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" The problem of determining the appropriate statistical method in human and social research "

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Abstract :
This research aims to find a solution to a problem faced by most researchers in the field of human and social sciences. The problem is related to the use of the appropriate statistical method for analyzing data and testing hypotheses, choosing between the two main types of statistics: parametric and non-parametric. Choosing the statistical method is not random, but rather depends on the fulfillment of certain conditions, such as normality of distribution, sample size, homogeneity, and measurement level (nominal, ordinal, categorical, or relative), the research poses a crucial question: How does a social researcher choose the appropriate statistical method to test the hypotheses of his research?
Keywords: Problem; Statistical method; Parametric statistics; Non-parametric statistics

1. Introduction:

Scientific research is the cornerstone of any society that aspires to achieve development and civilization. It is also the only way to identify the problems that individuals and institutions suffer from. For this purpose, universities, scientific research laboratories, and institutes were established all over the world. Many theoretical and applied research and studies have been accomplished in various scientific fields. Thanks to these studies, scientists have overcome some problems that hindered their progress and civilization, such as public health problems and environmental pollution. Due to the diversity and complexity of problems, many research fields have emerged, each specializing in studying the phenomena that fall within its scope using a specific methodology. Natural and physical sciences study natural and physical phenomena, while human and social sciences study the phenomena classified within them.

2. Problem Statement:

Based on the above, the following problem can be raised: To what extent do researchers in the field of human and social sciences succeed in choosing the appropriate statistical method to analyze the data of their studies?

3. Importance of the Research:

The importance of the research lies in emphasizing the importance of choosing the appropriate statistical method to analyze the data. The wrong choice of the statistical method leads to real problems, not only in interpreting the results but also affects the conclusion of the study.

This research aims to know how to choose the appropriate statistical method, which is based on three things:

Research Objective: For example, if the goal is to predict the performance of workers in a particular institution, then using regression analysis is the most appropriate.

Type and Distribution of Data Used: For example, are the data nominal, ordinal, interval, or ratio?

Nature of Observations: Binary/non-binary, are the sample data correlated or independent?

4. Methodology:

This research falls within the type of exploratory research that aims to identify phenomena or increase knowledge about them. The hypothesis here is to clarify the research problem further. The reason for calling it exploratory research is that it reveals or increases knowledge about ideas. Designing such research requires flexibility that allows for the study of different aspects of the phenomenon, where our previous knowledge about it is non-existent or limited, which makes it difficult to draw a well-defined plan that takes into account all expectations (Muhammad Mounir, 2000, p. 26).

5. Concept of Scientific Research:

As is known, the concept consists of two words: "research," which may mean to some investigation or inquiry, and for others, a question or inquiry about something or a topic of particular importance to them. The second word is "scientific," which refers to science, which means, for individuals and simply put, documented comprehensive knowledge about a specific topic by clearly defining its various dimensions or pillars that form its perceived reality by the parties or stakeholders involved (Muhammad & al., 1999, p. 4).

6. Definition of Scientific Research:

Scientific research means: "Organized investigation using specific scientific methods and approaches to scientific facts to verify their accuracy, modify them, or add new ones." It is also: "An organized scientific activity, a way of thinking, and a way of looking at facts that seek to uncover the truth, relying on objective methods to understand the relationship between these facts, and then extract general principles and laws or explanatory laws" (Ammar & Muhammad Mahmoud, 2007, pp. 12 - 13)

7. Characteristics of Scientific Research:

Despite the different types and fields of scientific research, all scientific research has unified and common characteristics. Here are some of the most prominent characteristics of scientific research:

7.1. Objectivity and Neutrality:

Regardless of the field, scientific research can only succeed in reaching logical, sound results and solutions if the researcher adheres to objectivity and neutrality. This means that the researcher must set aside all beliefs, desires, and biases while conducting research. The work must be logical, neutral, and scientific, based on sound results and facts that are far from any preconceived notions or personal considerations. Neutrality does not mean that the researcher abandons their values, beliefs, and biases, but rather that they keep them to themselves and their personal lives without letting them affect their research work, which can be distorted if objectivity and neutrality are not maintained.

7.2. Testability:

The testability of the research topic or problem is a fundamental aspect of research work and one of the most important characteristics of scientific research. Scientific research generally relies on sensory information and data that can help to reach accurate, measurable results to verify their validity.

