

On Computation of t test- According to syllabus: **Two problems to be written in the practical files: One for Independent Group and one for paired observation of small single groups by difference method.**

## **Introduction:**

In education & psychology, there are mean & several other representative values like median, standard deviation, etc for studying the characteristics of a certain population & there are many occasions when people are more interested in knowing about the significance of the difference between two sample means (independent or correlated), drawn from the same or different populations.

### **Concept of Standard Error:**

In statistics, a sample mean deviates from the actual mean of a population- this deviation is the standard error of the mean.

### **Concept of Null Hypothesis:**

Null hypothesis is the starting point of solving a problem related to the significance of difference between means. Such a hypothesis always emphasizes that there exists no real difference between two population means & that the difference found between sample means is therefore, insignificant. For example: there exists no significant difference between the achievements of two groups taught by different methods.

The task of rejection or retention of a null hypothesis rests on some of the following points:

- Setting up the level of confidence or Significance:

The experimenter has to take a decision about the level of confidence or significance at which he is going to test, his hypothesis. At times he may decide to use 0.05 or 5% level of significance for rejecting a null hypothesis (when a hypothesis is rejected at the 5% level it is said that the chances are 95 out of 100, that the hypothesis is not true & only 5 chances out of 100 that it is true). At other times, he may prefer to make it more rigid & therefore, use the 0.01 or 1% level of significance. If a hypothesis is rejected at this level, the chances are 99 out of 100 that the hypothesis is not true & that only 1 chance out of 100 is true.

- Size of the Sample & concept of normal distribution & t distribution:

Usually, a sample of 30 cases or more is taken as a large sample & a sample of less than 30 as small. It is seen that the means of large samples randomly drawn from the same population produce a normal distribution. So, if the samples are large ( $N=30$  or greater than 30), then the distribution of differences between means will be a normal one & represented in terms of standard sigma (z) scores.

On the other hand, if it is small ( $N$  is less than 30) in size, the distribution does not take the shape of a normal curve; then the distribution will take the form of a t- distribution. Therefore, in case of small samples processing, a t-distribution of differences between means, it is the rule of thumb to make use of t values rather than z scores of the normal curve. T distribution is sometimes called “Student” distribution in honour of its discover W.S. Gosset (1980) who wrote under the pen name “Student”.

- Concept of degrees of freedom:

The number of independent variables is usually called the number of degrees of freedom. The concept of degrees of freedom is widely used in dealing with small sample statistics. The symbol *df* is frequently used to represent this concept. The ‘freedom’ in the term degrees of freedom signifies ‘freedom to vary’. Therefore, the degrees of freedom associated with a given sample are determined by the number of observations (the number of values of the variables) that are free to vary. The degrees of freedom are reduced through the constraints or restrictions imposed upon the observations or variables. As a general rule one degree of freedom is lost for each constraint or restriction imposed. The number of degrees of freedom in any case, is given by the formula,

