Non-parametric inference is a statistical approach that does not rely on specific assumptions about the underlying population distribution. It is often used when the data does not meet the assumptions of traditional parametric tests or when the data is measured on ordinal or nominal scales. Here is a step-by-step guide to non-parametric inference, including mathematical symbols and notations:

Step 1: **Formulate Hypotheses**

* Start by stating the null hypothesis (H0) and the alternative hypothesis (H1) in terms of the population parameters or distribution.
* For example, H0: There is no difference between two groups, and H1: There is a difference between two groups.

Step 2: **Choose a Non-parametric Test**

* Select an appropriate non-parametric test based on the research question and the type of data.
* Common non-parametric tests include the Mann-Whitney U test, Wilcoxon signed-rank test, Kruskal-Wallis test, and Friedman test.

Step 3: **Collect and Organize Data**

* Collect the data relevant to the research question or hypothesis.
* Organize the data into groups or categories based on the experimental design or research objective.

Step 4: **Ranking or Ordering Data**

* For many non-parametric tests, the data needs to be ranked or ordered.
* Assign ranks to the data points within each group, regardless of their specific values.
* Ties (data points with the same value) can be handled by assigning average ranks.

Step 5: **Calculate Test Statistic**

* Calculate the test statistic based on the chosen non-parametric test.
* The test statistic depends on the specific non-parametric test being used.
* For example, the Mann-Whitney U test uses the sum of ranks or U statistic, the Kruskal-Wallis test uses the sum of ranks or H statistic, etc.

Step 6: **Determine Critical Value or p-value**

* Determine the critical value or p-value associated with the calculated test statistic.
* The critical value is obtained from a reference distribution (e.g., chi-square distribution or normal distribution) based on the sample size and the chosen significance level (alpha).
* Alternatively, the p-value can be obtained from the reference distribution or by using permutation or bootstrap resampling techniques.

Step 7: **Compare Critical Value or p-value with Significance Level**

* Compare the critical value or p-value with the chosen significance level (alpha).
* If the critical value is greater than the calculated test statistic or the p-value is greater than alpha, fail to reject the null hypothesis.
* If the critical value is less than the calculated test statistic or the p-value is less than alpha, reject the null hypothesis in favor of the alternative hypothesis.

Step 8: **Draw Conclusions**

* Based on the decision made in Step 7, draw conclusions about the research question or hypothesis.
* If the null hypothesis is rejected, it suggests evidence of a difference or relationship between groups or variables.
* If the null hypothesis is not rejected, it indicates insufficient evidence to conclude a difference or relationship.

It's important to note that the specific steps and calculations can vary depending on the chosen non-parametric test. The above steps provide a general framework for conducting non-parametric inference, but it's recommended to consult appropriate statistical references or software documentation for the specific details of the chosen non-parametric test.

Discuss Mann-Whitney U test, Wilcoxon signed-rank test, Kruskal-Wallis test, and Friedman test and the distributions they are related to

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Sure! Let's discuss each of these non-parametric tests and the distributions they are related to:

1. **Mann-Whitney U Test**:

* The Mann-Whitney U test, also known as the Wilcoxon rank-sum test, is used to compare two independent groups or samples.
* It is related to the distribution of the U statistic, which represents the sum of ranks in one of the groups.
* The null hypothesis assumes that there is no difference between the two groups in terms of their distributions.
* The test is suitable for ordinal or continuous data.
* The distribution associated with the Mann-Whitney U test is the asymptotic distribution of U, which approximates the normal distribution for large sample sizes.

1. **Wilcoxon Signed-Rank Test**:

* The Wilcoxon signed-rank test is used to compare paired observations or dependent samples.
* It is related to the distribution of the signed-ranks, which are the ranks of the differences between paired observations.
* The null hypothesis assumes that there is no difference between the paired observations.
* The test is suitable for ordinal or continuous data.
* The distribution associated with the Wilcoxon signed-rank test is the exact distribution of the test statistic under the null hypothesis, which is derived from the distribution of the signed-ranks.

1. **Kruskal-Wallis Test**:

* The Kruskal-Wallis test is used to compare three or more independent groups or samples.
* It is related to the distribution of the H statistic, which is based on the sum of ranks in each group.
* The null hypothesis assumes that there is no difference between the groups in terms of their distributions.
* The test is suitable for ordinal or continuous data.
* The distribution associated with the Kruskal-Wallis test is the chi-square distribution with (k - 1) degrees of freedom, where k is the number of groups.

1. **Friedman Test**:

* The Friedman test is used to compare three or more dependent groups or samples.
* It is related to the distribution of the Friedman statistic, which is based on the ranks of the observations within each group.
* The null hypothesis assumes that there is no difference between the dependent groups.
* The test is suitable for ordinal or continuous data.
* The distribution associated with the Friedman test is the chi-square distribution with (k - 1) degrees of freedom, where k is the number of groups.

These non-parametric tests provide a way to assess the null hypothesis without assuming specific distributions for the data. They are particularly useful when the data does not meet the assumptions of parametric tests or when dealing with ordinal data.