PONDICHERRY UNIVERSITY

(A Central University)

DIRECTORATE OF DISTANCE EDUCATION

MASTER OF ARTS IN SOCIOLOGY

First Year

Course Code:61

Paper Code: MASY1003

SOCIAL RESEARCH METHODS AND STATISTICS

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SOCIAL RESEARCH METHODS AND STATISTICS

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SOCIAL RESEARCH METHODS AND STATISTICS

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Reference Books:

The Practice of Social Research – Babbie.E.R. 1979, Wadsworth Publishing Company Inc., California .

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UNIT - I

INQUIRY AND SCIENCE

LESSON - 1.1

SCIENCE

DEFINITION OF SCIENCE

In general, there are two broad views of science; the static, and the dynamic. The static view is that science is an activity that contributes systematised information to the world. The scientist's job is to discover new facts and to add them to the already existing body of information. Science is thus conceived to be a body of facts. Science, in this view, is also a way of explaining observed phenomena. The emphasis, then, is on the 'present state of knowledge and adding to it', on the extent of knowledge, and on the present set of laws, theories, hypotheses, and principles.

The dynamic view, on the other hand, regards science more as an 'activity', what scientists do. The present state of knowledge is important, of course. But it is important mainly because it is a base for further scientific theory and research. This has been called a 'heuristic view'. The heuristic view in science emphasises theory and inter-connected conceptual schemata that are fruitful for further research. A heuristic emphasis is a discovery emphasis. The heuristic view in science stresses problem-solving rather than facts and bodies of information.

Einstein and Infield (1938:280) state the essence of science as "Science is the attempt of the human mind to find a connection between the world of ideas and the world of phenomena. All the essential ideas in science were born in dramatic conflict between reality and our attempt at understanding the same".

Science aims at creation of new knowledge or finding out the truth. In this sense, science is a means for acquiring knowledge. A scientific endeavour operates at several levels viz., creation of new knowledge, ascertaining truth, discovering truth that already exists, or has occurred and the verification/modification of the old stock or branch of knowledge. "Science is an objective, logical and systematic method of analysis of phenomena devised to permit the accumulation of reliable knowledge. It is a systematised form of analysis ... not any particular body of knowledge" (Lastrucci, 1967:6).

Science is independent of any particular subject-matter or order of facts. It takes knowable universe for its object. Science is an intellectual construction – a working thought-model of the world and its aim is to describe and conceptualise the impersonal facts of experience in verifiable terms, as exactly, as simply and as completely and meaningfully as possible.

Science is based upon facts, i.e., such propositions as are supported by material evidence. It is not facts themselves which make science. It is rather the method by which they are dealt with.

Science has been popularly defined as an accumulation of systematic knowledge, and 'knowledge' refers to the goal of science while 'systematic' refers to the method that is used to attain the goal. In fact, the aim of any kind of study, whether scientific or otherwise, is to acquire knowledge, to know the truth and reality behind a phenomenon. Thus it is the systematic knowledge which ultimately distinguishes science from other branches of knowledge.

Science is "a systematised knowledge derived through observations, experimentation or any other systematic method or procedure in order to determine the nature of the phenomena being studied or the causes behind specific events". (G. Thakur, 1993:3). This definition considers science both as a body of knowledge, and as a system of procedure and methods.

Goode and Hatt say science is a method of approach to the entire empirical world, i.e. to the world which is susceptible to human experience. Furthermore, it is an approach which does not aim at persuasion, at the finding of 'ultimate truth' or at conversion. It is merely a mode of analysis that permits the scientist to state propositions in the form of 'if, then'. They further state, the sole purpose of science is to understand the world in which man lives.

In other words, a branch of knowledge which can be called science should necessarily be studied through the scientific method.

Bernard defines science in terms of six major processes that take place within it. These are testing, verification, definition, classification, organisation, and orientation which include prediction and application (L.L. Bernard, 1934: 273-74).

The function of science, when science is regarded as a discipline or activity aimed at improving things and at making progress is to make discoveries, to learn facts, to advance knowledge in order to improve things. This function of science is to improve man's lot. The criterion of practicality is pre-eminent here.

A very different view of the function of science is well expressed by Braithwaite. According to him the function of science is "to establish general laws covering the behaviours of the empirical events or objects with which the science in question is concerned, and thereby to enable us to connect together our knowledge of the separately known events, and to make reliable predictions of events as yet unknown" (R. Braithwaite, 1955:1).

The basic aim of science is theory. Perhaps less cryptic, the basic aim of science is to explain natural phenomena. Such explanations are called theories. Other aims of science are explanation, understanding, prediction and control. If we accept theory as the ultimate aim of science, however, explanation and understanding become simply sub-aims of the ultimate aim.

Science and common sense differ sharply in five ways. These disagreements revolve around the words 'systematic' and 'controlled'.

(i) The uses of conceptual schemes and theoretical structures are strikingly different. While the man in the street uses 'theories' and concepts, he ordinarily does so in loose fashion. He often blindly accepts fanciful explanations of natural and human phenomena. The scientist, on the other hand, systematically builds his theoretical structures, tests them for internal consistency, and subjects aspects of them to empirical test.

(ii) The scientist systematically and empirically tests his theories and hypotheses. The man in the street tests his 'hypotheses', too, but he tests them in what might be called a selective fashion. He often 'selects' evidence simply because it is consistent with his hypothesis. The social scientist carefully guards his research against his own preconceptions and predilections and against selective support of his hypotheses. For one thing, he is not content with armchair exploration of a relation; he must test the relation in the laboratory or in the field. He insists upon systematic, controlled, and empirical testing of these relations.

(iii) The third difference lies in the notion of control. The scientist tries systematically to rule out variables that are possible 'causes' of the effects he is studying other than the variables that he has hypothesised to be the 'causes'. The layman seldom bothers to control his explanations of observed phenomena in a systematic manner. He ordinarily makes little effort to control extraneous sources of influence. He tends to accept those explanations that are in accord with his preconceptions and biases.

(iv) The scientist is constantly preoccupied with relations among phenomena. So is the layman who invokes common sense for his explanations of phenomena. But the scientist consciously and systematically pursues relations. The layman's preoccupation with relations is loose, unsystematic and uncontrolled.

(v) A final difference lies in different explanations of observed phenomena. The scientist, when attempting to explain the relations among observed phenomena, carefully rules out what have been called 'metaphysical explanations'. A metaphysical explanation is simply a proposition that cannot be tested. In short, science is concerned with things that can be publicly observed and tested. If propositions or questions do not contain implications for such public observation and testing, they are not scientific questions.

The important characteristics of science, thus, are: (i) empirical, (ii) theoretical, (iii) cumulative, and (iv) non-ethical.

LESSON - 1.2

THE SCIENTIFIC METHOD

By 'Research' is meant any enquiry or investigation regarding any phenomena or event in order to discover facts. Science includes a body of knowledge and a system of procedures. A scientific research means an investigation carried on through systematic procedures. Thus, investigation carried on in the field of any science comes under scientific research. In this sense research in social sciences is also scientific.

The scientific research has two important characteristics:

(i) That the scientific research is systematic and controlled, which means that scientific investigation is ordered and the research situation is disciplined. Among the many alternative explanations of a phenomenon, all but one are systematically ruled out. One can thus have greater confidence in the tested and established relationship among the variables.

(ii) That scientific investigation is empirical, which means that it has to be tested or checked against objective reality. As it is easy to exaggerate or over-generalise, each study must be subjected to empirical enquiry and test. Thus, criterion of testing one's hypothesis or theories systematically and empirically makes the results of scientific research different from the non-scientific ones.

To fulfil the above two characteristics scientific research makes use of what we call as 'scientific method'.

Science implies two things: a body of knowledge as well as a system of methods. When we talk about scientific method we are actually talking about the methodological aspect of science, i.e., its system of procedures followed in any investigation.

Scientific method has been defined differently by different scholars. Some definitions spell out the steps or procedures to be followed to make

it scientific, while the others point out its characteristics. To G.A. Lundberg, a scientific method consists of systematic observation, classification and interpretation of data. And the main difference between our day-to-day generalisations on the one hand and the conclusions derived through the application of the scientific methods on the other, lie in the degree of formality, rigorousness, verifiability and general validity of the latter.

The scientific method is also viewed as a system of techniques and processes. Techniques may differ from one science to another; but all the sciences are similar in the sense that they all aim to fulfil the essential characteristics of scientific methods, like objectivity, reliability and validity, besides their aim to discover general laws.

"The scientific method is a systematic, organised series of steps that ensures maximum objectivity and consistency in researching a problem" (Schaefer and Lamm, 1989:33).

The scientific method has two important bases – one that deals with the method employed and the other with the result achieved. Any mode of investigation by which science has been built up and is being developed is entitled to be called as a scientific method.

The scientific method refers to a procedure or a mode of investigation by which scientific and systematic knowledge is acquired. In an effort to obtain accurate knowledge, scientific method applies several distinct steps. These steps include identifying a problem, formulating hypotheses, developing a research design, collecting data, analysing data and arriving at conclusions.

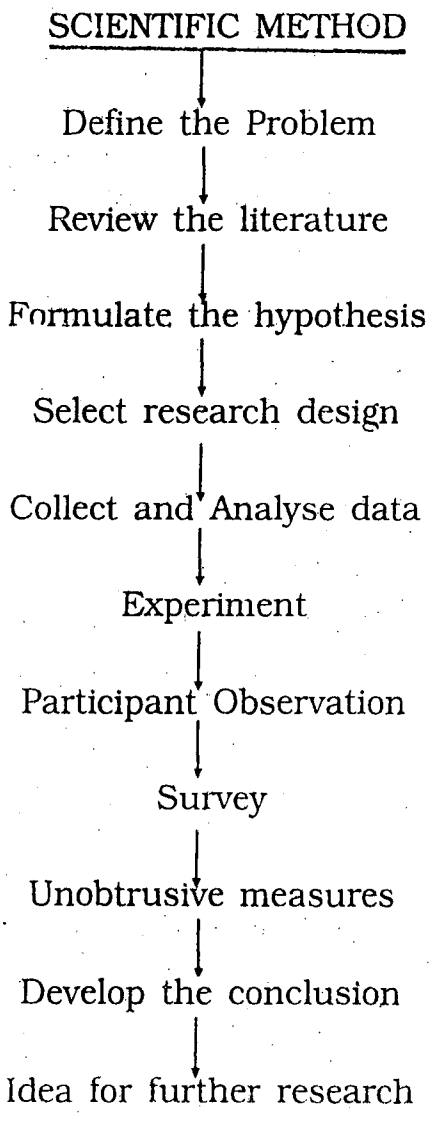
The scientific method is a system of techniques and processes. Techniques may differ from one science to another, but all the sciences are similar in the sense that they aim to fulfil the essential characteristics of scientific method viz., objectivity, reliability and validity. Scientific method allows researchers to objectively and logically evaluate the facts collected. This can lead to further ideas for social research.

From the above definitions, the following derivations about scientific method can be made:

1. It is a system of procedures which are similar to some extent and different in other in case of different sciences. However, it has some basic standardised steps or procedures, which are observation, classification, interpretation and application. Following these procedures any study or investigation can be made scientific.

2. It has some specific goals, which are development of theories or laws, which provide explanations and predictions.

The following figure explains this process:



3. There are different techniques for different category of sciences, viz., natural, formal, social and so on. The techniques differ in relation to the phenomena to which they are suited and in terms of their exactness or other scientific characteristics.

4. There are certain essential criteria which must be fulfilled in order that any study can be called as scientific. These are: objectivity, reliability and validity. Besides these, the study must also fulfil the notion of prediction and control.

CHARACTERISTICS OF THE SCIENTIFIC METHOD

The essential characteristics or criterions of scientific methods are: (i) Objectivity, (ii) Reliability, (iii) Validity, (iv) Verifiability, (v) Definiteness, (vi) Generality, (vii) Control and Predictability, and (viii) System.

1. Objectivity

Study of any phenomena may be either subjective or objective. A study is called as 'subjective' when it is influenced by the values, feelings and beliefs of the researcher. On the contrary, any study is considered as 'objective' when it is based upon the objective observation of the factual events and not upon personal judgements. In other words, when a phenomenon is observed in its true form without being affected by the observer's own views it may be termed as objective observation.

Objectivity is an essential criterion to consider any study as scientific or non-scientific. The main criterion of objectivity is that all persons should arrive at the same conclusion about the phenomenon. Objectivity, as stated by Lundberg, permits repetition of observation under practically identical conditions. This facilitates verification of observation by many observers. Objectivity is fundamental to all sciences.

2. Reliability

In simple terms, reliability means the degree of accuracy of a measuring instrument. It refers to the degree to which scores of a test remain constant for the same unit of measurement over times. Reliability

is, according to Kerlinger, "the relative absence of errors of measurement in a measuring instrument". It would be wrong to expect that a measuring instrument will be perfecty free from errors. The success of measurement depends upon the degree or extent to which errors can be eliminated. Important instruments of investigation in the area of social or behavioural sciences are questionnaire, schedule, interview, content analysis and case history. Their reliability depends upon the way they are constructed and used. The extent to which they are reliable, they are dependable also.

There are three different ways by which reliability of a measuring instrument is tested:

(i) If repeated study of the same thing with the same or comparable measuring instrument under the same conditions gives the same or similar result then the instrument can be called as being reliable.

(ii) Second way of knowing the reliability of a measuring instrument is by knowing whether the measures obtained from a measuring instrument are true measures of the property being measured. That is, whether the measures are accurate or not.

(iii) The third way of testing reliability is by measuring the exact amount of error in a measuring instrument:

3. Validity

Validity of a measuring instrument means the extent to which differences in scores on it reflect true differences among individuals, groups, or situations in the characteristic which it seeks to measure, or true differences in the same individual, group or situation from one occasion to another, rather than constant or random errors. A valid and reliable measuring instrument is one that measures the characteristics both accurately and distinctly. That means the differences in scores on the measuring instruments should reveal true differences among the individuals, objects or units of measurement. The measuring instruments vary among themselves in the specificity or exactness of measurement.

Any measuring instrument is valid when it measures most accurately the objects or individuals and their characteristics. The questions that emerge in relation to the validity of a measuring instrument are:

(a) What does it measure?

(b) Are the data it provides relevant to the characteristics in which we are interested?

(c) Do the difference in scores represent true differences in the characteristics being measured or are the differences due to influence of other factors?

4. Verifiability

Scientific research is a continuous process of verification. Process of verification consists of repeated study of the same thing under the similar conditions in order to check the accuracy of the conclusion or inferences drawn. It means that the conclusions drawn through a scientific method are subject to verification at any time. Verifiability presupposes that the phenomena must be capable of being observed and measured.

If the predictions made are found to be correct or if repeated study gives the same result then the study can be considered as accurate, reliable, or valid. Verification consists of corroboration of the expressed results, generally by replication of the observations by unbiased observers.

Problem of verification in empirical science resolves itself into four aspects: (a) The logical structure of the hypothesis and of the research design, (b) The precision and appropriateness of the method, (c) Criteria of reliability and validity, and (d) The credibility of the investigation and the problem of verification.

5. Definiteness

Scientific method implies the quality of definiteness. Any conclusion derived through this are always definite in nature. The researcher can test the correctness of, or accuracy of generalisation drawn by him when they are definite in nature.

6. Generality

Scientific laws are universal in their application. As the aim of science is to trace order in nature, science seeks to ascertain the common characteristics of types of objects and general laws or conditions of events. Scientific conclusions are not particularistic but general in nature. They are not related to the specific or unique characteristics or behaviours of the individual units, but rather, are related to the common characteristics of a class of individuals. The generalisations drawn cover not only the individuals who have been studied but also the similar individuals who were not selected in sample.

7. Control and Predictability

Another characteristic of science is that its result can be predicted with sufficient accuracy. Predictability is based on two factors, viz., fixity of relationship between cause and effect and the stability of causative factors themselves. Predictability, thus, depends, on the one hand upon the nature of phenomena itself and on the other, upon our knowledge of various causative factors. If the number of these causative factors is large and they pull their weight in different directions, accurate prediction becomes rather difficult. This is the kind of difficulty that social phenomena have to face.

8. Systems

Scientific conclusions are not only true but are also born out of a systematic mode of investigation. It is only under these circumstances that the results can be verified. This is what Lundberg calls, 'formality and rigorousness' and Wolfe terms as 'system'. In every science there is an accepted mode of investigation and inference which must be adhered to. The result arrived at by means of haphazard methods, even if true, can not be called scientific because their accuracy is purely accidental.

The important characteristics of the scientific method may be summarised as follows:

1. Scientific method is used with a purpose such as to verify any old theory or to acquire new knowledge.
2. Scientific method is related to a theory in two ways:
   i) every scientific method is operationalised on some theoretical basis; and
   ii) every scientific method through its research activity either gives birth to a new theory or modifies the old theory. At the very least, it comes out with a new hypothesis rejecting the old one.
3. Every scientific activity aims at validating or revalidating established facts. However, it must be noted that all research activities do not lead to the generation of new knowledge; sometimes a research activity may not modify the established truth.
4. Scientific method seeks a systematic pattern in the social phenomena studied.
5. Objectivity is another basic characteristic of the scientific method.
6. Verifiability refers to the re-testing by repeated occurrences of the facts.

LESSON - 1.3

RESEARCH

DEFINITION OF RESEARCH

Research in common parlance refers to a search for knowledge or a scientific and systematic search for pertinent information on a specific topic. In other words, it is a systematised effort to gain new knowledge.

Research means any enquiry or investigation regarding any phenomena or event in order to discover facts.

The Encyclopaedia of Social Sciences defines research as "the manipulation of things, concepts or symbols for the purpose of generalising to extend, correct or verify knowledge, whether that knowledge aids in construction of theory or in the practice of an art" (D. Slesinger and M. Stephenson, 1930).

Webster's International Dictionary defines research as "a careful critical inquiry or examination in seeking facts or principles; diligent investigation in order to ascertain something".

Research is "an endeavour to discover intellectual and practical answers to problems through the application of scientific methods to the knowable universe" (Wilkinson and Bhandarkar, 1988:1).

Thus, research refers to a critical and exhaustive investigation or experimentation having as its aim the revision of accepted conclusions in the light of newly discovered facts. In other words, research is a systematic attempt to push back the bounds of comprehension and seek beyond the horizons of our knowledge some 'truth', some reality, shrouded in a subtle way and consequently, to keep on extending as well as consolidating these horizons without end. Therefore, the activities that go by the name of research involve mainly a 're-search', i.e. activities undertaken to repeat a search.

Research may mean searching for a theory, testing a theory, or solving a problem. It means that a problem exists and has been identified and that a solution for it is necessary. The problem is not ordinary in the sense that the solution is here and now. Experience, authority, inductive reasoning and deductive reasoning may also solve problems but their procedures are not scientific in the real sense of scientificness.

Research is considered to be the more formal, systematic, and intensive process of carrying on a scientific method of analysis. Research is a systematic activity directed towards discovery and the development of an organised body of knowledge. Research is, then, as defined by J.W. Best (1978:8-9) "the systematic and objective analysis and recording of controlled observations that may lead to the development of generalisations, principles, or theories, resulting in prediction and ultimate control of many events that may be consequences or causes of specific activities".

F.N. Kerlinger (1973:11) defines scientific research as "systematic, controlled, empirical, and critical investigation of hypothetical propositions about the presumed relations among natural phenomena". This definition states two points: (i) scientific research is systematic and controlled in effect that scientific investigation is so ordered that investigators can have critical confidence in research outcomes. This means that the research observations are tightly disciplined. Among the many alternative explanations of a phenomenon, all but one are systematically ruled out; (ii) scientific investigation is empirical. Subjective belief must be checked against objective reality.

Scientific research, therefore, consists of obtaining information through empirical observations that can be used for the systematic development of logically related propositions attempting to establish causal relations among variables.

Research is systematic when it follows steps or stages that begin with identification of the problem, relating this problem to existing theories, collection of data, analysis and interpretation of these data, drawing of

conclusions, and integration of these conclusions into the mainstream of knowledge.

Research may be motivated by the desire to know or understand for the sake of knowing or by the desire to know in order to use this knowledge for practical concerns.

LESSON - 1.4

SOCIAL RESEARCH

DEFINITION OF SOCIAL RESEARCH

"Social research" is a broad term referring to different kinds of scientific inquiries conducted in the field of social sciences and to some extent, the behavioural sciences. In other words, the term 'social research' may be used to cover all scientific inquiries within the field of social behavioural sciences.

Encyclopaedia of the Social Sciences defines social research as "a systematic method of exploring, analysing, and conceptualising social life in order to extend, correct or verify knowledge, whether that knowledge aids in the construction of a theory or in the practice of an art" (Slesinger and Stevenson, 1930: 330).

Social research may be defined as a scientific undertaking which, by means of logical and systematised techniques, aims to: (i) discover new facts or verify and test old facts; (ii) analyse their sequences, interrelationships, and causal explanations which are derived within an appropriate theoretical frame of reference; (iii) develop new scientific tools, concepts, and theories which facilitate reliable and valid study of human behaviour (P.V. Young, 1956).

It is clear that a researcher's primary goal - distant or immediate - is to explore and gain an understanding of human behaviour and social life, and thereby gain greater control over them.

Social research is, thus, nothing more than the application of scientific procedures of manipulation (purposeful control) of observation, of analysis and of synthesis at a higher level of generality to the social-human phenomena with a view to test, modify and enlarge the systematic knowledge about social facts and social life.

Social research, therefore, has a reference to scientific undertaking centred on social phenomena which aims to discover new facts or verify old ones, to analyse their sequences, inter-relationships, causal explanations and natural laws governing them by means of logical and systematised methods.

Social research, thus, has the following characteristics:

1. Social research deals with social phenomena. It studies human behaviour – feelings, responses, attitudes, etc. of humans as social beings under different circumstances.
2. Social research is carried out not only for discovering new facts, new relationships and new laws governing the phenomena but also the verification of old ones.

   Verification is needed for two reasons:

   (i) there may be an improvement in research technique which may necessitate the testing of old concepts, and

   (ii) the phenomena under study might have undergone a change which may require testing the validity of old concepts.
3. Social research tries to establish causal connection between various human activities.

OBJECTIVES OF SOCIAL RESEARCH

Objectives of social research differ with nature of studies and goals to be attained; some studies aim at gathering descriptive data, or explanatory data, or data from which theoretical constructs could be formulated, or data which promote administrative changes or comparisons.

Though each research study has its own specific purpose, the objectives of social research may be described as follows:

(i) To gain familiarity with a social phenomenon or to achieve new insights into it;

(ii) To portray the characteristics of a particular individual, situations or a group;

(iii) To determine the frequency with which something occurs or with which it is associated with something else; and

(iv) To test a hypothesis of a causal relationship between variables.

Empirical social research, like any other type of research, does not aim at persuasion nor at finding ultimate truths (Cohen and Nagel, 1934:5). Rather, it aims, through precise demonstration, to understand and clarify the behaviour of man, the social world in which he lives, the relationships which he maintains, the influences which are exerted upon him, and the effects these have upon him and, subsequently, upon the social institutions of which he is a part. Research studies aim at gathering empirically verifiable and valid data, and data which are meaningful in relation to the formulated hypotheses and the theoretical frame of reference.

Social research is interested in the discovery and interpretation of social processes, patterns of behviour, similarities and dissimilarities that apply to typical social phenomena and social systems. Facts are selected and related according to their intrinsic nature and their susceptibility to organisation into a logical system. This search for knowledge has a definite relation to people's basic needs and welfare. The social scientist assumes that all knowledge is potentially useful.

Various objectives of social research may be classified into parts:

(i) academic objectives; and

(ii) utilitarian objectives.

The academic purpose of social research, as of any other research, is the acquisition of knowledge - to get true and intimate knowledge of human society and its functioning, to know and understand the laws that operate behind various social activities of man.

The utilitarian purpose of social research is to understand social life and thereby gain a greater measure of control over social behaviour.

STEPS IN SOCIAL RESEARCH

Every scientific investigation is based on certain well-planned steps and carried on with the help of certain accepted principles. Although not all research studies follow the same pattern, it is possible to spell out the steps that occurs frequently in the research process.

Formulating the Research Problem

Formulation of a general topic into a specific research problem constitutes the first step in a scientific enquiry. Essentially two steps are involved in formulating the research problem: (i) understanding the problem thoroughly, and (ii) rephrasing the same into meaningful terms from an analytical point of view. This would facilitate stating as clearly as possible what is to be investigated i.e., from a vague topic of interest to a more specific area of investigation, developing a reasonable research question and the objectives of investigation.

Suppose, a research is conducted to study an abstract concept - such as status, intelligence or prejudice – it is necessary to develop workable and valid operational definitions of the concepts. An 'operational definition' is an explanation of an abstract concept that is specific enough to allow a researcher to measure it.

Reviewing the Literature

The next step is to review the existing literature to get acquainted with the selected problem, and to find out what has already been done, what is still to be done and in what way the proposed study is going to search for the new. Prior work may offer general descriptions, raise key questions, discuss the strengths and limitations of measures that have already been tried, and suggest profitable lines of further research.

By conducting a review of literature, researchers refine the problem under study, examine different techniques used, decide the possible techniques to be used and avoid obvious pitfalls.

The survey of the related literature is not merely a ritual; it enhances the knowledge of the problem and also gives additional conceptual and methodological guidance. In other words, review of literature gives both a thematic as well as a methodological direction.

Formulating Hypotheses

From a careful examination of relevant theory and previous findings, the researcher would be able to state one or more hypotheses – tentative, testable statements of relationships between particular variables. Hypotheses are important since they provide the focal point for research. Hypothesis should be specific and limited to the research in hand because it has to be tested. It also indicates the type of data required and the type of methods of data analysis to be used.

Developing a Research Design

Researchers decide on a design for the study in order to guide them in collecting and analysing data, so as to test a hypothesis and determine if it is supported or refuted. Research design is the detailed plan for selecting the unit of analysis, determining how the key variables will be measured, selecting a sample, assessing sources of information, and obtaining data to test correlation, time order, and to rule out rival hypotheses.

There are a number of questions to be answered while the research design is being developed: Will the study be a survey, an experiment or a case study? If it is a survey, will data be collected from a cross-section of an entire population or will a sample be selected from only a particular area? Will simple percentage or more sophisticated statistical methods be used?

Collecting Data

Researchers gather information in a variety of ways, depending on what they want to investigate and what is available. They may use field observation, interviews, questionnaires, available statistics, historical documents, content analysis, etc. The researcher should select the

appropriate method(s) of collecting the data taking into consideration the nature of investigation, objective and scope of the enquiry, financial resources, available time and the desired degree of accuracy.

Analysing Data

Once the data are collected and classified according to decisions made during research design, they can be analysed to determine if the hypotheses are valid or not. This is not as easy or automatic as it sounds. Results are not always obvious. As the same data can be interpreted in several ways, judgements have to be made.

Arriving at Conclusions

After analysing the data, a researcher has to arrive at some conclusions. It is at this stage that the hypotheses are formally accepted, rejected or modified. The conclusions of the study are related to the theory or research findings on which the hypotheses are based. However, it is to be noted that scientific studies do not aim at answering all the questions that can be raised about a particular subject. Therefore, the conclusion of a research study represents both an end and a beginning. It terminates a specific phase of the investigation, but it should also generate ideas for future study.

USE OF SOCIAL RESEARCH

The various uses of social research may be grouped broadly under the following four general categories:

i) To gain familiarity with a phenomenon or to achieve new insights into it, often in order to formulate a more precise research problem or to develop hypotheses.

ii) To portray accurately the characteristics of a particular situation or group or individual (with or without specific initial hypotheses about the nature of these characteristics).

iii) To determine the frequency with which something occurs or with which it is associated with something else (usually, but not necessarily, with a specific initial hypothesis).

iv) To test a hypothesis of a causal relationship between variables.

The following are the important practical benefits and theoretical implications of social research:

i) Social research plays an important role in guiding social planning. Effective social planning depends for its success on a systematic knowledge of the societal resources and liabilities. Social research is of immense help in securing such knowledge.

ii) Social research by affording first-hand knowledge about the organisation and working of society and its institutions, gives a greater control over social phenomena.

iii) Social research also unravels diversity in the midst of apparent unity.

iv) Social research has direct implications for social welfare as it provides guidelines for appropriate measures of welfare or reform.

v) Social research has the effect of initiating and guiding social growth on proper lines and towards desirable goals.

vi) Social research effects constant improvements in the tools and techniques of research.

VALUE OF SOCIAL RESEARCH IN INDIA

Social research, like any other research, is a continuous process. In this continuing process a few specialised theories have emerged, and the emphasis or concentration on areas of study and avenues of theorising has kept shifting from time to time.

Research designed to test hypotheses derived from social theories developed in different socio-cultural contexts, in addition to testing and clarifying the theories by unfolding the ramifications of their operation, also help define by pointing out their limitations and thus add to their representativeness.

Social researches conducted in different socio-cultural contexts go a long way in providing rich insights whereby different concrete phenomena may be grouped under a concept, and by enlarging the bounds of the

concepts which are the building blocks of theories, help enlarge the scope by theories. For example, a study of 'modernisation' in the Indian context which may be considered a unique magnetic field of social forces pulling in opposite directions, is rightly expected to be quite revealing and enlightening besides its feed-back to theory.

Any specific phenomenon in a particular socio-cultural context, that may legitimately be considered a concrete referent of a concept but which does not conform to the expectations (predictions) based on the theory of which the concept is a unit, introduces a problem. The solution of this problem by research has definite consequences for the theory in terms of its revision or clarification or rejection.

Why do we need researches conducted in diverse socio-cultural settings in a country like India? It is because findings of researches conducted in particular socio-cultural settings (i.e., the generalisations or theories) cannot be expected to apply automatically to any other socio-cultural context as these contexts differ from each other in important respects. A virtual transplant of research products, i.e., theories, on to any other socio-cultural context may be either improper or inadequate because the soils are different. This warrants acceptance of these products of research only after vigorous testing in diverse socio-cultural settings. Therefore, such diversified social researches carried out across the country have a very special place not only for enhancing our theoretical knowledge but also for practical purposes in terms of shaping our social policy and planning.

The heterogeneous nature of Indian society occupies a unique place in the realm of social research, particularly after India's independence, as it heralded a new era of consciousness and development, of progressive policy-making and legislation and of multitudinous changes and problems. Moreover, India is wedded to the policy of social welfare and social justice through socialism.

Social planning is important as it plans for development – material, social and cultural–in such a manner that the weaker and more vulnerable sections of the population in particular, would benefit from its fruits and join the main stream of national consciousness.

To achieve the cherished goal of development through social planning, the need for systematic social surveys and researches in areas where plans were proposed to be implemented was recognised by the planners. If planning was to be meaningful to people for whom it is intended, if it was to be realistic in a particular context of needs and aspirations, if the programme of its implementation was to be a people's programme and not one imposed on them, then it should be based on complete and reliable data on the people who are to be the beneficiaries, their need-structure (priorities), their values, their attitudes, their strengths and weaknesses. Systematic studies of communities is a pre-requisite for the successful implementation of any developmental programme for the community as it depends ultimately on the peoples' acceptance and participation.

India is a welfare state. In addition to the general social services like education, health etc., the specialised social services intended for the benefit of the weaker and vulnerable sections of the population, women, children and the physically, mentally and socially handicapped are being implemented. These services in order to be beneficial and fruitful have to be based on a reliable assessment of the need and feelings of the people whose welfare is being contemplated. Scientific social surveys and researches can provide the reliable data required.

India is passing through various stages and dimensions of social transformation such as industrialisation, urbanisation, population explosion and so on. The manifold and multi-faceted implications of these social forces need to be understood by conducting scientific social researches on a fairly large scale. It provides a systematic understanding of the nature of problems, proper diagnosis and an effective treatment plan.

LESSON - 1.5

SOCIAL RESEARCH METHODS: SOCIAL SURVEY

DEFINITION OF SOCIAL SURVEY

The word 'survey' is derived from the words 'Sur' or 'Sor' and 'Veeir' or 'Veoir' which mean 'over' and 'see' respectively. Thus, the literal meaning of the word survey is to take over something from a high place but it has come to be used as a term with a specific connotation of its own.

The term 'social survey' indicates the study of social phenomena through survey methods. In this sense, 'social survey' is used for technique of investigation by direct observation of phenomena or collection of information through interviews, questionnaires, etc.

According to S.M. Harrison, social survey is "a comparative undertaking which applies scientific method to the study and treatment of current related social problems and conditions having definite geographic limit and bearing, plus such a spreading of facts, conclusions and recommendations as will make them as far as possible the common knowledge of the community and a force for intelligent co-ordinated action".

For H.N. Morse, survey is "a method of analysis in scientific and orderly form for defined purpose of given social situation or problem or population".

M. Abrams defines social survey as "a process by which quantitative facts are collected about the social aspect of a community's composition and activities".

Survey is "a method of collecting data in which a specifically defined group of individuals are asked to answer a number of identical questions" (T.L. Baker, 1988:165).

It is clear from the above definitions that (i) social survey is confined to the study of immediate problems of society; (ii) its geographical scope is sufficiently limited and its field of study is geographically localised; (iii)

the purpose of survey is to prepare constructive programme of social research or removal of immediate evils; (iv) the facts collected in a survey may form the basis of further social research on the matter. They may result in formulation of a new hypothesis requiring further elaboration, but it is not always the object of a survey; and (v) it requires co-operative effort and use of scientific methods.

A social survey, broadly speaking, refers to a first-hand investigation and analysis of social phenomena, and its purpose is to provide scientifically gathered facts or materials. Thus, it may be defined as an operation undertaken basically to provide scientifically gathered material, affording a basis for drawing conclusions, theory construction and/or formulating a programme for action.

Social survey has social action as its central concern. In this sense, social survey is viewed not only as a method for the study and analysis of social phenomena but also one serving as a basis for a programme of social planning and social action.

OBJECTIVES OF SOCIAL SURVEY

A survey may be organised for administrative purposes, or to investigate some cause-effect relationship or to throw fresh light on some aspect of sociological theory. The various objectives of social survey may be classified as follows:

1. Supply of Information on a Problem

The purpose of many surveys is simply to provide information -- say to a government department, a business concern or a research institute. Most of the surveys are utilitarian in nature and are meant to provide information regarding practical problems.

2. Description of Phenomena

Surveys are also used for detailed description of phenomena as a way of studying social conditions, relationship and behaviour. Surveys help the researcher to come in direct contact with the phenomena under study and

thus provide him all required details. The purpose of these surveys is to collect general information and they are not meant to prove or disprove anything. These surveys may, therefore, be started without any specific hypothesis. Of course, an analysis of the data so collected may serve as a basis for a hypothesis later on.

3. Explanation of Phenomena

Many surveys aim at explaining rather than describing the relationships between a number of variables. The function of the surveys may be theoretical i.e., test some hypotheses or practical i.e., to assess the influence of various factors which can be manipulated by public action upon some phenomena.

A survey may thus be general or specific. It may be purely utilitarian or may have academic importance aimed at verification of some established theory or any of its corollaries. It thus, helps in the refinement and expansion of old theories and in the establishment of new ones. Even those theories that are based upon logical inferences of accepted principles have to stand the test of verification through surveys.

TYPES OF SOCIAL SURVEYS

Surveys may be classified according to their subject matter, technique of data collection, regularity, etc. The different types of surveys may be classified as follows:

General or Specific Surveys

When a survey is conducted for collecting general information about any population, institution or phenomena without any particular objective or hypothesis it is known as a general survey. Such surveys are mostly undertaken by the government for supplying regular data on many socio-economic problems. Census of population every tenth year is a typical example of such a survey.

Specific surveys are conducted for specific problems or for testing the validity of some theories or hypotheses. These surveys are naturally more

pointed and only such information as is directly related to the specific purpose is collected. Information gathered through these surveys is generally of very little value outside the problem under study.

Regular and 'Adhoc' Surveys

Some surveys are regular in nature and must be repeated at regular intervals. For such surveys a permanent machinery for collecting information is usually set up. Such surveys are undertaken where continuous data is required to study the trend or the effect of time upon the phenomena under study.

Ad hoc surveys, on the other hand, are undertaken once for all. Ad hoc surveys are undertaken mostly for testing a hypothesis or supplementing some missing information regarding any research problem.

Preliminary and Final Surveys

A preliminary survey is generally known as 'pilot study' and it is the forerunner of the final survey. The purpose of this survey is to get first hand knowledge of the universe to be surveyed. It helps a person to get acquainted with the problem and the nature of respondents from whom the information is to be collected. It is, therefore, very useful in preparing the schedule or questionnaire and organising the survey on proper lines. Final survey is made after the pilot study has been completed.

Census and Sample Surveys

In a census survey every single unit in the universe is to be contacted and information collected. In case of sample surveys only a small part of it is taken as representative of the whole and data collected are made applicable to the whole universe. Sample surveys are becoming more popular these days because of their convenience, time-saving and low cost. Besides this, techniques have been developed which permit the calculation of error with adequate precision.

DIFFERENCES BETWEEN SOCIAL SURVEY AND SOCIAL RESEARCH

Social Survey	Case Study
1. It is concerned with specific person, specific problems and situations.	1. It is concerned with general and abstract problems.
2. The object is to fulfil immediate needs and use knowledge available at a given time. It is thus practical in nature.	2. The object is long time research of broad perspectives in order to develop more accurate procedures and theories. Thus its primary aim is theoretical in nature.
3. The purpose is to improve the lot of men. It is thus utilitarian in nature.	3. The purpose is to increase the general knowledge of man or devise improvement in the technique of study. It is thus purely scientific in nature.
4. It results in a social reform, an administrative change or a remedial measure for removing immediate evils.	4. It results in formulation of new theories or discovery of new techniques of study or modification of old concepts.
5. It may form the basis of some hypotheses.	5. It develops hypotheses and thus evolves a theory.
6. A hypothesis is not necessary for it. Generally, a social survey is undertaken without any hypothesis.	6. A hypothesis is essential. The social research is mainly concerned with the testing of hypothesis thus formed.
7. It may be conducted on professional basis. Many surveys are conducted not for any interest in the topic but on payment from other interested parties.	7. It is never conducted on professional basis as no one stands to gain specially through such a type of study. Thirst for knowledge is the only incentive and its ultimate satisfaction is the only reward.

LESSON - 1.6

CASE STUDY

DEFINITION OF CASE STUDY

Case study refers to an intensive investigation of a social unit. The method of exploring and analysing the life of a social unit, be it a person, a family, an institution or a community, is known as case study method. In spite of the varying size of the unit of study, the fundamental point is that each unit is taken as a whole. Case study is a form of qualitative analysis.

Case study aims at deep and detailed study of the unit. It is an approach which views any social unit as a whole. As one has to make a study of the unit in its entirety, the number of units has to be small. Case study may also cover a sufficiently wide cycle of time.

The objective of case study method is to find out the factors that account for the behaviour patterns of the given unit and its relationships with the environment. The case data are always gathered with a view to tracing the natural history of the social unit, and its relationships with the social factors and the forces involved in its surrounding milieu. In sum, the social researcher tries, by means of case study method, to understand the complex of factors that are operative within a social unit as an integrated totality.

Case studies are accomplished primarily through intensive observation and information obtained from informants through interviews. Newspaper files, official records and surveys may supplement these techniques. This method assumes that the findings in one case can be generalised to other situations of the same type.

Case studies represent a more enlightening and fundamentally more reliable record of personal experiences, with a wealth of concrete detail, vivid memories, tension situations and multifarious reactions to social

situations which may escape the attention of even the most skilled investigator. Though human behaviour may vary according to situations, it is possible to identify the basic human nature even in the midst of such variations. This is an assumption that underlies the collection of case data. Various researchers have employed a number of different means and techniques to get at data substantiating, supplementing and verifying the information gained through the case study method.

Whether the case data can be regarded as sufficiently typical representative facts affording a secure basis for theory construction is a question. In other words, whether the materials offered by case history can be considered an adequate basis for generalising with respect to the category of cases that the particular case under study represents. Although case data are not amenable to rigorous analysis, a skillful handling and interpretation of such data may help gain insights.

Case histories are replete with valuable information of a personal nature. This information helps the researcher to portray not only the personality of the person and the social situation impinging upon him but also in formulating relevant hypotheses. The researcher can conduct a more effective analysis of a particular aspect if he has acquired an intimate acqaintance with it by means of personal documents.

Though specific case situations may not serve as a sufficient basis for understanding human behaviour, they may be regarded as the possible examples of a line of reasoning by which the researcher might be enabled to develop new concepts or theories or test the existing conceptual schemes.

Case study is based upon the following basic assumptions:

1. Totality of the Being

In the case study method, each unit under study is indivisible whole and cannot be studied piecemeal and in fragments. It is because of this basic assumption that the unit has to be studied in its wholeness.

2. Underlying Unity

In the face of apparent diversity among different units there is an underlying unity. A particular unit has its uniqueness but it is not different from other units in all respects. It is also representative of a group, and can be studied as a type rather than a pure individual. This underlying unity makes it possible to apply the inference drawn from the unit or group of units to the group as a whole.

3. Complexity of Social Phenomena

Social phenomenon is not only a total whole, it is very complex also. A greater part of man's life is subjective, unknown and incapable of observation. The understanding of human nature and his actions, therefore, requires much deeper probe and a keen insight. A systematic study of human behaviour is thus possible only through case study.

4. Influence of Time

Social phenomena are influenced by time also.

Case study method has the following distinctive features:

(i) It increases knowledge.

(ii) It leads to the development of empirical hypotheses.

(iii) Flexibility with respect to the type and amount of data gathered, the sources of information, and the procedures used to gather information.

(iv) It can also be used for preventive purposes.

SOURCES OF CASE DATA

Following are the main sources of case data:

1. Personal documents – diaries, autobiography, memoires, letters, etc.

2. Life history.

Personal Documents

Most of the people keep diaries, write their autobiographies or memoires. These personal documents contain the description of the

remarkable events in the life of the narrator as well as his reactions towards them. They may also contain the description of even those events in which he has played his part only as a witness or a distant spectator. They are self revealing records which intentionally or unintentionally yield direct information. Such personal documents, although sufficiently subjective in nature, are useful for research purposes. Diaries are mostly written for self-satisfaction and the writer is not likely to distort facts deliberately.

Life History

Life history is the study of various events of respondent's life together with an attempt to find their social significance. It is in this way that life history differs from the pure historical narrative of facts. While the pure narrative aims at narrating the facts only, life history aims at revealing the meaning and significance of these events in the context of motivating factors of social life. It is thus a combination of facts and the inferences. Life history is generally constructed through prolonged interviews with the respondents, availability of any other written materials about the respondents and the analysis of the facts so collected.

IMPORTANCE OF CASE STUDY METHOD

1. Case data are useful for diagnosis, therapy and administrative purposes.
2. Case study helps in formulating valid hypotheses. When various cases are thoroughly studied and carefully analysed, the researcher can arrive at various generalisations which may be developed into useful hypotheses.
3. Case study is useful in framing questionnaire and schedule. If a questionnaire or schedule is drafted after thorough case study it helps to understand the peculiarities of the group as well as individual units, and the type of response likely to be available.
4. Case study is helpful in stratification of the sample. By studying the individual units thoroughly they can be put in definite classes or types.

5. It is possible to locate deviant cases. The analysis of such cases may lead to new insights.
6. Where the research problem concerns a process rather than an incident case study is the suitable method.
7. Case study enlarges the range of personal experience of the researcher as it studies the whole range of subject's life. The researcher may also get an intimate knowledge of many other aspects.
8. By comparing case data one can search for similarities or uniformities that enable him to classify or analyse data to formulate ultimately the law of their occurrences and relationship.

LIMITATIONS OF CASE STUDY METHOD

1. The first and the foremost difficulty, the one that is the basis of all others, is the over confidence that the researcher develops in his mind. In case study he studies each unit in its complete dimensions, and therefore, begins to feel as if he knows everything about the unit and needs no further enlightenment about it. In this way case study develops a false sense of confidence which is highly detrimental to any scientific study.
2. Generalisations are drawn from too few cases.
3. The method is quite loose and unsystematic. No controls are exercised upon the informant or the researcher. The data collected in this way is generally incapable of verification and the generalisations drawn from it may also not be very accurate.
4. There is enough scope for errors due to selection of a case that is not typical of the group, inaccurate observation, faulty inference, errors in the reporting, failures of the memory, unconscious omission or repression of unpleasant facts, a tendency to dramatise facts, and describe what is more imaginary than real.
5. The researcher develops a tendency towards ad-hoc theorising. In place of finding some scientific explanation to a particular

phenomenon, he may try to find some common sense explanation for it. He is so overconfident due to his intimate knowledge of the unit, that he begins to presume that even his common sense or intuitive explanations are most scientific. Such explanations, being incapable of verification, are hardly reliable.

6. The time and money needed for case study is much more.

Despite the formidable limitations of case data, they are not used infrequently. Life history documents that afford a basis for comparisons contributing to statistical generalisations and drawing of inferences about the uniformities in human behaviour are of great value. There is no reason to underrate the personal documents even if some of these do not provide ordered data about personal lives of people.

KEY WORDS

Science	–	A method which aims at creation of new knowledge or finding out the truth.
Scientific method	–	refers to a procedure or a mode of investigation by which scientific and systematic knowledge is acquired.
Research	–	a systematic and objective analysis directed towards discovery and the devleopment of an organised body of knowledge.

BOOKS FOR FURTHER READING

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UNIT – II

LESSON - 2.1

SOCIAL AND SCIENTIFIC INQUIRY

The debates over the scientific status of various disciplines under social science – like sociology, philosophy, political science, anthropology, etc. – is one of the most interesting topics among academicians, in which, one of the unresolved problems is the validity and objectivity of scientific study of human behaviour. The role of science in human inquiry further troubles the scientific status of social science research. The idea of social sciences have been opposed by both within and outside the field. Within the fields, the social science movement has pictured a redirection to the extent that it renamed the established academic disciplines. For example, department of government has been replaced by department of political science. Also, the shift in emphasis from description to systematic explanation and the growth of sub-fields remain the end product of social science movement. Like the social scientists – oriented in traditional methods – there was opposition from physical scientists too, who object to the application of scientific method to study human social behaviour. However, the following description on the foundations of social scientific theory and foundations of social scientific research will enable you to know what could and could not be done in social scientific inquiry.

THE FOUNDATIONS OF SOCIAL THEORY

In the earlier unit, we discussed the topic of social scientific theory with a few examples of its operation in practice. As a rigorous attempt we shall look at the fundamental bases of social theory as they affect social science. The following paragraphs discuss the clearance of the common misunderstandings.

Theory, not Philosophy or Belief

Social scientific theory aims at what is, not with what should be. For centuries, social theory combined these two orientations. Social philosophers mixed liberally their observations of what happened around them, their speculation as to why, and their ideas about how things ought to be. Though modern social scientists are wedded to this orientation, it is necessary to understand that social science has to do only with how things are and why.

These clarifications about scientific theory or broadly the science itself concretely putforth that it cannot settle debates on value. For instance, science cannot determine whether Hinduism is better than Christianity except in terms of some set of agreed criteria. Scientifically we could determine which religion most support enhancement of women's status and autonomy to make decisions if we are able to agree on some measures of status and autonomy, and our conclusion in that case would depend totally on the measures we had agreed on and no general meaning beyond this. In the same sense, if we could agree that crime rates, or giving to charity were good measures of a religious quality, then we would be in a position to determine scientifically whether Buddhism or Islam was the better religion. Here again we tie the conclusion and criterion agreed upon. As a matter of practicality seldom individuals are able to agree on criteria for determining issues of values and hence, obviously science is also seldom of any use in setting such debates. Also, science, which deals with rational proofs, is inappropriate to test the non rational matters like people's conviction in values.

This issue can be further taken and discussed under the chapter on evaluation research. Today most of the social scientists have started sharing interest and involved in studies of programs that reflect ideological points of view where the biggest problems faced by researchers is to make people agree on criteria of success and failure. Still these criteria are essential if social scientific research aims at matters of value. By analogy, a stopwatch

cannot tell us if one sprinter is better than another unless we can agree that speed is the critical criterion.

In toto, it is vivid that social science can help us only in what is and why. And the query of what ought to be can be addressed only when there is an agreement on the criteria for deciding what's better than something else, which seldom occurs. With this understanding we shall scan some of the fundamental bases upon which social science allows us to develop theories about what is and why..

Social Regularities

The ultimate aim of the social science is to determine the logical and persistent patterns of regularities in social life. One such is the fundamental assumption that life is regular, not confusive or random. Though this assumption applies to all science it also remains a barrier to those who approach social science for the first time.

Unquestionably at first glance it would look that the subject matter of the physical sciences is more regular than social sciences. Of course a heavy object falls to earth every time we drop it while a person may vote for a particular candidate in one election and against that same candidate in the next election. Similarly ice always melts when heated while seemingly honest people sometimes steal. Such examples can always lead us to lose sight of the high degree of regularity in social affairs.

