# SNS COLLEGE OF TECHNOLOGY

Kurumbapalayam (Po), Coimbatore – 641 035

**An Autonomous Institution**

Accredited by NAAC – UGC with 'A++' Grade

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

## DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

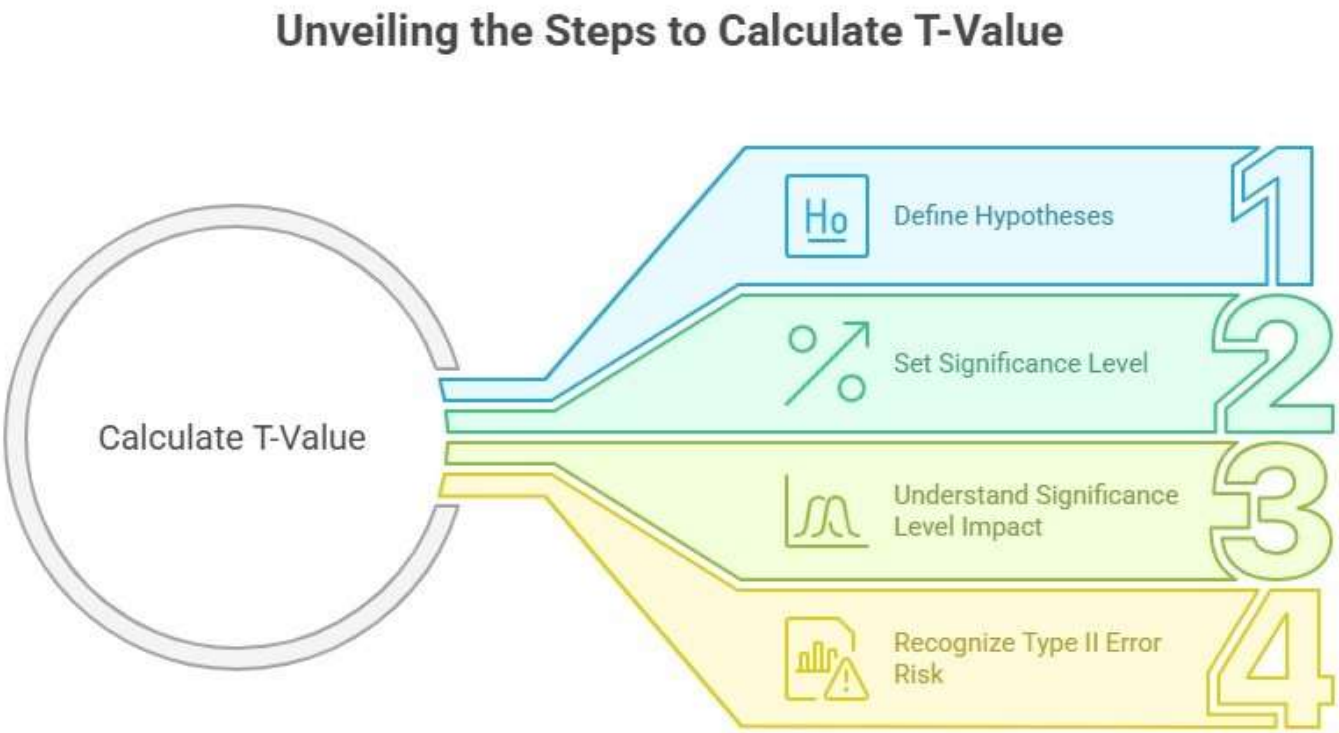
## COURSE NAME: 23ADO201- DATA SCIENCE FUNDAMENTALS (OPEN ELECTIVE )

