculated in Excel by following function:
 - ✓ T.TEST(array1,array2,tails,type)
 - ✓ T. TEST **uses the data in array1 and array2 to compute a non-negative t-statistic.** If tails=1, T. TEST returns the probability of a higher value of the t-statistic under the assumption that array1 and array2 are samples from populations with the same mean.



Step 3: Decision rule

Since $p\text{-value} < \alpha$, we reject H_0 at 5% los

Step 4 :

Conclusion: Mean height of Males is not equal to mean height of Females

Testing of Hypothesis can also be done using the Data Analysis option in Data tab and selecting the appropriate test.



THANK YOU !