To start, a vast number of formal norms in society create a considerable degree of regularity. To wit, only persons of a certain age or older are permitted to vote in elections. In American society women were not drafted in the armed forces while men were so. Such formal prescriptions, regulate or regularize social behaviour.

Aside these formal prescriptions, there are certain other social norms that create more regularities. Registered congressmen are more likely to vote for congress candidates than are registered communists. The list of

regularities like physicians earn more than unskilled workers; men earn more than women; whites earn more than blacks; could go on and on.

All science is based on the fundamental assumptions that regularity exists in what is to be studied, and we have noted that regularities exist in social life. Thus, logically, social behaviour would appear to be susceptible to scientific analysis. But in reality are the kinds of regularities which we have just looked at really dependable enough for scientific study? We would have known that an unskilled labour earns more than a physician. First of all are there kinds of regularities worthy of scientific study? Isn't it pretty obvious that men earn more than women? We don't need scientific theories to understand something like that.

Before we proceed further, we shall discuss the three major objections that might be raised in regard to the kinds of social regularities that we have been looking at. First, some of the regularities may seem trivial, as everyone is aware of them. Here the main problem is with what everyone knows is that it may not be so. An example could be cited from Stouffer's study of attitudes toward promotion in the army. A method instructor began his class by revealing some of the important discoveries of social science research like [1] Army air corpsmen with rapid promotion were more likely to think the promotion system was fair than MPs who had slow rate of promotions, [2] Educated soldiers were more likely to resent being drafted than were less educated soldiers. By the time these important discoveries have been revealed most students have begun playing with pencils and chatting with each other about how obvious and trivial all that was. Then the instructor pointed out dramatically that all the findings, as we saw in the promotion examples are false. The actual research disproved each, and Stouffer was able to create a logical theoretical explanation for each being the way it was.

Here the point to be noted is that documenting the obvious is a valuable function of any science – physical/social. Often, the obvious turns out to be wrong and apparent triviality is not a legitimate objection to any

scientific endeavour. (Darwin, in ironic reference to much of his own research – where he tested the things that every one else already knew – coined the phrase 'Fool's Experiment').

The second objection is that contradictory cases may be cited, indicating that the 'regularity' isn't totally regular anyway. This objection is also inappropriate. For example, it is not important that a particular woman earns more money than a particular man if men earn greater than women overall. Social regularities represent probabilistic pattern and a general pattern need not be reflected in cent percent of the observable cases. This rule is applicable to both physical and social sciences. For example, in genetics the mating of a blue-eyed person with a brown-eyed person will probably result in a brown-eyed child. The birth of a blue-eyed child does not challenge the observed regularity and hence the geneticists state only that the brown-eyed child is more likely and, further, that brown-eyed child will be born in a certain percentage of the cases. Similarly, social scientists too make such probabilistic predictions like women overall will be likely to earn less than men. Added to this, the social scientist has grounds for asking why that is the case.

Third, it is argued that the people involved in the regularity could upset the whole thing if they wanted to. This objection that social regularity could be upset through the conscious will of the actors is not a sufficient challenge to social science, even though there does not seem to be a parallel situation in the physical sciences [an object cannot resist falling to earth 'because it wants to']. There is no denying that the registered Hindu congressmen could go to the polls and vote for a non-Hindu independent candidate just to upset/confuse the political scientist studying the election. All voters in an election could suddenly withdraw so as to frustrate the pollsters. Likewise, workers could go to work early or stay away from work and thereby prevent the expected rush-hour commuter traffic. But these things do not happen sufficiently often to seriously threaten the observation of social research.

As a matter of fact, social norms do exist and social scientist can observe these norms. Scientists can observe and explain those changes as the norms changes. Ultimately, social regularities persist as they tend to make sense for the people involved in them. When the social science suggests that it is logical to expect a given type of person to behave in a certain manner, such type of person may very well agree with the logical basis for the expectation. Thus, although the registered Hindu congressmen could vote for the non-Hindu independent candidate, such a voter would be the first to consider it stupid to do so.

Aggregated, not Individuals

Acceptance of existence of social research is susceptible to and worthy of theoretical and empirical study. Explicitly, social scientists study social patterns rather than individual ones. All the above mentioned patterns reflect the aggregated actions and situations of many individuals. Though social science often deals with the motivations that affect individuals, the individual per se is seldom the subject of social science. We create the theories about nature of group life not on individual persons.

These aggregated regularities are sometimes amazing. For example consider the Birth Rate. People have babies for an incredibly wide range of personal reasons. They may do it either because their own parents want them to or feel the way of completing their womanhood/manhood or to hold their marriages together or/and still have babies by accident. All of us may cite more detailed idiosyncratic stories. They may relate this giving birth or not giving birth to a baby with many factors such as buying a TV, fire in the house, promotion in work, etc. But none of our reasons are going to exactly match with others. Despite this vast diversity and idiosyncrasy of each individual's reasons, the overall birth rate in a society is remarkably consistent from year to year. If the birth rate is 19.1% per 1000 this year it is bound to be closer to 19.1% next year. There is consistency in its growth rate and you can imagine the position of demographers if for the past 5 successive years the birth rate of society were to be 19.1%, 30.1%, 17.2%, 33.0%, 20.2%.

In ultimatum, social science deals with aggregates not with individual behaviour. For example their purpose is only to explain why aggregated patterns of both are so regular even when the individuals participating in them may change over time. Importantly social science doesn't seek to explain people but aims to understand the system within which people operate, the system that explains why people do what they do. Here the elements are not people but variables.

A Variable Language

This idea of variables is complex and this can be cleared by an analogy that tells a story. The subject of a physician's attention is the patient. The patient may be ill and the physician's purpose is to assist that patient in getting well. On the other side, a medical researcher may study the physician's patients where the patient is viewed as a carrier of the disease, which is what the researcher is really studying. Here, you cannot complain that medical researchers don't care about real people. Their aim of studying disease is to protect people from them. In their actual research, patients are directly relevant only for what they reveal about the disease under study. In fact, medical researchers do meaningfully study the disease without studying the actual patients. Social science involves the study of variable and the attributes that compare them. Social science theories are written in variable language and people are involved only as the carriers of those variables.

Attributes are characteristics or qualities that describe an object – a person. Example would include female, alienated, conservative, cruel, brave, radical, industrialist and so forth. In short anything that you would say to describe yourself or someone else would involve an attribute. On the other hand variables are logical groupings of attributes. Say male and female would be attributes while sex/gender would be the variables composed of those two attributes. The variable religion would be composed of attributes such as Hindus, Muslims, Christians and so forth. Social class variable would compose a set of attributes such as upper class, middle class, lower class, etc.

The relationship between attributes and variables lies at the heart of both description and explanation in science. A college class room can be described in terms of variable sex basis, the observed frequency of the attributes male and female. The class is 60 percent men and 40 percent women. An unemployment rate can be thought of as a description of the variable employment status of a labour force in terms of the attributes employed and unemployed. Their relationship is more complicated in the case of explanation and gets into the heart of the variable language of scientific theory. This can be explained with the illustration (fig I) involving two variables – caste and employment. For the sake of simplicity let us assume that the variable employment has only two attributes: employed and unemployed and similarly the variable caste with two attributes forward caste (FWC) and backward caste (BWC).

Now let us suppose that 90% of the people who have the attribute FWC also have the attribute unemployed, while the rest 10% have the attribute employed. And let us suppose that 30% of the unemployed people have the attribute FWC while 70% have the attribute BWC.

The figure illustrates a relationship/association between the variables caste and employment status. The relationship can be seen as in terms of pairing of attributes of the two variables, which predominantly will be (1) those who are unemployed belong to BWC and (2) those unemployed belong to FWC. Let us seek this relationship in two different ways. To start with suppose, you play a game in which two persons bet on one's ability to guess whether a person picked by one of you from the figure is employed or unemployed. In the process of this game you would know the probability of success and failure. Secondly, suppose you ask the person to say the attribute of one of the variables, say BWC, and you guess the employment status and would know that your correct answers would have increased compared to the earlier ones. This improvement in your guessing employment status by knowing the caste status is an illustration of variables being related.

Now let us turn to the general understanding of relationships to appreciate the logic of social scientific theory. Theories describe the relationships that might logically be expected among variables, which involves the notion of causation. A person's attributes on one variable are expected to cause, predispose or encourage a particular attribute on another variable. In the example discussed above a person's community status decides his employment status. It seems that there is something about being in particular community that lead people to be unemployed than if they are in other community. This discussion can be further taken in later chapters, as independent variables and dependent variables respectively. In this example, we assume that employment status is determined or caused by something; employment status depends on something, hence it is called the dependent variable. That on which the dependent variable depends is called the independent variable; hence employment depends on community. For an other example, you can find education depends on something else – such as family size. People whose family size is larger than the other, or vice-versa. In this the respondent's education depends on family size – independent variable.

Notice that the theory has to do with the two variables - education and employment - not with people per se. As indicated earlier people are mere carriers of those two variables and hence the relationship between the variables can only be seen through an observation of people. Thus, theory is constructed of a variable language and it describes the association that might logically be expected to exist between particular attributes of different variables.

DETERMINISM AND HUMAN BEHAVIOUR

This idea of determinism or causation is one of the pillars of social science theory. Science is based on the assumption that all events have antecedent causes that can be identified and logically understood. For scientists nothing happens just for the sake but for a reason. All the events are susceptible to rational explanation. There are certain points of opposition in this regard. First the specific causes for all events is unknown

to scientists. Second, multiple causation is accepted by science. A given event may have several causes, say for example, a voting decision may have resulted from a number of different factors. And one event may have one cause while a similar event may have a different cause. Though two people may vote for the same person for different reasons it is assumed that reasons exist in each case.

Finally science is much based on a probabilistic form of determinism. Thus event X may result in event Y 90% of the time or 80% of all congressmen may vote for a given political candidate, while only 17% of the communists do so. Here we can say that political party affiliation would be used to determine voting behaviour though other factors are not introduced to explain this discrepancy.

Often, social science mismatches with commonsense keeping the prior events and conditions, social scientists may conclude that a group of people behave in certain fashion. To it, recall the voting behaviour of the religious groups. In this sense, the condition of religiosity, prejudice, X political orientation determine the person's voting behaviour. Though the voting behaviour can be reverse, it is simply unlikely to occur. The deterministic posture of the social sciences represents its most significant departure from more traditional humanistic examinations of social behaviour.

Basically theory is aimed at making sense out of the world and involves the development of logical explanation and expectation. To review, theory deals with what is, not what ought to be. It is based on an assumption that social life, in the aggregate, possesses order that out social affairs are not totally confusive or random. That order is to be found in the relationships among variables and people are involved as only the manifest carriers of those variables. In toto we study people for the purpose of knowing the relationship between variables and this is not something which is irrelevant to people. From the social scientific point of views, what we do, think and feel reflects the impact of social variables on us. Your participation or non participation in a riot may be importantly affected by

your feelings of alienation and powerlessness make you feel that they are the causes in the social conditions around you which reiterate the view that social science is not possible without deterministic point of view.

THE FOUNDATION OF SOCIAL RESEARCH

The earlier chapter, discussed the fundamental characteristics of social science research in the context of error we often make in more causal inquiry. Here we shall look at those characteristics more in detail in a positive point of view.

Two Logical Systems

The most complex and difficult branch of philosophy is logic. We shall illustrate the meaning of logic in science with a few examples. For example, a given event cannot, logically, cause another event that occurred earlier in time. The movement of a bullet cannot cause the explosion of the gunpowder propelling it. Thus, science and religious views too differ in their approach. Christians believe that Jesus was destined to be crucified and that this destiny caused him to be betrayed and tried. This view would not be accepted with the logic of science, where it is impossible for an object to have two mutually exclusive qualities. The flip of a coin cannot result in both a head and a tail. Likewise, a given event cannot have mutually exclusive results. Thus, getting a college education cannot make a person both wealthier and poorer at the same time. At the same time, we cannot say science in practice is wholly devoid of illogical assertions. To wit, physicists currently regard light as both particles and waves, though they are contradictory description of light. This conclusion exists in science as light behaves as particle under some conditions and as waves under other. In this subject physicists continue to use the two contradicting conceptualization as 'they may be appropriate in a given conditions' and still they represent a strain for the logic of science.

Beyond the commonsense notion of logic there are two distinct logical systems important to the scientific quest: Deductive logic and Inductive logic. In the words of Beverage,

Logicians distinguish between inductive reasoning (from particular instances to general principles, from facts to theories) and deductive reasoning (from the general to the particular, applying a theory to a particular case). In induction one starts from observed data and develops a generalization which explains the relationships between the objects observed. On the other hand, deductive reasoning starts from some general law and applies it to a particular instance.

The approaches of traditional perspective of science is deductive logic. To say, 'All men are mortal; Ram is a man; therefore Ram is mortal'. On the other hand with the inductive logic, you may start to note that Ram is mortal and later by observing many you might find that all the observed human behaviour were mortal and thereby arrive at the tentative decision that all human behaviour are mortal.

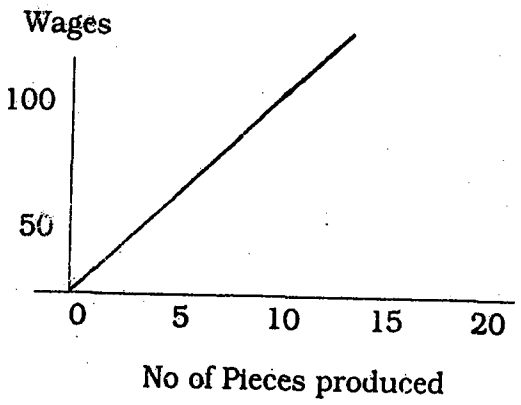
The above discussion is reported in a graphic comparison of the inductive and deductive methods with different illustrations (Fig I). Generally we are interested in the relationship between the number of pieces produced (X axis) and the wages earned for that work (Y axis). Let us logically examine the matter from deductive process. Earning more wages reflects a worker's capability of finishing a task and the special skill acquired by him. His capability to complete a task, that is, producing a piece and his skill enabling him to do so will earn him a pay, sometimes even better pay, irrespective of the number of pieces produced by him. In this fashion we shall arrive at a hypothesis, suggesting positive relationship between pieces produced and wage earned by him. This is shown in figure 1A.

Next step in this deductive method is to make necessary observation to test our hypothesis. The observation of different workers by their number of pieces produced and wages earned is depicted in graph of fig 1B. Finally the synchronization of both the hypothesis and observation is shown in the graph of fig 1C. Seldom our observation match with our expectation

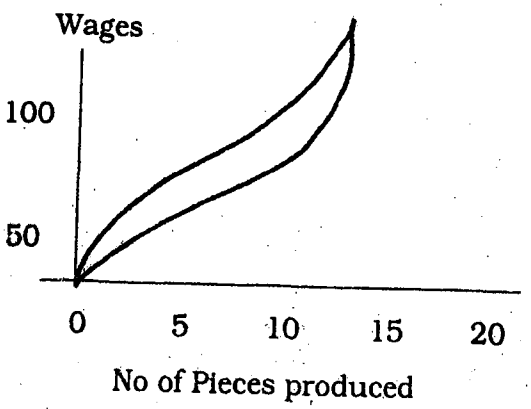
Fig. I. Deductive and Inductive methods

1. DEDUCTIVE METHOD

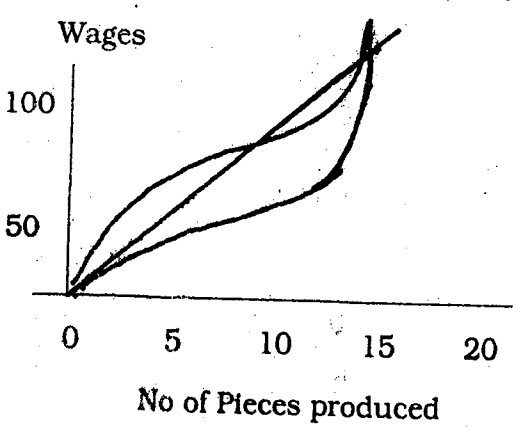
1A HYPOTHESIS



1B OBSERVATIONS

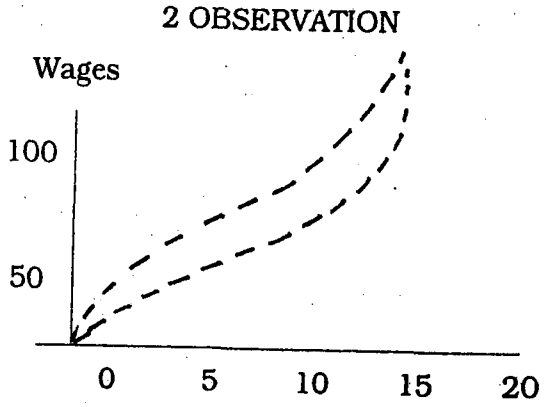


1C ACCEPT/REJECT HYPOTHESIS

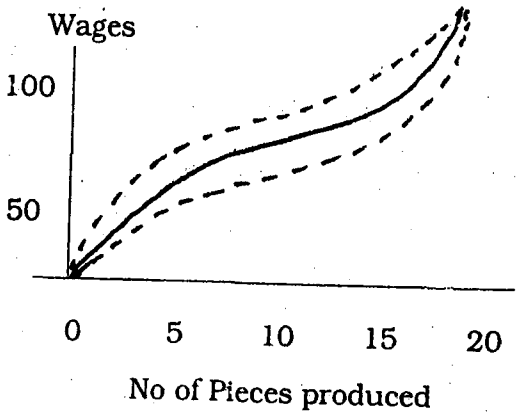


2. INDUCTIVE METHOD

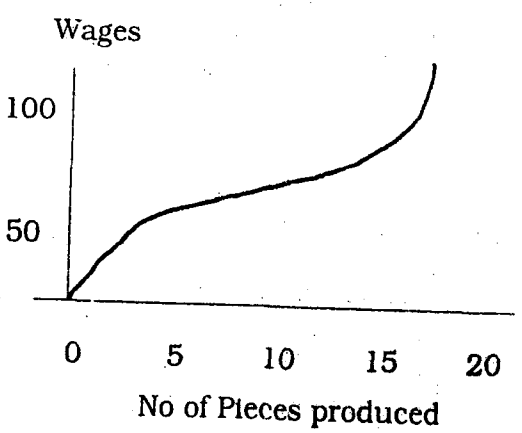
2 OBSERVATION



2B FINDING A PATTERN



2C TENTATIVE CONCLUSION



and it is up to the researcher to consider and decide whether the match is close enough to the hypothesis confirmed.

On the other side, in the inductive method we would trigger with a set of observation (graph 2A of fig1). In our curiosity to know the relation between pieces produced and wages earned we might plan to gather data in relevance to it. Later we may find a pattern in the figure (Fig 2B), the pattern found between the points 1 to 15 pieces produced, each additional piece having hiked an employee's wage. Producing more than 25 pieces a day results in a return to the initial pattern: more pieces more wages. Thus in the inductive method we arrive at a tentative conclusion (Fig 2C) as to the pattern of relationship between the two variables.

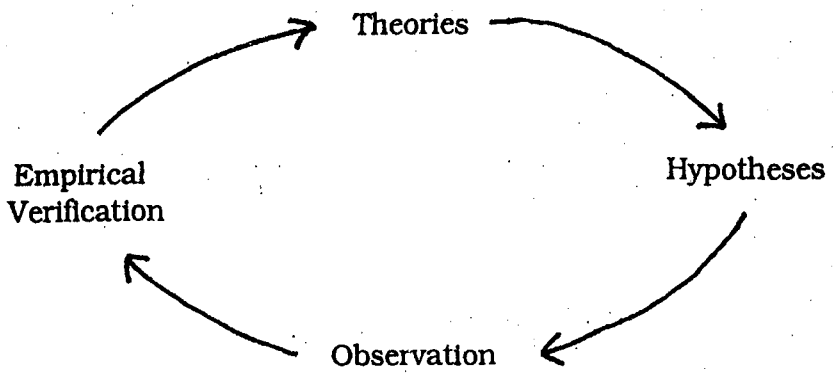
Thus, in actual practice theory and research interact through a never ending alternation of induction, deduction, induction, and so forth. This is clearly depicted in Walter Wallace circle in forthcoming pages. As per his model theories generate hypothesis, hypothesis suggests observation, observation facilitates generalisation and this in turn contributes to modification of theory. This modified theory then suggests modified hypotheses and new set of observations producing revised generalisation further modifying the theory. Interestingly as per the model there is neither a beginning point nor an ending point. A researcher can start at any point and end anywhere. In toto, this scientific norm of logical reasoning remains a bridge between theory and research. In practice the scientific inquiry involves an alternation between deduction and induction. In deductive phase we reason toward observations and we reason from observation in an inductive phase, thus stressing the need for both logic and observation.

EMPIRICAL VERIFICATION

The utility of the formulation of general laws or equation describing the world around us, is less useful, unless they can be verified through the collection and manipulation of empirical data. But, can a scientific theory be proved for ever? According to physicists, earth has a vast mass and hence a ball thrown out of a door will move toward earth. This

explanation of gravity is empirically verifiable. A researcher can throw any heavy object out of a door and observe that it falls to the earth. Though it does not prove the theory of gravity, the researcher specifies that if the ball does not fall to the earth, then the theory of gravity is incorrect. Since the ball behaves in the expected fashion the theory of gravity has not been disconfirmed.

Fig. 2.3.



When we say that the scientific explanation must be subject to empirical testing, we mean that the researcher must be able to specify the condition under which the theory would be disproved. The more and more we fail to disprove the theory the more confident that the theory is correct. It is also important to realise that we will never have proved it.

Like physical sciences, the social scientists must describe conditions under which a given proposition would be judged incorrect and disproved. The social scientific proposition must also be testable in real world. There is no point in asserting the association between two variables without suggesting ways in which the two variables could be measured and the proposition to be tested. To wit, religious beliefs, such as the existence of God are not susceptible to empirical verification. But hypotheses about human affairs can be tested empirically. For example, in America it has been commonly believed that women are incapable of reasoning as logically as men, which could be tested empirically. The recent success of women in the thinking profession suggests that a controlled empirical test would

wipe out the common belief. Thus we discover that "common sense" doesn't make much sense in terms of the empirical reality.

Observation is a conscious and deliberate act. A brief preview of some of the steps of operationalisation will be worthy to enhance your understanding power about empirical verification in science. Observation, in science, is a matter of measurement, that is, the rigorous classification or quantification of things observed. Two important criteria applied to measurement of science are: validity and reliability. Validity refers to the extent that the measurement procedures accurately reflect the concept under study whereas reliability is concerned with the match between the operational definition and the actual measurement made. These concepts can be dealt in detail in future lessons. Once observation and measurement procedures seem to be valid and reliable, we often face the problem of having too much to observe and measure. For example, suppose that you wanted to study the relationship between education and alienation. Even if you were satisfied that you could adequately measure both a person's education and level of alienation, you are left with population to be observed. You have to decide on some methods for picking a reasonable number of people. The selection of observation in this sense is called sampling. These aspects will be dealt in depth in future.

Thus, conscious controlled measurement and sampling are the two key elements of empirical verification distinguishing social scientific inquiry from the casual inquiry.

GENERALISATION

General understanding rather than explaining individual events is one of the aims of science. The scientist is typically more interested in knowing and understanding why all heavy objects fall to the earth than the height from which it is released. As such, aim at understanding how and why large groups of people voted as they did rather than explaining why a given person voted as he did. This feature of science is closely related to its probabilistic determinism. It is believed that we could explain the reasons

lying behind a given event say, why a girl votes for candidate M. It is easy to plan out every single factor behind that individual's voting decision. If we were successful, then presumably we would predict the voting behaviour of identical persons with perfect accuracy. However, such a capability would not give much useful information, in the long run, about the voting behaviour in general. First, it is doubtful that we would ever find another person with exactly the same characteristics. Also, our discoveries will help us very little in understanding the voting behaviour of people with other characteristics. When we are able to understand voting behaviour in general probably we would be happier with less than cent percent understanding. This is where scientific and historical approaches to the same subject matter differs. To wit, the historian aims at understanding everything about a specific event, while the scientist is more interested in generally understanding a class of similar events with different thoughts.

Thus, generality is an important characteristic of scientific discoveries. The discovery that red balls fall to the earth at a given acceleration is less useful than the discovery that balls of all colours do so. To the social scientists, a theory of voting behaviour that applies only to voters of all races is less useful. A theory of religiosity that applies only to Buddhism is less useful than one that applies to people of all religions. A social scientists often begins with an attempt to explain a more limited range of social behaviour or the behaviour of a limited subset of population, only with the goal to expand the findings to explain other forms of behaviour and other subsets of the population.

PARSIMONY

Though scientists spend much of their effort and time in discovering the factors that determine types of events, they also attempt to discover those factors that do not determine the events. Thus, we ignore or discount the colour of falling object as irrelevant when we try to determine the acceleration of a falling object. In this sense we say that science is parsimonious in representing a balance between power and efficiency in explanation.

A social scientist, like physical scientists attempts to gain the most explanatory power out of the smallest number of variables. Though the additional consideration of new variables adds explanatory and predictive power, in many cases, it also results in a more complicated model and in practice they reduce the generalisability of explanation, since certain variables may exhibit different effect as different subset of the population.

Like its deterministic posture, parsimonious character of social science is also criticised by those holding a more individualistic view of human behaviour. Unlike these critics, the social scientists consciously attempt to limit such inquiry. A social scientist might attempt to explain voting behaviour through the observation of two-thirds of variables. The critics may point out that all the voters had many individualistic reasons for voting as they did and this limited number of variables did not explain the depth of decision making for any of the subjects under the study. Here the problem is, differences in the goal fixed by the critic and the scientist. A social scientist has a specific goal, say, greatest amount of understandings from smaller number of variables.

Finally, scientists attempt to understand the reason for the events, using limited explanatory factors. In practice, the number of explanatory factors taken into account increase the degree of determination achieved. To wit, one political scientists may achieve a certain degree of explanation of voting behaviour through the use of two variables - party affiliation and social class. Another might achieve a more complete understanding by accounting other factors such as race, region of upbringing, sex, education and so forth. Often, the scientist is forced to opt between simplicity and degree of explanation. We try to maximize both, ideally.

SPECIFICITY

Any scientist must specify his or her methods of measurement. Possibly this is especially important in the social science as we deal with concepts more vaguely. A physicist may define acceleration more rigorously than the layman, but there is less valence between the scientific definition

and common understanding of the term. However, concepts such as religiosity and prejudice have such varied meanings in common language as their rigorous definitions are not readily apparent.

When a researcher carries out a research project on the topic of prejudice, the scientists may generate specific operationalisation of the concept prejudice. For example, agreement with several questionnaire statements that seek to indicate prejudice. While reporting a research, a researcher must carefully describe in detail his operationalisation in such a mature way thus, enabling a reader to know or understand how the conceptualization is being measured, though he disagrees with the operationalisation.

Generalisability of any given discovery is substantiated through the use of different operationalisation of the concepts involved. Though a given concept like prejudice is not susceptible to a single measurement acceptable by every one, the researcher can at least conclude that the given set of factors results in prejudice.

INTERSUBJECTIVITY

One of the frequent assertions about science is 'it is objective' and it often results in a good deal of confusion as to what objectivity is. It has been recently noted that no scientists are completely objective in their respective research work. To some extent all scientists are influenced by their personal motivation – subjective.

The terms 'science is intersubjective' implies that two scientists with different subjective orientations would arrive at the same conclusion if each conducted the same experiment. This can be clarified further with an example. The tendency for individuals in America to align themselves with the Democratic party than the Republican party has led many to assume that Democrats as a group are better educated than Republicans. It is also reasonable to assume that a Democrat scientist would be happy while a Republican scientist would not. Still, these two scientists may agree upon the design of the research project that data would be collected from

American electorate relating to party affiliation and educational levels. The independent studies of both might reveal that Republicans as a whole have a higher educational level than Democrats. Both the scientists with opposite subjective orientation would arrive at the same empirical conclusion and this is what intersubjectivity is.

LESSON - 2.2

THE ETHICS AND POLITICS OF SOCIAL RESEARCH

Conforming to accepted professional practices is being ethical (Webster, 1968). In common usage, ethics is typically associated with morality and both concern matters of right and wrong. Dictionaries define ethical as 'conforming to the standards of conduct of a given profession or group'. But the source of distinction is what is right and what is wrong varies from individual to individual. Though there is general agreement about ethical principles in research there are some disagreements about the way to word codes of ethics and what to do in a situation in which there is a conflict of interest, such as between the right of the majority to know and the right to privacy of the minority. It is generally agreed that it is unethical for researchers to harm anyone in the course of research especially if it is without the person's knowledge and permission, including deceiving a respondent about the true purpose of a study, asking a respondent questions that cause him/her an unpleasant experience, causing guilt or invading one's privacy. Respondents may also be injured by being studied without their knowledge, or by violation of a promise of confidentiality. Researchers can also act unethically during data analysis. For example they may reveal only a part of the facts, presenting facts out of context, falsifying findings or offering misleading presentation such as 'lying with statistics'.

In practice every research should want and be ethical due to many reasons. A researcher reputed for his unethical conduct may not get a sponsor and find difficulties in convincing the respondents to extend their cooperation in the study. At times like a gambler, a researcher tries to equivocate a bit the findings when they do not support the hypothesis, only on the intention that it is temporary. When such falsification is discovered, professionals' and public's reaction is often quite severe. In the context of manipulation of data a question arises as how a research

investigator can cause harm to his or her sample. Ironically all researches deal with the most critical practical issues which are often negative things or the problems we want to ameliorate. For instance, researchers may be interested in discovering the causes for suicide, addiction or effect of population density. They ignore all those persons, a majority, who are not affected by the problem and as well are not interested in knowing why some are happy and others did not commit suicide and also it is unethical to inflict them on healthy persons. Generally we have to find a cause to find a cure and for which we have to demonstrate its existence, in the course of which, we may harm our subjects. For example we hypothesise that density and overcrowding have negative effects on persons for which we also feel unethical to test this hypothesis by actually harming people.

With these few words on the meaning of ethics, we shall turn to the ethical issues to be discussed and resolved in social scientific research.

ETHICAL ISSUES IN SOCIAL RESEARCH

Survey research very often is charged for its invasion of privacy, which may also arise in other types of research, but, to a lesser degree. Though this terminology is very subjective, in common words, invasion of privacy means any question that arouses feeling of anxiety or guilt in a respondent. To cite an example, an individual brought up in strict religious environment may have masturbated, but may feel extremely guilty about it and would never like to share with others even if questioned. Certainly the individual feels that his privacy is invaded when questions of this sort are posed. Hypothetically just imagine if you are going to query a girl candidate in an educational institution about sexual practice including masturbation. Don't you think that she would express her resentment towards the question or retort back for the right exercised in seeking such responses. However, this problem could be overcome if the sample is informed about the purpose of the study. If the respondent is satisfied with the genuineness of research she may underscore the privacy invaded, her embarrassment and on the other hand if she is not willing to cooperate and perceives this research is trivial and serves no purpose than harassing her, let her

withdraw from it. But again, today the length of the questionnaire and its contents are voluminous and in addition, the frequency of research places many types of questionnaire in front of a sample which merely bore them and force to attribute less value for research. Here again, the role of researcher is to convince and get good results from them.

Another issue of ethics is the deception of research subjects. In a way, like a participant observer who joins any group to study, a researcher may study them without informing or seeking their permission. This is in no way less than spying. The use of rats or monkeys in the place of human beings is felt degrading or dehumanizing, on the ground that human species is pushed to the level of lab animals. Another form of deception involves informing that the subject is part of a study but hiding the true nature of the study. To wit, in a mailed questionnaire, convinced by the investigator the samples co-operate in sharing the information not knowing that they are likely to be compared with others. Deceiving the subject is rare in survey studies unlike in psychological and social psychological experiments.

Ensuring voluntary participation of the subject is essential in social research. They reveal the personal information about themselves which they would not do so unless and until you are a close friend. However, the recording of personal information by phychiatrists and lawyers are justified on the ground that they serve the personal interests of the respondents which is seldom claimed by a social researcher. The norm that no one should be forced to participate is easier in theory than in practice. For instance, when a sociology instructor administers a questionnaire to be filled in for her/her paper work, though few students are willing, they would do it, just out of fear concurning their internal marks. On the other hand, if the instructor leaves the class after supplying the questionnaire or keeps a box to post the schedules, it is relatively accepted. Sometimes the researcher would not inform the subject being studied, fearing that it would affect the social process and would later

inform them, when the subjects wouldn't have the opportunity to volunteer or refuse to participate.

Causing no harm to the people being studied is one of the most ethical questions involved. Very often subjects feel uncomfortable in revealing their deviant behaviour, attitudes they feel unpopular, personal profile such as income, receipt of welfare payments and the like. Sometimes the questions posed by the interviewer make them to think over the aspects for themselves for the first time and sometimes questions concerning codes of ethical conduct, can be a continuous source of agony for the subject. All these injuries posed by you as a researcher can be overcome with a few precautions. Just question and record the most necessary personal information which is very vital to you where you may feel that only a little agony would be left over for the subjects studied. You may argue that you are dealing with social aggregates and present the data only in categorized tables. But, a few at least who may be voracious readers who can thoughtfully place themselves in different cells of your tables will be affected as far as their self image is concerned.

Professional Code of Ethics

The importance and ambiguities of ethical issues discussed above have made the social, scientific and professional societies to draft a code of ethics, which depicts the accepted and unaccepted professional behaviour. This written code of ethics came in the recent past in print, formally. The recent development of written ethical code within the last 15 years are probably due to two reasons. Many macro and micro level research studies are claimed out with large number as their sample size and radical sociologists are not comfortable with the unwritten code of ethics stipulating the rule that a researcher must be apolitical, value-free and objective, etc. A format of the code of conduct adopted by American Association for Public Opinion Research is given in Table 2.1 at the end of this unit.

TWO ETHICAL CONTROVERSIES

It is a right guess that the written and published code of ethical conduct is not that effective in social research as in other disciplines. In fact debates over the agreements and disagreements over the given code of conduct is still going on. In this section let us take up thought-provoking two cases over controversies in social research.

Experiment 1

A graduate student (Humphrey) was interested in the study of homosexuality. Beyond this, he developed a special interest to look into the casual and fleeting homosexual acts engaged in by some non homosexuals. The main focus of his research interest, was on homosexual acts between strangers meeting in the public restrooms, in parks, which is called by homosexuals as 'tea rooms. Such of his curiosity also brought out many interesting phenomena to his notice. At first, he found that the participants seemed to live 'normal' lives, at the outset, as any other family men or accepted members of a community. Added to this, they acted so cautiously that it would not portray their homosexual act. Among them. they maintain an ethic of remaining anonymous during their tea room visits.

Now, as a researcher, how would you study something of this sort? You may be certainly clear by now that you cannot go directly for a personal interview with the participant.

Back to the graduate student, he took advantage of the social structure of the situation in hand to research on the tea room action. There are three people involved in this business – the two men who are actually involved in the homosexual act and a lookout called the 'watch queen'. This researcher began to pose himself as a look out as and when the time was conducive and appropriate. As he prepared to watch the action, he could make a field observation like any one could do on political rallies or similar ones.

To enhance his understanding about the activity in the given situation the researcher needed to know something more about the participants of such activity. As indicated earlier a direct interview of the person is not going to be a thrilling experience for the study unit and hence a different interesting solution should be developed. As and when possible the researcher noted down the license numbers of participants' vehicles and traced their names and addresses with assistance of the police. Later he visited those men at their homes, disguising himself as a researcher conducting a survey, to avoid recognition, and gathered as much personal information as he could not get much information from the 'tea room'.

If you have answers to the few questions posed as to how would you continue with this research, you can appreciate yourself if you had the same idea as the researcher followed. Or else if you have gone beyond this to the extent of raising and concerning ethical issues you can cross check with the few criticism raised by others.

The first opposition was on the ground that this research invaded the privacy of individuals in the name of science. They are of the opinion that anything that is practiced in a public rest room, which do not expect any formalities, is the individual's business and not a researcher's. Most of them charged the researcher for the deceit involved as the researcher made others believe that he was only a voluntary participant. A few beyond all these, stated that anything that is going on in a public place is fair to observe but should not have gone in for a follow up survey. They expressed the researcher's deed of tracing the participant's house addresses and interview as a false pretense and unethical.

On the other side there are a few justifications too, for the deed of the researcher. At first, keeping in mind the societal structure and development they appreciated the importance or the worthiness of the topic studied. Adding to it they opined that this type of respondents could not have been approached in any other way and in fact they regard the deceit

followed by the researcher as it was harmless and for his carefulness not to harm his subjects.

In conclusion, this ethical controversy remained unresolved. This original experiment still debated, may continue in future too, and yet provokes emotions and includes those ethical issues people disagree with. Now you should express your thinking and say whether the researcher was ethical in doing what he did, what are the parts of research you agree and disagree, with etc.

Experiment 2

In contrast to the earlier experiment which was a field study of participant observation, this second example is a psychological case in a lab setting. Unlike the examination of deviance in the earlier one, this case is going to examine conformity.

Stanley Milgram, based his experiences on World War II and Vietnam war, where many innocent young people and children were killed only because it was an order from the higher authority. If people were willing to obey orders to harm others, we could anticipate how dangerous it is to real life and, as expectedly many criticised Milgram's experiment.

He brought 40 adult men from different walks of life into a lab setting designed to carry out the study of observing people's willingness to harm others when following orders. The experiment starts with an introduction of pairs - selected through a draw of lots where one is assigned the role of teacher and the other participant, the job of pupil. The pupil would be taken to the other room, seated in a chair and an electrode attached to his wrist. The other one, a teacher, probably you, would have been seated in front of the electric control panel covered with electrical units such as switches. You can notice the different labels of volts ranging from 15 to 315 given to different switches, carrying labels such as 'extremely-intensive shocks'.

The experiment would run like this: The student may be read by the teacher a list of word pairs and would be tested for his ability to match them. Both of them could not see each other as they are in different rooms. So for you, as a tutor, the light in front of you would show his answer. You will be given an instruction that as and when you find that the pupil is committing a mistake you can punish him by administering a mild shock at the beginning to him. The door separating both the rooms would be kept open and the pupil's response to the shock is audible to you. Then you read another list of words to test him again.

The experiment progresses; while on the one hand you are asked to increase the voltage of power as the student commits errors, on the other hand, you hear the pupil screaming, crying and asking to relieve him from shock. Later, it goes to the extent of the student kicking the wall and screaming to stop the experiment. Still you are ordered to increase the volt of power. In due course, you find that your increasing of voltage did not fetch any reply from the student room. The experimenter might further add that no response is an error and may instruct you to administer higher shocks and ends with the higher ones.

Now the question to you is what you would have done when the pupil first began screaming; later kicking on the wall; and further when there was silence. As a normative expectation, you would have stopped administering the shocks. Let us see what these 40 samples did. All of them were administering shocks till the students started kicking the wall and there was no hesitation/withdrawal from any one. Later only 5 stopped. Two out of 3 continued till the highest shock non-stopping.

Are you puzzled by the experiment or have you guessed something? Yes, the entire experiment was partially hypothetical in the sense that all the 40 are only teachers and the experimenter played the role of pupil and above all the sounds from the other room were only mimicry. The point here is, by nature no one would hurt another person though it is

imaginative. Also the experiment is planned to test the willingness to obey the orders to the extent of killing someone.

This experiment is also not free from criticism. There were both methodological and ethical charges waged upon it. While expressing the effects of the decrease on the subjects, many expressed that they personally experienced such pain as they thought they were administering to someone. A few requested the experimenter to even 'stop' the experiment of giving shocks. They were upset and nervous and few had uncontrollable seizures.

Basing the above discussions a question arises as 'can a social researcher remain ethical'? We have a confusion in pursuing both the goals – of demonstrating the harmful effects on people and our ethical interest in avoiding such harm – and overcoming this confusion of achieving both the goals of demonstrating harmful effects empirically without actually harming people, which is highly impossible as well as a herculean task. The constant thinking over the solution for this problem has brought out a few approaches, of course, with some demerits, which are discussed below.

To start with, utilizing animals in lieu of human subjects is not uncommon in physical and medical researches, which is a rarity in social sciences research. Administration of drug to animals may help physical science to identify the side effects of such medicine. But, the absence of any social factors such as religion, education, income etc., which the social scientist is interested in, obviously limit the scope of utility of animals in social science. In the recent past, though, they have discovered that chimpanzees can react to the human action and communication in sign language. Thus, are we to conclude that identification and development of new advanced communication or other cultural features in animals will make them more useful for social scientific research? If agreed, a question arises as whether is it much difficult for human behaviour to claim superiority over animal behaviour and we are not sure as how far the social scientists could rationalize their practice of using animals in harmful

researches in place of humans, only because of the fact that there are many opposition against those research harmful to animals and proclaim it unethical and opine that it should be banned.

Second, a researcher may or would find a condition in which negative effects exist and thus relieved from not being responsible for producing them. In simple words, a researcher finds the hypothesized harmful cause already existing in natural surroundings so that the researcher will not feel responsible for any harm done to subjects. A research in urban ecology, specifically researching on density and social problems or construction of a flyover/overbridge and noise pollution in that area would be apt examples. They just compare the dense and less dense areas to know and highlight the differences in negative effects of density. In the other research they just compare the noise decibels before and after the construction of the bridge. Here they did not generate density of population or more traffic and hence they escape from the negative reputation. The few problems are like minimal amount of experimental control over extraneous variables.

Whatsoever the nature of the cause and effect would be if it is for a short period of time, the effects though negative may be only mild. Mostly this is practiced in experimental research by physical scientists. You can test the noise pollution with the experimental density group who can be retained for a short time for a just cause.

Also, getting the permission of the study units or respondents after explaining the deleterious effects of the experiment could in some way improve the ethicality of the research. A respondent should know the very purpose of the survey, its possible dangers and the credentials of the researcher. Every question should contain an introductory note about all these, which in turn induce the subjects to voluntarily participate in the research. In certain case, researchers also go to the extent of getting a written consent from the sample. To wit, research studies on AIDS patients could not afford to escape all these steps. These ethics are customary in medical research whereas a social researcher atleast should give a

forethought of all these. In a few organizations a committee is set up to review the proposals and verify whether the proposed research would risk the human behaviour or would include any hazardous medical experiments in social research involving things such as discomforts, anxiety, harassment, invasion of privacy or dehumanizing procedures. A research with the above mentioned negative effects of human behaviour would continue only after getting the written consent of the respondent.

Justification of the harm caused on subject on the ground that it is a lesser evil than the harm the investigator is attempting to cure, or because the researcher considers the subject evil is in a way trying to remain ethical in research. But as sociology is silent about the question of value it also cannot decide the direction in which society ought to go. This is the one shaping most codes of ethics for social researchers.

Unlike census survey, social scientific research based on sample surveys would both adequately represent the views of the entire universe or population without troubling every citizen. In the issue of privacy invasion sampling further adds to the ethics and profit of research. For instance, suppose you propose to carry out a survey in an educational institution comprising of a population of 5000. Basing your pretesting results you may find say, 6 questions are invading the privacy of the respondent. As a researcher you might find advantages to apply to draw a random sample, if necessary a quota or stratified from your full sampling frame for testing these 6 sensitive questions only. A person in the subsample will receive a questionnaire with these questions and others may receive a questionnaire excluding them. This in turn also adds to the ethicality of the research by affecting a small sample.

Finally, we maintain privacy by dealing with the aggregates not on individuals. He can neither use pseudonyms or publish aggregate data. For example instead of publishing an individual's income we may publish the aggregate income of the ward, town, etc. such that the given individual's income is unidentified.

In an advanced level, computer simulation also facilitates a research to hold the ethics of research. We can simulate social interaction and gain response from the computer instead of individual which may reduce the number of subjects required in the experiments and thus the number that can be harmed by the research.

This ambiguous and important topic of research, cannot be brushed aside only because it is difficult to resolve them. To enhance your understanding a few hypothetical research situations are given below and you can see the ethical component in each. You can discuss with others about your feelings toward these hypothetical situations and check how far you accept or reject the procedure described.

1. A social psychology tutor gets the questionnaire filled in by the fresh students of the academic year and analyses and prepares an article for publication in a journal.

2. After a field study of students' unrest, university authorities demand that the researcher identify those who were causing damages to university property. The researcher co-operates, fearing for his academic future.

3. A researcher discovers that 90 percent of the young widows interviewed in a village are willing to remarry. Publication of this finding will certainly create a tension among the conventionalist community members. Since the analysis by sanctification of husband is planned or since there is no preplanned analysis on remarriage, the researcher deciding to ignore the findings and keep quiet.

4. Researchers obtain the list of AIDS patients they wish to study. They contact the patients with the explanation that each has been selected at random from among the general population to take a sampling of 'practice of safe sex'.

5. A participant observer pretends to join a terrorist group in order to study it and is successfully accepted as a member of the inner planning circle. What should the researcher do if the group make plans for

a. bombing administrative headquarters

b. shooting national leaders

c. a peaceful, though illegal, demonstration?

d. kidnap a VIP's child.

THE POLITICS OF SOCIAL RESEARCH

Like ethics politics too have different ideological points of view. That which is unacceptable through one point of view will be accepted and appreciated from a different view of point, by different thinkers. There is a great amount of disagreement on political aspects of research, hampering consensus. Though the ethics and politics are closely intermingled, often, when we say that we mean the ethical aspects, we the social researchers keep the methods employed whereas the political issues are much tuned with the substance of research utility. To wit, critics did raise an ethical objection to the Milgram experiments, citing that the methods harmed the experimental subjects. This political objection could have been grounded on the doubt whether obedience is worthy topic for further study. On the one hand it might be that we need or should not tinker with people's willingness to follow orders from superordinates or on the other hand, from an opposite political group it might have been felt that the findings could be used to make people blindly be obedient.

The second point of differentiation between politics and ethics is, there are no formal codes of accepted political conduct comparable to the codes of ethical conduct. Though there are few ethical norms involving political aspects we do not have political norms that could be agreed upon say social researcher. One of the generally accepted views regarding political norm is a researcher's personal, political orientation should not interfere with his or her scientific research. As you are expected to hold aside the political views when you establish the realm of science we idealize science as apolitical, amoral and objective.

Any book on research methods elaboratively discusses if social scientific research can be objective. But different scientists with different

subjective views arrive at the same results by adopting accepted research technique, it should set aside the personal values and views during the research time it is supposed to be possible. This is what Max Weber (1918) coined as 'value-free sociology' where like other sciences sociology should not be circumscribed by the personal values if need to contribute to society. But there have been numerous disagreements about whether particular research understanding are value free or do they represent the researcher's political values.

The controversy between social research and politics is more intermingled in the area of race relations. To illustrate, in the year 1986 US supreme court established the principle of 'separate but equality' as a reconciliation to guarantee equality to blacks with the norms of segregation, without the assistance of social scientific research. But it is widely believed that the conflicts were influenced by the writings of sociologist, W. G. Summner noted for his view that the norms and folkways of a society were relatively impervious to social legislation and social planning. The court ruled out the hypothesis that social prejudices may be overcoming legislation and desired wisdom of laws which conflict with the general sentiments of the country. To cite another instance to highlight political controversy surrounding social research psychologists, Jensen's research article on IQ tests scores of Blacks and Whites brought out the findings that genetic differences between Blacks and Whites account for the lower average IQ scores of Blacks. He was soon recognized and found in college campus addressing the gathering with few research questions on this. Thus these illustrations add to bring all the fact that political ideology often gets involved in matters of social research though abstraction model of science is divorced from ideology.

Table 2.1

Code of Professional Ethics and Practices

We, the members of the American Association for Public Opinion Research, subscribe to the principles expressed in the following code.

Our goal is to support sound practice in the profession of public opinion research (By public opinion research we mean studies in which the principal source of information about individual beliefs, preferences, and behaviour is a report given by the individual himself or herself)

We pledge ourselves to maintain high standards of scientific competence and integrity in our work, and in our relations both with our clients and with the general public. We further pledge ourselves to reject all tasks or assignments which would be inconsistent with the principles of the code.

THE CODE

1. Principles of Professional Practice in the Conduct of our Work

A. We shall exercise due care in gathering and processing data, taking all reasonable steps to assure the accuracy of results.

B. We shall exercise due care in the development of research designs and in the analysis of data.

1. We shall employ only research tools and methods of analysis which, in our professional judgement, are suited to the research problem at hand.
2. We shall not select research tools and methods of analysis because of their special capacity to yield a desired conclusion.
3. We shall not knowingly make interpretations of research results, nor shall we tacitly permit interpretations, which are inconsistent with the data available.
4. We shall not knowingly imply that interpretations should be accorded greater confidence than the data actually warrant.

