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Lesson No.: **1**	

INTRODUCTION TO RESEARCH METHODOLOGY

STRUCTURE

1.0 OBJECTIVES

After reading this lesson you should be able to-

- Describe what research is and how is it defined;
- Distinguish between applied and basic research;
- Explain why managers should know about research;
- Discuss what managers should and should not do in order to interact most effectively with researchers;

- Discuss what research means to you and describe how you, as manager, might apply the knowledge gained about research; and
- Discuss advantages and disadvantages of internal and external researchers.

1.1 INTRODUCTION

Just close your eyes for a minute and utter the word research to yourself. What kinds of images does this word conjure up for you? Do you visualize a lab with scientists at work Bunsen burners and test tubes, or an Einstein-like character writing dissertations on some complex subject, or someone collecting data to study the impact of a newly introduced day-care system on the morale of employees? Most certainly, all these image do represent different aspects of research. Research is simply the process of finding solutions to a problem after a thorough study and analysis of the situational factors. Managers in organizations constantly engage themselves in studying and analyzing issues and hence are involved in some form of research activity as they make decisions at the workplace. As is well known, sometimes managers make good decisions and the problem gets solved, sometimes they make poor decisions and the problem persists, and on occasions they make such colossal blunders that the organization gets stuck in the mire. The difference between making good decision and committing blunders lies in how managers go about the decision-making process. In other words, good decision making fetches a "yes" answer to the following questions: Do managers identify where exactly the problem lies, do they correctly recognize the relevant factors in the situation needing investigation, do they know what types of information are to be gathered and how, do they know how to make use of the information so collected and draw appropriate conclusions to make the right decisions, and finally, do they know how to implement the results of this process to solve the problem?

This is the essence of research and to be a successful manager it is important for you to know how to go about making the right decisions by being knowledgeable about the various steps involved in finding solutions to problematic issues. This is what this book is all about.

1.2 SCOPE OF BUSINESS RESEARCH

The scope of business research is limited by one's definition of "business". Certainly research in the production, finance, marketing, or management areas of a for-profit corporation is within the scope of business research. A broader definition of business, however, includes not-for-profit organizations, such as the American Heart Association, the Sac Diego Zoo, and the Boston Pops Orchestra, Each of these organizations exists to satisfy social needs, and they require business skills to produce and distribute the services that people want. Business research may be conducted by organizations that are not business organizations. The reserve bank of India, for example, performs many functions that are similar, if not identical, to those of business organizations. Reserve bank economists may use research techniques for evaluative purposes much the same way as managers at Reliance or Ford. The term business research is utilized because all its techniques are applicable to business settings.

Business research covers a wide range of phenomena. For managers the purpose of research is to fulfill their need for knowledge of the organization, the market, the economy, or another area of uncertainty. A financial manager may ask, "Will the environment for long-term financing be better two years from now?" A personnel manager may ask, "What kind of training is necessary for production employees?" or "What is the reason for the company's high turnover?" A marketing manager may ask, "How can I monitor my sales in retail trade activities?"

1.3 BUSINESS RESEARCH DEFINED

The task of business research is to generate accurate information for use in decision making as we say above, the emphasis of business research is on shifting decision makers from intuitive information gathering to systematic and objective investigation. Business research is defined as the systematic and objective process of gathering, recording, and analyzing data for aid in making business decisions.

This definition suggests, first, that research information is neither intuitive nor haphazardly gathered. Literally, research (re-search) means to "search again". It connotes patient study and scientific investigation wherein the researcher takes another, more careful look at data to discover all that can be known about the subject of study.

Second, if the information generated or data collected and analyzed are to be accurate, the business researcher must be objective. The need for objectivity was cleverly stated by the nineteenth-century American humorist Artemus Ward, who said, "It ain't the things we don't know that gets us in trouble. It's the things we know that ain't so". Thus the role of the researcher is to be detached and impersonal, rather than biased in an attempt to prove preconceived ideas. If bias enters the research process, the value of the data is considerably reduced.

A developer who owned a large area of land on which he wished to build a high-prestige shopping center wanted a research report to demonstrate to prospective retailers that there was a large market potential for such a center. Because he conducted his survey exclusively in an elite neighbourhood, not surprisingly his findings showed that a large percentage of respondents wanted a "high-prestige" shopping center. Results of this kind are misleading, of course, and should be disregarded. If the user of such findings discovers how they were obtained, the developer loses credibility. If the user is ignorant of the bias in the design and unaware that the researchers were not impartial, his decision may have consequences more adverse than if he had made it strictly on intuition. The importance of objectivity cannot be overemphasized. Without objectivity, research is valueless.

Third, the above definition of business research points out that its objective is to facilitate the managerial decision process for all aspects of business: finance, marketing, personnel, The definition is not problem-solving and decision-making activities, business research generates and provides the necessary information upon which to base decisions. By reducing the uncertainty of decisions, it reduces the risk of making wrong decisions. However, research should be an aid to managerial judgement, not a substitute for it. There is more to management than research. Applying research remains a managerial art.

1.4 BASIC RESEARCH AND APPLIED RESEARCH

One reason for conducting research is to develop and evaluate concepts and theories. Basic- or pure-research attempts to expand the limits of knowledge. It does not directly involve the solution to a particular, pragmatic problem, but it had been said, “There is nothing so practical as a good theory.” Although this statement is true in the long run, basic research findings generally cannot be immediately implemented. Basic research is conducted to verify the acceptability of a given theory or to know more about a certain concept.

For example, consider this basic research conducted by a university. Academic researchers investigated whether or not an individual’s perception that he or she was doing well on a task would have any influence on future performance. Two nearly identical groups of adults were given ten puzzles to solve. All of the individuals had identical sets of puzzles to solve. After the subjects had given their solutions to the researchers, they were told “how well” they did on the test. All of the persons in the first group were told that they had done well (70 percent correct regardless of the actual percent correct. The members of the other group were told that they had done poorly (30 percent correct). Then both groups were given another set of ten puzzles. The group that had been told they had done well on the first set of puzzles performed better with the second set of puzzles than did the group that had been told they had been relatively unsuccessful with the first puzzle solving. The results of this basic research expand scientific knowledge about theories of general performance behaviour. This study was conducted because the researchers thought the theory being tested was far-reaching and applicable to a broad range of situations and circumstances.

Applied research is conducted when a decision must be made about a specific real-life problem. Applied research encompasses those studies undertaken to answer questions about specific problems or to make decisions about a particular course of action or policy. For example, an organization contemplating a paperless office and a networking system for the company's personal computers may conduct research to learn the amount of time its employees spend at personal computer in an average week.

The procedures and techniques utilized by basic and applied researchers do not differ substantially. Both employ the scientific method to answer the questions at hand. Broadly characterized, the scientific method refers to techniques and procedures that help the researcher to know and understand business phenomena. The scientific method requires systematic analysis and logical interpretation of empirical evidence (facts from observation or experimentation) to confirm or disprove prior conceptions. In basic research, first testing these prior conceptions or hypotheses and then making inferences and conclusions about the phenomena leads to the establishment of general laws about the phenomena.

Use of the scientific method in applied research assures objectivity in gathering facts and testing creative ideas for alternative business strategies. The essence of research, whether basic or applied, lies in the scientific method, and much of this book deals with scientific methodology. The difference in the techniques of basic and applied research is largely a matter of degree rather than substance.

1.5 MANAGERIAL VALUE OF BUSINESS RESEARCH

We have argued that research facilitates effective management. At the Ford Motor Company a marketing manager stated, "Research is fundamental to everything we do, so much so that we hardly make any significant decision without the benefit of some kind of market research. The risks are too big." Managers in other functional areas have similar beliefs about research in their specialties.

The prime managerial value of business research is that it reduces uncertainty by providing information that improves the decision-making process. The decision making process associated with the development and implementation of a strategy involves three interrelated stages.

1. Identifying problems or opportunities
2. Selecting and implementing a course of action
3. Evaluating the course of action

Business research, by supplying managers with pertinent information, may play an important role by reducing managerial uncertainty in each of these stages.

Identifying Problems or Opportunities

Before any strategy can be developed, an organization must determine where it wants to go and how it will get there. Business research can help managers plan strategies by determining the nature of situations by identifying the existence of problems or opportunities present in the organization.

Business research may be used as a diagnostic activity to provide information about what is occurring within an organization or in its environment. The mere description of some social or economic activity may familiarize managers with organizational and environmental occurrences and help them understand a situation. For example, the description of the dividend history of stocks in an industry may point to an attractive investment opportunity.

Information supplied by business research may also indicate problems. For example, employee interviews undertaken to delineate the dimensions of an airline reservation clerk's job may reveal that reservation clerks emphasize competence in issuing tickets over courtesy and friendliness in customer contact. Once business research indicates a problem, managers may feel that the alternatives are clear enough to make a decision based on experience or intuition, or they may decide that more business research is needed to generate additional information for a better understanding of the situation.

Whether an organization recognizes a problem or gains insight into a potential opportunity, an important aspect of business research is its provision of information that identifies or clarifies alternative courses of action.

Selecting and implementing a course of action

After the alternative courses of action have been identified, business research is often conducted to obtain specific information that will aid in evaluating the alternatives and in selecting the best course of action. For example, suppose a facsimile (fax) machine manufacturer must decide to build a factory either in Japan or in Sough Korea. In such a case, business research can be designed to supply the exact information necessary to determine which course of action is best of the organization.

Opportunities may be evaluated through the use of various performance criteria. For example, estimates of market potential allow managers to evaluate the revenue that will be generated by each of the possible opportunities. A good forecast supplied by business researchers is among the most useful pieces of planning information a manager can have. Of course, complete accuracy in forecasting the future is not possible because change is constantly occurring in the business environment. Nevertheless, objective information generated by business research to forecast environmental occurrences may be the foundation for selecting a particular course of action.

Clearly, the best plan is likely to result in failure if it is not properly implemented. Business research may be conducted with the people who will be affected by a pending decision to indicate the specific tactics required to implement that course of action.

Evaluating course of action

After a course of action has been implemented, business research may serve as a tool to inform managers whether planned activities were properly executed and whether they accomplished what they were expected to accomplish. In other words, business research may be conducted to provide feedback for evaluation and control of strategies and tactics.

Evaluation research is the formal, objective measurement and appraisal of the extent to which a given action, activity, or program has achieved its objectives. In addition to measuring the extent to which completed programs achieved their objectives or to which continuing programs are presently performing as projected, evaluation research may provide information about the major factor influencing the observed performance levels.

In addition to business organization, nonprofit organization, such as agencies of the federal government, frequently conduct evaluation research. It is estimated that every year more than, 1,000 federal evaluation studies are undertaken to systematically assess the effects of public programs. For example, the General Accounting Office has been responsible for measuring outcomes of the Employment Opportunity Act, the Head Start program, and the Job Corps program.

Performance-monitoring research is a term used to describe a specific type of evaluation research that regularly, perhaps, routinely, provides feedback for the evaluation and control of recurring business activity. For example, most firms continuously monitor wholesale and retail activity to ensure early detection of sales declines and other anomalies. In the grocery and retail drug industries, sales research may use the universal product code (UPC) for packages, together with computerized cash registers and electronic scanners at checkout counters, to provide valuable market share information to store and brand managers interested in the retail sales volume of specific product.

United Airlines' Omnibus in-flight surveys provide a good example of performance monitoring research. United routinely selects sample flights and administers questionnaire about in-flight service, food and other aspects of air travel. The Omnibus survey is conducted quarterly to determine who is flying and for what reasons. It enables United to track demographic changes and to monitor customer ratings of its services on a continuing basis, allowing the airline to gather vast amounts of information at low cost. The information relating to customer reaction to services can be compared over time. For example, suppose United decided to change its menu for in-flight meals. The results of the Omnibus survey might indicate that shortly after the menu changed, the customers' rating of the airline's food declined. Such information would be extremely valuable, as it would allow management to quickly spot similar trends among passengers in other aspects of air travel, such as airport lounges, gate-line waits, or cabin cleanliness, Thus managerial action to remedy problems could be rapidly taken.

When analysis of performance indicated that all is not going as planned, business research may be required to explain why something "went wrong." Detailed information about specific mistakes or failures is frequently sought. If a general problem area is identified, breaking down industry sales volume and a firm's sales volume into different geographic areas may provide an explanation of specific problems, and exploring these problems in greater depth may indicate which managerial judgments were erroneous.

1.6 WHEN IS BUSINESS RESEARCH NEEDED?

A manager faced with two or more possible courses of action faces the initial decision of whether or not research should be conducted. The determination of the need for research centers on (1) time constraints, (2) the availability of data, (3) the nature of the decision that must be made, and (4) the value of the business research information in relation to its costs.

Time constraints

Systematically conducting research takes time. In many instances management concludes that because a decision must be made immediately, there will be no time for research. As a consequence, decisions are sometimes made without adequate information or thorough understanding of the situation. Although not ideal, sometimes the urgency of a situation precludes the use of research.

Availability of data

Frequently managers already possess enough information to make a sound decision without business research. When there is an absence of adequate information, however, research must be considered. Managers must ask themselves, "Will the research provide the information needed to answer the basic questions about this decision?" If the data cannot be made available, research cannot be conducted. For example, prior to 1980 the people's republic of China had never conducted a population census. Organizations engaged in international business often find that data about business activity or population characteristics, found in abundance when investigating the United States, are nonexistent or sparse when the geographic area of interest is an underdeveloped country. Further, if a potential source of data exists, managers will want to know how much it costs to obtain those data.