### III YEAR / VI SEMESTER

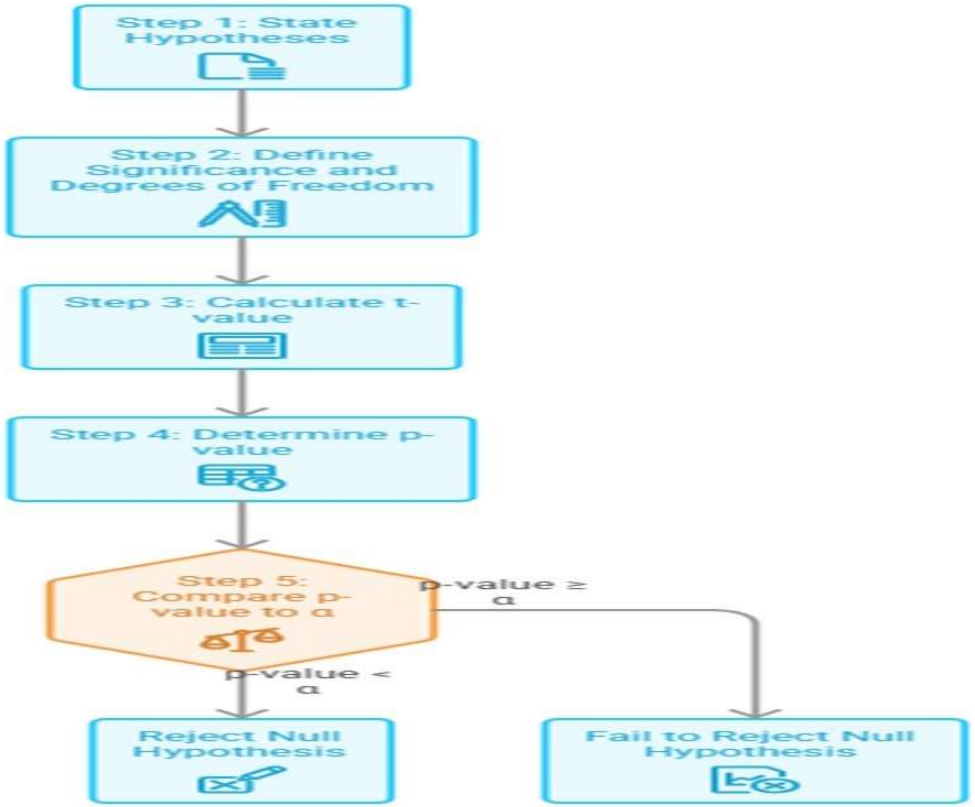
### Unit 4 - ANALYSIS OF VARIANCE

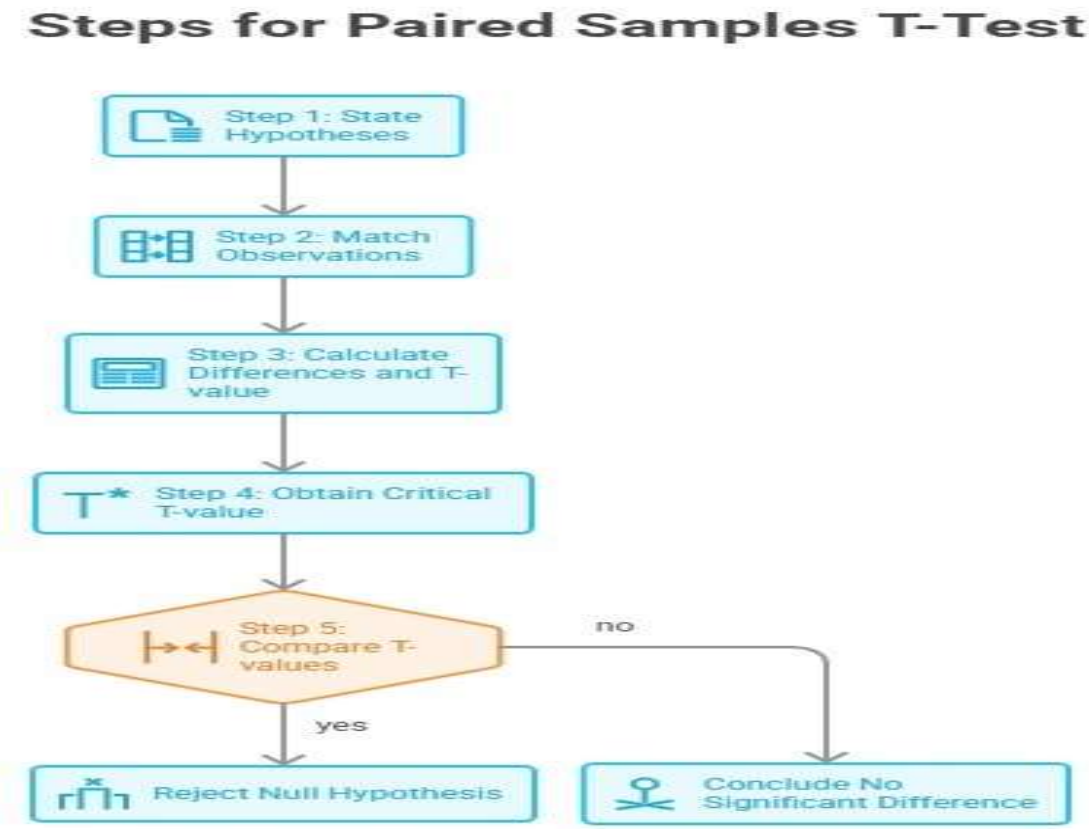
### Topic : Sampling Distribution of T and T-test Procedure