7.3. Accuracy and Consistency of Results:

The consistency of research results is one of the fundamental characteristics of scientific studies. This requires reaching the same research results if the researcher repeats the study under the same conditions and using the same methods.

7.4. Scientific Research Methodology:

Successful scientific research is a study that is characterized by a correct methodology appropriate for scientific research. This methodology defines the organized way of collecting, studying, and discussing data and information to reach the research objectives and achieve accurate results.

7.5. Accuracy and Reliability in Research Work:

Accuracy in all procedures and stages of the study and the commitment to providing accurate information and data are among the most important characteristics of scientific research. Accuracy and reliability in all research procedures and stages, from the introduction to the conclusion, are essential for the success of the scientific study. The scientific knowledge presented in research is supposed to be accurate, clear, and free of ambiguity. The researcher should rely on describing things accurately and clearly. In this way, scientific writing differs from literary writing. For example, in a literary work, it can be said that many people die in China every month, while in scientific research, it is necessary to provide accurate statistics on the number of deaths.

7.6. Results Supported by Evidence:

One of the fundamental characteristics of scientific research is that the researcher presents research results that achieve the research objectives and answer its questions or confirm or deny the research results. These results must be supported by logical evidence and proofs, without any reliance on probability or conjecture in the research results.

7.7. Scientific Knowledge Accumulation:

One of the most important characteristics of scientific research is the accumulation of scientific knowledge, which occurs when a significant portion of scientific research relies on previous studies. This is done by building on those studies, which form the basis for building and adding new information, which helps to achieve the expected scientific benefit from the research. With the accumulation of research, information, and facts, sciences and societies develop, nations advance, and individuals reach the expected prosperity.

7.8. Documentation:

In any scientific study, regardless of the scientific field, the researcher must document all research sources and references that they relied on in their study in a sound scientific manner. No scientific research can succeed or be accepted without documenting the sources and references that demonstrate the researcher's scientific integrity and clarify their capabilities, efforts, and endeavors to enrich and enhance scientific research.

7.9. Predictability:

The scientist or researcher does not seek to describe the research phenomenon only, but also to explain and predict it. Natural sciences remain the sciences that can be predicted more than social sciences. The reason for this is that controlling natural topics is simpler and less complex (Characteristics of Scientific Research, 2021).

8. Statistical Methods Used in Scientific Research:

The question of what statistical methods in scientific research, their relationship to research, and whether they are a main pillar of research or not is frequently asked by researchers. Let us answer these questions now.

Initially, it is indeed one of the main pillars of scientific research. It is a means of obtaining accurate results logically and accurately, in which some methodologies are used. The statistical method is divided into several sections.

The importance of the statistical method in scientific research lies in its being a fundamental tool used by universities, government agencies, and large institutions to measure something, to obtain accurate results. However, it is required that this be done to measure a real problem or tangible reality. It cannot be applied to a problem that has no basis in reality.

Now, we will learn together about the most important types of statistical methods and when each one is used to reach the desired results:

8.1 Descriptive Statistics:

One type of scientific mathematical statistics, used to summarize numbers, to know the data set, and is mostly used to obtain a statistical inference to test a random sample of the population, or students, or couples, it is conducted in the form of a chart to obtain accurate results, and it is also used the most when conducting experimental studies.

8.1.1. Measures of Descriptive Statistics:

There are two types of descriptive statistics: measures of central tendency and measures of variation.

Measures of central tendency: These measures indicate the "average" value of a data set. The three most common measures of central tendency are the mean, median, and mode.

Measures of variation: These measures indicate how spread out the data is. The two most common measures of variation are the range and standard deviation.

In addition to these measures, there are also several univariate and multivariate descriptive statistical methods. Univariate methods are used to analyze data for a single variable, while multivariate methods are used to analyze data for multiple variables.

8. 1.1.1. Definition of Measures of Central Tendency:

Measures of central tendency are used to identify the "center" of a data set. The three most common measures of central tendency are:

Mean: The mean is the average of all the values in a data set. It is calculated by adding up all the values and dividing by the number of values.

Median: The median is the middle value in a data set. It is calculated by ordering the values from smallest to largest and finding the value that has half the values above it and half the values below it.

Mode: The mode is the most common value in a data set. It is calculated by finding the value that occurs the most often.

