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REVIEW ARTICLE ON PARAMETRIC AND NONPARAMETRIC TEST

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INTRODUCTION

Statistics, an essential element of data management and predictive analysis.it is classified into two types, parametric and non-parametric.

PARAMETRIC TEST

Parametric tests are based on the assumptions related to the population or data sources while, non-parametric test is not into assumptions.

Parametric statistics consists of the parameters like mean, standard deviation, variance, etc. Thus, it uses the observed data to estimate the parameters of the distribution. Data are often assumed to come from a normal distribution with unknown parameters. Parametric tests are those that assume that the sample data comes from a population that follows a probability distribution — the normal distribution — with a fixed set of parameters.

parametric tests makes assumptions about the populations parameters Followings are.

Normality — the sample data come from a population that approximately follows a normal distribution.

Homogeneity of variance — the sample data come from a population with the same variance.

Independence — the sample data consists of independent observations and are sampled randomly.

Outliers — the sample data don't contain any extreme outliers.

Parametric Test Types

Z Test

When you need to compare the sample's mean with a hypothesized value (which often refers to the population mean), then one sample z-test is used.The test has major requirements, such as the sample size should be more than 30, and the population's standard deviation should be known.

One sample

If either of the requirements mentioned above cannot be met, then you can use another type of parametric test known as the one-sample t-test.Here if the sample size is at least more than 15 and the standard deviation of the sample is known, then you can use this test. Here the sample distribution should be approximately normal.

Paired (dependent) t test-

Paired t-test is used when from the same subject data is collected; typically before and after an event, here to compare the mean of the before and after group, you can use the paired t-test. The assumptions here include groups being independent, the values of before and after belonging to the same subjects, and the differences between the groups should be normally distributed.

Two Sampled (Independent) t-Test

In situations where there are two separate samples, if the mean of both these samples is statistically significantly different not, then a two-sampled t-test can be used.It assumes that each sample's data distribution should be roughly normal, values should be continuous, the variance should be equal in both the samples, and they should be independent of each other.

One-way Analysis of Variance

An extension of two sampled t-tests is one-way ANOVA, where we compare more than two groups. Suppose someone asks you if that is ANOVA a parametric test, the answer to that is a definitive yes. ANOVA analyses the variance of the groups and requires the population distribution to be normal, variance to be homogeneous, and groups to be independent.

Pearson's Coefficient of Correlation

To understand the association between two continuous numeric variables, you can use a person's coefficient of correlation.

It produces an 'r' value where a value closer to -1 and 1 indicates a strong negative and positive correlation respectively.

A value close to 0 indicates no major correlation between the variables. A part of its assumption is that both the variables in question should be continuous.

Advantage of Parametric Tests

- These tests are helpful with continuous/quantitative variables.
- Applicable for specific probablilty distribution data.
- Assumption are made.
- More powerful and precise than nonparametric test.
- The output from such tests is easy to interpret.
- Provides all necessary information regarding population.
- Long calculations provide accuracy and precision to the results.

Disadvantages of Parametric Test

- Sensitive to violations of the assumtions.
- Only be able to assess data that is continuous.
- May be affected by the assumptions of normal distribution.
- The assumptions may not always be true.
- Used only for interval data and ratio data.
- Not valid for small sample size.

Limitations of Parametric Test

- A large sample size is required to run such tests.
- Measurement of the central tendency (i.e., the central value of data) is typically done using the mean.
- The outputs from such tests cannot be relied upon if the assumptions regarding the population deviate significantly.
- When using such tests, there needs to be a deep or proper understanding of the population.

Application of parametric tests

- Parametric tests are based on the assumption that the samples are drawn from a normal population and on interval scale measurement.
- Common parametric tests are focused on analysing and comparing the mean or variance of data.

NON-PARAMETRIC TESTS

Non-parametric statistics depend on either being distribution free or having specified distribution, without keeping any parameters into consideration non-parametric tests; these are the experiments that do not require any sample population for assumptions. For this reason, non-parametric tests are also known as distribution free tests as they don't rely on data related to any particular parametric group of probability distributions. it's more factual than the parametric tests. non-parametric statistics is generally preferred for the studies where a net change in input has minute or no effect on the output. Like even if the numerical data changes, the results are likely to stay the same.

Types of non-parametric tests

1. Wilcoxon Rank Sum Test

The Wilcoxon test also known as rank sum test or signed rank test. It is a type of non-parametric test that works on two paired groups. The test helps in calculating the difference between each set of pairs and analyses the differences.

The Wilcoxon test is used to compare two related samples, matched samples, or repeated measurements on a single sample to assess whether their population mean rank is different or not.