Nature of the decision

The value of business research will depend on the nature of the managerial decision to be made. A routine tactical decision that does not require a substantial investment may not seem to warrant a substantial expenditure for business research. For example, a computer software company must update its operator's instruction manual when minor product modifications are made. The cost of determining the proper wording for the updated manual is likely to be too high for such a minor decision. The nature of such a decision is not totally independent from the next issue to be considered: the benefits versus the costs of the research. However, in general the more strategically or tactically important the decision, the more likely that research will be conducted.

Benefits versus costs

Some of the managerial benefits of business research have already been discussed. Of course, conducting research activities to obtain these benefits requires an expenditure; thus there are both costs and benefits in conducting business research. In any decision-making situation, managers must identify alternative courses of action, then weigh the value of each alternative against its cost. It is useful to think of business research as an investment alternative. When deciding whether to make a decision without research or to postpone the decision in order to conduct research, managers should ask: (1) Will the payoff or rate of return be worth the investment? (2) Will the information gained by business research improve the quality of the decision to an extent sufficient to warrant the expenditure? And (3) Is the proposed research expenditure the best use of the available funds?

For example, TV Cable Week was not test-marketed before its launch. While the magazine had articles and stories about television personalities and events, its main feature was a channel-by-channel program listing showing the exact programs that a particular subscriber could receive. To produce a “custom” magazine for each individual cable television system in the country required developing a costly computer system. Because development required a substantial expenditure, one that could not be scaled down for research, the conducting of research was judged to be an improper investment. The value of the research information was not positive, because the cost of the information exceeded its benefits. Unfortunately, pricing and distribution problems became so compelling after the magazine was launched that it was a business failure. Nevertheless, the publication’s managers, without the luxury of hindsight, made a reasonable decision not to conduct research. They analyzed the cost of the information (i.e. the cost of business research) relative to the potential benefits.

1.7 MAJOR TOPICS FOR RESEARCH IN BUSINESS

Research is expected to improve the quality of business decisions, but what business-decision topics benefit from research efforts? Exhibit 1.1 lists several major topics for research in business.

EXHIBIT 1.1: MAJOR TOPICS FOR RESEARCH IN BUSINESS

- General Business, Economic, and corporate Research
- Short-range forecasting (up to one year)
- Long-range forecasting (over one year)
- Studies of business and industry trends
- Inflation and pricing studies
- Plant and warehouse location studies
- Acquisition studies
- Export and international studies
- Financial and Accounting Research
- Forecasts of financial interest-rate trends
- Stock, bond, and commodity value predictions
- Capital formation alternatives
- Research related to mergers and acquisitions
- Risk-return trade off studies
- Impact of taxes
- Portfolio analysis
- Research on financial institutions
- Expected-rate-of-return studies
- Capital asset pricing models
- Credit risk management in corporates
- Cost analysis
- Management and Organizational Behavior Research
- Total quality management
- Morale and job satisfaction

- Leadership styles and their effectiveness
- Employee productivity
- Organizational effectiveness
- Structural studies
- Absenteeism and turnover
- Organizational communication
- Time and motion studies
- Physical environment studies
- Labor union trends
- Sales and Marketing Research
- Measurement of market potentials
- Market-share analysis
- Market segmentation studies
- Determination of market characteristics
- Sales analysis
- Establishment of sales quotas, territories
- Distribution-channel studies
- New-product concept tests
- Test-market studies
- Advertising research Buyer-behavior/consumer satisfaction studies
- Corporate Responsibility Research
- Ecological impact studies
- Legal constraints on advertising and promotion studies
- Sex, age, and racial discrimination worker-equity studies
- Social values and ethics studies.

1.8 INTERNAL VERSUS EXTERNAL CONSULTANTS/RESEARCHERS

Internal Consultants/Researchers

Some organizations have their own consulting or research department, which might be called the Management Services Department, the Organization and Methods Department, R & D (research and development department), or by some other name. This department serves as the internal consultant to subunits of the organization that face certain problems and seek help. Such a unit within the organization, if it exists, would be useful in several ways, and enlisting its help might be advantageous under some circumstances, but not in others. The manager often has to decide whether to use internal or external researchers. To reach a decision, the manager should be aware of the strengths and weaknesses of both, and weigh the advantages and disadvantages of using either, based on the needs of the situation. Some of the advantages and disadvantages of both the internal and external teams are now discussed.

Advantages of Internal Consultants/Researchers

There are at least four advantages in engaging an internal team to do the research project:

1. The internal team would stand a better chance of being readily accepted by the employees in the subunit of the organization where research needs to be done.
2. The team would require much less time to understand the structure, the philosophy and climate, and the functioning and work systems of the organization.
3. They would be available for implementing their recommendations after the research findings are accepted. This is very important because any "bugs" in the implementation of the recommendations could be removed

with their help. They would also be available for evaluating the effectiveness of the changes, and considering further changes if and when necessary.

4. The internal team might cost considerably less than an external team for the department enlisting help in problem solving, because they will need less time to understand the system due to their continuous involvement with various units of the organization. For problems that are of low complexity, the internal team would be ideal.

Disadvantages of internal Consultants/Researchers

There are also certain disadvantages to engaging internal research teams for purposes of problem solving. The four most critical ones are:

1. In view of their long tenure as internal consultants, the internal team may quite possibly fall into a stereotyped way of looking at the organization and its problems. This would inhibit any fresh ideas and perspectives that might be needed to correct the problem. This would definitely be a handicap for situations in which weighty issues and complex problems are to be investigated.
2. There is scope for certain powerful coalitions in the organization to influence the internal team to conceal, distort, or misrepresent certain facts. In other words, certain vested interests could dominate, especially in securing a sizable portion of the available scant resources.
3. There is also a possibility that even the most highly qualified internal research teams are not perceived as “experts” by the staff and management, and hence their recommendations do not get the consideration and attention they deserve.

4. Certain organizational biases of the internal research team might in some instances make the finding less objective and consequently less scientific.

External Consultants/Researchers

The disadvantages of the internal research teams turn out to be the advantage of the external teams, and the former's advantages work out to be the disadvantages of the latter. However, the specific advantages and disadvantages of the external teams may be highlighted.

Advantages of External Consultants

The advantages of the external team are:

1. The external team can draw on a wealth of experience from having worked with different types of organizations that have had the same of similar types of problems. This wide range of experience would enable them to think both divergently and convergently rather than hurry to an instant solution on the basis of the apparent facts in the situation. They would be able to ponder over several alternative ways of looking at the problem because of their extensive problem-solving experiences in various other organizational setups. Having viewed the situation from several possible angles and perspective (divergently), they could critically assess each of these, discard the less viable option and alternatives, and focus on specific feasible solutions (think convergently).

2. The external teams, especially those from established research and consulting firms, might have more knowledge of current sophisticated problem-solving models through their periodic training programs, which the teams within the organization may not have access to. Because knowledge obsolescence is a real threat in the consulting area, external research institutions ensure that their members are current

on the latest innovations through periodic organized training programs. The extent to which internal team members are kept abreast of the latest problem-solving techniques may vary considerably from one organization to another.

Disadvantages of external consultants

The major disadvantages in hiring an external research team are as follows:

1. The cost of hiring an external research team is usually high and is the main deterrent, unless the problems are very critical.
2. In addition to the considerable time the external team takes to understand the organization to be researched, they seldom get a warm welcome, nor are readily accepted by employees. Departments and individuals likely to be affected by the research study may perceive the study team as a threat and resist them. Therefore, soliciting employees' help and enlisting their cooperation in the study is a little more difficult and time-consuming for the external researchers than for the internal teams.
3. The external team also charges additional fees for their assistance in the implementation and evaluation phases.

Keeping in mind these advantages and disadvantages of the internal and external research teams, the manager who desires research services has to weigh the pros and cons of engaging either before making a decision. If the problem is a complex one, or if there are likely to be vested interests, or if the very existence of the organization is at stake because of one or more serious problems, it would be advisable to engage external researchers despite the increased costs involved. However, if the problems that arise are fairly simple, if time is of the essence in solving moderately complex problems, or if there is a system wise need to establish procedures and policies of a fairly routine nature, the internal team would probably be the better option.

Knowledge of research methods and appreciation of the comparative advantages and disadvantages of the external and internal teams help managers to make decisions on how to approach problems and determine whether internal or external researchers will be the appropriate choice to investigate and solve the problem.

1.9 BUSINESS RESEARCH IN A GLOBAL ACTIVITY

Business today operates globally. Business research, like all business activity, has become increasingly global. Some companies have extensive international business research operations. Upjohn conducts business research in 160 different countries.

Companies that conduct business in foreign lands must understand the particular nature of those markets and determine whether they require customized business strategies. For example, although the 14 nations of the European Community not share a single market, business research shows that they do not share identical tastes for many consumer products. Business researchers have learned that there is no such thing as a typical European consumer or worker; the nations of the European Community are divided by language, religion, climate, and centuries of tradition. For example, Scantel Research, a British firm that advises companies on color preferences, found inexplicable differences in the way Europeans take their medicine. The French prefer to pop purple pills, while the English and Dutch wish for white ones. Consumers in all three countries dislike bright red capsules, which are big sellers in the United States. This example illustrates that companies that do business in Europe must learn whether they need to adapt to local customs and habits.

A.C. Nielsen, the company that does television ratings, is the world's largest business research company. More than 60 percent of its business comes from outside the United States. Although the nature of business research can change around the globe, the need for business research is universal. Throughout this book we will discuss the practical problems involved in conducting business research in Europe, Asia, Latin America, the Middle East, and elsewhere.

1.10 RESEARCH METHOD VERSUS METHODOLOGY

It seems appropriate at this juncture to explain the difference between research methods and research methodology. Research methods may be understood as all those methods/techniques that are used for conduction of research. Research methods or techniques, thus, refer to the methods the researchers use in performing research operations. In other words, all those methods which are used by the researcher during the course of studying his research problem are termed as research methods. Since the object of research, particularly the applied research, is to arrive at a solution for a given problem, the available data and the unknown aspects of the problem have to be related to each other to make a solution possible. Keeping this in view, research methods can be put into the following three groups:

1. In the first group we include those methods which are concerned with the collection of data. These methods will be used where the data already available are not sufficient to arrive at the required solution;
2. The second group consists of those statistical techniques which are used for establishing relationships between the data and the unknowns;
3. The third group consists of those methods which are used to evaluate the accuracy of the results obtained.

Research methods falling in the above stated last two groups are generally taken as the analytical tools of research.

Research methodology is a way to systematically solve the research problem. It may be understood as a science of studying how research is done scientifically. In it we study the various steps that are generally adopted by a researcher in studying his research problem along with the logic behind them. It is necessary for the researcher to know not only research methods/techniques but also the methodology. Researchers not only need to know how to develop certain indices or tests, how to calculate the mean, the mode, the median or the standard deviation or chi-square, how to apply particular research techniques, but they also need to know which of these methods or techniques, are relevant and which are not, and what would they mean and indicate and why. Researchers also need to understand the assumptions underlying various techniques and they need to know the criteria by which they can decide that certain techniques and procedures will be applicable to certain problems and others will not. All this means that it is necessary for the researcher to design his methodology for his problem as the same may differ from problem to problem. For example, an architect, who designs a building, has to consciously evaluate the basis of his decisions, i.e., he has to evaluate why and on what basis he selects particular size, number and location of doors, window and ventilators, uses particular materials and not others and the like. Similarly, in research the scientist has to expose the research decisions to evaluation before they are implemented. He has to specify very clearly and precisely what decisions he selects and why he selects them so that they can be evaluated by others also.

From what has been stated above, we can say that research methodology has many dimensions and research methods do constitute a part of the research methodology. The scope of research methodology is wider than that of research methods. Thus, when we talk of research methodology we not only talk of the research methods but also consider the logic behind the methods we use in the context of our research study and explain why we are using a particular method or technique and why we are not using others so that research results are capable of being evaluated either by the researcher himself or by others. Why a research study has been undertaken, how the research problem has been defined, in what way and why the hypothesis has been formulated, what data have been collected and what particular method has been adopted, why particular technique of analyzing data has been used and a host of similar other questions are usually answered when we talk of research methodology concerning a research problem or study.

Research and Scientific Method

For a clear perception of the term research, one should know the meaning of scientific method. The two terms, research and scientific method, are closely related. Research, as we have already stated, can be termed as “an inquiry into the nature of, the reasons for, and the consequences of any particular set of circumstances, whether these circumstances are experimentally controlled or recorded just as they occur. Further, research implies the researcher is interested in more than particular results; he is interested in the repeatability of the results and in their extension to more complicated and general situations.” On the other hand, the philosophy common to all research methods and techniques, although they may vary considerably from one science to another, is usually given the name of scientific method. In this context, Karl Pearson writes, “The scientific method is one and same in the branches (of science) and that method is the method of all logically trained minds…….the unity of all sciences consists alone in its methods, not its material; the man who classifies facts of any kind whatever, who sees their mutual relation and describes their sequences, is applying the Scientific Method and is a man of science.” Scientific method is the pursuit of truth as determined by logical considerations. The ideal of science is to achieve a systematic interrelation of facts. Scientific method attempts to achieve "this ideal by experimentation, observation, logical arguments from accepted postulates and a combination of these three in varying proportions." In scientific method, logic aids in formulating propositions explicitly and accurately so that their possible alternatives become clear. Further, logic develops the consequences of such alternatives, and when these are compared with observable phenomena, it becomes possible for the researcher or the scientist to state which alternative is most in harmony with the observed facts. All this is done through experimentation and survey investigations which constitute the integral parts of scientific method.

Experimentation is done to test hypotheses and to discover new relationships, if any, among variables. But the conclusions drawn on the basis of experimental data are generally criticized for either faulty assumptions, poorly designed experiments, badly executed experiments or faulty interpretations. As such the researcher must pay all possible attention while developing the experimental design and must state only probable inferences. The purpose of survey investigations may also be to provide scientifically gathered information to work as a basis for the researchers for their conclusions.

