UNIT 3 RESEARCH DESIGN

Objectives

After studying this unit you should be able to:

- Explain the concept and importance of research design in the context of marketing research problems
- Discuss the causality factor in the context of research design
- Describe the various kinds of research designs and their applications for different research situations.

Structure

3.1 INTRODUCTION

In the last two units you studied about the nature and importance of marketing research. In this unit you will learn about the first phase in planning the research project, which is formulating a research design. Based on causality, research designs have been divided into four categories of exploratory, descriptive, quasi-experimental and experimental designs. While exploratory and descriptive studies provide information on events and attributes from which inferences can be drawn, they can only offer tenuous conclusions. In order to draw conclusions it is important to formulate quasi-experimental or experimental designs. This units describes different types of designs within the four categories mentioned above as well as the marketing situations where these designs could be most appropriately applied.

3.2 RESEARCH DESIGN-MEANING AND IMPORTANCE

The research design is a comprehensive master plan of the research study to be undertaken, giving a general statement of the methods to be used. The function of a research design is to ensure that requisite data in accordance with the problem at hand is collected accurately and economically. Simply stated, it is the framework, a blueprint for the research study which guides the collection and analysis of data. The research design, depending upon the needs of the researcher may be a very detailed statement or only furnish the minimum information required for planning the research project. To be effective, a research design should furnish at least the following details.

a) A statement of objectives of the study or the research output.

b) A statement of the data inputs required on the basis of which the research problem is to be solved.

c) The methods of analysis which shall be used to treat and analyse the data inputs.

Let us try to understand the elements through an example:

A newly opened supermarket sells a broad line of merchandise ranging from provision to household appliances and kitchenware. The general manager (sales) believes that the total profits of the supermarket can be enhanced by getting people to buy in larger quantities which could be achieved by offering attractive cash discount on bigger purchases. As the other executives are doubtful about this. The hypothesis can be tested by carrying out a marketing research exercise.

1) The objective is to calculate the margin earned on sales when this discount is offered and compare it with the margin when discount is not being offered.
2) The data to be collected over a period of time
    a) Sales in rupees to a selected sample of customers during the period when the discount is offered.
    b) Sales in rupees to the same customer when the discount is not being offered.
    c) The average order size in the two periods.
    d) The average margins earned during the two periods.
    e) The cost of promotional inputs regarding the discount.
3) The analysis of the data will be
    a) Sales in rupees in period I minus those in period II.
    b) Subtract cost of incentives.
    c) Also subtract cost of promotional inputs.

The importance of research design lies in the fact that it makes a statement of what is to be done in order to achieve the research objectives and how it is to be done. It is an expression of what is expected of the research exercise in terms of results and the analytical input needed to convert data into research findings.

The research design furnishes a clear idea as to the activities that would need to be undertaken in order to achieve the research objective. It is therefore, helpful if the research design after being finalised is put in writing to enable the researcher to have a frame of reference and prevent the study from deviating.

At the stage of analysis and interpretation also, the research design helps in providing direction to the computation and interpretation process to arrive at solution and recommendations. This is however not to suggest that a design is a rigid straitjacket to which the study must always conform. The research design only represents an expectation of likely results but as the study proceeds, many unexpected results may come forth which may necessitate framing of new hypothesis or at least modifying some. The research design is only a guiding and not a limiting framework for research study.

3.3 CAUSALITY: THE BASIS OF CLASSIFICATION OF VARIOUS TYPES OF RESEARCH DESIGNS

There are four types of research designs which are broadly classified as:

1) Exploratory Designs
2) DescriptiveDesigns
3) Quasi-Experimental Designs
4) Experimental Designs

These designs will be discussed in detail very shortly. However, one point may be noted that the basis of classification of various types of research designs is causality, which is the subject matter of discussion of this section.

Let us start our discussion with an example. Suppose the sales manager of a company manufacturing table fans carried out a training programme for its salesmen operating in a state. Three months after the training programme, it was observed that there was an

increase in sales in that state by 40 per cent. The sales manager claimed that the training programme was effective and therefore, the salesmen operating in other states should also undergo the same training programme. We can see that the sales manager is inferring that the training programme has resulted in a sales increase of 40 per cent. That is to say that training programme is the cause of increased sales.

The sales manager is referring to sales training as a causal variable and the sales increase as the effect variable. We may now ask a question whether this statement is valid? Has the sales training really resulted' in increase in sales? The possible answer is that we cannot say with certainty that the sales training has caused the increase in sales. There could have been other factors which might have been responsible for the increased sales. Increase in sale might have been caused by decrease in the price of the table fans, a strike at a competitor's factory, increased product penetration in the distribution channel, weather conditions, etc. Therefore, it is very essential that the sales manager should know that conditions under which proper causal statements can be made. To be able to make any causal statements, one should ensure whether the following three conditions are met:

i) We must have very strong evidence to say that there exists a strong association between an action (causal variable) and the ultimate outcome (effect variable).

ii) The other condition for the causal relationship is that the action (causal factor) must precede the observed outcome (effect variable).

iii) We must have strong evidence to say that there were no other possible factors (causal factors) which could have resulted in the observed outcome.

