



## Research Methodology

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**Abstract:** The need for scientific evidence should be the basis of clinical practice. In any research on human beings each subject must be adequately informed by the aim, methods, anticipated benefits and potential hazards of the study. Research design is a master plan which specifies the methods and procedures. Interpretation leads to the establishment of explanatory concepts. Research methodology is an approach to methodically explain the research problem. It may be implicit as a science of studying how research is through scientifically. In it we study the different steps that are usually adopted by a research problem along with the logic after them. It is required for the researcher to identify not only the research methods/techniques but also the methodology. It indicates the logic development of the process used to generate theory that is procedural framework within which the research is connected. It provides the principles for organizing, planning, designing, and conducting research.

**IndexTerms – Research, time factor, analysis, hypothesis, execution, presentation, evidence, research problem, ANOVA.**

### INTRODUCTION

Research in common parlance refers to a search for knowledge. Research is an art of scientific investigation. It is the pursuit of truth with the help of study, observation, comparison and experiment. Research is an academic activity and as such the term should be used in a technical sense. In short, the search for knowledge through objective and systematic method of finding solution to a problem is research. Research can be referred to as a careful investigation or enquiry specially through search for new facts in any branch of knowledge. According to Clifford Woody research comprises defining and redefining problems, formulating hypothesis or suggested solutions; collecting, organizing, and evaluating data; making deductions and reaching conclusions; and at last, carefully testing the conclusions to determine whether they fit the formulating hypothesis.

### RESEARCH

Research is a quest for knowledge through diligent search or investigation or experimentation aimed at the discovery or interpretation of new knowledge. Scientific method is a systemic body of procedures and techniques applied in carrying out investigation or experimentation targeted at obtaining new knowledge. Here research and scientific methods may be considered a course of critical enquiry leading to discovery of facts or information which increases our understanding of human health and disease.

### THESIS

- A proposition laid down as a theme to be discussed and proved. A discussion to maintain and prove a thesis especially written or delivered by a candidate for a university degree- Ph.D.

### RESEARCH APPROACHES

❖ They are further sub – classified into

1. Inferential approaches
2. Experimental approaches and
3. Simulation approaches

1. **INFERENCE APPROACHES:** The purpose of inferential approach to research is to form a data base from which to infer characteristics or relationships of population.
2. **EXPERIMENTAL APPROACHES:** Is characterized by much greater control over the research environment and in this case some variables are manipulated to observe their effect on other variables.
3. **SIMULATION APPROACHES:** This involves the construction of an artificial environment within which relevant information and data can be generated.

## SIGNIFICANCE OF RESEARCH

- “All progress is born of inquiry. Doubt is often better than overconfidence, for it leads to inquiry, and inquiry leads to invention” is a famous Hudson Maxim in context of which the significance of research can well be understood.
- Research inculcates scientific and inductive thinking and it promotes the development of logical habits of thinking and organization.
- The role of research in several fields of applied economics, whether related to business or to the economy, has greatly increased in modern times.

## OBJECTIVES OF RESEARCH

- The purpose of research is to discover answers to questions through the application of scientific procedures.
- **Though each research study has its own specific purpose, we may think of research objectives as falling into several following broad groupings:**
  - 1) To gain familiarity with a phenomenon or to achieve new insights into it (exploratory or formulative research studies)
  - 2) To portray accurately the characteristics of a particular individual, situation or a group (descriptive research studies)
  - 3) To determine the frequency with which something occurs or with which it is associated with something else (diagnostic research)
  - 4) To test a hypothesis of a causal relationship between variables (hypothesis-testing research studies)

## TYPES OF RESEARCH

- DESCRIPTIVE VS ANALYTICAL
- APPLIED VS FUNDAMENTAL
- QUANTITATIVE VS QUALITATIVE
- CONCEPTUAL VS EMPIRICAL
- OTHER TYPES OF RESEARCHES

### DESCRIPTIVE VS ANALYTICAL

#### *Descriptive research:*

Descriptive research includes surveys and fact-finding enquiries of different kinds.

#### *Analytical research:*

In analytical research, on the other hand, the researcher must use facts or information already available, and analyze these to make a critical evaluation of the material.

### APPLIED VS FUNDAMENTAL

- ❖ Research can either be applied (or action) research or fundamental (to basic or pure) research.

#### *Applied research:*

The central aim of applied research is to discover a solution for some pressing practical problem, whereas basic research is directed towards finding information that has a broad base of applications and thus, adds to the already existing organized body of scientific knowledge.

#### *Fundamental research:*

Gathering knowledge for knowledge's sake is termed 'pure' or 'basic' research. Research concerning some natural phenomenon or relating to pure mathematics are examples of fundamental research.

### QUANTITATIVE VS QUALITATIVE

#### *Quantitative research:*

Is based on the measurement of quantity or amount. It deals with objective aspects.

#### *Qualitative research:*

Qualitative research, on the other hand, is concerned with qualitative phenomenon, i.e., phenomena relating to or involving quality or kind.

### CONCEPTUAL VS EMPIRICAL

#### *Conceptual research:*

Conceptual research is that related to some abstract idea(s) or theory. It is generally used by philosophers and thinkers to develop new concepts or to reinterpret existing ones.

#### *Empirical research:*

On the other hand, empirical research relies on experience or observation alone, often without due regard for system and theory. We can also call it as experimental type of research.

**OTHER TYPES OF RESEARCH**

- ❖ Research can be field-setting research or laboratory research or simulation research, depending upon the environment in which it is to be carried out.
- ❖ Historical research is that which utilizes historical sources like documents, remains, etc.

Operations research is an example of decision-oriented research since it is a scientific method of providing executive departments with a quantitative basis for decisions regarding operations under their control.

**IMPORTANCE OF KNOWING HOW RESEARCH IS DONE**

- **Importance of knowing the methodology of research or how research is done stems from the following considerations:**

- (i) The knowledge of methodology provides good training specially to the new research worker and enables him to do better research.
- (ii) The knowledge of research methodology is helpful in various fields such as government or business administration, community development and social work where persons are increasingly called upon to evaluate and use research results for action.
- (iii) It enables us to make intelligent decisions concerning problems.

