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STRATEGIES FOR ANALYZING QUANTITATIVE DATA IN RESEARCH

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ABSTRACT
Numbers are meaningless unless we analyze and interpret them in order to reveal the truth that lies beneath them. With statistics, we can summarize large numerical data sets, make predictions about future trends, and determine when different experimental treatments have led to significantly different outcomes. Thus, statistical procedures are among the most powerful tools in the researcher's toolbox. Quantitative study designs are specific, well structured, have been tested for their validity and reliability and can be explicitly defined and recognized. Quantitative research is based on the measurement of quantity or amount. In quantitative research, the measurement and classification requirements of the information that is gathered demand that study designs are more structured, rigid fixed and predetermined in their use to ensure accuracy in measurement and classification.

INTRODUCTION
Quantitative research is a systematic empirical investigation of observable phenomena by using statistical, mathematical or computational techniques. The aim of quantitative research is to develop and employ mathematical models, theories and/or hypotheses pertaining to phenomena. The process of measurement is central to quantitative research because it provides the fundamental connection between empirical observation and mathematical expression of quantitative relationships. Quantitative data is any data that is in numerical form such as statistics, percentages, etc. The researcher analyzes the data with the help of statistics. The researcher is hoping the numbers will yield an unbiased result that can be generalized to some larger population. Qualitative research, on the other hand, asks broad questions and collects word data from phenomena or participants [1]. The researcher looks for themes and describes the information in themes and patterns exclusive to that set of participants. Qualitative methods produce information only on the particular cases studied, and any more general conclusions are only hypotheses. Quantitative methods can be used to verify which of such hypotheses are true.

Quantitative research is generally made using scientific methods, which may include:

- the generation of models, theories and hypotheses;
- The development of instruments and methods for measurement;
- Experimental control and manipulation of variables;
- Collection of empirical data;
- Modeling and analysis of data;

There are two basic approaches to research viz., quantitative approach and qualitative approach. This approach can be further sub-classified into the following:

(a) Inferential approach: The aim of this approach is to form a data base from which to infer characteristics or relationships of population.
(b) Experimental Approach: It is characterized by much greater control over the research environment and in this case some variables are manipulated to observe their effect on other variables.
(c) Simulation: It involves the construction of an artificial environment within which relevant information and data can be generated.

Quantitative data can be collected and are product of all strategies given below:

- Experiment
- Survey
- Case Study
- Action Research
- Grounded Theory
- Ethnography
- Archival Research

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It can range from simple counts such as the frequency of occurrences to more complex data such as test scores, prices or rental costs. To be useful these data need to be analyzed and interpreted. Quantitative analysis techniques assist us in this process. They range from creating simple tables or diagrams that show the frequency of occurrence and using statistics such as indices to enable comparisons, through establishing statistical relationships between variables to complex statistical modeling. If our focus is to measure the magnitude of that variation, 'how many people have a particular value, belief, etc.?' the quantitative designs are more appropriate[2].

STUDY DESIGNS IN QUANTITATIVE RESEARCH

Commonly used design in quantitative Studies can be classified in the following:

(i) The number of contacts with the study population.
(ii) The reference period of the study.
(iii) The nature of the investigation.

(i) Study Design based on the number of contacts: Based on the number of contacts with the study population, designs can be classified into three groups:

(a) Cross-sectional studies - These are the most commonly used design in the social sciences. It is extremely simple in design. First researcher has to decide the problem, identify the study population and he/she must their respondents to find out the required information. This study is appropriate for the following topics:

- The extent of unemployment in a city.
- Consumer satisfaction with a product.
- The attitude of the population towards uranium mining in Australia.
- The relationship between the home environment and the academic performance of a child at school.
- The quality assurance of a service provided by an organization.

Advantage and Disadvantage – Due to only one contact with the study population they are easy to analyze. But their biggest disadvantage is that they cannot measure change.

(b) The before and after study design – It is the most appropriate design for measuring the impact or effectiveness of a programme. The change is measured by comparing the difference in the phenomenon or variables before and after the intervention. The following are examples of topics that can be studied using this design:

- The effect of an advertisement on the sale of a product.
- The impact of incentives on the productivity of employees in an organization.
- The effect of a drug awareness programme on the knowledge about, and use of drugs among young people.
- The effectiveness of a marriage counseling service.
- The effect of random breath testing on road accidents.