## Empathy


Unveiling the Steps to Calculate T-Value
Calculate T-Value
Ho
Define Hypotheses
1
Set Significance Level
2
Understand Significance Level Impact
3
Recognize Type II Error Risk
4

# One Sample T-test Procedure




Steps for Paired Samples T-Test
Step 1: State Hypotheses
Step 2: Match Observations
Step 3: Calculate Differences and T-value
Step 4: Obtain Critical T-value
Step 5: Compare T-values
no
yes
Reject Null Hypothesis
Conclude No Significant Difference

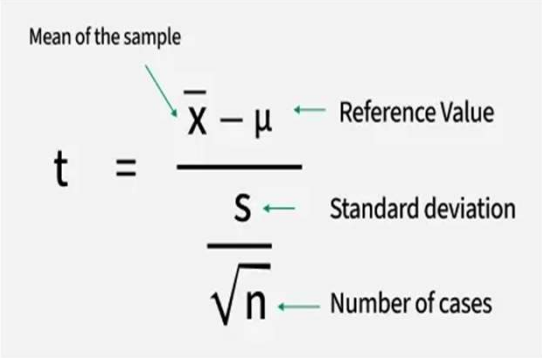
## T-Distribution Table

A T-Distribution table is used to obtain a critical t-value that is used as a reference to the calculated t-value for obtaining further results. Critical t-value depends on values of the level of significance and degrees of freedom. A concise form of the table for critical t-values is as follows for your reference:

| Degrees of Freedom (df) | α = 0.05 | α = 0.01 |
|---|---|---|
| 1 | 12.706 | 63.657 |
| 2 | 4.303 | 9.925 |
| 3 | 3.182 | 5.841 |
| 4 | 2.776 | 4.604 |
| 5 | 2.571 | 4.032 |
| 6 | 2.447 | 3.707 |
| 7 | 2.365 | 3.499 |
| 8 | 2.306 | 3.355 |
| 9 | 2.262 | 3.250 |
| 10 | 2.228 | 3.169 |
| 11 | 2.201 | 3.106 |
| 12 | 2.179 | 3.055 |
| 13 | 2.160 | 3.012 |
| 14 | 2.145 | 2.977 |
| 15 | 2.131 | 2.947 |
| 16 | 2.120 | 2.921 |
| 17 | 2.110 | 2.898 |
| 18 | 2.101 | 2.878 |
| 19 | 2.093 | 2.861 |
| 20 | 2.086 | 2.845 |

## Solved Problems of T-Test Formula

Problem 1: Determine whether the average weight of a sample of 20 mangoes is significantly different from the population's average weight of 70 grams. The sample mean weight is 70.55 grams, and the sample standard deviation is 2.82 grams. Use one sample T-test.