**What is a research problem?****RESEARCH PROBLEM**

- The term 'problem' means a question or issue to be examined
- Research problem refers to some difficulty/need which researcher experiences in the context of either theoretical or practical situation and wants to obtain a solution for the same.

**SELECTION OF A RESEARCH PROBLEM**

- The research problem undertaken for study must be carefully selected.
- The task is a difficult one.

The following points may be observed by a researcher in selecting a research problem:

- i. Too narrow problems should be avoided.
- ii. Controversial subject should not become the choice of an average researcher in this connection.

**NECESSITY OF DEFINING A PROBLEM**

- Quite often we all hear that a problem clearly stated is a problem half solved. This statement signifies the need for defining a research problem.
- Defining a research problem properly is a prerequisite for any study and is a step of the highest importance.
- In fact, formulation of a problem is often more essential than its solution.

**PROCEDURAL STEPS IN RESEARCH PROBLEM**

- Research process consists of series of actions or steps necessary to effectively carry out research and the desired sequencing of these steps.

- (1) formulating the research problem
- (2) extensive literature survey
- (3) developing the hypothesis
- (4) preparing the research design
- (5) determining sample design
- (6) collecting the data
- (7) execution of the project
- (8) analysis of data
- (9) hypothesis testing
- (10) generalizations and interpretation
- (11) preparation of the report or presentation of the result

**1.FORMULATING THE RESEARCH PROBLEM**

- There are two types of research problems they are:

- i. Which relate to states of nature and
  - ii. Which relate to relationships between variables.
- At the very outset the researcher must single out the problem he wants to study.
- a) understanding the problem thoroughly, and
  - b) rephrasing the same into meaningful terms from an analytical point of view.
- ❖ There are two types of literature:

- a) *Conceptual literature* - consists of the concepts and theories.
- b) *Empirical literature* - consisting of studies made earlier which are similar to the one proposed.
- ❖ Research problem is a very important step in the entire research process.
- ❖ The problem to be investigated must be defined unambiguously for that will help discriminating relevant data from irrelevant ones.

## 2.EXTENSIVE LITERATURE SURVEY

- It is compulsory for a research worker writing a thesis for a Ph.D. degree to write a synopsis of the topic and submit it to the necessary Committee or the Research Board for approval.
- For this purpose, the abstracting and indexing journals and published or unpublished bibliographies are the first place to go to. Academic journals, conference proceedings, government reports, books etc.

## 3.DEVELOPMENT OF WORKING HYPOTHESIS

- ❖ Hypothesis can be developed by following approach:
  - (a) Discussions with colleagues and experts about the problem, its origin and the objectives in seeking a solution
  - (b) Examination of data and records, if available, concerning the problem for possible clues
  - (c) Review of similar studies in the area or of the studies on similar problems.

## 4.PREPARING THE RESEARCH DESIGN

- The preparation of the research design, appropriate for a particular research problem, involves usually the consideration of the following:

- (i) the means of obtaining the information
- (ii) the availability and skills of the researcher and his staff (if any)
- (iii) explanation of the way in which selected means of obtaining information will be organized.

## 5.DETERMINING SAMPLE DESIGN

- The researcher must decide the way of selecting a sample or what is popularly known as the sample design.
- Probability samples are those based on simple random sampling, systematic sampling, stratified sampling, cluster/area sampling whereas non-probability samples are those based on convenience sampling, judgement sampling and quota sampling techniques.
- A brief mention of the important sample designs is as follows:

(i)**Deliberate sampling**: Deliberate sampling is also known as purposive or non-probability sampling.

(ii)**Simple random sampling**: This type of sampling is also known as chance sampling or probability sampling where each item in the population has an equal chance of inclusion in the sample.

(iii) **Systematic sampling**: An element of randomness is usually introduced into this kind of sampling by using random numbers to pick up the unit with which to start.

(iv) **Stratified sampling**: If the population from which a sample is to be drawn does not constitute a homogeneous group, then stratified sampling technique is applied.

(v) **Quota sampling**: In stratified sampling the cost of taking random samples from individual strata is often so expensive.

(vi) **Cluster sampling and area sampling**: The clustering approach makes the sampling procedure easier and increase the efficiency of field work, especially in the case of personal interviews

(vii)**Multi-stage sampling**: This is a further development of the idea of cluster sampling.

(viii)**Sequential sampling**: This is somewhat a complex sample design where the ultimate size of the sample is not fixed in advance but is determined according to mathematical decisions on the basis of information yielded as survey progresses.

## 6.COLLECTING THE DATA

i. **By observation**: This method implies the collection of information by way of investigator's own observation.

ii. **Through personal interview**: The investigator follows a rigid procedure and seeks answers to a set of pre-conceived questions through personal interviews.

iii. **Through telephone interviews**: This method of collecting information involves contacting the respondents on telephone itself.

- ❖ This is not a very widely used method.

iv.**By mailing of questionnaires**: The researcher and the respondents do meet each other in this method of survey. It is the most extensively used method.

v.**Through schedules**: Under this method the enumerators are appointed and given training. They are provided with schedules containing relevant questions.

## 7.EXECUTION OF THE PROJECT

- Execution of the project is a very important step in the research process.
- If the execution of the project proceeds on correct lines, the data to be collected would be adequate and dependable.
- The researcher should see that the project is executed in a systematic manner and in time.
- A careful watch should be kept for unanticipated factors.

## 8.ANALYSIS OF THE DATA

- After the data have been collected, the researcher turns to the task of analyzing them.
- The analysis of data requires several closely related operations such as establishment of categories, the application of these categories to raw data through coding, tabulation and then drawing statistical inferences.