The scientific method is, thus, based on certain basic postulates which can be stated as under:

1. It relies on empirical evidence;
2. It utilizes relevant concepts;
3. It is committed to only objective considerations;
4. It presupposes ethical neutrality, i.e., it aims at nothing but making only adequate and correct statements about population objects;
5. It results into probabilistic predictions;

6. Its methodology is made known to all concerned for critical scrutiny and for use in testing the conclusions through replication;
7. It aims at formulating most general axioms or what can be termed as scientific theories.

Thus, "the scientific method encourages a rigorous, impersonal mode of procedure dictated by the demands of logic and objective procedure." Accordingly, scientific method implies an objective, logical and systematic method, i.e., a method free from personal bias or prejudice, a method to ascertain demonstrable qualities of a phenomenon capable of being verified, a method wherein the researcher is guided by the rules of logical reasoning, a method wherein the investigation proceeds in an orderly manner and a method that implies internal consistency.

1.11 ETHICS AND BUSINESS RESEARCH

Ethics in business research refers to a code of conduct or expected societal norm of behavior while conducting research. Ethical conduct applies to the organization and the members that sponsor the research, the researchers who undertake the research, and the respondents who provide them with the necessary data The observance of ethics begins with the person instituting the research, who should do so in good faith, pay attention to what the results indicate, and surrendering the ego, pursue organizational rather than self-interests. Ethical conduct should also be reflected in the behavior of the researchers who conduct the investigation, the participants who provide the data, the analysts who provide the results, and the entire research team that presents the interpretation of the results and suggests alternative solutions.

Thus, ethical behavior pervades each step of the research process-data collection, data analysis, reporting, and dissemination of information of the Internet, if such an activity is undertaken. How the subjects are treated and how confidential information is safeguarded are all guided by business ethics.

There are business journals such as the journal of business Ethics and the Business Ethics Quarterly that are mainly devoted to the issue of ethics in business. The American Psychological Association has established certain guideline for conducting research, to ensure that organizational research is conducted in an ethical manner and the interests of all concerned are safeguarded.

1.12 SUMMARY

Business research is a management tool that companies use to reduce uncertainty. Business research, the manager's source of information about organizational and environmental conditions, covers topics ranging from long-range planning to the most ephemeral tactical decisions.

Business research is the systematic and objective process of gathering, recording, and analyzing data for decision making. The research must be systematic, not haphazard. It must be objective to avoid the distorting effects of personal bias. The objective of applied business research is to facilitate managerial decision making. Basic or pure research is used to increase the knowledge of theories and concepts.

Managers can use business research in all stages of the decision-making process: to define problems; to identify opportunities; and to clarify alternatives. Research is also used to evaluate current programs and courses of action, to explain what went wrong with managerial efforts in the past, and to forecast future conditions.

A manager determines whether business research should be conducted based on (1) time constraints, (2) the availability of data (3) the nature of the decision to be made, and (4) the benefits of the research information in relation to its costs.

There is a broad variety of applied research topics, such as general business, economic, and corporate research; financial and accounting research; management and organizational behavior research; sales and marketing research; and corporate responsibility research.

1.13 KEYWORDS

Research is simply the process of finding solution to a problem after thorough examination and analysis of factors.

Business Research is systematic and objective process of collecting, recording and analyzing data to facilitate business decisions.

Basic/Pure Research is an attempt to verify the acceptability of theory or to expand the limits of knowledge.

Applied Research is conducted when a decision is made about a specific real life problem.

Research Methods are methods/techniques used for concluding a research.

Research Methodology is a way to systematically solve a research problem.

Scientific Method attempts to achieve a systematic interrelation of facts by experimentation, observation, logical arguments from accepted postulates and a combination of these in varying proportions.

1.14 SELF ASSESSMENT QUESTIONS

1. Give some examples of business research in your particular field of interest?

2. In your own words, define business research and list its tasks.
3. How might a not-for-profit organization use business research?
4. What is the difference between applied and basic research?
5. Discuss how business research can be used in each stage of the decision-making process.
6. In your own words, describe the scientific method and state why it is an essential aspect of business research.
7. Describe a situation where business research is not needed and a situation where business research is needed. What factors differentiate the two situations?
8. Why should a manager know about research when the job entails managing people products, events, environments, and the like?
9. For what specific purposes is basic research important?
10. When is applied research, as distinct from basic research, useful?
11. Why is it important to be adept in handling the manager-researcher relationship?
12. Explain, giving reasons, which is more important, applied or basic research.

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Lesson No.: **2**	

TYPES OF BUSINESS RESEARCH AND THE RESEARCH PROCESS

STRUCTURE

2.0 OBJECTIVE

After reading this lesson the learners will be able to

- Differentiate between research and business research
- Understand the types of business research
- Know the process of research
- Differentiate between research project vs. research program
- Identify the problems of researchers in India

2.1 INTRODUCTION

Recently the business process outsourcing (BPO) has attracted the attention of concerned governments, researchers, economists and planners. India has been judged as a best destination for BPO. This has raised many issues: In what ways, BPO is beneficial to Indian economy? How can we sustain the benefits of BPO? What are the critical success factors in it? What are the characteristics of BPO companies. A scientific research study can provide answer to the above questions. This lesson describes how managers make decisions about planning research strategies and research process.

2.2 DECISION MAKING

Formally defined, decision making is the process of resolving a problem or choosing among alternative opportunities. The key to decision making is to recognize the nature of the problem/opportunity, to identify how much information is available, and to recognize what information is needed. Every business problem or decision making situation can be classified on a continuum ranging from complete certainty to absolute ambiguity.

Complete certainty means that the decision maker has all the information that he or she needs. The decision maker knows the exact nature of the business problem or opportunity. For example, an airline may need to know the demographic characteristics of its pilots. The firm knows exactly what information it needs and where to find it. If a manager is so completely certain about both the problem/opportunity and future outcomes, then research may not be needed at all. However, perfect certainty especially about the future, is rare.

Uncertainty means that managers grasp the general nature of the objectives they wish to achieve, but the information about alternatives is incomplete. Predictions about the forces that will shape future events are educated guesses. Under conditions of uncertainty, effective managers recognize potential value in spending additional time gathering information to clarify the nature of the decision.

Ambiguity means that the nature of the problem to be solved is unclear. The objectives are vague and the alternatives are difficult to define. This is by far the most difficult decision situation.

Business managers face a variety of decision making situations. Under conditions of complete certainty when future outcomes are predictable business research may be a waste of time. However, under conditions of uncertainly or ambiguity, business research becomes more attractive to the decision maker. As the situation moves farther along the scale toward ambiguity, the need to spend additional time on business research becomes more compelling.

2.3 TYPES OF BUSINESS RESEARCH

Business research produces information to reduce uncertainty. It helps focus decision making. In a number of situations business researchers will know exactly what their business problems are and design studies to test specific hypotheses. For example, a soft drink company introducing a new clear cola might want to know whether a gold or silver label would make the packaging more effective. This problem is fully defined and an experiment may be designed to answer the business question with little preliminary investigation. In other, more ambiguous circumstances management may be totally unaware of a business problem. For example, a plant manager may notice when employee turnover increases dramatically, but be totally ignorant of the reason for the increase. Some exploratory research may be necessary to gain insights into the nature of such a problem.

Because of the variety of research activity, it will be helpful to categorize the types of business research. Business research can be classified on the basis of either technique or function. Experiments, surveys, and observational studies are just a few common research techniques. Classifying them on the basis of purpose or function allows us to understand how the nature of the problem influences the choice of research method. The nature of the problem will determine whether the research is (1) exploratory, (2) descriptive, or (3) causal.

2.3.1 Exploratory studies

Exploratory studies are conducted to clarify ambiguous problems. Management may have discovered general problems, but research is needed to gain better understanding of the dimensions of the problems. Management needs information to help analyze a situation, but conclusive evidence to determine a particular course of action is not the purpose of exploratory research. Usually, exploratory research is conducted with the expectation that subsequent research will be required to provide conclusive evidence. It is a serious mistake to rush into detailed surveys before less expensive and more readily available sources of information have been exhausted.

In an organization considering a program to help employees with child-care needs, for example, exploratory research with a small number of employees who have children might determine that many of them are from families in which both parents work and that these employees have positive reactions to the possibility of an on-site child-care program. In such a case exploratory research helps to crystallize a problem and identify information needs for future research.

2.3.2 Descriptive research

The major purpose of descriptive research, as the term implies, is to describe characteristics of a population of phenomenon. Descriptive research seeks to determine the answers to who, what, when, where, and how questions. Official statistics on unemployment and other characteristics of the labour force are derived from the current population survey, which is conducted monthly.

Let us consider an example of descriptive research. A university placement service may want to determine if its facilities and services are adequate. A descriptive study might be initiated to determine how many interviews each student desires, whether students are able to schedule appointments with certain desirable organizations, and if there are any problems with physical facilities. It is clear that mere description of a situation may provide important information and that in many situations descriptive information is all that is needed to solve business problems, even though the answer to why is not given.

Accuracy is of paramount importance in descriptive research. Although errors cannot be completely eliminated, good researchers strive for descriptive precision. Suppose the purpose is to describe the market potential of personal photocopying machines. If the study does not present a precise measurement of the sales volume, it will mislead the managers who are making production scheduling, budgeting, and other decisions based on that study.

Unlike exploratory research, descriptive studies are based on some previous understanding of the nature of the research problem. For example, state societies of certified public accountants (CPAs) in America, conduct annual practice management surveys that ask questions such as “Do you charge clients for travel time at regular rates?” “Do you have a program of continuing education on a regular basis for professional employees?” “Do you pay incentive bonuses to professional staff?” Although the researcher may have a general understanding of the situation, the conclusive evidence, answering questions of fact necessary to determine a course of action, has yet to be collected. Frequently, descriptive research will attempt to determine the extent of differences in the needs, perceptions, attitudes, and characteristics of subgroups.

The purpose of many organizational behaviour studies, for example, is to describe the reasons employees give for their explanations of the nature of things. In other words, a diagnostic analysis is performed when employees in the various subgroups are asked questions such as “Why do you feel that way?” Although the reasons employees feel a certain way are described, the findings of a descriptive study such as this, sometimes called diagnostics, do not provide evidence of a causal nature.

2.3.3 Causal Research

The main goal of causal research is identification of cause and effect relationships between variables. (Exploratory and descriptive research normally precede cause-and-effect relationship studies). In causal studies it is typical to have an expectation of the relationship to the explained, such as predicting the influence of price, packaging, advertising, and the like, on sales. Thus researchers must be knowledgeable about the research subject. Ideally, a manager would like to establish that one event (say a new package) is the means for producing another event (an increase in sales).

Causal research attempts to establish that when we do one thing, another thing will follow. The word cause is frequently used in everyday conversation, but from a scientific research perspective, a causal relationship is impossible to prove. Nevertheless, researchers seek certain types of evidence to help them understand and predict relationships.

A typical causal study would brings out that when management changes one variable (e.g., training) what shall be the effect on another variable (e.g., productivity). In this situation there is evidence for establishing causality because it appears that the cause precedes the effect. In other words, having an appropriate causal order of events, or temporal sequence, is one criterion for causality that must be met to measure a relationship. If an organizational behaviour theorist wishes to show that attitude change causes behaviour change, one criterion that must be established is that attitude change precedes behaviour change.

Further, there is some evidence of concomitant variation in that, in our example, increased training and increased productivity appear to be associated. Concomitant variation is the occurrence of two phenomena or events that vary together. When the criterion of concomitant variation is not met-that is, when there is no association between variables-reason suggests that no causal relationship exists. If two events vary together, one may be the cause. However, this by itself is not sufficient evidence for causality because the two events may have a common cause, that is, both may be influenced by a third variable.

For instance, one morning at Atlantic City's beach a large number of ice cream cones are sold and that afternoon there is a large number of drownings. Most of us would not conclude that eating ice cream cones causes drownings. More likely, the large number of people at the beach probably influenced both ice cream cone sales and drownings. It may be that the "effect" was produced in other ways. Because there is concomitant variation and a proper time sequence between the occurrence of Event A and Event B, causation is not certain. There may be plausible alternative explanations for an observed relationship. A plurality of causes is possible.

Consider a presidential candidate who reduces advertising expenditures near the end of the primary campaign and wins many more delegates in the remaining primaries. To infer causality-that reducing advertising increases the number of delegates-might be inappropriate because the presumed cause of the increase may not be the real cause. It is likely that, near the end of a race, marginal candidates withdraw. Thus the real cause may be unrelated to advertising.

In these examples the third variable that is the source of the spurious association is a very salient factor readily identified as the more likely influence on change. However, within the complex environment in which managers operate, it is difficult to identify alternative or complex causal factors.

In summary, research with the purpose of inferring causality should:

1. Establish the appropriate causal order or sequence of events.
2. Measure the concomitant variation between the presumed cause and the presumed effect.
3. Recognize the presence or absence of alternative plausible explanations or causal factors.

Even when these three criteria for causation are present, the researcher can never be certain that the causal explanation is adequate.

Most basic scientific studies in business ultimately seek to identify cause-and-effect relationships. When one thinks of science, one often associates it with experiments. Thus to predict a relationship between, say, price and perceived quality of a product, causal studies often create statistical experimental controls to establish “contrast groups”. A number of business experiments are conducted by both theory developers and pragmatic business people.

