Paper :- Research Methodology

1. **Explain the concept of research. What are the important factors of an ideal research design.**

Answers: Research is an academic activity and as such the term should be used in a technical sense. According to Clifford Woody research comprises defining and redefining problems, formulating hypothesis or suggested solutions; collecting, organising and evaluating data; making deductions and reaching conclusions; and at last carefully testing the conclusions to determine whether they fit the formulating hypothesis. D. Slesinger and M. Stephenson in the Encyclopaedia of Social Sciences define research as "the manipulation of things, concepts or symbols for the purpose of generalising to extend, correct or verify knowledge, whether that knowledge aids in construction of theory or in the practice of an art."3 Research is, thus, an original contribution to the existing stock of knowledge making for its advancement. It is the persuit of truth with the help of study, observation, comparison and experiment. In short, the search for knowledge through objective and systematic method of finding solution to a problem is research. The systematic approach concerning generalisation and the formulation of a theory is also research. As such the term 'research' refers to the systematic method consisting of enunciating the problem, formulating a hypothesis, collecting the facts or data, analysing the facts and reaching certain conclusions either in the form of solutions(s) towards the concerned problem or in certain generalisations for some theoretical formulation.

IMPORTANT CONCEPTS RELATING TO RESEARCH DESIGN

Before describing the different research designs, it will be appropriate to explain the various concepts relating to designs so that these may be better and easily understood

1. Dependent and independent variables: A concept which can take on different quantitative values is called a variable. As such the concepts like weight, height, income are all examples of variables. Qualitative phenomena (or the attributes) are also quantified on the basis of the presence or absence of the concerning attribute(s). Phenomena which can take on quantitatively different values even in decimal points are called 'continuous variables'.* But all variables are not continuous. If they can only be expressed in integer values, they are non-continuous variables or in statistical language 'discrete variables'

2. Extraneous variable: Independent variables that are not related to the purpose of the study, but may affect the dependent variable are termed as extraneous variables. Suppose the researcher wants to test the hypothesis that there is a relationship between children's gains in social studies achievement and their self-concepts. In this case self-concept is an independent variable and social studies achievement is a dependent variable. Intelligence may as well affect the social studies achievement, but since it is not related to the purpose of the study undertaken by the researcher, it will be termed as an extraneous variable. Whatever effect is noticed on dependent variable as a result of extraneous variable(s) is technically described as an 'experimental error'. A study must always be so designed that the effect upon the dependent variable is attributed entirely to the independent variable(s), and not to some extraneous variable or variables.

3. Control: One important characteristic of a good research design is to minimise the influence or effect of extraneous variable(s). The technical term 'control' is used when we design the study minimising the effects of extraneous independent variables. In experimental researches, the term 'control' is used to refer to restrain experimental conditions.

4. Confounded relationship: When the dependent variable is not free from the influence of extraneous variable(s), the relationship between the dependent and independent variables is said to be confounded by an extraneous variable(s).

5. Research hypothesis: When a prediction or a hypothesised relationship is to be tested by scientific methods, it is termed as research hypothesis. The research hypothesis is a predictive statement that relates an independent variable to a dependent variable. Usually a research hypothesis must contain, at least, one independent and one dependent variable. Predictive statements which are not to be objectively verified or the relationships that are assumed but not to be tested, are not termed research hypotheses.

6. Experimental and non-experimental hypothesis-testing research: When the purpose of research is to test a research hypothesis, it is termed as hypothesis-testing research. It can be of the experimental design or of the non-experimental design. Research in which the independent variable is manipulated is termed 'experimental hypothesis-testing research' and a research in which an independent variable is not manipulated is called 'non-experimental hypothesis-testing research'. For instance, suppose a researcher wants to study whether intelligence affects reading ability for a group of students and for this purpose he randomly selects 50 students and tests their intelligence and reading ability by calculating the coefficient of correlation between the two sets of scores. This is an example of non-experimental hypothesis-testing research because herein the independent variable, intelligence, is not manipulated.