## 9.HYPOTHESIS – TESTING

- ❖ After analyzing the data as stated above, the researcher can test the hypothesis.
- Hypothesis-testing will result in either accepting the hypothesis or in rejecting it.
- If the researcher had no hypothesis to start with, generalizations established based on data may be stated as hypothesis to be tested by subsequent researches in times to come.

## 10.Generalisations and interpretation

- If a hypothesis is tested and upheld several times, it may be possible for the researcher to arrive at generalization, i.e., to build a theory.
- If the researcher had no hypothesis to start with, he might seek to explain his findings based on some theory. It is known as interpretation.

## 11. Preparation of the report or the thesis

- ❖ The layout of the report should be as follows: (i) the preliminary pages; (ii) the main text, and (iii) the end matter.
- 1. In its preliminary pages the report should carry title and date followed by acknowledgements and foreword.
- 2. The main text of the report should have the following parts:

(a) **Introduction:** It should contain a clear statement of the objective.

(b) **Summary of findings:** findings should be summarized.

(c) **Main report:** The main body of the report should be presented in logical sequence and broken-down into readily identifiable sections.

(d) **Conclusion:** Towards the end of the main text, researcher should again put down the results of his research clearly and precisely.

3. At the end of the report, appendices should be enlisted in respect of all technical data.

- Report should be written in a concise and in simple language.

## Criteria of Good Research

1. The purpose of the research should be clearly defined and common concepts be used.
2. The research procedure used should be described in sufficient detail.
3. The researcher should report with complete frankness, flaws in procedural design and estimate their effects upon the findings.
4. Conclusions should be confined to those justified by the data of the research and limited to those for which the data provide an adequate basis.

## RESEARCH DESIGN

- The formidable problem that follows the task of defining the research problem is the preparation of the design of the research project, popularly known as the “research design”.
- The research design is the conceptual structure within which research is conducted.

## NEED FOR A RESEARCH DESIGN

- Research design stands for advance planning of the methods to be adopted for collecting the relevant data and the techniques to be used in their analysis, keeping in view the objective of the research and the availability of staff, time and money.
- Preparation of the research design should be done with great care as any error in it may upset the entire project.

## FEATURES OF A GOOD DESIGN

- A good research design is needed for a particular research problem, this usually involves the following factors:

i.the means of obtaining information

ii. the availability and skills of the researcher and his staff, if any

- iii. the objective of the problem to be studied
- iv. the nature of the problem to be studied
- v. the availability of time and money for the research work

#### **BASIC PRINCIPLES OF EXPERIMENTAL DESIGNS**

- Professor Fisher has enumerated three principles of experimental designs:
  1. the Principle of Replication
  2. the Principle of Randomization
  3. the Principle of Local Control

#### **DETERMINING SAMPLING DESIGN**

- Sampling can be defined as the investigation of part of a population, in order to provide information, which can then be generalized to cover the whole population.
- For example, if you take a spoonful of ice-cream from a container and taste it, you will be able to make a general statement about how much you like that kind of ice-cream. You will have to taste a sample. You don't have to eat the whole thing in order to make an informed opinion.

#### **STEPS IN SAMPLE DESIGN**

- While developing a sampling design, the researcher must pay attention to the following points:
    - i. **Type of universe:** The first step in developing any sample design is to clearly define the set of objects, technically called the Universe.
    - ii. **Sampling unit:** A decision has to be taken concerning a sampling unit before selecting sample. Sampling unit may be a geographical one such as state, district, village, etc., or a construction unit such as house, flat, etc.
    - iii. **Source list:** It is also known as 'sampling frame' from which sample is to be drawn. It contains the names of all items of a universe (in case of finite universe only). If source list is not available, researcher has to prepare it.
- List should be comprehensive, correct, reliable and appropriate.
- iv. **Size of sample:** This refers to the number of items to be selected from the universe to constitute a sample. The size of sample should neither be excessively large, nor too small.
  - v. **Parameters of interest:** In determining the sample design, one must consider the question of the specific population parameters which are of interest.
  - vi. **Budgetary constraint:** Cost considerations, from practical point of view, have a major impact upon decisions relating to not only the size of the sample but also to the type of sample.
  - (vii) **Sampling procedure:** Finally, the researcher must decide the type of sample he will use i.e., he must decide about the technique to be used in selecting the items for the sample.

In fact, this technique or procedure stands for the sample design itself.

#### **CHARACTERISTICS OF A GOOD SAMPLE DESIGN**

- a) Sample design must result in a truly representative sample.
  - b) Sample design must be such which results in a small sampling error.
  - c) Sample design must be viable in the context of funds available for the research study.
  - d) Sample should be such that the results of the sample study can be applied, in general, for the universe with a reasonable level of confidence.
- Sampling is of 2 types:
    1. probability sampling and
    2. non-probability sampling
  - In probability sampling, the chance that an element in a target population will be selected is known.
  - In non-probability sampling, the chance that an element in a target population will be selected in the sample is unknown.

#### **Types of Sampling Techniques**

##### **Probability sampling**

1. Simple random
2. Stratified random
3. Systematic random
4. Area/cluster sampling

**Non-probability sampling**

1. Accidental/convenience
2. Judgement/purposive
3. Network/snowball
4. Quota sampling
5. Dimensional sampling
6. Mixed sampling

**Probability Sampling****a) *Simple Random Sampling***

Every member of the population has an equal chance of being included in the sample. This type of sampling is used when the population is homogenous.

e.g. lottery method (computer, roulette, table of random numbers).

**b) *Stratified Random Sampling***

The sample is deliberately drawn in a systematic way. The population is heterogeneous.

For example, Hindus, Christians, Muslims as these groups are not distributed equally in the population.

In a sample size of 50; suppose the racial population distribution is as follows:

- Muslims = 100
- Christians = 80
- SC/ST = 20.

• A proportionate stratified sampling would require 10 people be selected from each group. A disproportionate sampling would mean the selection of each stratum at a percentage. In this case  $N = 50$  is 10% of  $N = 500$

- i.e. 10% of 300 = 30,  
10% of 100 = 10,  
10% of 80 = 8,  
10% of 20 = 2.