Advantage and Disadvantage – The main advantage of this study design is that it can measure change in a situation, phenomenon, issue, problem and attitude. The disadvantage of this study depends upon the nature of the investigation, the study population and method of data collection.

(c) The longitudinal study design – To determine the pattern of change in relation to time, a longitudinal design is used. Example- When researcher wish to study the proportion of people adopting a programme over a period[3].

Advantage and Disadvantage –The advantage of this study is that it allows researcher to measure the pattern of change and obtain factual information, requiring collection on a regular or continuing basis, thus enhancing its accuracy.

The disadvantage of this study is that it can suffer from the conditioning effect. Conditioning effect is a situation where, if the same respondents are contracted frequently, they begin to know what is expected of them and may respond to questions without thought, or they may lose interest in the enquiry, with the same result.

(ii) Study designs based on the reference period: The reference period refers to the time-frame in which a study is exploring a phenomenon, situation, event or problem. Studies are categorized as:

- retrospective
- prospective
- retrospective-prospective

(a) The retrospective study design: It investigates a phenomenon, situation, problem or issue that has happened in the past. Some topics which are classified as retrospective studies as:

- The relationship between levels of unemployment and street crime.

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- The living conditions of Aboriginal and Torres Strait Islander peoples in Australia in the early twentieth century.

(b) The prospective study design: It refers to the prevalence of a phenomenon, situation, problem, attitude or outcome in the future. Experiments are usually classified as prospective studies. It is classified as follows:

- To measure the effects of a change in migration policy on the extent of immigration in Australia.
- To find out the effect of parental involvement on the level of academic achievement of their children.

(c) The retrospective- prospective study design: It focuses on past trends in a phenomenon and studies it into the future. Part of the data is collected retrospectively from the existing records before the intervention is introduced and then the study population is followed to ascertain the impact of the intervention. Examples of retrospective- prospective studies are:

- The impact of incentives on the productivity of the employees of an organization.
- The impact of maternal and child health services on the infant mortality rate.

(iii) Study designs based on the nature of investigation: Study designs based on the nature of investigation can be classified as:

- Experimental
- Non- experimental
- Quasi or semi-experimental

Suppose researcher want to test the impact of a particular teaching method on the level of comprehension of students. In this situation there is assumed to be cause-and-effect relationship. There are two ways of studying this relationship. The first involves the researcher introducing the intervention that is assumed to be the 'cause' of change, and waiting until it has produced or has been given sufficient time to produce the change. It starts from the cause to establish the effects; it is classified as an experimental study. The second consists of the researcher observing a phenomenon and attempting to establish what caused it. It starts from the effects to trace the cause; it is classified as non-experimental study. A semi-experimental study has the properties of both experimental and non-experimental studies[4].

ANALYSIS OF QUANTITATIVE DATA

For the analysis of quantitative data researcher should follow the following steps:

(i) Researcher should collect data for quantitative data and subsequently coded at different levels of numerical measurement.
(ii) Data are entered for computer analysis as a data matrix in which each column usually represents a variable and each row a case.
(iii) All data should be recorded using numerical codes to facilitate analyses.
(iv) For comparisons researcher should use existing coding schemes.
(v) For primary data pre-set codes on the data collection form to minimize coding after collection.
(vi) Enter codes for all data values, including missing data.
(vii) Data matrix should be checked for errors.
(viii) Initial analysis should explore data using both tables and diagrams. It shows:

- Tables to show specific values;
- Bar charts, multiple bar charts, histograms and occasionally, pictograms to show highest and lowest values;
- Line graphs to show trends;
- Pie charts and percentage component bar charts to show proportions;
- Box plots to show distributions;
- Scatter graphs to show relationships between variables.

(ix) Analysis may involve using statistics such as

- The mean, median and mode to describe the central tendency;
- The inter-quartile range and the standard division to describe the dispersion;
- Chi- square, Cramer's V and phi to test whether two variables are significantly associated;
- T-test and ANOVA to test whether groups are significantly different.
- Correlation and regression to assess the strength of relationships between variables;
- Regression analysis to predict values;

(x) Longitudinal data may necessitate selecting different statistical techniques such as:

- Index numbers to establish a trend or to compare trends between two or more variables measured in different units or at different magnitudes;

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- Moving averages and regression analysis to determine the trend and forecast[5].