C. We shall describe our findings and methods accurately and in appropriate detail in all research reports.

2. Principles of Professional Responsibility in our Dealings with People

A. The Public

1. We shall cooperate with legally authorized representatives of the public by describing the methods used in our studies.
2. We shall maintain the right to approve the release of our findings whether or not ascribed to us. When misinterpretation appears we shall publicly disclose what is required to correct it notwithstanding our obligation for client confidentiality in all other respects.

B. Clients or Sponsors

1. We shall hold confidential all information obtained about the client's general business affairs and about the findings of the research conducted for the client, except when the dissemination of such information is expressly authorized.
2. We shall be mindful of the limitations of our techniques and facilities and shall accept only those research assignments which can be accomplished within these limitations.

C. The Profession

1. We shall not cite our membership in the association as evidence of professional competence since the association does not certify any persons or organizations.
2. We recognize our responsibility to contribute to the science of public opinion research and to disseminate as freely as possible the ideas and findings which emerge from our research.

D. The Respondent

1. We shall not lie to survey respondents or use practices or methods which abuse, coerce, or humiliate them.
2. We shall protect anonymity of every respondent, unless the respondent waives such anonymity for specified uses. In addition, we shall hold as privileged and confidential all information which tends to identify the respondent.

UNIT – III

LESSON – 3.1

THE STRUCTURE OF INQUIRY

RESEARCH DESIGN

A research design is a plan of the proposed research study. It is a detailed plan or method which defines the procedures for collecting and analyzing data scientifically. Kirk (1968:1) and Selltiz et al. (1959:50) indicate that research designs are plans that specify how data should be collected and analysed. Selitiz et al. add that research designs should also seek to combine relevance to the research purpose with economy in procedure. "A research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure" (Selltiz et al., 1959:50).

According to F.N. Kerlinger, research design is "the plan, structure, and strategy of investigation conceived so as to obtain answers to research questions and to control variance" (1964:275).

The terms, plan, structure and strategy need to be explained further to make the structure and procedure of research design more clear. The 'plan' includes everything to be done by the researcher in research procedure, i.e., from writing the hypothesis, defining the hypothesis operationally and collecting data to the final analysis of data. Thus, 'plan' means the overall scheme or program of research; 'structure' means the outline scheme or the paradigm of the specific research project; paradigm means a structure or a guiding model that regulates the operationalisation of the variables; 'operationalisation' means outlining or defining the variables in terms of the indices or indicators and specifying their relationship to each other. 'Strategy' refers to the methods used to gather and analyse the data.

The working out of the plan or design consists of making certain decisions with respect to the following as: What the study is about and the types of data that are needed; Why the study is being made; Where the needed data can be found; Where, or in what areas the study will be carried out; When, or what periods of time, the study will include; How much material or how many cases will be needed; What bases of selection will be used; What techniques of gathering data will be adopted; and how will the data be analysed. Thus, the considerations which enter into making the decisions regarding what, when, how much, where, by what means, constitute a plan of study or study design (P.V. Young, 1984).

It may be said that a research design includes at least the following component parts, which are interdependent and not mutually exclusive: sources of information, nature of study, objectives of study, socio-cultural context of study, geographical areas to be covered by the study, periods of time to be encompassed, dimensions of the study, the bases for selecting the data and techniques to be used in gathering data.

A research design, thus, is the logical and systematic planning and directing of a piece of research. It may be tentative at the beginning and may undergo many modifications and changes as the study progresses and insights into it deepen. It is not a specific plan to be followed without deviation, but rather, a series of guideposts to keep one headed in the right direction. Regardless of the type of research design selected or the objectives hoped to achieve, a universal characteristic of any research plan is flexibility. A research plan conceived at one point in time is not necessarily free from alteration when unexpected conditions are encountered in a given social setting. Thus, research designs are guidelines for investigative activity and not necessarily hard-and-fast rules that must remain unbroken.

PURPOSES OF RESEARCH

A social research may be carried out for different purposes. Broadly speaking, there are 3 general purposes of research as Explorative,

Descriptive and Explanatory. A researcher who wants to have a familiarity with the topic may start with exploratory design. There are many issues like tax payers' revolt, policemen morale, college dormitory regulation, and so forth which any one might start to investigate. There are three purposes to carry out Exploratory studies.

1. Simply to satisfy the researcher's curiosity and desire for better understanding;
2. to test the feasibility of undertaking a more careful study;
3. to develop the methods to be employed in a more careful study.

In social scientific research explorative studies have got more value as a researcher is creating new ground or area to work with, based on which researchers yield new insights for topics of research. The limitation of this design is they can only hint at future insights to be verified, but seldom provide satisfactory answers to research questions. This type of studies are always considered as a step consisting of problem-finding, requiring more carefully controlled studies to test the hypothesis and have a general applicability too. Exploratory studies help in clarification of concepts, in locating important variables, in establishing priorities for future research, in gathering information about practical possibilities for carrying out research in real-life setting, and in providing a census of problems regarded as urgent by people working in a given field of social relations. Exploratory research design is flexible enough to permit the consideration of many different aspects of a phenomenon. It is highly unstructured. In other research designs we begin with specific hypothesis which we aim to test but in exploratory research design, it is development of specific systematic research project. Exploratory research is necessary to obtain the information that will help in formulating relevant hypotheses for more definite investigation.

Second major purpose of research may be to describe the structure and events existing around. It provides description of an individual, a community, a society, or any other unit under investigation accurately. A researcher adopting scientific procedures to explain will certainly carry out

carefully and the results will be accurate and precise. The description provided by it is aimed to involve minimum bias and maximum reliability. The census records, district hand books, block statistics, voters' list, directory and so forth are vital sources of secondary data which is also an example for scientific description. Unlike exploratory design, descriptive designs aim at testing non causal hypothesis. However, the quality of description and generalizability of the observed phenomena depends on the scientific and meticulous mode of maintaining secondary data.

There are two types of description – Qualitative description and Quantitative description – which vary by their structure. The quantitative description is obtained through the use of schedule, structured interview, questionnaire, or through any other structured method. The description may be about the individuals, groups and communities in terms of their socio-economic condition, cultural pattern; about facilities such as living condition or on habits and attitudes of the people. Qualitative description may include aspects such as customs, norms, values and ideologies of social structure and organizations or pattern of human behaviour. The source of obtaining information may be through historical method or comparative method. One of the most used techniques of observation is participant observation where the gathered informations are combined to draw inferences.

Descriptive studies apart from providing a picture about variation or distribution of characteristics in the population, also help in discovering the association of variables. These studies also occupy important place in survey research, specially if and when developmental program would be based upon assessment of people's opinion and attitude. It is also of great use for a preliminary and final stages of experimental study. It suggests the possible factors behind the occurrence of events which help the applied workers to deal with every day practical problems and to make definite plans for further action. Descriptive research design has both advantages and disadvantages. Its chief merits are that it is easy to obtain information about the characteristics, nature, attitudes or problems of the people easily

and it is easy to prepare the list of variables to be tested for the effect of one or two variables upon a dependent variable. The major demerits are faults that may be involved at the stages of its construction and application, collection of only those evidences which would support the ideas of investigators or their hypothesis, less information on effects of variables on one another, and faults arising out of investigator's bias.

Explaining the things around may also be a general purpose of research. A political analyst may be interested as to why in the recent election party A lost to Party B or why citizens voted for candidate M rather than candidate Z. To wit, if a student just describes the student riot it is descriptive, rather if he tries to give explanation as why they did it, it is said to be explanatory. In brief, the explanatory research aims at examining most of the different aspects of the situation and the event simultaneously.

However, strictly speaking most of the works have one or more purposes of research. This may be out of curiosity or because of progression in research. Suppose, you want to find out a new medicine for curing AIDS patients, you have to set the new therapy and describe it as you try to trace the impact of the therapy will explore and finally basing your results, you may try to explain why the therapy is successful for a few and failure for many.

UNIT OF ANALYSIS

The research topics in social scientific research vary widely in what or whom to be studied, which is put technically as units of analysis. In social survey a researcher may observe a large section of people and enlist their personal characteristics as age, sex, attitudes and so forth. Later they are categorised and the results are presented for different aggregates providing description of different individuals of the study population. To wit, you may note the years of experience, sex and age of the contestants for a competition. Later you may conclude that mean years of experience is 12 years and mean age of the group is 45.2 and 55% are females and the remaining are males. Though you finally describe it as a group or class

the individual in it would be the unit of analysis. Units of analysis is nothing but the units whose individual characteristics are segregated for purposes of describing some larger group.

If the purpose is to explain as to why few contestants succeeded and few failed you may try to tabulate the information by gender, seniority and age and come to a conclusion that senior males are selected more than younger females. Here too the unit of analysis would be only individual. Thus unit of analysis are those units that we initially describe for the ultimate purpose of aggregating their characteristics in order to describe some larger group or explain some abstracted phenomenon. Individual, group, organization and social artifacts are different units of analysis for different research.

Individual is the most typical and widely adopted unit of analysis in social scientific research. Researchers mostly obtain information from individuals to explain and describe the social group and interaction by aggregating and manipulating the responses of individuals. Though, the norm of generalized understanding in social science recommends that scientific finding should apply for all kinds of people, seldom researchers study all, but it is stretched by carrying out different cross cultural and cross sectional studies. Students, politicians, residents, workers, voters, teachers, parents, children, officers, politicians and so forth are a few examples of individuals as unit of analysis. Here again the term teacher implies some population of entire teaching community, may be, to a given rank, institution, region, and so on.

Unlike studying the individuals and concluding for the masses, social scientific research also studies social groups as a unit of analysis. The best example for groups as unit of analysis would be families. The so gathered information from the families can be interpreted through some statistical measure. You can say the mean income, mean size of the rooms, number of tubelights, material possessions like time saving gadgets,etc. Basing this statistics you may try to further explore whether higher income

and small sized household possess more time saving gadgets. Here the individual family would be the unit of analysis. Street gangs, clubs, census blocks, cities, villages, friendship cliques, married couples are a few examples of groups. You may take social groups as your unit of analysis but the group is attributed by the characteristics of the individual members like age, sex, education, caste, etc. In descriptive study we shall examine and report the statistics on material possessions of the families. In explanatory study we may try to explain if large sized families or the professional status of the family head is contributing for possessing more time saving gadgets. Individuals and groups may be characterized in different ways like membership in an organisation, their environment, etc. You may interpret the type of dwellings of different families across income level and we may try to find out whether women from such families are members of any organisation.

Examples for organisation as a unit of analysis would be corporation, churches, colleges, army divisions, academic departments, supermarkets, District Industries Center, etc. If you treat group as your unit of analysis, a corporation is characterized by percentage of individuals from different income levels, caste groups, type of family, size of family and the organisation statistics like number of employees, the net profit, gross assets, number of contracts and so forth. As a description we might examine the average contract of all organisations. In an explanatory study we may try to determine whether old organisation tend to get more contracts than recently incepted ones. The issue of unit of analysis may become complex in accordance with the purpose of research. To start with if you propose to know whether companies with more married women are more likely to set up marital counseling than companies whose employees are females but unmarried, here the unit of analysis is the company. If you ask if women with more tenure of work are likely to work in companies with counseling centers than one woman with lesser years of experience, the unit of analysis would be individual worker. Finally if you want to know whether married women workers working for longer years in an

organisation attend workshops on counseling than those who are unmarried and recently employed, the unit of analysis would be individual again. Thus, unless and until you are clear about the unit of analysis it is impossible to decide what to observe about whom on what.

Social artifacts or the product of social beings and their behaviour would also be a unit of analysis. These include social objects such as books, poems, paintings, automobiles, buildings, songs, poetry, jokes and scientific discoveries. All these objects comprise a population of all such objects as all novels, all introductory sociology books, all cook books, all paintings of particular painter and so forth. If you would aim to describe the book you may characterise it in terms of its size, length, weight, price, content, number of portraits, volume of size, or author's description. You may analyse all books or a particular kind of book for the purpose of description or explanation. A researcher might examine the matrimonial columns of different weeklies for the purpose of describing or explaining the changes in the choice of marriage where the unit of analysis is each advertisement. Social interaction like weddings may also be an example of social action as unit of analysis as you may venture into the parties' characteristics, couple's personal characteristics, ceremonial practices, inter caste marriage, dowry practices and so forth. Likewise, in scientific research you have many number of social artifacts like friendship choices, court cases, traffic accidents, divorces, fistfights, ship landings, airline hijackings, race riots and congressional hearings.

The above paragraphs on unit of analysis gives the possible units for analysis. You might have come to a conclusion that individual human behaviours are typically the unit of analysis but in reality many research questions can be aptly replied through examination of other units of analysis. Though it is not essential that you should classify your unit of analysis as individuals, groups, organizations and so forth, it is just sufficient if you are able to pinpointedly say your units to be analysed. You must decide whether you are studying teaching or teachers, sports or players, music or musicians, marriage or spouses, Non-government

organisation or social work activities and the like. It is the right time to introduce the two concepts – Ecological fallacy and Reductionism – to brief unit of analysis. Ecological fallacy is nothing but the danger of making assertions about one unit of analysis based on the examination of another. A hypothetical illustration of this fallacy can be discussed. Suppose there is a research interest to learn why students attending course J are more than students attending X course. Further assume that students attending J course are immediately absorbed in the employment market than students of course X. This does not mean that course X is less important or students of course X are less talented or less intelligent. It is possible that students of both the courses may be absorbed immediately and few unemployed. Here we run the risk of ecological fallacy. The second concept of reductionism refers to shrinkage of variables and concepts to study a broad range of human behaviour. This is in fact tied with the discipline and the respective specialization. A sociologist may be concerned with social variables like values, norms and roles; a psychologist considers personality types and traumas; and an economist on supply and demand. If a researcher probes into the reason for low standard of living where different disciplines go by their own discipline indicators. If an economist views it through national income and percapita income it is said to be economic reductionism. If a psychologist views through psychological factors it is psychological reductionism. Both the above two problems arise out of indefinite unclear boundaries and definition of unit of analysis.

TOPICS FOR RESEARCH

While different characteristics of the units have to be studied as spelt out, you should now know the range of possible characteristics which is presented as topics for research. Broadly speaking there are 3 classes: Condition, Orientation and Action.

The condition or state of being of the units may be considered as a characteristic. An individual is characterized by factors such as age, sex, caste, religion, marital status, membership, economic status, nativity status, taste, habits, knowledge. The organisation has the feature of

structure, size, time of origin, location and all other characteristics of its members like their skill, tenure of experience, vocational training, hobbies, talents and so forth; the physical objective be described in terms of their attributes such as size, colour, length, idea behind it and the character of the creator, say a painter, portrait, artist, novelist etc. If you take social interaction it may include aspects like topics of interaction, context of interaction, purpose of interaction, relationship involved in interaction and so forth.

When we analyse an individual or group or organisation we also consider their orientation such as attitudes, beliefs, personal traits, prejudices, predispositions and the like. An individual may be featured as religious, politically conservative, anti-caste, gender biased, dull headed, superstitious, intelligent. The social group and organisation may be oriented in terms of their purpose, policy, regulation, procedures and above all orientations of the individuals who form the group or organisation. Social interaction like hijacking, court proceedings, congression as politically motivated, unbiased and so forth.

When the focus is on social interaction we either observe directly or seek second hand information to know why a person voted for a particular party, why a person purchases a product of particular company, why a person dropped out of school, visits church, invests in so and so company or agitates against particular government policy program and so on. You can either see the second hand information like voters' list to study the voting behaviour or go for personal interview. At a higher level when you analyse the groups you may take family issues like picnics, prayers, money transactions, migration and so forth; corporation may sponsor concert, political campaign, fix prices; and social interaction can check the success or failure of marriage, winning or losing court cases, fistfights whether aggravate or reduce the antagonism and so on.

By all these you can come to know about your main focus of study though you could not strictly place your research problem as condition or orientation or interaction.

THE TIME DIMENSION

High level or macro research and those which plan to recommend policy measures to the government would also like to determine the causation between variables; generalization of research findings and where the time sequence of events and situation remain a critical element. A researcher explaining or describing an event must know its representativeness to the current state or past or future. We should know how time is related and cuts across the earlier considerations of what, of whom, and for what purpose the observation has to be made. Basing time duration the research can be classified as cross sectional and longitudinal.

Cross sectional studies take a cross section to study phenomenon at one point of time and carefully analyzing them. Experimental and descriptive studies are often cross sectional. The census enumerated in the beginning of a decade is a cross sectional which is a description of population at a given time. A researcher trying to explain the causes for religious tensions in one particular pocket is also an example for cross sectional studies as the situation may vary next time. The major limitation of the explanatory cross sectional studies is that the causal analysis computed for given time of reference is based on observation at one point of time. This is similar to the problems of using a still photograph to explain the entire characteristics and functions of the individual.

Certain types and topics of research facilitates observation beyond a specific time reference which is called as Longitudinal studies. A researcher observing the students' protest right from its genesis till it is solved is an example for it. The analysis and updating of any secondary sources of information like newspaper editorials or supreme court cases are examples for such studies. There are three special types of longitudinal studies: cohort studies, trend studies and panel studies.

A trend study is one which examines the changes within some general population over time. Tracing the demographic changes like sex composition and age structure; political aspect like winning or losing are good examples of such studies. A cohort study examines the changes of these cohorts or subpopulation as they change overtime. It may include cases like those born in particular year, attending college on particular day, joined school on particular year and so forth. For example, if you wanted to know the attitudinal change of a specific population born in particular year say, in 1970's. you may choose at present various cohorts with an age range of 20-25, 40-41, 60-65, etc. They may vary by age but all those cohorts are those born in between 1950-1960. Panel studies are similar to cohort with a slight modification, where the same set of people is studied each time. To wit, the same set of customers of particular company product can be interviewed every time to know which company product did they purchase.

Longitudinal studies are advantageous over cross sectional studies but comes at the cost of time, money and labour. Another problem is the researcher should be present at the place of incident to observe and may require many research workers too. However, the time fixation or duration approximately is very essential and difficult task in Longitudinal studies as it involves certain loopholes like asking the respondents to recall the earlier response and sampling mortality.

MOTIVATIONS FOR RESEARCH

A budding researcher will be both confused with the steps of research as well as worried as what to observe and what not to. Every event occurring around will be worth to probe and record whereas the feasibility of observation and carrying out is questionable. Unless and until concretely the researcher is able to answer the one word questions of earlier research design frames he cannot have good abstraction. This is because he does not know how a research design actually looks like though he is confident enough to frame one. Altogether a researcher should know the ways in which social research gets started.

A researcher may be motivated to start research basing his understanding on existing formal theories which he would like to test. A researcher starts with the postulates later put in the form of hypothesis which is to be tested. A researcher motivated to test the formal theories should specify several concepts contained in it, select a research method and research setting appropriate to testing and determine and obtain the research needed.

Research projects in the social sciences aim to test substantial portion of general theories. Some go for testing portion of comprehensive theories and more of them go for developing and testing limited theoretical hypotheses. Comprehensive and limited theories differ only in the manner in which the hypotheses are derived in the implication of the results of testing it.

Exploring some unstructured interest may also be a motivation for research. Here the researcher is unclear about the exact relationships of variables and has no idea on what he expects. Here you don't have a general theory from which hypothesis could be listed out to test but only mere curiosity and concern. An illustration may help you to understand. Suppose that you are interested in finding the faculty attitudes toward students' participation. You do not have any formal theory to chart out a hypothesis regarding faculty attitude toward a student's participation. You may start the research by examining them in different departments comprising your college. Department offices may provide information pertaining to student representation on the respective department committees. You find variation in it and explore why in some departments there is a representation and in some there is nothing. Later you might consider variables such as number of faculty members, age in average, academic field, caste, sex composition and so forth. If you find any pattern of difference between the department – those giving representation and those that do not – it will help you to explain the situation in your own department. This can further be proceeded with studying a few cases in depth and later unstructured interview with informants and finally decide

to proceed with the structured study. As you do not have formal hypothesis and the entire research is unplanned the data gathered would be unstructured and open ended.

One more motivation for research may frequently be commissioned to engage in research project which is contracted research. Contracted research is typically predicted as a need for specific fact and findings with policy implication.

HOW TO DESIGN A RESEARCH PROJECT

All the foregone pages of this chapter would give you a macro perspective of social research and at the same time might be confused as to where to start and how to proceed. Suppose in partial fulfillment of the degree course, you are asked to carry out a project work how and where would you start your research? Answer to this question may include the entire syllabus prescribed for you. Hence the purpose of this section is to provide you in succint form the various steps in research design (Fig 3.1).

To begin with, the diagram shows the interest, ideas and theories which are the only possible beginning points for a line of research. The letters A, B, X and Y are variables or concepts like compassion, prejudice, alienation and so on. Thus, say, you may be interested in finding out what causes alienation among a few or why women are more compassionate than men.

The entire task begins with a specific set of ideas as how that particular thing would be. You may assume that the reproductive responsibility attached with women might make them to be more compassionate than men. This is marked with the question mark in the diagram to show that you are not sure about it in this initial stage. The last cell of the row is marked by theory as a complex set of relationships among several variables. You can notice that there is a possible movement forward and backward, a cyclical one, indicating that initial interest or curiosity may lead to idea formulation which may fit into larger theory and this theory may generate new ideas and new interest and so on. Having

understood the type of research you may correctly finalize that this is explorative one.

Fig 3.1

INTEREST	IDEA	THEORY
? ——> Y	X ——> Y	A ——> B ——> E ——> F
Y ——> ?	A ——> B	C ——> D ——> X ——> Y

CONCEPTUALISATION	CHOICE OF RESEARCH METHOD	POPULATION AND SAMPLING
Specify the meaning of the concepts and variables to be studied	Field research Content analysis Existing data Experiments Evaluation research Survey research	What do we want to draw conclusions about? Who will be observed for that purpose?

OPERATIONALISATION	OBSERVATION
How will we actually measure the variables under study?	Collecting data for analysis and interpretation

DATA PROCESSING

Transforming the data collected into a form appropriate to manipulation and analysis

ANALYSIS

Analyzing data and drawing

conclusions

Under the cell conceptualization, we tend to think loosely in terms of concepts such as compassionate, support system, well-being, alienation and so forth. You should spell out what you exactly mean by the given concepts so as to proceed with further steps of research. Estimating the strengths and weaknesses of different choices of research methods a

researcher should choose the respective type of research method. Having specified the concepts and choice of research methods a researcher should specify the measurement technique which is stated as operationalisation. In addition to all the above ones he should specify what is going to be the study population, what information is likely to be obtained from whom about what, in what form and so forth. You may decide to study student population or housewives or double loader and so on but pinpointedly should finalize your units of analysis and representatives of the universe.

Observation is the keystone of any empirical investigation where the researcher decides the research methods and different observation methods to be used. The voluminous information collected by you is not easily quantifiable and interpretable and so the researcher to some extent should know the ways in which the so collected scientific data are likely processed or treated quantitatively.

The final stage is the analysis where the collected data is manipulated in such a way to draw inferences for our original interest or idea or theory that initiated the entire research process. Basing which you may again recommend for another new cycle of research design.

Thus to sum up a research design is similar to the blueprint of a house construction which guides the builder to proceed with construction. It tells the researcher as what step to follow, what should be size of sample and how these representatives should be selected from the universe. It helps to locate variables and facilitate manipulation of it suiting to our theoretical interest with the guideline to decide the statistical tool to be applied by deciding the selected set of causative variables. Finally it indicates the way in which the qualitative and quantitative representation of the variables to be analysed and what possible conclusions to be drawn from the analysis.

LESSON - 3.2

CONCEPTUALIZATION AND MEASUREMENT

MEASURING ANYTHING THAT EXITS

The process of moving from vauge ideas to clear picture is the general issue of conceptualization, which lays foundation for the next step of research operationalisation. To start with, the first question that arises in any social researcher's mind is that whather science could measure anything and everything, particularly the important aspects of human social existence. It is quite common that every researcher will be dissatisfied with the way the variable is measured by others. Everyone may have a feeling that others have left out the important aspects in their measurement. It may be such that some would measure religiosity by more number of temple visits and some others may measure compassion by nothing which how many times a person cries while watching a particular sad film. The greatest dissatisfaction would arise when you find yourself being misclassified by the measurement system. The dictionary meaning of the proposed concept and our personal experience put together will help us to conclude that it is miseleading to go by any one of the definition. Measurement in social science is a special problem where social scientists conceive that social science can measure anything that exists.

To start which, in the argument of measuring anything that exists, how do you know that particular concept is existing in the society? For instance, prejudice is a word existing in the dictionary and in our usage, but we have never seen prejudice in any form and do not know how it looks like actually. Still this word is used often by all of us. In the course of travelling we observe that such things do exist and even observe more than what is found in the difinition. Thus, a word like prejudice evokes a mental image in everyone's mind and in our file we might write in detail what we mean by prejudice, what all we have heard about it, whatever we have observed on this issue, its various definitions and so forth.

The technical term for this mental image is said to be concepts. All these mental images cannot be communicated directly in raw form as the prepared list will be lengthy and unorganised. Hence, to communicate we may give a term, often used as a heading under which we communicate the concept and explain things we observe about the concept. For example, we know that compassion as a concept is existing. Suppose you find that Mr. M was crying while watching an emotional scene in a movie you may think of including it as a compassion indicator. Later while you refer the literature and meaning of the concept you may also find that it never fits into the definition and find out that it is only sentimentality. Thus, we can measure anything that is real. For example, we can measure whether Mr. M puts the little bird back in the nest, visits hospital or orphanage during his birthdays, gives charity to orphanage or protection of rare animal species and so on. All these things are real and so we can measure them. But still a question arises in our mind as whether compassion is measurable.

Conceptualisation is the process by which we precisely spell out what we mean by a particular term. Suppose if we want to know whether women are more compassionate than men, we need some precise questions to elicit that information and establish an agreement on answers suiting to the working agreements of the meaning of the term. These working agreements allow us to venture into the concept with some meaningful questions.

The conceptualization process conclude with the set of indicators of what we have in mind. Indicators are real and observable things, giving evidence of the presence or absence of the concept that we intended to study. If we agree with weeping during watching a film, visiting orphanage, giving charity and so forth as indicators of compassion we may observe that presence or absence of these, indicates a given score of 6, 7, or 3 and so forth for the list of 10 intended indicators. Here the units to be analysed are individuals. As discussed earlier if you find different entries you may find different strategies for different combinations.

Conceptualisation may be classified as feelings, sentiments, actions and so forth which can be called as dimensions. Researchers should be cautious to check whether different indicators measure different aspects of the concept and they are not interchangeable. Interchangeability of indicators mean that several indicators represent to some degree the same concept where they behave in the same fashion as the concepts behave.

There is a continuous confusion over definition and reality. Though the observation and experiences are real, the concepts are only our mental creation. The process of conceptual entrapment continues from observation through giving a name to the observed and using the name as concept for checking the indicators of the given concept. This is presented in Fig. 2.

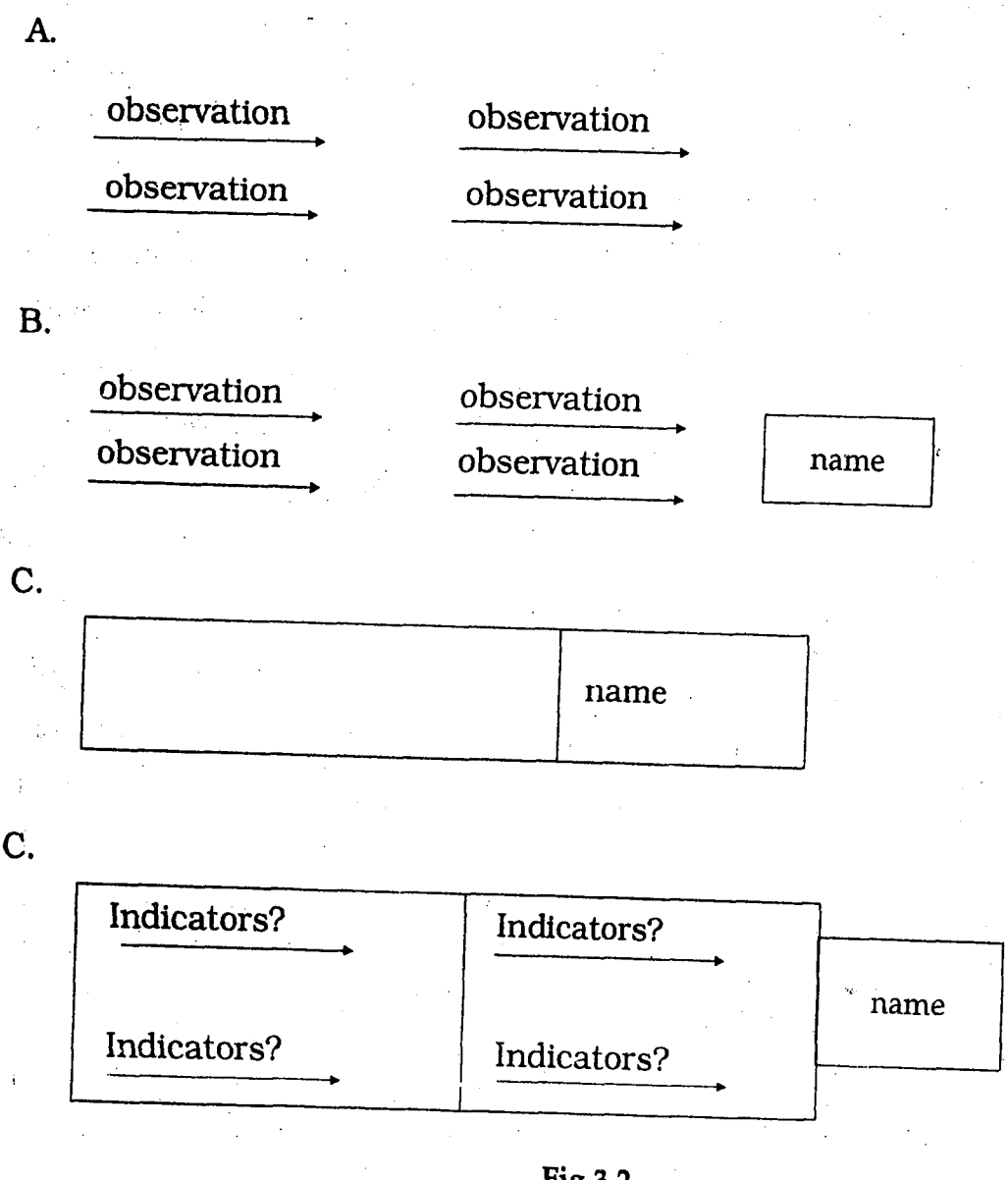


Fig.3.2

Creating a conceptual order is one of the important stages in scientific inquiry which depends on nominal and operational definition. A nominal definition is one that is assigned to a term. The description of the operations that will be involved in measuring it, is called as operational definition. To wit, we may specify that status of women is measured with the two combination of decision making power and employment status though we rule out the other possible aspects of status as age, education, income and so forth. Though others may disagree with our workable definition and operationalisation we may be clear in our steps of research.

DEFINITION AND RESEARCH PURPOSES

The distinction between the purpose of research as description and explanation is very important for the process of definition of measurement. At the outset, everybody thinks that description is simpler than explanation which is not so in reality. The importance of definitions for descriptive research should be clear. If you aim at describing and reporting the unemployment rate in a city the definition of being unemployed is critical. An interesting example would be defining labour force. It is absurd to include 3 years old children as unemployed as they are not considered as labour force. As per census bureau, all children below 14 years are considered as children and are not supposed to be included in labour force definition. Further if we proceed with this operational definition a question is obviously ready as what to do with high school and college students, the retired, the disabled and housewives. If you refine your definition of labour force as "all persons 14 years of age and above, who are employed, in looking for work, or waiting to be called back to a job from which they have been laid off or furloughed", here unemployed persons would be those members of labour force who are not employed. Next issue of clarity is "looking for work". Likewise the definition and research purposes are synchronized and it should be cautiously considered by a field researcher.

CRITERIA FOR MEASUREMENT OF QUALITY

In continuation of our discussion on anything is measurable and synchronization of reality and actual concept, it will be worthwhile to think

processes too. A team of coders may take different coding frames for the same informants. Field or survey researchers pose a few reliability problems, too. You may pose a question about United States' policy to a rural illiterate woman who has not even come out of her village. Here the respondent is not competent enough to answer, as the question is irrelevant to the population.

How to overcome the unreliability? At first ask the respondents only those questions which they are likely to know and answer. A researcher should be clear in the questions he is likely to pose and should ensure that the questions are relevant to the study population. Second, commonsense advice, is not to pose different types of questions to elicit the same information. The best way to assure reliability is to use the tools which are proved with the test of reliability earlier. To ensure reliability, a researcher can check the tool with a few respondents before carrying out a macro survey. Finally clarity, specificity, training and practice will minimise the problem of unreliability.

Conventionally validity refers to the extent to which an empirical measure adequately reflects the real meaning of the concept under consideration. A researcher can go for face validity where he can prepare the list of indicators, prepare a questionnaire or check with few experts. Second, we can go by the concrete agreement survey or research reports like Census Bureau and follow the operational definition of such concepts as family, household and employment status which seem to have a workable validity of those concepts. Finally the best validity measure is when different indicators measure the same concept and arrive at the same conclusion as it is expected to be more valid. However, often, there is a constant tension between reliability and validity as they overlap in many contexts.

LESSON – 3.3

OPERATIONALISATION

OPERATIONALISATION CHOICES

Refinement and specification of abstract concepts is conceptualisation while operationalisation refers to the development of specific research procedures that will result in empirical observation representing those concepts in the real world. This chapter is devoted to present some issues in operationalisation that applies to most or all types of studies that a social research could undertake. A researcher while deciding the observation or measurement has many queries like how and what to measure, what range of variation to consider, what levels of measurement to use and how many indicators to be concerned with and so on. While measuring the concepts, a researcher has a wide variety of options to measure them. Realise, however, that operationalisation does not proceed through a systematic checklist.

You know that observation is the keystone for scientific research to collect data in different modes but, you would not have known that there are different modes of observation. There are many sources to draw on and special ways of trapping them which can be distinguished in three types.

At first, it is sometimes appropriate to base your measurements on direct observations which you learn by just looking and listening to things going on around you – dealt in detail in field research. If you wanted to measure the strength of students' strike you have to count the protesters. Social scientists often learn about life by observing what goes on in the natural course of things while in the case of experiments it is appropriate to structure the course of things and then observe what happens. The second general mode of observation involves the examination of existing statistics and documents, where the data you need are already compiled and ready for interpretation – census – or where you need to often compile

them from raw sources, as you do in content analysis. This method is often used by historians who want to study the past. Finally, you have to learn often about human affairs by asking questions, most likely in survey research, where the information is obtained from the individual, about his particulars as well as information of other groups, and aggregated for picturing the groups in overall. To wit, information pertaining to new born cannot be obtained from the infants and we have to get the information from the doctors, nurse, parents and so forth. Likewise, in gathering census data the household head or a representative of the household is interviewed to elicit information pertaining to the entire household. They are called as informants.

Similar to observation, the different sources of information and different techniques of observation, a particular variable can be measured in a different form. A researcher should to some extent, know the extremes he is interested in measuring. If you want to measure an income of the household in terms of lakhs, not many people earn around lakhs. It all depends on the target population and their characteristics. The range of variation takes different dimension when the study aims at measuring attitudes and orientations. Let us suppose that you are interested in gathering people's attitude toward rickshaw pullers as a mode of transportation. You may find that a few will support it as the greatest, while another section will be less interested in it. Here you must ask how much they favour this mode of transportation and categorise it from 'favour it very much' to 'don't favour it at all'. But, this type of operationalisation conceals part of the attitudinal spectrum of the people. In the abovesaid example there may be a few who oppose rickshaw pulling on humanity grounds and a few others may do it on the ground that it is slow and in toto they fit best into the category 'dont't favour it at all'. This response is simply above mere opposing it. The degree of opposition varies from a very little to very much. Many public issues yield various degrees of support and opposition. Here it doesn't mean that a researcher should measure entire range of variation but should provide room for considering the group

of attributes which are unique. The decision on range of variation should be governed by expected distribution of attributes among the subject under study.

In the course of range of variation a researcher should estimate the variation between the extremes that he is interested in. To wit, if you gather data on age, you must be clear as what specific information you require. Is it essential that you need the exact years of age as 17 years, 18 years and if so you should know the significance of such exactivity in your research. On the other hand is it enough to get the aggregates like below 20 years, below 30 years and so forth. Likewise if you want to know the party affiliation, is it enough to know whether they are democratic or autocratic or degrees of democracy and autocracy? Of course, though many questions can be raised like this, it is left to the researcher's purpose of inquiry and nature of study. Sometimes, the elaborate specific information so gathered can be clubbed during analysis but the grouped data cannot be converted into specificity. Hence a researcher should forecast the utility of the data in future.

A researcher travailing through operationalisation process should be clear about the dimension he is interested in. Suppose, you propose to study on corruption in Government departments, there are multi dimensional aspects such as what they think about corruption: how much corruption is taking place: what do they think is the cause of it: how certain are they that it is corrupt: do they think that the corruption is inevitable and so forth. The list can never end as corruption takes different forms in government machinery and you should be clear of what dimension you are interested in your inquiry.

LEVELS OF MEASUREMENT

There are different levels of measurement for different variables depending upon the nature attributed. An attribute is a quality or characteristic of something while a variable is logical sets of attributes. The variable sex is inclusive of attributes male and female. The entire

process of conceptualisation and operationalisation can be seen as the specification of variables and attributes composing them. Employment status can be a variable while its attributes are employed and unemployed. The two important qualities of a variable are exhaustive and mutually exclusive. The range of variation for a variable gender is exhaustive as male and female where a respondent cannot fall in any other category than these two. Likewise they are mutually exclusive where the respondents can be either one of it but not both. But the structural qualities of the attributes comprising a variable warrants different levels of measurement nominal, ordinal, interval and ratio.

Attributes of those variables which are characterized as exhaustive and mutually exclusive represent nominal measure. Sex, race, religious affiliation, political party affiliation, college major, hair colour, birth place are some of the examples of nominal variables. The attributes of these nominal variables are distinct from one another and do not possess any other extra structural features. If you ask all the people to stand according to their birth place as born in India and born in America, all those standing in a given group share at least one thing in common. Unminding how the individual groups are formed, their closeness, their arrangement in the room and so forth, the only consideration would be that all members of a given group share the same state of birth.

Ordinal measures are inclusive of those variables whose attributes are logically rank-ordered, where the different attributes represent more or less of the variable. Social class, religiosity, conservatism, intellectual sophistication, prejudice, stereotypes and the like are some of the examples of ordinal measures. In a physical science we can say that one material is harder or softer than the other. Here we can only say in relative terms as which material it was harder or softer than, but not in absolute terms. To quote from sociological angle, if you arrange the students by level of education–primary, secondary, higher secondary, collegiate – ranging from the least to the highest we could determine that one had more or less the same formal education as the other. Only criteria is that they should be placed in rank order.

The actual distance separating the attributes of a variable is said to be interval measure. Unlike ordinal measure, here the logical distance between the attributes can be expressed in meaningful standard intervals. A physical science example would be Fahrenheit temperature scale. Here the difference between 80 degrees and 90 degrees is the same as that of difference between 40 degrees and 50 degrees. Likewise, the interval separating the IQ scores of 90 and 100 may be regarded as the same as the interval separating the scores of 140 and 150. Here it is nothing to say that a person having a score of 100 is twice as intelligent as a person scoring 50.

All the variables meeting the minimum requirements for interval measure also meet the requirement of ratio measure. But few, all the attributes mentioned above are based on a true zero point. Example from social scientific research would include age, length of residence in a given place, the number of organisations belonged to, number of visits to religious institution, number of friends, number of pen friends and so forth. For an hypothetical test we may ask all the organisation members to stand together in different groups according to their age as 10 years, 11 years and so on till the oldest person's age of the group. These several groups arranged in a line from youngest to oldest meet the requirement of ordinal measure permitting us to decide which person is younger, older and the same age as another. If you maintain a constant distance between the adjacent groups like an interval variable, you can measure how much older one person is than the other thus, permitting us to state as Mr. Z is twice older than Miss N.

OPERATIONALISATION ILLUSTRATIONS

1. Are sociology students or psychology students better informed about world affairs?

1a. Prepare a short quiz on world affairs and arrange to administer it to the students in a sociology class and in a comparable psychology

class. If you want to compare sociology and psychology major, be sure to ask them what they are majoring in.

1b. Get the instructor of a course in world affairs to give the average grades of sociology and psychology students in the course.

1c. Take a petition to sociology and psychology classes which urges that 'Indian headquarters be moved to New Delhi'. Keep a count of how many in each class sign the petition and how many inform you that the Indian headquarters is already located in New Delhi.

2. Who are the most popular administrators of your corporation: those in the sales department, purchase department, or the production department?

2a. If your organisation has a provision for management evaluation of officials, review some recent results and compute the average ratings given to the three groups.

2b. Begin visiting the refresher courses given in each group of departments and count the number of executives attending classes. Get the enrollment figures for the departments you study and calculate the average absentee rates.

2c. Around Deepavali season, select a group of executives or managers in each of the three departments and ask them to keep a record of the numbers of cards and presents they received from their employees during the season. See who gets more.

All the illustrations given above might make it sure that, in social research, variables are often operationalised by questioning of people–which is the most accepted way of getting data for analysis and interpretation. Though it is often used in survey research elaborately, all other types of observation including experiments and field research also use questions to elicit information. This task of questioning can be either from the investigator–interview method – or the respondent may be handed out a printed questionnaire and asked to fill it up – self administered questionnaires. Thus, it is clear that questions are the fulcrum of the operationalisation process where an initial researcher requires certain

general guidelines to ask and frame the questions which are the best operationalisation of the variables. The research process faces certain pitfalls which leads to obtain unnecessary and misleading information. The following pages will throw light on preparing a good questionnaire.

GUIDELINES FOR ASKING QUESTIONS

Questions and statements occupy a pivotal place in social science research especially in survey research. A questionnaire is inclusive of set of questions to be raised for the proposed dimension. Research proposed to explore a new phenomenon may be comprised of maximum number of statements in the form of questions. This is merely out of researcher's curiosity and interest to determine the extent to which a respondent holds particular attitude or perspective. This is the case when the researcher is unable to summarize the attitude in fairly brief statements. If he could draw brief statements for attitudes most perfectly we can ask the respondents to place themselves in the pole of continuum from agree to disagree. Rensis Likert is the first person to guage the attitude in 5 point scale – Strongly Agree, Agree, Undecided, Disagree and Strongly Disagree: or Strongly Approve, Approve, Undecided, Disapprove and Strongly Disapprove and so forth. It is upto the researcher's decision to conclude whether he is going to pick up only questions or only statements or both. A researcher aiming at maximization of objectivity and responses will profitably use both. This interchangeability of both questions and statements make the research design flexible, particularly during quantification, as well as interesting for the respondents to participate in the investigation.

As and once the mode of observation is decided as questionnaire, a researcher is left with two options. He can either go by open-ended questions or close-ended questions. In an open-ended questionnaire the respondent is allowed to decide and give his own answer to the question in any form. For example, you may ask a question as "What do you feel about Indian social security measures?" and shall provide some space in the response sheet to write by the respondents themselves in the given

space if it is a questionnaire method. Unlike this, in a close ended questionnaire the respondent is expected to select an answer from the given list provided by the interviewer. This format is widely used only due to its response uniformity and quick processing. In a close ended questionnaire, particularly if it is precoded, the data can be fed directly into the computer with a little attention on data cleaning. Even if it is transferred to data transfer sheets it can be done quickly. But in open – ended questionnaire responses may vary widely and at times responses may be out of focus or purely inessential. Here the role of researcher is multiple as he has to scrutinize the data before transferring to data sheets and carry out coding and processing. In brief it is a laborious task though yields maximum qualitative information, there are two structural requirements for constructing a close–ended questionnaire. At first the response categories should be exhaustive. The expected range of responses from the respondents should be exhaustive. If not fully after listing out the maximum expected response you can provide a space with a label as 'specify if any'. Second the response categories should be mutually exclusive. A respondent who is likely to tick or circle one or the other options should not be tempted or compelled to choose more than one. If the question is by nature likely to yield more than one response you should take care of the combination while processing. Or if you require only one response you can add in your instructions to select one best answer.

Ambiguity and less clarity of items ruin the entire purpose of research widely, particularly in survey research where the unclear and ambiguous questions misdirect the survey. It is quiet natural that the so listed items is very clear to you as it is your topic of examination you might have formed opinion about it basing your opinion on resumed literature. It is so sometimes that the researcher might have understood the concept specifically and fail to ask them succintly and precisely. To wit, if you are asking a question as 'what is your opinion about Indian Government policy?' a query or doubt may arise in the mind of the respondents as which policy of the government – economical, political or social? Thus,

ensuring the precision and clarity of items used in framing statements or questionnaire benefits the researcher by yielding exactly what he wants.

One more problem in survey questions are combinations of questions with different connotations. A researcher should avoid posing double barrelled questions. Frequently investigators ask series of questions with an expectation of single answer. This is more so when a researcher poses a complex question asking the respondent to agree or disagree with the given statement. To wit, the statement "all criminals should be identified and crucified". Irrespectively all may be willing to identify the criminals with different ideas like to rehabilitate, to punish, to minimise crime and so forth. But all may not agree for crucification. some would want to identify and punish the criminals but not crucify them, some would want to crucify the criminals but identify only organised criminals and not everybody. In some cases respondents may take neutral stand without misleading you owing to supporting one section of the statement and rejecting another part. As a guideline a researcher should check the word and its usage in questions and statements and verify if it is double barrelled ones.

As the purpose of research is to gather maximum information the researcher should check for the competence of the respondent to answer the set of proposed questions. The same question should be asked to you yourself and check if you could answer. For instance, if you wanted to know about some relationship in school age from a sample aged above 30 years it is doubtful whether respondents would remember with any accuracy. Most interesting example would be budgeting session where each and every wing would support their department but could not be in a position to comprehensively discuss about them. Supposedly if a researcher asks for the number of movies watched since adulthood you can imagine how accurate the response could be.

Similarly questions listed in the questionnaire should be relevant to most respondents. If you request them to express their attitude towards an issue familiar to them, the results are not going to be very useful. On

the other hand, if they are to express attitude towards an issue which they have never thought of, would also mislead the researchers. At times questions raised about fictitious issues or persons too, yield few responses. As the response is for fictitious issues you can afford to ignore but imagine the case of real issues. Here you may have no way of telling which response is generally reflecting attitudes and which reflect meaningless answers to an irrelevant question.

To avoid ambiguity and improve the precision of the statements' researchers often formulate long and complicated items. A researcher should avoid this and go for short items. Also from the view point of respondents they may not be willing to read lengthy complicated items to understand and respond. A respondent should be provided with a statement which is short and quickly readable, ensuring in-depth understanding and facilitate selection of an answer without difficulty. In brief, it is better to assume that respondents will/should read and answer quickly and hence a questionnaire should consist of short and clear items providing less room for misunderstanding and misinterpretation.

Misinterpretation by the respondents is often possible due to arrangement of negative items. Suppose if you have a statement that 'India should not tax unorganised workers', most of them will jump into conclusion basing the word 'not' and answer on that basis. Thus some will agree with the statement when they are in favour of taxing and others will agree when they disfavour taxing. A researcher may not know which is which. In a study of social science, people were asked a question as how they feel if the following kinds of people should be prohibited from teaching in public schools. They were also provided with a list of items in the response categories 'yes' or 'no' beside each entry. In this study many gave the answer yes to indicate willingness for such a person to teach rather than to indicate that such person should be prohibited.

Most of the concepts that are used in social science like prejudice has no ultimate correct definition and whereas a given person is prejudiced or

not depends on how we are defining the term. This is applicable to all those who are involved in completing a questionnaire. The meaning of a respondent's response to a question depends largely on the wordings of the question. Identification of an attitude or position with a prestigious person or agency may bias the responses. You should consider what generally the researchers call as social desirability of questions and answers. When you pose a question to respondents they will answer through filter as what will make them look good, particularly if it is fact to face interview situation. A male chauvinist though may not like his wife participating in family decisions, in the course of interview would say that they should be involved in decisions. Thus, a researcher should carefully examine the purpose of his/her inquiry and construct useful items. There are no ultimate conclusion as right or wrong.