**c) *Systematic Random Sampling***

This process involves the selection of certain elements in a series according to predetermined sequence.

**d) *Area or Cluster Sampling***

The cluster or area sample is particularly appropriate when a simple random sample proves to be prohibitive in terms of travel, time and cost.

For example, selected school, roll numbers, classes, etc.

**Non-Probability Sampling****a) *Accidental or Convenience Sampling***

One will not always be able to randomly sample from the population of interest.

- They are inexpensive and less time consuming.

**b) *Judgement or Purposive Sampling***

This involves the selection of elements, which represent a typical sample from a target population.

**c) *Network or Snowball Sampling***

This involves a multistage technique that utilizes social network of individuals who tend to share common characteristics.

- For example, alcoholics, drug addicts, child abusers, etc.

**d) *Quota Sampling***

This procedure involves the selection of proportional samples of subgroups within a target population to ensure generalization of findings.

- For example, racial minorities, elderly, poor etc.

**e) *Dimensional Sampling***

In this sampling technique, only a small sample is needed, since each selected case will be examined in more detail.

**f) *Mixed Sampling Designs***

Mixed sampling designs constitute the combination of both probability and non-probability sampling procedures.

**Sample Size**

- The following factors are to be considered:
  1. Type of study (descriptive, experimental, etc.)
  2. Number of variables (as variables increase sample size increase)
  3. Sampling method employed
  4. Expected effect size (expected difference in scores)

5. Data analysis technique

#### Factors Governing Size of Sample

1. It should be easily handled by personnel in given amount of time.
2. Sample must be large enough to allow sensible conclusions to be drawn from it.

#### Use of Sampling

- 1) Sampling may be the only way to obtain information about a population, because the true extent of the population is unknown.
- 2) The need to reduce cost.
- 3) Savings in time, manpower and money.

#### Hypothesis and Study Design

- Descriptive studies—the results obtained from this study will enable us to formulate a hypothesis.
- Analytical studies—the hypothesis proposed in the descriptive study will be tested.
- Experimental studies—these are studies with high strength of evidence.

#### MEASUREMENT IN RESEARCH

❖ In our daily life we are said to measure when we use some yardstick to determine weight, height, or some other feature of a physical object.

❖ Measurement is a relatively complex and demanding task, specially so when it concerns qualitative or abstract phenomena. Technically speaking, measurement is a process of mapping aspects of a domain onto other aspects of a range according to some rule of correspondence.

#### MEASUREMENT SCALES

• The most widely used classification of measurement scales are:

- a) nominal scale
- b) ordinal scale
- c) interval scale
- d) ratio scale

a) **Nominal scale:** Nominal scales provide convenient ways of keeping track of people, objects, and events. Nominal scale is the least powerful level of measurement. It indicates no order or distance relationship and has no arithmetic origin.

▪ Nominal data are, thus, counted data.

▪ Despite all this, nominal scales are still very useful and are widely used.

b) **Ordinal scale:** Thus, the use of an ordinal scale implies a statement of 'greater than' or 'less than' (an equality statement is also acceptable) without our being able to state how much greater or less.

▪ The real difference between ranks 1 and 2 may be more or less than the difference between ranks 5 and 6.

▪ Since the numbers of this scale have only a rank meaning, the appropriate measure of central tendency is the median.

c) **Interval scale:** In the case of interval scale, the intervals are adjusted in terms of some rule that has been established as a basis for making the units equal.

▪ Interval scales provide more powerful measurement than ordinal scales

▪ Powerful statistical measures can be used with interval scales.

d) **Ratio scale:** Ratio scales have an absolute or true zero of measurement. The term 'absolute zero' is not as precise as it was once believed to be.

▪ Ratio scale represents the actual amounts of variables.

▪ Measures of physical dimensions such as weight, height, distance, etc. are examples.

▪ Multiplication and division can be used with this scale.

#### Sources of Error in Measurement

• Measurement should be precise and unambiguous in an ideal research study.

• The following are the possible sources of error in measurement:

1. Respondent
2. Situation
3. Measurer
4. Instrument

(a) **Respondent:** At times the respondent may be reluctant to express strong negative feelings.

(b) **Situation:** Situational factors may also come in the way of correct measurement.

(c) **Measurer:** The interviewer can distort responses by rewording or reordering questions.

(d) **Instrument:** Error may arise because of the defective measuring instrument.

#### Tests of Sound Measurement

• Sound measurement must meet the tests of validity, reliability, and practicality.

• In fact, these are the three major considerations one should use in evaluating a measurement tool.

1. **Test of Validity:** Validity is the most critical criterion and indicates the degree to which an instrument measures what it is supposed to measure.

There are three types of validity in this connection:

a. Content validity is the extent to which a measuring instrument provides adequate coverage of the topic under study.



- b. Criterion-related validity relates to our ability to predict some outcome
- c. Construct validity is the most complex and abstract.
2. **Test of Reliability:**  
Reliability can be improved in the following two ways:
  - (i) By standardizing the conditions under which the measurement takes place i.e., we must ensure that external sources of variation such as boredom, fatigue, etc., are minimized to the extent possible. That will improve stability aspect.
  - (ii) By carefully designed directions for measurement with no variation from group to group, by using trained and motivated persons to conduct the research and by broadening the sample of items used. This will improve equivalence aspect
3. **Test of Practicality:** The practicality characteristic of a measuring instrument can be judged in terms of economy, convenience, and interpretability.
  - (a) detailed instructions for administering the test
  - (b) scoring keys
  - (c) evidence about the reliability
  - (d) guides for using the test and for interpreting results

## TECHNIQUE OF DEVELOPING MEASUREMENT TOOLS

The technique of developing measurement tools involves a four-stage process, consisting of the following:

- (a) Concept development
- (b) Specification of concept dimensions
- (c) Selection of indicators
- (d) Formation of index

## Data collection methods

### COLLECTION OF PRIMARY DATA

- We collect primary data during doing experiments in experimental research but in case we do research of the descriptive type and perform surveys, whether sample surveys or census surveys, then we can obtain primary data either through observation or through direct communication.
- There are several methods of collecting primary data, particularly in surveys and descriptive researches.

