1.1 INTRODUCTION

The concept of research is as old as civilization. Research methodology is a very wide term and has inevitably been used in all areas of knowledge and investigation.

Definition: Research methodology is a scientific procedure of systematic and thorough investigation in a field of knowledge to unravel certain hidden facts or establish principles envisaged by experience, theorization or observation. Research also suggests ways for achieving the objectives.

1.2 AREAS OF RESEARCH

Research is conducted almost in all areas or fields of knowledge, utility and subject matter. The processes, procedures and approaches of research vary in accordance to objectives, purposes of study, type of population under investigation, items to be produced, types of results aspired and resources available in terms of funds, trained personnel, time and equipment.

One opts to conduct research as per his/her requirements e.g., a physicist conducts research in the laboratory; an astronomer studies the movement of galaxies, planets, stars and other celestial bodies in the fields, laboratory and planetarium; a sociologist conducts surveys in a section of society as per his objectives, a pharmacologist tests the efficacy of drugs against diseases, a marketing executive carries out studies among likely customers to know about the quality of a product, their likes and dislikes, expectations, scope, future demand and so forth. An agricultural scientist conducts experiments in the field as well as laboratory. Research for production and utility of various items and machine parts is conducted in laboratories and workshops.

Research is a diversified topic and it is not possible to include all types of research areas and their methodology at one place. So this book will cover experimental research to a limited extent and more extensively survey methods of research in the areas of marketing and administration. Maximum emphasis has been given to the analysis of data and interpretation of results which is the backbone of the research methodology.

Besides research, there may be intentional or serendipitous observations and innovations termed as discovery and invention that though look alike but differ in meaning and purpose. They can be defined as follows:

Discovery: It is an act to reveal or uncover certain things, facts or phenomena that existed somewhere in the universe but were unknown. For instance, Christopher Columbus discovered America on 12th October, 1492. A team of workers from New Zealand and Australia discovered the Tusman booby, Sula Tasmani, in fact the species of birds. A British astronomer David Anderson discovered a new planet named as Wasp-17 which moves around the sun in opposite direction.
Invention: Something conceptualized by one’s own mind to create some device, propound a theory or produces something new and useful (that is not in existence) is termed as invention. For example, invention of telephone by Alexander Graham Bell, electricity by Benjamin Franklin, personal computer by Steve Jobs and Steve Wozniak and so on.

1.3 MARKETING MANAGEMENT, MARKET AND MARKETING RESEARCH

The above three terms are close in practice, yet they are different. Hence, each of these terms are explicated adequately.

Marketing management: Marketing management is the process of decision making with regard to marketing problems.

Market research: A research conducted to study the flow of money and general trends of the market is called market research. It is general in nature.

Marketing research: It is a systematic approach of obtaining information qualitatively or quantitatively which is analyzed to identify marketing problems that are consequently utilized in developing marketing strategies.

Marketing research has two facets namely,

(i) to identify marketing problems,

(ii) to find solution of the marketing problems.

These two intertwined facets lead to cover another aspect i.e., to assess the marketing opportunities.

Note: There is a difference in market and marketing researches. Yet they are interchangeably used in common parlance.

The present book confines to research methodology. As already mentioned, research is a systematic process. It implies that each and every research has to be conducted in a manner following certain standard procedure. In this way, a researcher has to carry out his/her research step by step. To ensure the same, a blue-print of research procedure is given below.

Formulation of the research problem and needs

Decision about type of research

Research hypothesis

Collection of data

Selection of sampling method or Experimental Design

Random sampling

Non-random sampling
Formulation of the problem: A researcher should first identify the problem on which the research is to be carried out. Before starting the research work, following points should be kept in mind.

(i) The purpose of the study.

(ii) Type of research to be conducted—especially qualitative, quantitative or both.

(iii) Information or data needed.

(iv) Whether the research is merely to identify a problem or it is meant to seek solution of a known problem.

(v) Target population should be specified about which the study is to be carried out.

(vi) It should clearly mention the period in which the research is to be completed.

(vii) Budgetary provisions should also be made and funding agency which shall finance the project be decided before starting the research work.