The first condition is that of concomitant variation. Concomitant variation is the extent to which a cause, X, and effect Y occur or vary together. In our example, the sale training programme and increase in sales would need to occur together. To be able for us to conclude causality, the condition of concomitant variation between variables in question must exist. However, it may be worth mentioning that a strong association between two variables does not constitute a proof of a causal relationship, It is quite likely that the strong association between two variables may be as a result of random variation or both the variables may be influenced by an extraneous variable.

The second condition for causal relationship is the requirement that the causal factor (action) must occur either prior or simultaneously with effect factor(outcome). However, the fact that the action precedes outcome does not establish causal relationship. It might be a mere coincidence that sales training took place prior to increase in sales of the table fans. There is also a possibility that sales training and increase in sales of table fans are strongly associated. This however, does not prove the existence of causal relationship.

The third condition for inferring causation is the absence of other possible causal factors. This means that all other possible factor influencing the outcome (in our case increase in sales of table fan) are either absent or are kept constant. It is only then we could say logically that the sales training has resulted in increase of sales of fable fans. In reality, it is impossible to find the absence of other factors or to hold some factors constant. For example, we know that the sales of table fans is influenced by weather conditions. Is it possible to keep weather conditions constant? Or can we be sure that the competitor would not change the price? The obvious answer is "No".

In a case where the outcome is completely determined by only one causal factor, we can say that causal factor is the deterministic cause of the outcome. That is the `causal factor' in this case is both necessary and sufficient condition for the occurrence of outcome. However, in a situation where the outcome is influenced by a host of causal factors, any of the causal factor is the probablistic cause of the outcome. That is to say it is a necessary but not a sufficient condition for the occurrence of outcome.

There are three possible ways to control the influence of extraneous variables. Firstly, we may physically control the extraneous variable. For example, a company trying to study the impact of two different packagings of a product on sales may control the

extraneous variable like price by keeping it constant for both packaging containing the same amount and quality of good. The second way to control the effect of extraneous variables if the physical control is not possible is to randomize the assignment of treatments to test units. The third way to control the extraneous variables is through the use of experimental designs, the discussion of which -would follow in the subsequent sections. If the control of extraneous variable on the dependent variable is not possible by any one of the method, we say that experiment is confounded and such an extraneous variable is called a confounding variable.

Activity 1

Suppose the manufacturer of a particular brand of a desert cooler decreased the price of his sets by 5%. It was observed that there was an increase in sales during the succeeding four months as compared to what the company had prior to price reduction. Has the price reduction increased the sales? Justify your answer.

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3.4 EXPLORATORY RESEARCH DESIGN

Ideally all marketing research projects must start with an exploratory research as this helps in providing a sharper focus of the situation and a clearer definition of the problem at hand. The exploratory research design, as the name suggests, involves getting a feel of the situation and emphasises a discovery of ideas and possible insights that may help in identifying areas of further rigorous study. For example a food product manufacturer, wanting in introduce a breakfast cereal may be in knowing the desirable attributes of such a product before really defining the product concept. The main objective of the exploratory research is to fine tune the broad problem into specific problem statement and generate possible hypotheses. It therefore, gives useful direction for farther research. The exploratory studies are mainly used for:

1) Providing information to enable a more precise problem definition or hypothesis formulation.

2) Establishing research priorities.

3) Giving the researcher a feel of the problem situation and familiarising him with the problem.

4) Collecting information about possible problems in carrying out research, using specific collection tools and specific techniques for analysis.

Since exploratory studies are not conclusive studies, the design of the study is highly flexible and informal. However, rarely ever does formal design exist in case of exploratory studies. Structured and/or standardised questionnaires are replaced by judgement and intuitive inference drawing on the basis of collected data. Convenience sampling rather than probability sampling characterises exploratory designs. The generally used methods in exploratory research are:

a) Survey of existing literature

b) Survey of experienced individuals

c) Analysis of selected case situations.

Survey of existing literature

Published literature presents a very economical source of study for the purpose of hypothesis generation and problem definition. A large variety of published and unpublished data is available through books and journals, newspapers and periodicals, government publications and individual research projects as well as data collected by trade associations. A lot of data is also generated internally in the company and some of it could be relevant to given problem situations. You will read more about types of secondary data and their use in marketing research in the unit on Data Collection. While survey of existing literature may not provide solutions to the research problem, it can certainly provide direction to the research process.

Survey of experienced individuals

Clue to solving many a marketing problems can be had by talking to individuals who have expertise and ides about the research subject. These individuals could be top executives, sales managers, sales men and channel members who handle the product or related products and consumers or potential consumers. The information collection exercise does not involve a scientifically designed survey, it is merely an attempt together all possible information about the subject of research from people who have specific knowledge about it. The success of this type of experience survey depends upon the freedom of response given to the respondent as well as upon the expertise and communication ability of the people questioned. However, at this stage, since the researcher also has very limited experience with the research problem, he may not be able to elicit very valuable responsers from the individulse.

Analysis of selected cases

This method involves the selection of a few extreme examples reflecting the problem situation and a thorough analysis of the same, In certain cases this sort of study may help in identifying the possible relationships that exist between the variables in a given marketing problem situation. The emphasis in this type of study is upon understanding the research subject as a whole. For example, a company is interested in finding out the reasons for the wide variation in sales productivity of its salesmen, as an exploratory study it could thoroughly analyse the case of some of its best and some of its worst salesmen. This exercise may help in identifying possible relationships between demographic and /or personality variables which may affect variation in sales productivity. The relationships, their extent and direction can then be measured using conclusive research designs.