2. Mann- Whitney U Test

The Mann-Whitney U test also known as the Mann-Whitney-Wilcoxon test, Wilcoxon rank sum test and Wilcoxon-Mann-Whitney test. It is a non-parametric test based on null hypothesis. It is equally likely that a randomly selected sample from one sample may have higher value than the other selected sample or maybe less. Mann-Whitney test is usually used to compare the characteristics between two independent groups when the dependent variable is either ordinal or continuous. But these variables shouldn't be normally distributed.

3. Kruskal Wallis Test

Sometimes referred to as a one way anova on ranks, Kruskal Wallis H test that is used to determine the statistical differences between the two or more groups of an independent variable. The word ANOVA is expanded as Analysis of variance. The major purpose of the test is to check if the sample is tested if the sample is taken from the same population or not.

4. Friedman Test

The Friedman test is similar to the Kruskal Wallis test. It is an alternative to the ANOVA test. The only difference between Friedman test and ANOVA test is that Friedman test works on repeated measures basis. Friedman test is used for creating differences between two groups when the dependent variable is measured in the ordinal.The Friedman test is further divided into two parts, Friedman 1 test and Friedman 2 test.The test is even applicable to complete block designs and thus is also known as a special case of Durbin test.

5. Chi-square test

Chi-square, also known as the goodness of fit test is typically used to test independence of two categorical variables. There are numerous reasons for it, such as the variables being categorical (discreet), the groups being tested can be unequal (whereas parametric tests require the groups to be roughly equal), and the data having no homoscedasticity.

6. Other Distribution Free Tests

Distribution free tests are defined as the mathematical procedures. These tests are widely used for testing statistical hypotheses. It makes no assumption about the probability distribution of the variables. names of distribution free tests is as follows.

- **Anderson-Darling test:** It is done to check if the sample is drawn from a given distribution or not.
- **Statistical bootstrap methods:** It is a basic non-statistical test used to estimate the accuracy and sampling distribution of a statistic.
- **Cochran's Q:** Cochran's Q is used to check constant treatments in block designs with 0/1 outcomes.
- **Cohen's kappa:** Cohen kappa is used to measure the inter-rater agreement for categorical items.
- **Kaplan-Meier test:** Kaplan Meier test helps in estimating the survival function from lifetime data, modeling, and censoring.
- **Two-way analysis Friedman test:** Also known as ranking test, it is used to randomize different block designs.
- **Kendall's tau:** The test helps in defining the statistical dependency between two different variables.
- **Kolmogorov-Smirnov test:** The test draws the inference if a sample is taken from the same distribution or if two or more samples are taken from the same sample.
- **Kendall's W:** The test is used to measure the inference of an inter-rater agreement**.**
- **Kuiper's test:** The test is done to determine if the sample drawn from a given distribution is sensitive to cyclic variations or not.
- **Log Rank test:** This test compares the survival distribution of two right-skewed and censored samples.
- **McNemar's test:** It tests the contingency in the sample and revert when the row and column marginal frequencies are equal to or not.
- **Median tests:** As the name suggests, median tests check if the two samples drawn from the similar population have similar median values or not.
- **Pitman's permutation test:** It is a statistical test that yields the value of p variables. This is done by examining all possible rearrangements of labels.
- **Rank products:** Rank products are used to detect expressed genes in replicated microarray experiments.
- **Siegel Tukey tests:** This test is used for differences in scale between two groups.
- **Sign test:** Sign test is used to test whether matched pair samples are drawn from distributions from equal medians.
- **Spearman's rank:** It is used to measure the statistical dependence between two variables using a monotonic function.
- **Squared ranks test:** Squared rank test helps in testing the equality of variances between two or more variables.
- **Wald-Wolfowitz runs a test:** This test is done to check if the elements of the sequence are mutually independent or random.

Advantages of non-parametric tests are

- It is easy to understand and apply.
- It consists of short calculations.
- The assumption of the population is not required.
- Non-parametric test is applicable to all data kinds.
- Data do not follow any specific distribution.
- Suitable for ordinal data.

Disadvantages of Nonparametric Test-

- Less efficient as compared to parametric test.
- Less powerful than parametric test.
- Can be used only when measurments are nominal or ordinal.
- Results may or may not provide an accurate answer because they are distribution free.

Limitations of non-parametric tests are

- It is less efficient than parametric tests.
- Sometimes the result of non-parametric data is insufficient to provide an accurate answer.

Application of non-parametric tests

- Where parametric tests are not giving sufficient results.
- When the testing hypothesis is not based on the sample.
- For the quicker analysis of the sample.
- When the data is unscaled.

The current scenario of research is based on fluctuating inputs, thus, non-parametric tests and parametric tests become essential for in-depth research and data analysis.

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