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Artículos científicos

Lo cuantitativo y cualitativo desde un tratamiento estadístico

The Quantitative and Qualitative from a Statistical Treatment

O quantitativo e qualitativo a partir de um tratamento estatístico

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Resumen

El objetivo del presente escrito es el rescate de las técnicas de la estadística no paramétrica. La estadística no paramétrica es la más apropiada para escalas de baja categoría: nominal y ordinal (investigación cualitativa). Es importante porque es muy útil para trabajar muestras pequeñas de datos categóricos u ordinales, independientemente de la distribución de las muestras que se desean contrastar. Entre los resultados de este trabajo, se muestra una matriz de investigación científica que devela 10 tipos de diseño de investigación, que resultan de combinar cuatro criterios dicotómicos como materia prima obligada para hacer investigación. Y se concluye que cuando se usan variables cualitativas y escalas nominales u ordinales han de usarse técnicas estadísticas no paramétricas, considerando que las variables cualitativas son categóricas o clasificatorias, dado que denotan cualidad e imperan en el campo de las ciencias sociales y son de criterio observacional.

Palabras clave: cuantitativo, cualitativo, escalas de medición, estadística, matriz de investigación.

Abstract

The objective of this writing is to rescue the techniques of non-parametric statistics. Nonparametric statistics is the most appropriate for low-category scales: nominal and ordinal (qualitative research). It is important because it is very useful for working with small samples of categorical or ordinal data, regardless of the distribution of the samples to be contrasted. Among the results of this work, a scientific research matrix is shown that reveals 10 types of research design that result from combining four dichotomous criteria as an obligatory raw material for doing research. And it is concluded that when qualitative variables and nominal or ordinal scales are used, non-parametric statistical techniques must be used, considering that qualitative variables are categorical or classificatory, since they denote quality and prevail in the field of social sciences and are observational criteria.

Keywords: quantitative and qualitative, measurement scales, statistics, research matrix.

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Resumo

O objetivo desta escrita é o resgate de técnicas estatísticas não paramétricas. A estatística não paramétrica é a mais adequada para escalas de categoria inferior: nominal e ordinal (pesquisa qualitativa). É importante porque é muito útil para trabalhar com pequenas amostras de dados categóricos ou ordinais, independentemente da distribuição das amostras a serem contrastadas. Entre os resultados deste trabalho, mostra-se uma matriz de pesquisa científica que revela 10 tipos de desenho de pesquisa, que resultam da combinação de quatro critérios dicotômicos como matéria-prima necessária para realizar pesquisas. E conclui-se que quando se utilizam variáveis qualitativas e escalas nominais ou ordinais, devem ser utilizadas técnicas estatísticas não paramétricas, considerando que as variáveis qualitativas são categóricas ou classificatórias, pois denotam qualidade e prevalecem no campo das ciências sociais e são de interesse observacional. critérios.

Palavras-chave: quantitativo, qualitativo, escalas de medição, estatística, matriz de pesquisa.

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Introduction

Statistics is part of our daily life. Orlandoni (2010) states that, as a science, "statistics is a set of procedures and techniques designed for the purpose of obtaining, organizing, analyzing, interpreting and presenting information on a certain fact or phenomenon that can be expressed numerically" (p. 243) . That is, it draws conclusions from data through measurements and counts. And due to the variability present in the data, statistics generally works with samples, which makes random error appear in their models.

Data is classified as quantitative or measurement and qualitative or classificatory data, and can appear in natural and social sciences. In addition, the data help to classify research projects in one of the four dichotomous criteria: observational-experimental, prospective-retrospective, longitudinal-transversal, monogroup-comparative, and based on this classification, define the project in question in one of the ten possible types of studies or projects that exist (Cienfuegos and Cienfuegos, 2016).

Parametric statistics has the virtue of being able to work with discrete and continuous variables, which possibly gives rise to a normal distribution, with which statistical techniques and tests such as z, t, chi square, among others, can be applied through the parameters μ, □2,

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□, N… Consequently, the virtue of non-parametric statistics is to work with discrete variables associated with counting, which gives rise to free distribution models, that is, they do not follow a normal distribution. It is more suitable for small samples, however, it is also applicable to larger population samples, although the application is more laborious and less effective. The most used are the sign test, Wilcoxon, Friedman, median test, Mann-Whitney u, Kruskal-Wallis, Spearman's ro and Kendall's tau. Tests use nominal or ordinal scales (Gómez, Danglot y Vega, 2003).

Thus, there is a great diversity of techniques, a wide range of possibilities to carry out scientific research and respond to a previously expressed research problem, whatever the origin and type of data presented. That is why it is important to venture into the study of the quantitative and qualitative from a statistical treatment, that is, from parametric and non-parametric statistics.

The parameter is the data to be able to evaluate or assess a certain situation. In the words of Reyes, Vargas, Burgos and Navarrete (2018):

> "They define those variables and constants that appear in a mathematical expression, its variation being what gives rise to the different solutions of a problem. In this way, a parameter supposes the numerical representation of the enormous amount of information that is derived from the study of a variable. (p. 28).

Parametric statistics, its statistical techniques of parameter estimation, confidence intervals and hypothesis testing specify a form of distribution of the random variable and of the statistics derived from the data. Another characteristic is that the population from which the sample is obtained can be normal or approximately normal. Parametric tests assume statistical distributions underlying the data, therefore, they assume certain validity conditions to accept their result as reliable.