8.2 Inferential Statistics:

the inferential statistical method, which is used to uncover results, while formalizing the results that have been inferred from specific information. It relies on collecting as much information and data as possible, which is collected through conducting experiments, posing hypotheses, and guessing, in addition to studying random samples to obtain the results of studies and research, about a phenomenon or a problem to reach a logical or realistic result, as this is the purpose of using descriptive statistical methods, because it is used to display the results immediately after observing and recording them directly.

9. Levels of Measurement:

There are four levels of measurement: nominal, ordinal, interval, and ratio.

9.1. Nominal Level: This is the lowest level of measurement and is suitable for qualitative or categorical variables that require individuals to be classified into separate groups to distinguish them by a particular characteristic. The aim of measurement in this case is classification that takes into account the qualitative differences between individuals. The numbers used in this level of measurement are simple symbols used as names for separate and distinct categories or groups. Examples of variables at this level include gender, nationality, religion, social status, affiliation with specific institutions, and so on.

9.2. Ordinal Level: In this level, individuals or objects can be ranked according to a particular property or characteristic. For example, individuals can be asked to rank their career preferences, where the profession of computer programmer might be given the number 1, engineer the number 2, car technician the number 3, and so on. This means that this individual has conducted a type of ordinal measurement of their career preferences according to certain criteria that they used in this regard.

9.3. Interval Level: This level of measurement is concerned with determining the amount of difference between two things. A common example of this is the thermometer, where some thermometers have Fahrenheit scales; where the number 32 degrees Fahrenheit represents the freezing point, and the number 212 degrees Fahrenheit represents the boiling point, and the numbers between them refer nominally to a specific expansion or contraction of the mercury or liquid column in the thermometer. This level does not have a true zero.

9.4. Ratio Level: This level of measurement is characterized by the properties that exist at the interval level in addition to the existence of an absolute zero on the measurement scale that corresponds to the absence of the property or characteristic being measured. An example of this is lengths and masses, and so on (Salah al-Din Mahmoud, 2000, pp. 19 - 21).

10. Parametric and Nonparametric Tests

Parametric and nonparametric tests are statistical methods used to analyze quantitative variables (numerical data). To use a parametric test, the following conditions must be met:

The sample must be normal and also moderate in distribution, as it does not require assumptions or information about the underlying distribution.

It focuses on the ranking of scores and does not rely on numerical values.

The parametric test is mostly used with large samples, and of course the non-parametric test with small samples.

The sample must be drawn according to the normal curve in case of using the parametric test.

However, if the non-parametric test is to be used, it does not require obtaining information about the underlying distribution

11. Stages of Statistical Methods in Scientific Research

After learning about the statistical methods used in scientific research, we will now learn about the stages that the researcher goes through during their use, to finally reach the desired results.

It is important to note that the statistical methods used in scientific research are constantly evolving, and more and more analytical tools and data sets are being used to help researchers produce ideal, organized, and accurate scientific research.

The stages of statistical methods in scientific research are as follows:

11.1. Data Collection Stage

This is the first and most important stage, which must be carried out with full concentration. In this stage, primary sources are used, which are obtained from agency investigators. It is important to note that this information and data are not organized at all.

In addition, secondary sources are requested from agency investigators specifically to conduct scientific research. In this case, the sources will be very organized.

11.2. Organizing and Presenting Numerical Data

After obtaining the secondary sources, which will be organized, they are collected and arranged according to the following steps:

Eliminate all inaccurate and duplicate data. The secondary sources must be filtered to obtain more accurate results.

Rely on common characteristics to accurately classify the data.

Design tables to display the data.

Prepare the presentation in the form of a chart or graph.

11.3. Analyzing Numerical Data

After organizing the data and secondary sources, comes the stage of analyzing the numerical data, which will help in understanding the results without the need to use difficult statistical rules. The following methods are used in the analysis:

Median

Measures of central tendency

Measures of dispersion

Correlation

Standard deviation

11.4 Interpreting Numerical Data

The fourth and final stage is interpreting and analyzing the numbers to obtain accurate results. In this stage, put all your focus on it, with the need to have the skill and experience, so as not to waste the time and resources that were used in the statistical analysis.

12. Disadvantages of Using Statistical Methods in Research Preparation

After explaining in the previous lines the types of statistical methods for preparing scientific research, we must explain what are the disadvantages that researchers may face, which are as follows:

Inability to comprehensively enumerate the data. To obtain more accurate data, it is necessary to follow the method of comprehensive enumeration.

Problems during the study of the sample. The researcher may find problems with the size of the sample and its incompatibility.