1.4 TYPES OF RESEARCHES

Truly speaking, research is of one type that is research. But on the basis of the method of collection of information or data, type of data to be collected, analytical procedures and revelation of results to be gleaned and so on, the researches are further classified under the specified headings. The same have been discussed adequately in this section. In common parlance, the research is named on the basis of the discipline e.g., a research in biology is called biological
research, in medical sciences as medical research, in agricultural sciences as agricultural research, about market studies as marketing research and so forth. Besides these, here the coverage of types of researches will be somewhat different. Firstly some more classified researches are elucidated. Later a broad classification is given like qualitative and quantitative research, applied research, pure or fundamental research, etc.

**EXPLORATORY RESEARCH**

As the name implies, exploratory research is conducted to make a thorough study of a situation or issue which can be used in business or other sector for any of the following purposes.

(a) To isolate key issues.
(b) To formulate the problem in an exact manner to seek its solution.
(c) To develop hypothesis.
(d) To identify key variables to be included in a real research.
(e) To provide proper guidelines to conduct research precisely.

**DESCRIPTIVE RESEARCH**

The purpose of descriptive research is to describe some phenomenon related to the area of interest. Under this research one attempts to find out –

(a) Characteristics of relevant groups such as consumers of a particular product, retailers of certain market areas, sales of departmental stores offering discount and other traits.
(b) To assess the percentage of people of an area who have the tendency to go to big malls rather than buying from local shops.
(c) To find out the eating habits, liking for fashionable clothes or liking for clothes of a particular brand, etc.

Moreover, the descriptive research can provide an idea about the degree of association between two or more variables. But it is not suitable for ascertaining the actual relationship between variables.

**APPLIED RESEARCH**

A study of investigation carried out to solve an existing problem bothering to any managerial, social or natural system is called applied research.

For instance, a company is not able to sell its product in proportion to its production. The marketing chief wants to find out the reasons for not meeting out the targeted sale so that corrective measures can be taken. This is a kind of applied research. A study of human resource management choices and organizational strategy also come under applied research.

**FUNDAMENTAL RESEARCH**

A study to generate a body of knowledge to comprehend certain natural or social phenomena for causes of their occurrence and to provide certain principles or theories is called fundamental or basic or pure research. The knowledge is used to solve certain present or future problems. Research leading to propound some theory which may create an insight into a subject is termed as basic or theoretical research. This has long term advantages and utilities. Fundamental research works as foundation for applied research.

**CAUSAL RESEARCH**

The experience of scientists, businessman and managers reveals that the change in one variable induces the change in other variable. The variable which brings about the change is
called independent variable or predictor variable. The variable having the effect of change is known as dependent variable or predictant. For example, a general feeling is that decrease in price of an item increases its demand. In this case, causal research is appropriate for

(a) ascertaining the independent variable(s) and dependent variable.
(b) surmising the relationship which is likely to exist between independent variable(s) and dependent variable. This relationship may be linear, quadratic or any other functional form.

1.5 DISTINCTION BETWEEN EXPLORATORY, DESCRIPTIVE AND CAUSAL RESEARCHES

Three types of researches are discussed in the preceding sections. They are undoubtedly different yet the distance between them is not absolute. In a research project, more than one type of research may be involved depending on the nature of the problem to be tackled and information at hand. Even then some norms in general can be enunciated.

(i) When a researcher is not clear about the problem to be solved, exploratory research has to be conducted initially to decide about the exact problem and further course of action. Through exploratory research one would be able to establish the hypotheses, identify variable(s) to be measured. This would lead to finalization of the analysis of data to arrive at the precise conclusions.

(ii) Descriptive and/or causal researches follow exploratory research. Finally the data are to be analyzed statistically to draw valid conclusions about the hypothesis. This enables an executive officer to take final action.

(iii) If the problem is well known, it is not required to conduct exploratory research. One can take real research directly. A researcher may start the descriptive, causal or basic research directly.

1.6 QUALITATIVE RESEARCH

Qualitative research is not much different from exploratory research. This is unstructured and exploratory in nature in which the information is gathered from small samples, focus groups (given ahead) and one to one interviews to probe the respondents. Pilot surveys also belong to the category of qualitative research. This provides basis for formulating the research problem and guidelines to conduct the research in a systematic and logical manner.

Focus group: A small group of concerned respondents with whom an interview is conducted by a trained moderator in an unstructured and natural manner is called a focus group. If the respondents are disguised about the purpose of the interview in a qualitative research, then it is regarded as indirect approach of exploration.