Activity 2

Study three marketing, research projects conducted in your organisation or any other organisation that you aft familiar with:

1. What sort of preliminary research preceded these projects:

   A) .....

   B) .....

   C) .....

2. What was the type of exploratory design used for this preliminary research.?

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3.5 DESCRIPTIVE RESEARCH DESIGN

Primarily in use for preliminary studies, this type of designs are employed to facilitate description and inference building about population parameters and the relationship among two or more variables. Description or inference could be' quantitative or qualitative in nature. Descriptive designs only describe the phenomenon under study attempting to establish a relationship between factors. The data collected may relate to the demographically or the behavioural variables of respondents under study or some situational variables. For example, descriptive research design could be suited to measure the various attributes of successful sales people, or evaluate a training programme or a retailing situation.

The design could be used to study how customers behaved when a new sales promotion programme was introduced. It does not, however, determine the extent of association between the different variables i.e. the income and age of people as associated with response to the sales promotion. Descriptive design can however, be used to draw inferences about the possible relationships between variables.

As descriptive designs are aimed only at providing accurate descriptions of variables relevant to the problem under consideration, they are generally used for preliminary and explorative studies. Very often however, the decision makers choose to accept descriptive data which would permit inference drawing about causality between variables. They may not want to or may not be able to afford experimental studies in terms of time involved and as such descriptive design may at times be used for conclusive studies also.

Descriptive designs are a very frequently used, perhaps the most commonly used category of research design. In short descriptive research can be used for the following purposes.

a) To describe the characteristics of certain groups of interest to the marketer e.g. users of the product, potential users, non users, possible receivers of promotional communication by the company and so on.

b) To estimate the proportion of people in a given population who behave in a certain way for example the proportion of consumers who are prone to deals.

c) To make specific predictions for specified future periods.

d) To develop inferences whether certain variables are associated, for example income and shopping place preference.

In comparison to an exploratory research study, the descriptive study is more formal and less flexible. As the descriptive design in directed at collecting qualitative and quantitative data to enable, description of variables, it involves formulation of more specific hypothesis and testing them through statistical inference of discipline designs may include case research designs, longitudinal and cross sectional designs as well as focus group studies. Of these we shall discuss the panel, cross-sectional and focus group designs.

Panel Research Design

Also known as longitudnal research, the panel design involves the continual or periodic information collection from a fixed panel or sample of respondents. The elements of this panels may be retail outlets, deal9rs, consumers or just individuals. A panel is expected to be constant over time and adjustments are made to provide for dropouts and representativeness. A continual measurement of variables relating to the elements of the panel provides a very good idea of their response patterns and may provide clues for future behaviour .The longitudal analysis used involves repeated measurements of the same variables to facilitate a variety of inferences to be drawn about the behaviour of the elements of the panel. Recently the omnibus panel has also been devised where though a fixed sample of elements is maintained but the information collected from the sample members may vary over time or vary between individuals. For example, at one time information on attitudes with respect to a proposed packaging change may be

sought while at another time the information on attitudes with respect to a proposed packaging change may be sought while at another time the information may pertain to respondent reaction to an advertising copy.

Though relatively new in India, panel studies are being increasingly used by research agencies to enable a continual tapping of consumer attitudes, developing buyer profiles, brand behaviour in the market and predicting changes in market position of different brands.

Cross Sectional Design

The cross sectional study is aimed at taking a one time stock of the situation or the phenomenon in which the decision maker is interested. Cross sectional designs give the picture of the situation at a given point of time. For example, if the marketer is interested in knowing the market position of the company vis-a-vis its competitors or the number of people who recall the advertisement of the company out of the total population of viewers, a cross sectional design could be employed to gather information. Since the data gathered in this type of design consists of responses from a sample which contains a large number of sources, it provides a "Cross section" of the situation. In quite a few marketing situations cross sectional data furnish good inputs. Consider the following examples:

- An instant food manufacturing company has provided display racks for its retailers so that its product can be prominently displayed. Before embarking upon a second round of distribution of these racks, it wants to find out how many retailers are actually using the racks and the type of retail establishments that are using them.

- An electronics goods company which provides high quality after sales service to its customers and wants to evaluate the customer response to it.

None of the examples given above seek to establish causal relationships. Cross sectional studies may however uncover relationships, which may be conclusively tested by using the experimental designs.

The cross sectional studies may have an informal design rather than an explicitly described design. When the latter is the case, the design only includes the nature and the source of data, the analytical methods and the nature of the expected results.

Focus Groups

The focus group, an informal design, basically consists of bringing together a group of people to have an extensive, free flowing discussion relating to their experiences or opinion.

The usual procedure is to tape record the conversations and later analyse them. The discussion in the focus group is led and guided by a moderator, who has a fairly standardised way of establishing a relaxed and congenial atmosphere, initiating the discussion and keeping it on the desired focus. The purpose of the focus group design is exploratory, seeking to get respondent opinions of experiences on a particular subject matter. The objectives of the focus group study are clearly specified, but there is no structure of the discussion pattern. In fact, a distinct effort is made to keep the discussion free flowing. The success of the focus group design depends upon a well trained and disciplined moderator who can keep the discussion on to the desired course and elicit responses from all the participants of the group. Consider the following example.