OPERATIONALISTION GOES ON AND ON

To conclude it is right to say that the term operationalisation is continuous and goes on till the end of research. Though conceptualisation and operationalisation precede data collection they travel throughout the research project, sometimes even after analyzing collected data. As stated earlier you must be clear that a given variable can be measured in different ways in your research. This is particularly so when the selected concept is ambiguous and open to various interpretations and definitions, in course of which you are in a position to give alternative operational definitions and may have several single indicators to be treated as composite measures. These different measures of a variable, representing different conceptualisation and operationalisation will help you to decide the one which gives you the clearest and useful answer to your research questions. A researcher should choose the measure that conforms to the expectation of his research point. Operationalisation is a continuous process but not a blind commitment to a given measure. A question on willingness to give money to charity if yields 'yes' response from all respondents, is not going to lead you anywhere. A researcher should clarify the nature of social life and the validity and utility of the information depend on its sources.

UNIT – IV

THE LOGIC OF SAMPLING

The complete enumeration or collection of data for each and every unit of the population or universe, as put by statisticians, is said to be census. Its chief merits are representation by each and every unit of the study population, as a result serves as a basis for future surveys and the results drawn are more accurate, representative and reliable. Like the interest of the psychologists on selective perception, the fundamental component of scientific research is also the same. It is neither possible nor desirable to observe the majority of things available for observation. Even if you have decided the conceptual limit of the relevant observation it is still difficult to observe the masses of particular inquiry, say, if you are interested in knowing the well-being of senior citizens and explore the social security measures of government and non government organizations. Though you have narrowed down the target population as elderly (60+) there are millions of aged Indians whom you cannot observe clearly.

Sampling is the process of selecting a subset of observation for the purpose of drawing conclusions about the large set of possible observation. As per the above definition sampling would be the selection of 2000 senior citizens in place of everyone in such a way that the so selected would essentially reveal the same information as what we would have obtained from million of older persons. Thus, the method of selecting a portion of the universe with a view to draw conclusion about the universe in toto is said to be sampling.

Representativeness is the key principle of sampling. The goal of scientific sampling is to select a few who can be a representative of the masses. If you wanted to draw conclusions about all Indian Destitute Homes you have to sample a few destitute homes that are replica of all homes. For example if you want to compare the stories of Hindi writers and Tamil writers you will have to select from each for study. Here you

also should insure that the so selected samples are representative of all other writings.

There are enough incidents in our political field to justify the efficiency of sampling method. Once when you find the fact and research investigation on a particular issue are one and the same you change your mind to the course of accepting 'sampling' as better than studying the whole universe. At times you find that sampling results are more accurate than the results gathered from the total population. There are several reasons for this bizarre. At first a large scale survey requires a large staff to interview for which the number of investigations are increased unminding the quality and results in overall poor quality of data too. Instead by paying more to the investigator we could ask them to study cases which would facilitate follow up procedures and also at a less cost. Also interviewing the entire large population would require more time to cover. At times the data so collected remain meaningless as the duration of project is lengthy which in course of completion the originality of the observed phenomenon would be changed. Third, the managerial requirements of a very large survey is greater than normalcy. You need staff of different calibre, designation and skill to supervise, record keeping, training, office management and so forth. Census gathered once in a decade is the best example for all the above cited points.

The process of sampling involves three elements – selecting the sample, collecting the information, and making an inference about the population, which are interwoven. The two vital laws governing sampling methods are (1) the Law of statistical regularity, and (2) Law of Inertia of large numbers. The first law propounds the logic that a moderately large number of items chosen at random from a large group are almost sure to possess the features of the large group. Put in other form it states that randomly selected sample from a population is likely to possess almost the same characteristics as that of the population underlying the desirability of choosing the sample at random. As per the second law, all other things being equal, larger the size of the sample greater the accuracy of the results

would be only on the ground that larger the size more the stability. Thus a sample should essentially possess the following:

a. A sample should be so selected that it truly represents the universe, otherwise the results obtained may be misleading.

b. The size of the sample should be so selected that it truly represents the universe, otherwise it may not represent the characteristics of the universe.

c. All items of the sample should be selected independently of one another and all items of the universe should have the same chance of being selected in the sample.

d. There should be no basic difference in the nature of the units of the universe and that of the sample. If two samples from the same universe are taken, they should give more or less the same result.

The various methods of sampling may be broadly divided into two groups – [1] probability sampling and [2] nonprobability sampling.

PROBABILITY SAMPLING METHOD

Probability Sampling Method is one in which one can specify for each element of population the probability of its being included in the sample. Every probability samples are characterized by the fact that the probability of selection of each unit is known. This implies that the selection of sample items is independent of the person making the study, that is, the sampling operation is controlled so objectively that the items will be chosen strictly at random with a logic interpretation.

A researcher need not be careful in his sampling procedure if the universe is homogeneous, where in any one case would be sufficient to draw conclusion about the universe. It is almost similar to the case of a housewife testing a spoonful of rice to verify the cooked natured of the remaining rice. A chemist testing the content of a tablet need not test all the paracetamol to qualify. Similarly a medical practitioner to examine the blood of a person just sucks a syringe full of blood. Unlike this, where the population is so heterogeneous, the researcher also should develop more

scientific selection procedures. The credit of modern sampling theory is attributed to Agricultural Research especially R.A Fischer's work. Sociologists deal with heterogeneous populations where individuals differ in many ways. A sample drawn from the given population should provide useful descriptions of the total population for which various probability sampling techniques are recommended.

In the course of selection there is a possibility of bias consciously or unconsciously. An untrained researcher, if needed to sample out university students would visit university campus and start interviewing anyone who walks around. Here the danger is the influence of his personal biases on sample selection. Suppose if the researcher is with conservative outlook, may not interview all those with modern dresses and hippie culture, feeling that they would ridicule his research effort. Even if you go for straight forward students you may not know how many types of students groupings in what proportion are existing. On the other hand conscientiously if he has made an attempt to systematically interview every 9th person entering a library here too the representativeness is questioned. There are different types of students – member/non-member, day scholar/hostelite, Science/ Arts – visiting a library for different purpose in different frequencies.

The so selected sample if should be useful in estimating the characteristics of the population, they should represent the population. They need not be representative in every aspect at least to those characteristics relevant to the study groups. As Leslie Kish (1965) rightly puts it, the vital principle of a probability sampling is 'a sample will be representative of the population from which it is selected if all members of the population have an equal chance of being selected in the sample'. This ensures two advantages of perfect and more representation and enables us to compute the accuracy of sample representativeness. To explore further in detail we shall familiarize ourselves with a few terminologies related to sampling.

The unit about which the information is collected and which provides the basis of analysis is called as ELEMENT. In surveys, people or certain types of people are elements which is often discussed as Units of analysis of any given study. The theoretical and hypothetical aggregation of all these elements are called as UNIVERSE. If the individual Indian is an element then Indians would be the Universe. The theoretically specified aggregation of survey elements is labelled as POPULATION. The term Indian is vague and while you precisely provide a workable population definition, say, college students, residents of a location, graduates and undergraduates and so forth it is crystal clear about the population for which the inference is to be drawn. This aggregation of elements from which the survey sample is actually selected is termed as SURVEY POPULATION. Practically, here you guarantee that every element that meets the theoretical definition laid down has a chance of being selected in the sample. In cases where a list of specific population is maintained though it eases and facilitates probability of selection there are chances for a few to be non representative. In a students' list a few may be omitted due to many reasons as late admission, non-payment of fees and so forth. Likewise, if you take a telephone directory, numbers of a few very important persons of the society may not be found in it either to avoid nuisance or on request by the concerned for security.

A SAMPLING UNIT is that set of elements considered for selection in some stage of sampling. They are by and large elements. For example, a researcher may select a sample of census blocks from different districts, then sample of households of that blocks and sample of individuals of that household. Here your sampling units are spread over in 3 different stages as blocks, households and individuals, terminologically designated as primary sampling unit, secondary sampling unit and final sampling unit.

To ensure equal representation and probability of selection, a list of all contestants is essential and this is termed as sampling frame which is the actual list of sampling units, from which the samples are selected. A sample of students selected from a students' roster is a sampling frame.

The list obtained from blocks is a sampling frame. The entire task of social scientific research depends on observation and the elements or aggregates of elements from which information is collected is said to be an OBSERVATION UNIT or Unit of Data Collection. A researcher may interview the class representatives (the observational unit) to collect information about all students of the class (unit of analysis). Variation in the attributes qualify a factor to be variable. A variable [sex, age, education, marital status] is a set of mutually exclusive attributes [female/male, young/old. literate/illiterate. married/widowed]. A researcher always aims at describing the distribution of attributes composing a variable in a population. A parameter is a sum of description of a given variable in a population.

PROBABILITY SAMPLING TECHNIQUE AND SAMPLING DISTRIBUTION

Survey researchers who overwhelmingly depend on Non probability sampling technique proceed on the hope that the selected set of elements from a population is in such a way that its description would accurately portray the total population from which they were drawn. Probability sampling technique ensures both the representativeness and also prescribes methods for estimating the degree of probable success.

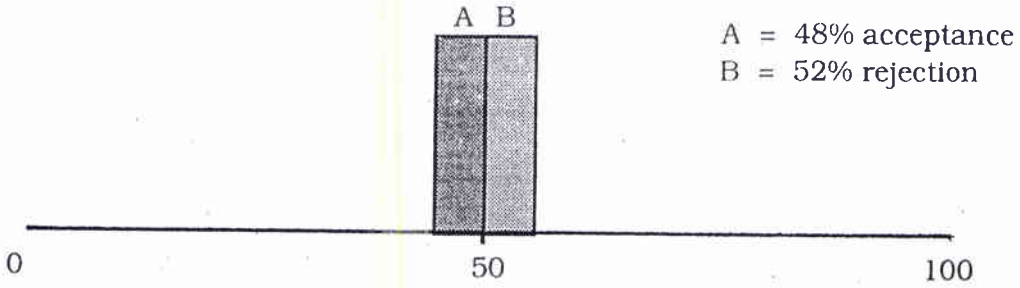
The key to this process is random selection where every element is given equal chance to be selected and is independent of any other events in the process of selection. In the frequent toss of a coin the selection of head or a tail is independent of previous selection of head or tail. Rolling a pair of dices is also a perfect example. A survey researcher often uses table of random numbers or at advanced level the computer programs providing a random selection. This utility of random selection method is two fold where it serves as a check for conscious or unconscious bias and provides a basis for estimating population parameters and error.

BINOMIAL SAMPLING DISTRIBUTION

A survey example would enable us to discuss the concept of sampling distribution. Assume that you are interested in knowing the workers' acceptance or rejection of the Bonus percentage proposed by the

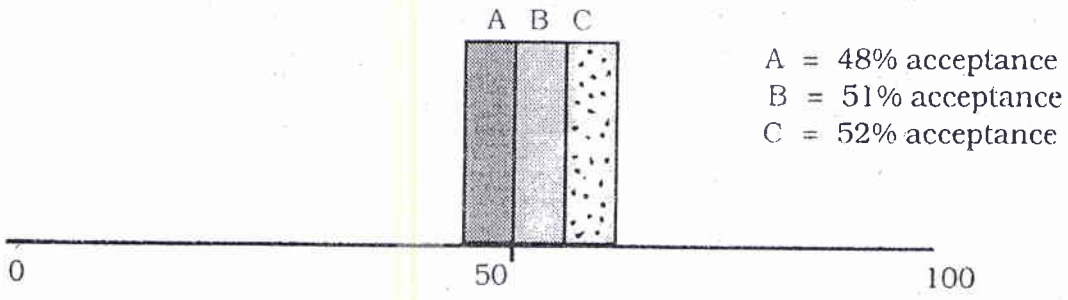
management. The aggregate of workers will be the survey population, while the workers' muster roll will be the sampling frame. The individual worker is the element. Here the variable is the attitude of workers towards bonus percentage, a binomial variable, accepted or rejected. You may randomly start selecting the workers for estimating the workforce of the organization. Assume that you have given numbers to the workers' muster roll and randomly chosen 200 subjects and started interviewing the attitude towards bonus issue. Also assume that, of the total worker sample interviewed 48% have accepted and 52% have rejected the management policy [Fig 4.1]. You

Fig. 4.1: % of workers rejecting policy



may go for a second 200 samples and may find that 51% accepts and 49% rejects the policy. By repeating this process for the third time you may discover that 52% accepting and 48% rejecting. When the three hypothetical results when plotted in a graph [Fig. 4.2] where X axis denotes the percentage rejecting, you find 3 different levels of rejection. A selected

Fig. 4.2: Results produced by Three Hypothetical surveys

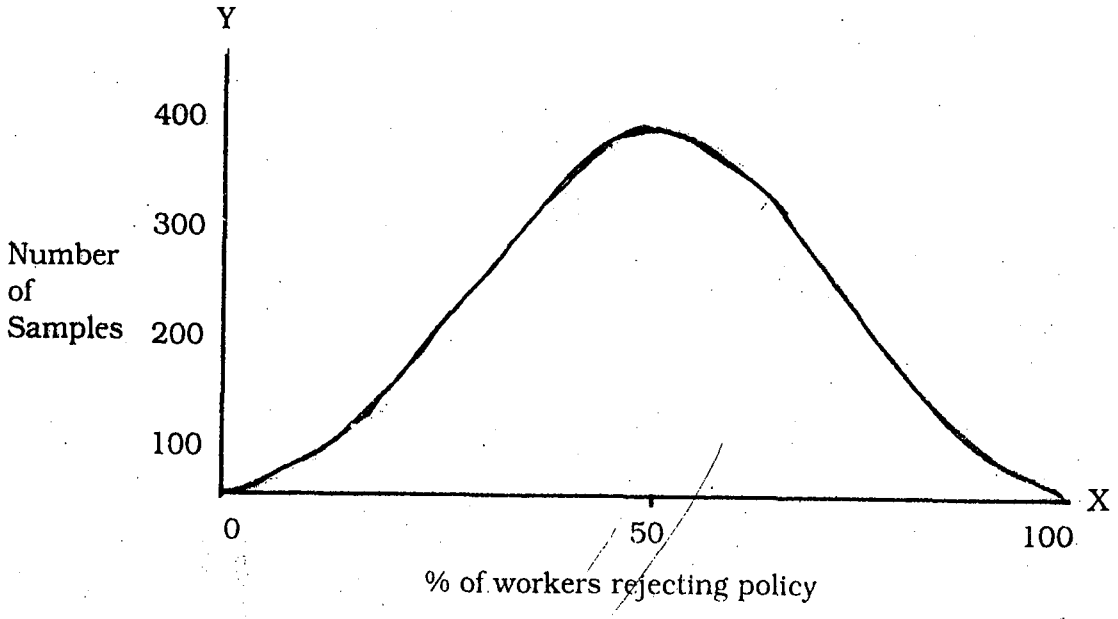


sample should represent the population and give estimates of the parameters pertaining to total population. As we were not content with the first result we have proceeded with the second and third and have only

further confused ourselves. To overcome and solve this confusion you may draw more and more sample of 200 workers, question them and record their rejection or acceptance and plot the new sample statistics on our summary graph. In course of this exercise you may find new samples provide one or the other previous results. Considering this situation you can create a Y axis.

The distribution of sample statistics given in Fig 4.3 is said to be sampling distribution. Here we find that increase in number of samples

Fig. 4.3



selected and interviewed, increases the range of estimates provided by the sampling operation. Though we have increased our confusion by attempting to guess the population parameters the probability theory provides certain important rules regarding the sampling distribution. At first, if the samples so selected are true representative of the population, though the sample statistics widely vary, they will be distributed around the population parameter. More of these sample statistics will be near 50 percent than elsewhere. Second, probability theory provides a formula to know and estimate how the selected samples' statistics are clustered around the true value. This formula is inclusive of 3 factors. The population parameters for the binomial (P and Q symbols), the sample size (n) and the standard error (s). Suppose in our fourth sample of 200 workers 50 percent rejects

management policy, by applying the appropriate values you may find that the standard error is equal to 5 % or .05.

$$S = \sqrt{\frac{PQ}{n}}$$

Standard error is a worthy piece of information in terms of probability theory, which indicates that certain proportion of the sample estimates will fall within specified increments of standard error from the population parameter. Approximately 34 percent of the sample estimates will fall within one standard error above the population parameter and another 34% will fall within one standard error below the parameters. In toto 68% of the total samples, that is two thirds, will give estimates within, positive or negative, 5 percent of the parameters. The theory also propounds that 95 percent of the selected sample will fall with positive or negative 2 standard error of the true values and 99.9 percent of the samples will be within 3 standard error. The standard error is an inverse function of sample size. Increase in sample size decreases standard error. All the above information is provided to establish randomness in sample selection in specifically large ones.

The result of these inferences and estimation is that we are able to estimate a population parameter and also the expected degree of standard error on the basis of one sample drawn from a population. The first sample which is randomly selected and interviewed gives 50 percent rejecting the management policy while we are 95% confident that between 40% and 60% reject it. This stage is called the confidence interval. The discussion example considers only one type of statistic - the percentages produced by a binomial or dichotomies variable - the same logic can be applied to examine many other statistics like mean income, mean age and so forth.

POPULATION AND SAMPLING FRAME

Any researcher will be ambitious enough to cover the entire population to justify and give weightage to his research finding. Instead of 10 Indians criticizing the ruling government if entire population criticizes we would accept and appreciate it. But as you know it is neither affordable to gather

mass information nor advisable to do so. The sample is always viewed as an approximation of the whole rather than as a whole in itself. Using statistics, a researcher should prove how far the given estimated sample value is an estimate of true population value. Hence a good researcher starts from top [population] and works down [sample]. But most of them go to the bottom directly with a small number of respondent may conduct a successful study. For this, the total population needs to be identified in advance in the absence of which you cannot assess the sample adequacy.

A sample frame is the list of elements from which a probability sample is selected. A researcher interested in conducting a study on voting behaviour can rely on the voters' list maintained in government agencies as a sample frame to draw samples with the precaution taken to ensure whether the list is updated. The example of sampling frames can go on as list of professionals, taxpayers, license holders, census, district hand books, telephone directories and so forth.

Very well knowing the importance of population and selection of sample basing it, less pages are allotted in any text to discuss the literature on population. The following guidelines should be borne in mind in probability selection procedure. At first the sample survey findings is only a representative of the aggregation of elements composed in sampling frame. Second, omissions are inevitable in a sampling frame where the researcher using sampling frame should estimate the extent of such omissions. Third, as you guarantee to the population of the sampling frame you should ensure that all listed persons are given equal chance to represent in the survey. With these elaborate information on probability theorem we shall proceed to know in detail the different techniques.

SIMPLE RANDOM TECHNIQUE

A simple random sample is selected by a process that not only gives each element in the population an equal chance of being included in the sample but also makes the selection of every possible combination of the desired number of cases equally likely. Simple random sampling refers to

that sampling technique in which each and every unit of the population has an equal opportunity of being selected in the sample. In simple random sampling the items which get selected in the sample is just a matter of chance and hence personal bias of the investigator does not influence the selection. Drawing a simple random sample requires either a list or some other systematic [illegible] availability of a list, the procedure for drawing a simple random sample is not complicated. Following are the requirements for applying simple random sampling:

1. It requires a clear definition of the population to be sampled. The units composing the population must also be clearly defined.
2. It is essential to have a complete listing of all the elements.
3. All the units in the population should be available at the time of selection of samples.
4. As the samples are to be selected independently of one another, all the items in the population should have the same chance of being included in the sample.
5. At each selection, all the remaining items in the population should have the same chance of being drawn.
6. All the possible samples of a given size are equally likely to be selected.

To ensure randomness of selection one may adopt either lottery method or consult Table of Random Numbers. For example if you want to sample a few citizens of a community at first you have to take the list of community members - sampling frame - and assign a code number for all of them. Say you have 1000 population and want to select 105 members. The next step is to decide the number of digits you will be in need of in the random numbers. In our case it is 3. Now use the Fig. 3.4 (table format) and can find that you have several rows and columns of 5 digit numbers. The table represents a series of random numbers from 00001 to 999999. Looking at the table you would be confused as to how to chose a three digit number, where to start and where to end and what would be the pattern of moving in the chart, say up to down or vice-versa and so forth. As you require

only three digits you can consider the first three digits of the leftmost or rightmost or the center ones. If the table number is 56028 either you can consider 560 or 028 or 602, basing which you can proceed to gather as many sample as you require. But the point is if you chose the rightmost you should use only the rightmost for the complete selection and should not have a mixture of many formats. Likewise you can start either from top to bottom or vice-versa, left to right or vice-versa, orthogonal or diagonal and so forth. Here again you should stick to any one pattern of proceeding. Suppose if you have opted to choose the first figure of each paragraph, the middle three numbers and from top to bottom, the figures will be 048, 792, 891, 108 and so forth.

Lottery method is a very popular method of taking a simple random sample. In this method all the items of the universe are numbered or named on separate slips of paper of identical size and shape. These slips are then folded and mixed up in a container or drum. A blindfold selection is then made of the number of slips required to constitute the desired sample size. The selection of items thus depends entirely on chance. If we want to take a sample of 10 persons out of a population of 100, the procedure is to write the names of all the 100 persons on separate slips of paper, fold these slips, mix them thoroughly and then make a blindfold selection of 10 slips. However, while adopting lottery method it is absolutely essential to see that the slips are of identical size, shape and colour, otherwise there is a lot of possibility of personal prejudice and bias affecting the results.

SYSTEMATIC SAMPLING

A systematic sample is formed by selecting one unit at random and then selecting additional units at evenly spaced intervals. This method is popularly used in those cases where a complete list of the population from which sample is to be drawn is available. The list may be prepared in alphabetical, geographical, numerical or some other order. The items are serially numbered. The first item is selected at random generally by following the lottery method. Subsequent items are selected by taking every

k'th item from the list where 'k' refers to the sampling interval - the standard distance between elements selected in the sample - and proportion of sample size in universe size is used to compute sample ratio - proportion of elements selected in the population that are selected. Suppose if you wanted to start randomly between numbers 1 and 10, the interval is 10 and the ratio is 1/10.

This technique is also not free from loopholes. The arrangement of the elements in the list may make you to select systematically same type of sample. This is referred as periodicity. For example assume that you wanted to select a sample of apartments in an apartment building. The samples are drawn from a list of apartments arranged in numerical order (for example, 101, 102, 103...) there is a danger of sampling interval coinciding with the number of apartments in a floor. In such cases the sample might include only one particular corner of the apartments or houses near elevator and so forth.

STRATIFIED SAMPLING

Stratified sampling method is a modified procedure of selection which ensures more representativeness - minimizes the probable sampling error. Sampling error is reduced by increase in size and homogeneity in population. If the population is 99 percent homogeneous the sampling results are more likely to yield a representative results and on the other hand if the population is fifty fifty deviation the chances of sampling error is likely to be more. This theory facilitates us to minimize the size of the sample for a survey, provided the appropriate numbers are drawn from the subset of a homogeneous population. To make it further representative, different attributes of the units of analysis say if individual, age, sex, class and so forth can be considered to select samples from different appropriate stratification. The sampling stratification method vary widely and the simple list of population elements can be grouped in discrete groups basing any stratification variables to be used. To sum up, in this method the population is first divided into two or three or as many strata required. The criterion for stratification may be a single one or multiple ones. With

the help of simple random sample the sub-samples are drawn for each stratum and they are clubbed as one for the total sample. To decide the sample size within strata, one can use either a proportional or disproportional allocation. In a proportional stratified sampling plan, the number of items drawn from each strata is proportional to the size of the strata. This indicates that in order to obtain maximum efficiency in stratification, one should assign greater representation to a stratum with a larger desperation and smaller representation to one with small variation. In disproportional stratified sampling an equal number of cases is taken from each stratum regardless of how the stratum is represented in the universe. The chief merits of this method are, more representative than earlier ones, greater accuracy and reduces time and labour in collection of information.

ILLUSTRATION 1

Having understood the probability techniques we shall investigate how to design sampling to have a representation from University students. The study purpose was to survey with a self administered tool, cross sectional, the students of University of Hawaii, 1968. Let us scan the steps and decisions involved in sample selection.

Survey Population and Sampling Frame

The university maintains the student's names, local and permanent addresses, social security numbers and a variety of other information such as field of study, class, age, sex, and so forth in magnetic tapes. This exhaustive list is maintained in files of magnetic tapes. While scanning the information it was found that most of them are inappropriate for the proposed study. Thus, it was necessary to define the survey population prescribing the limits. The final definition incorporated those 15,225 day program degree candidates registered for the fall 1968 semester on the Manoa campus of the university, including all colleges and departments, graduates and post graduates, natives and foreigners. Using the computer program a small number of students were found to fit into the necessary purpose.

The final list of students provided room for stratification and the decision was to sufficiently finalise to stratify them by college class in the initial stage and later if required could be stratified by their attributes such as age, sex, college, major and so forth.

Having decided the division by class, the sample was systematically selected across the entire rearranged list and proposed to cover a sample of 1,100 by a sampling fraction of 1/14 thus generating random number between 1 and 14. All those students having the number who are fourteenth number in the list were selected as a sample. As it is a computer program after identifying the sample a printout of all the selected students' name and mailing addresses in six self adhesive mailing labels were obtained to affix them to the cover mailing the questionnaires.

As any other researcher the proposed investigator also had money crunch and planned to refix the sample size. It was felt that mailing questionnaires to thousand and odd would be expensive and so with a random star it was proposed to select a few numbers which would be excluded from the survey and the final figure was 770. This modification is a hint for beginners in research to know how flexible the sampling design is that even in the midstream there are provisions for a researcher adopting probability technique to revise the decision on the sample size. However, it is known that the reduction in size is going to enhance the sampling error though the size is reasonably representative.

MULTISTAGE CLUSTER SAMPLING

All the above procedures are quiet simple provided the sampling frame is available. But a researcher may have different objectives where he may be required to select samples of different groups or population which cannot be listed for the sake of sampling. Practically speaking there may not be any sampling frame. To wit, no statistics is available about the commuter population, city, all married women, all students, all workers, all agriculturists, all church goers and so forth. This type of survey necessitates multi stage and complex sampling design. This design involves

two steps - identifying the cluster/groups and selection of elements from each cluster or group. This design is apt for a researcher when he faces impossibilities and impracticalities of compiling an exhaustive sampling frame or list of study units, for instance, all temple visitors or theatre goers.

Suppose a researcher interested in studying the impact of density of population in a city causing pollution, had to depend on some source like district hand books, census blocks or otherwise though exact city population figures will not be found. He should first identify and select the blocks that create a list of persons living in each selected block and subsample them. To make it further complex, the course of listing may start from listing the selected blocks, through listing the person residing, number of households, number of individuals in each household and finally the sample of persons listed in the household. This multi stage cluster sample involves the task of listing and sampling.

The utility of cluster sampling is its efficiency at the cost of lesser accuracy. Going back to the argument on sampling error you may find that your confidence level is 5 percent. When you do clusters at different stages, at every stage the standard error is also multiplied. A researcher limiting his sample size can have several options in designing the cluster sample. If he desires to choose 900 workers he can choose one organization and select 900 workers or chose 900 organizations and choose one from each. Undoubtedly neither of these are advisable though you have variety of choices.

Recalling the sampling distribution guidelines you may know that standard error is reduced by the two factors of increasing sample size and homogeneity of elements. The sample of clusters would be representative if large number is selected from one cluster and if all the elements in the cluster are similar. It is up to the researcher's affordability to select as many clusters as possible. For a sample of 900 you can go either for 450 blocks and select 2 households from each or choose 90 blocks and select

10 households from each and so on. But as the size of the sample is going to be less, if the number of blocks is increased the standard error is likely to be more.

POPULATION PROPORTIONATE TO SIZE (PPS) SAMPLING

Most of the large scale survey projects adopt this sophisticated sampling technique. This technique would produce an overall sampling scheme where every element of the population would have equal probability of selection. Though cluster is an improvement over the first two techniques it produces sample of different sizes from different clusters thus reducing equal chance for all clusters. In such case the PPS design could be of great use.

The overall probability of selection for elements under PPS technique will be calculated as follows.[1]

1. The probability of a cluster being selected is equal to its population share of all the elements in the population times the number of clusters to be selected.
2. The probability of an element being selected within a cluster is equal to the number to be selected within each cluster divided by the number of elements contained within that particular cluster.
3. The overall probability of an element being selected equals (1) times (2).

This can be explained with an example. Suppose an organization is composed of 2,000 branches and 1,00,000 employees. We plan to select 1,000 employees where each employee should have a 1,000/1,00,000 or .01 chance of selection. We decide to accomplish this by picking 200 branches PPS and selecting 5 workers from each of this. Now consider a branch containing 100 employees where the branch has a probability of selection equal to

$$\text{200 blocks to be chosen} \times \frac{\text{100 [employees in the organiszation]}}{\text{1,00,000 [total employees of the organization]}} = .2$$

[1] Babbie E R. 1979. The Practice of Social Research. The Wordsworth Publishing Company.

If this organisation is selected each employee has a second stage probability of selection equal to

$$\frac{\text{5 [to be selected on each branch]}}{\text{100 [employees in the organisation]}} = .05$$

Multiplication of .2 and .05 gives you an overall probability of equal selection to .01 as required. The result is going to be the same irrespective of the strength of the organisation. For example

$$1.\ 200 \times \frac{200}{100{,}000} \times \frac{5}{200} = .01$$

$$2.\ 200 \times \frac{339}{100{,}000} \times \frac{5}{339} = .01$$

PPS is not this easy to compute as shown in the examples. Sometimes the requirement and the existing data on the clusters are not round figures where there is a high or low probability of selection to different clusters. As usual another problem is that some households are not interviewed either because of their migration temporarily, they are never at home or refuse to be interviewed. This technique is primarily beneficial of the homogeneity principle of the population. However interpretation of an organisation can either be improved by selecting more blocks and reducing the number or by increasing the number and reducing the blocks. As stated earlier, however increase the sample in each blocks that the viceversa.

Illustration 2

The new method of cluster sampling which is a bit confusive can be well understood by a simple and less complex illustration. The main purpose of the study was to examine the attitude of women members of the church, desirably women in the diocese of the Episcopal church. As guessed there is no complete list of all church women and a multistage sample design was created. In the initial stage churches were selected with probability proportionate to size (PPS) and then women were selected from each.

The first stage of church selection was possible with the annual report published by the diocese containing a list of more than 100 churches with their membership size, which served the purpose of sampling frame for the first round of sampling. The number of women to be interviewed was decided to be around 500 which was decided to be collected from 25 churches with 20 each. To accomplish this the churches were ecologically arranged and then churchwise membership was tabulated (Tab. 1.1). The cumulative total of church.

Table 1.1

Form used in listing of churches

Church	Membership	Cumulative Membership
Church 1	3,000	3,000
Church 2	5,000	8,000
Church 3	2,700	10,700

Membership came around 2 lakhs. The aim at this stage was to select 25 churches in such a way that all would have a chance of selection in proportion to the size. To proceed further with the cumulative scores the range was fixed equaling the membership size of that church. Church 1 was given numbers from 1 to 3000 and church 2 between 3001 and 8000 and church 3 with numbers ranging between 8001 and 10700 and so on. Twenty five churches were easily systematically selected from the range of 1 to 2 lakhs with the sampling interval set as 8,000 (2 lakhs/25) and a random start was selected between 1 and 8000. If the random number was 6666 church B was selected as it fell between 3000 and 8,000. This random start proceeded with 8,000 within whose range the resultant numbers appeared was selected into the sample churches. Thus each church has a chance to represent as it is proportionate to size. A church with 6000 members had twice the chance of selection as a church of 3,000 and greater chance of selection.

The next task was to decide the selection of church women. From the selected churches list of women members, which vary in form and content,

were obtained. As the lists in few cases also included men, the task of sorting has to be carried out. A sampling interval was computed on the basis of the number of women members and the number desired (20) for those selected churches. If the church contained 1000 women the interval was set at 200. A random start was given to select women within the sample interval and this was continued for all the selected churches.

Here again every woman of the selected church was given equal chance to represent only with the assumption that fifty percent of the church membership is of women. This is concerned because recall that we start the entire selection on the basis of membership size not on genderwise membership size. This slight insignificance could be overcome by further sophistication in sample design in second stage. The selection starts with the assumption that 50% are women (of 2000 members 1000 are women) rather than the actual figure. If it were assumed at the initial stage itself as 1000 in church the interval could have been set at 50 (1000/20) and this interval could have been used to select members irrespective of size of membership. If 1,000 women were in fact listed, then their church had the proper chance of selection and 20 women could have been selected. If the size is 1,200, 24 would have been represented.

Thus to sum up the few pages above, it is worth to comment that probability sampling techniques are choosing elements from the population randomly with nonzero probabilities. Depending upon the purpose of research and survey field conditions the techniques can be simple or complex, expensive and time consuming. However laborious it is, this technique is concluded to be effective for its two major credits - avoids and checks conscious and unconscious bias and minimises sampling error.

NON-PROBABILITY TECHNIQUES

There are research conditions and situations where a researcher cannot follow probability techniques discussed in foregone pages. Sometimes it may not be appropriate though possible to administer, and nonprobability technique gives a helping hand. One of the chief demerits

of Nonprobability sampling technique is as the probability of person to be chosen is unknown the researcher in normal course cannot claim for the representativeness of the sample to the large population. This in turn handicaps the researcher's ability to generalise the findings basing gathered sample. You cannot estimate the sampling error - the degree of deviation from the representation could not be predicted. But the Non probability sampling holds the merit of less complication, less expensive and could be done on the spur of the moment unminding the statistical complexity of probability sample. Nonprobability sample is apt for a trial–error survey and if the researcher is not willing to generalise basing the sample. A researcher interested in validating the tool will be less interested in sampling procedure and hence can go by nonprobability sampling techniques.

Purposive/Judgement Sampling

The investigator neither needs to have a quota to fill within various strata nor pick out some close by. The researcher uses neither own judgement about which respondents to chose, and select those who serve the purpose of the study. A researcher may occasionally find appropriate to select sample on the basis of his knowledge on population, its elements and the nature of research aims. Especially when in the initial stages of validating or trying to find out the applicability of the questionnaire he may be interested in checking it with variety of people, though they do not represent any meaningful population. This is referred as a pre test in a survey.

There are cases where you have to study a subset of a large population, easily identifiable and complete enumeration is impossible. To wit, if you want to study the chieftain of all tribal groups, though they are visible it would not be feasible to define and sample all chieftains. Likewise in a probability sampling particularly multistage sampling design if you want to compare religious and nonreligious community workers, you cannot afford to enumerate and sample all such leaders. You can get a list from Associations established to voice out their opinion and sample a few. Here

the only criteria is you should ensure selection of cases cross sectional and ensure good representation of the selected ones.

The benefits of this sampling design is that a researcher can use his/her research skill and prior knowledge to choose respondents. He can choose an average Indian student or 'all Indian girl' or typical housewife. He can consider the commonness of the group or the deviant cases contributing for deviation. The best example would be to predict the election results. If in a particular constituency a particular party is winning consequently he can test with the party members for voting to the party or test with the non-party members for not voting.

Snowball Sampling

Most of the recent research works succeed with the help of snow ball technique, particularly by those conducting observational research and carrying out community studies. Though it is a nonprobability sampling technique, experts did develop a strategy to draw a probabilistic snowball sample thus allowing computation of estimates of standard error and the use of statistical tests of significance. Irrespective of its theory of probability the technique is carried out at different stages. In the first stage, a few cases having required characteristics are identified and interviewed. These few are used as informants to acquire information about other similar qualified persons. In the second stage these people are informed as going to serve as informants and provide sample for third stage and so on. This term snowball is an offshoot of the analogy snowball which while starting will be small and becomes bigger and bigger as it rolls down. If you wish for probabilistic technique in snowball, you should randomize the selection in each stage. If content with nonprobability sampling technique, but wanted to qualify further, the representation can go for quota sampling.

Quota Sampling

Political history and research in political science have proved the merits of quota sampling technique, as how in many occasions the survey by quota have prevented a disaster or forewarned a crisis. This sampling

design too addresses the issue of representativeness like probability technique, but in a different form. This technique starts with the matrix describing the feature of the target population. Say, before you administer your tool you should know the proportion by gender, marital status, education, occupation and so forth. If it is proposed for a national survey, you need to know proportion by nature, region, direction, sex ratio, age structure [illegible]

Having prepared a matrix with all the categorical sortings assigned in specific cells, you can choose those persons having all characteristics of a given cell. Later you assign weight to all the persons in a given cell in appropriation to that portion of the total population and you would obtain a reasonable representation of the total population.

This technique inherits few limitation as it functions. The accuracy of the constructed quota frame (matrix) is questioned as it is difficult to up-date the information for this purpose alone. Second, within a given cell there may be bias in selection of sample elements, though you assure the estimation of proportion of the population, it is obvious that an investigator ordered to interview 5 persons meeting the given complex set of characteristics may still avoid person living at the top floor, owing to vicious dogs, aloofed houses etc. Attempts are however, being made to synchronize the quota sampling with probability sampling with its effectiveness at questionable future.

Dimensional Sampling

The offshoot of quota sampling is a dimensional sampling technique which is also a multidimensional form of quota sampling. The notion of this technique is to specify all dimensions (variables) of interest in the population and assure that every combination is represented by atleast one case. This is designed and advised for studies intended to study small sample and basing which planning for large scale study is to be made. The chances of absence of needed value of variables for not representing

is a foreseen danger in quota sampling which could be overcome by dimensional sampling.

A researcher can also rely on the available subjects to test survey. A researcher may interview all and any one who passes him during his course of stay in that particular stop. However, though stopping and interviewing a person in a busy street is almost never an adequate sampling technique, he can employ frequently if it is necessary. To gather opinion poll in University from students, large lecture classes can be kept as a frame and sample can be drawn. Though it is popular for its less cost and easiness it is criticized as to the value of data gathered. However, the so collected data can be used for pretesting a questionnaire but not to generalise for the entire student population.

Having understood different techniques of sampling you may be confused as how to select an appropriate method of sampling. It should be noted that no one method can be regarded as best under any circumstances as each method has its own advantage and limitations. A number of factors such as nature of the problem, size of universe, size of sample, availability of time, finance and so forth would decide the choice of a particular method of sampling.

UNIT – VI

ANALYSIS OF DATA

QUANTIFYING DATA

By now you would have understood the importance of collecting data in social science through different modes of direct and indirect modes of observation. Apart from accumulating the information, it is a special art to present it in a meaningful way. In a way a social researcher is at a loss as to what to do with the collected data. One of the strong criticisms waged against social researchers are that they collect enormous information and later find it difficult to present every data so gathered. Apart from being mentally prepared to sacrifice a few information from reporting, researcher must plan to reduce the mass of data to a succint set of findings, thus enabling his scientific audience to understand. This process of reducing data to some form is known as data reduction, which consists of coding the data, often in these days it is made suitable for analysis via computers and modern electronic data processing equipment. Analysis of data is nothing but administration of various statistical tests on the data often manually, or with the help of desk calculators and frequently suggestible via computers.

This section is concerned with the qualitative data conversion to appropriate quantitative analyses. This chapter is purposely designed to give a description about such methods of converting social science data into a machine readable form – which can be read and manipulated by computers and similar machines used in data analysis. This chapter will enable you to convert your data into the form of data cards (IBM cards), magnetic tapes or similar ones in a real research project.

Philosophically social scientific research is objected to, for attempting to reduce living human beings to holes in punched cards. However, this section will deal with the mechanics of accomplishing such reduction. Data gathered through survey is enormous as well as demand more labour, time

and energy to process, where analysis through computers are considered as a boon to social scientific research.

A QUICK LOOK AT COMPUTER HARDWARE

Today, voluminous survey data are analysed by means of automatic data processing equipment. The function of this equipment is as follows: The so coded data are generally fed into these machines through computer cards, thus to improve the efficiency in very large survey or macro studies where the data are transferred from cards to magnetic tape. In advanced countries, a standard computer card is so familiar as they use it for everything from paying bills to college registration. This specially designed standard card or IBM card contains 80 vertical columns, usually numbered, running from left to right on which information can be stored and read by the computer (See fig 1). All the mechanized data processing equipment is designed to locate and read any specified column. The so fed data are stored on cards by punching holes within the columns. There each vertical columns are further divided into 12 spaces. The first ten spaces are numbered as 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, from top to bottom and above the 0 space two unnumbered space are provided and designated as [–] and [+] or called as 11 or 12, X or Y, respectively.

A key punch machine reads from left to right in the space of columns of IBM cards. A keyboard similar to typewriter is used to punch specified holes (0, 1, 2, . . .) into specified columns of a given card by the keypunch operator. The job of punching starts from 0, goes through till 9 (vertically down column wise) and the two empty spaces conceived as X and Y or 11 and 12. After this, at the top of the card above the 12 punches, there is a space for identification of the symbol in each column by means of a printed letter or numerical picturing like a typewriter. You can also punch special characters and alphabetical letters in the form of multiple punches in a column. Social research mostly use simple punching of numerical data. The keypunch machine does not punch only in a single horizontal line but punches anywhere up and down the column depending on the numbers chosen. It has got the capacity of reading the punches in a given

column of one card and transfer those punches to the same column of the card following it in the deck (duplicate option). A key punch machine may be programmed to carry out certain operations automatically too.

Likewise it is left to the researcher's choice to choose and decide the columns to use for storing each questionnaire items. But practically speaking, it is easier to go from left to right with the provision that new punches are made at the left of later ones. To make it simple, a person cannot and should not punch the responses to question 10 in column 6 and the response to question 1 in column 7, but could go orderly from left to right. There is a standard practice that first 4 or 5 columns are reserved for an identification number. This varies and depends upon the size of the sample, as number of columns required for a large size sample is in progressive relationship. Suppose if you have collected data or administered questionnaire anonymously. Still and more so you should have an identification number for both the questionnaire and the computer card, thus enabling you to cross-check the suspected punching error on the computer card and check the accuracy by referring back to the original questionnaire.

The so gathered and coded data are put in machine readable form by assigning one or more specific columns of a data card (a field) to a variable, and assigning punches without that column to the various attributes composing that variable. To wit, a sample's nationality might be recorded in column 6 of the card. If the sample were Indian a 1 might be punched in that column and if Non Indian a 2. The sample's age might be assigned to columns 6 and 7 - a 2 column code say, if the person's age is 27 years of age, 2 and 7 would be punched in respective columns. The data if it is categorised or grouped the same age can be stored in a single column. Here, you would have a single punch for under 20, 2 punch for 20 and so forth.

Thus, the given card represents the data provided by the sample that is unit of analysis. If the Unit of analysis were magazines' matrimonials

being examined in a content analysis, each data card would represent a matrimony. Specific variables are assigned to the columns of each card describing one particular matrimony. For example, you might allot 2 columns to store the last two digits of the data in which the matrimony appeared.

In the earlier chapter on different modes of observation, the task of precoding of questionnaire and other data collection documents just mean the specification of card and column assignments to specific data items. This can be well understood with the questionnaire format. A sample is given below.

(6 – 15) I	SA	A	DA	SDA	DK
1. Government should identify the weaker sections to effectively distribute the community resources equally.	1	2	3	4	5
[presume that there are 10 questions of this sort numbered as 1 to 10)					

The answers to items 1 to 10 in question I will be sorted in columns 6-15. The numbers 1, 2, 3, 4, 5 printed under the answer categories SA (strongly agree) will be sorted as a I punch, the answer A will be sorted as a 2 punch and so on.

As discussed earlier, survey research collect voluminous information from large sample, by and large, through the questionnaire technique. Here a data card may stand for a single questionnaire with enough columns assigned to the various items contained in the questionnaire. Answer to a question "Have you ever visited a foreign university?" might be stored in column 36. As usual, you may give 1 punch to Yes response and a 2 punch to No response. The vital point to be grasped is that each card represents a single research Unit of Analysis and that each field of one or more card columns is used for storing the same variable on each card. To wit, each respondent's detail information on foreign university visit question will be stored in column 3.

Counter sorter is one of the most simple machines capable of reading data cards. This machine will be set to read to given columns. As you feed the cards they are stored into pockets corresponding to the punches found in the column and the counter indicates the number having each of the punches. If marital status is recorded in column 6, the sorter would be in that column and unmarried and married would be stored into the respective one or two pockets.

One of the major merits of using counter sorter is that it gives the tabulation of responses given to questions by simply counting the punches found in the column assigned to the question. It goes a step ahead in even examining the relationship between variables.

Suppose you want to determine whether girls or boys are more compassionate. As given above, having separated the samples by sex, the counter sorter should be set to read the column containing responses to the question seeking compassionate as indicated by the punches contained in that column. Likewise the procedure will be repeated for females and the distribution of responses would then be compared (see fig 2.1).

The joint representation of the two variables

	Male	Female
Compassionate	100	175
Not Compassionate	150	75

The percentage table

	Male	Female
C	20	35
NC	30	15

It thus can be concluded that women are more compassionate than men.

By now a doubt might have cropped up in your mind as what to do if the columns are exhausted and where to store the remaining information, where again survey researchers may need so often. For a questionnaire you may have a separate set of cards which are referred to as decks. For a sample of 60 individuals deck one is a set of 100 cards containing the second 80 columns of information and so on. In addition to the card

identification number, each card is also given a deck number. General guidelines for column allocation is to make sure that enough columns are allotted to each variable to accommodate all possible codes. If you are not sure about the columns required, it is always better to leave extra columns between variables, when use of extra cards will not be necessitated. Researchers who have enough experience in this type of data processing mostly recommend to leave spaces between columns for easy reliability when checking errors since a card with all 80 columns punched can appear very crowded and difficult to read.

The above description of functioning of counter sorter may seem to give an impression that it is the best and most useful data processing. But it is not so where in practice it faces certain limitations in data analysis. At first the counter sorter is limited with the counting and sorting of cards. Though, you plan to use these capabilities for high level sophisticated analysis, the machine itself cannot perform sophisticated data manipulation.

In comparison with other machines the counter sorter is a 'slow coach'. Above all, the counter sorter is also limited to the examination of one card per unit of analysis in the analysis of relationship among variables. Unlike other machines facilitating construction of 'work-decks' containing all the required data for one particular phase analyses, this counter sorter is limited to 80 columns per unit of analysis.

Today computer holds the pride and the responsibility of carrying out any sophisticated analysis. The limitation of the computer sorter is overcome by the manipulation programs of computers. A computer performs intricate computation of various variables simultaneously and provide sophisticated presentation of results beyond merely counting and sorting data. Here the data is stored in magnetic tape or discs and the data can be passed quickly through machines faster than the counter sorter cards. Above all the simultaneous extensive manipulation and computation further speedens up the overall analysis. One of the greatest

advantages of computer analysis is it can analyse data contained in several cards per unit of analysis at a time. Today most of the quantitative social science data analyses are achieved through the software developed to make the computer simulate the steps involved in computer sorter. The computer gives you a ready-made tabulation of the variables defined, unlike a computer sorter where to achieve this table you have to undergo many steps. There are many softwares developed for social scientific research and the most popular among these are SPSS and SAS. The following pages will explain the steps involved in converting data into forms amenable to the use of counter sorter and computers.

SELECT DATA PROCESSING TERMINOLOGY

A brief look into various data processing terminologies will enable you to further understand the method of analysis through computer.

A FILE is a collection of data pertaining to a given case. A data file constitute the entire information obtained from a single sample or a survey respondent. The entire experiences and behaviour of an experimental subjects during the course of investigation constitute the subject file.

The concrete instances of the unit of analysis is referred as a CASE. Each sample would be a case in a survey. In a content analysis of famous films, each film is a case and every subject is a case in an experiment. The number of respondents in a survey or subject in an experiment are generally called as sample size which is nothing but the number of cases, designated by the letter 'n'.

As discussed under field research, a file is composed of one or more RECORDS. This is nothing but a data card where the data file of one particular sample may be recorded in one or more data cards - similar to usage of cards in counter sorter.

Though you store the data on magnetic tapes/discs, the card format is often maintained. As and when you add a record in a file, a description of the location of a specific data item, say an item in the questionnaire,

must be given an identification so as to facilitate location at the appropriate record, as and when required. Imagine that in one particular study we have 3 cards assigned to a case for data storage in a file. The cards would be given an identification as card 1, 2, and 3 where they contain a set of information cardwise. Say, the information obtained from a sample on their opinion about government policies shall be recorded in column 30 of card 3. When you scan through the cards of the entire sample the column 30 of card 3 will give you the same information about opinion about government policy. Likewise column 31 of card 3 may contain some other information which again will be uniformly maintained for all samples.

Set of records containing the same items of information for the entire sample is termed as DECK. Deck 1 will contain all the card 1's punched for all subjects. A deck identification is required if more than one record per case is maintained for coding and keypunching of data, thus enabling us to distinguish different records of each file.

The idea of data card column is technically called in computer languages as BYTE. In simple words this specifies the data or information location within a record. As the keypunch system is abandoned the term column is less useful and hence it is replaced as BYTE as we store data in magnetic tapes and discs.

The usage of punch in data cards is technically re-termed as CODE. Similar to terminologies like card and column, as Magnetic disc and magnetic tape do not have holes to punch in, the term punch also seems to be inappropriate.

