
UNIT 3 EXPERIMENTAL RESEARCH (FIELD EXPERIMENT)

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3.0 INTRODUCTION

In the previous unit you have studied about the concept, meaning, characteristics, steps, strengths and weakness of Ex-post facto research. Now we are going to read about the experimental research and field research. Research can be classified into four major categories: (i) laboratory experiments, (ii) experiment research (field experiments), (iii) field studies and (iv) survey research. In this unit you will learn about experiments, types of experimental research design etc. You will also learn about the criteria of a good experimental design.

3.1 OBJECTIVES

After reading this unit, you will be able to:

- Define experimental research and field experiments;
- Describe the strength and weaknesses of field experiments;
- Define research design and its objectives;
- Explain criteria for a good research design;
- Explain types of experimental research design and its uses; and
- Elucidate the characteristics of a good research design.

3.2 EXPERIMENTAL RESEARCH AND FIELD EXPERIMENTS

Every research requires the identification of the problem which itself is an important step in any research work. In the following section we try to provide how a research problem is identified and what is research especially experimental research etc.

3.2.1 Identifying the Research Problem

The first step in any research is to define the research problem.

This helps the investigator to focus on a more narrow research area to be able to study it appropriately. Some time it is seen that the research problem is often operationalisation and hence it is imperative to define how to measure the research problem.

The results in such cases will depend on the exact measurements that the researcher chooses and may be operationalised to test the conclusions of the research problem. After defining the research problem the investigator must formulate hypothesis. This can be positive or negative or it can be null hypothesis for the research problem.

3.2.2 Experimental Research

Experimental research is mainly used in science subjects such as physics, chemistry, medicine, biology etc. Experiment requires two variables, one independent variable and the other dependent variable. It is important that in experimental research the independent variable is manipulated and the effect of manipulation is observed on the dependent variable. All other extraneous factors are completely controlled within the laboratory. It is based on research design which uses manipulation and controlled testing to understand the causal processes. Generally, we can manipulate one or more variables to determine their effect on a dependent variable. In other words it is a systematic and scientific approach to research in which the researcher manipulates one or more variables, and controls and measures the other variables.

3.2.3 Field Experiments

Field experiments on the other hand refer to experiments conducted in real life situations. Here the control of extraneous factors is not possible as it is a natural setting and there is no way to control any factor so absolutely as one does in the laboratory experiments. Hence in field experiments we take two groups matched for a number of factors such as age, sex, education, socio-economic status etc. Both these groups are in real life setting and thus are subjected to similar extraneous variables and thus the experimenter can observe the effects of his manipulation on one group and compare with the other group which is not subjected to any intervention. Take for example that the researcher wants to study the effects of different methods of teaching (e.g. lecture vs. tutorial). The school is the natural setting from where the researcher randomly selects 100 children from a particular standard (5th standard) and randomly assign them to two groups, viz., experimental (50 children) and control group (50 children). To the experimental group children the researcher uses the lecture method and to

the control group tutorial method. Then the effects of the academic performance of these children are compared before and after the introduction of the methods of teaching. If there is a difference in the academic performance of children in regard to the two methods of teaching, the experimenter can conclude that a particular method of teaching (e.g. tutorial) is more effective than the other method (lecture).

There are considerable differences between the experimental research and field experiments which are given in the table below:

Table 3.1:Differences between experimental research and field experiments

Experimental research	Field experiment
1) The subjects are homogeneous.	1) The subjects may vary in a number of characteristics.
2) The experimental subjects are in controlled conditions.	2) The subjects are not in controlled but in natural settings and conditions.
3) One experimental group is taken and subjected to the manipulation of the independent variable (Intervention) and see the effects of it on the subjects of the experimental group.	3) Two groups matched for certain basic characteristics which may confound the results are taken and one is subjected to intervention while the other is not. At the end the results of two groups on a dependent variable are compared to see the effect of intervention.
4) The cause effect relationship can be clearly established as in the laboratory experiment all extraneous factors are controlled and the pure effects of intervention can be studied.	4) The cause effect relationship can be established to quite an extent but not to the same accuracy of experimental research as extraneous factors are not controlled as in the laboratory.
5) Prediction based on the experiment is possible and one can even accurately predict a phenomenon given the same conditions.	5) Prediction is possible to certain extent as the real life situation may not be the same in all places where the study is conducted.
6) The experiment is always quantitative in terms of results.	6) The field experiment is both qualitative and quantitative in terms of results.
7) The experiment is replicable.	7) The field experiments are replicable but may require modifications in terms of the matching factors.

We can use the experimental research in different ways such as:

- There is time priority in a causal relationship (cause precedes effect)
- There is consistency in a causal relationship (a cause will always lead to the same effect)

- The magnitude of the correlation is great.