EXHIBIT 2.1: TYPES OF BUSINESS RESEARCH

	Exploratory Research (Ambiguous Problem	Descriptive Research (Aware of Problem)	Causal Research (Clearly Defined Problem)
Possible situation	“Absenteeism is increasing and we don’t know why”.	“What kind of people favour trade protectionism?”	“Which of two training programs is more effective?”
	“Would people be interested in our new-product idea?”	“Did last year’s product recall have an impact on our company’s stock price?”	“Can I predict the value of energy stocks if I know the current dividends and growth rates of dividends?”
	“What task conditions influence the leadership process in our organization?”	“Has the average merger rate for savings and loans increased in the past decade?”	“Will buyers purchase more of our product in a new package?”

Note: The degree of uncertainty about the research problem determines the research methodology.

Exhibit 2.1 illustrates that exploratory research is conducted during the early stages of decision making when the decision situation is ambiguous and management is very uncertain about the nature of the problem. When management is aware of the problem but not completely knowledgeable about the situation, descriptive research is usually conducted. Causal studies require sharply defined problems, even though uncertainty about future outcomes exists.

2.4 STAGES IN THE RESEARCH PROCESS

As previously noted, business research can take many forms, but systematic inquiry is a common thread. Systematic inquiry requires careful planning in an orderly investigation. Business research, like other forms of scientific inquiry, is a sequence of highly interrelated activities. The stages in the research process overlap continuously, and it is somewhat of an oversimplification to state that every research project follows a neat and ordered sequence of activities. Nevertheless, business research often follows a generalized pattern. The stages are shown in Exhibit 2.2.

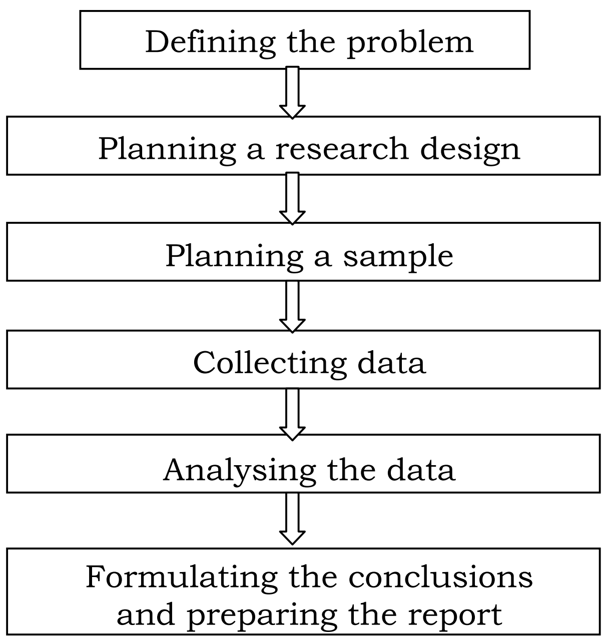

EXHIBIT 2.2: PHASES OF THE RESEARCH PROCESS

In practice, the stages overlap chronologically and are functionally interrelated. Sometimes the later stages are completed before the earlier ones. The terms forward and backward linkage are associated with the interrelatedness of the various stages. The term forward linkage implies that the earlier stages of research will influence the design of the later stages. Thus the objectives of the research outlined in the problem definition will have an impact on the selection of the sample and the way in which the data will be collected. The decision concerning who will be sampled will affect the wording of questionnaire items. For example, if the research concentrates on respondents who have low educational levels, the wording of the questionnaire will be simpler than the language used when the respondents are college graduates. The notion of backward linkage implies that the later steps have an influence on the earlier stages in the research process. If it is known that the data will be analysed by computer, then computer coding requirements are included in the questionnaire design. Perhaps the most important backward linkage is the knowledge that the executive who will read the research report needs certain information. The professional researcher anticipates executives' need for information in the planning process and considers this need during the analysis and tabulation stages.

A number of alternatives are available to the researcher during each of the six stages of the research process. The research process can be compared with a guide or a map. On a map some paths are better charted than others. Some are difficult to travel, and some are more interesting than others. Rewarding experiences may be gained during the journey. It is important to remember there is no right path or best path for all journeys. The road one takes depends on where one wants to go and the resources (money, time, labour, and so on) one has available for the trip. The map analogy is useful for the business researcher because in each stage of the research process there are several paths to follow. In some instances, the quickest path will be the appropriate means of research because of certain time constraints. In other circumstances when money and human resources are plentiful, the path the research takes may be quite different. Exploration of the various paths of business research decisions is our primary purpose.

Each of the six stages in the research process is briefly described below. Discussion of the research process begins with problem discovery and definition because most research projects, albeit at an earlier moment in time, are initiated because of some uncertainty about some aspect of the firm or its environment.

2.4.1 Problem discovery and definition

In Exhibit 2.1, the research process begins with problem discovery, and identifying the problem is the first step toward its solution. The word problem, in general usage, suggests something has gone wrong. Unfortunately, the term problem does not connote a business opportunity, such as expanding operations into a foreign country, nor does it connote the need for evaluation of an existing program, such as employee satisfaction with professional development programs. Actually, the research task may be to clarify a problem, to evaluate a program, or to define an opportunity, and problem discovery and definition will be used in this broader context. It should be noted that the initial stage is problem discovery, rather than definition. However, the researcher may not have a clear-cut statement of the problem at the outset of the research process). Often, only symptoms are apparent to begin with. Profits may be declining, but management may not know the exact nature of the problem. Thus the problem statement is often made only in general terms. What is to be investigated is not yet specifically identified.

It was Albert Einstein who noted that “the formulation of a problem is often more essential than its solution”. This is good advice for managers. Too often managers concentrate on finding the right answer rather than asking the right question. Many do not realize that defining a problem may be more difficult than solving it. In business research, if the data are collected before the nature of the business problem is carefully thought out, the data probably will not help solve the problem.

The adage “a problem well defined is a problem half solved” is worth remembering. This adage emphasizes that an orderly definition of the research problem gives a sense of direction to the investigation. Careful attention to problem definition allows the researcher to set the proper research objectives. If the purpose of the research is clear, the chances of collecting the necessary and relevant information-without collecting surplus information-will be much greater.

To be efficient, business research must have clear objectives and definite designs. Unfortunately, in many cases little or no planning goes into the formulation of a research problem. Consider the case of the Ha-Psu-Shu-Tse (a Pawnee Indian word for red corn) brand of Indian fried bread mix. The owner of the company, Mr. Ha-Psu-Shu-Tse, thought his product, one of the few American Indian food products available in the United States, wasn’t selling because it wasn’t highly advertised. He wanted a management-consulting group to conduct some research concerning advertising themes. However, the management consultants pointed out to the Ha-Psu-Shu-Tse family that the brand (family) name on the bread might be a foremost source of concern. It was suggested that investigating the brand image and consumer behaviour research might be the starting point, rather than advertising copy research. Family management agreed. (It should be emphasized that we are now using “problem” to refer to the managerial problem, which may be a lack of knowledge about consumers or advertising effectiveness and the lack of needed information). Frequently business researchers will not be involved until line management discovers that information is needed about a particular aspect of the decision at hand. Even at this point the exact nature of the problem may not be well defined. Once a problem area has been discovered, the researcher can begin the process of precisely defining it.

Although the problem definition stage of the research process is probably the most important stage, it is frequently a neglected area of research. Too often it is forgotten that the best place to begin a research project is at the end. Knowing what is to be accomplished determines the research process. A problem definition error or omission is likely to be a costly mistake that cannot be corrected in later stages of the process.

Exploratory research

Many research projects with clearly defined research problems, such as an annual survey of industry compensation, do not require exploratory research. There are, however, many research studies that would have inadequate problem definitions if exploratory research were not conducted.

Exploratory research is usually conducted during the initial stage of the research process. The preliminary activities undertaken to refine the problem into a researchable one need not be formal or precise. The purpose of the exploratory, research process is a progressive narrowing of the scope of the research topic and a transformation of the discovered problems into defined ones, incorporating specific research objectives. By analysing any existing studies on the subject, by talking with knowledgeable individuals, and by informally investigating the situation, the researchers can progressively sharpen the concepts. After such exploration the researchers should know exactly what data to collect during the formal project and how the project will be conducted. Exhibit 3.4 indicates that a decision must be made regarding the selection of one or more exploratory research techniques. The colour of the exhibit is different for the exploratory research stage to indicate that this stage of research is optional.

The business has four basic categories of techniques for obtaining insights and gaining a clearer idea of a problem: Secondary data analysis, pilot studies, case studies, and experience surveys.

Secondary data

Secondary, or historical, data are data previously collected and assembled for some project other than the one at hand. Primary data are data gathered and assembled specifically for the project at hand. Secondary information can often be found inside the company or in the library, or it can be purchased from firms that specialize in providing information, such as economic forecasts, that is useful to organizations. The researcher who assembles data from the *Census of Population* or the *Survey of Current Business* is using secondary sources.

A literature research study or a literature survey of published articles and books discussing theories and past empirical studies about a topic is almost universal in academic research projects. It is also common in many applied research studies. Students who have written term papers should be familiar with the process of checking card catalogues, indexes to published literature, and other library resources to establish a bibliography portraying past research. Suppose, for example, a bank is interested in determining the best site for an electronic funds transfer system machine. A logical first step would be to investigate the factors that bankers in other parts of the country consider important. By reading articles in banking journals, the bank management might quickly discover that the best locations are residential areas where people are young, highly educated, and earning higher-than-average incomes. These data might lead the bank to investigate census information to determine where in the city such people live. Reviewing and building upon the work already compiled by others is an economical starting point for most research.

Secondary data can almost always be gathered faster and at a lower cost than primary data. However, secondary data may be outdated or may not exactly meet the needs of the researcher because they were collected for another purpose. Nevertheless. Secondary sources often prove to be of great value in exploratory research. Investigating such sources has saved many a researcher from 'reinventing the wheel" in primary data collection.

Pilot studies

Pilot studies collect data from the ultimate subject of the research project to serve as a guide for the larger study. When the term pilot study is used in the context of exploratory research, the data collection methods are informal and the findings may lack precision because rigorous standards are relaxed. For instance, a downtown association concerned with revitalization of the central business district (CBD) conducted a very flexible survey with questions that were open ended. The interviewers were given considerable latitude to identify executives' (the ultimate subjects) opinions about future requirements in the downtown area. The results of this survey were used to suggest possible topics for formal investigation.

The focus group interview is a more elaborate exploratory pilot study. Increasingly popular in recent years, the focus group gathers six to ten people for a group dynamics session. This loosely structured discussion assumes that individuals are more willing to share their ideas as they share in the ideas of others. Qualitative information obtained in these studies serves as a basis for subsequent quantitative study.

For example, the Philadelphia Museum used focus groups to investigate how well its exhibits and shows catered to the public. A local resident who had never visited the museum mentioned that he was not aware of any important artwork there. Another participant in the same focus group voiced the opinion that the museum would be filled with "pictures I would not understand … I've seen art where it looked like kids splashed paint". These findings (confirmed by other research) influenced the museum to reinstate an image of van Gogh's sunflowers on the cover of its brochures.

Since the purposes of exploratory research are to gain insights and to discover new ideas, researchers may use considerable creativity and flexibility. It is common to collect data with several exploratory techniques. Exhausting these sources is generally worth the effort because the expense is relatively low. Further, insights into how and how not to conduct research may be gained from activities during the problem definition stage. If the conclusions made during this stage suggest business opportunities, the researcher is in a position to begin planning a formal, quantitative research project.

Statement of research objectives

A decision must initially be made as to precisely what should be researched. After identifying and clarifying the problem, with or without exploratory research, the researchers should make a formal statement of the problem and the research objectives. This delineates the type of information that should be collected and provides a framework for the scope of the study or research project.

The answers to questions such as "To what extent did the new compensation program achieve its objectives?" are typical research objectives. In this sense the statement of the problem is a research question.

The best expression of a research objective is a well-formed, testable research hypothesis, and a hypothesis is a statement that can be refuted or supported by empirical data. For example, an exploratory study might lead us to the hypothesis that male-dominated unions discriminate against women who want to enter the trades. In basic research, theory is the guide that helps generate hypotheses. Once the hypothesis has been developed, the researchers are ready to select a research design.

2.4.2 Planning the research design

After the researcher has formulated the research problem, the research design must be developed. A research design is a master plan specifying the methods and procedures for collecting and analysing the needed information. It is a framework of the research plan of action. The objectives of the study determined during the early stages of the research are included in the design to ensure that the information collected is appropriate for solving the problem. The research investigator must also determine the sources of information, the design technique (survey or experiment, for example), the sampling methodology, and the schedule and cost of the research.

Selecting the appropriate research design

There are four basic design techniques for descriptive and causal research– surveys, experiments, secondary data, and observation. The objectives of the study, the available data sources, the urgency of the decision, and the cost of obtaining the data will determine which design technique is chosen. The managerial aspects of selecting the research design will be considered later.

Surveys

The most common method of generating primary data is through surveys. A survey is a research technique in which information is gathered from a sample of people by use of a questionnaire. The task of writing a questionnaire, determine the list of questions, and designing the exact format of the printed or written questionnaire is an essential aspect of the development of a survey research design.

Research investigators may choose to contact respondents by telephone, by mail, or in person. An advertiser who spends $900,000 for 30 seconds of commercial time during the Super Bowl may telephone people to quickly gather information concerning their response to the advertising. Your congressional representative may send you a mail questionnaire to learn how he or she should vote on issues. It is an inexpensive method of data collection for a member of congress or any person. A forklift truck manufacturer, trying to determine why sales in the wholesale grocery industry are low, might choose a mail questionnaire because the appropriate executives are hard to reach by telephone. A computer manufacturer, wishing to conduct an organizational survey among employees, might determine the need for a versatile survey method whereby an interviewer can ask a variety of personal questions in a flexible format. Although personal interviews are expensive, they are valuable because investigators can utilize visual aids and supplement the interview with personal observations. Each of these survey methods has advantages and disadvantages. The researcher's task is to find the most appropriate way to collect the information that is needed.