An established toilet soap manufacturer wants to change the advertising theme for his prestigious brand of soap, so as to strengthen its image of a luxury soap using a focus group of young women college students, housewives and some executives. A free wheeling discussion about expectations from toiletries in general and bathsoap in particular was generated and recorded to give valuable ideas and insights for the creative strategy to be used for the advertising theme.

Focus groups serve as excellent tools for preliminary research as they reveal problems and opportunities which emanate from the free and frank discussions by the consumers about their problems, fancies, expectations, satisfactions and dissatisfactions. They are easy to organise and interesting to analyse, and become very good sources of ideas for campaigns, product improvement or repositioning, desirability of deals, dealer selection and so on. The danger associated with focus group lies in the possibility that once analysed, the focus group data may be used for conclusive purposes, to draw conclusions or how people behave. The size of the focus group being very small, it is dangerous to draw conclusions about consumers' behaviour only on the basis of the recorded and duly analysed discussions.

Activity 3

Which of the following are true about a research design:

		T	F
a)	A research design helps to keep the study execution in line with the original purpose and intentions.	☐	☐
b)	It tells the researcher what to do at every stage of the execution.	☐	☐
c)	It forms the basis of understanding between a client and an agency.	☐	☐
d)	It is immaterial whether the design is written or is kept informally in mind.	☐	☐
e)	It must include a quantifiable model of the plan of analysis.	☐	☐

3.6 FACTORS INFLUENCING EXPERIMENTS VALIDITY

Before taking up the discussion on Quasi-Experimental Designs and Experimental Designs, it would be worthwhile to understand the factors that influence experiment's validity. There are two important concepts of validity that are related to experimentation namely internal validity and external validity.

Internal Validity: It means that no other plausible cause of the observed results should exist except those tested. This is the basic minimum that should be present in an experiment before any conclusion about treatments can be made. The presence of other extraneous factors or the absence of internal validity, makes the experiment confounded.

External validity: It relates to the question of "generalization" of the results obtained from the experiments. We are interested in knowing whether it is possible to project the conclusions of the experiment to what population, geographical areas etc.

Although, we would want an experiment to satisfy both internal and external validty, it is not uncommon to find experiment meeting all the internal validity requirements and yet be invalid externally. This could possibly happen because of the following reasons:

i) Environment at the time of test may be different from the environment of the real world Where the decisions are taken.

ii) Results obtained in a six week test may not hold good in an application of, say, twelve months.

iii) The population used for experimentation of the test may not be similar to the population where the results of experiment could be applied.

iv) Treatments in the test may be different from the one used in the real world.

It is desirable to understand the sources of errors that are responsible for reducing experiment's internal and external validity. This will help the researcher guide the choice of design to use.

An experiment's validity is influenced by a host of extraneous factors. These are explained below:

1) **History:** History deals with the occurrence of specific nonrecurring events that are external to the experiment but occur at the some time as the experiment. Suppose we measure the sales of a territory before and after salesmen were trained The difference in the sales may indicate the treatment effect (sales training). However, an increase in sales can not be attributed to sales training alone . An improvement in business condition before and sales training might have resulted in the increase in sales. Therefore, longer the time period involved between observations, greater is the chance that history will confound an experiment of this type and hence will significantly affect the results.

2) **Maturation:** Maturation is similar to history except this it is concerned with the changes that occur with the passage of time in the people involved in the design. In our sales training examples, an increase in sales may be due to the fact the salesmen have become more experienced with the passage of time and hence they know their customers better. It may be noted that it is not only people that change over time, but also stores, geographic regions, and organisations etc. The duration of time period has a direct impact on results of maturation effect.

3) **Testing:** In the process of an experiment, respondents may know that their behvaviour is being observed or the results are being measured. This would sensitize and bias respondents. In our example of training salespersons, if the salespersons know that they are being trained to know how effective the training is, they might respond differently than what they would have done otherwise. For example, if sales in a territory are recorded before training of the salespersons and another observation on sales is taken after the training and if the respondents are aware of it, they are likely to become sensitized and behave differently.

   As another example, consider a case where the respondents have filled a pre-treatment questionnaire. The respondents are likely to respond differently if they are asked to fill the same questionnaire after they are exposed to the treatment. This is because they have now become `experts' with that questionnaire.

4) **Instrumentation:** This refers to the effect caused by changes in measuring instrument or process during the experiment.

   If difference in total rupees sales volume per territory on a "before" and "after" training is used as the yardsticks to know the effectiveness of sales training, a price change during this time interval could make a substantial difference. This is one example of changing instrument. The experience of the investigators, a change in the mood of the investigators, a change in the investigators are some other examples which may affect the measurment and hence the interpretation of the results.

5) **Selection Bias:** The selection bias occurs when test units are selected in such a way as not to be representative of the population. It refers to assigning of test units to treatment groups in such a way that the groups differ before being subjected to treatments. If groups are selected on the judgement of the researcher,. there is always a possibility of selection bias. The selection procedure should be random as this will result in a measureable random variation. However, if a non-random procedure is 'adopted, the results will be affected by a non-measurable error.