#### I. Observation Method:

- The observation method is the most used method specially in studies relating to behavioral sciences.
- Observation becomes a scientific tool and the method of data collection for the researcher.
- The main advantage of this method is that subjective bias is eliminated, if observation is done accurately.
- The information obtained under this method relates to what is currently happening.

Observation method has various limitations:

- It is an expensive method.
- The information provided by this method is very limited.
- If the observation takes place in the natural setting, it may be termed as uncontrolled observation, but when observation takes place according to definite pre-arranged plans, involving experimental procedure, the same is then termed controlled observation.

#### II. Interview Method:

- The interview method of collecting data involves presentation of oral-verbal stimuli and reply in terms of oral-verbal responses.

##### a) **Personal interview:**

This sort of interview may be in the form of direct personal investigation or it may be indirect oral investigation.

- But in certain cases, it may not be possible or worthwhile to contact directly the persons concerned or on account of the extensive scope of enquiry, the direct personal investigation technique may not be used.
- The method of collecting information through personal interviews is usually carried out in a structured way.

The chief merits of the interview method are as follows:

- (i) More information and that too in greater depth can be obtained.
- (ii) Observation method can as well be applied to recording verbal answers to various questions.
- (iii) The language of the interview can be adopted to the ability or educational level of the person interviewed and as such misinterpretations concerning questions can be avoided.

There are also certain weaknesses of the interview method they are:

- (i) It is a very expensive method, especially when large and widely spread geographical sample is taken.
- (ii) Certain types of respondents such as important officials or executives or people in high income groups may not be easily approachable under this method and to that extent the data may prove inadequate.
- (iii) Interviewing at times may also introduce systematic errors.

##### (b) **Telephone interviews:**

This method of collecting information consists in contacting respondents on telephone itself.

The chief merits of such a system are:

- 1) It is more flexible in comparison to mailing method.
- 2) It is faster than other methods i.e., a quick way of obtaining information.
- 3) It is cheaper than personal interviewing method
- 4) Recall is easy.
- 5) No field staff is required.

Certain demerits of this method are:

1. Little time is given to respondents for considered answers; interview period is not likely to exceed five minutes in most cases.
2. Surveys are restricted to respondents who have telephone facilities.
3. It is not suitable for intensive surveys where comprehensive answers are required to various questions.

### III. COLLECTION OF DATA THROUGH QUESTIONNAIRES:

- This method of data collection is quite popular, particularly in case of big enquiries.
- It is being adopted by private individuals, research workers, private and public organizations and even by governments.
- The respondents have to answer the questions on their own.

The merits claimed on behalf of this method are as follows:

- 1) There is low cost even when the universe is large and is widely spread geographically.
- 2) It is free from the bias of the interviewer; answers are in respondents' own words.
- 3) Respondents have adequate time to give well thought out answers.

The main demerits of this system can also be listed here:

- 1) Low rate of return of the duly filled in questionnaires; bias due to no-response is often indeterminate.
- 2) It can be used only when respondents are educated and cooperating.
- 3) The control over questionnaire may be lost once it is sent.
- 4) This method is likely to be the slowest of all.
  - Before using this method, it is always advisable to conduct 'pilot study' (Pilot Survey) for testing the questionnaires.
  - Pilot survey is in fact the replica and rehearsal of the main survey.
  - Quite often questionnaire is considered as the heart of a survey operation.

#### 1. General form:

So far as the general form of a questionnaire is concerned, it can either be structured or unstructured questionnaire.

#### 2. Question sequence:

To make the questionnaire effective and to ensure quality to the replies received, a researcher should pay attention to the question-sequence.

The following type of questions should generally be avoided as opening questions in a questionnaire:

1. questions that put too great a strain on the memory or intellect of the respondent
2. questions of a personal character

#### 3. Question formulation and wording:

About this aspect of questionnaire, the researcher should note that each question must be very clear for any sort of misunderstanding can do irreparable harm to a survey. Question should also be impartial in order not to give a biased picture. Questions should be constructed with a view to their forming a logical part of a well thought out tabulation plan.

In general, all questions should meet the following standards:

- (a) should be easily understood.
- (b) should be simple.

### IV. COLLECTION OF DATA THROUGH SCHEDULES:

- This method of data collection is very much like the collection of data through questionnaire, with little difference which lies in the fact that schedules (proforma containing a set of questions) are being filled in by the enumerators who are specially appointed for the purpose.
- This method of data collection is very useful in extensive enquiries and can lead to reliable results.
- However, it is very expensive.

#### SOME OTHER METHODS OF DATA COLLECTION

- Let us consider some other methods of data collection, particularly used by big business houses in modern times.

#### 1. Warranty cards:

Warranty cards are usually postal sized cards which are used by dealers of consumer durables to collect information regarding their products.

#### 2. Distributor or store audits:

Distributor or store audits are performed by distributors as well as manufactures through their salesmen.

#### 3. Pantry audits:

Pantry audit technique is used to estimate consumption of the basket of goods at the consumer level.

#### 4. Consumer panels:

An extension of the pantry audit approach on a regular basis is known as 'consumer panel', Mostly consume panels are of two types

- i. the transitory consumer panels
- ii. the continuing consumer panel.

#### 5. Use of mechanical devices:

The use of mechanical devices has been widely made to collect information by way of indirect means. Eye camera, Pupillometric camera, Psychogalvanometer, Motion picture camera and Audiometer are the principal devices so far developed and commonly used by modern big business houses.

#### 6. Depth interviews:

Depth interviews are those interviews that are designed to discover underlying motives and desires and are often used in motivational research.

Unless the researcher has specialized training, depth interviewing should not be attempted.