Experiments

Business experiments hold the greatest potential for establishing cause-and-effect relationships. The use of experimentation allows investigation of changes in one variable, such as productivity, while manipulating one or two other variables, perhaps social rewards or monetary rewards, under controlled conditions. Ideally, experimental control provides a basis for isolating causal factors because outside (or exogenous) influences do not come into play.

Test marketing is a frequent form of business experimentation. The example of Chelsea, Anheuser-Busch's "not-so-soft soft drink", illustrates the usefulness of experiments. Anheuser-Busch first introduced Chelsea as a socially acceptable alternative to beer for adults who didn't want to get intoxicated. As a result of the natural flavourings used, Chelsea contained a slight amount of alcohol (less than 0.5 per cent)- well within the FDA guidelines for classification as a soft drink. During an experiment to test-market the "not-so-soft soft drink", and the not-so-sweet concept, a Virginia nurse' association and some religious groups strongly criticized the company and the new product. These critics suggested that Anheuser-Busch had introduced a product that might encourage children to become beer drinkers. They contended that Chelsea was packaged like beer and looked, foamed, and poured like beer. The criticism led the brewery to suspend production, advertising, and promotion of the drink. It later reintroduced the product as a soft drink, with only "a trace of alcohol" and with not-so-sweet and stylish attributes, as a "natural alternative" to soft drinks. This experiment pointed out to Anheuser-Busch that the variable-alcohol level-caused an inadvertent miscommunication: Consumers confused the original Chelsea wit beer.

An experiment controls conditions so that one or more variables can be manipulated in order to test a hypothesis. In the Chelsea situation there was a trial of a proposed course of action and observation of the effect on sales. This case illustrates that extraneous variables are difficult to control and can influence results. It also portrays a field experiment where a deliberate modification of marketing strategy was made. Other experiments- laboratory experiments- are deliberate modifications of an environment created for the research itself. Laboratory experiments are often used in basic research to test theories. The following laboratory experiment concerned a test of equity theory. Student subjects, hired and paid for the task of scoring research questionnaires, were separated into two groups. One group was led to believe that it was less qualified than the other workers because it lacked previous experience in coding questionnaires. The group was also told that even though it was less qualified, its pay would be the same as the pay for experienced workers. Thus the students believed themselves to be overpaid. The other group did not receive any messages about the others' experience and thus was led to believe that the pay was equitable. Both groups coded the questionnaires for two hours. The "equitably" paid group was less productive than the group that believed it was overpaid.

Secondary data

As in exploratory research, descriptive and causal studies also use previously collected data. Although the terms secondary and historical are interchangeable, secondary data will be used here. An example of a secondary data study is the development of a mathematical model to predict sales on the basis of past sales or on the basis of a correlation with related variables. Manufacturers of personal computers may find that sales to households are highly correlated with discretionary personal income. To predict future market potential, data concerning projections of disposable personal income may be acquired from the government or from a university. This information can be mathematically manipulated to forecast sales. Formal secondary data studies have benefits and limitations similar to exploratory studies that use secondary data. Also, the analysis of secondary data studies generally requires a greater quantitative sophistication.

Observation techniques

In many situations the objective of the research project is merely to record what can be observed-for example, the number of automobiles that pass a site for a proposed gasoline station. This can be mechanically recorded or observed by any person. The amount of time it takes an employee to perform a task may be observed in a time-and-motion study. Research personnel, known as “mystery shoppers”, may act as customers to observe the actions of sales personnel or do “comparative shopping” to learn the prices of competitive outlets.

The main advantage of the observation technique is that it records behaviour without relying on reports from respondents. Observational methods are often non-reactive because data are collected unobtrusively and passively without a respondent’s direct participation. For instance, the A.C. Nielsen Company’s people meter is a machine attached to television sets to record the actual programs being watched by various members of the household. This eliminates the possible bias of respondents stating that they watched the president’s State of the Union address rather than the situation comedy that was on another channel.

Observation is more complex than mere “nose counting”, and the task is more difficult to administer than the inexperienced researcher would imagine. Several things of interest simply cannot be observed. Attitudes, opinions, motivations, and other intangible states of mind cannot be recorded by using the observation method.

Evaluating research design

Researchers argue that there is no one best research design for all situations. There are no hard-and-fast rules for good business research. This does not mean that the researcher, when faced with a problem, is also faced with chaos and confusion. It means that the researcher has many alternative methods for solving the problem. An eminent behavioural researcher has stated this concept quite eloquently:

"There is never a single, standard, correct method of carrying out a piece of research. Do not wait to start your research until you find out the proper approach, because there are many ways to tackle a problem-some good, some bad, but probably several good ways. There is no single perfect design. A research method for a given problem is not like the solution to a problem in algebra. It is more like a recipe for beef stroganoff. There is no one best recipe."

Knowing how to select the most appropriate research design develops with experience. Inexperienced researchers often jump to the conclusion that the survey method is the best design, because they are most familiar with this method. When Chicago's Museum of Science and Industry wanted to determine the relative popularity of its exhibits, it could have conducted a survey instead, a creative researcher, familiar with other research designs, suggested a far less expensive alternative-an unobtrusive observation technique. It was suggested that the museum merely keep track of the frequency with which the floor tiles in front of the various exhibits had to be replaced, indicating where the heaviest traffic occurred. When this was done, it was found that the chick-hatching exhibit was most popular. This method provided the same results as a survey, but at a much lower cost.

Once an appropriate design has been determined, the researcher moves on to the next stage-planning the sample to be used.

2.4.3 Planning the sample

Although the sampling plan is included in the research design, the actual sampling is a separate stage of the research process. However, for convenience, the sample planning and sample generation processes are treated together in this section.

If you take your first bite of a steak and conclude it needs salt, you have just conducted a sample. Sampling involves any procedure that uses a small number of items or that uses parts of the population to make a conclusion regarding the whole population. In other words, a sample is a subset from a larger population. If certain statistical procedures are followed, it is unnecessary to select every item in a population because the results of a good sample should have the same characteristics as the population as a whole. Of course, when errors are made, samples do not give reliable estimates of the population. A famous example of error due to sample selection is the 1936, Literary Digest Fiasco. The magazine conducted a survey and predicted that Alf Landon would win over Franklin D. Roosevelt by a landslide. History tells us there was an error due to sample selection. The post-mortems showed that literary digest had sampled telephone and magazine subscribers. In 1936 these people were not a representative cross section of voters because a disproportionate number of them were republicans.

This famous example teaches that the first sampling question that must be asked is, “Who is to be sampled?” The answer to this primary question requires the identification of a target population. Defining the population and determining the sampling units may not be obvious. For example, for answers to image questions a savings and loan company may survey people who already have accounts. He selected sampling units will not represent potential customers who do not have accounts with the savings and loan. Specifying the target population is a crucial aspect of the sampling plan.

The next sampling issue concerns sample size. How big should the sample be? Although management may wish to examine every potential buyer of a product, every employee, or every stock traded on an exchange, it is unnecessary (as well as unrealistic) to do so. Typically, large samples are more precise than small samples, but it proper probability sampling is implemented, a small proportion of the total population will give a reliable measure of the whole. (a later discussion will explain how large a sample must be to be a truly representative universe or population.)

The final sampling decision requires the researcher to choose how the sampling units are to be selected. Students who have taken their first statistics course generally are familiar with simple random sampling, where every unit in the population has an equal and known chance of being selected. However, this is only one type of sampling. For example, a cluster sampling procedure may be selected because it may reduce costs and make the data gathering procedures more efficient. If members of the population are found in close geographic clusters, a sampling procedure that selects area clusters rather than individual units in the population will reduce costs. In other words, rather than selecting 1,000 individuals throughout the United States, it may be more economical to select 25 countries and then sample within those counties. This substantially reduces travel, hiring, and training costs. In determining the appropriate sample plan, the researcher will have to select the most appropriate sampling procedure to meet established study objectives.

There are two basic sampling techniques: probability and non-probability sampling. A probability sample is defined as a sample in which every member of the population has a known, nonzero probability of selection. If sample units are selected on the basis of personal judgement (e.g., a test plant is selected because it appears to b typical), the sample method is a non-probability sample. In actuality, the sampling decision is not a simple choice between two methods. Simple random samples, stratified samples, quota samples, cluster samples, and judgemental samples are some of the many types of samples that may be drawn.

2.4.4 Data collection

Once the research design (including the sampling plan) has been formalized, the process of gathering information from respondents may begin. Obviously, because there are many research techniques, there are many methods of data collection. When the survey method is utilized, some form of direct participation by the respondent is necessary during the process. The respondent may participate by filling out a questionnaire or by interacting with an interviewer. If an unobtrusive method of data collection is utilized, the subjects do not actively participate. For instance, a simple count of motorists driving past a proposed franchising location is one kind of data collection. However the data are collected, it is important to minimize errors in the data collection process. For example, it is important that the data collection be consistent in all geographic areas. If an interviewer phrases questions incorrectly or records a respondent's statements inaccurately (not verbatim), this will cause major data collection errors. Often there are two phases to the process of collecting data: pretesting and the main study. A pretesting phase, using a small subsample, may determine whether the data collection plan for the main study is an appropriate procedure. Thus a small-scale pretest study provides an advance opportunity for the investigator to check the data collection form to minimize errors due to improper design elements, such as question wording or sequence. Additional benefits are discovery of confusing interviewing instructions, learning if the questionnaire is too long or too short, and uncovering other such field errors. Tabulation of data from the pretests provides the researcher with a format of the knowledge that may be gained from the actual study. If the tabulation of the data and statistical tests do not answer the researcher's questions, this may lead the investigator to redesign the study.

2.4.5 Data processing and data analysis

Editing and coding- Once the field work has been completed, the data must be converted into a format that will answer the decision maker's questions. Data processing generally begins with the editing and coding of the data. Editing involves checking the data collection forms for omissions, legibility, and consistency in classification. The editing process corrects problems like interviewer errors (e.g., an answer recorded on the wrong portion of a questionnaire) before the data are transferred to a computer or readied for tabulation.

Before data can be tabulated, meaningful categories and character symbols must be established for groups of responses. The rules for interpreting categorizing, recording and transferring the data to the data storage media are called codes. This coding process facilitates computer or hand tabulation. Of course, if computer analysis is to be utilized the data are entered into the computer and verified. Computer-assisted (on-line) interviewing illustrates the impact of technological changes on the research process. Telephone interviewers are seated at a computer terminal. Survey questions are printed out on the screen. The interviewer asks the questions and then types the respondents' answers on the keyboard. Thus answers are collected and processed into the computer at the same time, eliminating intermediate steps where errors could creep in.

Analysis

Analysis is the application of logic to understand and interpret the data that have been collected about a subject. In simple description, analysis may involve determining consistent patterns and summarizing the appropriate details revealed in the investigation. The appropriate analytical technique for data analysis will be determined by management's information requirements, the characteristics of the research design, and the nature of the data collected. Statistical analysis may range from portraying a simple frequency distribution to very complex multivariate analysis such as multiple regression.

2.4.6 Conclusions and report preparation

As mentioned earlier, most business research is applied research. Hence the purpose of the research is to make a business decision. An important but often overlooked aspect of the researcher's job is to look at the analysis of the collected information and ask, "what does this mean to management?" the final stage in the research process is to interpret the information and make conclusions for managerial decisions.

The research report should communicate the research findings effectively. All too often the report is a complicated statement of the study's technical aspects and sophisticated research methods. Often, management is not interested in detailed reporting of the research design and statistical findings but wishes only a summary of the findings. It cannot be overemphasized that if the findings of the research remain unread on the manager's desk, the study is useless. Research is only as good as the applications made of it. Business researchers must communicate their finings to a managerial audience. The manager's information needs will determine how much detail is provided in the written report. The written report serves another purpose: it is a historical document that will be a source of record for later usage, such as repeating the survey or providing a basis for building upon the survey findings.

2.5 RESEARCH PROJECT VERSUS RESEARCH PROGRAM

Discussion of the business research process began with the assumption that the research investigator wished to gather information to achieve a specific objective. We have emphasized the researcher's need to select specific techniques for solving one-dimensional problems, such as identifying the characteristics of productive employees, selecting the best packaging design, or forecasting bond values.

However, when we think about a firm's strategic activity in a given period of time, perhaps a year, we realize that business research is not a one-shot approach. Research is a continuous process. We may conduct an exploratory research study and then conduct a survey. It is very likely that a specific research project will be conducted for each aspect of a program. If a new product is being developed, the different types of research might include (1) market potential studies, to identify the size and characteristics of the market; (2) product usage testing, where consumers' reactions to using prototype products will be recorded; and (3) brand-name and packaging research to determine the product's symbolic connotations. Ultimately, the new product may (4) go into a test market.

Because research is a continuous process, management should view research at strategic planning level. Research program strategy refers to a firm's overall plan to utilize business research. This program is a planning activity that places each research project into the company's strategic plan.

2.6 PROBLEMS ENCOUNTERED BY RESEARCHERS IN INDIA

Researchers in India, particularly those engaged in empirical research, are facing several problems. Some of the important problems are as follows:

1. The lack of a scientific training in the methodology of research is a great impediment for researchers in our country. There is paucity of competent researchers. Many researchers take a leap in the dark without knowing research methods. Most of the work, which goes in the name of research is not methodologically sound. Research to many researchers and even to their guides, is mostly a scissor and paste job without any insight shed on the collated materials. The consequence is obvious, viz., the research results, quite often, do not reflect the reality or realities. Thus, a systematic study of research methodology is an urgent necessity. Before undertaking research projects, researchers should be well equipped with all the methodological aspects. As such, efforts should be made to provide short-duration intensive courses for meeting this requirement.