**Solution:**

To perform a T-test, first of all, we define two hypotheses:

•Null hypothesis: The sample mean weight of mangoes is equal to the known population mean. (i.e., 70 grams).

•Alternative hypothesis: The sample mean weight of mangoes is not equal to the known mean value.

Then, determine the degrees of freedom ($d_f$): $d_f = n - 1 = 20 - 1 = 19$ and define the level of significance($\alpha$) as 0.05 for this case. Next, determine the t-value from the formula,

$t = (70.55 - 70) / (2.82 / \sqrt{20})$

$\Rightarrow t \approx 1.041$

From the t-distribution table, we find $1.041 < 2.093$. (i.e. p-value for $\alpha = 0.05$). So, the null hypothesis is true. Thus, we conclude that the sample does not vary significantly from the population.

**Problem 2: Determine if there is a significant difference in the average scores between the two teams. The following data is given:**
**Team A: Score: 65, 68, 70, 63, 67**
**Team B: Score: 62, 66, 69, 64, 68**

**Solution:**

*According to the question, we come to know that we need to perform an Independent Samples T-test. Set up the null hypothesis and alternative hypothesis:*

•*Null hypothesis: The means of the two groups are equal ($\mu_A = \mu_B$).*

•*Alternative hypothesis: The means of the two groups are not equal ($\mu_A \neq \mu_B$).*

*Next, we calculate the sample means ($\bar{x_A}$ and $\bar{x_B}$) and sample standard deviations ($\sigma_A$ and $\sigma_B$):*

*Team A:*

•*Sample size ($n_A$) = 5*

•*Sample mean ($\bar{x_A}$) = (65 + 68 + 70 + 63 + 67) / 5 = 66.6*

•*Sample standard deviation ($\sigma A$) ≈ 2.607*

*Team B:*

•*Sample size (nB) = 5*

•*Sample mean ($\bar{x}B$) = (62 + 66 + 69 + 64 + 68) / 5 = 65.8*

•*Sample standard deviation ($\sigma B$) ≈ 2.588*

*Now, we calculate the t-value using the formula:*

$t = (\bar{x}A - \bar{x}B) / \sqrt{((\sigma A2 / nA) + (\sigma B2 / nB))}$

$\Rightarrow t = (66.6 - 65.8) / \sqrt{\{(2.6072/5) + (2.5882/5)\}}$

$\Rightarrow t \approx 0.296$

*Then, determine the degrees of freedom (df):*

$df = nA + nB - 2 = 5 + 5 - 2 = 8$

*and set the level of significance as 0.05.*

*From the table, we get the critical t-value as 2.306. As the calculated t-value is less than the critical t-value, we conclude that the null hypothesis is not rejected, which suggests that there is no significant difference between the average scores of the two teams.*

# Activity

**ACTIVITY: T-TEST PROCEDURE (One-Sample T-Test)**

🎯 **Objective**

To determine whether the **sample mean differs significantly** from the population mean.

📋 **Step-by-Step Procedure**

🔷 **Step 1: Define Hypothesis**

•**Null Hypothesis ($H_o$):** Sample mean = Population mean

•**Alternative Hypothesis ($H_1$):** Sample mean ≠ Population mean

🔷 **Step 2: Collect Data**

•Take a **random sample**

•Record observations (n < 30 preferred)

🔷 **Step 3: Calculate Sample Statistics**

•Mean ($\bar{x}$)

•Standard Deviation (s)

•Sample size (n)

🔷 **Step 4: Apply Formula**

Use the formula:

$$t = \frac{\bar{x} - \mu}{s/\sqrt{n}}$$

**Step 7: Decision Rule**

•If **|t calculated| > t critical** → Reject $H_o$

•If **|t calculated| ≤ t critical** → Accept $H_o$

🔷 **Step 8: Conclusion**

•State whether there is a **significant difference or not**

📊 **Activity Example**

👉 Compare:

