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Any statistical test that uses t distribution can be called a t-test, or the "student's t-test". It is basically used when the sample size is small i.e. $n < 30$.

For example, if a person wants to test the hypothesis that mean height of student's of a college is not different from 150 cms, he can take a sample of size say 20 from the college. From the mean height of these students, he can test the hypothesis. The test to be used for this purpose is t-test.

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Student's T-test for Different Purposes

There are different types of t-test ^[1] each for different purpose. Some of the popular types are outlined below:

1. **Student's t-test for single mean** is used to test a hypothesis on a specific value of the population mean. Statistically speaking, we test the null hypothesis ^[2] $H_0: ? = ?_0$ against the alternative hypothesis ^[3] $H_1: ? > < ?_0$ where ? is the population mean and $?_0$ is a specific value of the population that we would like to test for acceptance.

The example on heights of students explained above requires this test. In that example,

$\sigma = 150$.

2. The **t-test for difference of means** is used to test the hypothesis that two populations have the same mean.

For example suppose one is interested to test if there is any significant difference between the mean height of male and female students in a particular college. In such a situation, t-test for difference of means can be applied. One would have to take two independent samples from the college- one from males and the other from females in order to perform this test.

An additional assumption of this test is that the variance of the two populations is equal.

3. A **paired t-test** is usually used when the two samples are dependent- this happens when each individual observation of one sample has a unique relationship with a particular member of the other sample.

For example we may wish to test if a newly developed intervention program for disadvantaged students is useful. For this, we need to obtain scores from say 22 students in a standardized test before administering the program. After the program is over, the same test needs to be administered again on the same group of 22 students and scores obtained.

The two samples- the sample of prior intervention scores and the sample of post intervention scores are related as each student has two scores. The samples are therefore dependent. The paired t-test can be applicable in such scenarios.

4. A **t-test for correlation coefficient** is used for testing an observed sample correlation coefficient (r).

For example suppose a random sample [4] of 27 pairs of observation from a normal population gave a correlation coefficient 0.2. Notice that this is the sample correlation coefficient obtained from a sample of observations. One may be interested to know whether the variables are correlated in the population. In this case we can use t-test for correlation coefficient

5. A **t-test for testing significance of regression coefficient** is used to test the significance [5] of regression coefficients in linear [6] and multiple [7] regression setup.

Assumptions

Irrespective of the type of t-test used, two assumptions have to be met.

1. the populations from which the samples are drawn are normal [8].
2. the population standard deviation [9] is not known.

Student's t-test [10] is a small sample test. It is difficult to draw a clearest line of demarcation between large and small sample. Statisticians have generally agreed that a sample may be considered small if its size is < 30 .

The test used for dealing with problems relating the large samples are different from the one

used for small samples. We often use z-test ^[11] for large samples.

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