However, the underlying distribution in nonparametric statistics does not fit the so-called parametric criteria. "Its distribution cannot be defined a priori, since it is the observed data that determines it" (Reyes et al., 2018, p. 32). It makes no assumptions about the probability distributions of its variables, it uses descriptive and inferential statistics and in terms of measurement levels: nominal and ordinal data. Although it offers less rigidity, it has the advantage of being able to be applied to a wide variety of situations because it does not require normally distributed populations. Qualitative data can be strengthened with other methods arising from qualitative epistemology.

This article aims to analyze the quantitative and qualitative and its measurement scales through the statistical gaze based on the scientific research matrix, important elements in the use of parametric statistics and especially rescuing the second, which, Although it has some limitations, it can achieve ordered statistical results to facilitate the understanding of the phenomenon studied.

Measurement scales

Before starting any statistical analysis, it is of great importance to define the nature of the data and the rules that classify them in some of the types of measurement scales. The measure is the number or category that is assigned when measuring a phenomenon. Measurement is the observation of a phenomenon or property and the assignment of a number or category as a way to represent that phenomenon; the measurement is always associated with the variable, which constitutes the characteristic of the population or sample to be studied. The scales and variables, population or sample represent the most important reference concepts of a quantitative or qualitative research from a statistical treatment.

Measurement means assigning certain characteristics to objects and events according to certain rules, and the way numbers are assigned is how the scale of measurement is determined. Measurement scales (the act of measuring) comprise four types: nominal, ordinal, interval and ratio: they refer to categories, numbers, proportions and percentages and are applied in quantitative and qualitative research. The measurement scale "determines which operations are possible to use and therefore the statistical tests that are permissible" (Dagnino, 2014, p. 109-110).

The nominal scale responds to the type of data that can only be classified into categories or classes, for example, the gender variable has two categories: male and female and each of them is subject to counting. With this type of scale it is not possible to carry out arithmetic operations or establish an order relationship; but counts can be made to obtain frequencies and percentages in contingency tables or double-entry tables.

The most common measure of association for qualitative data is the contingency coefficient in contingency tables. The important property of the nominal scale is equality or equivalence.

All the elements that are part of a category according to their nature are equal or equivalent. The properties of equality are the following:

- Reflexive: x = x, for any value of *x*.
- Symmetric: $x = y \Rightarrow y = x$.
- Transitive: si $x = y$ y $y = z \Rightarrow x = z$, equivalent to the syllogism, to define hypotheses.

Items in the male category exclude items in the female category; that is, they are mutually exclusive: if one occurs, the other cannot occur. There is no order relationship between them: masculine is not stronger or more intelligent than feminine. Nor are there middle terms: either it is masculine or it is feminine, and so on with all the nominal variables.

The variable or ordinal scale gives better information than the nominal one. Nonparametric techniques for this scale are valid. In this scale, the elements of a category are related to each other by the concept of order, with the signs > (greater than) and < (less than), for example: pain intensity: strong, regular, low; income: high, medium, low. Obviously: strong > regular > low and high > medium > low.

If parametric techniques were used with ordinal data, an error would be made: the conclusions would be doubtful and unreliable or unreliable. In social sciences, most tests are nonparametric, although parametric tests are also used. Its properties are:

- Inequality: $a > b$ y $a < b$; $b > c$ y $b < c$…, property that is:
    - Irreflexive: it is not true for any x that x > x.
    - Asymmetric: x > y, then y is not greater than x.
    - Transitive: $x > y$ y $y > z \Rightarrow x > z$.

On ordinal scales the appropriate test is the median (with data above and below it). Contingency coefficients and rank statistics also apply. The only assumption for some range tests is that the data have a continuous distribution that can take on any value in a certain interval.

Now, the maximum level of measurement is reached with interval and ratio scales. The interval scale makes use of the real number line. The ordinal scale has the properties and characteristics of the nominal and the interval scale has the properties of the nominal and ordinal.

In interval scaling, zero is arbitrary. The most commonly used scales for measuring temperature are degrees Celsius (°C) and degrees Fahrenheit (°F). On both scales, the freezing point and boiling point are different: from 0 to 100 in °C and from 32 to 212 in °F. 0°C is equivalent to 32°F and 100°C is equivalent to 212°F. However, they provide the same information (Runyon and Haber, 1986).

In social sciences it is not right to work with interval scales, although doing so depends on the case; The most advisable thing is to take advantage of the benefits and advantages offered by qualitative techniques and non-parametric techniques, among other tools. Nonparametric techniques are not generally taught in professional studios; For many years, traditional statistics have been applied almost exclusively, which allows obtaining: means, standard deviations, t tests, F tests, as well as analysis of variance, analysis of variance of regression and correlation, strongly supported by the assumptions of the model "when these are fully satisfied".

The interval scale measures variables numerically and represents magnitudes with the equality property of the distance between scale points of the same amplitude, for which order is established between their values and allows equality comparisons to be made. Parametric tests can and should be used; non-parametric ones would downplay the importance of the analysis by not using all the information contained in an interval scale. It is based on the assumption that the variable under study has a normal data distribution and a large sample size (greater than or equal to 30). On this scale, zero does not correspond to the absence of the physical characteristic used in the units of measure.

The ratio or proportion scale has all the characteristics and properties of the interval scale, plus zero is real. This means that, in practice, having an arbitrary zero does not constitute any problem or obstacle to using parametric statistics and consequently the quantitative, because the numbers associated with this scale are true, including zero, as happens when measuring weight in tons, kilos and grams, in such a way that the ratio between any two units of weight is independent of the unit of measure. Arithmetic operations can be done with greater confidence, as well as statistical tests, including geometric mean and coefficient of variation. Table 1 shows the type of variable, its correspondence with a certain measurement scale and its main characteristics.