The length of the record maintained to write the data is called as RECORD LENGTH. In a card based data storage system the record length is 80 column or 80 bytes no matter whether all the 80 columns are used. However, the current storage through magnetic discs or tapes minimize the concern for the traditional 80 column format. Instead of two or three cards used to punch in you can create files on discs or tapes, composed of 240 bytes in length which would pose a picture as though you

manufactured a long card with 240 columns. Thus, therefore a given data item, can be located at byte 196 rather than a column 30 of card 2.

The main task of data reduction is coding. The gathered data must be converted to the form of numerical codes representing attributes of variables, later assigned for storage in a specified location in data file, thus permitting analysis of data is called as CODING. For computer analysis coding generally consists of assigning a code number to each answer category so that the answers may be stored and retrieved, unlike alphabets or words and thus there is a necessity to convert the information categories from words to numbers. Rather than punching a 'Yes' or a 'No' response on a computer card it is much simpler with less space to assign each answer a number - Yes = 1; No = 2 - and punch the appropriate number on the card.

In the process of data reduction a set of computer cards named DATAFILE will be the end product. This data file may contain one or more IBM cards for each case depending on the amount of data to be stored. Here again, there is a need to distinguish closed ended questions and open ended questions where observation and document data are generally labelled as open ended questions. Numerically coded data or open ended data such as open ended survey questions, observation field note, or documents that are not content analysed, are generally not statistically or qualitatively analysed by computers etc.

Coding process differs in different types of research and in observation such as content analysis it is inherent in gathering data or during observing and in survey research you engage yourself in coding process after the data collected is completed. In analyzing the content the voluminous qualitative information are transferred into a capsule form thus facilitating interpretation as well as quantification of data. We also have a standard published coding frame for few variable such as occupation (list of all occupations given by District Industries Center), Caste (Government Gazette), Quality of life Index (WHO) etc. However, all the existing coding

frame need not or cannot be exhaustive as it varies from sector and society. Also, if you adopt it, the focus of the research when it either changes or when it is multifold, there is a necessity to recode continuously. To wit, occupation at the first phase need to be classified as employed or unemployed which further if need to be classified as white-collar and blue-collar as the objective is to know the type of occupation you may have to recode. As there are multiple utilities of data it is always better to have an exhaustive and detail coding frame, rather than specific utility of analysis, making it flexible to combine as and when necessary or carry out analysis in detail if warranted. There are two approaches to coding as follows:

A structured preplanned questionnaire type or any other survey research can proceed with the research with numerical coding given in the questionnaire itself (pre-coding) or after the administration of the questions and answers obtained (post-coding). A close ended questionnaire or questions which could categorize the answers in advance or numerical responses (Yes/No/Don't Know) which need not be converted proceed with pre-coded schedule. A researcher administering open ended questionnaire cannot anticipate the answers or different categories of response often cannot establish codes until he or she scanned the data. Response categories in a close ended questionnaire should be exhaustive and mutually exhaustive, like attributes of a variable. You should ensure that every piece of information observed fits into only one code category and multiple ones.

Irrespective of your time of coding - prior or after - the procedure involves two parts. At first a number should be chosens and given to differentiate each and every response category. Second, you give appropriate column or columns in the computer card to contain the code numbers for that variable. As an example consider the following questions.

30. Government policies aim at maintaining equality in the society (circle any one)

SA 1

A 2

DA 3

SDA 4 66/

Remember that respondents answering to the above question may or should circle only one answer and they individually maintain their own computer card. The number in the right hand corner indicates the column of the computer card in which the code for question 36 is to be punched. As signs (+, –) and letters are prohibited in computer card coding only symbols (0, 1, 2, 3, 4, 5, 6, 7, 8, 9) are recorded in a single columns. Again 2 punches on the card with 2 symbols is also invalid as the computer cards do not accept double punching and treats it as letters. Recall the criteria of variables under measurement, where exhaustive and mutual exclusiveness is stressed; and these facilitates perfect coding and quick analyses. In case, multiple responses are unavoidable, either you should recode suiting to the column or provide that many columns for each and every response. Likewise, when the data varies widely, that variable may go beyond 9, say 10, which cannot be stored in single column and hence provide 2 columns in advance which means you can store upto 99 categories and if you have 100, provide 3 columns and so on. For example in the above sample question you store in column 66 the responses for question 30. If question 31 is on age of the parent which are certainly double digits you store that in providing 2 columns. For example if the age is 27 store 2 in column 67 and 3 in column 68. What to do if for few rare cases which may require an extra column. Say if a person's age is 100 and another's 108. You may have a doubt as whether you should provide an extra column for the sake of two cases or just to club the two under the category 90+. It is left to the researcher's interest and his perception of importance of storing the data as it is, by providing 3 columns or column with the maximum prevailing predominantly, like clubbing with 90+.

Unlike close ended questions open-ended questions challenge the researcher's coding work. As it is difficult for him to anticipate the categories or responses unless and until he has carried out a preliminary analysis he cannot proceed with the coding job. You can understand this with the following sample question.

66. What are the general problems faced by you as a single woman?

27-29/

For this single variable three columns 27, 28, 29 are reserved to record upto 100 different responses. All the three columns if not required for all the sample, the third column can be left blank without any harmful effects. At the same time it is impossible to provide extra columns if data requires extra columns and further makes the data entry cumbersome and difficult warranting major recoding.

One of the peculiar problems of coding is with questions eliciting multiple responses. In this case the responses may be mutually exclusive and not overlapping but triggers or allows the respondent to give as many multiple punching here. Here the only option is to provide as many columns as possible for different responses or combination of responses. This is nothing but allowing to treat all the response categories as different variables.

72. Which of the following material possessions do you possess (circle all that apply)

1.	Mixie.....	1	51/
2.	Grinder.....	2	52/
3.	Refrigerator.....	3	53/
4.	Gas stove.....	4	54/
5.	Water cooler.....	5	55/
6.	Washing machine.....	6	56/
7.	Vacuum cleaner.....	7	57/
8.	Airconditioner.....	8	58/
9.	Cooking range.....	9	59/

Here a sample may circle one or more than one but as you can do only punch, it is always better to create separate columns as given above. This is nothing but converting all the nine responses as variables in 9 columns. Each response is treated in binary or dichotomous as 'possessed' and 'not possessed. If a sample reports possessing a refrigerator (3) and airconditioner (8) the key puncher will punch a 3 in column 53 and 8 in column 58 and all other columns are left empty. Here as we treat all the 9 responses separately and mutually exclusively, we need not code them in 9 different numbers, and we can give a code of 1 to those possessing and a 0 to those not possessing. This is avoided since same number in adjacent columns confuses the researcher. This coding of multiple responses under different readings is not free from limitations. At first it consumes more 'byte' or space in the computer per person t[illegible]he normal space required in using a card. Also, the empty spaces may pose as if there is non response, though not so, causing certain problems in data reduction and analysis.

Use of blanks in analyzing the data through counter sorter will not cause any problem immediately but it is a warning for those who do it in computer. The problem is two fold. At first the blank space in respective columns signifies both non response as well as unintended error made by the keypuncher while punching the column. Second there is a technical problem wherein, a few computer programs assign special value for blanks as part of their internal operation. This blank may confuse as well as enable desired computation.

There are certain distinct advantages of pre coding. At first it saves tremendous amount of labour and time, thus speeding up the work, as the sample can indicate a numerical code at the time of answering the questionnaire. This reduces the cost of hiring a coder to read all questionnaires and prepare a code for each answer. Secondly a code book is usually prepared for post coding - defining the meaning of each code. However, as discussed above precoding is impossible in certain surveys where the researcher is unable to predict answer categories for different

questions. Sometimes, if the response is anticipated to the maximum of 2 digits, where you provide only 2 columns, and in scanning the questionnaire if you find responses predominantly in 3 digits, you have to undergo the process of recoding which is tiresome besides the wastage of time, cost and labour.

Either you may have a well developed frame or you carry out a field research where you observe a new phenomenon, there a researcher cannot anticipate the occurrences of relationships and have no idea of coding frame. He has to check the field notes prepared by him and files, then go for preparing a coding frame. Suppose, fortunately if you have an assistant to code, your workload is doubled by defining the code categories and later training the coders so that the coding is done meaningfully. You have to explain with different examples the meaning of the code categories. To ensure the coder's understanding you should code several cases and ask the coder to code and later compare both the codes and schedules. Any discrepancy indicate imperfect communication of your coding scheme to your coders. Even if you notice perfect agreement of the codings of both of yours, you should continue with check code at least a portion of the schedule throughout the coding process. On the other hand, if you do not have a coder, and if you yourself is going to do the coding job, you should ensure reliability as no one is perfect, particularly initial researcher on trial, are certainly not.

POSTCODING

Just opposite to precoding, this refers to the task of coding after obtaining the answered questionnaires. This is by and large unnecessary and disadvantageous for simple questions for which coding can be done prior to survey. For example, if we are gathering some information pertaining to marital status of the study unit, we can write it as follows.

1. circle one - Unmarried 1

married 2

If not precoded as above and if you want to postcode we would put it as below:

1. Marital status ---

By now having familiarity with the functioning of a keypuncher you would know that it could not memorize the appropriate codes for every question and we have to do it. Such not precoded questionnaire demands scrutiny of every questionnaire and suit the appropriate one (either1 or 2) for the key puncher to copy. This special and distinct step in data processing require tedious paper handling and there are copious chances to commit clerical error, which is unnecessary and avoidable. However the postcode is advantageous over precoding in a sense where the coder can ascertain what responses were obtained by the researcher from the given respondent, before coding, thus simplifying the data reading. For example, if a questionnaire has ten options, in the examination of filled in questionnaires it may reveal that only 3 of the answer categories were used by the respondents and thus only 3 codes are necessary and only one column is required in the computer card instead of 2.

Recall the questionnaire with open ended questions where no answer categories are provided for the respondents but letting them to decide by themselves the categories. Practically to code such questionnaires you have to read all the questionnaires and make a list of responses review the dimensions and assign categories and then start coding. Knowing the responses and its frequency, post coding is as straightforward as precoding. A researcher has to just decide the number of columns needed and assign the numbers and code only those respondents and leave the rest which did not yield any response.

Unlike precoding, postcoding facilitates a researcher to code multiple responses to a single variable by drafting different combination of given answers. For example, if the sample is instructed to select two answers from a given 5 categories there would be 32 possible different combinations of responses like a and b, b and c, and so on. Now knowing this different

possible combination a coder can give a separate code for the 32 different combinations of responses and provide 2 columns in computer card. Now you can imagine how exhaustive and laborious the coding should be for the question seeking as many combinations as possible (see question 6). Here the researchers can code combinations only after having counted the number of combinations and later considering the frequency of occurrences and finally decide the feasibility of coding.

CONSTRUCTION OF CODEBOOK

The lengthy process of coding is data conversion into numerical codes representing attributes of a variable, assigning card and column location with a data file. A code book is a module describing the location, attributes and code of a respective variable. One of the main functions of a code book is to define the meaning of the numerical code and depict the location of the variable on the computer card. A code book is primary guide used in the coding process and helps us to locate the variable and interpret the punches in the data file during analysis.

A completely precoded questionnaire will have a numerical code for each answer category for every question and an edge code to tell the location of the variable in the computer card. In such cases a separate code book is unnecessary and the blank copy of the questionnaire can serve as a code book. A separate code book is essential for those research planning for post coding where open ended questions are thrown to elicit multiple answers and there is insufficient space to identify all the codes from the questionnaire itself.

There are different options in which the coding process may be integrated with the keypunching process. Traditional data processing method involves coding of data in the questionnaire and the transfer of code assignments to transfer the code sheet. Such sheets too possess 80 by 80 matrices resembling a card. The code sheets are handed over to the keypuncher who does the job of card punching and with the help of a verifier, similar to keypunch machine, the punched-in holes are read. Code

is possible only through computer program. The worthiness of contingency cleaning depends upon the logical presentation of question in a questionnaire and its numbers. Errors can be deducted while processing data too. For example in the above example if the researchers believed to face errors because of prevalence of unmarried girls, but did not have time or money to carry out a complete job of contingency cleaning, could avoid the problem by using the card sorting machine to separate unmarried respondents from those with married ones. A researcher can thus analyse the question in detail for the respondent unmarried. These women who are unmarried but have responded for status of wifehood need not be included in the subsample analysed and thus can be of little concern.

UNIT - VII

LESSON - 7.1

SOCIAL STATISTICS

DEFINITION OF STATISTICS

Statistics is used either as a synonym for the word 'data' or as 'scientific method of studying data'. There have been many definitions of the term 'Statistics'. Some have defined statistics as statistical data (plural sense) whereas others as statistical methods (singular sense). A few definitions are analytically examined below:

Statistics as Data

All data are not Statistics. Only data having some special qualities are termed Statistics. This would be clear from a consideration of some of the definitions of Statistics as data.

A.L. Bowley defines Statistics as "numerical statements of facts in any department of enquiry placed in relation to each other".

Webster defines Statistics as "the classified facts representing the conditions of the people in a State ... ... specially those facts which can be stated in numbers or in tables of numbers or in any tabular form or in tables of numbers or in any tabular or classified arrangement".

However, according to Horace Secrist, Statistics is "aggregate of facts affected to a marked extent by multiplicity of causes, numerically expressed, enumerated or estimated according to reasonable standards of accuracy, collected in a systematic manner for a pre-determined purpose and placed in relation to each other." This definition of Statistics is comprehensive and points out the characteristics that data must possess so that they may be called Statistics. The characteristics are:

1. Statistics are an aggregate of facts. Thus statements like "the height of Mr. A is 5' 6" is not a statistical statement whereas the statements like "the average height of the citizens of Bombay is 5' 6" is a statistical statement.

2. Statistics are affected to a marked extent by multiplicity of causes. For example, statistics of agricultural production are affected by a multiplicity of causes like climatic factors, quality of soil, quality of seed and manure, method of cultivation, etc.

3. Statistics are numerically expressed. All Statistics are numerical statements. Qualitative descriptions like 'good', 'bad', 'poor', 'rich' 'young', 'old' do not constitute Statistics. For example, statements like "population of India is expanding very rapidly" or "a considerable proportion of India's population is very poor" do not constitute statistical statements whereas statements like "the population of India increased by 23.8% during the decade 1961-1971 as against 21.6% during the decade 1951-1961" or "the number of people living below the poverty line in India rose from 17.7 crores in the year 1960-61 to 21.55 crores in the year 1967-68" are statistical statements.

4. Statistics are either enumerated or estimated according to reasonable standards of accuracy. Whatever method of these two is adopted, it is necessary that a certain standard of accuracy should be laid down for all cases. However, the degree of accuracy aimed at would depend upon the nature and object of the study being conducted.

5. Statistics are collected in a systematic manner for a pre-determined purpose. Generally before the actual process of data collection is started, it is necessary to work out the plan for the collection of data keeping in view the object and nature of the enquiry.

6. Statistics should be placed in relation to each other. The numerical facts should be comparable if they are to be called Statistics. To ensure comparability, it is necessary that there is a certain element of uniformity

and homogeneity in the data. The data should relate to the same phenomenon. For example, it may relate to changes in a variable over a period of time or it may relate to different values of the variable in many different regions at a particular point of time.

Statistics as a Scientific Method

In this form, Statistics supplies a kit of tools that can be applied in various disciplines of knowledge to analyse and interpret data, and help to discover 'what the facts really are'. In this sense Statistics is a scientific method and not a science. Because the aim of science is to achieve "a systematic interrelation of facts" whereas, the aim of a scientific method is to "discover what the facts really are". On this ground, says Bernard Ostle, it is better to regard Statistics as a scientific method rather than a science.

Keeping this view in mind, different statisticians have defined Statistics differently. For example, A.L. Bowley defines Statistics as "the science of counting", "the science of averages", and "the science of the measurement of social organism, regarded as a whole in all its manifestations". Yet these definitions are inadequate. While the first one limits the scope of Statistics to merely collection of data, the second emphasises only the study of averages whereas the third confines its scope to the field of social organism only.

Boddington defines Statistics as "the science of estimates and probabilities". This is also incomplete because the study of probabilities and estimates is only a part of Statistics.

According to Croxton and Cowden, Statistics is "the science of collection, presentation, analysis and interpretation of numerical data". This definition is the most comprehensive as it points out the four main stages in a statistical enquiry, viz., Collection of data, Classification of data, Analysis of data, and Interpretation of data.

According to Bernard Ostle, the field of study of Statistics includes the following:

1) Collecting and summarising data.
2) Designing experiments and surveys.
3) Measuring the magnitude of variation in both experimental and survey data.
4) Estimating population parameters and providing various measures of the accuracy and precision of these estimates.
5) Testing hypotheses about populations.
6) Studying relationship among two or more variables.

ORIGIN AND GROWTH OF STATISTICS

The term statistics is used either as a substitute for the word 'data' or as a scientific method of studying data. Originally it meant the official records of the State. With the passage of time it began to be used for all types of data.

In India, the system of registering births and deaths existed even much before Kautilya's Arthashastra. More than 2000 years ago, Indians had a good idea of the utility of data, and official and administrative records were maintained. This tradition was carried forward in Medieval Ages and one can find extensive collection of agricultural, land revenue, administrative and other data. The famous land and revenue Minister of Akbar, Raja Todarmal, maintained good records of land and agricultural statistics. Similarly in many other ancient countries like Egypt, Rome and Greece, statistics on military strength of the nation vis-a-vis the enemies were frequently collected and records of deaths and births maintained. Statistics was, thus, projected as 'the science of statecraft'.

However, the use of Statistics as a scientific method is not very old and its origin is easily traceable. During the mid-Seventeenth century, the gamblers of France and England threw challenging problems of games to mathematicians and scientists who solved those problems and, in the

process, laid the foundation of the Theory of Probability. In the early stages of the development of Statistics, it was the theory of probability that received the greatest attention and by the time other techniques were evolved, this theory had already gained firm foundations. This can be seen from the fact that around 1800 A.D. the theory of probability had already gained a mature stature while the other techniques of analysis were developed mostly after 1800.

Francis Galton (1822-1921) found that the offsprings of abnormally tall or short parents tend to 'step back' or 'regress' to the average height of society. He introduced the concept of 'regression' in Statistics. Karl Pearson (1857-1936) was a pioneer in the field of correlation studies and the coefficient was devised by him. W.C.Gosset (writing under the pen name of 'Student') introduced the famous 't' - distribution in 1908 which considerably enlarged the scope of Statistics.

R.A. Fisher (1890-1962) introduced and developed many significant concepts such as Point Estimation, Analysis of Variance, Tests of Significance, Design of Experiments and many other statistical tools and applied them in such diversified fields as biometry, education, genetics, agriculture, etc. making statistical methods very popular in the process.

FUNCTIONS OF STATISTICS

Statistics helps in removing ignorance and arbitrary decisions and helps in formulating correct policies through an analysis of past facts and their projections into the future. The main functions of Statistics are as follows:

1. It presents the numerical facts in a convincing form. Numerical presentation of facts is more appealing and convincing. For example, a mere statement of the fact that a large number of people in India live below the poverty line does not carry much weight whereas a statement of the fact that 48% of the population in India lives below the poverty line sounds very convincing.

2. It simplifies the complex facts. Facts as data are merely a mass of figures and do not convey much unless they are reduced and condensed with the help of Statistics. With the help of Statistics, data can be reduced to a single frequency distribution and then not only graphs or diagrams can be constructed but also Mean, Standard Deviation, etc. can be calculated to present the information in an intelligible form.
3. Statistics presents a comparison of facts and studies their relationship with one another with the help of various techniques at its disposal.
4. It tests hypotheses in different fields of knowledge.
5. Not only does Statistics help in the study of present facts, it also helps in predicting the future trends.
6. Various statistical analysis may be used for prediction, based on the study of past data, so as to formulate policies for the future.
7. Statistics enlarges the field of individual knowledge and experience.

SCOPE OF STATISTICS

The scope of statistics is so vast and ever-expanding that it is difficult to define. Statistics pervades all subject matter and its use has permeated almost every facet of human lives. It is a tool of all sciences indispensable to search and intelligent judgement and has become a recognised discipline in its own right. There is hardly any field whether it be trade, industry or commerce, economics, biology, botany, astronomy, physics, chemistry, education, medicine, sociology, psychology, meteorology or geology where statistical tools are not applicable.

Statistics and the State

Since ancient times statistics have been used in framing suitable military and fiscal policies. Most of the statistics such as that of crime, military strength, population and taxes etc., were a by-product of administrative activity. Statistical data and statistical method are of great

help in promoting human welfare. It helps in framing suitable policies and the Government depends on factual data for its efficient functioning.

Statistics and Business

With the growing size and ever-increasing competition the problems of the business enterprises are becoming complex and they are using more and more statistics in decision-making. Business management has become a specialised job and the modern business establishments with wide range of commodities need to know the market for the products and make profits. The risk of uncertainty in the market fluctuations compel the business world for careful planning, evaluation and application of statistical methods concerning the business activities. Business, no doubt, is being run on estimates and probabilities. Marketing surveys are increasingly used to understand the taste of consumers, favourable as well as the unfavourable situations prevailing in the market vis-a-vis sales of the products and future expansions with the help of the statistics.

Statistics and Economics

Economics is concerned with the production and distribution of wealth as well as in the complex institutional set-up connected with consumption, savings and investment of income. Statistical data and statistical methods are of immense help in the proper understanding of economic problems and in the formulation of economic policies, and also evaluating their effect. Econometrics which comprises the application of statistical methods to the theoretical economics is widely used in economic research. Statistical methods of sampling are particularly useful for collecting the basic data of economic studies. Statistics relating to what to produce, how to produce and when to produce are important and they need a lot of statistical data; in the absence of which it is not possible to arrive at correct decisions.

Statistics and Physical Sciences

All the physical sciences including astronomy, geology and physics, invariably use more and more of statistics - data, methods and applications - in both theoretical and practical fields.

Statistics and Natural Sciences

Statistical techniques have proved to be extremely useful in the study of all natural sciences like biology, medicine, zoology, botany and environmental sciences. In fact, it is difficult to find any scientific activity where statistical data and its methods are not used.

Statistics and Research

Statistics is indispensable in research work. Most of the advancement in knowledge has taken place because of experiments conducted with the help of statistical methods. In fact, there is hardly any research today that one can find complete without statistical data and use of statistical methods. Also, it is impossible to understand the meaning and implications of most of the research findings in various disciplines of knowledge without applying the principles of statistics.

Statistics and other Uses

Statistics are also useful to bankers, brokers, insurance companies, social workers, labour unions, trade associations and chambers of commerce and to the politicians. In fact, the applications of statistics are so numerous that statistics today has risen from the science of statecraft to the science of universal applicability. It is instrumental in enhancing human knowledge and is a master key that enables to solve the problems of mankind almost in every field.

LESSON - 7.2

STATISTICAL ANALYSIS

MEASURES OF CENTRAL VALUE

Sociological research often involves collecting large amounts of data in numerical form. Sociologists use statistics to interpret the numbers in their data and to draw valid conclusions from those numbers. The most basic statistics used in Sociology are those that measure the central value (Averages).

One of the important objectives of statistical analysis is to determine various numerical measures, which describe the inherent characteristics of a frequency distribution. Such a value is called the "Central value' or an 'Average' or the 'Expected value of the variable'.

The central values are very much useful in:

i) Describing the distribution in concise manner

ii) For comparative study of different distribution

iii) For computing various other statistical measures such as Dispersion, Skewness, Kurtosis and various other basic characteristics of a mass of data.

The most common measures of cental tendency are the Arithmetic Mean, Median, Mode, Geometric Mean and Harmonic Mean.

ARITHMETIC MEAN

Arithmetic mean is the most popular and widely used measure for representing the entire data by one value. Its value is obtained by adding together all the items and by dividing this total by the number of items.

There are two types of arithmetic mean:

(a) Simple arithmetic mean, and

(b) Weighted arithmetic mean.

Simple Arithmetic Mean

There are three methods of calculating simple arithmetic mean. They are done by using:

(i) individual observations

(ii) discrete series

(iii) continuous series of data.

Individual observations

(a) Direct method: In case of individual series where frequencies are not given, the calculation of mean is very simple. Add together the various values of the variable and divide the total by the number of items.

$$\text{Arithmetic mean} = \frac{\text{Sum of all values}}{\text{Number of values}}$$

Symbolically

$$\bar{X} = \frac{X_1 + X_2 + X_3 + \ldots X_n}{N} \qquad \text{or } \bar{X} = \frac{\Sigma X}{N}$$

where

$\bar{X}$ - arithmetic mean

ΣX - sum of the variable

N - number of observations

Steps in solving the problems

i) Add together all the values of the variable X and obtain ΣX

ii) Divide the total i.e., ΣX by the number of observations, i.e., N.

Example

Find out the mean of the marks obtained by 10 students in an examination:

Marks : 33, 35, 44, 34, 41, 45, 39, 46, 38, 47

$$\text{Mean } (\bar{X}) = \frac{\Sigma X}{N} \quad \frac{402}{10} = 40.2$$

Thus the average mark is 40.2.

(b) Short-cut method

In case of a series of individual observations, the value of any one item is taken as average. This is known as "assumed mean" or "working origin". It is denoted by the capital letter 'A'. Deviations of values of items are found out and put down with proper algebraic signs. By making use of arbitrary origin, arithmetic mean can be calculated as follows:

$$\overline{X} = A + \frac{\Sigma d}{N}$$

where,

A - assumed mean

d - deviation of items from assumed mean, i.e., $d = (X - A)$

N - number of observations

Steps in solving problems

i) Take an assumed mean (any value whether existing in the data or not can be taken as the assumed mean)

ii) Take the deviations of the items from the assumed mean and denote these deviations by 'd'

iii) Obtain the sum of the deviations, i.e., Σd

Example

Serial No.	Marks	$d = X - A$ (A = 40)
1	33	-7
2	35	-5
3	44	4
4	34	-6
5	41	1
6	45	5
7	39	-1
8	46	6

9	38	–2
10	47	7
N = 10		Σd = +2

Assumed mean is taken as 40 i.e., (A = 40)

$$\bar{X} = A + \frac{\Sigma d}{N}$$

$$= 40 + \frac{2}{10}$$

$$= 40 + 0.2$$

$$= 40.2$$

The average mark is = 40.2

Discrete Series

In case of discrete series, arithmetic mean can be calculated by two methods:

(a) Direct method, and

(b) Short-cut method

(a) Direct method

The direct method of computing arithmetic mean consists of multiplying the frequencies by their respective mid-points, adding up their products and dividing the aggregate by the total number of frequencies.

$$\bar{X} = \frac{\Sigma fx}{N}$$

where

f - frequency

x - the variable

N - total number of observation i.e. f

Steps in solving the problem

i) Multiply the frequency of each row with the value and obtain the total, i.e., Σ fx

ii) Divide Σ fx by N, i.e., total frequency.

Example

No. of children:	4	6	3	8	9	5
No. of families:	17	9	5	20	15	12

No. of children per family (x)	No. of families (f)	fx
4	17	68
6	9	54
3	5	15
8	20	160
9	15	135
5	12	60
	Σf = 78	Σfx = 492

$$\bar{X} = \frac{\Sigma fx}{\Sigma f} = \frac{492}{78} = 6.3$$

The mean of children per family is 6.3.

b) Short-cut method

The short cut method of computing arithmetic mean consists of assumed mean from the series of 'x'.

$$\bar{X} = A + \frac{\Sigma fd}{N}$$

where,

A - assumed mean

f - frequency

d - (X – A)

N - total number of frequencies (Σf)

Steps in solving the problem

i) Take an assumed mean

ii) Take the deviations of variable 'x' from the assumed mean and denote the deviations by 'd'

iii) Multiply these deviations with the respective frequency and take the total fd

iv) Divide the total obtained in step (iii) by the total frequency.

Example

Calculate arithmetic mean by the short-cut method using frequency distribution.

Wages per day (x):	20	30	40	50	60	70
No. of works (f):	8	12	20	10	6	4

Wage per day (x)	No. of workers (f)	d = (x–A)	fd
20	8	–20	–160
30	12	–10	–120
40	20	0	0
50	10	10	100
60	6	20	120
70	4	30	120
	N = 60		Σfd = 60

$$\bar{X} = A + \frac{\Sigma fd}{N}$$

$$= 40 + \frac{60}{60}$$

$$= 40 + 1$$

$$= 41$$

The average wage earned is Rs. 41.

Continuous Series

In continuous series arithmetic mean may be computed by applying any of the three methods:

(a) Direct method

(b) Short-cut method, and

(c) Step-deviation method

(a) Direct method

The direct method is one in which the items are distributed among class intervals and the frequencies are expressed with reference to the class intervals.

This method can be used when class intervals are equal as well as unequal.

$$\bar{X} = \frac{\Sigma fm}{N}$$

where

m - mid point of various classes

f - frequency

N - total frequency

$$\text{Mid-point} = \frac{\text{Lower limit} + \text{Upper limit}}{2}$$

Steps involved in solving the problem

i) Obtain mid-point of each class and denote it by 'm'

ii) Multiply the mid-point of each class by the class frequency and obtain fm.

iii) Divide the total, i.e., Σ fm, by N (Σf)

Example

From the following data compute arithmetic mean by direct method:

Marks (x)	0-10	10-20	20-30	30-40	40-50	50-60
No. of students (f):	5	10	25	30	20	10

Marks	No. of students f	Mid-point m	fm
0-10	5	5	25
10-20	10	15	150
20-30	25	25	625
30-40	30	35	1050
40-50	20	45	900
50-60	10	55	550
	N = 100		Σ fm = 3300

$$\bar{X} = \frac{\Sigma fm}{N}$$

$$= 3300 / 100$$

$$= 33$$

The average of marks is 33.

(b) Short-cut method

The short-cut method of computing Arithmetic mean involves the conversion of continuous series into discrete series. This can be done by replacing the class-intervals by their mid-points. Once this is done, the method is same as used in discrete series.

$$\bar{X} = A + \frac{\Sigma fd}{N}$$

where,

A - assumed mean

Σ fd - Sum of total deviations

N - Number of items

d - (m – A)

Steps involved in solving the problem

i) Obtain mid-point of each class 'm

ii) Take any one of the mid-points as assumed mean 'A'

iii) Find out the deviation of mid-point of each class from the assumed mean 'd' (m – A).

iv) Multiply the deviations by their respective frequencies and obtain 'fd' and the total so obtained is Σ fd.

Example

Calculate Arithmetic mean by short-cut method from the following data:

Marks (x)	0-10	10-20	20-30	30-40	40-50	50-60
No. of students (f):	5	10	25	30	20	10

Marks	No. of students f	Mid-points m	d = m–A	fd
0-10	5	5	–30	–150
10-20	10	15	–20	–200
20-30	25	25	–10	–250
30-40	30	35	0	0
40-50	20	45	10	200
50-60	10	55	20	250
	N = 100			Σfm = 200

Taking assumed mean as 35

$$\bar{X} = A + \frac{\Sigma fd}{N}$$

$$= 35 + \frac{(-200)}{1}$$

$$= 35 - 2 = 33.$$

The average of marks is = 33

(c) Step Deviation Method

In order to simplify calculations, we can divide the deviations by class intervals, i.e., calculate (m – A) and then multiply by 'c' for getting mean.

$$\bar{X} = A + \frac{\Sigma fd^i}{N} \times c$$

where

A - assumed mean

Σfd^i - sum of the deviations

N - number of items

c - common factor (class interval)

$$d^i = \frac{m-A}{c}$$

The formula is applied when class intervals are equal. This method reduces the amount of arithmetics involved in solving the problem.

Steps involved in solving the problem

i) Obtain mid-point of each class 'N'

ii) Take any one of the mid-points as assumed mean 'A'

iii) Find out the deviations of mid-point of each class from the assumed mean and obtain 'd'

iv) Divide the deviations so obtained by a common factor 'c' and obtain 'd^i'

v) Multiply the 'd^i' by their respective freqencies (f) and total the products so obtained Σfd^i.

Example

Calculate Arithmetic mean by step deviation method from the following data:

Marks (X)	0-10	10-20	20-30	30-40	40-50	50-60
No. of students (f):	5	10	25	30	20	10

Marks (X)	No. of students (f)	Mid-points (m)	$d^i = m - A/c$	fd^i
0-10	5	5	-3	-15
10-20	10	15	-2	-20
20-30	25	25	-1	-25

30-40	30	35	0	0
40-50	20	45	1	20
50-60	10	55	2	20
	N = 100			$\Sigma fd^i = -20$

Taking assumed mean as 35.

$$\bar{X} = A + \frac{\Sigma fd^i}{N} \times c$$

$A = 35$

$\Sigma fd^i = -20$

$N = 100$

$c = 10$

$$= 35 + \frac{(-20)}{100} \times 100$$

$$= 35 - 2$$

$$= 33$$

The average of marks is 33.

Merits of Arithmetic Mean

1. Arithmetic mean is easy to understand and simple to compute.
2. As it takes into account every value of the series it is the most representative of the entire group.
3. It is defined by a rigid mathematical formula with the result that everyone who computes the average gets the same answers.
4. It possesses fairly good sampling stability.
5. It is relatively reliable in the sense that it does not vary too much when repeated samples are taken from the same population.
6. It can be used for further analysis and algebraic treatment.
7. It is typical in the sense that it is the centre of gravity of the values on either side of it.

8. It is a calculated value and not based on position in the series.
9. It has some desirable properties to its credit.
10. It is calculated on the basis of all observations of the series.

Demerits of Arithmetic Mean

1. The value of average is unduly affected by the extreme items, i.e., very small and very large items.
2. The mean cannot be computed when the frequency distribution has open classes at both ends.
3. If any item of the series is ignored, the accuracy of the mean will be affected.
4. It gives greater importance to bigger items and lesser importance to smaller items.
5. The arithmetic mean is not always good measure of central tendency. It holds good only when the variables are reasonably normal (bell shaped).
6. In many situations it gives meaningless and misleading results.
7. The Arithmetic mean cannot be used where data are not susceptible to quantitative measurement.
8. Sometimes the Arithmetic mean gives fallacious conclusions.
9. The Arithmetic mean cannot be located by mere obervation unlike Median and Mode.

MEDIAN

The median by definition refers to the middle value in a distribution. Thus in a ditribution, one half of the items have a value the size of the median value or smaller and the other half have a value the size of the median value or larger. The median is just the 50th percentile value. It splits the distribution into two halves.

As distinct from the Arithmetic mean, which is calculated from the value of every item in the series, the median is called a positional average.

The term position refers to the place of a value in a series lies on either side of it.

For example, if the income of five employees is Rs. 900, 950, 1020, 1200 and 1280 the median would be Rs.1020.

900
950
1020 – value at middle position of the array.
1200
1280

In the above example median was calculated for odd number of observations. When an even number of observations are listed, there is no single middle position value and therefore median is calculated by taking the average of the two middle most items.

For example, if the income of six employees is Rs. 900, 950, 1020, 1200, 1280, 1300 the median income would be:

900
950
1020
1200 – The two middle most position values.
1280
1300

$$\text{Median} = \frac{1020 + 1200}{2} = \text{Rs. } 1110.$$

Hence, in case of even number of observations median may be found by averaging the two middle position values.

When N (number of observations) is odd, the median is a natural value with the remainder of the series in two equal parts on either side of it. If N is even, the median is a derived figure, i.e., half the sum of the middle values.

Median can be obtained for Individual observations, Discrete series, and Continuous series.

Individual Observations

For individual observations, median is calculated by using the following formula:

Median = Size of N + $1/2^{th}$ item

where,

N = number of observations.

Steps in solving the problem

(i) Arrange the data either in ascending or descending order.

(ii) Add 1 to the total number of observations and divide it by 2.

$$\text{i.e., } \frac{N+1}{2}$$

Example

Calculate median from the following marks scored by 7 students:

6, 4, 9, 5, 2, 8, 12

Since the above data is of even numbers, it is necessary to arrange them either in ascending or descending order for the calculation of median.

Marks (if arranged in ascending order)

2 4 5 6 8 9 12

Marks (if arranged in descending order)

12 9 8 6 5 4 2

Median = Size of N + $1/2^{th}$ item, i.e., 7 + 1 = 4th item.

Size of 4th item = 6

Hence the median marks = 6

Example

The monthly salary of 8 persons working in a factory are as follows:

3200, 1800, 2500, 3100, 2300, 3000, 2800, 2900

S.No.	Salary (Rs.)
1	3200
2	3100
3	3000
4	2900
5	2800
6	2500
7	2300
8	1800
N = 8	

Median = Size of N + 1th item

$$= \frac{8+1}{2} = 4.5\text{th item}$$

$$\text{Size of 4.5th item} = \frac{4\text{th item} + 5\text{th item}}{2}$$

$$= \frac{2900 + 2800}{2} = \frac{5700}{2} = 2850$$

Median salary is Rs. 2850.

Discrete Series

Steps in solving the problem

(i) Arrange the data in ascending or descending order

(ii) Find out cumulative frequency

(iii) Apply the formula

$$\text{Median} = \frac{\text{Size of N+1}}{2}\text{th item}$$

iv) Look at the cumulative frequency column and see whether the total is either equal to N+1 or next higher than that and determine the value of the variable corresponding to this.

Example

From the following data find out the median cotton production in the state of Tamil Nadu:

Number of districts:	3	6	6	5	8
Cotton production (kg. per hectare)	4000	4800	3200	4100	3900

Cotton production in ascending order	No. of districts (f)	cf
3200	6	6
3900	8	14
4000	3	17
4100	5	22
4800	6	28
	N = 28	

$$\text{Median} = \text{Size of } \frac{N+1}{2}\text{th item}$$

$$= \frac{28+1}{2} = 14.5\text{th item}$$

Size of 14.5th item = 4000

Hence the median cotton production in the state is = 4000 kg/hec.

Continuous Series

Formula for determining median in case of continuous series is

$$\text{Median} = L + \frac{N/2 - cf}{f} \times i$$

where,

L = Lower limit of the median class, i.e., the class in which the middle item of the distribution lies.

cf = Cumulative frequency of the class preceding the median class or sum of the frequencies of all classes lower than the median class.

f = Simple frequency of the median class

i = The class interval of the median class

Median class is a class in which N/2th item lies.

Example

Find out median from the following data:

Ghee (in kg):	2-4	4-6	6-8	8-10	10-12	12-14	14-16
No. of Cows:	4	60	50	36	30	15	5

Ghee (in kg)	Frequency	cf
2-4	4	4
4-6	60	64
6-8	50	114
8-10	36	150
10-12	30	180
12-14	15	195
14-16	5	200
	N = 200	

Median = Size of N/2th item = 200/2 = 100th item

Hence the median lies in the class 6–8

$$\text{Median} = L + \frac{N/2 - cf}{f} \times i$$

L = 6

N/2 = 100

cf = 64

f = 50

i = 2

Therefore,

$$\text{Median} = 6 + \frac{100 - 64}{50} \times 2$$

$$= 6 + \frac{36}{25}$$

Median = 7.44 kg.

Merits of Median

1. Median value is not affected by the presence of extreme items.
2. Median considers position and not the value of every items, therefore, it is useful in case of open-end classes.
3. It is easy to understand and simple to compute.
4. It is mostly used in skewed distributions such as income distribution.
5. It can be calculated even if the items at the extremes are unknown.
6. It is the most appropriate average in dealing with qualitative data, which are not counted or measured, but are scored.
7. The value of median can be determined graphically.

Demerits of Median

1. It is necessary to arrange the data for calculating median.
2. Since it is a positional average, its value is not determined by each and every observation.
3. The value of median is affected more by sampling fluctuations.
4. In the case of continuous series median is only estimated.
5. It is not capable of algebraic treatment.
6. The median cannot be computed exactly when the number of items included in a series of data is even.
7. It is erratic if the number of items is small.

MODE

The mode of the modal value is that value in a series of observations which occurs with the greatest frequency. For example, the mode of the series 3, 5, 8, 5, 4, 5, 9, 3 would be 5, since this value occurs more frequently than any of the others.

Though mode is said to be that value which occurs most often in the data, i.e., with the highest frequency, this definition cannot safely be applied to any distribution because of the vagaries of sampling.

Thus, it can be said that the value about which the items are closely concentrated; it is the value which has the greatest frequency density in its immediate neighbourhood. It is the value around which the items tend to be most heavily concentrated. Therefore, mode refers to the value which occurs most frequently in a distribution. Moreover, mode is the easiest to compute since it is the value corresponding to the highest frequency.

For example, if the data are:

Size of shoes:	5	6	7	8	9	10	11
No. of persons:	10	20	25	40	26	19	7

the modal size is 8, since it appears maximum number of times in the series.

Calculation of Mode

Determining the precise value of the mode of a frequency distribution is by no means an elementary calculation, as it involves mathematical propositions. However, there are several elementary methods of estimating the mode. These methods have been discussed for individual observations, discrete series and continuous series.

Individual Observation

For determining mode, count the number of times the various values repeat themselves and the value occurring maximum number of times is the modal value. The more often the mode value appears relatively, the more valuable the measure is an average to represent data.

Example

Calculate the mode from the following data:

No. of students:	1	2	3	4	5	6	7	8	9	10
Marks:	10	27	24	12	27	27	20	18	15	30

Solution:

Size of item	No. of items it occurs
10	1
12	1
15	1
18	1
20	1
24	1
27	3
30	1
Total	10

Since the item 27 occurs the maximum number of times i.e., 3, hence the modal marks are 27.

Note: Thus, the process of determining mode in case of individual observations essentially involves grouping of data.

When there are two or more values having the same maximum frequency, one cannot say which is the modal value and hence mode is said to be ill-defined. Such a series is also known as bi-modal or multi-modal.

For example, observe the following data:

Income (in Rs.):	110	120	130	120	110	140	130	120	130	140
Size of item:	110	120	130	140						
No. of times it occurs:	2	3	3	2						

Since 120 and 130 have the same maximum frequency i.e., 3, mode is ill-defined.

Discrete Series

In discrete series quite often mode can be determined just by inspection, i.e., by looking to that value of the variable around which the items are most heavily concentrated. However, and error of judgement is possible in those cases where the difference between the maximum frequency and the frequency preceding it or succeeding it is very small and the items are heavily concentrated on either side.

In such cases, it is desirable to prepare a grouping table and an analysis table. These tables help us in ascertaining the modal class.

A grouping table has six columns. In column 1, the maximum frequency is marked or put in a circle: in column 2, frequencies are grouped in two's: in column 3, leave the first frequency and then group the remaining in two's: in column 4, group the frequencies in three's: in column 5, leave the first frequency and group the remaining in three's: and in column 6, leave the first two frequencies and then group the remaining three's. In each of these cases, take the maximum total and mark it in a circle or by bold type.

After preparing the grouping table, prepare analysis table. While preparing analysis table, put column number on the left hand side and the various probable values of mode on the right hand side. The values against which frequencies are the highest are marked in the grouping table and then entered by means of a bar in the relevant 'box' corresponding to the values they represent.

The procedure of preparing grouping table and analysis table are explained below with the help of the following example.

Example

From the following data of the heights of 100 persons determine the modal height:

Height (in inches):	58	60	61	62	63	64	65	66	68	70
No. of persons:	4	6	5	10	20	22	24	6	2	1

Solution:

Grouping Table

Height (in inches)	Frequency					
	Col. 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6
58	4	10				
60	6			15		
61	5		11		21	
62	10	15				35
63	20		30			
64	22	42		52		
65	24		46		66	
66	6	30		32		52
68	2		8		9	
70	1	3				

Analysis Table

Col. No.	Height (in inches)									
	58	60	61	62	63	64	65	66	68	70
1							1			
2					1	1				
3						1	1			
4				1	1	1				
5					1	1	1			
6						1	1	1		
Total				1	3	5	4	1		

Since the value 64 has occurred the maximum number of times i.e., 5, the modal height is 64 inches. It should be noted that by inspection one is likely to say that the modal value is 65 inches since it occurs the

maximum number of times i.e., 24. But, this is incorrect as revealed by the Grouping Table and Analysis Table.

Continuous Series

Steps:

(i) By preparing grouping table and analysis table or by inspection, ascertain the modal class.

(ii) Determine the value of mode by applying the following formula:

$$M_o = L + \frac{\Delta_1}{\Delta_1 + \Delta_2} \times i$$

L - lower limit of the modal class

Δ_1 - the difference between the frequency of the modal class and the frequency of the pre-modal class, i.e., preceding class (ignoring signs)

Δ_2 - the difference between the frequency of the modal class and the frequency of the post-modal class, i.e., succeeding class (ignoring signs)

i - class interval of the modal class

Another form of this formula is:

$$M_o = L + \frac{f_o - f_1}{2f_1 - f_o - f_2} \times i$$

where,

L - lower limit of the modal class

f_1 - frequency of the modal class

f_0 - frequency of the class preceding the modal class

f_2 - frequency of the class succeeding the modal class

i - the class interval of the modal class

While applying the above formula for calculating mode, it is necessary to see that the class intervals are uniform throughout. If they are unequal, they should first be made equal on the assumption that the frequencies

are equally distributed throughout the class, otherwise we will get misleading results.

Where mode is ill-defined, its value may be ascertained by the following formula based upon the relationship between mean, median and mode:

Mode = 3 Median – 2 Mean

This measure is called the empirical mode.

Example

Calculate mode from the following data:

Marks	:	0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100
No. of students	:	3	5	7	10	12	15	12	6	2	8

Solution:

Marks	No. of students
0-10	3
10-20	5
20-30	7
30-40	10
40-50	12
50-60	15
60-70	12
70-80	6
80-90	2
90-100	8

By inspection the modal class is 50–60.

$$M_0 = L + \frac{\Delta_1}{\Delta_1 + \Delta_2} \times i$$

$L = 50$

$1 = (15 - 12) = 3$

$$2 = (15 - 12) = 3$$

$$i = 10$$

$$M_o = 50 + \frac{3}{3+3} \times 10$$

$$= 50 + 5 = 55.$$

Merits of Mode

1. Mode is the most typical or representative value of a distribution.
2. Its value can be determined in open-end distributions without ascertaining the class-limits.
3. The value of mode can also be determined graphically.
4. Like median, the mode is not unduly affected by extreme values.
5. It can be used to describe qualitative phenomenon.

Limitations of Mode

1. The value of mode cannot always be determined so easily; in some cases, we may have bi-modal series.
2. The value of mode is not based on each and every item of the series.
3. It is not a rigidly defined measure; it is the most unstable average.
4. While dealing with quantitative data, the disadvantages of the mode outweigh its good features and hence it is not very popular.
5. It is not capable of algebraic manipulations.

LESSON - 7.3

MEASURES OF DISPERSION

DEFINITION OF DISPERSION

The various measures of central value give us one single figure that represents the entire data. But the averages alone cannot adequately describe a set of observations, unless all the observations are the same. It is necessary to describe the variability or dispersion of the observations. In two or more distributions the central value may be same but still there can be wide disparities in the formation of the distribution. Measures of dispersion help us in studying this important characteristic of a distribution.

The phenomenon of scatteredness of the values in the distribution is known as dispersion.

A.L. Bowley defines dispersion as "the measure of the variation of the item".

According to Spiegel, "the degree to which numerical data tend to spread about an average value is called the variation or dispersion of the data".

"A measurement of the scatteredness of the mass of figures in a series about an average is called measure of variation or dispersion" (Simpson and Kafka).

It is clear that dispersion (also known as scatter, spread or variation) measures the extent to which the items vary from some central value. Since measures of dispersion give an average of differences of various items from an average, they are also called averages of the second order.

SIGNIFICANCE OF MEASURING VARIATION

1. To determine the reliability of an average: Measures of variation help to understand as to how far an average is representative of the mass.

If dispersion is small, the average is a typical value in the sense that it closely represents the individual value and it is reliable in the sense that it is a good estimate of the average in the corresponding universe. On the other hand, when dispersion is large the average is not so typical, and unless the sample is very large, the average may be quite unreliable.

2. To serve as a basis for the control of variability: It determines the nature and cause of variation in order to control the variation itself. Thus, measurement of dispersion is basic to the control of causes of variation.

3. To compare two or more series with regard to their variability: The study of variation may also be looked upon as a means of determining uniformity or consistency. A high degree of variation would mean little uniformity or consistency whereas a low degree of variation would mean great uniformity or consistency.

4. To facilitate the use of other statistical measures: Many powerful analytical tools in statistics are based on measures of variation of one kind or another.

Properties of a Good Measure of Variation

A good measure of variation (dispersion) should possess the following properties or characteristics:

i) It should be simple to understand

ii) It should be easy to calculate

iii) It should be rigidly defined

iv) It should be based on each and every item of the observation

v) It should be amenable to further mathematical treatment

vi) It should have sampling stability, and

vii) It should not be unduly affected by extreme values.