### 7. Content-analysis:

Content-analysis consists of analyzing the contents of documentary materials such as books, magazines, newspapers, and the contents of all other verbal materials which can be either spoken or printed.

- “Content-analysis is measurement through proportion.... Content analysis measures pervasiveness and that is sometimes an index of the intensity of the force.”
- The analysis may be at a relatively simple level or may be a subtle one.

### COLLECTION OF SECONDARY DATA

- Secondary data may either be published data or unpublished data.

Usually published data are available in: various publications of the central, state or local government, various publications of foreign governments or of international bodies and their subsidiary organizations, reports and publications of various associations connected with business and industry, banks, stock exchanges, etc.

The sources of unpublished data are many; they may be found in diaries, letters, unpublished biographies, and autobiographies.

### SELECTION OF APPROPRIATE METHOD FOR DATA COLLECTION

There are various methods of data collection. As such the researcher must judiciously select the method/methods for his own study, keeping in view the following factors:

1. **Nature, scope and object of enquiry:** The method selected should be such that it suits the type of enquiry that is to be conducted by the researcher.
2. **Availability of funds:** Finance, in fact, is a big constraint in practice and the researcher must act within this limitation.
3. **Time factor:** Availability of time has also to be considered in deciding a particular method of data collection.
4. **Precision required:** Precision required is yet another important factor.

### CASE STUDY METHOD

#### Meaning:

The case study method is a very popular form of qualitative analysis and involves a careful and complete observation of a social unit, be that unit a person, a family, an institution, a cultural group or even the entire community.

- It is a method of study rather than breadth.
- According to H. Odum, “The case study method is a technique by which individual factor whether it be an institution or just an episode in the life of an individual or a group is analyzed in its relationship to any other in the group.
- Burgess has used the words “the social microscope” for the case study method.

#### Characteristics:

The important characteristics of the case study method are as under:

1. Under this method the researcher can take one single social unit or more of such units for his study purpose.
2. In the context of this method, we make complete study of the social unit covering all facets.
3. In respect of the case study method an effort is made to know the mutual inter-relationship of causal factors.

#### Assumptions:

The case study method is based on several assumptions.

- i. The assumption of uniformity in the basic human nature although human behavior may vary according to situations.
- ii. The assumption of studying the natural history of the unit concerned.
- iii. The assumption of comprehensive study of the unit concerned.

Major phases involved:

Major phases involved in case study are as follows:

- i. Recognition and determination of the status of the phenomenon to be investigated or the unit of attention.
- ii. Collection of data, examination, and history of the given phenomenon.
- iii. Diagnosis and identification of causal factors.
- iv. Application of remedial measures i.e., treatment and therapy.
- v. Follow-up program to determine effectiveness of the treatment applied.

#### Advantages:

- 1) This method enables the researcher to trace out the natural history of the social unit and its relationship with the social factors and the forces involved in its surrounding environment.

- 2) It helps in formulating relevant hypotheses along with the data which may be helpful in testing them.
- 3) Case study method enhances the experience of the researcher and this in turn increases his analyzing ability and skill.

#### Limitations:

- i. It consumes more time and requires lot of expenditure.
- ii. Case study method is based on several assumptions which may not be very realistic at times, and as such the usefulness of case data is always subject to doubt.
- iii. Case study method can be used only in a limited sphere., it is not possible to use it in case of a big society. Sampling is also not possible under a case study method.

#### Processing and Analysis of Data

##### PROCESSING OPERATIONS

With this brief introduction concerning the concepts of processing and analysis, we can now proceed with the explanation of all the processing operations.

##### 1. **Editing:**

Editing of data is a process of examining the collected raw data (specially in surveys) to detect errors and omissions and to correct these when possible.

##### 2. **Coding:**

- Coding refers to the process of assigning numerals or other symbols to answers so that responses can be put into a limited number of categories or classes.

- Coding is necessary for efficient analysis and through it the several replies may be reduced to a small number of classes which contain the critical information required for analysis.

##### 3. **Classification:**

Classification can be one of the following two types, depending upon the nature of the phenomenon involved:

##### (a) **Classification according to attributes:**

- As stated above, data are classified based on common characteristics which can either be descriptive (such as literacy, sex, honesty, etc.) or numerical (such as weight, height, income, etc.).

- Data obtained this way based on certain attributes are known as statistics of attributes.

##### (b) **Classification according to class-intervals:**

- Unlike descriptive characteristics, the numerical characteristics refer to quantitative phenomenon which can be measured through some statistical units.

- Each group of class-interval, thus, has an upper limit as well as a lower limit which are known as class limits. The difference between the two class limits is known as class magnitude.

##### 4. **Tabulation:**

When a mass of data has been assembled, it becomes necessary for the researcher to arrange the same in some kind of concise and logical order. This procedure is referred to as tabulation.

- Tabulation is essential because of the following reasons:

1. It conserves space and reduces explanatory and descriptive statement to a minimum.

2. It facilitates the summation of items and the detection of errors and omissions.

Generally accepted principles of tabulation:

1. Every table should have a clear, concise and adequate title so as to make the table intelligible without reference to the text and this title should always be placed just above the body of the table.

2. Every table should be given a distinct number to facilitate easy reference.

3. The column headings (captions) and the row headings (stubs) of the table should be clear and brief.

4. The units of measurement under each heading or sub-heading must always be indicated.

5. Explanatory footnotes, if any, concerning the table should be placed directly beneath the table, along with the reference symbols used in the table.

6. To emphasize the relative significance of certain categories, different kinds of type, spacing and indentations may be used.

7. It is important that all column figures be properly aligned. Decimal points and (+) or (–) signs should be in perfect alignment.

8. Abbreviations should be avoided to the extent possible and ditto marks should not be used in the table.

## STATISTICS IN RESEARCH

- The role of statistics in research is to function as a tool in designing research, analyzing its data, and drawing conclusions therefrom.
- There are two major areas of statistics viz., descriptive statistics and inferential statistics.
- Descriptive statistics concern the development of certain indices from the raw data, whereas inferential statistics concern with the process of generalization.
- Inferential statistics are also known as sampling statistics and are mainly concerned with two major types of problems: (i) the estimation of population parameters, and (ii) the testing of statistical hypotheses.