2. There is insufficient interaction between the university research departments on one side and business establishments, government departments and research institutions on the other side. A great deal of primary data of non-confidential nature remain untouched/untreated by the researchers for want of proper contacts. Efforts should be made to develop satisfactory liaison among all concerned for better and realistic researches. There is need for developing some mechanisms of a university-industry interaction programme so that academics can get ideas from practitioners on what needs to be researched and practitioners can apply the research done by the academics.

3. Most of the business units in our country do not have the confidence that the material supplied by them to researchers will not be misused and as such they are often reluctant in

supplying the needed information to researchers. The concept of secrecy seems to be sacrosanct to business organisations in the country so much so that it proves an impermeable barrier to researchers. Thus, there is the need for generating the confidence that the information data obtained from a business unit will not be misused.

4. Research studies overlapping one another are undertaken quite often for want of adequate information. This results in duplication and flutters away resources. This problem can be solved by proper compilation and revision, at regular intervals, of a list of subjects on which and the places where the research is going on. Due attention should be given toward identification of research problems in various disciplines of applied science which are of immediate concern to the industries.

5. There does not exist a code of conduct for researchers and inter-university and inter-departmental rivalries are also quite common. Hence, there is a need for developing a code of conduct for researchers which, if adhered sincerely, can win over this problem.

6. Many researchers in our country also face the difficulty of adequate and timely secretarial assistance, including computerial assistance. This causes unnecessary delays in the completion of research studies. All possible efforts be made in this direction so that efficient secretarial assistance is made available to researchers and that too well in time. University Grants Commission play a dynamic role in solving this difficulty.

7. Library management and functioning is not satisfactory at many places and much of the time and energy of researchers are spent in tracing out the books, journals, reports, etc., rather than in tracing out relevant material from them.

8. There is also the problem that many of our libraries are not able to get copies of old and new acts/rules, reports and other government publications in time. this problem is felt more in libraries which are away in places from Delhi and/or the state capitals. Thus, efforts should be made for the regular and speedy supply of all governmental publications to reach our libraries.

9. There is also the difficulty of timely availability of published data from various government and other agencies doing this job in our country. Researcher also faces the problem on account of the fact that the published data vary quite significantly because of differences in coverage by the concerning agencies.

10. There may, at times, take place the problem of conceptualization and also problems relating to the process of data collection and related things.

2.7 SUMMARY

Decision-making is the process of resolving a problem or choosing from alternative opportunities. Decision makers must recognize the nature of the problem/opportunity, identify how much information is available, and recognize what information is needed. Every business decision can be classified on a continuum ranging from complete certainty to absolute ambiguity.

There are three major types of business research projects. Which one is to be used is decided by the clarity with which the research problem is defined. Exploratory research is chosen when management knows only the general problem. It is not conducted to provide conclusive evidence but to clarify problems. Descriptive research is conducted when there is some understanding of the nature of the problem (it is used to provide an accurate description of the problem). Causal research identifies cause-and-effect relationships when the research problem has been narrowly defined.

The research process proceeds in a series of six interrelated phases. The first is problem definition, which may include exploratory research. Once the problem is defined, the researcher selects a research design. The major designs are survey techniques, experiments, secondary data analysis, and observation. Creative selection of the research design can minimize the cost of obtaining reliable results. After the design has been selected, a sampling plan is chosen, using either a probability or a non-probability sample, or a combination of the two.

The design is put into action in the data collection phase. This phase may involve a small pretest before the main study is undertaken. In the analysis stage the data are edited and coded, then processed, usually by computer. The results are interpreted in light of the decisions that management must make. Finally, the analysis is presented to decision makers in a written or oral report. This last step is crucial because an excellent project will not lead to proper action if the results are poorly communicated.

Quite often research projects are conducted together as parts of a research program. Such programs can involve successive projects that incorporate earlier findings into later research designs.

A major problem facing students of business research is that each stage in the research process is difficult to consider separately. However, without concentrated emphasis on each stage of the total research process, it is difficult to understand the individual stages in the research process. Thus learning business research is like walking a tightrope between too broad an outlook and too narrow a focus.

2.8 KEYWORDS

Exploratory Research is conducted with the expectation that subsequent researcher will be required to provide conclusive evidence.

Descriptive Research is oriented towards finding description of the characteristics of a population of phenomenon.

Causal Research is the research which attempts to study cause-effect relationship between events.

Research Project is a part of program for which research is required.

Research Program is strategy which deals with overall plan to utilize business research.

2.9 SELF ASSESSMENT QUESTIONS

1. For each situation below, decide whether the research should be exploratory, descriptive, or causal:
    a. Establishing the functional relationship between advertising and sales.
    b. Investigating reactions to the idea of a new method of defence budgeting.
    c. Identifying target-market demographics for a shopping center.

d. Estimating stock prices for IBM two years in the future.

e. Learning how many organizations are actively involved in just-in-time production.

f. Learning the extent of job satisfaction in a company.

2. Describe a research situation that allows one to infer causality.

3. A researcher is interested in knowing the answer to a why question, but does not know what sort of answer will be satisfying. Is this exploratory, descriptive, or causal research? Explain.

4. Describe the process of business research.

5. Do the stages in the research process follow the scientific method?

6. In the research process, why is the problem definition stage probably the most important stage?

7. The department of the treasury is conducting technological research into creation of a feasible, plastic-like substance upon which currency notes can be printed. Currency printed on this substance would increase the circulation life of low-value currency notes and enhance their utility in vending equipment. What type of research should be conducted?

8. What research design seems appropriate for each of the following studies?

   a. The manufacturer and marketer of flight simulators and other pilot-training equipment wish to forecast sales volume for the next five years.

   b. A manager notices the number of grievances is increasing. The manager wishes to investigate this occurrence.

c. A financial analyst wishes to investigate whether load or no-load mutual funds have high yields.
d. A corporation wishes to evaluate the quality of its college-recruiting program.
e. An academic researcher wishes to investigate if the United States is losing its competitive edge in world trade.
f. A food company researcher is interested in knowing what types of food are carried in brown-bag lunches to learn if the company can capitalize on this phenomenon.

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Lesson No.: **3**	

PROBLEM FORMULATION AND THE RESEARCH PROPOSAL

STRUCTURE

3.0 OBJECTIVES

After going through this lesson, you should be able to :

- discuss the nature of decision makers' objectives and the role they play in defining the research problem;
- understand that proper problem definition is essential for effective business research;
- explain the Iceberg principle;

- understand that identifying key variables is important;
- discuss the influence of the statement of the business problem on the specific research objectives;
- state research problems in clear and precise research objectives;
- explain the purpose of the research proposal; and
- outline a research proposal.

3.1 INTRODUCTION

You know that a decision maker's degree of uncertainty influences decisions about the type of research that will be conducted. This lesson elaborates on the conditions under which decision making occurs and the process managers use to clearly define business problems and opportunities.

Remember that managers may be completely certain about situations they face. For example, a retail store may have been recording and analyzing optical scanner data for years and know exactly what information its optical scanners need to record every day. Routine research techniques regularly investigate routine problems that have already been defined.

At the other extreme, a manager or researcher may describe a decision-making situation as absolute ambiguity. The nature of the problem to be solved is unclear. The objectives are vague and the alternatives are difficult to define. This is by far the most difficult decision situation.

Most decision-making situations fall somewhere between these two extremes. Managers often grasp the general nature of the objectives they wish to achieve, but some uncertainty remains about the nature of the problem. They often need more information about important details.

Their information is incomplete. They need to clear up ambiguity or uncertainty before making a formal statement of the business problem.

3.2 IMPORTANCE OF PROPER PROBLEM DEFINITION

The formal quantitative research process should not begin until the problem has been clearly defined. Properly and completely defining a business problem is easier said than done. When a problem or opportunity is discovered, managers may have only vague insights about a complex situation. For example, morale may be declining at a West Coast television studio, and management does not know the reason. If quantitative research is conducted before learning exactly what issues are important, false conclusions may be drawn from the investigation. The right answer to the wrong question may be absolutely worthless. A decision made on the basis of a solution to the wrong problem may actually be harmful.

Consider what happened when Coca-Cola made the decision to change its Coke formula. The company's managers decided to investigate the ultimate consumers' reactions to the taste of reformulated Coke and nothing more. (The company carried out a series of taste tests in shopping malls. No take-home taste tests were conducted.) In retrospect we know about the consumer protests associated with dropping the original formula of Coke, and we are aware that there was a larger problem. Coke's business research was too narrow in scope and the problem was not adequately defined. Coca-Cola tested one thing and one thing only. The business research failed to identify consumers' emotional attachment and loyalty to the brand as a problem for investigation. There is a lesson to be learned from the Coca-Cola mistake: Do not ignore investigating the emotional aspects of human behavior.

Just because a problem has been discovered or an opportunity has been recognized does not mean that the problem has been defined. A

problem definition indicates a specific managerial decision area that will be clarified by answering some research questions.

3.3 SOURCES OF PROBLEMS

You may be asking yourself, “So where do I find one of those numerous significant problems that need research?” While there are several major sources of problems, the most meaningful ones are generally those derived from theory. Many of us will casually comment that we have a theory about something, meaning that we have a hunch or belief about something. As Kerlinger (1973) states, “A theory is a set of interrelated constructs (concepts), definitions, and propositions that represent a systematic view of phenomena by specifying relations among variables, with the purpose of explaining and predicting phenomena.”

There are many relevant theories in management, such as theories of motivation and leadership, from which problems can be drawn. The fact that a theory is a theory and not a body of facts means that it contains generalizations and hypothesized principles that must be subjected to rigorous scientific investigation. Problems derived from a theoretical problem area are not only preferable in terms of contribution to true scientific progress in management, they also facilitate the formulation of hypotheses based on a sound rationale; these hypotheses in turn facilitate ultimate interpretation of study results. The results of a study based on a theoretical problem contribute to their related theory by confirming or disconfirming some aspect of the theory and also by suggesting additional studies that need to be done.

To be perfectly honest, however, the selection of a problem based on theory may be too complicated for many beginning researchers. There are a great number of problems that need research that are not theoretical in nature. An obvious source of such problems is the researcher’s personal experiences. Many management students who are beginning researchers come from the ranks of the employed. It is hard to imagine an employee who has never had a idea concerning a better way to do something (a way to increase efficiency or improve morale) or been a participant in a program or consumer of a product whose effectiveness was untested. Thus practical experience may be a source of researchable problems. This is not to say that an idea based on these experiences will never lead to a theoretical problem, it is just more likely that the problem will result in an applied research study that may be easier for the beginning researcher to manage.

As mentioned previously, the literature is also a good source of problems. In addition to overviews and summaries, which are more helpful in narrowing down a problem area, specific studies often indicate next-step studies that need to be conducted. The suggested next step may involve a logical extension of the described study or simply replication of the study in a different setting in order to establish the generalizability of its findings. It is generally not a good idea, however, simply to replicate a study as it was originally conducted; there is much to be learned from developing and executing your own study. Replication of certain studies, however, is highly desirable, especially those whose results conflict with previous research or do not support some aspect of an established theory.

3.4 CHARACTERISTICS OF RESEARCH PROBLEMS

A research problem by definition involves an issue in need of investigation. So, a basic characteristic of a research problem is that it is "researchable." A researchable problem is first one that can be investigated through the collection and analysis of data. Some problems dealing with philosophical or ethical issues are not researchable. Research can assess how people feel or what they think about some of these issues, but research cannot resolve them. Whether or not there is reward and punishment in the hereafter may be an important problem to many people, but it is not researchable; there is no way to resolve it through the collection and analysis of data. Similarly, in management there are a number of issues that make great topics for debates (such as "Should drug testing be implemented for all employees?") but are not researchable problems when stated in that way.

A second major characteristic of a good problem is that it has theoretical or practical significance. Of course the most significant problems are those derived from theory; even if the problem is not theoretical, however, its solution should contribute in some way to improvement of the management process. If the typical reaction to your problem is, "Who cares?" it probably is not of sufficient significance to warrant a study!

A third major characteristic of a good problem is that it is a good problem for you. The fact that you have chosen a problem of interest to you, in an area in which you have expertise is not sufficient. It must be a problem that you can adequately investigate given: (a) your current level of research skill, (b) available resources, and (c) time and other restrictions. As a beginning researcher, you have access to one or more faculty members in addition to your instructor who can help you to assess the feasibility of your proposed study.

3.5 THE PROCESS OF PROBLEM FORMULATION

Defining a research problem involves several interrelated steps.

They are:

1. Ascertain the decision maker's objective.
2. Understand the background of the problem.
3. Isolate and identify the problem rather than its symptoms.
4. Determine the unit of analysis.

5. Determine the relevant variables.
6. State the research questions (hypotheses) and research objectives.

Ascertain the decision maker's objectives

As a staff person. the research investigator must attempt to satisfy the objectives of the line manager who requested the project. Management theorists suggest the decision maker should express his or her goals to the researcher in measurable terms. Relying on the expectation that a decision maker will follow this recommendation is, unfortunately, somewhat optimistic:

Despite a popular misconception to the contrary, objectives are seldom clearly articulated and given to the researcher. The decision maker seldom formulates his objectives accurately. He is likely to state his objectives in the form of platitudes which have no operational significance. Consequently, objectives usually have to be extracted by the researcher. In so doing, the researcher may well be performing his most useful service to the decision maker.

Researchers who must conduct investigations when the line manager wants the information "yesterday" do not usually get a great deal of assistance when management is asked, "What are your objectives for this study?" Nevertheless, both parties should attempt to have a clear understanding of the purpose for undertaking the research.