7. Experimental and control groups: In an experimental hypothesis-testing research when a group is exposed to usual conditions, it is termed a 'control group', but when the group is exposed to some novel or special condition, it is termed an 'experimental group'. In the above illustration, the Group A can be called a control group and the Group B an experimental group. If both groups A and B are exposed to special studies programmes, then both groups would be termed 'experimental groups.' It is possible to design studies which include only experimental groups or studies which include both experimental and control groups

8. Treatments: The different conditions under which experimental and control groups are put are usually referred to as 'treatments'. In the illustration taken above, the two treatments are the usual studies programme and the special studies programme. Similarly, if we want to determine through an experiment the comparative impact of three varieties of fertilizers on the yield of wheat, in that case the three varieties of fertilizers will be treated as three treatments.

9. Experiment: The process of examining the truth of a statistical hypothesis, relating to some research problem, is known as an experiment. For example, we can conduct an experiment to examine the usefulness of a certain newly developed drug. Experiments can be of two types viz., absolute experiment and comparative experiment. If we want to determine the impact of a fertilizer on the yield of a crop, it is a case of absolute experiment; but if we want to determine the impact of one fertilizer as compared to the impact of some other fertilizer, our experiment then will be termed as a comparative experiment. Often, we undertake comparative experiments when we talk of designs of experiments.

10. Experimental unit(s): The pre-determined plots or the blocks, where different treatments are used, are known as experimental units. Such experimental units must be selected (defined) very carefull.

2. What are the sources of hypothesis ? How many types of hypothesis are there ? Explain.

Sources of Hypothesis

There are several sources of hypothesis but some of the important ones are given as follows :

1. Previous study Previous knowledge and information regarding the topic of hypothesis will be extremely helpful to create a concrete hypothesis.
2. Personal experience If one has a personal experience regarding the topic of investigation, he/she can use that information in the hypothesis to make it more complete and good quality.
3. Thinking and imagination A researcher's creative thinking and imagination can sometimes aid in the formulation of a good hypothesis. A researcher's personal ideas and thinking abilities would result in a greater number of hypothesis formulations as well as control over the problem.
4. Scientific theory It would be extremely helpful to use scientific theories in hypothesis because it is capable of explaining all the facts related to the investigation.

Types of Hypothesis

There are basically several types of Hypothesis but some of the common and important type of formulation of Hypothesis are explained below:

1. **Simple hypothesis** It is also known as a basic hypothesis. It depicts the relationship between two variables, one of which is known as the independent variable or ‘cause' and the other as the dependent variable or ‘effect.'

2. **Complex hypothesis** A complex hypothesis is one that has multiple dependent and independent variables.

3. **Null hypothesis** It contradicts the empirical hypothesis because it asserts that there is no relationship between the dependent and independent variables. It basically says that the data and variables being tested do not exist.

4. **Alternative hypothesis** It is also referred to as a sustained hypothesis or a research hypothesis. To begin, numerous hypothesis are proposed. The most efficient one is then chosen from among them. Alternative hypothesis are further classified into four main types

1. Point alternative hypothesis
2. Non-directional alternative hypothesis
3. One-tailed directional hypothesis
4. Two-tailed directional hypothesis

5. **Logical hypothesis** It is logically verified, as the name implies. The verification process entails the following steps:

    - Agreement
    - Disagreement
    - Different points of view

6. **Empirical hypothesis** It is also known as a 'working hypothesis.' During the formulation phase, it is only an assumption, but once tested, it is no longer just an idea or notion. It is actually changing in relation to those independent variables.

7. **Statistical hypothesis** The statement could be logical or illogical, but if statistical evidence validates it, it becomes a statistical hypothesis.

OR

2. What are the essentials of a good questionnaire ?

Answers : To be successful, questionnaire should be comparatively short and simple i.e., the size of the questionnaire should be kept to the minimum. Questions should proceed in logical sequence moving from easy to more difficult questions. Personal and intimate questions should be left to the end. Technical terms and vague expressions capable of different interpretations should be avoided in a questionnaire. Questions may be dichotomous (yes or no answers), multiple choice (alternative answers listed) or open-ended. The latter type of questions are often difficult to analyse and hence should be avoided in a questionnaire to the extent possible. There should be some control questions in the questionnaire which indicate the reliability of the respondent. For instance, a question designed to determine the consumption of particular material may be asked first in terms of financial expenditure and later in terms of weight.