6) **Test Unit Mortality:** It is quite possible that some of test units might drop out from the experiment while it is in progress. Referring to the sales training example, some of the sales persons, who are undergoing training might quit before the training is over. There is no way of knowing whether it is those who were not improving left the training. Also, it is not possible to determine whether those who left the training would produce the same results as those who stayed till the completion of the training programme. In short, the interpretation of the results will become difficult task.

Activity 4

Explain with the help of suitable examples the factors that influence experiment's validity.

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3.7 QUASI-EXPERIMENTAL DESIGNS

In order to facilitate the discussion on Quasi-experimental Designs and Experimental Designs (to be discussed in 3.8), the following notational system will be used.

i) X represents the exposure of a test group to an experimental treatment whose effect is to be observed or measured.

ii) refers to the measurement or observation of the dependent variable on the test units. Suppose more than one observation or measurement is taken, the subscripts O_1, O_2, O_3 etc., will be used to indicate temporal order.

iii) R symbolizes that individuals have been selected at random to separate treatment groups or groups have been allocated at random to separate treatments.

iv) Movement from left to right indicates a time sequence of events.

v) All notations in one row indicate that subjects belong to that specific treatment group.

vi) Vertical arrangements of the notations mean that the events occur simultaneously.

To make the national scheme clear , let us consider the following example:

Example 1

The symbols 0, x 0_2 represents that the measurement were taken on a group both prior to (01) and after (0_2) of receiving the treatment (X).

Example 2

The symbols

R O_1 x.O_2

R x O_3

Indicate that two groups of individuals were assigned at random to two different treatment groups at the same time. The groups received the same treatment (X). One group received both a pretest (O_1) and post test measurement (O_2). The second received the post test measurement (O_3) at the same time as O_2.

Now having understood the notation scheme, we begin our discussion on Quasi experimental design.

Quasi – experimental Designs: In these designs the researcher has control over data collection procedures but lacks control over the scheduling of the treatments and also lacks the ability to randomize test units ‘exposure to treatments. There are various designs which fall under the category of quasi-experimental designs. Some of these will be discussed here. These design have inherent weakness as their internal validity is questionable. They lack the control attributes of the truly experimental designs .The

following quasi-experimental designs will be discussed in this section.

1) After-Only without Control Group
2) Before-After without Control Group
3) The Static-Group Comparison
4) Logitudinal Designs (Time Series Designs)
5) Multiple Time-Series Designs.

1) After-Only without Control Group: This design is also called a "One-shot case study." The design may be presented symbolically as follows:

X O

In this design, test units are not selected at random. The test units are either self-selected or arbitrarily selected by the experimenter. A single group of test units are first exposed to treatment (X), and then measurements are taken on the dependent variable afterwards (O).

For example, a sales manger may request the members of his sales force to volunteer participation in the sales training programme and their sales performance is measure after training programme is completed.

It is not possible to draw meaningful conclusions from such a design. This is because we do not have any observation (measurement) on the sales performance of the sales persons prior to their undergoing training.

The level of O is the result of various uncontrolled factors. The effect of history, maturation, selection and mortality are substantial and non measurable making the design internally invalid.

2) **Before-After without Control Group:** This design is also termed a "One group pretest-post test design." This design is superior to the design" After-Only without Control Group." It provides a measurement of what existed prior to the test group being subjected to the treatment. This design is presented symbolically as follows.

O_1 x O_2

Referring to the sales training example as discussed in "After-only without Control Group", a pretest measurement of sales performance has been added to the design discussed earlier. Now the question is whether the difference is sales performance as measured by O_2 -- O_1 can be attributed, to the sales training programme? One could list out a number of extraneous factors which could be responsible for this difference (O_2 - O_1) thereby making this design useless and disqualified for internal validity. Some of these factors are listed below:

i) The test units had volunteered for the sales training programme (selection bias)
ii) Economic environment might have improved during that period (history)
iii) The salespersons might have gained more experience during the training period which would have resulted in the improved sales performance (maturation).
iv) The pretest measurement might have affected performance(testing)
v) Prices might have changed during that period (instrumentation)
vi) Some test units might have left during the period of training (moratality)

3) **The Static-Group Comparison Design:** In this design we use two groups of subjects. Group 1 is exposed to the treatment whereas Group 2 has not been

exposed to it. Group 2 is called a control group and is used as the baseline for comparison since it has not been exposed to the treatment. In marketing, the control group treatment is called the current level of marketing activity. The design may be diagrammed symbolically as follow:

Group 1 (Experimental Group):	X_1	O_1
Group 2 (Control Group):	X_2	O_2

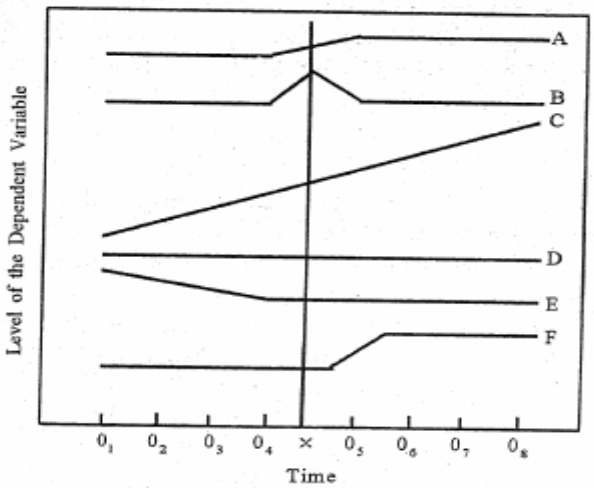
Here X_2 represents baseline marketing programme (existing programme) which is to be compared with the new programme (treatment) X_1 . For example X_1 could be new sales training programme which is to be compared with the existing programme X_2 (may be called control group treatment).