One effective technique for uncovering elusive research objectives consists of presenting the manager with each possible solution to a problem and asking whether he or she would follow that course of action. If the decision maker says "no," further questioning to determine why the course of action is inappropriate usually will help formulate objectives.

Often exploratory research can illuminate the nature of the opportunity or problem and help managers clarify their objectives and decisions.

Iceberg principle: Why do so many business research problems begin without clear objectives or adequate problem definitions? Managers are logical people, and it seems logical that definition of the problem is the starting point for any enterprise. Frequently researchers and managers cannot discover the actual problem because they lack sufficiently detailed information; the **iceberg principle** serves as a useful analogy. A sailor on the open sea notices only a small part of an iceberg, Only 10 percent of it is above the surface of the water, and 90 percent is submerged. The dangerous part of many business problems, like the submerged portion of the iceberg, is neither visible to nor understood by managers. If the submerged portions of the problem are committed from the problem definition (and subsequently from the research design), the decisions based on the research may be less than optimal. The example of the new Coke is a case in point. Omission of important information or a faulty assumption about the situation can be extremely costly.

Understanding the background of the problem

Although no textbook outline exists for identifying the business problem, the iceberg principle illustrates that understanding the background of a problem is vital. Often experienced managers know a great deal about a situation, and can provide the researchers with considerable background information about previous events and why those event happened. In situations in which the decision maker's objectives are clear, the problem may be diagnosed exclusively by exercising managerial judgment. In other situations in which information about what has happened previously is inadequate or if managers have trouble identifying the problem, a **situation analysis** is the logical first step in defining the problem. A situation analysis involves a preliminary investigation or informal gathering of background information to familiarize researchers or managers with the decision area. Gaining an awareness of organizational or environmental conditions and an appreciation of the situation often requires exploratory research.

Isolating and identifying the problem, not the symptoms

Anticipating all of the dimensions of a problem is impossible for any researcher or executive. For instance, a firm may have a problem with its advertising effectiveness. The possible causes of this problem may be low bran awareness, the wrong brand image, use of the wrong media, or perhaps too small a budget. Management's job is to isolate and identify the most likely causes. Certain occurrences that appear to be "the problem" may be only symptoms of a deeper problem. Exhibit 3.1 illustrates how symptoms may cause confusion about the nature of the true problem.

Other problems may be identified only after a search of background information and after conducting exploratory research. How does one ensure that the fundamental problem, rather than symptoms associated with the problem, has been identified? There is no easy or simple answer to this question. Executive judgement and creativity must be exercised.

EXHIBIT 3.1 SYMPTOMS CAN BE CONFUSING

Organization	**Symptoms**	**Problem Definition Based on Symptoms**	**True Problem**
20-year-old neighborhood swimming association in a major city	Membership has been declining for years; new water park with wave pool and water slides moved into town a few years ago.	Neighborhood residents prefer the expensive water park and have a negative image of the swimming pool.	Demographic changes: Children in the neighborhood have grown up, and older residents no longer swim at all.
Cellular phone manufacturer	Women employees complain that salaries are too low.	Salaries need to be compared to industry averages.	Benefits program is not suited to women's needs (e.g., maternity leave).

Brewery	Consumers prefer taste of competitor's product.	Taste of brewery's product needs to be reformulated.	Old-fashioned package is influencing taste perception.
Television station	Few employees change retirement plan after money market annuity option becomes available.	Attributes of money market annuity program need to be changed.	Except for those close to retirement, most employees are not highly involved in detailed pension-investment decision; knowledge about plan is minimal.

Determine the unit of analysis

Defining the problem requires that the researcher determine the unit of analysis for study. The researcher must specify whether the level of investigation will focus on the collection of data about organizations, departments, work groups, individuals, or objects. In studies of home buying, for example, the husband-wife dyad rather than the individual typically is the unit of analysis because the purchase decision is jointly made by husband and wife.

Researchers who think carefully and creatively about situations often discover that a problem may be investigated at more than one level of analysis. Determining the unit of analysis, although relatively straightforward in most projects, should not be overlooked during the problem definition stage of the research. It is a crucial aspect of problem definition.

Determine the relevant variables

Another aspect of problem definition is identification of the key variables. The term variable is an important one in research. A *Variable* is defined as anything that varies or changes in value. Because a variable represents a quality that can exhibit differences in value, usually in magnitude or strength, it may be said that a variable generally is anything that may assume different numerical or categorical values.

Key variables should be identified in the problem definition stage. Attitude toward brokerage firms may be a variable, for example, as people's attitudes may vary from positive to negative. The attitude toward each of the many characteristics of brokerage firms, such as availability of investment advisory services, newsletters, toll-free calls, and the like, would be a variable.

In statistical analysis a variable is identified by symbol such as X. Categories or numerical values may then be associated with this symbol. The variable "sex" may be categorized as male or female; sex is therefore a **categorical**-or classificatory-**variable** because it has a limited number of distinct values. On the other hand, sales volume may encompass an infinite range of numbers; it is therefore a **continuous variable**-one having an infinite number of values.

To address the specific problem, managers and researchers should be careful to include all of the relevant variables that must be studied. Similarly, variables that are superfluous (i.e., not directly relevant to the problem) should not be included.

In causal research the terms dependent variable and independent variable are frequently encountered. A **dependent variable** is a criterion or a variable that is to be predicted or explained. An **independent variable** is a variable that is expected to influence the dependent variable. For example, average hourly rate of pay may be a dependent variable that is influenced or can be predicted by an independent variable such as number of years of experience.

State the research questions and research objectives

Both managers and researchers expect problem solving efforts to result in statements of research questions and research objectives. At the end of the problem solving stage of the research process researchers should prepare a written statement that clarifies any ambiguity about what they hope the research will accomplish.

How can the problem statement be clarified?

Formulating a series of research questions and hypotheses can add clarity to the statement of the business problem. For example, a company made the following statement to define a training problem: In the broadest sense, the business problem is to determine the best ways our company can train existing and potential users of desktop personal computers. This problem statement led to the following research questions: How familiar are employees with the various software applications for personal computers? What attitudes do employees have toward these software packages? How important are the various factors for evaluating the use of a personal computer? How effective are our training efforts in terms of increased knowledge and increased use of the new applications?

The inclusion of research questions makes it easier to understand what is perplexing managers and indicates the issues to be resolved. A research question is the researcher's translation of the business problem into a specific need for inquiry. For example, a research question such as "Is Advertising Copy X better than Advertising Copy Y?" is vague and too general. Advertising effectiveness can be variously measured-by sales, recall of sales message, brand awareness, intentions to buy, and so on. A more specific research question such as "Which advertisement has a higher day-after recall score?" helps the researcher design a study that will produce pertinent information. The answer to the research question should be a criterion that can be utilized as a standard for selecting alternatives. This stage of the research is obviously related to problem definition. The goal of defining the problem is to state the research questions clearly and to have well formulated hypotheses.

A **hypothesis** is an unproven proposition or possible solution to a problem. Hypothetical statements assert probable answers to research questions. A hypothesis is also a statement about the nature of the world, and in its simplest form it is a guess. A manager may hypothesize that salespersons who show the highest job satisfaction will be the most productive salespersons. An organizational researcher may believe that if workers' attitudes toward an organizational climate are changed in a positive direction, there will be an increase in organizational effectiveness among these workers.

Problem statements and hypotheses are similar. Both state relationships, but problem statements phrased as questions are interrogative and hypotheses are declarative. Sometimes they are almost identical in substance. An important difference, however, is that hypotheses are usually more specific than problem statements; they are usually closer to the actual research operations and testing. Hypotheses are statements that can be empirically tested.

Formal statements of hypotheses have considerable practical value in planning and designing research. They force researchers to be clear about what they expect to find through the study, and further, the formal statement raises crucial questions about the data that will be required in the analysis stage. When evaluating a hypothesis, research management should make sure the information collected will be useful in decision making. Notice how the following hypotheses express expected relationships between variables:

There is a positive relationship between "mail order" catalog buying and the presence of younger children in the home.

Voluntary turnover (quitting) will be higher among employees who perceive themselves to be inequitably paid than among employees who perceive themselves to be equitably paid.

Among non-exporters, the degree of perceived importance to overcoming barriers to exporting is related positively to general interest in exporting (export intentions).

Common stocks bought at high dividend yields will afford lower average returns than securities bought at lower dividend yields.

Managers with decisive and flexible decision styles will process less accounting data than those with hierarchic and integrative decision styles.

EXHIBIT 3.2: BUSINESS PROBLEM TRANSLATED INTO RESEARCH OBJECTIVES

Management Problem	**Research Questions**	**Research Objectives**
Should the organization offer outplacement?	Are managers aware of outplacement services?	To determine managers' awareness using aided recall
	How concerned are managers about outplacement services	To measure managers' satisfaction with existing personnel policies
Which of the service should be offered?	How do managers evaluate the need for severance pay?	To obtain ratings and rankings of the various outplacement services
Severance pay? New employment assistance? Personal counseling? Job contacts?	New-employment assistance? Job contacts? What are the benefits of each outplacement service?	To identify perceived benefits and perceived disadvantages of each out placement service

Should the services be provided by in house personnel or outside consultants?	Would managers prefer in house personnel or outside consultants? How much would each alternative cost?	To measure managers' perceived benefits and disadvantages of in-house versus outside consultants To identify costs associated with each alternative
Do employees with tenor more years of service have different awareness levels etc. than employees with less than ten years of service	Do the answers to the above questions differ by employee's years of service	To compare, using cross- tabulations levels of awareness, evaluations, etc. of managers with tenor more years of service with managers with less than ten years of service

Note: For simplification, hypotheses are omitted from the table.

Decision-Oriented Research Objectives: The research objective is the researcher's version of the business problem. Once the research questions and/or hypotheses have been stated the research project objectives are derived from the problem definition. These objectives explain the purpose of the research in measurable terms and define standards of what the research should accomplish. In addition to stating the reason for initiating the research project, outlining objectives helps to ensure that the project will be manageable in size. Exhibit 3.2 illustrates how the business problem of a large organization– is translated into research objectives.

In some instances the business problems and the research objectives are the same. The objectives must, however, specify the information needed to make a decision. Identifying the information needed may require managers or researchers to be as specific as listing the exact wording of the questions in a survey of explaining exactly what behavior might be observed or recorded in an experiment. Statements about the required precision of the information or the source of the information may be required to clearly communicate exactly what information in needed. Many career decisions, for example, are made by both a husband and wife. If this is the case, the husband-wife decision-making unit is the unit of analysis. The objective of obtaining X information about research questions from this unit should be specifically stated.

It is useful if the research objective is a managerial action standard. If the criterion to be measured (e.g., absenteeism, sales, or attitude changes) turns out to be X, then management will do A: if it is Y, then management will do B. This type of objective leaves no uncertainty about the decision to be made once the research is finished.

The number of research objectives should be limited to a manageable quantity. The fewer the study objectives, the easier it to ensure that each will be addressed fully.

In our earlier example of an organization's research concerning outplacement service, the broad research objective- to determine manager's perceived need for outplacement services in the organization-was translated into specific objectives, namely to determine ranked preferences for severance pay, new employment assistance, and the like; to compare the needs of employees having more than ten years of service with those having less than ten, years of service' and so on. Therefore specific objectives influence the research design because they indicate the type of information needed. Once the research is conducted, the results may show an unanticipated aspect of the problem and may suggest that additional research is necessary to satisfy the main objective. Exploratory research may help in the overall definition of the management problem. In routine situations or when managers are quite familiar with background information, however, it is quite likely the problem definition will be based exclusively on the decision maker's objectives.

3.6 FORMULATION AND STATEMENT OF A HYPOTHESIS

Definition and Purpose

A hypothesis is a tentative explanation for certain behaviors, phenomena, or events that have occurred or will occur. A hypothesis states the researcher's expectations concerning the relationship between the variables in the research problem; a hypothesis is the most specific statement of the problem. It states what the researcher thinks the outcome of the study will be. The researcher does not then set out to "prove" his or her hypothesis but rather collects data that either support the hypothesis or do not support it; research studies do not "prove" anything. Hypotheses are essential to all research studies with the possible exception of some descriptive studies whose purpose is to answer certain specific questions.

The hypothesis is formulated following the review of related literature and prior to the execution of the study. It logically follows the review since it is based on the implications of previous research. The related literature leads one to expect a certain relationship. For example, studies finding black type to be more effective than brown type in business letter would lead a researcher to expect it to be more effective in resumes, if there were no findings to the contrary. Hypotheses precede the study proper because the entire study is determined by the hypothesis. Every aspect of the research is affected by the hypothesis, including subjects (the sample), measuring instruments, design, procedures, data-analysis techniques, and conclusions. Although all hypotheses are based on previous knowledge and aimed at extending knowledge, they are not all of equal worth. There are a number of criteria that can be, and should be, applied to a given hypothesis to determine its value.

Characteristics of the Hypothesis

By now, it should be clear that a hypothesis should be based on a sound rationale. It should follow from previous research and lead to future research; its confirmation or disconfirmation should contribute to management theory or practice. Therefore, a major characteristic of a good hypothesis is that it is consistent with previous research. The chances of your being a Christopher Columbus of management research who is going to show that something believed to be square is really round are slim. Of course, in areas of research where there are conflicting results, you will not be able to be consistent with all of them, but your hypothesis should follow from the rule, not the exception.