The word experimental research has many meanings.

This is an experiment where the researchers manipulate one variable, and control the others variables. It can have a control group for comparison purposes, but invariably as the experimental situation is highly controlled in the laboratory, one group is sufficient for the experiment. The subjects are randomly assigned to experimental conditions if there are more than two experimental conditions. The researcher must be very clear as to what variable(s) need to be tested and measured.

Field experiments are also called as quasi experiments, as the researcher actively influences something to observe the consequences.

When dealing with human subjects it is always possible and advisable to use field experiments or quasi experiments. This is so because when certain phenomenon and its changes are observed in natural settings, it provides considerable inputs, information and knowledge about the phenomenon in real life situation. If society has to progress this type of research is important.

3.3 STRENGTHS AND WEAKNESSES OF FIELD EXPERIMENTS

The advantages or the strength of field experiments are given below:

- 1) It is useful to behavioural and social scientists such as the social psychologists, sociologists and educationists.
- 2) It is an appropriate method for studying complex social influences, processes, and changes in life like setting. The dynamics and small groups have been fruitfully studied by this method.
- 3) It is most suited method to the testing of theory and to the solution of practical problems.
- 4) It is suited to testing broad hypotheses.
5. Flexibility and applicability to a wide variety of problems are also possible by this method.

Weaknesses or limitations of field experiments are as given below:

- 1) The chances of extraneous variables confounding the research findings are more in field experiments due to the uncontrolled extraneous variables.
- 2) One of the problems is the negative attitude of researcher.
- 3) Consent and cooperation of concerned subjects and the institutional authorities, (the institution where the research is to be conducted) is required for the field experiment.
- 4) This type of research faces lack of precision problem.

3.4 CONSTRUCTING THE FIELD EXPERIMENT

Before constructing an experiment research there are various aspects to consider.

- 1) *Planning:* A good planning always ensures that the research is carried out properly and in proper conditions with appropriate tools and measures.
- 2) *Sampling:* One of the best ways to ensure that the research is conducted systematically and appropriately is to have a proper selection of sample. **Sampling** is taking any portion of a population or universe as representative of that population or universe. Sample can be classified into *probability* and *non probability sample*.
Probability samples use some form of random sampling in one or more of their stages. Non probability samples do not use random sampling; they thus lack the virtues being discussed. Still, they are often necessary and unavoidable.
The probability sampling includes stratified, cluster, systematic and random sampling method.
The non probability sampling includes quota, purposive and accidental sampling method.
- 3) *Research design:* Every research requires a blue print of the research work that will be carried out. Where the experiment will be conducted, that is the setting, who will be the subjects, that is the sample, how it will be conducted, what instruments will be used, what will be manipulated, what will be measured etc. The experimental design must also provide for the number of subjects that will be in the experiment and the number of subjects who will be considered as the control group.
- 4) *Tools of data collection:* What are the tools that will be used, how the results will be measured, and what statistical tools will be used etc.
- 5) *Procedure:* Once the subjects have been identified and setting has been decided where the experiment will be conducted, the next step is to get permission from authorities to use the setting. Having obtained the permission let us say from school authorities to conduct field experiment regarding which method of teaching leads to better academic performance, the subjects will be selected from a certain class. Let us say we choose children from class 5 all sections. Let us say there are 200 children. We need only 100 children and so from each of the 4 sections we take 25 out of 50 children randomly. From these 100 children, we again take 50 for control group and another 50 for experiment. This again we select randomly. Both the groups children are tested for academic performance and their scores are recorded. Then, to the experimental group of children we give instruction through lecture method and to the other group through tutorial method. After training for 1 month, the academic performance of both the groups are retested. Now the difference in the second testing for the two groups will indicate which method is more effective. Within the group also the pre and the post test performance could be measured and the difference noted as improvement or decrease in academic performance.
- 6) *Statistical analysis:* Appropriate statistics such as the t test will be used to find if the differences obtained between the two groups as well as between the pre and the post tests are statistically significant.

The above 6 steps are the ways in which the field experiment is conducted.

3.5 RESEARCH DESIGN

Research can be explained as Re + Search= again + explore, to explore the relationship between different variables. Research is a scientific methodology in a controlled setting. Observation and experiments are the basic scientific tools of research which gives the scientific status to the field of psychology. It is a systematic attempt to study.

The controlled observation means that we have to see the impact of independent variable and dependent variable under specific controlled condition and we have to manipulate the independent variable in a systematic way and record the relative changes in the dependent variable. For controlled observation it is essential for one to manipulate independent variables with certain controls and the principles of randomisation should be followed. In other words a good research design is that in which we can forecast or give a solution to the problem.