TYPES OF DISPERSION

Following are the important measures of dispersion:

1. The Range

2. The Interquartile Range and the Quartile Deviation
3. The Mean Deviation or Average Deviation
4. The Standard Deviation, and
5. The Lorenz Curve.

The range and the quartile deviation are positional measures because they depend on the values at particular position in the distribution. On the other hand, the mean deviation and the standard deviation are called calculation measures of deviation because all of the values are used in their calculation. The lorenz curve, however, is a graphic method.

THE MEAN DEVIATION

While average or the measures of central tendency gives a single value that represents a group of values, the measures of dispersion shows the extent to which the items vary from the central value. There are various methods to calculate the variations or deviations. Among them Mean Deviation and Standard Deviation are important.

Mean deviation is a measure of dispersion which is obtained on taking the average of the deviations of the given values from a measure of central value. Thus, it is also known as 'the average deviation'. Average deviation is the average amount of scatter of the items in a distribution from either the mean or the median ignoring the signs of the deviation.

Theoretically there is an advantage in taking the deviations from median because the sum of the deviations of items from median is minimum when signs are ignored. However, in practice the arithmetic mean is more frequently used in calculating the value of average deviation and this is the reason why it is more commonly called as mean deviation.

Mean deviation can be calculated for individual observations, discrete series, and continuous series.

Individual Observations

The formula for computing mean deviation is:

$$M.D. = \frac{\Sigma |D|}{N}$$

Where, |D| within parallel lines (read as mod 'd') denotes deviations from mean or median ignoring signs. In other words, it is the modulus value or absolute value of the deviation ignoring plus and minus signs.

Steps

i) Calculate the mean (or median) of the series.

ii) Take the deviations of items from mean (or median), i.e., d = (x–A) of each observation from the average A, ignoring ± signs and denote these deviations by |D|.

iii) Obtain the total of these deviations, i.e., Σ|D|.

iv) Divide the total obtained in step (iii) by the number of observations.

The measures of mean deviation are absolute measures depending on the units of measurement. The relative measure corresponding to the mean deviation, called the coefficient of mean deviation, is obtained by dividing mean deviation by the particular average used in computing mean deviation. Thus, if mean deviation has been computed from median, the coefficient of mean deviation shall be obtained by dividing mean deviation by median.

$$\text{Coefficient of M.D.} = \frac{\text{M.D.}}{\text{Mean}}$$

If mean has been used while calculating the value of mean deviation, in such a case coefficient of mean deviation shall be obtained by dividing mean deviation by the mean.

Thus,

$$\text{Coefficient of M.D. about mean} = \frac{\text{M.D.}}{\text{Mean}}$$

$$\text{Coefficient of M.D about median} = \frac{\text{M.D.}}{\text{Median}}$$

Example

Calculate mean deviation for the following data from mean:

Marks (out of 25) are 7, 4, 10, 9, 15, 12, 7, 9, 7. If these marks are doubled (converted out of 50) will the variation in marks increase?

Marks (x)	$(x - \bar{x})$	$\|D\|$
7	(7 – 8.89)	1.9
4	(4 – 8.89)	4.7
10	(10 – 8.89)	1.1
9	(9 – 8.89)	0.1
15	(15 – 8.89)	6.1
12	(12 – 8.89)	3.1
7	(7 – 8.89)	1.9
9	(9 – 8.89)	0.1
7	(7 – 8.89)	1.9
$x = 80$		$\|D\| = 21.1$

$$\bar{X} = \frac{80}{9} = 8.89$$

$$M.D = \frac{|D|}{N} = \frac{21.1}{9}$$

Thus, the mean deviation (M.D.) = 2.34

Discrete series

For discrete series, the formula for calculating mean deviation is:

$$M.D. = \frac{\Sigma f |D|}{N}$$ (by the logic as given before)

Steps

i) Calculate the median of the series

ii) Take the deviations of the items from median ignoring signs and denote them by $|D|$

iii) Multiply these deviations ($|D|$) by the respective frequencies (f) and obtain the total, i.e., $\Sigma f|D|$.

iv) Divide the total in step (iii) by the total of observation (N).

Example

x	f	fx
10	8	80
15	12	180
20	15	300
30	10	300
40	3	120
50	2	100
x = 165	N = 50	fx = 1080

$$\text{Mean } \bar{x} = \frac{\Sigma fx}{N} = \frac{1080}{50} = 21.6$$

|D| $(x - \bar{x})$	f |D|
11.6	92.8
6.6	79.2
1.6	24.0
8.4	84.0
18.4	55.2
28.4	56.8
	$\Sigma f \|D\| = 392.0$

$$\text{M.D.} = \frac{\Sigma f |D|}{N} = \frac{392}{50} = 7.84$$

M.D. = 7.84

Continuous Series

For the computation of mean deviation in continuous series, the procedure remains the same as discussed above. The only difference is that here we have to obtain the mid-point of median. Formula is same i.e.,

$$\text{M.D.} = \frac{\Sigma f |D|}{N}$$

Steps

i) Calculate the median of the series.

ii) Take the deviations of the items from median ignoring signs and denote by $|D|$

iii) Multiply these deviations by the respective frequencies and obtain the total, i.e., $\Sigma f |D|$

iv) Divide the total obtained in step (iii) by the number of observations.

Merits of Mean Deviation

1. It is simple to understand and easy to calculate.
2. It is rigidly defined.
3. It is not much affected by the fluctuations of sampling.
4. It is less affected by extreme values as compared to the standard deviation.
5. It is based on all the observations.
6. Since it is based on the deivations about a central value, it provides a better measure for comparison about the formation of different distributions.

Demerits of Mean Deviation

1. As mean deviation ignores signs at each stage, it introduces artificiality in the whole process and renders mean deviation useless for further mathematical calculations.

2. Mean deviation gives best results when deviation is taken about median. However, median is not a satisfactory measure when the degree of variability in the series is very high.

3. Mean deviation cannot be computed for distributions with open-end classes.

4. Mean deviation tends to increase with the size of the sample though not proportionally and not so rapidly as range.

STANDARD DEVIATION

Introduction

The Standard Deviation was first introduced by Karl Pearson. It is the most important measure of dispersion and is widely used in statistical analysis. Its significance lies in the fact that it is free from those defects from which the other measures of dispersion suffer. Standard deviation is also called 'Root-mean square error' as it is the square-root of the mean of the squared deviations from the Arithmetic mean. It provides accurate result. Standard deviation is denoted by the small Greek letter 'σ' (read as 'sigma').

The standard deviation measures the absolute dispersion or variability of a distribution; the greater the amount of dispersion or variability; the greater the standard deviation, for the greater will be the magnitude of the deviations of the values from their mean. A small standard deviation means a high degree of uniformity of the observations as well as homogeneity of a series; a large standard deviation means just the opposite. Thus if we have two or more comparable series with identical or nearly identical means, it is the distribution with the smallest standard deviation that has the most representative mean. Hence, standard deviation is extremely useful in judging the representativeness of the mean.

Standard deviation can be calculated for individual observations, discrete series and continuous series.

Individual Observation

Standard deviation for individual observation may be calculated by applying any of the two methods:

(a) By taking deviation of the items from the actual mean.

(b) By taking deviations of the items from an assumed mean.

(a) Deviations taken from actual mean: When deviations are taken from actual mean the following formula is applied.

$$\sigma = \sqrt{\frac{\Sigma x^2}{N}}$$

where

$$x = (X - \bar{X})$$

Steps

i) Calculate the actual mean of the series, i.e., $\bar{X}$

ii) Take the deviations of the items from the mean, i.e., find $(X - \bar{X})$. Denote these deviations by x.

iii) Square these deviations and obtain the total Σx^2.

iv) Divide Σx^2 by the total number of observations, i.e., N and extract the square-root. This gives the value of standard deviation.

(b) Deviations taken from assumed mean: When the actual mean is in fractions (say, 12.921) it would be too difficult to take deviations from it and then obtain squares of these deviations. In such a case either the mean may be approximated or the deviations be taken from an assumed mean. The former method of approximation is less accurate and therefore in such a case deviations are taken from assumed mean.

When deviations are taken from assumed mean the following formula is applied.

$$\sigma = \sqrt{\frac{\Sigma d^2}{N} - \left(\frac{\Sigma d}{N}\right)^2}$$

Steps

i) Take the deviations of the items from an assumed mean, i.e., obtain $(x - A)$. Denote these deviations by d. Take the total of these deviations, i.e., Σd.

ii) Square these deviations and obtain the total Σd^2.

iii) Substitute the values of Σd^2, Σd and N in the above formula.

Example

Calculate standard deviation from assumed mean for the following data:

Number of persons: 1 2 3 4 5 6 7 8 9 10

Blood Sugar level : 240 260 290 245 255 288 272 263 277 251

Solution:

X	d = (x – A) (A = 264)	d^2
240	–24	576
260	–4	16
290	26	676
245	–19	361
255	–9	81
288	24	576
272	8	64
265	–1	1
277	13	169
251	–13	169
$\Sigma X = 2641$	$\Sigma d = 1$	$\Sigma d^2 = 2689$

$$\sigma = \sqrt{\frac{\Sigma d^2}{N} - \left(\frac{\Sigma d}{N}\right)^2}$$

$\Sigma d^2 = 2689$; $\Sigma d = 1$ $N = 10$

$$\sigma = \left(\frac{2689}{10} - \frac{1}{10}\right)^2$$

$$= 268.9 - 0.01$$

$$= 16.398$$

Discrete Series

For calculating standard deviation in the discrete series any of the following methods may be applied:

(a) Actual mean method

(b) Assumed mean method

(c) Step deviation method

(a) Actual mean method: When this method is applied, deviations are taken from actual mean i.e. we find $(X - \bar{X})$ and denote these deviation by x. These deviations are then squared and multiplied by the respective frequencies.

$$\sigma = \sqrt{\frac{\Sigma fx^2}{N}}$$

where

$x = (X - \bar{X})$.

However this method is rarely used in practice because if the actual mean is in fractions the calculations take a lot of time.

(b) Assumed mean method: Formula for this method is

$$\sigma = \sqrt{\left(\frac{\Sigma\, fd^2}{N}\right) - \left(\frac{\Sigma fd}{N}\right)^2}$$

where,

$d = (X - A)$.

Steps

i) Take the deviations of the items from an assumed mean i.e., obtain $(X - A)$. Denote these deviations by d. Take the total of these deviations, i.e., Σd.

ii) Multiply these deviations by the respective frequencies and obtain the total, Σfd.

iii) Obtain the squares of the deviations, i.e., calculate d^2.

iv) Multiply the squared deviations by the respective frequencies and obtain the total Σfd^2.

v) Substitute the value of Σd^2, Σd and N in the above formula.

Example

Size of item:	3.5	4.5	5.5	6.5	7.5	8.5	9.5
Frequency:	3	7	22	60	85	32	8

Solution:

X	f	d(X – 6.5)	fd	fd^2
3.5	3	–3	–9	27
4.5	7	–2	–14	28
5.5	22	–1	–22	22
6.5	60	0	0	0
7.5	85	1	85	85
8.5	32	2	64	128
9.5	8	3	24	72
	N = 217		$\Sigma fd = 128$	$\Sigma fd^2 = 362$

$$\sigma = \sqrt{\left(\frac{\Sigma fd^2}{N}\right) - \left(\frac{\Sigma fd}{N}\right)^2}$$

$\Sigma fd^2 = 362$; $\Sigma fd = 128$; $N = 217$

$$\sigma = \frac{362}{217} - \frac{128}{217}$$

$= 1.668 - 0.348 = 1.149$

Step Deviation Method

In this method the deviations of mid-points from an assumed mean are used and these deviations are divided by the width of class interval, i.e., i. In case class intervals are unequal, the deviations of mid-points are divided by the lowest common factor (c) instead of i in the formula for calculating standard deviation.

Formula for calculating standard deviation is

$$\sigma = \sqrt{\left(\frac{\Sigma fd^2}{N}\right) - \left(\frac{\Sigma fd}{N}\right)^2} \times i$$

where,

$d = \frac{(X - A)}{i}$; and

i = class interval

Example

Find out the standard deviation for the following distribution:

X :	4.5	14.5	24.5	34.5	44.5	54.5	64.5
Y :	1	5	1	22	17	9	4

Solution:

X	f	d(X – 34.5) / 10	fd	fd^2
4.5	1	–3	–3	9
14.5	5	–2	–10	20
24.5	12	–1	–12	12
34.5	22	0	0	0
44.5	17	1	17	17
54.5	9	2	18	36
64.5	4	3	12	36
	N = 70		Σfd = 22	Σfd^2 = 130

$$\sigma = \sqrt{\left(\frac{\Sigma fd^2}{N}\right) - \left(\frac{\Sigma fd}{N}\right)^2} \times i$$

$\Sigma fd^2 = 130$; $\Sigma fd = 22$; $N = 70$; $i = 10$

$$\sigma = \left(\frac{130}{70}\right) - \left(\frac{22}{70}\right)^2 \times 10$$

$$= 1.857 - 0.099 \times 10$$

$$= 1.758 \times 10$$

$$= 1.326 \times 10$$

$$= 13.26$$

Continuous Series

In continuous series any of the methods discussed above for discrete frequency distribution can be used. However in practice the step deviation method is widely used.

The formula is:

$$\sigma = \sqrt{\left(\frac{\Sigma fd^2}{N}\right) - \left(\frac{\Sigma fd}{N}\right)^2} \times i$$

where,

$d = \frac{(m - A)}{i}$

i = class interval

m = mid point.

Steps

i) Find the mid points of the various classes.

ii) Take the deviations of these mid points from an assumed mean i.e obtain (m – A). Denote these deviations by d.

iii) Multiply these deviations by the respective frequencies of each class and obtain the total Σfd.

iv) Obtain the squares of the deviations i.e calculate d^2.

v) Multiply the squared deviations by the respective frequencies of each class and obtain the total Σfd^2.

vi) Substitute the value of Σd^2, Σd and N in the above formula.

Note: The only difference in the procedure in case of continuous series is to find the mid points of the given classes.

Example

Calculate the standard deviation for the following data:

Marks:	0-10	10-20	20-30	30-40	40-50	50-60	60-70
No. of students:	5	12	30	45	50	37	21

Solution:

Marks	m	f	d(m – 35) / 10	fd	fd2
0-10	5	5	–3	–15	45
10-20	15	12	–2	–24	48
20-30	25	30	–1	–30	30
30-40	35	45	0	0	0
40-50	45	50	1	50	50
50-60	55	37	2	74	148
60-70	65	21	3	63	189
		N = 200		Σfd=118	Σfd^2=510

$$\text{Mean } \bar{X} = A + \frac{\Sigma fd}{N} \times i$$

$$= 35 + \frac{118}{200} \times 10$$

$$= 35 + 5.9$$

$$= 40.9$$

$$\sigma = \sqrt{\left(\frac{\Sigma fd^2}{N}\right) - \left(\frac{\Sigma fd}{N}\right)^2} \times i$$

$\Sigma fd^2 = 510 : \Sigma fd = 118 : N = 200: i = 10$

$$\sigma = \frac{510}{200} - \left(\frac{118}{200}\right)^2 \times 10$$

$$= 2.55 - 0.348 \times 10$$

$$= 1.484 \times 10$$

$$= 14.84$$

Uses of Standard Deviation

The standard deviation is the best measure of dispersion and is most extensively employed in statistical analysis. A number of statistical techniques have been developed taking it as the base, the most important being the Analysis of Variance, Skewness, Kurtosis, Regression, Correlation, Tests of Significance.

Merits of Standard Deviation

1. It is rigidly defined.
2. It is based on all the observations.
3. It is amenable to further mathematical treatment.
4. Of all the measures of dispersion, standard deviation is least affected by fluctuations of sampling.

Demerits of Standard Deviation

1. As compared to other measures of dispersion, standard deviation is difficult to calculate.
2. It gives greater weightage to extreme values because the deviations are squared.

COEFFICIENT OF VARIATION

The coefficient of variation developed by Karl Pearson, is used to compare the variability of two or more than two series. That series are

group for which the coefficient of variation is greater is said to be more variable or less consistent, less uniform, less stable or less homogeneous. On the other hand, the series for which coefficient of variation is less is said to be less variable or more consistent or more uniform, more stable or more homogeneous.

Coefficient of variation is denoted by C.V. and is obtained as follows:

$$\text{Coefficient of variation or C.V.} = \frac{\sigma}{\bar{X}} \times 100$$

It may be noted that although any measure of disperson can be used in conjunction with any average in computing relative dispersion, in practice the standard deviation as the measure of dispersion and the arithmetic mean as the average are used. When the relative disperson is stated in terms of the arithmetic mean and the standard deviation, the resulting percentage is known as the coefficient of variation or coefficient of variability.

Coefficient of Dispersion

A measure of relative dispersion is the ratio of a measure of absolute dispersion to an appropriate average. It is sometimes called a Coefficient of Dispersion, because coefficient means a pure number that is independent of the units of measurement. It should be remembered that while computing the relative dispersion the average used as base should be the same one from which the absolute deviations were measured. This means that the arithmetic mean should be used with the standard deviation, and either the arithmetic mean or median with the mean deviation.

Measures of dispersion may be either absolute or relative. Absolute measures of dispersion are expressed in the same statistical unit in which the original data are given (such as Rupees, Kilograms etc.). These values may be used to compare the variations in two distributions provided the variables are expressed in the same units and of the same average size. In case two sets of data are expressed in different units, the absolute

measures of dispersion are not comparable. In such cases measures of relative dispersion should be used.

Example

From the following data find out which series is more consistent.

Variable	Series A	Series B
10-20	20	13
20-30	18	22
30-40	32	40
40-50	40	32
50-60	22	18
60-70	18	10

Solution

In order to find out which series is more consistent, the coefficient of variation of series A and series B are to be compared.

Calculation of coefficient of variation for series A

Variable	m	f	d(m–45)/10	fd	fd^2
10-20	5	20	–3	–30	90
20-30	25	18	–2	–36	72
30-40	35	32	–1	–32	32
40-50	45	40	0	0	0
50-60	55	22	1	22	22
60-70	65	18	2	36	72
		N = 140		Σfd = –40	Σfd^2 = 288

$$\text{(Mean) } \bar{X} = A + \frac{\Sigma fd}{N} \times i$$

$$= 45 + \frac{-40}{140} \times 10$$

$$= 45 - 2.86$$

$$= 42.14$$

$$\sigma = \sqrt{\left(\frac{\Sigma fd^2}{N}\right) - \left(\frac{\Sigma fd}{N}\right)^2} \times i$$

$\Sigma fd^2 = 228$; $\Sigma fd = -40$; $N = 140$; $i = 10$

$$\sigma = \frac{228}{140} - \left(\frac{-40}{140}\right)^2 \times 10$$

$$= 2.057 - 0.082 \times 10$$

$$= 1.975 \times 10$$

$$= 1.405 \times 10 = 14.05$$

$$\text{C.V.} = \frac{\sigma}{X} \times 100$$

$$= \frac{14.05}{42.14} \times 100$$

$$= 33.34 \text{ percent.}$$

Calculation of coefficient of variation for series B

Variable	m	f	d(m–45)/10	fd	fd^2
10-20	5	18	–3	–54	162
20-30	25	22	–2	–44	88
30-40	35	40	–1	–40	40
40-50	45	32	0	0	0
50-60	55	18	1	18	18
60-70	65	10	2	20	40
		N = 140		$\Sigma fd = -100$	$\Sigma fd^2 = 348$

$$\text{(Mean) } \bar{X} = A + \frac{\Sigma fd}{N} \times i$$

$$= 45 + \frac{-100}{140} \times 10$$

$$= 45 - 7.14$$

$$= 37.86$$

$$\sigma = \sqrt{\left(\frac{\Sigma fd^2}{N}\right) - \left(\frac{\Sigma fd}{N}\right)^2} \times i$$

$\Sigma fd^2 = 348$: $\Sigma fd = -100$: $N = 140$: $i = 10$

$$\sigma = \frac{348}{140} - \left(\frac{-100}{140}\right)^2 \times 10$$

$$= 2.486 - 0.510 \times 10$$

$$= 1.976 \times 10$$

$$= 1.406 \times 10 = 14.06$$

$$\text{C.V.} = \frac{\sigma}{\bar{X}} \times 100$$

$$= \frac{14.06}{37.86} \times 100$$

$$= 37.14 \text{ percent.}$$

C.V. (Series A) = 33.34 per cent : C.V. (Series B) = 37.14 per cent.

Since coefficient of variation is less for series A, it is more consistent, than series B.

Coefficient of Mean Deviation

The relative measure corresponding to the mean deviation, called the coefficient of mean deviation, is obtained by dividing mean deviation by the particular average used in computing mean deviation. Thus, if mean

deviation has been computed from median, the coefficient of mean deviation, shall be obtained by dividing mean deviation by median.

For example, if mean deviation about median has been calculated, then,

$$\text{Coefficient of M.D.} = \frac{\text{M.D.}}{\text{Median}}$$

If mean has been used while calculating the value of mean deviation, in such a case, coefficient of mean deviation shall be obtained by dividing mean deviation by the mean.

Example

Calculate mean deviation from median and its coefficient from the following data:

Class:	0-10	10-20	20-30	30-40	40-50	50-60	60-70
Frequency:	4	8	11	15	11	7	4

Solution:

Class	f	c.f.	m	|D| = (m – 34.67)	f|D|
0-10	4	4	5	29.67	118.68
10-20	8	12	15	19.67	157.36
20-30	11	23	25	9.67	106.37
30-40	15	38	35	0.33	4.95
40-50	11	49	45	10.33	113.33
50-60	7	56	55	20.33	142.31
60-70	4	60	65	30.33	121.32
					Σf|D|=764.62

Median = Size of $\frac{N}{2}$ th item

$= \frac{60}{2} = 30$. Therefore, the median class is 30-40.

$$\text{Median} = L + \frac{N/2 - cf}{f} \times i$$

$$L = 30;\ N/2 = 30;\ cf = 23;\ f = 50;\ i = 10$$

$$\text{Median} = 30 + \frac{30 - 23}{15} \times 10$$

$$= 30 + \frac{7 \times 10}{15} = 30 + \frac{70}{15} = 34.67$$

$$\text{M.D.} = \frac{Ef|D|}{N}$$

$$= \frac{764.62}{60} = 12.74$$

$$\text{Coefficient of M.D.} = \frac{\text{M.D.}}{\text{Median}} = \frac{12.74}{34.67} = 0.37$$

Short-cut Method

When the central value (either mean or median) is in fraction, the method of calculation becomes very lengthy. In such cases it is better to follow the short-cut method as described below:

If mean deviation from median is to be calculated, the following formula may be used:

$$\text{M.D. from median} = \frac{\Sigma mfA - \Sigma mfB - (\Sigma fA - \Sigma fB)\ Me}{N}$$

ΣfA - sum of frequencies above the median

ΣfB - sum of frequencies below the median

m - mid-points of the class intervals

ΣmfA - sum of products of the mid-points of the frequencies above the median

ΣmfB - sum of products of the mid-points of the classes and their frequencies below the median

N - sum of all frequencies

Me - is the median.

If mean deviation is to be calculated from its mean, the value can be used instead of the median in the formula. Hence, mean deviation about mean would be:

$$\text{M.D. about mean} = \frac{\Sigma mfA - \Sigma mfB - (\Sigma fA - \Sigma fB)\,\bar{X}}{N}$$

Example

Class	f	c.f.	m	mf	F
0-10	4	4	5	20	4
10-20	8	12	15	120	12
20-30	11	23	25	275	23
30-40	15	38	35	525	38
40-50	11	49	45	495	49
50-60	7	56	55	385	56
60-70	4	60	65	260	60
	60				

Median = 34.67

ΣmfB = 20+120+275 = 415 (values below the median class)

ΣmfA = 1665.

ΣfA = 37

ΣfB = 23

$$\text{M.D. about median} = \frac{1665 - 415 - (37 - 23) \times 34.67}{60}$$

$$= \frac{1250 - 14 \times 34.67}{60}$$

$$= \frac{1250 - 485.38}{60} = \frac{764.62}{60} = 12.74$$

which is the same as the result obtained earlier.

Example

Calculate mean deviation from mean and its coefficient from the data contained in example above.

Solution

Class	f	m	$d = \frac{m - 35}{10}$	fd
0-10	4	5	-3	-12
10-20	8	15	-2	-16
20-30	11	25	-1	-11
30-40	15	35	0	0
40-50	11	45	1	11
50-60	7	55	2	14
60-70	4	65	3	12
	60			-2

$$\bar{X} = 35 \frac{2}{60} \times 10 = 35 - \frac{1}{3} = 35 - 0.33 = 34.67$$

Since mean is the same as median, mean deviation from mean is obtained in the same way as mean deviation from median and has the same value i.e. 12.74.

$$\text{Coefficient of Mean Deviation} = \frac{\text{Mean Deviation}}{\text{Mean}} = \frac{12.74}{34.67} = 0.37$$

Differences Between Mean Deviation and Standard Deviation

Both these measures of dispersion are based on each and every item of the distribution. Yet they differ in the following respects:

1. Algebraic signs are ignored while calculating mean deviation whereas in the calculation of standard deviation signs are taken into account.

2. Mean deviation can be computed either from median or mean. The standard deviation, on the other hand, is always computed from the Arithmetic mean because the sum of the squares of the deviations of items from arithmetic mean is the least.

UNIT - VIII

CORRELATION AND REGRESSION

LESSON - 8.1

CORRELATION

DEFINITION OF CORRELATION

The degree of relationship between the variables under consideration is measured by what is known as correlation analysis. The measure of correlation called the correlation coefficient or correlation index summarises in one figure the direction and degree of correlation. The correlation analysis refers to the technique used in measuring the closeness of the relationship between the variables. According to Simpson and Kafka, "correlation analysis deals with the association between two or more variables". In other words, it attempts to determine the degree of relationship between variables.

According to A.M. Tuttle, "correlation is an analysis of the co-variation between two or more variables".

Thus correlation is a statistical device which helps in analysing the co-variation of two or more variables.

It should be noted that the detection and analysis of correlation (i.e. co-variation) between two statistical variables requires relationship of some sort which associates the observation in pairs, one of each pair being a value of each of the two variables. In general, the pairing relationship may be of almost any nature, such as observations at the time or place or over a period of time or different places.

SIGNIFICANCE OF THE STUDY OF CORRELATION

The study of correlation is used widely in practice because of the following reasons:

i) Most of the variables show some kind of relationship. With the help of correlation anaysis it is possible to measure in one figure the degree of relationship existing between the variables.

ii) Once it is known that two variables are closely related, we can estimate the value of one variable given the value of another.

iii) Correlation analysis contributes to the understanding of behaviour of the variables, aids in locating the important variable on which others depend, may reveal the connection by which disturbances spread and suggest the paths through which stabilising forces may become effective.

iv) Development in the methods of science is possible by increase in the knowledge of relationship or correlation. Thus it helps to find multiplicity of inter-related forces.

v) The effect of correlation is to reduce the range of uncertainty. The prediction based on correlation analysis is likely to be more variable and near to reality.

TYPES OF CORRELATION

Correlation is generally described by three important types:

i) The positive or negative

ii) The simple, partial and multiple

iii) The linear and non-linear

Positive and Negative Correlation

Whether correlation is positive (direct) or negative (inverse) would depend upon the direction of change of the variables. If both the variables are varying in the same direction, i.e., if as one variable is increasing, the other on an average, is also increasing or, if as one variable is decreasing the other on an average is also decreasing, correlation is said to be positive. If on the other hand, the variables are varying in opposite direction, i.e., as one variable is increasing the other is decreasing or vice-versa, correlation is said to be negative.

The following examples would explain the difference between positive and negative correlation:

Positive correlation

i)	X:	10	12	15	18	20	25	32	40
	Y:	15	20	22	25	37	42	47	51
ii)	X:	80	70	60	50	40	30	20	10
	Y:	50	44	41	34	30	20	11	6

Negative correlation

i)	X:	20	30	40	50	60	70	80	90
	Y:	40	30	22	15	10	5	3	2
ii)	X:	90	80	70	60	50	40	30	20
	Y:	10	20	30	40	50	60	70	80

Simple, Partial and Multiple Correlation

The distinction between simple, partial and multiple correlation is based upon the number of variables studied.

When only two variables are used or studied it is of simple correlation. When three or more variables are studied it is of either multiple or partial correlation. While in multiple correlation three or more variables are studied simultaneously, whereas in partial correlation only two variables to be influencing each other the effect of other influencing variables being kept constant.

Linear and Non-linear (Curvilinear) Correlation

The distinction between linear and non-linear correlation is based upon the constancy of the ratio of change between the variables. If the amount of change in one variable tends to bear constant ratio to the amount of change in the other variable then the correlation is said to be linear.

For example, observe the following two variables X and Y:

X: 10 20 30 40 50

Y: 70 120 210 280 350

It is clear that the ratio of change between the two variables is the same. If such variables are plotted on a graph paper all the plotted points would fall on a straight line.

Correlation would be called non-linear or curvilinear if the amount of change in one variable does not bear a constant ratio to the amount of change in the other variable.

It may be pointed out that in most of the practical situations, a non-linear relationship can be found between the variables. Since techniques of analysis for measuring non-linear correlation are far more complicated than those for linear correlation, it is generally assumed that the relationship between the variables is of the linear type.

The following two diagrams show the difference between linear and non-linear correlation:

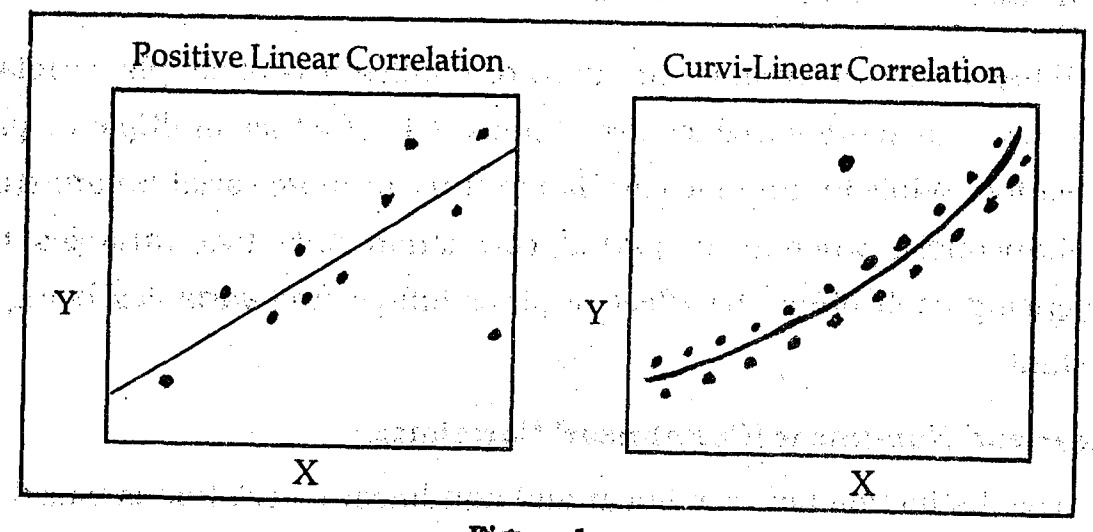


Figure-1

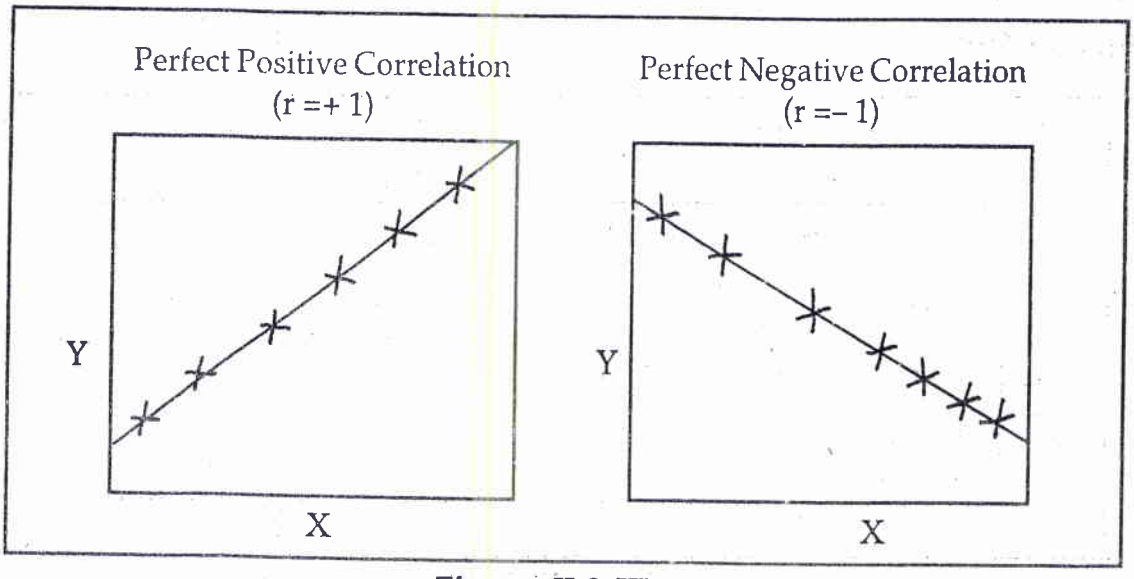
Methods of Studying Correlation

To ascertain whether two variables are correlated or not, the following methods are used:

1. Scatter Diagram Method
2. Graphic Method
3. Karl Pearson's Coefficient of Correlation
4. Concurrent Deviation Method
5. Method of Least Squares

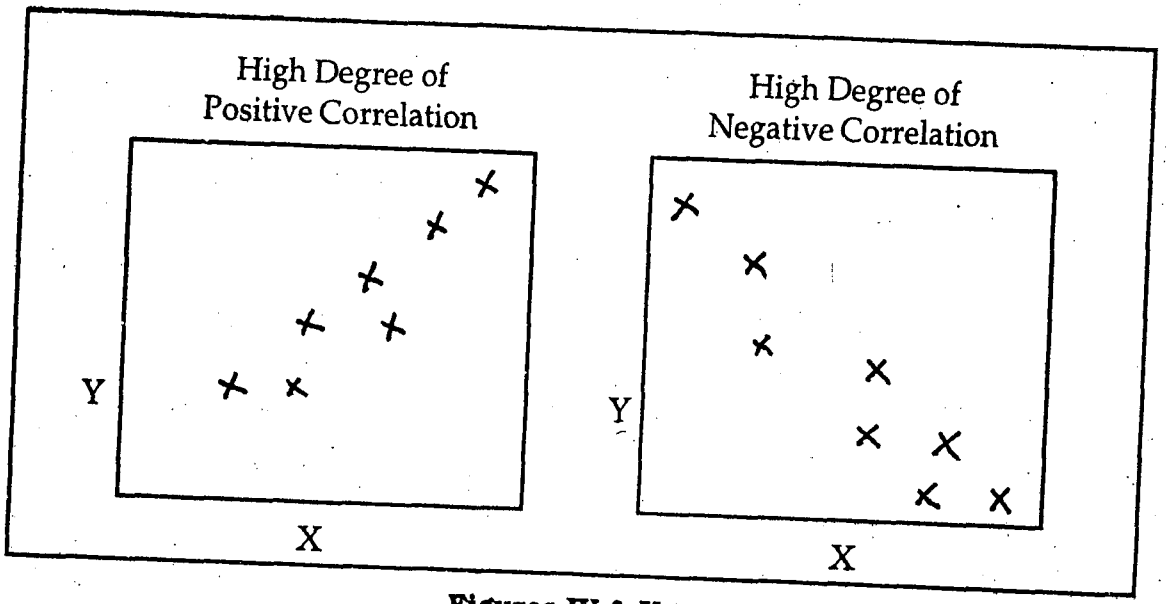
SCATTER DIAGRAM METHOD

The simplest device for ascertaining whether two variables are related is to prepare a dot chart called scatter diagram. When this method is used the given data are plotted on a graph paper in the form of dots, i.e., for each pair of X and Y values we put a dot and thus obtain as many points as the number of observations. By looking to the scatter of the various points one can form an idea as to whether the variables are related or not. The greater the scatter of the plotted points on the chart, the lesser is the relationship between the two variables. The more closely the points come to a straight line, the higher the degree of relationship. If all the points lie on a straight line falling from the lower left-hand corner to the upper right-hand corner, correlation is said to be perfectly positive (i.e., r = +1) (diagram II). On the other hand, if all the points are lying on a straight line rising from the upper left-hand corner to the lower right-hand corner of the diagram, correlation is said to be perfectly negative (i.e., r = –1) (diagram III).



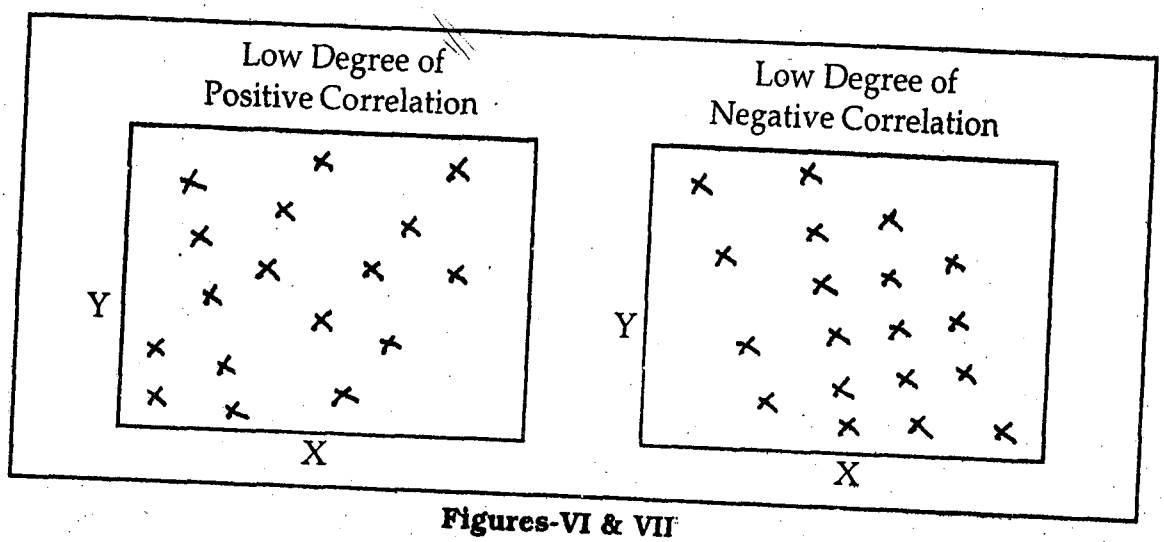
Figures-II & III

If the plotted points fall in a narrow band there would be a high degree of correlation between the variables – correlation shall be positive if the points show a rising tendency from the lower left-hand corner to the upper right-hand corner (diagram IV), and negative if the points show a declining tendency from the upper left-hand corner to the lower right-hand corner of the diagram (diagram V).



Figures-IV & V

On the other hand, if the points are widely scattered over the diagram it indicates very little relationship between the variables - correlation shall be positive if the points are rising from the lower left-hand corner to the upper right-hand corner (diagram VI), and negative if the points are running from the upper left-hand side to the lower right-hand side of the diagram (diagram VII).



Figures-VI & VII

If the plotted points lie on a straight line parallel to the X-axis or in a haphazard manner, it shows absence of any relationship between the variables (i.e., r = 0) as shown in diagram VIII.

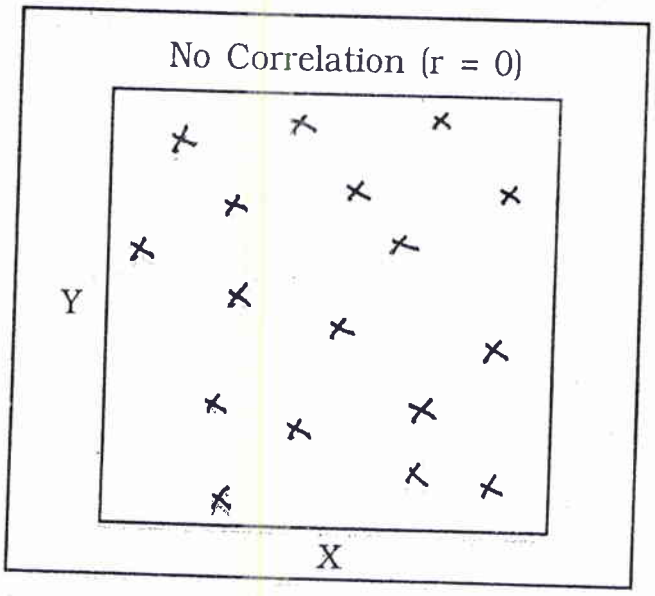


Figure-VIII

Merits of Scatter Diagram

1. It is a simple and non-mathematical method of studying correlation between the variables. As such it can be easily understood and a rough idea can very quickly be formed as to whether or not the variables are related.
2. It is not influenced by the size of extreme items whereas most of the mathematical methods of finding correlation are influenced by extreme items.
3. Making a scatter diagram usually is the first step in investigating the relationship between two variables.

Limitations of Scatter Diagram

By applying this method one can get an idea about the direction of correlation and also whether it is high or low. However, one cannot establish the exact degree of correlation between the variables as is possible by applying the other mathematical methods.

PEARSON'S COEFFICIENT OF CORRELATION

Of the several mathematical methods of measuring correlation, the Karl Pearson's method, popularly known as 'Pearson's coefficient of correlation', is most widely used in practice. The Pearson's coefficient of correlation is denoted by the symbol 'r'. It is one of the very few symbols that are used universally for describing the degree of correlation between series. The formula for computing Pearson's 'r' is:

$$r = \frac{\Sigma xy}{N\sigma x\, \sigma y}$$

where,

$x = (X - \bar{X})$; $y = (Y - \bar{Y})$

σx = Standard deviation of series X

σy = Standard deviation of series Y

N = Number of pairs of observations

r = the (product moment) correlation coefficient

It is important to remember that this method can be applied only where deviations of items are taken from actual mean and not from assumed mean.

The value of the coefficient of correlation (as obtained by the above formula) shall always lie between + 1 or –1. when r = + 1, it means there is perfect positive correlation between the variables.

When r = –1, it means there is perfect negative correlation between the variables. When r = 0, it means there is no relationship between the two variables. However, in practice such values of r as + 1, –1, and 0 are rare. We normally get values which lie between + 1 and –1 such as + 0.8, – 0.26, etc. The coefficient of correlation describes not only the magnitude of correlation but also its direction. Thus, coefficient of correlation describes not only the magnitude of correlation but also its direction. Therefore, r = + 0.8 would mean that correlation is positive because the sign r is + and

the magnitude of correlation is 0.8. Similarly, r = – 0.26 means low degree of nagative correlation.

The above formula for computing Pearson's coeffcient of correlation may be transformed to the following form which is easier to apply:

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$$

where,

$$x = (X - \bar{X}) \text{ and } y = (Y - \bar{Y})$$

It is obvious that while applying this formula one need not calculate separately the standard deviation of X and Y series as is required by the earlier formula. This simplifies greatly the task of calculating correlation coelficient.

Steps:

(i) Take the deviations of X series from the mean of X and denote these deviations by x.

(ii) Square these deviations and obtain the total, i.e., Σx^2.

(iii) Take the deviations of Y series from the mean of Y and denote these deviations by y.

(iv) Square these deviations and obtain the total, i.e., Σy^2.

(v) Multiply the deviations of X and Y series and obtain the total, i.e., Σxy.

(vi) Substitute the values of Σxy, Σx^2, and Σy^2 in the above formula.

Example:

Calculate Karl Pearson's coefficient of correlation from the following data and interpret its value:

Roll No. of students	:	1	2	3	4	5
Marks in Accountancy	:	48	35	17	23	47
Marks in Statistics	:	45	20	40	25	45

Solution:

Let marks in accountany be denoted by X and marks in statistics by Y.

Roll No.	X	(X–34) x	x^2	Y	(Y–35) y	y^2	xy
1	48	+14	196	45	+10	100	+140
2	35	+1	1	20	–15	225	–15
3	17	–17	289	40	+5	25	–85
4	23	–11	121	25	–10	100	+110
5	47	+13	169	45	+10	100	+130
	$\Sigma X = 170$	$\Sigma x = 0$	$\Sigma x^2 = 776$	$\Sigma Y = 175$	$\Sigma y = 0$	$\Sigma y^2 = 550$	$\Sigma xy = 280$

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$$

$x = (X - \bar{X})$ and $y = (Y - \bar{Y})$

$$\bar{X} = \frac{\Sigma x}{N} = \frac{170}{5}$$

$$= 34$$

$$\bar{Y} = \frac{\Sigma y}{N} = \frac{175}{5}$$

$$= 35$$

$\Sigma xy = 280$; $\Sigma x^2 = 776$; $\Sigma y^2 = 550$

$$r = \frac{280}{\sqrt{776 \times 550}}$$

$$= \frac{280}{653.299}$$

$$= 0.429$$

Direct method for calculating correlation

Correlation coefficient can also be calculated without taking deviations of items either from actual mean or assumed mean, i.e., actual X and Y values. The formula in such a case is:

$$\frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{N\Sigma X^2 - (\Sigma X)^2}\ \sqrt{N\Sigma Y^2 - (\Sigma Y)^2}}$$

This formula would give the same answer as we get when deviations of items are taken from actual mean or assumed mean. The following example illustrates the point:

Example:

Calculate correlation coefficient for the following data:

Roll No. of students	:	1	2	3	4	5
Marks in Accountancy	:	48	35	17	23	47
Marks in Statistics	:	45	20	40	25	45

Solution

Calculation of correlation coefficient by the direct method

$$\frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{N\Sigma X^2 - (\Sigma X)^2}\ \sqrt{N\Sigma Y^2 - (\Sigma Y)^2}}$$

X	X^2	Y	Y^2	XY
9	81	15	225	135
8	64	16	256	128
7	49	14	186	98
6	36	13	169	78
5	25	11	121	55
4	16	12	144	48
3	9	10	100	30

		218		
2	4	8	64	16
1	1	9	81	9
$\Sigma X = 45$	$\Sigma X^2 = 285$	$\Sigma Y = 108$	$\Sigma Y^2 = 1356$	$\Sigma XY = 597$

$N = 9;\ \Sigma XY = 597;\ \Sigma X = 45;\ EY = 108;\ \Sigma X^2 = 285;\ \Sigma Y^2 = 1356$

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$$

$$x = (X - \bar{X}) \text{ and } y = (Y - \bar{Y})$$

$$r = \frac{9 \times 597 - 45 \times 108}{\sqrt{9 \times 285 - (45)^2}\ \sqrt{9 \times 1356 - (108)^2}}$$

$$r = \frac{5373 - 4860}{\sqrt{2565 - 2025}\ \sqrt{12204 - 11664}}$$

$$r = \frac{513}{\sqrt{540 \times 540}}$$

$$r = \frac{513}{540}$$

$$= 0.95$$

Calculation of correlation coefficient when change of scale and origin is made

Since 'r' is a pure number, shifting the origin and changing the scale of series does not affect its value.

Example:

Calculate coefficient of correlation from the following data:

X:	100	200	300	400	500	600	700
Y:	30	50	60	80	100	110	130

Solution

To simplify calculation let every value of X be divided by 100 and every value of Y by 10 and denote these series by X' and Y'.

X	X/100 X'	$(X'-\bar{X})$ x	x^2	y	Y--10 y'	$(Y'-\bar{Y})$ y	y^2	xy
100	1	-3	9	30	3	-5	25	15
200	2	-2	4	50	5	-3	9	6
300	3	-1	1	60	6	-2	4	2
400	4	0	0	80	8	0	0	0
500	5	1	1	100	10	2	4	2
600	6	2	4	110	11	3	9	6
700	7	3	9	130	13	5	25	15
		$\Sigma x=0$	$\Sigma x^2=28$			$\Sigma y=0$	$\Sigma y^2=76$	$\Sigma xy=46$

$$r = \frac{\Sigma xy}{\sqrt{\Sigma x^2 \times \Sigma y^2}}$$

$x = (X - \bar{X})$ and $y = (Y - \bar{Y})$

$\Sigma xy = 46$; $\Sigma x^2 = 28$; $\Sigma y^2 = 76$

$$r = \frac{46}{\sqrt{28 \times 76}}$$

$r = 0.997$

When Deviations are taken from an Assumed Mean

When actual means are in fractions, say for X and Y series 20.167 and 29.23, respectively, calculation of correlation by the method discussed above would involve too many calculations and would take a lot of time. In such a case the assumed mean method may be used for finding out correlation. When deviations are taken from an assumed mean the following formula is applied:

$$\frac{N\,\Sigma dxdy - (\Sigma dx\,\Sigma dy)}{\sqrt{N\Sigma dx^2 - (\Sigma dx)^2}\ \sqrt{N\Sigma dy^2 - (\Sigma dy)^2}}$$

where,

dx- refers to deviations of X series from an assumed mean, i.e., $(X - \bar{X})$.

dy- refers to deviations of Y series from an assumed mean i.e., $(Y - \bar{Y})$.