1.7 QUANTITATIVE RESEARCH

A research which quantifies the information/observations or is based on measurement data and is suitable for applying statistical analysis in any form is classified as quantitative research. As a matter of fact, quantitative research must follow qualitative research. Further, any finding of the qualitative research should not be regarded as conclusive. They simply provide initial guidelines for proper and reliable research. Quantitative research collects, compiles and analyzes data obtained from a sample to draw inferences about the target population from which the sample is drawn. On the basis of these conclusions, a researcher can recommend solution to the problem under investigation.
Comparison of qualitative and quantitative research

<table>
<thead>
<tr>
<th>Qualitative research</th>
<th>Quantitative research</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To develop clear understanding of the underlying implications of a problem. Data are in the form of words, diagrams or pictures.</td>
<td>1. To collect quantitative data or information, which can be quantified by some standard technique, are usually measurements or counts.</td>
</tr>
<tr>
<td>2. To provide guidelines for conducting full and final research.</td>
<td>2. Data are suitable for final conclusion and recommendations.</td>
</tr>
<tr>
<td>3. This research is based on small number of respondents or cases and their physical characteristics.</td>
<td>3. The research is based on a duly selected sample of adequate size from the target population. Also the size of the sample is larger than an unscheduled sample for qualitative research.</td>
</tr>
<tr>
<td>4. Usually the interview is unstructured.</td>
<td>4. Always a systematic and/or structured interview is conducted.</td>
</tr>
<tr>
<td>5. Hardly any statistical analysis is involved in deriving the information.</td>
<td>5. Data are statistically analyzed to arrive at correct and reliable conclusions. This enables to recommend the course of action.</td>
</tr>
<tr>
<td>6. The goal is to uncover or discover patterns that help to explain some phenomenon of interest.</td>
<td>6. The goal is to develop generalization that contributes to theory which enables a researcher to predict or explain some phenomenon which is under study.</td>
</tr>
</tbody>
</table>

1.8 LIBRARY RESEARCH OR DESK RESEARCH

There are certain subjects which require information about some facts and events that occurred in the past or expected to occur in future. Such information is searched out from the books, journals, scripts, dissertations, and so on. For example, a research in history or philosophy is a kind of literary research.

1.9 EXPERIMENTAL RESEARCH

A research conducted through an experiment in laboratory or field to test certain hypotheses and draw conclusions about the effect of manipulations, interventions (treatments or independent variables) on subjects or experimental units is known as experimental research. In an experiment all nuisance variables are kept under control as far as possible and manipulations are freed to show their effect. Experimental data are statistically analyzed to test the hypothesis and draw conclusions to make recommendations.

1.10 EXPERIMENT

An experiment can be regarded as a planned and systematic procedure to obtain quantitative data which can be analyzed to establish cause and effect relationship.

LABORATORY EXPERIMENTS

An experiment conducted in certain premise under controlled conditions having least or no intervention of natural and environmental conditions is called laboratory experiment. Experiments in chemistry, physics, engineering and some other sciences are usually laboratory experiments.
**FIELD EXPERIMENTS**

Experiments or trials which are conducted in natural environments are categorized as field experiments. Researches in botany, agriculture, horticulture and forestry involve field experiments. In field experiments, uncontrolled variability is more as compared to laboratory experiments. Data are obtained from each and every experimental unit.

**1.11 STATISTICAL SURVEYS**

A method of collecting information or data from the respondents selected in a manner using probability sampling design is called statistical survey.

The information is collected in a schedule or questionnaire specifically designed to gather data/views relevant to the problem under investigation.

The problems regarding opinion polls, likes and dislikes about a product or item, market trends, impact of advertising, social changes, fashion, etc. require statistical surveys.

**1.12 DIAGNOSTIC RESEARCH**

A research conducted in the area of marketing, social sciences, medical sciences and some other sciences to find out the reasons for the occurrence of a problem and to some extent its solution is called diagnostic research.

**Remark:** At the time of planning of a research project, one has to select a type of research out of various research categories discussed up till now.

**1.13 RESEARCH HYPOTHESIS**

A research hypothesis is very important part of planning of research.

Actually it is the postulation by human mind to explore into some unknown phenomenon.

**Origin of research hypothesis:** There are certain questions which constantly strike to a human mind on the basis of his observations, experiences or thoughts. These questions originate from the areas in which a person is working or living. A research hypothesis is driven by speculative questions. For instance, a doctor may feel that excessive exposure to ultraviolet (UV) rays cause skin cancer in human beings; persons working in mines develop lung diseases. A hotel owner or marketer would be interested to know the liking of the people for fast food as compared to traditional food, do elite in a city prefer branded ice-cream over local product; do youngsters like high speed auto bikes and so on. All such type of questions give rise to research hypotheses.