According to Kerlinger (1998), Research design is the

- i) *plan,*
- ii) *structure, and*
- iii) *strategy of investigation.*

The research design is conceived so as to obtain answers to research questions and to control variance. The above three aspects of research design are being explained below:

- i) Plan is the overall scheme or programme of the study. It can be in the form of proposal of the study.
- ii) Structure of the research is more specific. It is the outline, the scheme, the paradigm of the operation of the variables.
- iii) Strategy is more specific than plan. The method that we want to use to collect the data and analyse or interpret the data. The strategy also implies as to how the research objectives will be reached and how the problems encountered in the research will be tackled.

According to Myers (1980), the design is the general structure of the experiments, not its specific content.

Self Assessment Questions

State whether the statement is *True or False.*

- 1) The selection of a problem is the last step of research ().
- 2) After defining the research problem the hypothesis must be formulated ()
- 3) Experimental research use in science subjects ()
- 4) Field experiments refer in the real life situation ()
- 5) Flexibility and applicability is a weakness of field experiments ()
- 6) Structure is more specific than plan ()

3.6 OBJECTIVES OF RESEARCH DESIGN

The research design has two basic objectives:

- i) **To provide answers to research questions** – The investigator has the answer to research questions in the form of validity, objectivity, accuracy and economical aspects of the research concerned. The researcher is not inclined to answer the research questions in a layman's term but answer in terms of validity, objectivity, accuracy etc. For example, the factorial design is a design which deals with the interaction effect in an economical way. Different research problems require different research designs.

Research problems can be and are stated in the form of hypotheses and the research designs are carefully worked out to yield dependent and valid answers to the research questions epitomised by the hypotheses. If the hypothesis discussed is one of interaction, a factorial design is evidently more appropriate (Analysis of variance is used in factorial design). The adequate planning and executed design helps to make efficient observation and draw appropriate inferences from the result.

An adequate research design would suggest the number of observations that have to be made, and which variables are active and which are attributed etc. According to the adequate research design we can then act to manipulate the active variables and to categorize the attribute variables.

- ii) **To control variance under study**– The score deviation is called variance and these variances must be controlled. The investigators follow certain principles for constructing an efficient research design.

Principle 1: To maximise the variance of variable

The main concern of the investigators is to maximise the variance in a systematic way. It is called the *experimental variance*.

The Variance of the dependent variable (DV) is influenced by the independent variable (IV). The main task of an experimenter is to maximise the variance.

If the independent variable does not vary substantially, there is little chance of separating its effect from the total variance of the dependent variable.

Hence it is necessary to give chance to the variance to show itself separately from the total variance. The purpose of a good research design is to maximise systematic variance.

Principle 2: To control extraneous variance

The purpose of the effective research design is to control extraneous variance which may confound the results of the experiment.

There are three ways to control extraneous variables confounding the results:

- i) to eliminate the variable as a variable;
- ii) to control extraneous variance through randomisation,
- iii) to build it right into the design as an independent variable.

Our aim is to minimise error variance from the research study. It is unpredictable. Some time we see the impact of constant error in the study. For example, individual differences and intelligence. This type of error affects adversely the research findings.

We can minimise the error variance by two basic methods:

- i) the reduction of errors of measurement through controlled conditions and
- ii) an increase in the reliability of measures.

3.7 CRITERIA FOR A GOOD RESEARCH DESIGN

For research design to be considered good, we must ask the following questions?

- 1) Does the design give specific answer to the research question?
- 2) Does the design adequately test the hypothesis?
- 3) Does the design present the appropriate question/problem?
- 4) Does the design adequately control the extraneous independent variable?
- 5) Can we generalise the results of a study to other subjects?
- 6) Does the design give the internal and external validity?

3.8 TYPES OF EXPERIMENTAL RESEARCH DESIGNS

The pure experimental research is not always possible in behavioural and social sciences due to the difficulty in controlling all the variables and influences from outside of and inside the individuals which is possible only within a laboratory situation. The experimental situations in which experimenter can manipulate the independent variables and has liberty to assign subjects randomly to the treatment groups and the control groups may not be that possible or accurate. Also the control of the extraneous variables is not possible and children in a classroom keep getting stimulation from various sources. Hence one has to take such designs in which to the extent possible randomisation and control of variances are possible.

To conduct the field experiments there are experimental designs available and these are being discussed below. Let us consider the different types of designs:

3.8.1 Single Case Experimental Design

The single case experiment is useful in clinical research especially in the area of behaviour modification. This design provides us the detailed information of human behaviour which is not possible in the group designs. Repeated measurements are also possible and we can note subtle changes in the subjects' behaviour.

The design however is not very suitable for generalising the findings to the larger population as it is based on a small number of subjects and who have not been randomly selected.