Tabla 1. Clasificación de las variables de acuerdo con su función. Tipos de escalas de medición

Tipo de variable	Escala de medición	Características principales
Cualitativa (categóricas) (según su naturaleza): • Conforma la dicotomía observacional con nueve proyectos (ver cuadro 2). • Contiene datos categóricos, mutuamente excluyentes. • Enfatizan en la cualidad, por lo cual es común su uso en ciencias sociales. Se aplica estadística no paramétrica. Se puede realizar análisis con diagrama de barras y diagramas de sectores.	*Nominal:* permite la propiedad de la igualdad: es reflexiva, simétrica y transitiva. Sus mediciones se dan por conteo con números naturales. *Ordinal*: enuncia relación de orden. Admite la igualdad y desigualdad: $a > b; a < b$. Es irreflexiva, asimétrica, transitiva. Datos mutuamente excluyentes.	Se determinan frecuencias, atributos, datos categóricos. Números, letras y símbolos; se mide con $\square^2$ y binomial, proporción o porcentaje, medida de asociación: coeficiente de contingencia. Se determinan frecuencias por la mediana. Ejemplo: concentración poblacional: alta > media > baja.
Cuantitativas (numéricas) (según su naturaleza): • Conforma la dicotomía experimental con un solo proyecto: el experimento, el cual aplica operaciones aritméticas.	*Intervalo*: datos continuos, pero también discretos. Mide lo cuantitativo (variables continuas) y lo cualitativo (variables discretas al permitir asignar valor numérico a mediciones arbitrarias, como una opinión). Representan datos mutuamente excluyentes y	El cero es arbitrario. Pide normalidad y otros supuestos. Ejemplo: temperatura: 0 °C no implica ausencia absoluta de calor. El cero es real. Ejemplos: km, cm, tonelada, kg,

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• Cuando los supuestos funcionan satisfactoriamente, se usa la estadística paramétrica. Pueden presentarse datos cualitativos, como variables independientes.	exhaustivos *Razón:* datos continuos, también discretos. Medición: cuantitativo (variable continua), cualitativo (variables discretas). El dato se caracteriza por un punto de cero absoluto, lo que significa que no hay valor numérico negativo.	litro, cm, m^2, ingresos, edad, número de adultos.

Fuente: Cienfuegos y Cienfuegos (2016, p. 4), Coronado (2007) y Bautista, Victoria, Vargas y Hernández (2020)

Not a few researchers affirm that the advantages of each of the types of research, whether qualitative or quantitative, must be clear (Giraldi, 1998); In reality, what must be clear are the characteristics and the way in which they are used, their complementary points and their link with statistics and with the methodology of scientific research. All this is presented in table 1, which contains:

- The indicated variables: quantitative and qualitative.
- Measurement scales: nominal, ordinal, interval and ratio.
- Statistical techniques: parametric and non-parametric.
- Statistical tests, from median and binomial to t and F.
- The four criteria for classifying scientific research.
- The ten types, studies or research projects (table 2).

Once the variables and the measurement scale are clear, another step can be taken: select the type of research project. For which it is necessary to know the matrix of scientific research and the types of design, studies or projects that are included.

Scientific research matrix and the projects it contains

The scientific research matrix presents the 10 designs, studies or projects that contain it, located according to four dichotomous classification criteria (as can be seen in table 2):

1) observational Observational or experimental: the first arises when there is no randomization of treatments. The data is observed and measured, just as it occurs in nature, as long as there is no manipulation of the research material; this criterion gives rise to nine research projects. The second originates a single project: the experiment where the research material is manipulated. Working with one or another criterion is the researcher's decision.

2) Prospective or retrospective: the prospective is characterized by working in the present to obtain results in the future and the retrospective works with data from the past. This criterion is defined by the data.

3) Transversal or longitudinal: working with one measurement (transversal) or working with several measurements (longitudinal) is a researcher's decision.

4) The monogroup or comparative is also a decision of the researcher, who decides to work with a group (monogroup) or with more than one group (comparative).

Tabla 2. Matriz de investigación científica

Combinación de los cuatro criterios de clasificación de la investigación: 10 tipos de diseño, estudios o proyectos de investigación científica y nombre común.						
Criterios de clasificación dicotómica						
1 Observacional o experimental	2 Prospectivo o retrospectivo	3 Transversal o longitudinal	4 Monogrupal o comparativo	Diseño, estudio o proyecto (nombre común)	Núm. de proyecto	Características del proyecto
Observacional	Prospectivo	Transversal	Monogrupal	Encuesta. Monogrupal	1	No experimental ni pseudoexperimental
Observacional	Retrospectivo	Transversal	Monogrupal	Encuesta. Monogrupal	2	No experimental ni pseudoexperimental

Observacional	Prospectivo	Transversal	Comparativo	Encuesta. Comparativa	3	Pseudoexperimental
Observacional	Retrospectivo	Transversal	Comparativo	Encuesta. Comparativa	4	Pseudoexperimental
Observacional	Retrospectivo	Longitudinal	Monogrupal	Revisión de casos	5	No experimental Ni pseudoexperimental
Observacional	Retrospectivo	Longitudinal	Comparativo efecto-causa	Casos y controles	6	Pseudoexperimental

