

Explain about Parametric & Non-parametric test and formula of t-test with expansion?

Definitions of Parametric test:

If the information about the population completely known by means of parameters, then statistical tests are called "Parametric Test"

Ex: T-test, F-Test, Z-test and ANOVA-test

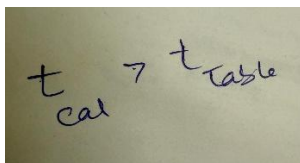
Non-Parametric tests:

If there is no knowledge about the population or the parameters, but you have to still test hypothesis of population it's called as non-parametric tests.

Criteria about non-parametric tests: If the data doesn't meet the parametric tests or data not continuous those data should be analysed in non-parametric tests.

Parametric	Non-parametric
Information about population is completely known	No information about population is available
Specific assumptions are made regarding the populations	No assumptions are made regarding the population
Test statistics are based on distribution	Tests statistics are not based on the distribution
These are applicable only for variables	These are applicable for variables and attributes
Parametric tests are powerful Ex: t-test, f-test, z-test, Anova-test	These are not so powerful compare to parametric tests Ex: Mann Whitney test, will-coxon signed Rank test, Kruskal test, Fired man test, sky square test

A **t-test** is a statistical test used to determine whether the means of groups differ significantly when the **sample size is small ($n < 30$)**. It was developed by **W.S. Gosset**, popularly known as the *student's t-test*. According to your notes, the decision rule for all t-tests is:


$$t_{cal} > t_{table}$$

If $t_{cal} > t_{table} \rightarrow H_0$ is rejected

The t-test is a **parametric test**, applied when data is quantitative and normally distributed.

Types of t-Tests

(A) Unpaired t-test (Independent t-test)

Used to compare **two different groups**.

Example in your notes: comparing birth weights of two socioeconomic groups.

(B) Paired t-test (Dependent t-test)

Used when **the same subjects** are measured **before and after** treatment.

Example: systolic BP before and after Yoga Therapy.

Unpaired t-Test Formula and Explanation

Ex: Following values are the birth weight of the high socio economic and low socio-economic group. Find whether there is no significance difference between the group

Meaning of Symbols	Group A	Group B
n	15	10
\bar{X}	2.92	2.26
SD	0.27	0.22

Formula:

$$t_{cal} = \frac{X_1 - X_2}{S_{(X_1 - X_2)}}$$

Where

$$S_{(X_1 - X_2)} = \sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}$$

Meaning of symbols

- \bar{X}_1, \bar{X}_2 – mean values of Groups 1 and 2
- S_1, S_2 – standard deviations (SD)
- n_1, n_2 – sample sizes

Formula for Standard Error of Difference

$$S_{(X_1 - X_2)} = \sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}$$

$$S_{(X_1 - X_2)} = \sqrt{\frac{(0.27)^2}{15} + \frac{(0.22)^2}{10}}$$

$$S_{(X_1 - X_2)} = \sqrt{\frac{0.0729}{15} + \frac{0.0484}{10}}$$

$$S_{(X_1 - X_2)} = \sqrt{0.00486 + 0.00484}$$

$$S_{(X_1 - X_2)} = \sqrt{0.0097} = 0.098$$

Final t calculation

$$t_{cal} = \frac{2.92 - 2.26}{0.098}$$

$$t_{cal} = \frac{0.66}{0.098} = 6.73$$

$$t_{cal} = 6.73$$

Degree of Freedom:

This is the standard formula for unpaired (independent) t-test.

$$df = n_1 + n_2 - 2$$

$$df = 15 + 10 - 2 = 23$$

$$df = 23$$

As the SD is not given standard significant level is 95%."

we assume the standard level = 95% confidence.

→ That means **5% error ($\alpha = 0.05$)**.

This is a rule commonly used in statistics.

So, go to t table

[Student's t Table \(Free Download\) | Guide & Examples](#)

from t table for df → error → t value

So df(degree of freedom) is 23 the t value is 2.069

$$t_{cal} = 6.73 \text{ and } t\text{-table value} = 2.069$$

Since **6.73 > t_{table}**,

→ **Null hypothesis (H_0) rejected.**

Paired t-Test Formula and Explanation

Used when samples are **dependent**, such as before–after measurements.

Formula:

$$t_{cal} = \frac{\bar{X} - \mu}{S/\sqrt{n}}$$

Where:

- **xi = (Before – After)** differences
- \bar{D} = mean of differences
- $\mu=0$
- **SD** = standard deviation of differences
- **n** = number of paired observations

Degree of freedom will be calculated to test in t-table value 'df = n – 1'

Example :

Following are the results of systolic B.P before & after treatment of Hypothesis Yoga Therapy of a 9 individuals test their significance

BT	AT	Xi (BT-AT)	Xi-X̄	(Xi - X̄) ²
122	120	2	-1	1
121	118	3	0	0
120	115	5	2	4
115	110	5	2	4
126	122	4	1	1
130	130	0	-3	9
120	116	4	1	2
125	124	1	-2	4
128	125	3	0	0
		27		24

Find the mean of Xi

$$\sum Xi = 27$$

$$\bar{X} = \frac{27}{9} = 3$$

Standard Deviation of Xi

$$S = \sqrt{\frac{\sum (X_i - \bar{X})^2}{n - 1}}$$

$$S = \sqrt{\frac{24}{8}} = \sqrt{3} = 1.732$$

$$\bar{x} = 3,$$

$$S = 1.732,$$

$$n = 9$$

$$t_{cal} = \frac{\bar{X} - \mu}{S/\sqrt{n}}$$

$$t_{cal} = \frac{3}{1.732/\sqrt{9}} = 5.199$$

Decision:

$$df = n-1 = 9-1 = 8$$

$$t_{table} = 2.306 \text{ (From t-table)}$$

Since **5.199 > 2.306**,

→ **Null hypothesis rejected**

→ Yoga Therapy produced a significant effect.

Decision Rule (common to both tests)

- When **t_cal > t_table**,
→ **H₀ is rejected**
→ Alternative hypothesis is accepted.