3.8.2 Quasi-Experimental Design

All experimental situations in which the researcher / experimenter does not have full control over the assignment of experimental units randomly to the treatment conditions or the treatment cannot be manipulated, are collectively called quasi-experimental designs.

There are the various experimental situations in which the experimenter does not have full control over the situations. The plan of such experiments constitutes the quasi- experimental design.

Though, quasi-experimental investigations have limitations, nevertheless these have advantages in certain respects. It is possible to select subjects randomly as pointed out earlier in the case of selecting students from class 5 of a school and randomly assign them to the experimental and control groups respectively. We conduct the experiment in natural and real life setting and so it has certain amount of realism and the information so gathered can also be to quite an extent generalised. It can provide answers to several kinds of problems about past situations and those situations which cannot be handled by employing pure experimental research design.

3.8.3 Experimental Design

This type of design is generally conducted in the laboratory with complete control over all variables and all subjects. In this type of research design one can assign subjects randomly to the treatment groups and one can manipulate the independent variable and study the pure effects of the manipulation on the dependent variable. Also, in such experiments, the experimenter has complete control over the scheduling of independent variables. In such experiments one can use high level advanced statistical methods to analyse the data. For example, the *F* test, Correlation and regression and multiple regression analysis, partial correlation etc. There are also three types of designs that we can use within the experimental design and these are (i) Between subjects design (ii) Within subject design and (iii) Mixed design (iv) classical pre test post test design (v) Solomon four groups design (vi) Factorial design. These are presented in detail below:

- i) *Between subject design* – Each subject is observed only under one of the several treatments conditions.
- ii) *Within subject design or repeated measures design* – Each subject is observed under all the treatment conditions involved in the experiment.
- iii) *Mixed design* – Some factors are involved from between subjects and some are from within subjects.
- iv) *Classical pretest-post test* – The total population of participants is randomly divided into two samples; the control sample, and the experimental sample. Only the experimental sample is exposed to the manipulated variable. The researcher compares the pretest results with the post test results for both samples. Any divergence in the results between the two samples is assumed to be a result of the experiment.
- v) *Solomon four group design* – The sample is randomly divided into four groups. Two of the groups are experimental samples. Two groups experience no experimental manipulation of variables. Two groups receive a pretest

and a post test. Two groups receive only a post test. This is an improvement over the classical design because it controls for the effect of the pretest.

- vi) *Factorial design* – This is similar to a classical design except additional samples are used. Each group is exposed to a different experimental manipulation.

All the above designs of research can be used in experimental research work for analysing the data. On the other hand these designs are not suitable for conducting field experiments though one could use them with certain modifications.

Having presented the experimental research and field experiment, the following section presents in detail the basic issues related to research design.

Self Assessment Questions

Fill in the blanks

- 1) Research problem can be stated in the form of
- 2) Research is a methodology in a controlled setting.
- 3) The main task of an experimenter is to maximise the
- 4) The experiment is useful in clinical research.
- 5) design is generally conducted in the laboratory with complete control over all variables and all subjects.

3.9 LET US SUM UP

The key points of our discussion in this unit have been as given below:

Experimental research is a systematic and scientific approach to research in which the researcher manipulates one or more variables, and controls and measures the other variables.

Research is a scientific methodology in a controlled observation and experiments are the basic tool, which gives the status of science of psychology. It is a systematic attempt to study.

The research design has two basic objectives: (i) To provide answers to research questions and (ii) To control variance under study.

Field experiment on the other hand is carried out in real life situation and deals with real life related problems and thus is important for our society.

It helps us to improve our everyday living lives and it is also able to predict the many important social phenomena. Typically, an experiment is constructed to be able to explain some kind of causation.

It has some strength and weakness of field experiment. The three types of experimental research design are (i) single case experimental design, (ii) quasi-experimental design, (iii) experimental design.

3.10 UNIT END QUESTIONS

- 1) Define experimental research.
- 2) Differentiate between experimental research and field experiment.
- 3) Define research design.
- 4) Explain two basic objectives of research design.
- 5) Explain the importance of field experiment in research.
- 6) How can we check the criteria of a good research design?
- 7) What are the three types of experimental research, explain each.
- 8) Explain Solomon four group designs.

3.11 SUGGESTED READINGS AND REFERENCES

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Myers, A. (1980). *Experimental Psychology*., New York: D. Van Nostrand Co.

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Shavelson, R.S. (3rd edition) Prentice Hall New York.

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3.12 ANSWERS TO THE SELF ASSESSMENT QUESTIONS

True or False

- 1) False, 2) True, 3) True, 4) True, 5) False, 6) False

Fill in the blanks

- 1) hypothesis, 2) scientific, 3) variance, 4) single case, 5) experimental.