Observacional	Retrospectivo	Longitudinal	Comparativo causa-efecto	Perspectiva histórica	7	Pseudoexperimental
Observacional	Prospectivo	Longitudinal	Monogrupal	Una cohorte	8	No experimental ni pseudoexperimental
Observacional	Prospectivo	Longitudinal	Comparativo	Varias cohortes	9	Pseudoexperimental
Experimental	Prospectivo	Longitudinal o transversal	Comparativo	Experimento	10	Experimental

Fuente: Méndez (1987), citado en Cienfuegos y Cienfuegos 2016, p. 12)

The matrix (table 2), in addition, prescribes as a result an experiment, a pseudo-experiment or not being any of these:

a) Five pseudo-experiments: three necessarily comparative designs, studies or research projects: cases and controls (project six, effect-cause), historical perspective (project seven, cause-effect) and that of several cohorts (project nine); in addition, the two comparative surveys (project three and four).

b) Four projects that are not experiments or pseudo-experiments, since they are not comparative like the one-group projects (projects one, two, five and eight).

c) It contains four projects via sample survey: the prospective and retrospective monogroup survey (projects one and two), which are neither experiments nor pseudo-experiments, and the prospective and retrospective comparative survey (projects three and four), both pseudo-experiments.

d) Finally, the experiment (project 10) and is called the experimental criterion; this research project is also considered to be inferential.

Of the four dichotomous classification criteria, the most important are one (observational-experimental) and four (monogroup-comparative). Table 2 shows four projects that characterize survey research projects based on questionnaires; this is a way of doing research. From this perspective, you can work with both open and closed questions, but it is recommended that open questions be avoided, since they give long answers and, moreover, are difficult to measure; however, this type of question is still important in studies from some qualitative epistemological-methodological perspectives other than the one presented here. The use of closed questions provides a concrete, precise, functional and perfectly codifiable response for statistical analysis.

Design via experiment (project 10) was consolidated in the 1930s with Fisher (1890-1962), creator of the block and randomization concepts, although today these concepts, as he thought of them, can be considered not current. What this statistician and biologist did was fine-tune and adjust the Galilean methodology, improving research techniques, one more link in the scientific chain, which has allowed statistics to be applied more efficiently from the parametric and non-parametric point of view, present in the ten projects from table 2.

The experiment must meet the requirement to randomize treatments, that is, randomly (randomly) assign participants in a trial to two or more treatment or control groups, thereby avoiding selection bias. If there is no randomization, there is no experiment, and then it refers to the observational criterion and the pseudo-experiment, which lacks some important properties and characteristics of the experiment, such as randomization and also the fact that the research material is not manipulated or transformed. by the investigator.

Do not confuse what is research and experimentation, nor what is experiment and pseudo-experiment. Not infrequently, an investigation is treated as an experiment without being one, and is not aware of it. Of course, the results are not reliable. When an experiment is done, research is done; but the research is not necessarily done through an experiment; that is, in many cases the research is not done experimentally but rather observationally.

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The quantitative and the qualitative coordinated through the use of statistics

Starting in the 20th century, the debate between the quantitative and the qualitative was opened, especially due to the emergence of new qualitative research perspectives that put very interesting methods for the analysis of the social within the reach of the social researcher. For this reason, it is common to find very general definitions of research under the idea that it refers to a process of searching for reliable solutions to the problems posed through the planned and systematic collection, analysis and interpretation of data (Mouly, 1978). .

They are definitions that somehow encompass quantitative and qualitative approaches from different epistemological theoretical positions. It can be said that the difference lies in the process followed to find solutions. For Erickson (1989), qualitative and quantitative approaches do not compete with each other, they only start from different assumptions and are subject to certain study problems.

In the debate, the differentiation between natural sciences and social sciences is considered. Wittrock (1986) says that who began to be such a differentiation was the German historian and social philosopher Whilhem Dilthey (1914-1976), who based on the work of his contemporary Polish Malinowski (1922-1966), which increased with the works of Winch (1958), Berger and Luckmann (1968), Giddens (1976), and many others.

On the other hand, Campbell and Stanley (1966) introduced the pseudo-experiment as a research tool for a type of qualitative research with statistical treatment. In 1978, they proposed the case study as a research method. At that time, the interest of social researchers to investigate only qualitatively, as a method different from the quantitative one, increased. In such a way that it is possible to affirm that the qualitative does not commune with the natural sciences, but with the experimental (Merino, 1995). The idea that both techniques can be complementary is not accepted, the presence of qualitative variables in the phenomena of the experimental criterion is not accepted (project 10 of table 2). It must be admitted that qualitative studies can take on various characteristics according to the epistemological perspective that is assumed. Here it is stated that it is possible to inject in experiments (depending on the skill of the researcher), one or more qualitative variables.

Knowledge of parametric and non-parametric statistics, of the methodology, type of variables, scales, randomization, assumptions, dichotomous criteria and type of projects provide a wide range of possibilities to jointly manage the quantitative and the qualitative. In particular, Campbell and Stanley (1966), creators of the pseudo-experiment concept, object to the exclusively quantitative approach and lament that social science has been deprived of obtaining a validation reinforcement in the qualitative.

The researcher must have the ability to work quantitatively and qualitatively individually and jointly with the use of statistics, if his methodology and epistemological perspective so require. The statistician, due to the random nature of phenomena, starts from uncertain circumstances and uncertainty, so he always arrives at approximate results, with a certain probability of approaching the truth, which he will never find. The mathematician, on the other hand, starts from axioms (propositions not subject to proof), which is why, they say, he always arrives at establishing truths, his models (mathematicians) are of a deterministic and deductive type.