The important statistical measures\* that are used to summarize the survey/research data are:

- (1) measures of central tendency or statistical averages
- (2) measures of dispersion
- (3) measures of asymmetry
- (4) measures of relationship
- (5) other measures

## Sampling Fundamentals

### NEED FOR SAMPLING

Sampling is used in practice for a variety of reasons such as:

1. Sampling can save time and money. A sample study is usually less expensive than a census study and produces results at a relatively faster speed.
2. Sampling may enable more accurate measurements for a sample study is generally conducted by trained and experienced investigators.
3. Sampling usually enables to estimate the sampling errors and, thus, assists in obtaining information concerning some characteristic of the population.

### SOME FUNDAMENTAL DEFINITIONS

1. *Sampling frame*: The elementary units or the group or cluster of such units may form the basis of sampling process in which case they are called as sampling units. A list containing all such sampling units is known as sampling frame.
2. *Sampling design*: It refers to the technique or the procedure the researcher would adopt in selecting some sampling units from which inferences about the population is drawn.
3. *Statistics and parameters*: A statistic is a characteristic of a sample, whereas a parameter is a characteristic of a population.
4. *Sampling error*: Sample surveys do imply the study of a small portion of the population and as such there would naturally be a certain amount of inaccuracy in the information collected. This inaccuracy may be termed as sampling error or error variance.
5. *Confidence level and significance level*: The confidence level or reliability is the expected percentage of times that the actual value will fall within the stated precision limits.

### SAMPLING THEORY

- Sampling theory is a study of relationships existing between a population and samples drawn from the population.
  - Sampling theory is applicable only to random samples.
  - Tossing of a coin or throwing a dice are examples of hypothetical universe.
  - On the other hand, the term sample refers to that part of the universe which is selected for the purpose of investigation.
- Sampling theory is designed to attain one or more of the following objectives:
- (i) **Statistical estimation**: Sampling theory helps in estimating unknown population parameters from a knowledge of statistical measures based on sample studies.
  - (ii) **Testing of hypotheses**: The second objective of sampling theory is to enable us to decide whether to accept or reject hypothesis.
  - (iii) **Statistical inference**: Sampling theory helps in making generalization about the population/ universe from the studies based on samples drawn from it.

### CONCEPT OF STANDARD ERROR

1. The standard error helps in whether the difference between observed and expected frequencies could arise due to chance.
2. The standard error gives an idea about the reliability and precision of a sample.

3. The standard error enables us to specify the limits within which the parameters of the population are expected to lie with a specified degree of confidence. Such an interval is usually known as confidence interval.

### Testing of Hypotheses I

#### (Parametric or Standard Tests of Hypotheses)

#### WHAT IS A HYPOTHESIS?

Ordinarily, when one talks about hypothesis, one simply means a mere assumption or some supposition to be proved or disproved. But for a researcher hypothesis is a formal question that he intends to resolve. Thus, a hypothesis may be defined as a proposition or a set of propositions set forth as an explanation for the occurrence of some specified group of phenomena either asserted merely as a provisional conjecture to guide some investigation or accepted as highly probable in the light of established facts.

#### Characteristics of hypothesis:

- (i) Hypothesis should be clear and precise.
- (ii) Hypothesis should be capable of being tested.
- (iii) Hypothesis should be limited in scope and must be specific.
- (iv) Hypothesis should be stated as far as possible in most simple terms so that the same is easily understandable by all concerned.

### PROCEDURE FOR HYPOTHESIS TESTING

The various steps involved in hypothesis testing are stated below:

- i. **Making a formal statement:** The step consists in making a formal statement of the null hypothesis ( $H_0$ ) and of the alternative hypothesis ( $H_a$ ).
- ii. **Selecting a significance level:** The hypotheses are tested on a pre-determined level of significance and as such the same should be specified. The factors that affect the level of significance are: (a) the magnitude of the difference between sample means; (b) the size of the samples; (c) the variability of measurements within samples; and (d) whether the hypothesis is directional or non-directional.
- iii. **Deciding the distribution to use:** After deciding the level of significance, the next step in hypothesis testing is to determine the appropriate sampling distribution.
- iv. **Selecting a random sample and computing an appropriate value:** Another step is to select a random sample and compute an appropriate value from the sample data concerning the test statistic utilizing the relevant distribution
- v. **Calculation of the probability:** One has then to calculate the probability that the sample result would diverge as widely as it has from expectations.
- vi. **Comparing the probability:** Yet another step consists in comparing the probability thus calculated with the specified value for  $\alpha$ , the significance level.

#### LIMITATIONS OF THE TESTS OF HYPOTHESES

- (i) The tests should not be used in a mechanical fashion.
- (ii) Test do not explain the reasons as to why does the difference exist.
- (iii) Results of significance tests are based on probabilities and as such cannot be expressed with full certainty.
- (iv) Statistical inferences based on the significance tests cannot be said to be entirely correct evidences concerning the truth of the hypotheses.

### Testing of Hypotheses-II

#### (Nonparametric or Distribution-free Tests)

IMPORTANT NONPARAMETRIC OR DISTRIBUTION-FREE TESTS The following distribution-free tests are important and generally used:

- (i) Test of a hypothesis concerning no difference among two or more sets of data (such as two-sample sign test, Fisher-Irwin test, Rank sum test, etc.).
- (ii) Test of a hypothesis of a relationship between variables (such as Rank correlation, Kendall's coefficient of concordance and other).

#### CHARACTERISTICS OF DISTRIBUTION-FREE OR NON-PARAMETRIC TESTS

1. They do not suppose any distribution and the consequential assumptions.
2. They are rather quick and easy to use.
3. They are often not as efficient or 'sharp' as tests of significance or the parametric tests.
4. Parametric tests cannot apply to ordinal or nominal scale data but non-parametric tests do not suffer from any such limitation.