$\Sigma dxdy$- sum of the product of the deviations of X and Y series from their assumed means.

Σdx^2 - sum of the squares of the deviations of X series from an assumed mean

Σdy^2- sum of the squares of the deviations of Y series from an assumed mean.

Σdx- sum of the deviations of X series from an assumed mean.

Σdy- sum of the deviations of Y series from an assumed mean.

The formula may also be written as:

$$\frac{N\,\Sigma dxdy - (\Sigma dx\,\Sigma dy)}{\sqrt{N\Sigma dx^2 - (\Sigma dx)^2}\ \sqrt{N\Sigma dy^2 - (\Sigma dy)^2}}$$

But formula give above is the easiest to apply.

Steps:

(i) Take the deviations of X series from an assumed mean and denote these deviations by dx and obtain the total, i.e., Σdx.

(ii) Take the deviations of Y series from an assumed mean and denote these deviations by dy and obtain the total, i.e., Σdy.

(iii) Square dx and obtain the total Σdx^2.

(iv) Square dy and obtain the total Σdy^2.

(v) Multiply dx and dy and obtain the total $\Sigma dxdy$.

(vi) Substitute the values of $\Sigma dxdy$, Σdx, Σdy, Σdx^2 and Σdy^2 in the formula given above.

Example

Find Karl Pearson's coefficient of correlation between the values of X and Y given below and calculate the probable error:

X: 78 89 96 69 59 79 68 61

Y: 125 137 157 112 107 136 123 108

Assume 69 and 112 as the mean values for X and Y, respectively.

Solution:

x	(X–69) dx	dx^2	Y	(Y–112) dy	dy^2	dxdy
78	9	81	125	13	169	117
89	20	400	137	25	625	500
96	27	729	156	44	1936	1188
69	0	0	112	0	0	0
59	–10	100	107	–5	25	50
79	10	100	136	24	576	240
68	–1	1	123	11	121	–11
61	–8	64	108	–4	16	32
N = 8	Σdx=47	Σdx^2=1475		Σdy=108	Σdy^2=3468	Σdxdy=2116

$$r = \frac{N\,\Sigma dxdy - (\Sigma dx\,\Sigma dy)}{\sqrt{N\Sigma dx^2 - (\Sigma dx)^2}\ \sqrt{N\Sigma dy^2 - (\Sigma dy)^2}}$$

$$r = \frac{8 \times 2216 - 47 \times 108}{\sqrt{8 \times 1475 - (47)^2}\ \sqrt{8 \times 3468 - (108)^2}}$$

$$r = \frac{16928 - 5076}{\sqrt{11800 - 2209}\ \sqrt{27744 - 11664}}$$

$$r = \frac{11852}{\sqrt{9591}\ \sqrt{16080}}$$

taking logarithms

$$\log(r) = \log(11852) - 0.5\{\log(9591) + \log(16080)\}$$
$$= 4.0737 - 4.0941$$
$$= \bar{1}.9796$$
$$r = \text{AL } \bar{1}.9796$$
$$= 0.955$$

$$\text{P.E.} = 0.6745 \frac{1 - r^2}{\sqrt{N}}$$
$$= 0.6745 \frac{1 - (0.955)^2}{\sqrt{8}}$$
$$= \frac{0.6745 \times 0.088}{2.828}$$
$$= 0.021.$$

Correlation of Grouped data

When the number of observations is large, the data are often classified into two-way frequency distribution called a 'correlation table'. In the correlation table, the class intervals for Y are listed in the captions or column headings, and those for X are listed in the stubs at the left of the table: but the order can be reversed. The frequencies for each cell of the table are determined by either tallying or card sorting just as in the case of frequency distribution of a single variable.

The formula for calculating the coefficient of correlation is:

$$r = \frac{N \Sigma fdxdy - (\Sigma fdx \, \Sigma fdy)}{\sqrt{N\Sigma fdx^2 - (\Sigma fdx)^2} \; \sqrt{N\Sigma fdy^2 - (\Sigma fdy)^2}}$$

Note: This formula is the same as the one discussed above for assumed mean. The only difference is that here the deviations are multiplied by the frequencies.

Step:

(i) Take step deviations of variable X and denote these deviations by dx.

(ii) Take the step deviations of the variable Y and denote these deviations by dy.

(iii) Multiply dxdy and the respective frequency of each cell and write the figure obtained in right-hand upper corner of each cell.

(iv) Add together all the cornered values as calculated in step (iii) and obtain the total $\Sigma fdxdy$.

(v) Multiply the frequencies of the variable X by the deviations of Y and obtain the total Σfdx.

(vi) Take the squares of the deviations of variable y and multiply them by the respective frequencies and obtain Σfdx^2.

(vii) Multiply the frequencies of the variable Y by the deviation of Y and obtain the total Σfdy.

(viii) Take the squares of the deviations of the variable y and multiply them by the respective frequencies and obtain Σfdy^2.

(ix) Substitute the values of $\Sigma fdxdy$, Σfdx^2, Σfdy and Σfdy^2 in the above formula and obtain the value of r.

Example

The following table gives the frequency, according to groups of marks obtained by 67 students in an intelligence test. Measure the degree of relationship between age and intelligence test:

Test Marks	Age in Years				Total
	18	19	20	21	
200-250	4	4	2	1	11
250-300	3	5	4	2	14
300-350	2	6	8	5	21
350-400	1	4	6	10	21
Total	10	19	20	18	67

Solution:

Y \ X	dy	Age in years 18 −1	19 0	20 1	21 2	f	fdy	fdy^2	fdxdy
	−1	4	0	−2	−2				0
200–250		4	4	2	1	11	−11	11	
	0	0	0	0	0				0
250–300		3	5	4	2	14	0	0	
	1	−2	0	8	10				16
300–350		2	6	8	5	21	21	21	
	2	−2	0	12	40				50
350–400		1	4	6	10	21	42	84	
Total		10	19	20	18	N = 67	Σfdy = 52	Σfdy^2 = 116	Σfdx fdy = 66
fdx		10	0	20	36	Σfdx = 46			
fdx^2		10	0	20	72	Σfdx^2 = 102			
fdxdy		0	0	18	48	Σfdxdy = 66			

$$r = \frac{N\Sigma fdxdy - (\Sigma fdx\ \Sigma fdy)}{\sqrt{N\Sigma fdx^2 - (\Sigma fdx)^2}\ \sqrt{N\Sigma fdy^2 - (\Sigma fdy)^2}}$$

$$r = \frac{67 \times 66 - 46 \times 52}{\sqrt{67 \times 102 - (46)^2}\ \sqrt{67 \times 116 - (52)^2}}$$

$$r = \frac{4422 - 2392}{\sqrt{6834 - 2116}\ \sqrt{7772 - 2704}}$$

$$r = \frac{2030}{\sqrt{4718}\ \sqrt{5068}}$$

$$r = \frac{2030}{68.688 \times 71.19}$$

$$r = \frac{2030}{4889.899}$$

$$= 0.415.$$

Assumptions of the Pearsonian Coefficient

Karl Pearson's coefficient of correlation is based on the following assumptions:

1. There is linear relationship between the variables, i.e., when the two variables are plotted on a scatter diagram a straight line will be formed by the points so plotted.
2. The two variables under study are affected by a large number of independent causes so as to form a normal distribution. Variables like height, weight, price, demand, suppy, etc., are affected by such forces that a normal distribution is formed.
3. There is a cause and effect relationship between the forces affecting the distribution of the items in the two series. If such a relationship is not formed between the variables, i.e., if the variables are independent, there cannot be any correlation. For example there is no relationship between income and height because the forces that affect these variables are not common.

Merits and Limitations of the Pearsonian's Coefficient

Among the mathematical methods used for measuring the degree of relationship, Karl Pearson's method is the most popular. Correlation coefficient summarises in one figure not only the degree of correlation but also the direction, i.e., whether correlation is positive or negative.

The main limitations of the method are:

1. The correlation coefficient always assumes linear relationship regardless of the fact whether that assumption is correct or not.
2. Great care must be exercised in interpreting the value of this coefficient as very often the coefficient is misinterpreted.
3. The value of the coefficient is unduly affected by the extreme items.

4. As compared with other methods, this method takes more time to compute the value of correlation coefficient.

RANK CORRELATION COEFFICIENT

The Karl Pearson's method is based on the assumption that the population being studied is normally distributed. When it is known that the population is not normal or when the shape of the distribution is not known, there is need for a measure of correlation that involves no assumption about the parameter of the population.

It is possible to avoid making any assumptions about the populations being studied by ranking the observations according to size and basing the calculation on the ranks rather than upon the original observations. It does not matter which way the items are ranked, item number one may be the largest or it may be the smallest. Using ranks rather than actual observations gives the coefficient of rank correlation.

This method of finding out covariability or the lack of it between two variables was developed by Charles Edward Spearman in 1904. This measure is especially useful when quantitaive measures for certain factors (such as in the evaluation of leadership ability or the judgement of beauty, etc.) cannot be fixed, but the individual in the group can be arranged in order thereby obtaining for each individual a number indicating his (her) rank in the group. Spearman's rank correlation coefficient is defined as:

$$r_s = 1 - \left[\frac{6\Sigma D^2}{N(N^2 - 1)}\right] \qquad \text{or}$$

$$r_s = 1 - \frac{6\Sigma D^2}{N^3 - N}$$

where,

'r_s' - denotes rank coefficient of correlation

'D' - refers to the difference of ranks between paired items in two series.

The value of this coefficient, interpreted in the same way as Karl Pearson's coefficient, ranges between +1 and –1. When r is +1 there is complete agreement in the order of the ranks and the ranks are in the same direction. When r is –1 there is complete agreement in the order of the ranks and they are in opposite directions. This shall be clear from the following:

R^1	R^2	D $(R^1 - R^2)$	D^2
1	1	0	0
2	2	0	0
3	3	0	0
			$\Sigma D^2 = 0$

$$R = 1 - \frac{6\Sigma D^2}{N^3 - N}$$

$$R = 1 - \frac{6 \times 0}{3^3 - 2}$$

$$= 1 - 0$$

R^1	R^2	D $(R^1 - R^2)$	D^2
1	3	–2	4
2	2	0	0
3	1	2	4
			$\Sigma D^2 = 8$

$$R = 1 - \frac{6\Sigma D^2}{N^3 - N}$$

$$R = 1 - \frac{6 \times 8}{3^3 - 3}$$

$$= 1 - 2 \quad = -1$$

Features of Spearman's Correlation Coefficient

1. The sum of the differences of ranks between two variables shall be zero,

   Symbolically, $\Sigma d=0$

2. Spearman's correlation coefficient is distribution-free or non-parametric because no strict assumptions are made about the form of population from which small observations are drawn.

3. The Spearman's correlation coefficient is nothing but Karl Pearson's correlation coefficient between the ranks. Hence, it can be interpreted in the same manner as Pearsonian correlation coefficient.

In rank correlation one may come across with two types of problems:

(i) Where ranks are given

(ii) Where ranks are not given.

Where ranks are given

Where actual ranks are given in the data the steps required for computing rank correlation are:

(i) Take the differences of the two ranks, i.e., $(R^1 - R^3)$ and denote these differences by D.

(ii) Square these differences and obtain the total ΣD^2.

(iii) Apply the formula

$$R = 1 - \frac{6\Sigma D^2}{N^3 - N}$$

Example:

The ranking of 10 students in two subjects, Accountancy and Auditing are as follows:

Accountancy	:	3	5	8	4	7	10	2	1	6	9
Auditing	:	6	4	9	8	1	2	3	10	5	7

What is the coefficient of rank correlation?

Solution:

Calculation of Rank Correlation

R^1	R^2	$(R^1 - R^2)^2$ D^2
3	6	9
5	4	1
8	9	1
4	8	16
7	1	36
10	2	64
2	3	1
1	10	/81
6	5	1
9	7	4
		$\Sigma D^2 = 214$

$$R = 1 - \frac{6\Sigma D^2}{N^3 - N}$$

$$R = 1 - \frac{6 \times 214}{10^3 - 10}$$

$$R = 1 - 1.297$$

$$R = -0.297.$$

Example:

Ten competitions in a beauty contest are ranked by three judges in the following order:

1st Judge:	1	6	5	10	3	2	4	9	7	8
2nd Judge:	3	5	8	4	7	10	2	1	6	9
3rd Judge:	6	4	9	8	1	2	3	10	5	7

Use the Rank correlation coefficient to determine which pair of judges has the nearest approach to common tastes in beauty.

Solution:

In order to find out which pair of judges has the nearest approach to common tastes in beauty it is essential to compare rank correlation between the judgements of:

(i) 1st Judge and 2nd Judge,

(ii) 2nd Judge and 3rd Judge, and

(iii) 1st Judge and 3rd Judge

Rank by 1st Judge R1	Rank by 2nd Judge R2	Rank by 3rd Judge R3	$(R1-R2)^2$ D2	$(R2-R3)^2$ D2	$(R3-R1)^2$ D2
1	3	6	4	9	25
6	5	4	1	1	4
5	8	9	9	1	16
10	4	8	36	16	4
3	7	1	16	36	4
2	10	2	64	64	0
4	2	3	4	1	1
9	1	10	64	81	1
7	6	5	1	1	4
8	9	7	1	4	1
N = 10	N = 10	N = 10	ΣD^2=200	ΣD^2=214	ΣD^2=60

Rank correlation between the judgements of 1st and 2nd judges:

$$R\ (I \text{ and } II) = 1 - \frac{6\Sigma D^2}{N^3 - N}$$

In the above table D^2 is directly calculated because D's are not required in applying the formula.

Therefore,

$$R \text{ (I and II)} = 1 - \frac{6 \times 200}{10^3 - 10}$$

$$= 1 - \frac{1200}{990}$$

$$= 1 - 1.212$$

$$= -0.212$$

Rank correlation between the judgements of 2nd and 3rd judges:

$$R \text{ (II and III)} = 1 - \frac{6\Sigma D^2}{N^3 - N}$$

Therefore,

$$R \text{ (II and III)} = 1 - \frac{6 \times 214}{10^3 - 10}$$

$$= 1 - \frac{1284}{990}$$

$$= 1 - 1.297$$

$$= - 0.297$$

Rank correlation between the judgements of 1st and 3rd judges:

$$R \text{ (I and III)} = 1 - \frac{6\Sigma D^2}{N^3 - N}$$

Therefore,

$$R \text{ (I and III)} = 1 - \frac{6 \times 60}{10^3 - 10}$$

$$= 1 - \frac{360}{990}$$

$$= 1 - 0.364$$

$$= 0.636$$

since coefficient of correlation is maximum in the judgements of the 1st and 3rd judges, it may be concluded that they have the nearest approach to common taste in beauty.

B. Where Ranks are not given

When ranks instead of actual data are given in a distribution, it is necessary to assign the ranks. Ranks can be assigned by taking either the highet value as 1 or the lowest value as 1. But whether we start with the lowest value or the highest value we must follow the same method in case of both the variables.

Example:

Calculate Spearman's coefficient of correlation between marks assigned to ten students by judges X and Y in a certain competitive test as shown below:

S.No.	1	2	3	4	5	6	7	8	9	10
Marks by Judge X	52	53	42	60	45	41	37	38	25	27
Marks by Judge Y	65	68	43	38	77	48	35	30	25	50

Solution:

First assign ranks and then calculate rank correlation coefficient.

Marks by Judge X	Rx	Marks by Judge Y	Ry	$(Rx - Ry)^2$ D^2
52	8	65	8	0
53	9	68	9	0
42	6	43	5	1
60	10	38	4	36
45	7	77	10	9
41	5	48	6	1
37	3	30	3	0

38	4	32	2	4
25	1	25	1	0
27	2	50	7	25
				$\Sigma D^2 = 76$

$$R = 1 - \frac{6\Sigma D^2}{N^3 - N}$$

Therefore

$$R = 1 - \frac{6 \times 76}{10^3 - 10}$$

$$= 1 - \frac{456}{990}$$

$$= 1\ 0.461$$

$$= 0.539$$

Merits and Limitations of Rank Correlation Method

Merits: This method is simpler to understand and easier to apply compared to the Karl Pearson's method. The answers obtined by this method and the Karl Pearson's method will be the same provided no value is repeated, i.e., all the items are different.

2. Where the data are of a qualitative nature like honesty, efficiency, intelligence, etc., this method can be used with great advantage. For example, the workers of two factories can be ranked in order of efficiency and the degree of correlation established by applying this method.

3. This is the only method that can be used where we are given the ranks and not the actual data.

4. Even where actual data are given, rank method can be applied for acertaining correlation.

Limitations:

1. This method cannot be used for finding out correlation in a grouped frequency distribution.

2. Where the number of items exceeds 30 the calculations become quite tedious and require a lot of time. Therefore, this method should not be applied where N exceeds 30 unless we are given the ranks and not the actual values of the variables.

When to use Rank Correlation Coefficient

The rank method has principal uses:

(1) When the initial data are in the form of ranks.

(2) If N is fairly small (say) not more than 25 or 30) rank method is sometimes applied to interval data as an approximation to the more time-consuming r. This requires that the interval data be transferred to rank orders for both variables. If N is much in excess of 30, the labour required in ranking the scores becomes greater than is justified by the anticipated saving of time through the rank formula.

CONCURRENT DEVIATION METHOD

This method of studying correlation is the simplest of all the methods. The only thing that is required under this method is to find out the direction of change of X variable and Y variable. The formula applicable is

$$rc = \pm \sqrt{\pm\left(\frac{2C - n}{n}\right)}$$

where,

rc - stands for coefficient of correlation by the concurrent method.

C - stands for the number of concurrent deviation or the number of positive signs obtained after multiplying Dx and Dy.

n - number of pairs of observations compared.

(Note: Since there is no sign for the first value X and Y, n is always taken to be one less than the actual number of pairs of observations. For example, if 10 pairs of observations are given, n would be taken to be 9 while applying concurrent deviation method).

Steps:

(i) Find out the directions of change of X variable, i.e., as compared with the first value, whether the second value is increasing or decreasing or is constant. If it is increasing put a +sign: if it is decreasing put a – sign (minus) and if it constant put zero. Similarly, as compared to the second value, find out whether the third value is increasing, decreasing or constant. Repeat the same process for other values. Denote this column by Dx.

(ii) In the same manner as discussed above, find out the direction of change Y variable and denote this column by Dy.

(iii) Multiply Dx with Dy and determine the value of C, i.e., the number of positive signs.

(iv) Apply the above formula, i.e.,

$$rc = \pm\sqrt{\pm\left(\frac{2C - n}{n}\right)}$$

Note: The significance of ± signs, both inside the under-root and outside the under-root, is that we cannot take the under-root of minus sign. Therefore, if $\left(\frac{2C - n}{n}\right)$ is negative, this negative value multiplied with the minus sign inside would make it positive and we can take the under-root. But the ultimate result would be negative. If $\left(\frac{2C - n}{n}\right)$ is positive then we get a positive value of the coefficient of correlation.

Example:

Calculation of coefficient of concurrent deviation from the following data:

Price	Imports
368	22
384	21
385	24
361	20
347	22
384	26
395	24
403	29
400	28
385	27

Solution:

Calculation of coefficient of concurrent deviation

Price X	Direction of change of variable X Dx	Imports Y	Direction of change of variable Y dy	DxDy
368		22		
384	+	21	–	–
385	+	24	+	+
361	–	20	–	+
347	–	22	+	–
384	+	26	+	+
395	+	24	–	–
403	+	29	+	+
400	–	28	–	+
385	–	27	–	+
				C = 6

$$rc = \pm \sqrt{\pm\left(\frac{2C - n}{n}\right)}; \; C = 6, \; n = 9$$

$$rc = \pm \sqrt{\pm\left(\frac{(2 \times 6) - 9}{9}\right)}$$

$$= \sqrt{\pm 0.333}$$

$$= + 0.577.$$

Merits and Limitations of Concurrent Deviation Method

Merits:

1. It is the simplest of all the methods.
2. When the number of items is very large, this method may be used to form a quick idea about the degree of relationship before making use of more complicated methods.

Limitations:

1. This method does not differentiate between small and big changes. For example, if X increases from 100 to 101 the sign will be plus and if Y increases from 60 to 160, the sign will be plus. Thus, both get equal weight when they vary in the same direction.
2. The results obtained by this method are only a rough indicator of the presence of absence of correlation.

LESSON - 8.2

REGRESSION

DEFINITION

Regression analysis reveals the average relationship between two variables and hence makes the possibility of estimating or predicting one variable using another known variable. The dictionary meaning of regresion is the act of going or returning back. The line describing the tendency of going back or regression is called 'regression line'. In recent times the term 'estimating line' is used instead of 'regression line' because of its more clarity.

"Regression is the measure of the average relationship between two or more variables in terms of the original units of the data".

Regression analysis is used to find a relation between two or more variables that are related causally.

Regression analysis attempts to establish the nature of the relationship between variables, i.e., to study the functional relationship between the variables and thereby provide a mechanism for prediction or forecasting".

It is clear from the above definitions that regression analysis is a statistical device with the help of which the unknown value of one variable from the known value of another variable can be estimated. The variable which is used to predict the variable of interest is called the 'independent variable' or 'explained variable'. The algebraic form of the regression is called 'regression equation'. The regression line will be straight and linear when the regression equation is of the form $Y = a + bX$.

Difference Between Regression and Correlation

	Correlation		Regression
1.	It measures the degree of relationship.	1.	It studies the nature of relationship between two variables.
2.	It is applied when there is no direction of dependency.	2.	It is applied when there is a direction of dependency.
3.	Here cause and effect relationship is not clear.	3.	Here cause and effect relationship between two variables is clear.
4.	It is used for prediction of relationship.	4.	It is used for prediction of the value of variable on the basis of other variable.
5.	Coefficient of correlation is a relative measure.	5.	Coefficient of regression is an absolute measure.
6.	It is applied only when there is linear relationship between the variables.	6.	It is applied when there exists both linear and non-linear relationship between the variables.

USES OF REGRESSION

Regression analysis reveals average relationship between two variables and this makes possible estimation or prediction. Regression analysis is useful in estimating (predicting) the value of one variable given the value of another. For example, if we know that advertising and sales are correlated we can find out the expected amount of expenditure for attaining a given amount of sales. Similarly, if we know that the yield of rice and rainfall are closely related we can find out the amount of rain required to achieve a certain production figure.

Regression analysis is a branch of statistical theory that is widely used in almost all the scientific disciplines. It is the basic technique for measuring or estimating the relationship among economic variables that

constitute the essence of economic theory and economic life. For example, if we know that two variables, price (X) and demand (Y) are closely related, we can find out the most probable value of (X) for a given value of (Y) or the most probable value of (Y) for a given value of (X). Similarly, if we know that the amount of tax and the rise in the price of a commodity are closely related, we can find out the expected price for a certain amount of tax levy.

Regression analysis is of considerable help not only to the economists and businessmen, but also to almost all the natural, physical and social sciences.

The regression analysis attempts to accomplish the following:

1) Regression analysis provides estimates of values of the dependent variable from values of the independent variable. The device used to accomplish this estimation procedure is the regression line. The regression line describes the average relationship existing between 'X' and 'Y' variables, i.e., it displays mean values of 'X' for given values of 'Y'. The equation of this line, known as 'regression equation' provides estimates of the dependent variable when values of the independent variable are inserted into the equation.

2) A second goal of regression analysis is to obtain a measure of the error involved in using the regression line as a basis for estimation. For this purpose the standard error of estimate is calculated.

3) The cause and effect relations are indicated from the study of regression analysis.

4) It establishes the rate of change in one variable in terms of the changes in another variable.

5) It is useful in economic analysis as regression equation can determine an increase in the cost of living index for a particular increase in general price level.

6) It helps prediction and thus it can estimate the values of unknown quantities.

7) It enables us to study the nature of relationship between the variables.

8) It can be useful to all natural, social and physical sciences.

Limitations of Regression Analysis

In making estimates from a regression equation, it is assumed that the relationship has not changed since the regression equation was computed.

The relationship shown by the Scatter diagram may not be the same if the equation is extended beyond the values used in computing the equation. For example, there may be a close linear relationship between the yield of a crop and the amount of fertiliser used: however, it would not be logical to extend this equation beyond the limits of the experiment for it is quite likely that if the amount of fertiliser was increased indefinitely, the yield would eventually decline as too much fertiliser is harmful.

REGRESSION LINES

Regression line is the line which shows the tendency of going back or regression. If we take the case of two variables say, X and Y, we will have two regression lines as the regression line of X on Y and regression line of Y on X. The regression line of Y on X gives the most probable values of Y for the given values of X. The regression line of X on Y gives the most probable values of X for given Y values. However, when there is either perfect positive (+1) or perfect negative (–1) correlation between the two variables, the regression lines will coincide with each other i.e., we will have only one line. The farther the two regression lines from each other, the lesser is the degree of correlation, and the nearer the two regression lines to each other, the higher is the degree of correlation. If the variables are independent, r is zero and the lines of regression are at right angles i.e., parallel to OX and OY.

It is to be noted that the regression lines cut each other at the point of average of X and Y, i.e., if from the point where both the regression lines cut each other a perpendicular is drawn on the X-axis, we will get the mean value of X and if from that point a horizontal line is drawn on Y-axis, we will get the mean value of Y.

Regression equations, also known as estimating equations, are algebraic expressions of the regression lines. Since there are two regression lines, there are two regression equations–the regression equation of X on Y is used to describe the variations in the values of X for given changes in Y and the regression equation of Y on X is used to describe the variation in the values of Y for given changes in X.

Thus, if we have to draw the two regression lines, i.e., X on Y and Y on X, we need two equations i.e., the regression equation of X on Y, and the regression equation of Y on X, as shown below:

Regression equation of X on Y is

$$Xc = a + bY$$

Regression equation of Y on X is

$$Y = a + bX$$

Using the above equations, we can find out the value of X with respect to known value of Y and the value of Y with respect to known value of X, if we know the values of 'a', 'b'. The value of a,b can be obtained using least square method.

Least-Square Method

By the least-square method we can find out the values of 'a' 'b'. And so the regression line or line of best fit can be determined.

The values of 'a', 'b' can be calculated from the following normal distribution:

(i) Regression equation of X on Y,

$$\Sigma X = Na + b\ \Sigma y^*$$

$$\Sigma XY = a\ \Sigma Y + b\ \Sigma y^2$$

(ii) Regression equation of Y on X,

$$\Sigma Y = Na + b\ \Sigma x$$

$$\Sigma XY = a\ Ex + b\ \Sigma x^2$$

Conclusion

Regression analysis provides estimates of values of the dependent variable from values of the independent variable. The device used to accomplish this estimation procedure is the regression line. A second goal of regression analysis is to obtain a measure of the error involved in using the regression line as a basis for estimation. With the help of regression coefficients we can calculate the correlation coefficient.

LESSON - 8.3

ASSOCIATION OF ATTRIBUTES

INTRODUCTION

Statistical data are generally based on two types of observations: i) observations possessing numerical characteristics, and ii) observations possessing descriptive characteristics.

Characteristics which can be measured numerically such as weight, age, height, etc. are put into the first category and are named as "statistics of variables". On the contrary, characteristics which cannot be measured numerically such as sex, religion, honesty, sickness, etc. are put into the second category and are called as "statistics of attributes".

Attribute means the quality of the observed object. When data are collected with regard to definite qualities and placed in one group, it is said to be classification according to attributes.

Attribute means quality and is thus non-measurable. Sex, marital status, blindness, deafness, dumbness, etc. are examples of attributes. Relationship between attributes can be studied with the help of the theory of Association of Attributes.

The main objective of the study of association of attributes is to find out whether attributes under study are associated or not. If the attributes are found to be associated, then it may be examined further as to whether the attributes are positively associated or negatively associated.

Thus, association of attributes may be defined as a statistical technique by which the relationship between attributes are studied.

The method of association of attributes is used to measure the degree of relationship between the two phenomena whose size we cannot measure and where we can only determine the presence or absence of a particular attribute.

While dealing with statistics of attributes it is necessary to classify the data on the basis of presence or absence of a particular attribute or characteristic. When only one attribute is studied, two classes are formed – one possessing that attribute or characteristic. When only one attribute is studied, two classes are formed – one possessing that attribute and another not possessing it. For example, when the attribute of employment is studied, two classes may be formed – those who are employed and those who are not employed: when two attributes viz., employment and sex are studied then four classes such as number of males employed, number of females employed, number of males unemployed, and number of females unemployed shall be formed.

Notation and Terminology

For the sake of simplicity and convenience certain symbols are used to represent different classes and their frequencies. It is customary to use capital letters 'A' and 'B' to represent the presence of the attributes and Greek letters 'a' (alpha) and 'β' (beta) to represent absence of the attributes. Thus 'a' = 'not A' and B = 'not β'. For example, if 'A' represents males, then 'a' would represent females. Similarly if 'B' represents literates, then 'β' would denote illiterates. The combination of different attributes is denoted by (AB), (Aβ), (aβ). Thus in the example described above, (AB) would mean number of literate males and (aβ) illiterate females. The number of observations in different classes is called 'class frequency'. Thus if the number of literate males is 50, the frequency of class (AB) is 50. Class frequencies are denoted by enclosing class notation in bracket like (AB), (aβ) etc.

Thus,

(A) denotes number of individuals possessing attribute 'A'

(AB) denotes number of individuals possessing attributes 'A' and 'B'

(aβ) denotes number of individuals possessing attributes 'a' and 'β'

Any letter or combination of letters like A, AB, aβ, etc., by means of which we specify the characters of the members of a class is termed a 'class symbol'.

Class-frequencies

The number of observations assigned to any class is termed as 'the frequency of the class' or 'the class-frequency'. Class-frequencies are denoted by enclosing the corresponding class symbols in brackets. Thus (B) denotes the number of B's, i.e., objects possessing attribute B. (Aβ) the number of Aβ's, i.e., objects possessing attribute A, but not B, and so on for any number of attributes.

Order of Classes and Class-frequencies

The order of a class depends upon the number of attributes specified. A class having one attribute is known as the 'Class of the first order', a class having two attributes as 'Class of the second order', and so on. The total number of obervations is denoted by the symbol N and is called the 'frequency of the zero order' since no attributes are specified. Thus,

N - frequency of the zero order.

(A) (B) }
(a) (β) } Frequencies of the first order.

(AB) (aB) }
(Aβ) (aβ) } Frequencies of the second order.

Number of Frequencies

In a study of 'n' attributes the total number of class frequencies is given by

i) For one attribute, the frequencies are $3^1 = 3$.

ii) For two attributes total frequencies are 32 = 9; they are in the order 1 + 4 + 4 = 9.

Any class frequency can always be expressed in terms of class frequencies of higher order since the total number of observations must be equal to the number of A's added to the number of a's, i.e.,

$$N = (A) + (a)$$

Similarly, the number of A's is equal to the number of A's which are B's added to the number of A's which are β's, i.e.,

$$(A) = (AB) + (A\beta)$$

Similarly,

$$(a) = (AB) + (a\beta)$$

Ultimate Class Frequencies

It is clear that every class frequency can be expressed in terms of the frequencies of the highest order, i.e., of order 'n'. Any frequency can be analysed into higher frequencies, and the process need stop only when we have reached frequencies of the highest order. For example, with two attributes,

$$(A) = (AB) + (A\beta)$$
$$(a) = (aB) + (a\beta)$$ ultimate class frequencies

The classes specified by 'n' attributes, i.e., those of the highest order, are termed the ultimate class frequencies.

The total number of classes of ultimate order is determined by the formula 2^n when n stands for a number of attributes studied. If two attributes are studied, then the number of classes of ultimate order shall be $2^2 = 4$; in case three attributes are studied then there would be $2^3 = 8$ classes of the ultimate order.

The frequencies of positive, negative and ultimate classes can be known from the following table which is known as 'the nine square table' (since nine squares are formed).

	A	a	Total
B	(AB)	(aB)	(B)
β	(Aβ)	(aβ)	(β)
Total	(A)	(a)	N

From this table certain relationships can be described:

(A) = (AB) + (Aβ) ; (a) = (aB) + (aβ)

(B) = (AB) + (aB) ; (B) = (Aβ) + (aβ)

N = (A) + (a) or N = (B) + (β)

or

N = (AB) + (Aβ) + (aB) + (aβ)

From this relationships if any of the ultimate class frequencies and any other three values are known, the frequencies of the remaining classes can be found out.

Example:

From the following table find out the missing frequencies:

(AB) = 100, (A) = 300, N = 1000, (B) = 600.

Solution:

Putting these values in the nine square table

	A	a	Total
B	(AB) 100	(aB) 500	(B) 600
β	(Aβ) 200	(aβ) 200	(β) 400
Total	(A) 300	(a) 700	N 1000

The missing frequencies are (Aβ), (aB), (aβ), (a) and (β)

$(A\beta) = (A) - (AB) = 300 - 100 = 200$

$(a) = N - (A) = 1000 - 300 = 700$

$(B) = N - (B) = 1000 - 600 = 400$

$(a\beta) = (B) - (AB) = 600 - 100 = 500$

$(a?) = (\beta) - (A\beta) = 400 - 200 = 200$

Thus the missing frequencies are:

$(A\beta) = 100$, $(a\beta) = 500$, $(aB) = 200$, $(\beta) = 400$, $(a) = 700$.

Kinds of Association

Association between attributes may be of three kinds: positive association, negative association and independence.

Positive association: When two attributes are present or absent together there is positive association between them. In such cases the actual frequency is more than the expected frequency.

Negative association: When the presence of an attribute is associated with the absence of the other attribute or when the presence of an attribute causes the absence of another attribute, there is negative association between them. In such cases the actual frequency is less than the expected frequency. The negative association is also known as disassociation.

Independence: When two attributes do not have the tendency to be present together, or one's presence does not cause presence or absence of the other, there is independence between them. In such cases the actual frequency is equal to the expected frequency.

METHODS OF STUDYING ASSOCIATION

In order to ascertain whether two attributes are associated or not, the following methods may be used:

1. Comparison of Observed and Expected Frequencies Method.
2. Proportion Method.

3. Yule's Coefficient of Association.
4. Coefficient of Colligation.
5. Coefficient of Contingency.

Comparison of Observed and Expected Frequencies Method

When this method is applied, the actual observation is compared with the expectation. If the actual observation is equal to the expectation, the attributes are said to be independent: if actual observation is more than the expectation, the attributes are said to be positively associated and if the actual observation is less than the expectation, the attributes are said to be negatively associated.

Symbolically, attributes A and B are:

(i) Independent if (actual observation) $(AB) = \frac{(A) \times (B)}{N}$ (expectation);

(ii) Positively associated if (actual observation) $(AB) > \frac{(A) \times (B)}{N}$ (expectation);

(iii) Negatively associated if (actual observation) $(AB) < \frac{(A) \times (B)}{N}$ (expectation);

The same is true for attributes a and B; a and β and A and β. Thus, attributes a and β shall be called:

(i) Independent, if $(a\beta) = \frac{(a) \times (\beta)}{N}$;

(ii) Positively associated, if $(a\beta) > \frac{(a) \times (\beta)}{N}$; and

(iii) Negatively associated, if $(a\beta) < \frac{(a) \times (\beta)}{N}$

Example

From the following data find out whether attributes (i) (AB), (ii) (Aβ), (iii) (aB) and (iv) (aβ) are independent, associated or dis-associated N = 100, (A) = 40, (B) = 80, (AB) = 30.

Solution:

(i) Apply the criterion of independence, i.e., attributes (AB) shall be called independent if:

$$(AB) = \frac{(A) \times (B)}{N} ;$$

positively associated if:

$$(AB) > \frac{(A) \times (B)}{N} ; \text{ and}$$

negatively associated or disassociated if:

$$(AB) < \frac{(A) \times (B)}{N} ;$$

$$\text{Expectation of } (AB) = \frac{(A) \times (B)}{N}$$

$$(A) = 40,\ (B) = 80,\ N = 100$$

$$\text{Expectation of } (AB) = \frac{40 \times 80}{100} = 32.$$

The actual observation (i.e., the given value of (AB), i.e., 30) is less than the expectations and hence the attributes are disassociated or negatively associated.

(ii) For finding out the nature of association between the attributes (Aβ), (aB) and (aβ), the unknown values are to be determined. This can be done by preparing a nine-square table:

	A	a	Total
B	30	50	80
β	10	10	20
Total	40	60	100

From the table (Aβ) = 10, (aB) = 50, (aβ) = 10, (a) = 60, (β) = 20

Attributes A and β shall be independent if

$$(A\beta) = \frac{(A) \times (\beta)}{N}$$

Expectation of $(A\beta) = \frac{(A) \times (\beta)}{N}$, where (A) = 40, ($\beta$) = 20, N = 100

Therefore, expectation of $(A\beta) = \frac{40 \times 20}{100} = 8.$

Thus the actual observation (i.e., $(A\beta) = 10$) is more than the expectation and hence the attributes A and β are positively associated.

(iii) Attributes a and B shall be called independent if

$$(aB) = \frac{(a) \times (B)}{N}$$

Expectation of $(aB) = \frac{(a) \times (B)}{N}$, where (a) = 60, (B) = 80, N = 100

Therefore, expectation of $(aB) = \frac{60 \times 80}{100} = 48$

Thus the actual observation (i.e., $(aB) = 50$) is more than the expectation and hence the attributes are positively associated.

(iv) Attributes a and β shall be called independent if

$$(a\beta) = \frac{(a) \times (\beta)}{N}$$

Expectation of

$$(a\beta) = \frac{(a) \times (\beta)}{N}, \text{ where } (a) = 60, (\beta) = 20, N = 100$$

Therefore, expectation of

$$(a\beta) = \frac{60 \times 20}{100} = 12.$$

Thus the actual observation $(a\beta) = 10$ is less than the expectation (12). Hence the attributes are disassociated.

Limitations

With the help of this method we can only determine the nature of association (i.e., whether there is positive or negative association or no association) and not the degree of association (i.e., where association is high or low). Yule's coefficient is superior because it provides information not only on the nature but also on the degree of association.

PROPORTION METHOD

If there is no relationship of any kind between two attributes A and B we expect to find the same proportion of A's amongst the B's as amongst the β's. Thus, if a coin is tossed we expect the same proportion of heads irrespective of whether the coin is tossed by the right hand or the left hand.

Symbolically, two attributes may be termed:

i) Independent if $\frac{(AB)}{(B)} = \frac{(A\beta)}{(\beta)}$

ii) Positively associated if $\frac{(AB)}{(B)} > \frac{(A\beta)}{(\beta)}$

iii) Negatively associated if $\frac{(AB)}{(B)} < \frac{(A\beta)}{(\beta)}$

If the relation (i) holds good the corresponding relations

$$\frac{(aB)}{(B)} = \frac{(a\beta)}{(\beta)} ;$$

$$\frac{(AB)}{(A)} = \frac{(aB)}{(a)}$$

$$\frac{(AB)}{(A)} = \frac{(a\beta)}{(a)}$$

must also hold true.

Example:

In a population of 500 students the number of married is 200. Out of 150 students who failed 60 belonged to the married group. It is required to find out whether the attributes marriage and failure are independent, positively associated or negatively associated.

Solution:

Let A denote married students.

Therefore, a represents unmarried students.

Let B denote number of failures.

Therefore, β would denote non-failures.

We are given the total number of students, i.e., N = 500

(A) = 200, (B) = 150 and (AB) = 60 (i.e., the number of married students who failed).

Applying the proportion method:

Attributes A and B shall be called independent if $\frac{(AB)}{(A)} = \frac{(aB)}{(a)}$

In other words, if the proportions of married students who failed is the same as the proportion of unmarried students who failed, it can be said that the attributes, marriage and failure, are independent.

Proportion of unmarried students who failed: i.e.,

$$\frac{(AB)}{(A)} = \frac{60}{200} = 0.3 \text{ or } 30\%.$$

Proportion of unmarried students who failed:

$$\frac{(a\beta)}{(a)} = \frac{90}{300} = 0.3 \text{ or } 30\%.$$

(aB) = (B) – (AB), i.e., 150 – 60 = 90

(a) = N – (A), i.e., 500 – 200 = 300.

Since the two proportions are the same, it is concluded that the attributes, marriage and failure, are independent.

In the proportion method, one can only determine the nature of association but not the degree of association.

YULE'S COEFFICIENT OF ASSOCIATION

The most popular method of studying association is the Yule's Coefficient because in this method not only can we determine the nature

of association, i.e., whether the attributes are positively associated, negatively associated or independent, but also the degree or extent to which the two attributes are associated. The Yule's Coefficient is denoted by the symbol 'Q' and is obtained by applying the following formula:

$$Q = \frac{(AB)(a\beta) - (A\beta)(aB)}{(AB)(a\beta) + (A\beta)(aB)}$$

The value of this coefficient lies between +1 and –1. When the value of Q is +1 there is perfect positive association between the attributes. When Q is –1 there is perfect negative association (or perfect disassociation) between the attributes and when the value of Q is zero the two attributes are independent.

The coefficient of association can be used to compare the intensity of association between two attributes with the intensity of association between two other attributes.

Example:

Investigate the association between eye colour of husbands and eye colour of wives from the data given below:

Husbands with light eyes and wives with light eyes = 309

Husbands with light eyes and wives with not-light eyes = 214

Husbands with not-light eyes and wives with light eyes = 132

Husbands with not-light eyes and wives with not-light eyes = 119

Solution:

Since we have to find out the association between eye colour of husband and that of wife, one attribute can be taken as A and another as B.

Let A denote husbands with light eyes.

Therefore, a would denote husbands with not-light eyes.

Let B denote wives with light eyes.

Therefore, β would denote wives with not-light eyes.

The given data in terms of these symbols is

$$(AB) = 309,\ (A\beta) = 214,\ (aB) = 132,\ (a\beta) = 119.$$

Applying Yule's method:

$$Q = \frac{(AB)(a\beta) - (A\beta)(aB)}{(AB)(a\beta) + (A\beta)(aB)}$$

Substituting the above values in the formula

$$Q = \frac{(309 \times 119) - (214 \times 132)}{(309 \times 119) + (214 \times 132)}$$

$$Q = \frac{8523}{65019}$$

$$Q = 0.131$$

Thus, there is a very little association between the eye colour of husband and wife.

COEFFICIENT OF COLLIGATION

Yule has computed another coefficient called the 'Coefficient of Colligation'. It is denoted by the symbol γ (pronounced as 'gama') and is obtained by applying the following formula:

$$\gamma = \frac{1 - \sqrt{\frac{(A\beta) \times (aB)}{(AB) \times (a\beta)}}}{1 + \sqrt{\frac{(A\beta) \times (aB)}{(AB) \times (a\beta)}}}$$

From this coefficient one can obtain Yule's Coefficient of Association, i.e., Q, as follows:

$$Q = \frac{2\gamma}{1 + \gamma 2}$$

It should be noted that though t and Q serve the same purpose, these coefficients are not directly comparable with each other. Further, in practice Q is more popularly used than t as a measure of association.

COEFFICIENT OF CONTINGENCY

In practice, qualitative data are not only classified into dichotomous categories but also into more than two classes, i.e., attribute A may be classified not only as A and not A, but also as A_1, A_2, A_3, etc. Similarly, another attribute B may be sub- divided into B_1, B_2, B_3, etc. The frequencies falling within the different classes may be arranged in the form of a Contingency Table (i.e., a frequency table in which a sample from the population is classified according to two or more attributes) as follows:

A \ B	B_1	B_2	B_3	. . .	B_n	Total
A_1	(A_1B_1)	(A_1B_2)	(A_1B_3)	. . .	(A_1B_n)	(A_1)
A_2	(A_2B_1)	(A_2B_2)	(A_2B_3)	. . .	(A_2B_n)	(A_2)
A_3	(A_3B_1)	(A_3B_2)	(A_3B_3)	. . .	(A_3B_n)	(A_3)
. . .	. . .	. . .	. . .	. . .	. . .	. . .
A_n	(A_nB_1)	(A_nB_2)	(A_nB_3)	. . .	(A_nB_n)	(A_n)
Total	(B_1)	(B_2)	(B_3)	. . .	(B_n)	N

For determining the degree of association between A's and B's on the whole the coefficient of mean square contingency as given by Karl Pearson may be used. The coefficient of mean square contigency is denoted by the symbol 'i' and obtained by applying the following formula:

$$C = \sqrt{\frac{\chi^2}{N + \chi^2}}$$

While finding out the value of 'i' it is assumed in the form of null hypothesis, i.e., the two attributes are independent and exhibit no association.

For calculation of 'i' it is necessary to determine the value of χ^2 (pronounced as chi-square). The steps in calculating the value of χ^2 are as follows:

Steps:

(i) Find the expected or independent frequency for each cell. Thus, for cell (A_1B_1) the expectation is

$$\frac{(A_1) \times (B_1)}{N}$$

(ii) Obtain the difference between the observed (actual) and expected frequency in each cell, i.e., find (O – E).

(iii) Square (O – E) and divide the figure by E, the expected frequency for each cell.

(iv) Add up the figures obtained in step (iii). This would give the value of χ^2.

$$\text{Thus, } \chi 2 = \Sigma \frac{(O - E)^2}{E}$$

Once the value of χ^2 is obtained it is easy to determine the value of 'i'

Example

The following table shows the association among 1000 criminals between their weight and mentality. Calculate the coefficient of contingency beween the two:

Mentality	Weight in Pounds					Total
	110-120	120-130	130-140	140-150	Above 150	
Normal	50	102	198	210	240	800
Weak	30	38	72	30	30	200
Total	80	140	270	240	270	1000

Solution:

Coefficient of contingency, or

$$C = \sqrt{\frac{\chi^2}{N + \chi^2}}$$

where,

$$\chi^2 = \Sigma \frac{(O - E)^2}{E}$$

Mentality A	Weight in Pounds → B					
	110-120 B^1	120-130 B^2	130-140 B^3	140-150 B^4	Above 150 B^5	Total
Normal A^1	50	102	198	210	240	800
Weak A^2	30	38	72	30	30	200
Total	80	140	270	240	270	1000

The expected frequency corresponding to the cell (A^1B^1) is

$$\frac{(A^1) \times (B^1)}{N} = \frac{800}{1000} \times 80 = 64$$

The expected frequency corresponding to the cell (A^1B^2) is

$$\frac{(A^1) \times (B^2)}{N} = \frac{800}{1000} \times 140 = 112$$

The expected frequency corresponding to the cell (A^1B^3) is

$$\frac{(A^1) \times (B^3)}{N} = \frac{800}{1000} \times 270 = 216$$

The expected frequency corresponding to the cell (A^1B^4) is

$$\frac{(A^1) \times (B^4)}{N} = \frac{800}{1000} \times 240 = 192.$$

The expected frequency corresponding to the cell (A1B5) is

$$\frac{(A^1) \times (B^5)}{N} = \frac{800}{1000} \times 270 = 216.$$

Mentality A	Weight in Pounds → B					Total
	B^1	B^2	B^3	B^4	B^5	
A^1	64	112	216	192	216	800
A^2	16	28	54	48	54	200
Total	80	140	270	240	270	1000

	O	E	$(O - E)^2$	$(O - E)^2 / E$
(A^1B^1)	50	64	196	3.062
(A^1B^2)	102	112	100	0.893
(A^1B^3)	198	216	324	1.500
(A^1B^4)	210	192	324	1.688
(A^1B^5)	30	16	196	12.250
(A^2B^1)	38	28	100	3.571
(A^2B^3)	72	54	324	6.000
(A^2B^4)	30	48	324	6.750
(A^2B^5)	30	54	576	10.667
			$X2 = E[(O - E)^2 / E = 49.048]$	

$$i = \sqrt{\frac{\chi^2}{N + \chi^2}}$$

$$i = \sqrt{\frac{49.048}{1000 + 49.048}}$$

$$i = \frac{49.048}{1049.048}$$

$$= \sqrt{0.0468}$$

$$= 0.216.$$

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UNIT - V

MODES OF OBSERVATION

LESSON – 5.1

FIELD RESEARCH

Field research is one among the several modes of observation. Today field research is in vogue only due to its techniques like participant observation, direct observations and case studies. Whenever we look around us and observe what is happening and try to understand it, we are engaged in field research. Though we observe and participate in social behaviour like street corner society, doctor's visiting room or an airplane and so forth they are said to be field research only if they are scientific. Field research is not only data collecting activity but also theory generating activity. A field research seldom starts with previous hypothesis to be tested, rather it will start with an initial observation and tentative generalisation and would suggest particular type of observation for future.

