Hypothesis Testing Part II
Type I & II Error and Test of 1 &2 Tailed Hypothesis

Khagendra Kumar

Dept. of Education

Patna University

Decision Making on Accepting & Rejecting Hypotheses

- To take decision for accepting or rejecting hypothesis, there are 4 possible outcomes:
- 1. Reject null hypothesis when it is false- correct decision (Method A ≠ Method B) correct decision
- 2. Not reject null hypothesis when it is true (Method A = Method B) correct decision
- 3. Reject null hypothesis when it is true (Method A = Method B) wrong decision
- 4. Not reject null hypothesis when it is false (Method A ≠ Method B) wrong decision

		Null Hypothesis (H_0) is:	
		TRUE	FALSE
Decision about null hypothesis (H_0)	FAIL TO REJECT	Correct	Type II Error
	REJECT	Type I Error	Correct

Type I Error

- **Type I Error**
- The first kind of error that is possible involves the rejection of a null hypothesis that is actually true.
- This kind of error is called a type I error and is sometimes called an error of the first kind.
- Type I errors are equivalent to false positives.
- Let's go back to the example of a drug being used to treat a disease. If we reject the null hypothesis in this situation, then our claim is that the drug does, in fact, have some effect on a disease. But if the null hypothesis is true, then, in reality, the drug does not combat the disease at all. The drug is falsely claimed to have a positive effect on a disease.

Type II error

- The other kind of error that is possible occurs when we do not reject a null hypothesis that is false.
- This sort of error is called a type II error and is also referred to as an error of the second kind.
- Type II errors are equivalent to false negatives.
- If we think back again to the scenario in which we are testing a drug, what would a type II error look like? A type II error would occur if we accepted that the drug had no effect on a disease, but in reality, it did.

Controlling Type I error

- For a 95% confidence level, the value of alpha is 0.05. This means that there is a 5% probability that we will reject a true null hypothesis.
- In the long run, one out of every twenty hypothesis tests that we perform at this level will result in a type I error.
- For a 99% confidence level (value of alpha is 0.01) there is 1% probability of rejection of a true null hypothesis.
- We could decrease the value of alpha from 0.05 to 0.01, corresponding to a 99% level of confidence and minimize type I error.
- However, if everything else remains the same, then the probability of a type II error will nearly always increase.

Controlling Type II Error

- **Increase the sample size**
- One of the simplest methods to increase the power of the test is to increase the sample size used in a test. A larger sample size increases the chances to capture the differences in the statistical tests, as well as increasing the power of a test.
- **2. Increase the significance level**
- Another method is to choose a higher level of significance. For instance, a researcher may choose a significance level of 0.10 instead of the commonly acceptable 0.05 level. The higher significance level implies a higher probability of rejecting the null hypothesis.
- The larger probability of rejecting the null hypothesis decreases the probability of committing a type II error while the probability of committing a type I error increases.

Errors can be minimized, can't be removed

- Type I and type II errors are part of the process of hypothesis testing. Although the errors cannot be completely eliminated, we can minimize one type of error.
- Typically when we try to decrease the probability one type of error, the probability for the other type increases.
- Type I & II errors can be controlled to some extent.
- Level of significance that we selected has a direct bearing on type I &II errors.
- Thus, the user should always assess the impact of type I and type II errors on their decision and determine the appropriate level of statistical significance.

One tailed & two tailed tests

- The tail refers to the end of the distribution of the test statistic for the particular analysis that you are conducting. For example, a *t*-test uses the *t* distribution
- The distribution of the test statistic can have one or two tails depending on its shape
- Symmetrical distributions like the *t* distribution has two tails. Asymmetrical distributions like the chi-square distribution has only one tail.