The control questions, thus, introduce a cross-check to see whether the information collected is correct or not. Questions affecting the sentiments of respondents should be avoided. Adequate space for answers should be provided in the questionnaire to help editing and tabulation. There should always be provision for indications of uncertainty, e.g., “do not know,” “no preference” and so on. Brief directions with regard to filling up the questionnaire should invariably be given in the questionnaire itself. Finally, the physical appearance of the questionnaire affects the cooperation the researcher receives from the recipients and as such an attractive looking questionnaire, particularly in mail surveys, is a plus point for enlisting cooperation. The quality of the paper, along with its colour, must be good so that it may attract the attention of recipients.

3. **What do you understand by factor analysis what is the importance of factor analysis in research ? Explain.**
Answers:

Factor analysis is by far the most often used multivariate technique of research studies, specially pertaining to social and behavioural sciences. It is a technique applicable when there is a systematic interdependence among a set of observed or manifest variables and the researcher is interested in finding out something more fundamental or latent which creates this commonality. For instance, we might have data, say, about an individual's income, education, occupation and dwelling area and want to infer from these some factor (such as social class) which summarises the commonality of all the said four variables. The technique used for such purpose is generally described as factor analysis. Factor analysis, thus, seeks to resolve a large set of measured variables in terms of relatively few categories, known as factors. This technique allows the researcher to group variables into factors (based on correlation between variables) and the factors so derived may be treated as new variables (often termed as latent variables) and their value derived by summing the values of the original variables which have been grouped into the factor.

Importance of factor analysis in research

(i) The technique of factor analysis is quite useful when we want to condense and simplify the multivariate data.

(ii) The technique is helpful in pointing out important and interesting, relationships among observed data that were there all the time, but not easy to see from the data alone.

(iii) (iii) The technique can reveal the latent factors (i.e., underlying factors not directly observed) that determine relationships among several variables concerning a research study. For example, if people are asked to rate different cold drinks (say, Limca, Nova-cola, Gold Spot and so on) according to preference, a factor analysis may reveal some salient characteristics of cold drinks that underlie the relative preferences.

(iv) The technique may be used in the context of empirical clustering of products, media or people i.e. for providing a classification scheme when data scored on various rating scales have to be grouped together

OR

What do you understand by the term 'Coefficient of correlation' prove that the coefficient of correlation lies be-tween –1 and +1.

A correlation coefficient is a statistical measure of the degree to which changes to the value of one variable predict change to the value of another. In positively correlated variables, the value increases or decreases in tandem. In negatively correlated variables, the value of one increases as the value of the other decreases. One example use case of a correlation coefficient would be to determine the correlation between unlicensed software and malware attacks.

Correlation coefficients are expressed as values between +1 and -1. A coefficient of +1 indicates a perfect positive correlation: A change in the value of one variable will predict a change in the same direction in the second variable. A coefficient of -1 indicates a perfect negative correlation: A change in the value of one variable predicts a change in the opposite direction in the second variable. Lesser d

Degrees of correlation are expressed as non-zero decimals. A coefficient of zero indicates there is no discernable relationship between fluctuations of the variables.

According to given in the question we have to prove that the coefficient of correlation lies between 1- and 1 so, first of all we have to understand coefficient of correlation as explained below:

Coefficient of correlation: The coefficient of correlation is the specific measure that quantifies the strength of the linear relationship between two variables given in a correlation analysis and the coefficient is symbolised by r in a correlation report.

Now, to prove that the coefficient of correlation lies between 1- and 1 we have to use the formula to find the correlation coefficient as given below:

Formula used:
$\Rightarrow r=\sum(xi-\bar{x})(yi-\bar{y})\sum(xi-\bar{x})2\sum(yi-\bar{y})2----------\sqrt{}.....(a)\Rightarrow r=\sum(xi-\bar{x})(yi-\bar{y})\sum(xi-\bar{x})2\sum(yi-\bar{y})2.....(a)$

Where, r is the correlation coefficient, xixivalues of the x-variable in the sample, $\bar{x}\bar{x}$is the mean of the values of the x-variable, yiyi values of the y-variable in the sample, and $\bar{y}\bar{y}$ is the mean of the values of the y-variable.

Now, we have to use the formula (A) above to determine the correlation coefficient which is basically r and we have to consider the obtained expression as expression (1)
Now, as we know that $X=(xi\bar{x})X=(xi\bar{x})$and $Y=(yi\bar{y})Y=(yi\bar{y})$so, we have to substitute these values in the expression (1) as obtained.

