Original Research Paper

Volume - 15 | Issue - 03 | March - 2025 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Education

APPLICATION OF T-TEST AS QUANTITATIVE TECHNIQUES IN RESEARCH: A STATISTICAL STUDY

Md. Abdul Mannan Bhuyean

PhD Scholar Of University Of Dhaka & Associate Professor, Department Of Law, University Of Information Technology And Sciences (UITS), Dhaka, Bangladesh.

ABSTRACT T- Test is the hypothesis test measurement. It's a statistical apparatus used to compare the means of two groups or the distinction between a group's mean and a standard value. The t-test is also identified as student's t-test, t- statistic, or t-distribution. In statistics, the t-test is the proportion of the difference in a number's assessed value from its anticipated value to its standard miscalculation. The t-statistic is used in a t-test to define whether to support or discard the null hypothesis. A t-test is decisive in research because it permits the researchers to statistically decide whether observed differences between two groups are noteworthy. It has great significance in the research arena to the hypothesis testing, dealing with lesser sample sizes, interpreting outcomes, versatility etc.

KEYWORDS :

DEFINITION

Generally, the t-test is an inferential statistic used in hypothesis testing to evaluate if there is a statistically significant difference between the mean softwo sample groups.[1]

T-Test Meaning

AT-test is the last statistical tool for identifying differences betweent womeans that may or may not be associated. Samples from the two categories or groups are chosen at random for testing. It is a statistical procedure in which samples are selected randomly, and there is no perfect normal distribution.[2]

A t-test is an inferential statistic that determines if there is a significant difference between two groups' means and how they are connected. T-tests are employed when data sets follow a normal distribution but have unknown variances, such as the data set obtained by flipping aco in 100 times.[3]

The t-test is a statistical hypothesis test that determines statistical significance by combining the t- statistic, t-distribution values ,and degrees of freedom.[4]

Key Takeaways[5]

- The t-test is an inferential statistic used to identify statistically significant differences between two variables' mean values.
- In statistics, the t-test is used to test hypotheses.
- To calculate a t-test, subtract the mean values from each data set, the standard deviation of each group, and the total number of data points.
- T-testsmaybedependentorindependent.

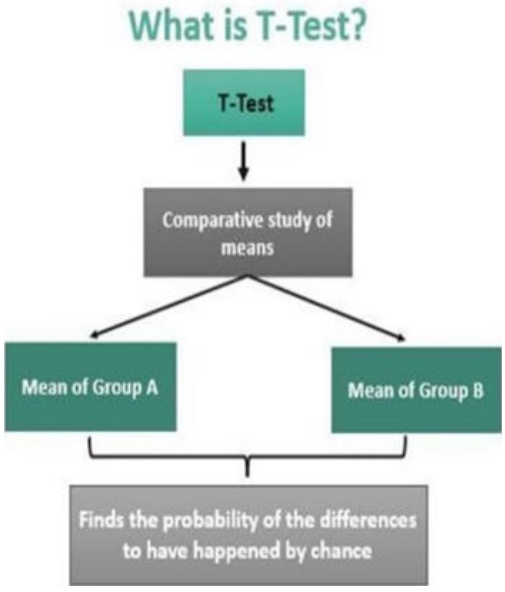


Figure:01 Conception a l Meaning of T-Test

The type of T-test to be performed depends on whether the samples to be studied are from the same or different categories. The approach yields a conclusion about the likelihood that the mean differences occurred by random. The test is useful for comparing population ages, crop lengths from various species, student grades, and so on.[6]

- AT-test compares mean sorproportions between two samples from the same or different categories.
- It focuses on hypothesis testing for specific populations.
- The discrepancy between population mean sand hypothe sized values.
- T-testsfor mean comparisons include one-sample, two-sample, paired, equal, and unequal variances.

T-Test Explained

A T-test examines a collection of data collected from two comparable or dissimilar groups to evaluate the likelihood of a difference in the outcome from what is typically achieved. The test's accuracy is determinedbyavarietyofelements,includingthedistributionpatternsutil izedandthe variations that influence the gathered samples. The test is performed based on the parameters, and a T-value is obtained as a statistical inference of the likelihood of the normal consequence being driven by chance.[7]

For example, a T-test may be used to deter mine if the mean length of petals of two distinct kinds of flowers is the same. The user can choose petals at random from two other flower species and reach a typical conclusion. The final T-test in terpretati on might be derived in one of two ways:

- Anullhypothesisindicatesthatthedifferencebetweenthemeansiszer oandequal.
- An alternate hypothesis suggests that the difference between the means is not zero. This hypothesis contradicts the null hypothesis, showing that the data set is very accurate and not random.