Scientific research is based on honesty, consistency, and accuracy. Unfortunately, the researcher may not have the experience necessary to deal with the problems that may occur during the statistical analysis.

13. When to Use Statistical Methods in Research

Statistical methods are important in scientific research because they contribute significantly to the research process, such as designing experiments, analyzing and interpreting data, and making appropriate decisions based on the research results.

14. What are Statistical Methods?

Statistical methods are defined as a set of data that the researcher collects and analyzes to reach results that contribute to solving a specific research problem. They can also be defined as a set of methods used in scientific research to reach satisfactory results (What are statistical methods in scientific research?, 2022).

The distinction between parametric and non-parametric statistics depends on the type of data to be analyzed and its level of measurement. Using the appropriate statistical method depends on the nature of the data (numerical/categorical or quantitative/qualitative) and the level of measurement of the research variables (nominal, ordinal, interval, or ratio).

When we present modern statistical methods, the most important methods of inference appear when we make several good assumptions about the nature of the population from which the sample was taken. Since the values of the population are the "parameters", these statistical methods are called parametric statistics. Recently, we have seen a great deal of progress in a large number of inference methods that do not make assumptions about the parameters. These modern non-parametric methods are used when inference requires fewer qualifications.

Non-parametric methods are sometimes called order tests or ranking tests because they are based on the rank or order of the scores, not on the numerical values.

Since the 1950s, there has been an increasing interest in non-parametric statistics because of its importance in calculating statistical significance, especially when parametric measures are not suitable for calculating such significance due to the lack of the necessary conditions for their use. The use of this type of statistics has become widespread in small and very small samples that the psychological researcher may resort to to choose his measurement tools preliminarily and quickly, and in free distributions that are not restricted to the normal distribution.

The use of non-parametric statistics is not limited to these two aspects but also extends to large samples. Most of its measures approach the normal distribution in their distributions according to the increase in the sample size. Therefore, it is unique in the statistical analysis of descriptive and ordinal measurement levels, and also extends to other levels of accurate measurement such as the relative, while the field of use of parametric statistics is limited to the upper levels of measurement that are represented in the interval scale.

14.1 Parametric Statistics

Parametric is a statistical term that means the original value of the original population, and it corresponds to the statistical statement that describes the numerical characteristics of the sample. In Arabic, it is a parameter, and the plural is parameters since it is a value that describes the original population from which the sample was derived.

The statistical description of the sample can be carried out directly from the scores obtained from the group of individuals who are selected, while the parameter (parametric) or the value of the original population from which the sample was drawn is usually a theoretical value based on probabilities. It is a value unknown to the researcher but rather estimates it in the light of the results obtained from the sample. Statistical sampling is considered the scientific method through which the researcher can approach the original population from which the sample was drawn to estimate the parameters of this population.

Parametric statistics are based on the normal probability curve, which assumes the normality of the data distribution. The statistical values of the original population are called parameters, and the statistical methods used in it are called parametric statistics.

14.2. Non-parametric Statistics

Non-parametric statistics are considered one of the statistical methods that do not require a distribution of data, and examples of it include (frequencies, percentages, chi-square, and Mann-Whitney test). The choice between parametric and non-parametric methods depends on each: level of measurement, data distribution, and sample size.

Non-parametric statistics is defined as: "The methods that can be applied to a wide range of distributions without assuming a specific distribution for the populations they deal with."

Non-parametric statistics is also defined as: "Statistics that does not change with the conditions that must be met for the use of non-parametric statistics, and it is also determined by the preconditions for the shape of the frequency distribution and the sample size."

In the case of nominal or ordinal measurement, we use non-parametric statistical methods. In addition, if the sample size is small, then we use non-parametric statistical methods regardless of the level of measurement in data collection (Shaaban Issa).

Conclusion

In conclusion, the choice of the appropriate statistical method is of great importance to the quality of the research, as well as to the researcher. When the researcher succeeds in choosing the appropriate method for analyzing the data of his research, he increases his knowledge of statistical methods to test his hypotheses, reach accurate results and generalize them, and predict phenomena in the future, which enables him to direct his research study towards correct and reliable results.

Many statistical methods are used in different situations, and each statistical method has certain conditions that must be respected. Therefore, the success of any scientific research depends on the success of the researcher in preparing it methodologically and analyzing its data statistically.

Therefore, the researcher recommends that students and researchers be aware of all the details of methodological and statistical matters to prepare correct and reliable scientific research in its results.

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