Now, we have to check for the inequality using schwarz's inequality according to which our obtained expression should be less than or equal to 1 and on solving further we will obtain the required value of r.
Complete step by step solution:

Step 1: First of all we have to use the formula (a) to find the correlation coefficient as mentioned in the solution hint.
$\Rightarrow r=\sum(xi\bar{x})(yi-\bar{y})\sum(xi\bar{x})2\sum(yi-\bar{y})2----------\sqrt{}\Rightarrow r=\sum(xi\bar{x})(yi-\bar{y})\sum(xi\bar{x})2\sum(yi-\bar{y})2.....(1)$

Step 2: Now, as we know that $X=(xi\bar{x})X=(xi\bar{x})$and $Y=(yi\bar{y})Y=(yi\bar{y})$ hence, on substituting the values in the expression (1) as obtained in the step 1
$\Rightarrow r=\sum XY\sum(X)2\sum(Y)2----------\sqrt{}\Rightarrow r=\sum XY\sum(X)2\sum(Y)2.....(2)$

Step 3: Now, to solve the expression (2) as obtained in the step 2 we have to use the swchwarz's inequality. Hence,

$\Rightarrow(SX2Y2)\leqslant\sum X2\sum Y2\Rightarrow(SX2Y2)\leqslant\sum X2\sum Y2$

Now, taking the terms to the left side of the expression,
⇒(SX2Y2)∑X2∑Y2⩽1⇒(SX2Y2)∑X2∑Y2⩽1

And as we know that,
⇒r=∑XY∑(X)2∑(Y)2−−−−−−−−−−−−√⇒r=∑XY∑(X)2∑(Y)2

Hence,
⇒r2=1⇒r=±1⇒r2=1⇒r=±1
Hence proved.

OR

4. Write a style of the research report.

Answers : The writing style in a research paper needs to be conventional and should abide by the guidelines provided by the institute. The aim of your writing should be to communicate properly to the audience. The text should feel organized and should flow smoothly. A good piece of writing follows a rhythm and flow and it has some sequence of ideas. A research paper should also be a smoothly written and well-organized piece of writing. Your's and other peoples' thoughts should be organized in a manner that creates harmony.

You should keep in mind that before finalizing your research paper you have to revise it several times. The reason for each revision can be different because there are so many components of writing that you have to check before finalizing it. You need to revise punctuations and grammatical mistakes, your flow of writing, the organization of ideas, and the wording or language. The revision or drafting gives you the confidence to present your research paper in front of the jury or the audience.

Writing style in a research paper

There are many conventional rules that you need to follow in order to write a good research paper. Keep in mind that a good research paper is not just what you have reviewed, compiled and concluded but it is also how you have presented it in your paper—-your writing style. The writing style in a research paper makes the first impression on the reader, it should be academic and conventional. There are certain general writing conventions that you can follow, your supervisor or teacher can help you with more details.

Clarity

Clarity is very important for any piece of academic writing and more for a research paper. A research paper is written for an audience so it should have clear wordings, sentences, and paragraphs to convey the message properly. Write in an active voice so that the readers can easily move along with your writing.

Specificity rather than general terms

The use of too many general terms in your research paper can make it less academic and less credible. The use of specific terms makes your research paper authentic and trustworthy. There are certain general notions we use in our daily life like young, old, wise, beautiful etc, avoid such general catchall terms that can make your research less credible. In a research paper, you should use terms that can be proven by some yardstick and that has a specific meaning.

Keep your audience in mind

While deciding about the writing style in a research paper you should also consider your audience. You do not need to use a lot of technical terms in a research paper that has to be read by an audience that does not understand it. Write in a manner that the audience can understand and comprehend.

Third Person

It is a general convention that a research paper is addressed in the “third person”. This convention is useful in many ways because in a research paper you do not want to make yourself the focus of the audience but you want the readers to focus on your findings. The quotations can be written in the language they have appeared on the source otherwise you can write everything else in the third person.

Straightforwardly

A simple straightforward language can help any type of audience understand your research paper easily. The goal of the research paper is to convey your message properly so your writing style should help you achieve your goal. When you write in a very decorative language your language itself becomes the center of attention and the reader could not focus on what you have described in the research paper.

Guard against biased wording

Guard yourself against biased wording, there are certain topics that are controversial and you might have an opinion but do not assert any opinion without any proof. Whatever you write in your research paper should have sound reason and should not be declared from your own past experiences. Your research paper should be a logical, reliable and credible source of information for the readers.