### Interpretation and Report Writing

#### MEANING OF INTERPRETATION

The task of interpretation has two major aspects:

- (i) The effort to establish continuity in research through linking the results of a given study with those of another.
- (ii) The establishment of some explanatory concepts.

## WHY INTERPRETATION?

- i. It is through interpretation that the researcher can well understand the abstract principle that works beneath his findings.
- ii. Interpretation leads to the establishment of explanatory concepts.
- iii. Researcher can better appreciate only through interpretation why his findings are what they are and can make others to understand the real significance of his research findings.

## TECHNIQUE OF INTERPRETATION

Interpretation is an art that one learns through practice and experience.

- i. Researcher must give reasonable explanations of the relations which he has found and he must interpret the lines of relationship in terms of the underlying processes.
- ii. It is advisable, before embarking upon final interpretation, to consult someone having insight into the study and who is frank and honest and will not hesitate to point out omissions and errors in logical argumentation.

## PRECAUTIONS IN INTERPRETATION

One should always remember that even if the data are properly collected and analyzed, wrong interpretation would lead to inaccurate conclusions.

At the outset, researcher must invariably satisfy himself that

- (a) the data are appropriate, trustworthy, and adequate for drawing inferences
- (b) the data reflect good homogeneity
- ii. He must never lose sight of the fact that his task is not only to make sensitive observations of relevant occurrences, but also to identify and disentangle the factors that are initially hidden to the eye.

## SIGNIFICANCE OF REPORT WRITING

- Research report is considered a major component of the research study for the research task remains incomplete till the report has been presented and/or written.
- Writing of report is the last step in a research study and requires a set of skills somewhat different from those called for in respect of the earlier stages of research.
- This task should be accomplished by the researcher with utmost care.

## LAYOUT OF THE RESEARCH REPORT

The layout of the report means as to what the research report should contain. A comprehensive layout of the research report should comprise

- (A) preliminary pages
- (B) the main text
- (C) the end matters.

### (A) Preliminary Pages

In its preliminary pages the report should carry a title and date, followed by acknowledgements in the form of 'Preface' or 'Foreword'.

### (B) Main Text

The main text provides the complete outline of the research report along with all details.

The main text of the report should have the following sections:

- (i) **Introduction:** The purpose of introduction is to introduce the research project to the readers.
- (ii) **Statement of findings and recommendations:** After introduction, the research report must contain a statement of findings and recommendations in non-technical language.
- (iii) **Results:** The result section of the report should contain statistical summaries and reductions of the data rather than the raw data.
- (iv) **Summary:** It has become customary to conclude the research report with a very summary.
- (C) **End Matter**

At the end of the report, appendices should be enlisted in respect of all technical data such as questionnaires, sample information, mathematical derivations, and the like ones. Bibliography of sources consulted should also be given. Index (an alphabetical listing of names, places, and topics along with the numbers of the pages in a book or report on which they are mentioned or discussed) should invariably be given at the end of the report.

## Types of reports

### (A) Technical Report

A general outline of a technical report can be as follows:

1. **Summary of results:** A brief review of the main findings just in two or three pages.
2. **Nature of the study:** Description of the general objectives of study, formulation of the problem in operational terms, the working hypothesis, the type of analysis etc.
3. **Methods employed:** Specific methods used in the study and their limitations.
4. **Data:** Discussion of data collected, their sources, characteristics, and limitations.
5. **Analysis of data and presentation of findings:** The analysis of data and presentation of the findings of the study with supporting data in the form of tables and charts be fully narrated.
6. **Conclusions:** A detailed summary of the findings and the policy implications drawn from the results be explained.

7. **Bibliography:** Bibliography of various sources consulted be prepared and attached.

8. **Technical appendices:** Appendices be given for all technical matters relating to questionnaire, mathematical derivations, elaboration on technique of analysis and the like ones.

9. **Index:** Index must be prepared and be given invariably in the report at the end.

### (B) Popular Report

The general outline of a popular report is as follows:

1. **The findings and their implications:** Emphasis in the report is given on the findings of most practical interest and on the implications of these findings.
2. **Recommendations for action:** Recommendations for action based on the findings of the study is made in this section of the report.
3. **Objective of the study:** A general review of how the problem arise is presented.
4. **Methods employed:** A brief and non-technical description of the methods and techniques used, including a short review of the data on which the study is based.
5. **Results:** This section constitutes the main body of the report wherein the results of the study are presented in clear and non-technical terms.
6. **Technical appendices:** More detailed information on methods used, forms, etc. is presented in the form of appendices.

### PRECAUTIONS FOR WRITING RESEARCH REPORTS

As such it must be prepared keeping the following precautions in view:

- 1) While determining the length of the report (since research reports vary greatly in length), one should keep in view the fact that it should be long enough to cover the subject but short enough to maintain interest.
- 2) Abstract terminology and technical jargon should be avoided in a research report.
- 3) Readers are often interested in acquiring a quick knowledge of the main findings and as such the report must provide a ready availability of the findings.
- 4) The reports should be free from grammatical mistakes and must be prepared strictly in accordance with the techniques of composition of report-writing such as the use of quotations, footnotes, documentation, proper punctuation etc.
- 5) A research report should show originality and should necessarily be an attempt to solve some intellectual problem.
- 6) Towards the end, the report must also state the policy implications relating to the problem under consideration.
- 7) Appendices should be enlisted in respect of all the technical data in the report.
- 8) Bibliography of sources consulted is a must for a good report and must necessarily be given.
- 9) Index is also considered an essential part of a good report and as such must be prepared and appended at the end.
- 10) Report must be attractive, neat, and clean, whether typed or printed.

### REFERENCES

- [1] C.R.Kothari, Research methodology, methods and techniques(second revised edition), page no.1to 359.
- [2] Joseph John, Text book of preventive and community dentistry (third edition), page no. 1056 to 1066.