BASIS OF COMPARISON	ONE-TAILED TEST	TWO-TAILED TEST
Meaning	A statistical hypothesis test in which hypothesis has a direction, is known as one tailed test.	A significance test in which hypothesis has no direction, is called two-tailed test.
Hypothesis	One tailed /one end	Two tailed/ two ends
Region of rejection	Either left or right	Both left and right
Determines	If there is a relationship between variables in single direction.	If there is a relationship between variables in either direction.
Result	Greater or less than certain value.	Greater or less than certain range of values.

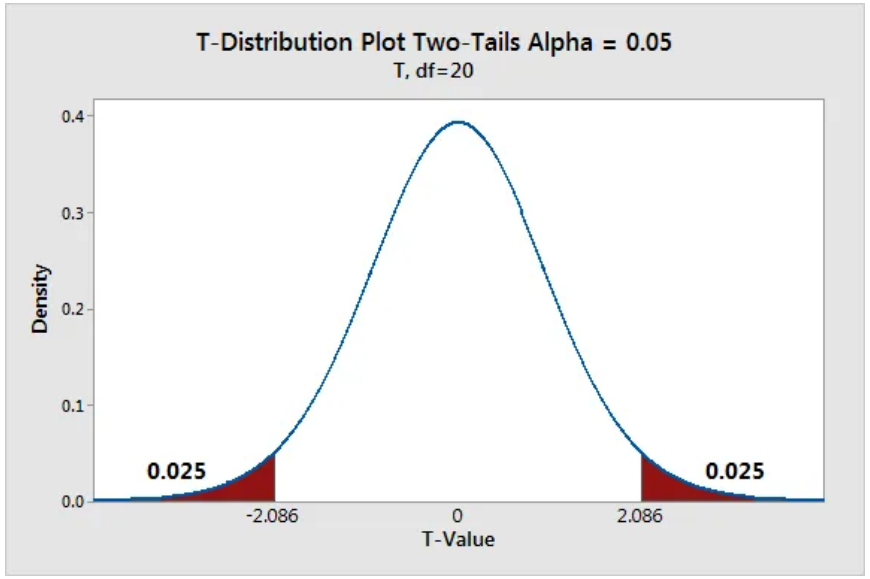
Explaining two tailed test

- A two-tailed test is appropriate to determine is any difference (higher or lower) between the groups being compared.
- For instance, if Group A scored higher or lower than Group B, then a two-tailed test can be used.
- This is because a two-tailed test uses both the positive and negative tails of the distribution. In other words, it tests for the possibility of positive or negative differences.