Until now, the instrument to investigate logical positivism has been the experiment (experimental criterion), for which it is considered important to currently consider not only the observational-experimental dichotomy, but also the prospective-retrospective, transversal-longitudinal and monogroup-comparative dichotomies. , whose combination results in 10 research projects, nine of which are little used to carry out scientific research.

For Wittrock (1986), the observer plays a very important role as an instrument of observation. In addition, he uses the descriptive term in the literal sense of the word ('describe'), a success; but it refers to observational research and qualitative research without relating them. This fact highlights the clear intention of treating the qualitative and the quantitative separately from the statistical point of view; that is, Wittrock still does not manage the function of the observational-experimental dichotomous criterion that, with the other three criteria, generates nine scientific research projects that do not have the characteristic of an experiment-type design (table 2).

The descriptive term, as opposed to the comparative, is used by Méndez (1987) to identify a monogroup-type population; leaving such a term, then, according to its grammatical definition, only to describe something and also to designate one of the two great branches of statistics: descriptive, the other being inferential.

Bisquerra (1989) says that qualitative research is at the opposite extreme of quantitative. In what follows we will see that this is not the case, that both techniques complement each other and can even be used together in the same research project. It should be noted that different authors use different terms instead of qualitative. For example:

- Erikson (1989) argues that he prefers the interpretive term.
- Guba (1983) uses the term naturalistic.
- Woods (1987) uses the term ethnography: a monographic description of the livelihoods of peoples who were ethno ('others', in Spanish).
- Lincoln and Guba (1985) refer to the emerging paradigm.

> The traditional model, positivist approach, developed in the natural sciences in different disciplines, has been receiving innumerable criticisms, but it has also given notable advances in knowledge: it has generated scientific laws and theories. Wittrock (1986) says that the research and development of the positivist approach, typical of the natural sciences, has been possible due to the uniformity of the phenomena under consideration. Does Wittrock mean that the phenomena studied in the natural sciences are homogeneous? It is believed that no, that the phenomena to be studied in natural sciences are not uniform (homogeneous). If anything characterizes natural phenomena, it is their heterogeneity, the cause of variability, also typical of social phenomena. Variability characterizes the world in general.

The qualitative has its origins in anthropology. This was born in the 19th century and its techniques began to spread thanks to the Chicago school (1910-1940); however, after the Second World War (1944) the quantitative technique predominated, leaving the qualitative one behind, which resurfaced in the 60s of the 20th century in the United States and England and whose interest stands out particularly in the field of research education in the 1980s.

Wittrock (1986) includes for the first time in the third edition of his Handbook of Research on Teaching a chapter on qualitative research. Later, other authors such as Bogdan and Biklen (1982), Erikson (1986), Méndez (1987), Morgan (1988) and Pfaffenberger (1988) also dealt with the subject.

The main difference between the experimental and the observational (table 2) is the fact that in the second there is no randomization of treatments or manipulation of the research material, although this does not mean that in all the observational there is a presence of the qualitative, because in the observational field quantitative data is also worked by counting with natural numbers.

Regarding the qualitative, Bisquerra (1989) mentions the following characteristics, some refutable:

1) That in qualitative research a hypothesis is not usually tested.

It really isn't. With qualitative research it is not only possible to generate hypotheses, but it is also possible to establish and test them. True, many of the hypotheses generated from qualitative research are not central (cause-effect), but only denote association between variables, but they are statistically testable hypotheses.

> Non-parametric statistical techniques and tests allow us to test qualitative hypotheses with nominal and ordinal scales. In general, all statistical tests have their hypotheses established. For those who affirm that the monogroup (for others descriptive) and comparative (observational) projects do not build hypotheses, the following is mentioned: the objectives established in the sample surveys give rise to a set of hypotheses that allow reaffirming the problem to sort out. The hypotheses are, therefore, the consequence of a deep knowledge of the problem and of the objectives.

2) From the point of view of Bisquerra (1989), qualitative research does not have procedural rules, qualitative variables are not operationally defined and are not usually measurable.

In this regard, if there are no procedural rules, it is difficult to speak of a scientific research method. Nonparametric statistical techniques and corresponding tests are, among other things, rules of procedure. Therefore, qualitative variables can be operationally defined, although not in the sense of carrying out arithmetic and algebraic operations, but in the sense that they can lead to an end, that they can have a certain effect. It is recommended to specify the meaning of terms, concepts and ideas. When he affirms that qualitative variables are not usually susceptible to measurement, he affirms it from certain theoretical, epistemological and methodological positions of the social sciences and makes explicit that they are not measured quantitatively, but counting procedures can be used, because they are discrete variables. . In addition to this, if it is a qualitative variable (cause) linked to a quantitative one (effect), it can be subject to measurement.

3) Bisquerra (1989) states that qualitative research is subjective.

This is recently reinforced by Quecedo and Castaño (2002), when they characterize it as subjective due to the type of data obtained; Its purpose is to reconstruct specific categories that the participants use in the conceptualization of their experiences and in their conceptions. But with the help of statistics it is possible to minimize, control or even successfully eliminate subjectivism; the researcher must be, with the material he handles, as less subjective as possible.

4) It also considers that qualitative research contains an overload of values of the researcher.

But not only qualitative research contains this overload, also quantitative. The values must be positive with a tendency to be objective. He also writes that it cannot be replicated; In this regard, in pseudo-experimental, comparative (observational) projects, there are repetitions, although in certain circumstances they are not true repetitions.

5) Affirms that qualitative research has little reliability.