The experiment result O_1-O_2 could be attributed to the selection procedure adopted for two groups. The test units were not randomly selected. So the result may be attributed to the pretest difference caused by selection procedures. Test unit mortality could also be another probable cause. These two reasons put together could make this design invalid.

4) Longitudinal Designs (Time-Series Design): This is an extension of one-group pretest-post test design. Here we take periodic measurements for some test units. The treatment is introduced and the measurement on the test units are again taken at various points of time.

For example, a company may be interested in studying the market share of one of its products. It takes measurement on the market share at periodical intervals. Then a new advertising compaign is introduced and periodic measurements on the market shares are taken again.

In order to explain this design, let us consider the following figure and explain the results of this type of design.



Possible Results from a Time-Series Experiment

At the outset, this design may appear to be similar to one group pretest-post test design. However, there is a difference between the two designs. In the pretest-post test design we would have obtained only two measurements namely 0_4 and 0_5 Here in this design we have in fact taken many pretest-post test observations so that there is more control over extraneous variables. In the pretest-post test design, where we use only two observations 0_4 and 0_5, the analysis of various situations is as follows:

a) The results for situations A, B and C are identical namely that the market share has increased.

b) For situations D, E and F, the conclusion is that the new advertising compaign (X) has no impact on market share as it has remained constant.

The conclusions arrived at from the various situations of the Longitudinal designs are as follows:

i) In situation A, the compaign has had a short-run positive effect, after which the market share sustained.

ii) In situation B, it is observed that the rise is market share was temporary. The new compaign had a short-run positive effect. We note that the market share reverted to the level existing before the application of the treatment.

iii) In situation C, we observe that the changes that occur after the application of the treatment are a continuation of a trend (they also existed prior to the application of the treatment). Therefore, it is quite likely that the new advertising compaign had no effect on the market share.

iv) In situation D, the conclusion would be same as obtained for situation C.

v) In situation E, it appears that the new advertising campaign seems to have stopped the decline in market share.

vi) In situation F, the treatment (the new advertising campaign) had a delayed effect and therefore it required a longer period to appear.

Because of multiple measurements in this design, the effect of maturation, testing and instrumentation can be ruled out. Further if the test units are selected randomly and measures are taken to prevent panel members (test units) dropping out, one could atleast reduce selection and test unit mortality factors. However, the main weakness of this design is that here it is not possible to control history. However, the researcher could maintain a record of various events like unusual economic activity, economic changes etc. and if no changes are observed, one could reasonably conclude that treatment has had an effect.

5) Multiple Time-Series Designs: This designs may be diagrammed as:

Experimental Group $O_1\ O_2\ O_3\ O_4$ X $O_5\ O_6\ O_7\ O_8$

Control Group $O'_1\ O'_2\ O'_3\ O'_4$ $O'_5\ O'_6\ O'_7\ O'_8$

Here the experimental group is the one which was selected for sales training (X) and the observation O_1, O_2……. represents the sales volume of this group. A comparable group or the sets of the salesmen could be treated as control group. Their measurements on sales volume are symbolised as $O'_1\ O'_2\ O'_3\ O'_4$.....etc. After training, the measurements on the sales volumes of both the groups are taken. The effect of the sales training may be obtained by comparing the average sales volume for the two groups before and after treatment. The main weakness of this design is the possibility of an interactive effect in an experimental group.

Activity 5

Describe a few specific situations from the functional area of marketing where you would recommend each of the following designs as being best suited. Justify your answer.

a) After-Only Without Control Group

b) The Static-Group comparison

c) Longitudinal Designs.

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Activity 6

Compare and contrast One Group Pretest-Post Test Design with Longitudinal Design. Use a suitable example from marketing.

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3.8 EXPERIMENTAL DESIGN

True experimental design provide a stronger and more reliable basis for the existence of casual relationship between variables. Here, the researcher is able to eliminate all extraneous variables from the experimental and the control group through the use of a random selection procedure. One of the advantages of using random selection procedure is that we can use inferential statistical techniques for the analysis of experimental results. One such technique is the analysis of variance. The following experimental designs will be discussed in this section.

1) After-only with One Control Group
2) Before-After with One Control Group
3) The Solomon Four Group Design
4) Completely Randomised Design
5) Randondzaed Block Design
6) Latin Square Design

1) After-Only with One Control Group:-Here, two groups are experimental and one control group are set up by randomisation procedure. The design requires only one treatment and post test measurement of both of experimental and the control group. The design may be written symbolically as follows:

Experimental Group	R	X	O_1
Control Group	R		O_2

It may be noted that no pretest measurements are taken in any of the two groups. The difference between the post test measurement of the two groups is taken as a measure of treatment effect. Here 0, measurement is composed of treatment effect and all the other extraneous variables and 0, is composed of extraneous factors only. Therefore :

O_1-O_2 = (Treatment effect + Extraneous factors) - (Extraneous factors) = Treatment effect.