•Population mean = 45

•Sample mean = 75

•Standard deviation = 25

•Sample size = 25

✓ Apply steps → Conclude whether the **fitness camp is effective**



🔷 **Step 5: Set Significance Level**

•Choose **α = 0.05** (commonly used)

🔷 **Step 6: Find Critical Value**

•Use **t-table** based on:

- Degrees of freedom (df = n - 1)
- Significance level

🔷

## TEST PROCEDURE – MCQs

**1. What is the first step in the test procedure?**

A) Execute test cases

B) Report defects

C) Understand requirements

D) Retesting

✅ **Answer:** C

**2. What is the purpose of writing test cases?**

A) To fix bugs



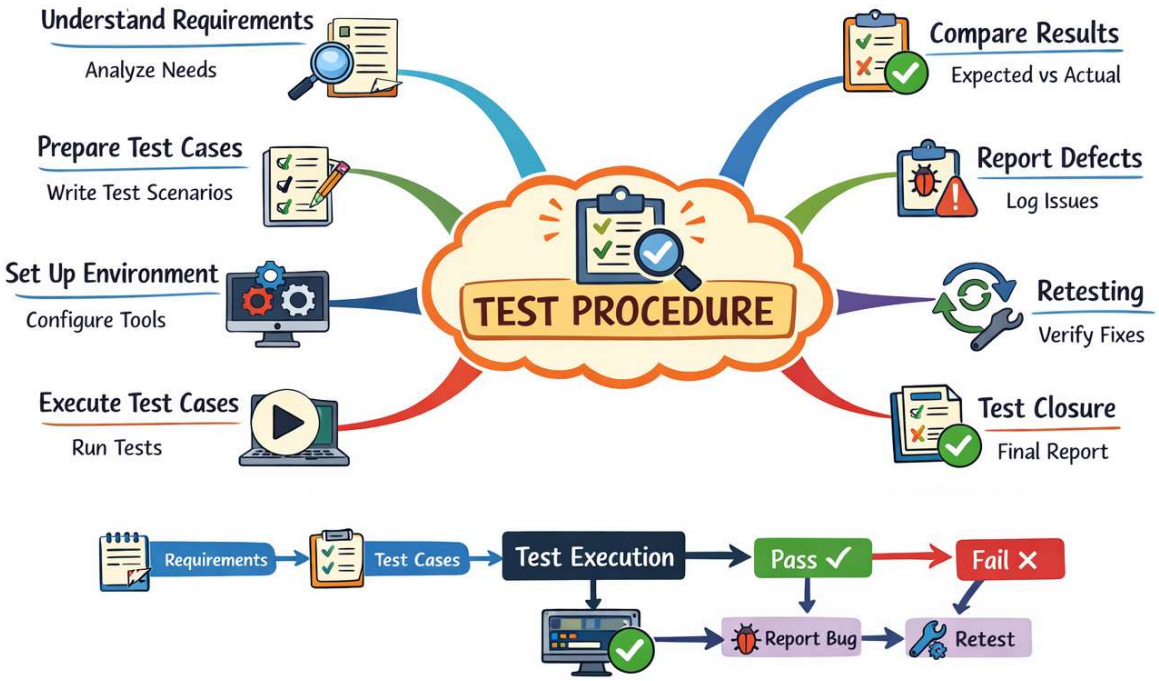
B) To define testing steps and expected results

C) To design software

D) To deploy application

✅ **Answer:** B

# MINDMAP


Understand Requirements
Analyze Needs
Prepare Test Cases
Write Test Scenarios
Set Up Environment
Configure Tools
Execute Test Cases
Run Tests
TEST PROCEDURE
Compare Results
Expected vs Actual
Report Defects
Log Issues
Retesting
Verify Fixes
Test Closure
Final Report
Requirements
Test Cases
Test Execution
Pass ✓
Fail ✕
Report Bug
Retest

| TEXT BOOKS | |
|---|---|
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| 4. | Aditya P. Mathur, ―Foundations of Software Testing _ Fundamental Algorithms and Techniques, Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008. |

# THANK YOU!

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