This concept means 'reliable condition' (reliable or trustworthy), 'possibility of functioning properly' and, reliable?, 'trustworthy', 'secure' (safety). However, the dictionary definition is not enough. Statistical analysis correctly applied communicates confidence and security in what is done.

6) Likewise, it gives it little representativeness (external validity).

There are no middle terms, you have it or you don't have it. Statistically, external validity means that there are one or more representative samples of the population or populations in question.

Representativeness means that the characteristics of the sample are almost similar to those of its population. The similarity of the sample with the population depends on the degree of generality of the population and this of the controlled characteristics. Méndez (1987) says that external validity is obtained and assured with:

- A well-defined population from the spatio-temporal point of view.
- A good measurement and counting process (quantitative and qualitative).
- A good selection of the sample that ensures representativeness.

However, biases can be generated that alter the external validity. Statistically, bias exists when the parameter value or expected mean value differs significantly from the true value. The statistical expression of the bias is as follows:

$$\text{Bias} = \text{Expected value} - \text{True value}$$

In that expression, Expected Value is the estimator and True Value is the parameter value, the one we never know.

Sampling and representativeness or external validity can occur in the selection of the sample, biases that alter the representativeness between sample and population. If this happens, the sample loses representativeness and, of course, the research project loses validity, reliability and precision.

Méndez (1987) states that the most important biases are:

a) Selection bias by the researcher: they occur when the researcher captures only a subsector of the population. Example:

- When choosing individuals with advanced or moderate illness when the intention is to extrapolate the conclusions to all levels of illness.

b) Iatrotropic self-selection biases; the prefix yatro means 'doctor' and refers to that factor that causes medical attention to be sought. These biases occur when the individuals who undergo sampling have some characteristic that makes them more likely to be sampled. Examples:

- A study on the application of insulin to beneficiaries of the Institute of Security and Social Services for State Workers (Isssste), Edo. of Mexico, it cannot be extrapolated to the entire population of Mexico.
- Rheumatic patients from high residential areas of CDMX are individuals who can pay for their medical care. They are not representative (external validity) of the entire population of the mentioned city that suffers from this disease.
- Students of the Autonomous University of the State of Mexico who enroll in cultural dissemination courses offered by the Chimalhuacán Professional Academic Unit are not representative of the entire population of university students who take cultural dissemination courses.
- Loaded dice, marked cards.

c) Inherent self-selection biases. They occur when a risk factor is associated with an inherent characteristic of the individual. Examples:

- The use of contraceptive pills is associated with high socioeconomic levels.
- Do vigorous physical exercise with an efficient cardiovascular system.

In these cases, results cannot be extrapolated to the entire population of women if they used contraceptive pills, or to the entire population if they performed vigorous physical exercise. Some of these biases, especially in retrospective studies,

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can be eliminated using stratification or attribute matching techniques, as long as they are measured or counted. In prospective projects, case a) and b), the biases can be eliminated with random samples. However, the biases in c) are more difficult to remove and will therefore cause the target population to be reduced in order to retain representativeness.

In experimental research projects, a representative sample of the population (the experimental surface) is randomly subdivided into subsamples (the treatments) to assign them to the different variants of the causal factor. Example:

- When comparing therapeutic treatments for a condition, a representative sample of the population is taken; the sample is divided into repetitions or into blocks if this were the case, and into as many experimental units as there are treatments x repetitions (of a social type and others). Treatments are randomly assigned. Thus, each subsample or set of complete treatments is representative of the patient population. (Méndez, 1987).

7) Now, continuing with Bisquerra (1989) as a critic of qualitative research, he says that its conclusions are not generalizable.

From the point of view of non-parametric statistics, the idea that the generalizable concept (to generalize) is so commonly used that its definition is not consulted as support for its understanding is accepted.

- *General: 'which is common to the whole, frequent, universal, usual'.*
- *Generalize: 'turn the majority into a practice'.*
- *Generality: 'majority'.*
- *Generalisable: 'synthesize, draw conclusions'.*

> *It is convenient to understand the concept statistically: generalizing implies, from the point of view of extrapolating space-time location, making inferences from the conclusions to the population under study. Extrapolation requires the existence of one or more samples. Sampling is usually necessary; having sampling, there is external validity, there is representativeness, there is extrapolation and inferences. If there is extrapolation there is generality, generalizable results, which means: that from a particular situation (the sample) we pass to a general case (the population), that is, it is generalized.*

Consequently, the sample and (scientific) theory strongly support the generalizability of the conclusions.

Although some qualitative methodologists such as Walker (1983, cited in Quecedo and Castaño, 2002, p. 10) assure that qualitative research focuses on the discovery of constructs and propositions from a database or sources of evidence that come from the observation, interview, written documents, among others; these data are ordered and classified, constructs and categories are generated to seek transferability, not to make scientific generalization. It is also valid, it depends on the methodology that is intended to be followed and what is sought to explain.

8) For Bisquerra (1989), qualitative research lacks accuracy and precision.

Here it is counterargued that for this statement to be valid, it is first necessary to understand the meaning of accuracy, precision and related concepts, especially from the statistical point of view. The dictionary considers them as synonyms, but under what circumstances? Let's see:

- *Accuracy: 'rigor and precision in the content of something'. 'Measurement approaching the true value'. With accuracy, the bias and error approach zero.*
- *Precision: 'quality of precision, accuracy'; instruments that tune to the maximum.*
- *Precise: 'exact, true, punctual, fair, balanced, concise'.*
- *Exact: 'precise, punctual'. It applies to science based on empirical facts.*
- *Specify: 'determine precisely. Force, compel, indispensable, necessary.*

Definitions that (statistically) help little or nothing. Therefore, it is necessary to statistically define precision. In sample-based projects, accuracy and precision are synonymous as long as there is no bias in the measurements. If there are biases (which are avoidable), accuracy and precision are not considered synonyms.