Here the absence of pretest measurement provides control over the testing and instrument effect. Also the interactive testing effect cannot occur. We, however, assume in this design that the pretest measurement of the characteristics under study are same in both the groups. It is also assumed that the test unit mortality affects each group equally. These assumptions can be justified if we take large-randomised samples. This design is very widely used in marketing.

2) Before-After with One Control Group: This design may be presented symbolically as:

Experimental Groups	R	O_1	X_1	O_2
Control Groups	R	O_3		O_4

This design is also called Pretest - Post test Design.

In this design two groups one `experiment and one `control' - are set up by randomisation process. The extraneous variables operate equally on the experimental

and control groups. Pretest measurement are taken in both the groups. However, it is the experimental group which is exposed to treatment. Post test measurement are taken for both the groups.

Since the extraneous factors operate equally on both the groups, therefore, the only difference between the two groups is as a result of the treatment of the experimental group.

Let A = Change in the measurements of the experimental group

$$O_2 - O_1$$

Let B = Change in the measurements of the control group

$$O_4 - O_3$$

Therefore, treatment effect - A-B = $(O_2 – O_1)-(O_4 -O_3)$

The main problem with this design is that it is not possible to remove sensitizing testing effect from the measurement effect. The estimate of the treatment effect given above also includes the sensitizing testing effect. The sensitizing test effects occurs in the experimental group and not in the control group. The individuals in the experiment group get affected because of the pretest measurements and may become very cautious and behave differently after being exposed to the treatment. Therefore the measure $A = O_2 – O_1$ will include a sensitizing testing effect. Since the control group is not exposed to the treatment and therefore this is missing in $B = O_4 - O_3$Therefore, this shows that the treatment effects as given by A-B will include sensitizing testing effect and therefore we cannot generalise the result of our treatment.

3) **The Solomon Four Groups Design :** This design is also called the four group six study design. This test overcomes the limitations of pretest - post test control group designs. This design is infact a combination of `Before After with one control group' and `After only with one control Group' designs. The design is symbolically presented as:

Experimental Groups	:	R	O_1	X	O_2
Control Groups	:	R	O_3		O_4
Experimental Groups	:	R			O_6
Control Groups		R			O_6

You may note that the experimental group 2 and control group 2 do not receive any pretest measurements. The results of group 2 help us in measuring and eliminating the sensitizing testing - effect since this type of sensitizing cannot occur in measurement 0_5. The results of the difference of various pretest and post test measurements give us the following effects.

Experimental Groups	:	$O_2 - O_1$ = treatment effect + extraneous + sensitizing testing effect)	(i)
Control Groups 1	:	$O_4 - O_3$ = extraneous factors	(ii)
Experimental Groups 2	:	$O_5 - O_1$ = (treatment effect + extraneous factors)	(iii)
		$O_5 - O_3$ = (treatment effect + extraneous factors)	(iv)
Contol Groups 2	:	$O_6 - O_1$ = extraneous factors	(v)
		$O_6 - O_3$ = extraneous factors	(vi)

By taking the average of equations (iii) and (iv), we get

$$O_5 - \frac{O_1 + O_3}{2} = \text{Treatment effect + Extraneous effect} \quad \text{(vii)}$$

By taking the average of equations (v) and (vi), we get

$$O_6 - \frac{O_1 + O_3}{2} = \text{Extraneous effect} \quad \text{(viii)}$$

Treatment effect

$$= \left(O_5 - \frac{O_1 + O_3}{2}\right) - \left(O_6 - \frac{O_1 + O_3}{2}\right)$$

$$= O_5 - O_6 = \text{Treatment effect}$$

By substracting equation (vii) from equation (i), we obtain the sensitizing testing effect as:

$$\text{Sensitizing testing effect} = (O_2 - O_1) - \left(O_5 - \frac{O_1 + O_3}{2}\right)$$

Please note that in order to measure the change in experiment group 2 , we required an estimate of pretest measurement on O_5 , we assumed that groups are equal before the experimental because of the random assignments of the subjects to all four of our group I and control group 1 and control group 1 respectively . Given the just mentioned assumption, the pretest measurement of experimental group 1 and control group 1 could be taken as an estimate of pretest measurement of experiment group 2. that is what we used in the equations (iii), (iv),(v) and (vi) listed above).

This design is also referred to as "the ideal control experiment." As you have seen that we are not only able to control all extraneous variables and sensitizing testing effect, but also could get their estimates. However, this design is not very commonly used in marketing because of increase in cost, time and effort required to conduct the experiment.

The three experimental designs discussed above allow us to manipulate or control an independent variable so as to measure its effect on the dependent variable thereby enabling us to make proper casual statements. Below we will discuss some designs where we can manipulate or control more than one level of independent variable on the dependent variable..

