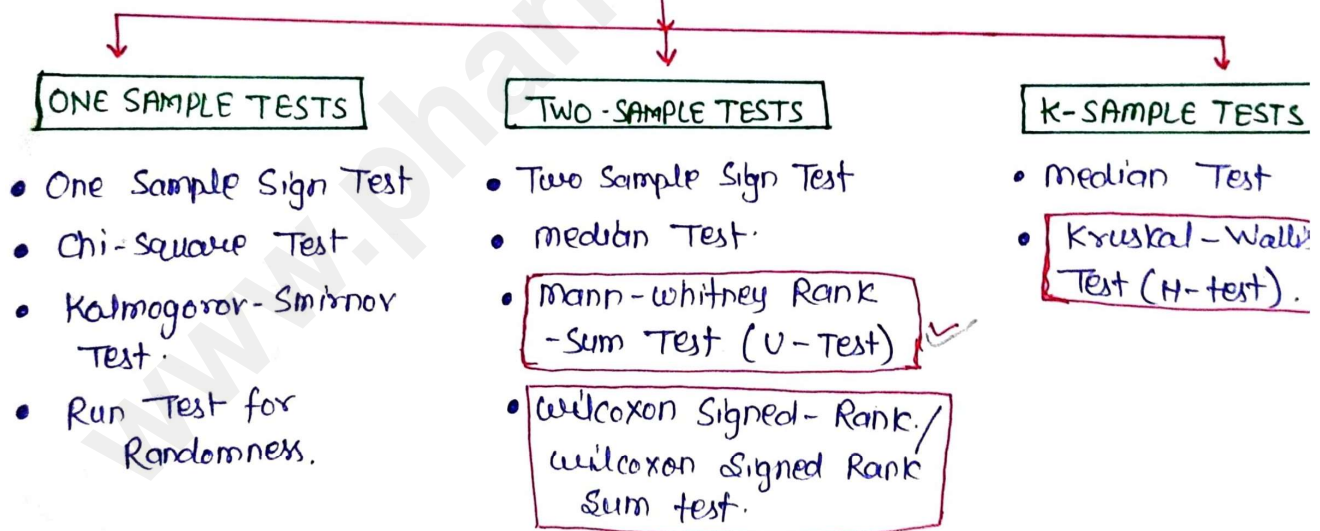


## UNIT-3

### CHAPTER-1 NON-PARAMETRIC TEST

- Non-Parametric tests are experiments that do not require the underlying population for assumptions.
- No parameters are associated with the null hypothesis.
- For both variables and attributes, non-parametric tests can be implemented.
- Non-parametric methods are also called **distribution-free test**. Since they do not have any underlying population.

#### Types of NON-PARAMETRIC TEST



For Example: One assumption for the one way ANOVA is that the data comes from a normal distribution.

If data isn't normally distributed, you can't run an ANOVA, but you can run the non-parametric alternative - the Kruskal-Wallis test.

## ① Wilcoxon Rank Sum Test / Mann-Whitney U-Test

- This non-parametric Test is analogous to t-tests for independent samples.
- To conduct such a test the distribution must contain ordinal data and <sup>are</sup> independent.
- Null Hypothesis :  $H_0 \rightarrow$  The two populations under consideration must be equal.
- Test Statistic :-  $U$  should be smaller of -

$$\left[ \begin{array}{l} U_1 = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1 \\ \text{or} \\ U_2 = n_1 n_2 + \frac{n_2(n_2+1)}{2} - R_2 \end{array} \right]$$

where,  $R_1 =$  Sum of Ranks in group 1  
 $R_2 =$  Sum of Ranks in group 2

- Decision criteria :- Reject the null Hypothesis if  $U \leq$  critical value.  
Less than or equal to.

## ② Wilcoxon Signed Rank Test

- It is used to compare two samples that ~~the~~ contain ordinal data and are dependent.
- The wilcoxon signed rank test assumes that the data comes from a symmetric distribution.

- Null Hypothesis ( $H_0$ ) :- The difference in the median is 0.
- Test Statistic ( $W$ ) :-  $W$  is defined as the smaller of the sums of the negative and positive ranks.
- Decision Criteria :- Reject the null Hypothesis if  $W \leq$  critical value.

### ③ Kruskal Wallis Test

- It is used for comparing more than two groups of data that are independent and ordinal.
- Null Hypothesis ( $H_0$ ) :- (m) population medians are equal.
- Test Statistic :- 
$$H = \left( \frac{12}{N(N+1)} \sum_1^m \frac{R_j^2}{n_j} \right) - 3(N+1)$$

where,  $N$  = total sample size.

$n_j$  and  $R_j$  = Sample size and the sum of ranks of the  $j^{\text{th}}$  group.
- Decision Criteria :- Reject the null Hypothesis if  $H \geq$  critical value.

#### ④ Friedman Test

- It is non-parametric test developed by Milton Friedman.
- It is non-parametric statistical test and alternative to ~~ANO~~ ANOVA with repeat measures.
- It is used to detect differences in treatments across multiple test attempts.
- Null Hypothesis ( $H_0$ ) :-  $\mu_1 = \mu_2 = \mu_3$  (the mean reaction times across the populations are all equal).
- Test Statistic :- 
$$Q = \frac{12}{mk(k+1)} \sum_1^k R_j^2 - 3m(k+1)$$

where,

$R_j^2$  = Square of the rank total for group.

$m$  = No. of independent blocks.

$k$  = no. of groups or treatment levels.

- Decision Criteria :- Null Hypothesis is accept or reject on the basis of some condition -

→ value of  $Q \geq$  critical value,  $H_0$  reject.

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