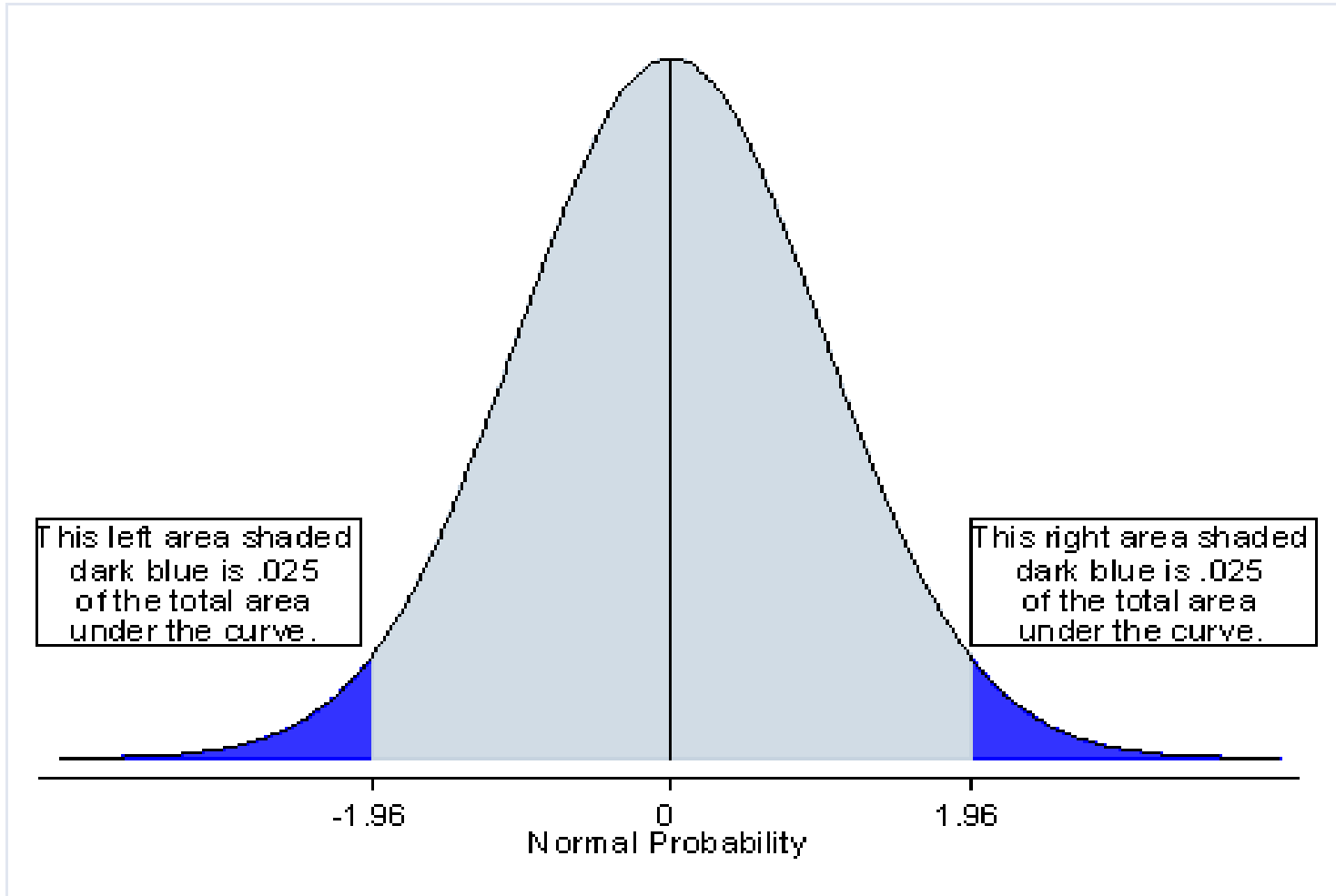
No. of degrees of freedom = No. of observations or variables – No. of constraints or restrictions. For eg., if we have five scores as 12, 10, 7, 6 & 5; the mean is 8 & the deviations of these scores from their mean are 4, 2, -1, -2, & -3 respectively. Here, if *df* would be = (N-1); that means out of the five deviations, only four are free to vary.

## Two-tailed & One-tailed tests of Significance:

**Two-tailed test (or, non-directional test):** A test for finding whether or not there is a significant difference between the means of two groups in an experiment, irrespective of which of them is higher or lower than the other. Example of null hypothesis in a two-tailed test- “There is no difference between the mean IQ’s of athletes & non-athletes.”

If you are using a **significance level** of 0.05, a **two-tailed test** allots half of your alpha to **testing the statistical significance** in one direction and half of your alpha to **testing statistical significance** in the other direction. This means that, .025 is in each **tail** of the distribution of your **test** statistic.

In case of 0.01 level of significance, thus .005 is in each tail of the distribution.



**One-tailed test (or, directional test):** A test for finding whether or not the mean of one group is significantly higher (alternatively, lower) than that of another in an experiment. Example of null hypothesis in a one-tailed test- “Athletes do not have higher IQ’s than non-athletes; or Athletes do not have lower IQ’s than non-athletes.”

A **one-tailed test** is a statistical **test** in which the critical area of a distribution is **one**-sided so that it is either greater than or less than a certain value, but not both. If the sample being tested falls into the **one**-sided critical area, in case of a t-distribution of small sample means, in making use of the one-tailed test, we have to look for the critical t values as 0.10 & 0.02 (instead of 0.05 & 0.01 as in the case of two-tailed test) to test the significance at 5% % 1% levels of significance, respectively.

## **Determining The Significance of Difference Between Two Means:**

The process of determining the significance of difference between two given sample means varies with respect to the largeness or smallness of the samples as well as the relatedness or unrelatedness (independence) of the samples. Accordingly, the following types have been derived:

- ✓ Large but independent samples
- ✓ Small but independent samples
- ✓ Large but correlated samples
- ✓ Small but correlated samples.

## Reference:

- Statistics in Psychology & Education: S. K. Mongal, 2017
- Statistics in Biology & Psychology, Debajyoti Das & Arati Das, 2004
- Statistics in Psychology & Education: Henry E. Garrett, 1981.