WHEN DO WE USE QUANTITATIVE METHODS?

If we take a pragmatic approach to research methods, the main question that we need to answer is 'what kind of questions are best answered by using quantitative as opposed to qualitative methods?'

There are four main types of research questions that quantitative research is particularly suited to finding an answer to:

(i) The first type of research question is that demanding a quantitative answer. Examples are: 'How many students choose to study education?' or 'How many maths teachers do we need and how many have we got in our school district?' That we need to use quantitative research to answer this kind of question is obvious. Qualitative, non-numerical methods will obviously not provide us with the (numerical) answer we want.

(ii) Numerical change can likewise accurately be studied only by using quantitative methods. Are the numbers of students in our university rising or falling? Is achievement going up or down? We will need to do a quantitative study to find out.

(iii) As well as wanting to find out about the state of something or other, we often want to explain phenomena. What factors predict the recruitment of maths teachers? What factors are related to changes in student achievement over time? this kind of question can also be studied successfully by quantitative methods, and many statistical techniques have been developed that allow us to predict scores on one factor, or variable (e.g. teacher recruitment) from scores on one or more other factors, or variables (e.g. unemployment rates, pay, conditions).

(iv) The final activity for which quantitative research is especially suited is the testing of hypotheses. We might want to explain something – for example, whether there is a relationship between pupil's achievement and their self-esteem and social background. We could look at the theory and come up with the hypothesis that lower social class background leads to low self-esteem, which would in turn be related to low achievement. Using quantitative research, we can try to test this kind of model[6].

Problems one and two above are called 'descriptive'. We are merely trying to describe a situation. Three and four are 'inferential'. We are trying to explain something rather than just describe it.

As we mentioned above, while quantitative methods are good at answering these four types of questions, there are other types of questions that are not well suited to quantitative methods.

(i) The first situation where quantitative research will fail is when we want to explore a problem in depth. Quantitative research is good at providing information in breadth, from a large number of units, but when we want to explore a problem or concept in depth, quantitative methods can be too shallow. To really get under the skin of a phenomenon, we will need to go for ethnographic methods, interviews, in-depth case studies and other qualitative techniques.

(ii) We saw above that quantitative research is well suited for the testing of theories and hypotheses. What quantitative methods cannot do very well is develop hypotheses and theories. The hypotheses to be tested may come from a review of the literature or theory, but can also be developed by using exploratory qualitative research[7].

(iii) If the issues to be studied are particularly complex, an in-depth qualitative study (a case study, for example) is more likely to pick up on this than a quantitative study. This is partly because there is a limit to how many variables can be looked at in any one quantitative study, and partly because in quantitative research the researcher defines the variables to be studied herself, while in qualitative research unexpected variables may emerge.

(iv) Finally, while quantitative methods are best for looking at cause and effect (causality, as it is known), qualitative methods are more suited to looking at the meaning of particular events or circumstances.

What, then, do we do if we want to look at both breadth and depth, or at both causality and meaning? In those cases, it is best to use a so-called mixed-methods design, in which we use both quantitative (for example, a questionnaire) and qualitative (for example, a number of case studies) methods. Mixed-methods research is a flexible approach, where the research design is determined by what we want to find out rather than by any predetermined epistemological position. In mixed-methods research, qualitative or quantitative components can predominate, or both can have equal status.

IMPORTANCE OF QUANTITATIVE RESEARCH

- It is more reliable and objective.
- It can use statistics to generalize a finding.

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- It tests theories or hypotheses.
- It assumes sample is representative of the population.
- It often reduces and restructures a complex problem to a limited number of variables.
- It gives less detailed than qualitative data and may miss a desired response from the participant.
- It looks at relationships between variables and can establish cause and effect in highly controlled circumstances.
- It subjectivity of researcher in methodology is recognized less[8].

CONCLUSION

Quantitative research is structured and predetermined in terms of what researcher wants to find about and how. The process of organizing large amounts of data was once a cumbersome, time-consuming and tedious task. The advantage of computers has made the process much simpler and more efficient. One important tool is an electronic spreadsheet, a software program that allows a researcher to enter and then manipulate data in a two-dimensional table. For statistical several statistical analysis software packages such as NCSS, SPSS, SAS, EVIEWS etc. are available. Through these software packages it has become easy to get output and interpret them. Researcher should interpret the tables, diagrams and statistics correctly.

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