The researcher is considered to be so skillful, careful, efficient, honest and ethical in his work that he will not allow the presence of bias. A biased estimator (allowing for bias) does not generate accuracy; but there can be precision (although there is bias). Thus, an unbiased estimator (without bias) generates accuracy and precision. Since precision is what matters most, with good control of bias accuracy should not be a concern. Bias control is achieved with good management and conduct of the research project, which depends on the researcher.

- *Accuracy statistically means 'the success obtained in estimating the true value of a parameter'. The estimator can be the mean and the variance (the most frequent). If the mean is biased, it cannot adequately represent (as an estimator) the true value.*
- *Precision statistically means 'the maximum deviation or permissible error that the researcher is willing to accept or tolerate' (between the estimator and the parameter). In other words: beyond a certain magnitude, we can no longer accept or support any more distance between the estimator and the parameter.*

In this way, precision is that value, measurement or estimate that is close to the expected value (true average value). If this is so, the error approaches zero and there is no bias. If there is no bias, accuracy is not an issue. But there is the problem in relation to the (sample) estimator, i.e. only if the sample exists.

The sample estimator is a variable whose values are determined based on the sample observations and estimates (with a certain probability of error) parameter values. During the estimation process, it is of the utmost importance to know the degree of distance between the value of the estimator and the true value of the parameter; this departure is called precision d.

> Accuracy is closely linked to reliability, which is the desired security or confidence that the estimator maintains the stated accuracy. Security or confidence that is achieved with a certain level of significance α, what is seen in $z_{\alpha/2}$. The expression that relates precision and reliability, object of our interest (for large samples), is the following:

$$d=Z\alpha/2$$

Raising By squaring and proceeding algebraically, as shown below, we establish the equation that allows us to calculate the precision d:

$$d = Z/2\, d^2 = \ldots\ldots (1)$$

According to López (2018), it is recommended that the estimator meets the following additional properties:

- *Unbiased: The unbiased property refers to the centrality of an estimator. That is, the mean of an estimator must coincide with the parameter to be estimated. We should not confuse the mean of an estimator with the mean estimator.*

- *Sufficient: the sufficiency property indicates that the estimator works with all the sample data. For example, the mean does not pick just 50% of the data. It takes into account 100% of the data to calculate the parameter.*
- *Consistent: the concept of consistency goes hand in hand with the size of the sample and the concept of limit. In simple words, it comes to tell us that the estimators fulfill this property when, in case the sample is very large, they can estimate almost without error.*
- *Efficient: The efficiency property can be absolute or relative. An estimator is efficient in the absolute sense when the variance of the estimator is minimal. We should not confuse variance of an estimator with variance estimator.*
- *Robust: an estimator is said to be robust if, despite the initial hypothesis being incorrect, the results are very similar to the real ones.*

The above properties are what will allow the conclusions drawn from the study to be reliable.

9) Another statement by Bisquerra (1989) is that qualitative research is not very rigorous and systematic.

Scientific rigor is given as much as the researcher or scientist wants. Unsystematic? Not at all: of course qualitative research conforms to a system. Qualitative research is just as valid and useful as quantitative research. Yes, it is true, objectives and general hypotheses are different since they obey different problems, but equally useful and efficient. It is advisable to review the definitions: system, systematic, systematize.

We will now go on to identify the characteristics of quantitative and qualitative techniques. Regarding the variables, non-parametric techniques are a valuable support for qualitative management. Example:

a) Schooling variable: primary, secondary, high school, bachelor's degree.
b) Income variable: < 3,000, between 3,000 and 10,000, > 10,000.
c) Electoral preferences variable: preference for a political party.
d) Aggressiveness variable: not at all aggressive, not very aggressive, medium aggressive, very aggressive and so on for other variables such as: depression, hostility, discipline.
e) Variable effect of applying sedatives to 18 people suffering from anxiety: slightly restless, moderately restless, very restless.

f) Variable comparison of two learning techniques: technique A and B.

There are some variables that have a hermeneutical treatment, although it is also feasible to manage them with quantitative or qualitative variables; everything depends on the problem, objectives, hypothesis. In social and natural sciences, theory plays an important role. By theory is meant the fact of explaining, arguing and interpreting with scientific rigor everything related to the problem, objectives, hypotheses, antecedents; that is, everything that surrounds the research process. The theory is expressed throughout the process; the whole process is theoretical framework. Theory is also understood as the background or bibliographic review in support of the research project and thesis. Theory is necessary in all science; although socially it is used as a fortress to observe an object of study.

Basic or pure research can be only deductive, first establishing the hypotheses and then the objectives. Newton's laws and the theories of Kepler and Einstein, among others, were established in this way. Note: what changes is the order, first the hypotheses. In applied research, the objectives are first, followed by the hypotheses (Méndez, 1987).

In this regard, it is commented that theory, observation and experiment are closely related as long as it is investigations via experiment. If we only observe and experiment without applying (scientific) theory, we will be using a purely empirical (of experience) and descriptive (of describing) aspect of reality, which lacks explanatory power. In the case of the discovery of planets, there is no experimentation, but there is research. Research is not always done by manipulating the research material (that is why the observational criterion exists, which is a particular case).