This T-test, however, is only legitimate and should be used to compare the mean or average of two categories or groups. It is not advisable to under take this when there are more than two comparisons to be made.

Assumptions

Thetestrunsonasetofassumptions,whichareasfollows:[8]

- Hypothesis testing uses a continuous or ordinal scale. The acknowledged factors and variations impacting the samples and their surroundings are based on conventional considerations.
- Random sampling is used throughout the tests. The trust worthiness of the samples is frequently called in to doubt since no uniqueness is maintained.
- When plotted against the T-test distribution, the data should follow a normal distribution with a bell-shaped curve.
- Alarger sample size is required for a more pronounced bell curve.
- The Variance should be close to equal standard deviations among samples.

Which T-Test to Use

The flowchart below may be used to identify which t-test to apply based on the characteristics of the sample sets. The main elements to considerare:[9]

- The similarity of the sample records

- The number of data records in each sample set
- The variance of each sample set

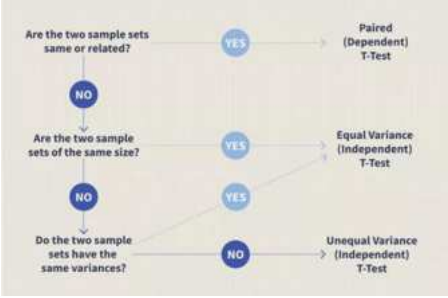


Figure:02 T-TestsinVarianceSample

Types Of T-test

Some of the widely used T-test type sareasfollows:

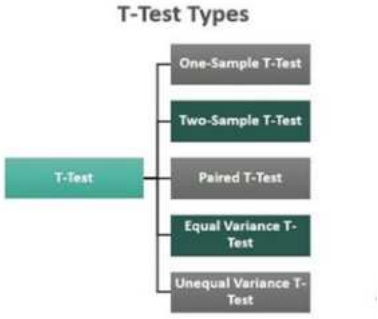


Figure:03 Methods of T-Test

- **1-One-SampleT-Test**

This test compares the mean or average of one group to the specified average, which is either the theoretical value or means of the population. For example, at each erwants to determine the average heightofclass5childrenandcompareittoagivenvalueofmorethan45kgs. Todothis,theteacherpicksasetofpupilsatrandomandnotestheirindividualweights.Next,she calculates the average weight for that group and determines if it reaches the standard established figure of 45 or above. One-samplet-testresultsareobtainedusing the following formula:

$t = (\bar{x} - \mu) / (s / \sqrt{n})$, where:

- T = t-statistic
- $\bar{x}$: is the sample mean
- **μ**: is the population mean (the hypothesized value you are comparing your sample to)
- **s**: is the sample standard deviation
- **n**: is the sample size

- **2-IndependentTwo-SampleT-Test**

Thistestcomparessamplesfromtwodistinctgroups,species,orpopulations.Itisoftenreferredto as an independent t-test. For example, if a teacher wishes to compare the heights of male and female pupils in class 5, she can apply the independent two-sample test. The **T-test formula** used to calculate this is:

The formula for a two-sample t-test is: $t = (\bar{x_1} - \bar{x_2}) / \sqrt{(s_1^2/n_1 + s_2^2/n_2)}$, where:

$\bar{x_1}$: is the mean of the first sample

$\bar{x_2}$: is the mean of the second sample

s_1^2: is the variance of the first sample

n_1: is the sample size of the first group

s_2^2: is the variance of the second sample

n_2: is the sample size of the second group

- **3-PairedSampleT-Test**

This hypothesis testing is performed when two groups are members of the same population or group. The groups are investigated at two separate periods or under two distinct settings. The formula for obtaining the t-value in case of paired sample t-test is:

t = (mean of the differences - hypothesized mean difference) / (standard deviation of the differences / √n), where "d" represents the difference between paired observations, "n" is the number of pairs, and "mean of the differences" and "standard deviation of the differences" are calculated from the differences between paired data points.