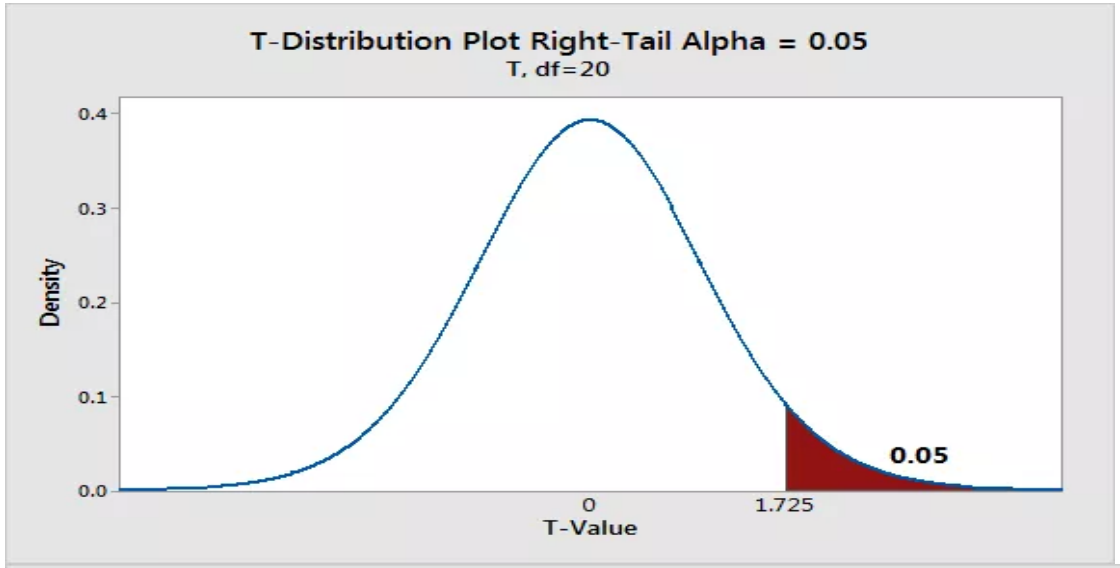
Explaining one tailed test

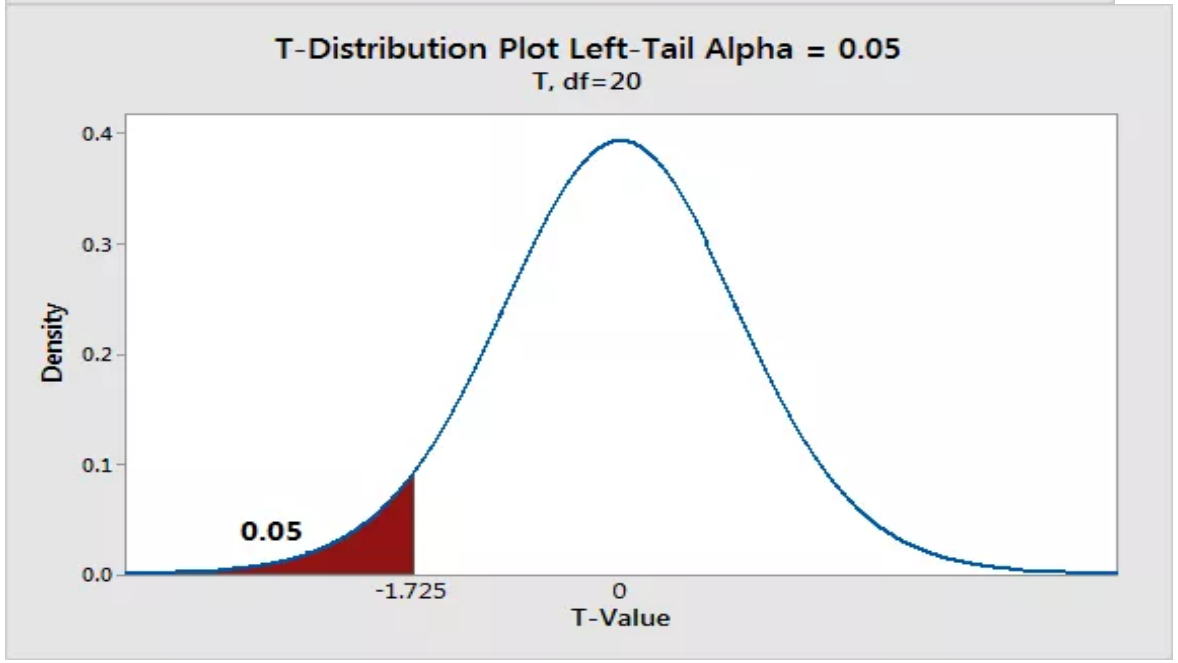
- A one-tailed test is used to determine a difference between groups in a specific direction.
- So, if one is only interested in determining if Group A scored higher than Group B, and not interested in possibility of Group A scoring lower than Group B, then a one-tailed test can be used.
- The main advantage of using a one-tailed test is that it has more statistical power than a two-tailed test at the same significance (alpha) level.
- In other words, your results are more likely to be significant for a one-tailed test if there truly is a difference between the groups in the predicted direction.

Two taile
Test
T distribut



One tailed test T distribution





ISSUE TO BE DISCUSSED IN THE LAST PART

- In this part we would be discussing the concept of df

THANK YOU