4) **Completely Randomised Design:** The test is useful when the investigator is interested in studying the effect of one independent variable on the dependent variable. The independent variable should have a number of categories (nominal scale). Each category of the independent variable is considered as a treatment. Suppose we wish to sell a product and want to know what price should be charged. Here the independent variable is price and the three different levels of price namely low, medium and high are used as treatments. The test units (shops) are randomly assigned to three different treatments (price levels). Suppose our dependent variable is sales, we could always compare average sales level corresponding to each of the treatment to determine which treatment (pi-ice level) was the best.

   The limitation of this design is that it does not take into account the effect of various extraneous variables on the dependent variable. In the example which we have considered, the possible extraneous factors would be competitor's price, size of the shops, the price of the substitute of the product in question and so on. It is assumed in this design that the extraneous factors have the same impact on all the test units.

5) **Randomized Block Design:** The randomized block design is an extension of completely randomized design. In the completely randomized design it was assumed that all the extraneous factors have the same impact on all the test units. This may not be true.

   In the examples used in the completely randomized design, we had three price levels tested in various shops. We did not take into consideration the fact that the

differences in the result could be due to the differences in the size of the shops. One could classify various shops on the basis of their size as:

Small size shops

Medium size shops

Large size shops

In the randomized block design it is possible to separate out the effect of one extraneous factor from the results thereby providing a clearer picture of the impact of treatment on sales.

In this experiment, we may for example, randomly assign nine small size shops to the three price level in a way that there are three shops for each price level. Similarly one could assign randomly nine medium size shops to the three price levels and nine large size shops to the three price levels. Having done this, one could use analysis of variance technique to separate out the effect of extraneous variable (size of shops) from the total experimental error and also analyse the effect of treatment (price level) on sales (dependent variable)

6) **Latin Square Design:** This design allows the researches to control and measure the effect of two extraneous variables on the dependent variable. Here the two extraneous variables need to be divided into as many categories as the number of levels of the independent variable (treatment). The Table 1 below illustrates the layout of Latin Square Design.

Table 1: Latin Square for Various Advertising Campaigns

		Packaging			
		I	I1	III	IV
Cities	1	A	B	C	D
	2	B	C	D	A
	3	C	D	A	B
	4	D	A	B	C

Suppose a marketing organisation wants to study the impact of four types of advertising campaigns on the sales of a product. The sales could be affected by say two extraneous variables like the type of city and the type of packaging. If Latin Square Design is to be used the cities need be divided into four types namely 1, 2, 3, 4 and four different types of packaging say I, II, III and IV are required. In Table 1 we have identified four categories for the row variable; the type of city, and four categories for the column variable, the type of packaging. The treatment variable the types of advertising campaign is identified as A, B, C and D. We note that the number of categories of extraneous variables is" the same as the number of treatments (4).

The treatments (four advertising campaigns) are assigned randomly to the cells of the table in such a way that each treatment appears once and only once in each row and each column. One this arrangement is made, the analysis of variance technique could be used to separate out and measure the effect of the two extraneous variables in question and also analyse the effect of treatments (four types of advertising campaign) on the dependent variable namely sales of the product.

This design is very complex to set up. Further, it can be very expensive to execute.

Activity 7

How would you use 'Before-After' with one Control Group design to measure the effectiveness of a new advertising on the sales of a particular brand of shampoo? Also, mention the weakness of this design.

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Activity 8

List out a few marketing studies where "Latin Square Design" could be used.

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3.9 SUMMARY

This unit on research design gives an overiew of the research designs and their application in marketing research. After discussing the meaning and benefits of a research design, the discussion focusses on the four basic types of designs namely exploratory, descriptive, quasi-experimental and experimental. Causality, the relationship between data and conclusions, forms the basis of this classification. The nature of causality and the need to measure it has also been discussed.

The major design categories and their applications have been described. Specific subtypes within the major categories have also been discussed. Under the descriptive design, panel design, cross sectional design and focus groups were discussed. The quasi- i experimental designs discussed include after only without control group, before-after without control group the static group comparison, longitudinal design and multiple time series designs.

Under the experimental design categories the designs covered are after-only with one control group; before-after with one control, Solomen four group design completely randomized design, randomised block design and Latin square design. Questions of internal and external validity of the experimental validity of experiment have also been discussed .

3.10 SELF-ASSESSMENT QUESTIONS

1) Explain the solomon-four group design. How far 1) does this design succeed in [i] controlling different extraneous variables? Illustrate your answer with the help of a suitable example from marketing.

2) Explain the various extraneous variables which if not controlled in an experiment may contaminate the effect of the independent variable.

3) What design would you use to

   a) Test whether the coloured newspaper advertisement is more effective than the existing black and white advertisement ?

   b) Know which of the several promotional techniques is most efficient in selling a particular product?

   c) Determine whether additional shelf space allocated to a product would increase the sales of that product in the supermarket?

   d) Determine the type of customers who would be the first adopters of a newly introduced brand?

Justify your answer.

4) What are the marketing research situations suitable for

   a) Focus group study

   b) Panel research design

   c) Cross-sectional design

   d) Quasi-experimental design

5) Distinguish between exploratory and descriptive research design.

3.11 FURTHER READINGS

Freund, John E. and Frank J. Williams, "Elementary Business Statistics - The Modern kiproach", Prgntice Hall International Edition.

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