- **4-EqualVarianceT-Test**

This test is used when the sample size in each group or population is equal or the variance of the two data sets is similar. It is also known as pooled T-test.Theformulausedhereisasfollows:

$$T - value = \frac{mean1 - mean2}{(n1 - 1)\ x\ var1^2 + (n2 - 1)\ x\ var2^2 \sqrt{\frac{1}{n1} + \frac{1}{n2}}}$$

Where,

- Mean1andmean2=averagevalueofeachsetofsamples
- var1andvar2=varianceofeachsetofsamples
- n1andn2=numberofrecordsineachset

- **5-UnequalVarianceT-Test**

When there is a difference between the variance and the number of samples in each group, the unequal variance test is employed. The formula, which is sometimes called Welch's test, is as follows:

$$T - value = \frac{mean1 - mean2}{\sqrt{(\frac{var1}{n1} + \frac{var2}{n2})}}$$

Where,

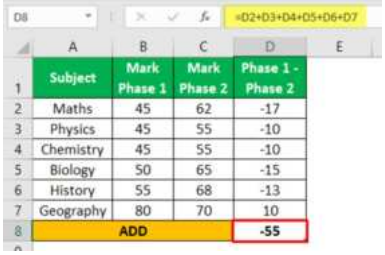
- mean1andmean2=Averagevalueofeachsetofsamples
- var1andvar2=Varianceofeachsetofsamples
- n1andn2=numberofrecordsineachset

Examplewith Calculation

Being a teacher of an Institution, let us evaluate the scores for each topic in the examination performed in two phases about the different subjects:

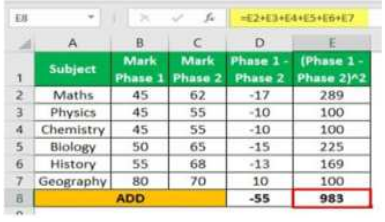
Subject	MarksPhase1	MarksPhase2
Mathematics	45	62
Physics	45	55
Chemistry	45	55
Subject	MarksPhase1	MarksPhase2
Biology	50	65
History	55	68
Geography	80	70

Step1: Subtractthemarksscoredinboththephases



Step2: Addupallthedifferences,i.e.,-55

Step3: Squareupthedifferences



Step4: Addupallthesquaresofdifference,i.e., 983

Step5: UsageofformulatocalculatetheTvalue

$$T = \{(\sum D)/N\}/\sqrt{\{\sum D2 - (\sum D)2/N)\}/(N-1) - N}$$

$=-9.16/\sqrt{\{983-(-55)^2/6)\}/(6-1)*6}$

$=-9.16/\sqrt{15.96}$

$=-9.16/3.99$

T Value=-2.29

Now obtain the degrees of freedom. To get this, deduct one from the sample size (6 - 1 = 5). The next step is to determine the p-value, which, if less, confirms the null hypothesis conclusion. For example, ap-value of roughly 0.9, or90%, implies that the T-value obtained is likely to bearandom observation. On the other hand, a p-value of roughly 0.025, or2.5%,indicatesthattheresultor t- value achieved is significant.

CONCLUSION

At the ending stage of the study, it may be supposed to that the T-test calculates the change between two means that mayormaynotbeallied, signifyingthepossibilitythatthediscrepancieshappened bychance. The exactnessoftheresultingfalloutsisdeterminedbyamultiplicityoffactors, includingthe disseminationshapesconsumedandthedeviationsthatin fluencethecongregatedsamples in the realm of research. Additionally,a T-testisonlyvalidandshouldbeused when comparing meansfrom onlytwoclassesorgroups. This test is not suggested for use when there are more than two comparisons to be done. One- sample is used to determine the mean or average of one group and equate it to the definite average. When samples from two distinct groups, species, or populations are compared, an independenttwo-sampletestisused. Pairedsamplingistheprocessoftestinghypotheseswhentwo groups belong to the same population or group.

Inadditiontoallthese,alikeVarianceisusedwhenthesamplesizeineachgr ouporpopulationis the same or the variances of the two data sets are undistinguishable. Uneven Variance befalls when the varianceand numberofsamplesineachgroupfluctuate.Mostmomentously ,whereasT valuesdenotethe prospectthatthevariancebetweenthesamplesmeans wasfashionedbychance,p-valuesimitate thelike lihoodofhaving passableprooftocontroverttheprivialitybetweenthetwosamples. Such type of test is very much attached with the quantitative research.

REFERENCES

1. https://www.investopedia.com/terms/t/t-test.aspaccessedonDecember12,2024.
2. Ibid.
3. Ibid.
4. Ibid.
5. Ibid.
6. https://www.investopedia.com/terms/t/t-test.aspaccessedonNovember29,2024.
7. https://www.wallstreetmojo.com/t-test/accessedonNovember28,2024.
8. Ibid.
9. https://www.investopedia.com/terms/t/t-test.aspaccessedonNovember28,2024.