**Definitions:**

1. A research hypothesis is a logical supposition, an unproven proposition, a thoughtful conjecture or a stipulated guess about certain factors or phenomenon which needs confirmation.

2. A research hypothesis is often a tentative statement about the relationship between the variables or a cause and effect relationship as stipulated on the basis of theoretical frame work or model.

A research hypothesis is to be formed at the time of formulation of the research problem. The job of the investigator is to ascertain the validity of the conjecture. The research hypotheses are not exact in their composition. Rather they are somewhat vague. That is why they are termed as weak hypotheses. They are modified and precisely expressed as statistical hypotheses at the time of testing of hypotheses.
Utility: Research hypotheses serve many purposes as follows:

(a) A research hypothesis specifies the information which shall be required for further investigation.
(b) The most important role of research hypothesis is to enable a researcher to decide the variables that are to be included in the research design.
(c) It enables an investigator to choose the target population.
(d) It provides basis to establish statistical hypothesis.
(e) Research design is also related to some extent to research hypothesis.
(f) It also paves the way for analytical model selection.

Data: Data are the quantitative measures as outcome of any process, survey or trial on which the inferences, decisions and future actions are based.

1.14 TYPES OF DATA

Data are broadly classified as primary data and secondary data. An outline of the same is given below.

Primary data: Those data which are collected in a scientific manner by an investigator or researcher for the first time from the respondents, subjects, items, experimental units directly for the purpose of his own project are called primary data. Editing of data is an ethical requirement prior to final analysis of data.

Secondary data: The data which were collected and used by someone else for his/her own studies and then maintained as record are called secondary data. Most of the official data preserved as record regarding population growth, prices, consumption, health, diseases, production, land use, epidemics, revenue and so on form the part of secondary data. Also research and information data which were published in magazines, research journals, reports and thesis work as secondary data for some new research studies. Of course, a researcher should ensure and scrutinize whether the data at hand are suitable for the present study.

Measurements: In a most general sense, measurements means assigning some real number (value) or seldom some symbols according to a prescribed rule to a characteristic of an unit, object, item or person. The most important feature of measurements is that the process of assigning numbers should be isomorphic, which means that there ought to be one to one correspondence between the assigned number and the characteristic being measured. For example, the height of persons, protein content in different food grains, electricity consumption of a washing machine, etc. Also measurements belong to the personal characteristics such as perception, attitude, preference and about electronic devices like air-conditioner, television, a weighing machine, a currency counting machine and so on.

Scaling: In opinion and marketing surveys, an investigator needs to operationalize concepts. Thus, scaling is a tool in which the objects are distinguished by creating a continuum upon them. For instance, a household with income of ₹ 5000 per month is put on scale as 1, ₹ 8000 per month as 2, ₹ 11000 per month as 3 and so on.

There are basically four types of scales namely,

(i) nominal scale,
(ii) ordinal scale,
(iii) interval scale,
(iv) ratio scale.

All of them shall be discussed adequately in Chapter 5.
1.15 Attitude Measurement

Many a times in marketing research surveys, questions are designed to measure the attitude of the customers. Attitude measures play an important role in market studies for the following reasons.

(i) Attitude helps to assess to what extent a person is agreeable to do something.
(ii) Attitudes do not change quickly.
(iii) Attitudes are indicative of preferences.

Attitudes can be measured by using the following procedures.

(a) By asking certain questions from the respondents.
(b) By observing one’s behaviour assuming that his behaviour is a reflection of his attitude.
(c) By noting one’s performance of an assigned job. It is presumed that one’s performance or the power of memorizing things is directly related to his/her attitude.
(d) By measuring physiological reactions with the help of mechanical or electronic devices.
(e) Through multiple measures i.e., through the mixture of so many measures.

1.16 Editing of Data

Data in statistics are just like blood in human body. If the blood is infected, a person is likely to suffer from disease(s). So is true with data i.e., if the data are contaminated in any manner, then there is every likelihood that the results shall be misleading, false, biased and unreliable. Therefore, it becomes necessary that one should examine the data very scrupulously for obvious anomalies or discordant, measurement errors, mistakes in copying, etc.