By applying only theory, without observing or experimenting (as Aristotle did), there is no contact with reality; that is to say, the theory (without observation and experimentation) lacks real bases. Aristotle is justified, because he lived for 2384 years. Experimentation in his time was not practiced. Aristotle (384-322 BC) founded the free fall of bodies based on theory without observing or experimenting. Aristotle created the theory that objects in free fall do so with a constant speed and that, of two objects, one of them falls faster the heavier it is.

Galileo (1564-1642) counter-argued Aristotle: he established, disregarding effects of air friction, that the rate of fall of an object is proportional to the time it has been falling and that the constant of proportionality is the same for all objects, regardless of His weight. This was established by throwing objects from the Leaning Tower of Pisa. He collapses Aristotle's theory through theory, observation and experimentation. Theory must always be accompanied by observation and experimentation (research via experiment). Thus, from these facts, the scientific method is born, in particular the experimental method. Galileo was thus the creator of the scientific method.

Giraldi (1998) says that in the social sciences there is a great interaction between the researcher and the phenomenon under study (contrary to what happens in the natural sciences). However, such interaction is not the exclusive property of the social sciences, it also exists in the natural sciences. There will always be a greater or lesser degree of interaction or interference between the researcher and the phenomenon studied, be it in the social sciences or the natural sciences. On the other hand, there may or may not be interaction between two or more factors or variables to be studied. The drawback is that, with the interaction, values of feelings, passion, subjectivism, dishonesty and lack of ethics are presented. However, it is common that, in social sciences, the researcher becomes the only protagonist (Méndez, 1987).

Much has been written in the social sciences about subjectivity and the abuse of objectivity in the natural sciences. In this regard, it is suggested to consult the following terms and relate them to this writing: objective, subjective, subjectivism. According to these definitions, the scientist must not get involved with the subjective, or it is his responsibility to minimize it. However, social sciences do not always work with objects (concrete things), but with abstract things. On the other hand, if the subjective is everything influenced by human judgement, by extension, both the social and natural sciences are subjective. Both, to a greater or lesser degree, are influenced by human judgment. If the influence is negative, the projects will be influenced to the detriment of humanity. If it is positive, scientific projects will be enriched.

According to the definition of the subjective, there is, then, in natural sciences the constant threat of subjectivity, which must be minimized by the experience, knowledge, judgment, ethics and by the strong and creative thinking of the researcher. On the other hand, it is said that creativity, skill and imagination are characteristic of the social sciences (Merino, 1995). This is believed to be false because such attributes are not exclusive to these sciences, they are also present in the natural sciences.

Conclusion

University students show unfavorable attitudes towards statistics, which is reflected in unsatisfactory results in terms of learning and application in the research they carry out (Ramos, 2019); for which it is required to continue exposing favorable arguments in the use and application of it. Generally, its teaching is related to the parametric, therefore, in this work the importance of qualitative projects with non-parametric statistical treatment is shown. In general, learning statistics is essential for the professional, since it allows him to analyze, interpret and make decisions about study problems.

Represents It is a look at research that is neglected in higher education, and in particular when it comes to qualitative studies. The reason could be the existence of other epistemological and methodological positions that think of both as independent from each other, with divergent methodologies, but always seeking interpretations of social phenomena, both of course valuable views.

From the quantitative and qualitative scientific research with statistical treatment they are considered non-exclusive and from its planning and clearly defined the study problem it is recommended to define variables, scales, type of project (of the ten existing ones), techniques and statistical tests. When qualitative variables and nominal or ordinal scales are used, non-parametric statistical techniques must be used, considering that qualitative variables are categorical or classificatory, since they denote quality and prevail in the field of social sciences and are of observational criteria. Observations are taken as they occur in nature. On the other hand, when quantitative (numerical) variables and interval or ratio scales are used, parametric statistical techniques (the traditional) must be used, considering that quantitative or numerical variables denote quantity and prevail in natural sciences and are experimental criteria.

For the types of variables, scales and projects (table 1 and 2), the statistical techniques and tests are already established. Nothing new. We hope that scientists will emerge who discover, in addition to what is known, other variables, other scales or other types of projects. However, as in the case of the experiment project, which in addition to being longitudinal can be transversal, other projects can arise in a similar way.

Partial retrospective projects (prospective and retrospective) can be built with data taken from the past and the present: Certain projects can dispense with statistics; although they follow a Poisson distribution (of rare events).

It is reiterated that research can be done without statistics; and this depends on what the researcher wants to do or demonstrate. If the qualitative researcher does not make use of statistics, he prefers the use of the term research assumption rather than hypothesis. But, from the point of view of research, where a problem and hypothesis are raised, which is sought to be rejected or accepted with a certain level of significance, the use of statistics is important.

The choice of measurement scale depends on the purpose of the investigation and represents an important decision element in the choice of design. By having these elements clearly identified, it will be easier to determine the type of instrument that allows you to collect data of interest for what you are looking for, for example, survey-type projects use the questionnaire and the structured interview with open or closed questions as a technique. but the scale is also used when seeking to measure attitudes or other psychological traits.

The researcher must have the ability to statistically apply what has already been established. Statistics does not only respond to complicated models. It is applied with quantitative and qualitative data, remembering that nominal and ordinal scales do not allow arithmetic operations, but counts and attributes, such as: totals, frequencies, percentages and prior to the execution of the investigation, results tables, widely used in sample surveys.

Future lines of research

In future argumentative articles or research results, it is essential to continue exposing topics that lead the researcher to use statistics in both quantitative and qualitative research to achieve inferences beyond the data, as the case may be. Statistical knowledge is a challenge and an opportunity.

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