By going directly to the social phenomenon under study and observing it completely, a researcher can develop a deeper and fuller understanding of it. This type of research is most suitable for those researchers aiming for qualitative information with simple quantification. Field researchers are capable in clipping various observations that are bound to escape from the eyes of other researchers. The most appropriate topic would be to study the attitudes and behaviour in the natural setting, for example, religious conversion in revival meetings. Field research is most appropriate to study the social processes over time. To wit, to see the riots and its after effects. Other appropriate studies for field research methods would be campus demonstration, courtroom proceedings, labour negotiations, public hearings and other similar events taking place in a given time and area. John Loftand in his 'Analysing Social Settings' suggests 6 different types of social

phenomena – Acts, Activities, Meanings, Participation, Relationships and Settings.

For example while standing in a bus stand you observe that the 'use me' dustbins are not used by the people and garbages are thrown around the dustbin. Presume that you take steps to clean the garbages. The immediate reaction of the crowd will be any in form as sarcasting, glaring and so forth and in brief, negative sanctions may be high. A few may realise their mistake and some may even join hands in your cleaning work. Apart from your experience if suppose you wanted to research in this line, the main requirement is you should have information pertaining to two questions. At first how the ego feels when he is fixed with such a public problem for which the responsibility is not assigned to him? Second, how did others around them react?

As a field researcher his roles are multiple. Raymond Gold discusses four different roles of the field researchers as complete participant, participant as an observer, observer as a participant and complete observer. A few ethical issues do arise in field research too. The subjects will be more sincere and honest if they do not know that they are being studied. On the other hand, if they know that they are being studied the group modify the researcher's behaviour in various ways. At first it may expel the researcher, second, may modify the speech and behaviour to portray respectability and third may bring about radical changes in the social process. If you are a complete participant you may affect what you are studying. To play the role of participant you must participate, for example, if you suggest what the riot group should do next, though you are not participating, you are directing them. A researcher when he plays the role of participant as observer would participate fully with the group under study with the information that he is carrying out a research. The observer as a participant is one who identifies himself/herself as a researcher and interacts with the participants in the social process but makes no pretense of actually being a participant. The best example would be a newspaper reporter who is learning about a social movement of migrant workers. He

has to stay with them, interview their leader, visit the hospital to see the injured workers and so on. The complete participant is one who observes a social process without becoming a participant of it in any way, and because of the researcher's unobtrusiveness the subjects will not know that they are being studied.

Field Preparation

Let us assume that you are interested in carrying out a field research regarding a campus political organisation. Before you enter into the field there are certain prerequisites to be fulfilled by any researcher. Say at first, like any other researcher you may be advised to review the existing literature on campus political organisation. To begin with you may have an array of literature of which you have to scan and select literature focussing your research. Review of literature will help you to frame theoretical framework and tune your relevant observational events. This phase of review of literature for a project can be divided into two as finding a relevant starting point and expanding the research in snowball fashion. To start with the relevant point you cannot ask any librarian, rather you should prepare a list of publications in the related field which can be observed from the list of Indexes maintained such as Index India, Sociological Abstracts, Current Contents and so forth. You should pay special attention to those references cited in each article and should try to hunt and read the articles. No guidelines can be prescribed for a researcher in this initial stage as what to read and what not to.

The next phase in field research is to make use of informants. You may discuss the issue with the few who have already done research in this field or approach a few who are aware of it. If you could establish a good relationship with informants it will help you to deal with the members of the group. There are many ways to make the initial contact with the people you plan to study. If you are a complete participant you should find a way of developing an identity with the people. If you are interested in studying the sweepers' community in Delhi city, it is not a bad advice

to choose a sweeper job and participate; whenever you want yourself to be identified as a researcher it is important to develop a rapport with them.

Sampling

The purpose of sampling technique is to ensure representativeness but it is difficult to follow controlled sampling technique. Here the population and the unit to be analysed is somewhat ambiguous. For instance, if you are willing to study the brothel houses in the city, a question may arise as to whether the brothel house or prostitutes of a city is your unit of analysis. In one sense field researchers do not sample but observe everything within their field. In one way sampling is very complicated in field research compared to other modes of observation. A researcher interested in act of riots can neither observe everything nor go for controlled observation.

There are three types of sampling techniques suggested for field research – the quota sampling, the snowball technique and the deviant cases. If you are not having representation from all categories you can go for quota: if you could not have a sampling frame, you can go for snow ball technique and if you find something as a rare phenomenon it can be a deviant case study.

Asking questions

In practice, field research is watching and listening to the action going on. It can also go for a systematic inquiry by probing into the facts with the list of questions and record the answers. Though questioning and recording the answer seems to be easy as it is a natural process for all of us, a researcher should be cautious in querying as 'what you ask is what you get'. If your question is put in such a fashion that it omits the important aspect of the issue then you may miss that important information in your diary. Let us suppose that you want to study why a group of students protest in campus. May be you are tempted to know that whether institutional head's order of prohibiting parking of two wheelers in the campus would be a reason. You may succeed in eliciting maximum

information on rioting causes but many would have joined for either excitement, or by force or for any other cause. Here arises the two important areas of research – wording in questionnaire and interview process. The nature of question is at times framed in such a manner that the answer for the previous question may alter the response of the succeeding ones. A field researcher should be a good listener and ensure that the respondent is travelling in the expected direction of research. As your entire field study lies on the strength of interviewing it is worthwhile to go through the notes collected everyday and concentrate on the left out issues on the next day. You might have missed few important information which can be the first question for the next day's interview.

How to record observation?

It is a fact that none of us are good in our memory. As asked earlier, how far can you correctly say the colour dress worn by your desk mate a week back? Hence a notebook, pencil and if necessary camera and tape-recorder are the basic tools of a field researcher. One of the merits of this type of research is observing the incident in hotshot. You can either take notes as you observe or if not possible allot a few minutes in between each phase, sit and recollect and record the information. Just as you could not observe everthing you cannot record everything too. However, ensure that you have recorded the most vital information in your records. As it is a social process, a few observations can be anticipated in advance and others will become apparent as the observation progresses. Depending on the nature of the study and observation, your note taking can also be standardised and systematised. But still these advance preparations should not hamper your observation of new events and recording them. A good field researcher should also be a good note taker. A few guidelines can be followed. At first do not trust your memory and try to record as many informations as possible if you feel it is in the jurisdiction of your research focus. Second, it is always advisable to take notes at different stages. Initially you may go for rough draft or sketchy ones and later keeping the major hints, you can try to develop it in the form of essays. Third, as

discussed earlier everyone of us will be confused as what to record and what not to. Record those unimportant things separately and when you check your notes and observe in the field keep an eye on such rare incidences. Though you have collected maximum information and you find only a section is useful to your report, there is nothing to be depressed as you can be content that you did not miss any vital information. Finally, you should know the art of maintaining the notes prepared by you. At first instead of writing, it is appreciable to keep your notes in typed format in single sheets, one sided, facilitating cutting and pasting in future and file them.

Data processing

How ever much a field researcher may be efficient in observing and gathering data from the field the life of the field research lies on the processing and presentation of the data. To begin with, the researcher should not be lazy to rewrite the short sketchy notes. He should make sure that the final report includes all minor and major vital information. He should first type a comprehensive and detailed report of his field visit. The on-the-spot scribblings in the field should be neatly long handed and typed and filed.

Creating files is one of the essential tasks in preserving field notes. You should maintain a chronological record of the observations and it is always better to have multiple copies of the format so that one copy can be retained to verify the original version. This is so because you may cut and paste different sections together and finally may make a mess of the entire thing. The so gathered files can be organised in many ways. You can give a heading to different dimensions and sort it according to the theme of the research or concept-wise too. You can create an index and number the files with relevant information in brief which may facilitate locating during emergency or crucial stages of research or report writing. A bibliographical file should be created to record the key information.

Knowing the difficulties in observation and record keeping in field research, by now you would have understood that data analysis is a tough task. Observation and data analysis is interwoven in field research. To start with the processing of data a researcher should separate the collected information under the headings of similarities and dissimilarities. You should watch out for the deviant cases and take note of them separately.

As discussed earlier, the observation of empirical events, and the evaluation of theory are all part of the same ongoing process. A field researcher may develop theories or generalise understandings during the course of observation itself, in the course of which, a researcher should pay special attention to new variables and should prescribe what general principles underlie the new observations. The inherent advantage of this research is that both data collection activity and data analysis would interact often. The field researcher is at the position of modifying the design continually as and when it is necessitated. However this advantage is at the cost of observing only those things which would support the theoretical conclusions. This danger can be avoided in a number of ways. At first you can link the qualitative information with quantification. Second is the point of intersubjectivity where you can enlist the assistance of others while refining the proposed theoretical conclusions. Finally, sensitivity and awareness may provide sufficient safeguards.

Illustration

Elliot Liebow, an anthropology graduate student, was hired to work on an ongoing study of child rearing practices among low-income families in the District of Columbia. He was assigned with the task of field visit where he was expected to interview low-income adult males of a larger number. He prepared himself for the field work through a series of meetings with the project staff, learning the kinds of materials to be collected. He started his field work in one of the suggested neighbourhoods. In his course of observation he noticed a police detective scuffling with an angry black woman. The researcher approached the two blacks watching the incident and queried about the happenings. They answered very cautiously and

Liebow could understand that they were giving negative feelings about the policeman. Eventually convinced with Liebow that he was not a policeman one among the two blacks spent few hours with him. In the meantime the researcher revealed his identity as researcher at the starting point; and was cautious enough to not to feign conversion to being black. Though recognised as an outsider, the group developed a friendly approach and started interacting with him. His new friends sought his legal advice as and when they needed them and respected him a lot. There was certainly a danger of his behaviour influencing the others around. His record keeping was neat as illustrated earlier in this chapter. Ultimately he gained a personal experience of street corner life in a black neighbourhood. The peak was he could see and understand others as they saw and understood themselves. He was able to learn their views and experiences of family life and unemployment.

Strengths and Weaknesses

The depth of understanding the phenomenon is the major strength of this mode of observation. Flexibility is another merit where the researcher is helped to modify the design in the field and at times at the end too. Field research is relatively inexpensive as it never requires costly equipments and expensive staff. There are few demerits too. It is ineffective in gathering explanatory qualitative information about the large sized population. It may be because it is expensive to train and appoint observers. Its major drawback is the conclusions drawn are suggestive rather than definitive. It seldom involves uniform operational definitions as it is very flexible. The chief weaknesses of field research is from the scientific norms of generalisability and intersubjectivity.

LESSON - 5.2

OBSERVATION

DEFINITION OF OBSERVATION

Among all the methods, observation method is the oldest method which has been used as a technique of investigation by both the natural and the social scientists. In this method one collects information by directly or indirectly watching and recording the events as they go on.

Observation may be defined as "systematic viewing, coupled with consideration of the seen phenomena. That is, consideration must be given to the larger unit of activity in which the specific observed phenomena occur" (P.V. Young, 1968: 161-162).

Observation is a process of acquiring knowledge through the use of the sense organs, specifically eyes. Moser says that, "... in strict sense, observation implies the use of the eyes rather than of the ears and the voice" (C.A. Moser, 1958: 168-169).

Observation means seeing things with a purpose. Observation becomes a method when it is based on a purpose and its operational part is systematic and scientific orientation. In observation, we use our eyes and eventhough we see so many things and several events, it is not possible to retain everything. It is because that we cannot retain anything if we are not seeing them with a purpose. This fact explains the importance of 'purpose' in observation.

In this method, the observer is able to establish direct contact with the object of observation.

According to Goode and Hatt (1952:119), observation may take many forms and is at once the most primitive and the most modern of research techniques. It includes the most casual, uncontrolled experiences as well as the most exact film records of laboratory experimentation. There are

many observational techniques, and each has its uses. However, day-to-day kind of observation is unsatisfactory for any scientific investigation since the social researcher seeks reliable and objective observations from which he can draw valid inferences. In other words, scientific observation is deliberate search, carried out with care and forethought as contrasted with the casual and largely passive perceptions of every day life.

Observation does not only mean a simple way of looking at the object. The observation as a method of data collection has become a standardised tool also.

Observation is not a very simple activity: it is a purposeful action for the data collection. If it is done without prior thinking and planning, its outcome may not be very useful. Therefore, in observation, a meticulous, solid and rational planning and preparation is essential. While doing so, the observer must answer the following questions:

What to observe?

How to observe?

When to observe, and

Where to observe?

TYPES OF OBSERVATION

Observation is classified into different categories or types according to its purpose and structuredness by various scholars.

P.V. Young discusses mainly two types of observation: non-controlled and controlled observation in their participant and non-participant aspects (P.V. Young, 1968:163-185).

According to Goode and Hatt, (1952:120-130) the types of observation are: (i) The simple observation, (ii) The un-controlled observation, (iii) The participant observation, and (iv) The non-participant observation. He categorised the above types of observation into two:

a) The simple observation, which includes the un-controlled participant and non-participant, and

b) The systematic observation, includes controls over the observer and the observed.

Observational method has also been classified as follows:

i) The individual observation (if the number of objects being observed is single it is known as 'individual observation').

ii) The mass observation (if the unit of observation is a collectivity, a group or a community in action, it may be called 'mass observation'),

iii) The structured/unstructured observation, and

iv) The quasi-participant observation.

The different types of observations differ from each other in the degree of their structuredness, degree of control, degree of participation and so also the degree of their validity, reliability and objectivity.

For the sake of clarity and easy presentation, the observation method is divided into the following types or on the basis of its structure and process:

(i) Systematic, structured and controlled observation method.

(ii) Unstructured and uncontrolled observation method.

This can further be sub-divided on the basis of degree of participation by the observer in the activities of the group being observed to the following types:

a] Non-participant observation.

b] Participant observation.

c] Quasi-participant observation.

These different types of observations are discussed below in terms of their structural differences, content of observation, manner of recording, relationship between observer and the observed and the methods of increasing the accuracy of observation.

Systematic, Structured and Controlled Observation Method

This method, most commonly called as structured observation method, is one in which the observer knows in advance as to what aspects of

behaviour or activities of the people are relevant for his purpose and therefore plans the manner of observation and recording of events much before the actual data collection begins. This means that in this method the things to be observed, the steps of observation, the conditions under which the observation is to be made, the manner of recording and the items under which the observation is to be recorded, etc., are pre-fixed. These make the observation highly structured and systematised.

Since the tools of data collection (including observation schedule) are pre-structured, the observer, therefore, has to act according to the guidelines decided earlier, and not that he would decide the course of observation while in the field.

Structured observation is characterised by a careful definition of the units to be observed, information to be recorded, the selection of pertinent data for observation and standardisation of conditions of observation.

The use of structured observational techniques presupposes that the researcher knows what aspects of the situation under study are relevant to his research purposes and is in a position therefore to develop a specific plan for making and recording observations before he actually begins the collection of data. It involves immediate recording of events as the observation is being made rather than the preparation of reports of what has happened, based upon memory.

Structured observation method is used when the researcher is well-acquainted with the problem under investigation and also the population which is to be studied. Hence, he can frame and also test more precise concepts and hypotheses in it. These criteria make the structured observation method different from the un-structured observation method which is used in exploratory research in which neither the problem nor the population is known.

Being standardised method, the structured observation can be easily repeated and its limitations can be easily assessed.

In structured observation method it is easily possible to achieve structured, precise, reliable and valid data as it is easy to eliminate or avoid inclusion of observer's biases and his selective perception of the events. However, the degree of validity to be achieved in the observation method depends upon degree of its structuredness, the condition under which it is carried on, and also the efficiency of the observer.

Structured observation can be carried on either in the field situation under a natural condition or in the laboratory setting under artificial but controlled conditions. Thus, structured observations can be made under controlled as well as un-controlled natural situations.

In structured observation method, accuracy can be achieved by using precise and exact measuring instruments which measure the variables. Therefore, for achieving reliable valued data through this method, the most important step would be to develop most standardised techniques for observing and recording the events.

In many structured observations only processes of observing and recording are standardised to the possible extent but there is no control over the observed. But if the investigator knows which specific aspect of group or individual action is relevant and need to be observed, then their systematic observation becomes possible. In this way the investigator may also be able to test the specific type of hypothesis to have control over the situation and to eliminate the effect of extraneous variables.

Simple, Unstructured, Uncontrolled Observation

The observation method is said to be simple and unstructured when things to be observed are not prefixed. The observer is more or less in a free situation. He has to decide in the field at the spot of observation about the things to be observed. This gives the observer greater opportunities for decision making. Hence the success of investigation depends upon the quality of the observer i.e., his capabilities of understanding the situation and observing.

It is considered as an uncontrolled method because there is no restriction over the observer as to what to observe, how to observe, how to record and so on. Also there is no control over the observers. The observers are allowed to act or behave according to their own wishes.

Simple, unstructured and uncontrolled observation may further be subdivided into three types, on the basis of the degree of participation by the observer and on the basis of the nature of relationship between observer and the observed:

a] Non participant observation method

b] Participant observation method

c] Quasi participant observation method

Participant Observation

Participant observation is a research technique in which a researcher collects information through direct participation in and observation of a group or community under study. This method allows the researcher to examine certain behaviours and communities that could not be investigated through other research techniques.

When the observer shares to a greater or lesser degree the life of the group he is observing, it is known as "participant observation". In other words, the participant observation is an attempt to put both observer and observed on the same side by making the observer a member of the group so that he can experience what they experience and work within their frame of reference.

In participant observation a researcher becomes a member of the group being studied. In some cases, the researcher actually 'joins' a group for a period of time to get an accurate sense of how it operates. In participant observation the researcher does observations while taking part in the activities of the social group being studied.

In this method of observation, the observer enters into the realm of social life of the unit of observation. The initial challenge that the

participant observer encounters is to gain acceptance into an unfamiliar group. It. no doubt, requires a great deal of patience and an accepting type of personality.

In participant observation though the observer becomes a member of the group being observed by him, he need not carry out exactly the same activities as the subjects. Only he has to find a role in the group which will not disturb the usual patterns of behaviour.

Since the members of the group or community are unaware of the purpose of the observer, their behaviour is least likely to be affected. Thus, the observer may be in a position to record the 'natural' behaviour of the group.

Since the observer participates in the activities and the events of the group under observation, he has an access to a body of information which could not easily be obtained by non-participant observation.

Since the period of participation of the observer in the group may continue for longer duration, the range of materials collected is likely to be much wider than those gained from a series of quite lengthy interview schedules or questionnaires.

Non-participant Observation

The non-participant observation is characterised by a relative lack of participation by the observer in the life of the group that he is observing. In this sense, the non-participant observation involves the espousal by the observer of a detached role of the observer and recorder without any attempt on his part to experience through participation that which the observed do.

However, a purely non-participant observation is difficult to practise. There is no standard set of relationships or role patterns for the non-participant observer, who is the 'non-member of the group', who should be ever present but never participating.

Quasi-participant Observation

Sometimes, in the height of the field situation the observer may adopt the middle path of mixing-up some elements of participant observation and some elements of non-participant observation. Thus his mode of observation is called quasi-participant.

Quasi-participant observation, by nature, permits flexibility in its approach – as to when it is required to be formal and when it is useful to be informal.

Uncontrolled Observation

Uncontrolled observation is used both in participant and non-participant forms. In uncontrolled observation no mechanical aid is used, and the data is collected without standardising method.

Controlled Observation

In controlled observation, the controls refer to the standardisation of observational techniques and/or controls over the variables in an experimental situation. In other words, control means control on the observer, the object of observation and the process of observation.

Controlled observation as a method is not widely practised in social research because of the complex and dynamic nature of the social phenomena and social reality. The major disadvantage of controlled observation is the creation of an artificial situation where natural and spontaneous expression of behaviour is marred.

In controlled observation, the observer must give prior thinking to time factor, formalisation and stability in procedure.

ADVANTAGES OF OBSERVATION METHOD

1. In this method, the observer is not only in a position to observe the object at primary level and record even such facts, but also he can make minute inspection of the objects and events. Observation, thus, also provides an opportunity for empirical study, i.e., first hand collection of facts.

2. There is scientific precision in this method, because facts are collected in a natural setting.
3. Through this method, observer can explain the cause and effect relationship.
4. Through observational techniques it is possible to record behaviour as it occurs.
5. In this method, observer does not depend upon verbal reports or communications of those who are being observed.
6. It is independent of people's willingness to come forward to report.
7. People's verbal expression as to explain their behaviour is not required.
8. When people do not want to be asked or they refuse to be present for personal interview, observation solves this problem of resistance without any sacrifice.
9. Observational method not only ensures reliability, objectivity, verifiability but is also helpful in formulation of hypothesis.

LIMITATIONS OF OBSERVATION METHOD

1. Observation as a method can be used to study only the on-going events: neither the past nor the future events.
2. It is often impossible to anticipate the occurrence of an event precisely enough to be able to be present to observe it.
3. We cannot have any control on the duration of the event, if it is in the natural setting.
4. We cannot have access to every event.
5. We cannot reach everywhere in the social world.
6. Since most of the observational data are qualitative in nature, it is very difficult to quantify them.
7. Qualitative data, by nature, have limited scientific validity. Hence, observational data cannot be an exception.

8. There are several peculiar phenomena and some very sensible events bound to happen in the social life of a group or community, which cannot be observed as they happen.
9. Above all, there is greater possibility of bias on the part of the observer as he happens to be a member of the society himself.
10. Subjective interpretation is another pitfall of observation. The observers may misread the state of mind or social atmosphere and characterise it in terms of their own values, rather than of those who are involved.
11. The act of observation affects the person being observed, directly or indirectly. The more involved he is with his subject- matter, the more likely it is that his observations will be affected by the involvement.
12. The major problem of observation is the observer himself. He may make quite incorrect inference from observations.
13. The observer can affect the objects of observation simply by being part of the observational situation.
14. Observation method requires more time, more money and skill. Thus, this method may not be used for large scale study.
15. Observation could be distorted due to the inadequacies of our sense-organs, due to the interdependence of observation and inference, and due to the impossibility of observing human beings without influencing their actions and being influenced by them.

LESSON - 5.3

INTERVIEW

DEFINITION OF INTERVIEW

The interview technique is a verbal method of securing data. It involves presentation of oral-verbal stimuli and reply in terms of oral-verbal responses (oral-stimuli, oral-responses). The interview approach involves a person designated the interviewer asking questions (mostly) in a face-to-face contact (generally) to the other person or persons designated the interviewee(s). In simple words, interviews can be called as the process of talking in more purposive and systematic manner than our day-to-day gossipping with each other.

P.V. Young (1956:149) defines interview as "a systematic method by which a person enters more or less imaginatively into the life of a complete stranger." This definition clarifies the process. In the interview method the researcher tries to penetrate deeply in his imagination into the circumstances presented by the subject. He tries to enter into the feelings of the respondent but at the same time tries to maintain the objectivity of research while studying about the individual. By studying each individual's behaviours or actions and reactions he tries to locate the feeling, thinking or motivation of the people that guide their behaviour, actions, interactions and inter-relations.

The definition by F.N. Kerlinger (1964:469) points to the relationship between interviewer and the interviewee and the purposes of interview. To him, the interview is "a face to face inter-personal role situation in which one person, the interviewer, asks a person being interviewed, the respondent, questions designed to obtain answers pertinent to the purposes of the research problem".

Interview has two basic objectives: Discovery and measurement.

Discovery indicates gaining new knowledge, new consciousness or new insights of certain unexplored qualititative aspects of the problem which is primary objective of interview. One can interview all the members of a group, or community, or all the persons selected under sample or only some selected persons. Interview thus helps in identification of new variables and sharpening of conceptual clarity. Interview gives something more than pure statistical descriptions achieved through surveys. Interview provides us with an additional qualitative description of the people, how they feel and why they do so. It enhances the understanding of sociological nature of the facts.

Measurement is likely to be valid if the interview schedule is structured in such a way. The scheduled interview is more efficient and effective in obtaining uniform coverage, precision and reliability of measurement. Though scheduled interviews are used where measurement is the predominating objective, in several situations non-scheduled interviews may also provide more valid measurements.

FUNCTIONS OF INTERVIEW

There are two important functions that the interview performs:

a) Description, and

b) Exploration

Description

Information obtained from interviews is particularly useful in providing insights into the 'discursive' nature of social reality. Except certain types of observation, no other types of research tool performs this function. Interview data can be an extremely useful descriptive tool and more so in bringing out the interactive quality of social life.

Exploration

Another valuable function of interview is that it provides insights into various dimensions of the subject or topic under the enquiry. Survey data do not always produce the fresh, illuminating information that a research

study requires. Regardless of the particular need, whether it be the identification of new variables for study, a sharpening of conceptual clarity, or whatever, the interview can serve as a highly effective exploratory device.

Talking with people and gaining insights into their conduct from inquiries about their feelings, attitudes and beliefs may provide just the right stimulation for the development of hypotheses for subsequent testing.

TYPES OF INTERVIEW

There are mainly two types of interview: (i) structured, and (ii) unstructured. Selection of a particular type of interview to be used depends upon the nature of the problem being investigated and the type of information wanted. The different types of interviews differ from each other in their structure, process, problems and the qualities of validity and reliability.

Structured Interviews

When an interview uses a set of pre-determined questions and standardised techniques of recording it is known as 'structured interview'. In other words, structured interview method is one which is based upon structured set of questions and is, therefore, highly standardised in form or content. The standardisation of questions as well as its recording ensures that all the respondents reply to the same questions, i.e., any given question has the same meaning for all the respondents.

In the structured interview method information is collected by the investigator by directly asking the respondents on the basis of a schedule. In it not only the type of information sought, but also the specific questions to be asked, the language of the question and their order is pre-fixed. Therefore the interviewer does not have the freedom to ask extra questions. He can only, from time to time, make use of probe questions and thus encourage the respondents to answer the questions. Here the interviewer's job is to see that the respondents answer the questions systematically and clearly. Interviewer can clarify the questions to the respondents only by

repeatedly reading out the questions or interpreting them in understandable language.

Thus, the interviewer in a structured interview follows a rigid procedure laid down, asking questions in a form and order prescribed.

Different types of questions are used in structured interviews, like the fixed alternative type and the open-ended questions. The fixed alternative questions or 'close-ended questions' are those in which the answers are limited to either in the form of Yes/No alternatives or in the form of categorical answers. Open-ended questions are those in which the respondents are free to give answers in their own language.

The set of questions used in the structured interview method may be any of the above types or a mixture of them. The types of questions used determine the structuredness of the interview method. Structured interview method is used when data is to be collected from a large number of persons. It helps in systematic collection, comparison, organisation and analysis of data within a limited time period. Thus, comparability is lost if questions are not asked in the same language and in the same order to all the respondents. Even simple change in the language makes the same study quite different. Similarly change in the order of questions also create different amount of emphasis on different questions and hence the answers are not comparable. It is better to use open-ended questions, wherever possible, because respondents are likely to give answers more freely according to their real attitude. Moreover, they are not indirectly compelled to place themselves in any one of the given categories.

Advantages of Structured Interview:

1. It ensures uniformity and comparability of interview-records, which facilitate bringing these different records into a single conceptual scheme, and thus affording a safe basis for generalisation.
2. It is more economical as it can cover large number of the respondents.
3. It demands lesser skills of the interviewer.

Unstructured Interviews

Unstructured interviews, as opposed to the structured ones, are characterised by greater flexibility of approach to questioning the respondents. It does not follow a system of pre-determined questions and standardised techniques of recording information. The interviewer is allowed greater freedom to put supplementary questions in case of need and at times he may even omit certain questions if the situation so requires. He may change the sequence of questions as well. Likewise, he has greater freedom while recording the responses to include some aspects and exclude others.

As interviewers do not follow a list of pre-determined questions, respondents are encouraged to relate freely and frankly their experience with little or no direction from the interviewer. The respondents are allowed the freedom to talk on whatever events seem significant to them, to provide their own definitions of the social situation, report their own foci of attention and reveal their attitudes and opinions as they deem fit.

The flexibility of the unstructured interview helps bring out the effective and value-laden aspects of the subject's responses and to determine the personal significance of his attitudes. Such interviews permit a free-flowing account of the personal and social contexts of beliefs and feelings. This type of interview achieves its purpose to the extent subject's responses are spontaneous rather than forced, specific, concrete and self-revealing.

Thus, in a non-structured interview, the interviewer has the freedom to ask supplementary questions, omit certain questions, change the sequence of questions and offer explanations and clarifications. He has freedom to record the responses according to his own frame of judging significance, relevance, and convenience. He is free to include some aspects and exclude others from his record, highlight certain responses and ignore others.

However, analysis of the unstructured responses becomes difficult and time-consuming compared to the structured responses. Unstructured

interviews demand deep knowledge and skill on the part of the interviewer. Collection of data by the unstructured interview is inevitably slow and hence, only a small sample can be normally expected to be covered. Because of the unrestricted range of subjects on which the respondents may desire to discuss, it is very difficult to articulate the recorded responses of different interviews into a single scheme.

1. Unstructured interviews facilitate a free and uninhibited response from the respondents.
2. It facilitates for intensive study which in turn helps to measure the values and experiences that determine the individual's attitudes.
3. The type of information that one cannot get through standardised structured interview is gained through this method.

Types of Unstructured Interview

The less structured or unstructured interviews include mainly non-directed interview, the focussed interview and the clinical interview methods. These interview techniques are more or less related and do resemble each other. These are similar in the sense that the respondents are free to choose the topics to be discussed and can discuss them in their own way they like. In these methods, the interviewer is able to develop his own understanding of the issues. Therefore these interview methods are called as 'formative interview methods'.

The major types of unstructured and partially structured interview are:

Focussed Interview: This type of interview focusses attention on the given experience of the respondent and its effects. The interviewer knows in advance the aspects of the subject he has to cover. The list of aspects may be derived either from formulation of the research-problem or from hypothesis or from theory or from his knowledge of the situation or from his personal experience. Thus, the interviewer not only has a definite framework of topics to be covered, but also the freedom to decide the manner and the sequence in which the questions are to be asked. In such

interviews, although the respondent is free to express completely his own line of thought, the direction of the interview is mainly in the hands of the interviewer. As the interviewer needs a definite type of information, his task is to make the respondent to confine to the issues under discussion.

Focussed interviews have been used mainly in the development of hypotheses.

Clinical Interview: This type of interview is quite similar to the focussed interview, yet the primary difference between them is that the clinical interview is concerned with broad underlying feelings or motivations or with the course of individual's life experience, rather than with the effects of the specific experience, as in the focussed interview.

Non-Directive Interview: In the non-directive interview, the initiative is more or less completely in the hands of the respondent. In the non-directive interview, although the interviewer is expected to ask questions about the given topics, he is not supposed to bias or direct the respondent to one rather than another response. In such interview, the interviewer's role is to encourage the respondent to talk about the given topic with the bare minimum of direct questioning or guidance. The interviewer's function is to serve as a catalyst to a comprehensive expression of the subject's feelings, and beliefs take on personal significance. To achieve this result, the interviewer must create a completely permissive atmosphere in which the subject is free to express himself without fear of disapproval, admonition and advice from the interviewer.

Despite the variations in interview-techniques, the interview method has the following major advantages and limitations:

ADVANTAGES OF INTERVIEW

1. There are some kind of information which are virtually impossible to be obtained by any other means. For example, information about a person's past experiences, his reactions to such experiences, his anticipated future behaviour, and a report of his thoughts while carrying out an

activity, can be obtained only by asking a verbal report from the persons concerned. Also, where the intention is to study perceptions or attitudes then asking persons to describe what they see and how they feel is the only possible way to obtain the information.

2. Interview is a direct method. As long as the researcher is assured that the respondents do not distort their description of attitudes and perceptions, the interview method is the most simple, direct and valid approach to use. It avoids difficulties and disagreements which occur in an attempt to infer the attitudes and the perceptions from the behaviour through observation.

3. The interviewer can modify the situation whenever necessary. He can clear up a misunderstanding about a question and keep the respondent on the track of providing only essential information. Also the interviewer can note special happenings and pick up clues which might prove to be highly valuable in interpreting the results and for future studies.

4. The personal interview, compared to questionnaires, usually yield a high percentage of returns.

5. Unlike the questionnaire approach, interview method can cover almost all the selected samples.

6. The information secured through interviews is likely to be more correct compared to other techniques. It is possible because the interviewer who is present on the spot can clear up the seemingly inaccurate or irrelevant answers by explaining the questions to the informant. If the informant deliberately falsifies replies, the interviewer is able to effectively check them and use special devices to verify the replies.

7. The interviewer can collect supplementary information about the informant's personal characteristics and environment which is often of great value in interpreting results. Interview is a much more flexible approach, allowing for posing of new questions or check-questions if need be. Its flexibility makes the interview a superior technique for the exploration of

areas where there is little basis for knowing what questions to ask and how to formulate them.

8. In as much as the interviewer is present on the spot, he can observe the facial expressions and gestures etc., of the informants as also the existing pressures obtaining in the interview-situation. The facility of such observation helps the interviewer to evaluate the meaning of the verbal replies given by informants.

9. Scoring and test-devices can be used, since the interviewer acts as experimenter. At the same time, visual stmuli to which the informant may react can be presented.

10. The use of interview method ensures greater number of usable returns compared to other methods. Returned visits to complete items on the schedule or to correct mistakes can usually be made without annoying the informant.

11. The interviewer can usually control which person or persons will answer the questions. If necessary, group discussions may also be held.

12. A personal interview may take long enough to allow the informant to become oriented to the topic under investigation. Thus, recall of relevant information is facilitated. The informant can be made to devote more time of, as is the case, the interviewer is present on the spot to elicit and record the information. The interviewer's presence is a double-headed weapon, the advantageous aspect of it being that face-to-face contact provides enough stimulation to the respondent to probe deeper within himself.

13. The interviewer may catch the informant off-guard and thus secure the most spontaneous reactions than would be the case if mailed questionnaire were used.

14. The interview method allows for many facilities which aid on-the-spot adjustments and thus ensure rich material. The interviewer can carefully sandwich the questions about which the informant is likely to be

sensitive. The interviewer can also change the subject by observing informant's reactions or give explanations if the interviewee needs them. In other words, a delicate situation can usually be handled more effectively by personal interview method.

15. The language of the interview can be adapted to the ability or educational level of the person interviewed. Therefore, it is comparatively easy to avoid misinterpretations or misleading questions.

16. The interview is a more appropriate technique for revealing information about complex, emotionally-laden subjects or for probing the sentiments underlying an expressed opinion.

LIMITATIONS OF INTERVIEW

1. Interview method demands more cost, energy and time. The transportation cost and the time required to cover addresses in a large area and the possibility of non-availability or 'not at home', respondents may make the interview method uneconomical and often inoperable.

2. The efficacy of interviews depends on the selection, training, skill and supervision of the interviewers, failing this, data collected may be inaccurate and incomplete.

3. The human equation may distort the returns. If an interviewer has a certain bias, he may unconsciously devise questions so as to secure confirmation of his views.

4. The presence of the interviewer on the spot may overstimulate the respondent, sometimes even to the extent that he may give imaginary information just to make it interesting. He may tell things about which he may not himself be very sure. He may get emotionally involved with the interviewer and give answers that he anticipates would please the interviewer.

5. It is also possible that the interviewer's presence may inhibit free responses because there is no anonymity. The respondent may hesitate to

give correct answers for the fear that it would adversely affect his image or may be used against him.

6. The personal interview usually takes more time: sometimes, the interview lasts for hours and at the end the interviewer may not check the free-flow of the respondent's replies for fear that it may disrupt the 'rapport.' The time spent for journey to and fro to the addresses and the possibility of not always being able to meet them is another difficulty.

7. Effective interview presupposes proper rapport with the respondent and controlling of the interview-atmosphere in a manner that would facilitate free and frank responses. This is often a very difficult requirement: it is not always possible for the interviewer to judge whether the interview-atmosphere is how it should ideally be and whether or not 'rapport' has been established.

8. Many actions of human beings are not easily verbalised, but easily observed.

It is worth remembering the comment made by G.W. Allport, while speaking about the uses of interviewing: "If we want to know how people feel, what they experience and what they remember, what their motives and emotions are like and the reasons for acting as they do, why not ask them?"

Conclusion

Interviews are extremely powerful research tool when used appropriately. More than any other method, the interview capitalizes on the most natural form of social communication – verbalising. As a result, once requisite skills have been mastered, interviewing is easily adapted to by almost any investigator.

However, questions of time and money plus the possibility of a rather low yield of useful scientific information relative to these investments force many researchers to opt for other methods.

LESSON - 5.4

QUESTIONNAIRE

DEFINITION OF QUESTIONNAIRE

By questionnaire we mean a set of questions developed in an organised and ordered manner for gaining information from the people in relation to a given problem.

A questionnaire, thus, consists of a number of questions printed (or typed) in a definite order or form (or set of forms). The respondents are expected to read and understand the questions and reply to them in writing in the relevant spaces provided for the purpose in the said forms. Ideally, the respondent has to answer the questions on his own, i.e., unaided by the investigator.

The questionnaire affords great facilities in collecting data from large, diverse and widely-scattered groups of people. It is used in gathering objective, quantitative data as well as for securing information of a qualitative nature. Needless to say, the questionnaire will obtain only the information or data that the respondent is willing and able to report.

ADVANTAGES OF QUESTIONNAIRE

1. Since the questionnaire contains specific, clear-cut directions, the investigator need not offer additional explanations. The questionnaire technique does not call for any special skills or training on the part of investigators in the field.

2. As the questionnaire approach makes it possible to cover, at the same time, a large number of people spread over a vast territory, it is more economical in terms of money, time and energy.

3. The questionnaire, by its very nature, is an impersonal technique. Uniformity from one measurement situation to another is provided by virtue

of its standardised wordings of questions, standardised sequence of questions and fixed or standardised instructions for recording responses.

4. It ensures anonymity. The respondents have a greater confidence that they will not be identified as holding a particular view or opinion

5. The questionnaire places less pressure on the respondents for immediate response. The respondent, given ample time can consider each point carefully before actually putting his reply in writing. If there is some kind of pressure for time, he may reply with the first thought that comes to his mind.

LIMITATIONS OF QUESTIONNAIRE

1. It can be administered only on the people with a considerable amount of education. Even among the highly educated persons very few have the motivation and the patience to write as much as they might speak out. Thus, questionnaires are hardly appropriate for a large section of population.

2. In a mailed questionnaire, the proportion of returns is usually low. Among the factors that may affect the returns are the sponsoring agency, the attractiveness of the questionnaire, its length, nature of the accompanying appeal, the ease of filling out the questionnaire and of mailing it back, inducements for replying and the kind of people to whom questionnaire is sent, etc. Even under the best of circumstance, a considerable proportion does not return the questionnaire.

3. In a questionnaire, if the respondent misinterprets a question or writes his reply unintelligibly, there is very little that can be done to correct this. In this approach there is no facility for repeating questions, explaining them or seeking clarification of a particular response.

4. In questionnaire approach, the validity of respondents' replies can hardly be appraised. The researcher is in no position to observe the gestures and expressions of the respondents. He cannot follow-up the inconsistencies or contradictions in the replies.

5. The usefulness of the questionnaire is restricted to issues on which the respondents have more or less crystallised views that can be simply expressed in words.

6. The success of the questionnaire approach depends upon the sense of responsibility among the subjects.

7. The researcher is not in a position to vary the stimuli or social atmosphere impinging upon the subjects according to his designs.

TYPES OF QUESTIONNAIRE

Questionnaire can be divided into three types on the basis of the type of response required. Response may be:

(a) Fixed or closed type

(b) Open-end type, and

(c) Mixture of both (a) and (b).

Fixed or Closed Response

In this type of questionnaire not only the questions but also the answers are given. The respondent will be asked to check the answer that fits him best. The fixed or closed type of questions can again be sub-divided depending upon the number of alternative answers given, into:

(i) Dichotomous alternative type (when reply to a question is to be given in terms of any one of the two alternatives, the question is called dichotomous. Here the respondent has to select any one of the two alternatives to which he agrees or which is applicable to him).

(ii) Multiple choice type (in this type the reply is not confined to two alternatives only but several possible replies are given from which the respondent selects one).

(iii) Rank order type (in this type the respondent has to rank his replies in order of preference among the number of alternatives. Here the respondents are asked to rank their answers in the order of their preference).

Use of fixed alternative questionnaire depends upon the degree of the researcher's knowledge of the people in the sample, upon the people's knowledge of the subject matter under investigation, and upon the assumption that the people would be capable of reflecting their mind to the stated questions.

Advantages:

1. Fixed-response items are easy to reply, to score and to code.
2. No writing is required on the part of the respondent which quickens the process of answering.
3. It is more useful to the respondents who cannot adequately express themselves verbally.
4. In case of mailed questionnaire, percentage of return is more when the questionnaire consists mainly of fixed alternative responses.

Limitation: It may not be possible to provide all relevant response alternatives. As a result, the respondents are often forced to make a choice among alternatives that do not fit them well.

Open-End Response: This type consists of questions written in specific language and respondents are free to give answers in their own words.

Advantages:

1. It is useful when the researcher has little knowledge on the subject matter.
2. It is useful for a detailed and deep study which will also provide insights into the subject matter.
3. Respondent is less restricted or is not forced to reply in terms of any of the given choices.

Limitations:

1. It involves difficulties of coding, classification and comparison of the responses.
2. Unwanted and unsolicited information may forthcome without being useful to the researcher for the particular problem.

Mixed Type Response

This type of questionnaire will consist of both fixed and open ended type of questions. This is by far the most useful type of questionnaire which provides the opportunity for the researcher to judiciously mix and get answers from the respondents. For certain questions where long and detailed answers are required, the question can be open-ended. For the rest of the routine details like demographic and psychographic profiles of the respondents the questions can be closed with forced choices. Because of its manifold advantages, most of the questionnaires are of this type of mixed response category.

CONSTRUCTION OF THE QUESTIONNAIRE

Construction of questionnaire is a difficult task. It has various steps and procedures to be considered in the questionnaire construction. Both the self-administered and mailed questionnaire require almost same steps in their construction. The following are the important steps in this process:

a) Examining the conceptual model

b) Framing of standardised questions

c) Pilot study or pre-test

d) Administration of questionnaire

Examining the Conceptual Model

It is done through literature survey, exploratory interviews and analysis. This is done for explaining the model and for locating the relevant variables. When the variables are not known and properly defined, it becomes difficult to decide as to what information is to be sought.

Framing of Questionnaire

In framing of a questionnaire the following considerations should be kept in mind:

1. Form of questions and answers: At the outset one has to decide about the general strategy of the questionnaire in terms of whether they are to be structured or unstructured, direct, indirect or projective questions in

achieve the objectives of the study. Then the form of each questio... be decided whether that should be open or closed, loaded o... ...aded, be single or be in sets, direct or indirect. Similarly structur... of answers or form of response has to be decided in terms of whether th... be dichotomous, multiple choice, scaled, short answers (limited to a w... or two) or of open-end type. The form or structure of the questionna... depends upon the nature of quality of information wanted and the type of the respondents.

2. Wording of the questions: Questions should be framed in the language of the respondents so that they are easily understandable ...only the words which carry same meaning to every person should b... ...ambiguous or loaded words and long questions should be avoided ... are difficult to follow, and, yield biased answers.

3. Level of informations: There is likelihood ...t the respondent w... actually does not know much about the subject und... investigation, m... pretend to know and provide information. This can be checked by using ...robe questions.

4. Specifying the questions: Specifying the questions in terms of time and place of the occurrence of an event helps in avoiding the bias that results from loss of memory.

5. Predisposing the answer: Frame of the question should suggest all possible alternatives for the respondent so that the respondent can select the category which represents his views to the nearest extent and does not select answers suggested by the investigator.

6. Protecting the respondent's ego: If one wants to study the respondent's unpleasant orientations or his negative attitudes, he should start with the questions that give the respondent a chance of expressing his positive feelings first: thereafter only the respondent should be asked to express his negative attitude or feeling.

7. Asking direct/inairect questions: Respondents may consciously or unconsciously give wrong or incomplete answers. Therefore both direct and indirect questions should be asked.

8. Sequence of questions: The questions are to be put in a particular sequence so that they do not hurt or discourage the respondent to give accurate answers. Thus one should start with more general and easy questions followed by specific, personal and intimate questions.

9. Categories for recording and coding: The categories to be used for recording and classification of answers have to be determined in advance. Use of closed answers saves time and also reduces mechanical errors of precoding the answers.

PILOT STUDY OR PRE-TEST

After the drafting of the questionnaire it is pretested through what is called a pilot study. The object of pilot survey is to make the questionnaire finalised to ensure its content, form, sequence of questions, spacing, arrangements and appearence etc., of the questions, and to make the questionnaire easily understandable, to eliminate misunderstanding, confusion and bias.

PRINTING OF THE QUESTIONNAIRE

While printing the questionnaire the following aspects are to be considered:

i) The physical format must be attractive and unambiguous.

ii) The sponsoring agency and the statement of purpose of the study must be clearaly mentioned.

iii) There must be some inducement for the respondent to co-operate.

iv) The guarantee of anonymity must be clearly specified.

v) The setup of questions and answer spaces must be very clear and consistent, with explicit instructions on how to answer.

vi) The entire form should be attractive and realistically spaced so as to maintain interest and minimise boredom.

ADMINISTRATION OF THE QUESTIONNAIRE

The researcher needs to make preparation for its application, depending upon the method of administering the questionnaire. The different methods of administering the questionnaire are:

i) Interview method

ii) Distribution method

iii) Postal delivery method

The Interview Method

This method has the advantage of depth of study with a very low probability of the respondent giving incorrect or inadquate answers due to misunderstanding of the questions.

Distribution Method

This method consists of distributing the questionnaire to the respondents at their place. The completed questionnaires are collected by the investigator later on. This method has the advantage that the respondent can fill-in the questionnaire in privacy without the fear of replies being overheard. The greatest disadvantage is that since the questionnaires are self- administered, there is the risk that the respondent may willingly or unwillingly provide the informations.

Postal Delivery Method

This method, often called as mailed questionnaire method, constitutes in distributing the questions through postal delivery along with a letter of request for postal return in prepaid envelopes. Then a follow-up letter is sent for return of the questionnaire.

The disadvantage of this method is that it is not so useful with the respondents of low level of education. Moreover, it has a very low percentage of return. It is also difficult to judge whether the questionnaire was completed by the particular respondent or by somebody else for him. The possibility of misinterpretation of questions by the respondents is always there. Respondents may not like to reply the questions which are highly

personal, private or sensitive. The main advantage of this method is the speed of its distribution besides the privacy in which the questionnaire is filled in. Moreover, it requires low cost to administer, as the cost of appointing and training of interviewers and of travelling is avoided.

THE CHARACTERISTICS OF A STRUCTURED QUESTIONNAIRE

Structured questionnaires are those in which there are definite, concrete and pre-ordained questions with additional questions limited to those necessary to clarify inadequate answers or to elicit more detailed responses. The questions are presented with exactly the same wording, and in the same order to all the respondents. The reason for standardisation is to ensure that all the respondents are replying to the same set of questions. The form of the question may be either closed (i.e., categorical) or open (i.e., inviting free response); and they are stated in advance, not constructed during the questioning.

A standardised questionnaire, therefore, presents questions for its administration in any of these two formats or both. In its 'close-ended format' it presents fixed alternative answer to questions (in which the responses are limited to the stated alternatives, like Yes or No) so that the respondent can just choose the appropriate one. On the other hand, in its 'open-ended format' it presents questions which the respondent is free to answer in his own words, i.e., the respondent is given the opportunity to answer in his own terms and in his own frame of reference.

The fixed, alternative or closed questions have the advantages of being 'standardisable', simple to administer, quick and relatively easy to analyse in comparison with the open questions. Respondents are more likely to understand the question when the alternative replies are provided. The alternative responses also clarify the dimensions along which answers are sought. The closed question requires the respondent himself to make a judgement about his attitude rather than leaving this to the interviewer or coder. Closed questions are more efficient where the possible alternative replies are known, limited in number and clear-cut. Thus, they are

appropriate in securing factual information and in eliciting opinions on matters on which people hold clear opinions. Closed questions have the advantage of focussing the respondent's attention precisely on the dimensions with which the investigator is concerned.

One of the major drawbacks of the closed question is that it may force a statement of opinion on an issue about which the respondent does not in fact have any opinion. On many issues, many individuals may not have any clearly-formulated or crystallised opinions. In such cases the closed questions are ill-equipped to reveal these. Although the wording of questions is the same for all respondents, different respondents are likely to make different interpretations, some of which may be quite different from those intended by the researcher. Closed questions do not provide information about respondent's own formulation of the issue, the frame of reference in which he perceives it, the factors that are important for him and motivations that underlie his opinions. When these matters are the focus of interest, open-ended questions are mostly warranted.

Open-ended questions are desirable when the issue is complex, when the relevant dimensions are hazy, or when the interest of the researcher is in the exploration of a process.