Thus, the quality of data is an important factor to arrive at valid conclusions.

Best analyst is one who elicits maximum information contained in the data which ultimately provides correct inferences. So to achieve his goal, a statistician should examine and rectify the data prior to its analysis. The process of checking data may involve editing and deleting of outliers and other discrepancies.

Editing: There is greater requirement of editing in survey data. In surveys, data are usually collected by filling of schedules or questionnaires (For details see Chapter – 2). Sometimes wrong information is entered or some information is missed in the forms by the interviewer due to their ignorance, negligence or inadvertently. Also many times such discrepancies creep in due to ignorance of the interviewee or his deliberate intention to hide facts. So each form (schedule or questionnaire) has to be scrutinized to check that all entries are complete and compatible with other data.

All entries in the forms are checked one by one. If one or more entries are missing, they are often completed with the help of other related entries. For instance, if it is not marked whether a respondent is married or unmarried but in the next answer it is given that he has two children, then the respondent is marked married. In this way, an entry is completed. But the reverse is not true. Similarly many other entries can be completed but not all of them.

Incompatibility of data means if a person reports his expenditure more than his family income, then it is not compatible. If a farmer reports his land holding quite small as compared to the production of food grain. Such entries sometimes are corrected by second hand information, then his information is compatible. Firstly hundred percent accurate data is neither possible nor required in statistical reporting. Secondly, accuracy cannot be checked by editing. If one wants to check correctness of entries in the filled forms, then a 5% sample of the filled forms is
selected. Again the same schedules or questionnaires are filled from the interviewees named in the selected forms. Then their forms are matched. If there is considerable discrepancy, then the corrections are to be incorporated.

During scrutiny, one should avoid to discard data or forms as far as possible because scrutiny is a weak tool. Editing should better be utilized to improve information and data to its correctness.

1.17 OUTLIERS AND THEIR DETECTION

Outliers: In the collected data if some observations are numerically far from rest of the data, then they are dubious outliers. These aberrant observations have an impact on subsequent analysis of data. They can occur in any distribution for two reasons,

(i) Due to human error, misreporting, malfunctioning of an instrument, etc.,

(ii) May arise naturally due to inherent variability present in the population.

If a faulty value is found to occur due to known reasons.

(i) Then the value should be corrected rather than discarding it. If an abnormal value is due to unknown reason, then one has to ensure whether this inconsistent value is beyond acceptable limits or not.

In any data set, discarding of observation(s) is least preferred because a lot of information, contained in it, is lost. On the other hand, outliers have great impact on estimators and testing of hypotheses because they are based on a limited number of sample values. Therefore, extreme distant values from rest of values should be checked thoroughly whether they can be attributed to error or they occur due to variability in the population. Such distant values so called outliers are especially named as discordants. As far as possible they should not be discarded but their reckless retention is likely to spoil the results of an investigation. Therefore, it becomes obligatory on the part of a researcher to ascertain whether they are within or beyond the acceptable limits.

DETECTION OF OUTLIERS

A number of theories, formulae and tests have been propounded to detect whether an observation is to be considered as an outlier. The problem of outliers is not confined to any single statistical technique but may interfere in all types of statistical analysis. The procedures for detecting outliers vary according to statistical analysis under process. At the same time the techniques for detection of outliers in case of univariate and multivariate analysis are altogether different. Here the discussion is confined to univariate normal distribution. Detection of outliers now a day is possible in univariate and multivariate data with the help of computer packages as well. How to deal with outliers can be retrieved from, [http://en.wikipedia.org/wiki/outliers](http://en.wikipedia.org/wiki/outliers).

Two simple methods of detecting outliers are discussed here under.

Box Plot Method

It is a diagrammatic method of detecting outliers in case of univariate distribution. Instead of explaining box plot method theoretically, it is explicated with the help of a numerical example.

Example 1.1: Consider the number of patients turning up at a diagnostic clinic during 30 days of June, 2009 for blood tests i.e., from June 1 to 30 as given below.

<table>
<thead>
<tr>
<th>June</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 – 10</td>
<td>14 13 23 3 19 21 17 31 28 39</td>
</tr>
<tr>
<td>11 – 20</td>
<td>36 29 42 38 26 22 33 32 18 26</td>
</tr>
<tr>
<td>21 – 30</td>
<td>29 35 30 29 58 31 39 24 34 42</td>
</tr>
</tbody>
</table>