The previously stated definition of a hypothesis indicated that it is a tentative explanation for the occurrence of certain behaviors, phenomena, or event. A good hypothesis provides a reasonable explanation. If your telephone is out of order, you might hypothesize it is because there are butterflies sitting on your telephone wires; such a hypothesis would not be a reasonable explanation. A reasonable hypothesis might be that you forgot to pay your bill or that a repair crew is working outside. In a research study, on the one hand, a hypothesis suggesting that employees with freckles are more effective salespeople than employees without freckles would not be a reasonable explanation for effective salesmanship, unless the product they were selling was a cosmetic cover-up. On the other hand, a hypothesis suggesting that employees with high motivation are able to sell more might be a good hypothesis.

A good hypothesis states as clearly and concisely as possible the expected relationship (or difference) between two variables and defines those variables in operational, measurable terms. A simply but clearly stated hypothesis makes it easier for consumers of research to understand, simplifies the testing, and facilitates formulation of conclusions following data analysis. The relationship expressed between two variables may or may not be a causal one. For example, the variables of high motivation and effective salesmanship might be hypothesized to be significantly related, or it might be hypothesized that salespeople with high motivation perform better on low-volume, high cost sales than they do on high-volume, low-cost sales. The above example also illustrates the need for operational definitions. What is high motivation? What does "perform better" mean? What are low-volume, high-cost sales as opposed to high-volume, low-cost sales? What type of sales are we talking about? Cosmetics? Electronics? Cars? The dependent variable in a hypothesis will often be operationally defined in terms of scores on a given test. For example, high, motivation may be defined as a score of 40+ on the Sales Motivation Inventory, Revised (Bruce, 1977). You may have already defined your terms in your problem statement; the general rule of thumb is to define terms the first time they are used. If the appropriate terms can be operationally defined again within the actual hypothesis statement without making it unwieldy, this should be done. If you did not define your terms in the problem statement or the hypothesis, then you should place your definitions immediately following the hypothesis.

If it is well formulated, defined, and stated, a hypotheses will also be testable. It should be possible to support or not support the hypothesis by collecting and analyzing data. It would not be possible to test a hypothesis that indicated that some employees are more honest than other because some have an invisible little angel on their right shoulder and some have an invisible little devil on their left shoulder. These would be no way to collect data to support or not support the hypothesis. In addition be being testable, a good hypothesis should normally be testable within some reasonable period of time. For example, the hypothesis that requiring new employees to participate in pre-retirement planning as part of their orientation will result in happier retirees would obviously take a very long time to test. The researcher would very likely be long gone before the study was completed, not to mention the negligible significance of the hypothesis to managers. A more manageable hypothesis with the same theme might be that requiring new employees to participate in pre-retirement planning as part of their orientation will result in more employee participation in voluntary retirement benefit programs.

Type of Hypotheses

Hypotheses can be classified in terms of how they are derived (inductive verses deductive hypotheses) or how they are stated (declarative versus null hypotheses). An inductive hypothesis is a generalization based on observation. Certain variables are noted to be related in a number of situations, and a tentative explanation, or hypothesis, is formulated. Such inductively derived hypotheses can be very useful but are of limited scientific value in that they produce results that are not meaningfully related to any larger body or research. Deductive hypotheses derived from theory do contribute to the science of management by providing evidence that supports, expands, or contradicts a given theory and by suggesting future studies. In other words, your hypothesis should be a logical extension of previous efforts, not an inferential leap.

Hypotheses are classified as research hypothesis or statistical hypothesis; research hypotheses are stated in declarative form, and statistical hypotheses are stated in null form. A research hypothesis states an expected relationship or difference between tow variables; in other words, the relationship the researcher expects to verify through the collection and analysis of data is specified. Research, or declarative, hypotheses are nondirectional or directional. A nondirectional hypothesis simply indicated that a relationship or difference exists; a directional hypothesis indicated the nature of the relationship or difference. For example, a nondirectional hypothesis might state:

There is a significant difference in amount of data input by data entry personnel who are evaluated on a weekly basis and those who are evaluated on a six months basis only.

The corresponding directional hypothesis might state.

Data entry personnel who are evaluated on a weekly basis input more data than personnel who receive evaluation on a six months basis.

A directional hypothesis should not be stated if you have any reason whatsoever to believe that the results may occur in the opposite direction. Non-directional and directional hypotheses involve different types of statistical tests of significance.

A statistical, or null, hypothesis states that there is no relationship (or difference) between variables and that any relationship found will be a change relationship, not a true one. For example, a null hypothesis might state:

There is no difference in the data entry input of personnel who are evaluated on a weekly basis and those who are evaluated on a six months basis.

While a research hypothesis may be a null hypothesis, this is not very often the case. Statistical, or null, hypotheses are usually used because they suit statistical techniques that determine whether an observed relationship is probably a change relationship or probably a true relationship. The disadvantage of null hypotheses is that they rarely express the researcher's true expectations based on insight and logic regarding the results of a study. One solution is to state two hypotheses, a declarative research hypothesis that communicated your true expectation and a statistical null hypothesis that permits precise statistical testing. Another solution is to state a research hypothesis, analyze your data assuming a null hypothesis, and then make inferences concerning your research hypothesis based on your testing of a null hypothesis. Given that few studies are really designed to verify the non-existence of a relationship, it seems logical that most studies should be based on a non-null research hypothesis.

Stating the Hypothesis

As previously discussed, a good hypothesis is stated clearly and concisely, expresses the relationship between two variables, and defines those variables in operational measurable terms. A general paradigm, or model, for stating hypotheses for experimental studies which you may find useful is as follows:

Ss who get X do better on Y than
Ss who do not get X (or get some other X)

If this model appears to be an over-simplication, it is, and it may not always be appropriate. However, this model should help you to understand the nature of a hypothesis statement. Further, this model, or a variation of it, will be applicable in a surprising number of situations. In the model,

S = the subjects,

X = the treatment, the independent variable (IV), and

Y = the observed outcome, the dependent variable (DV).

Study the following example and see if you can identify S, X, and Y:

New employees who have assigned mentors have higher first year perform evaluations than new employees who do not have assigned mentors.

In this example,

S = new employees

X = mentoring (assigned versus not assigned), IV, and

Y= performance (higher first year ratings), DV.

OK? Try one more

Management students, who have not had previous training in research or statistics, who successfully complete a research course during their first semester in graduate school, have higher overall GPAs (grade point averages) than management student... who successfully complete a research course at the end of their graduate studies.

In this example,

S = management students who have not had previous training in research or statistics,

X = timing of successful completion of a research course (first semester versus end of graduate studies), IV, and

Y = overall GPAs, DV.

For a null hypothesis, the paradigm is

There is no difference on Y between Ss who get X and Ss who do not get X (or get some other X).

See if you can think of an example that illustrates the model for null hypotheses.

Testing the Hypothesis

Hypothesis testing is really what scientific research is all about, In order to test a hypothesis, the researcher determines the sample, measuring instruments, design, and procedure that will enable her or him to collect the necessary data. Collected data are then analyzed in a manner that permits the researcher to determine the validity of the hypothesis. Analysis of collected data does not result in a hypothesis being proven or not proven, only supported or not supported. You may find as a result or taking this course that your language is changed; you may forever be less likely to assert what is proven or not, and it is to be hoped, you will be better able to evaluate other' results rather than accepting them on face value. The results of a study only indicate whether a hypothesis was "true" for the particular subjects involved in the study. Many beginning researchers have the misconception that if their hypothesis is not supported by their data, then their study is a failure, and conversely, if it is supported then their study is a success. Neither of these beliefs is true. It is just as important, for example, to know what variables are not related as it is to know what variables are related. If a hypothesis is not supported, a valuable contribution may be made in the form of a revision of some aspect of a theory; such revision will generate new or revised hypotheses. Thus, hypothesis testing contributes to the science of management, as well as business effectiveness, primarily by expanding, refining, or revising theory.

3.7 TIMING ASPECT OF A PROBLEM

Budget constraints usually influence the amount of effort that will be spent defining the problem. Most business situations are complex, and numerous, variables may have some influence. It is impractical to search for every conceivable cause and minor influence. The importance of the recognized problem will dictate what is a reasonable amount of time and money to spend to determine which explanations or solutions are most likely.

Managers- those responsible for decision making– generally want the problem definition process to proceed quickly, whereas researchers usually take long periods of time to carefully define problems and thereby frequently frustrate managers. Nevertheless, the time spent to identify the correct problem to be researched is time well spent.

3.8 THE RESEARCH PROPOSAL

The research proposal is a written statement of the research design. It always includes a statement explaining the purpose of the study (research objectives) or a definition of the problem. It systematically outlines the particular research methodology and details the procedures that will be utilized at each stage of the research process. Normally a schedule of costs and deadlines will be included in the research proposal. Exhibit 3.3 illustrates a short research proposal for an Internal Revenue Service (IRS) study to explore public attitudes toward a variety of tax-related issues.

Preparation of a research proposal forces the researcher to critically think through each stage of the research process. Vague plans, Abstract ideas, and sweeping generalizations about problems or procedures must become concrete and precise statements about specific events. What information will be obtained and what research procedures will be implemented have to be clearly specified so other may understand their exact implication. All ambiguities about why and how the research will be conducted must be clarified before the proposal is complete.

Because the proposal is a clearly outlined plan submitted to management for acceptance or rejection, it initially performs a communication function; is serves as a mechanism that allows managers to evaluate the details of the proposed research design and determine if alterations are necessary. The proposal helps managers decide if the proper information will be obtained and if the proposed research will accomplish what is desired. If the business problem has not been adequately translated into a set of specific research objectives and research design, the client's assessment of the proposal will help ensure that the researchers revise the proposal to meet the client's information needs.

The proposal needs to communicate exactly what information will be obtained, where it will be obtained, and how it will be obtained. For this reason, proposals must be explicit about sample selection, measurement, fieldwork, and so on. For instance, most survey proposals will include a copy of the proposed questionnaire, at bare minimum some sample questions, to ensure that managers and researchers agree on the information to be obtained and how questions should be worded.

EXHIBIT 3.3: AN ABBREVIATED VERSION OF A RESEARCH PROPOSAL FOR THE IRS

Purpose of the Research

The general purpose of this study is to determine the taxpaying public's perceptions of the role of the IRS in administering the tax laws, In defining the limits of this study, the IRS identified study areas to be addressed. A careful review of these question areas led to the development of the following specific research objectives:

1. To identify the extent to which taxpayers cheat on their returns, their reasons for doing so, and approaches which can be taken to deter this behavior.

2. To determine taxpayers' experience and satisfaction with various IRS services

3. To determine what services taxpayers need.

4. To develop an accurate profile of taxpayers' behavior relative to the preparation of their income tax returns.

Research Design

The survey research method will be the basic research design. Each respondent will be interviewed in the home of the respondent. The personal interviews are generally expected to last between 35 and 45 minutes, although the length of the interviews will vary depending on the previous tax-related experiences of the respondent. For example, if a respondent has never been audited, question on audit experience will not be addressed. Or, if a respondent has never contacted the IRS for assistance, certain questions concerning reactions to IRS services will be skipped.

Some sample questions that will be asked are:

Did you (or your spouse) prepare your federal tax return for (year)?

Self
Spouse
Someone else
Did the federal income tax package you received in the mail contain all the forms necessary for you to fill out your return?
Yes
No
Didn't receive one in the mail
Don't know

The format for the IRS research proposal in Exhibit 3.3 follows the six stages in the research process. Each stage implies that one or more questions must be answered bore selecting one of the various alternatives facing the business researcher. For example, before a proposal can be completed, one has to ask "What is to be measured?" Simply answering "market share" may not be enough – market share may be measured by auditing retailer' or wholesalers' sales, by using trade association data, or by asking consumers what brands they buy, The question of what is be measured is just one of the important questions that need to be answered before setting the research process into motion. For now an overview of issues is presented for each stage of the research process. Exhibit 3.4 outlines some of the basic questions that managers and researcher typically have to answer when planning a research design.

Review the IRS research proposal to see how some of these issues were answered in a specific situation. The entire textbook will have to be read before these issues can be fully understood, however.

If you were calling the IRS for assistance and someone were not able to help you immediately, would you rather get a busy signal or be asked to wait on hold?

☐ Busy signal

☐ Wait on hold

☐ Neither

☐ Don't Know

During the interview a self-administered written questionnaire will be given to the taxpayer. The questionnaire will ask certain sensitive questions such as:

Have you ever claimed a dependent on your tax return that you weren't really entitled to?

Yes ☐

No ☐

Sample Design

A survey of approximately 5,000 individuals located in 50 counties throughout the country will provide the database for this study. The sample will be selected on a probability basis form all households in the continental United States.

Eligible respondents will be adults, over the age of 18, Within each household an effort will be made to interview the individual who is most familiar with completing the federal tax forms. When there is more than one taxpayer in the household, a random process will be used to select the taxpayer to be interview.

Data Gathering

The fieldworkers of a field research organization will conduct the interview.

Data processing and Analysis

Standard editing and coding procedures will be utilized. Simple tabulation and cross tabulations will be utilized to analyze the data.

Report Preparation

A written report will be prepared, and an oral presentation of the findings will be made by the research analyst at the convenience of the IRS.

Budget and Time Schedule

(Any complete research proposal should include (1) a schedule of how long it will take to conduct each stage of the research and (2) a statement of itemized costs.)

In business one often hears the adage “Don’t say it, write it.” This is wise advice for the researcher who is proposing a research project to management. Misstatements and faulty communication may occur if the parties rely only on each individual’s memory of what occurred at a planning meeting. Writing the research design in a proposal format, specifying exactly what will be done, creates a record to which everyone can refer and eliminated many problems that might arise after the research has been conducted. Finding out after the fact (after the research) that information related to a particular variable was omitted or that the sample size was too small for a particular subgroup is less likely to occur with written proposals. Further, as a statement of agreement between the executives and researchers, the formal proposal will reduce the tendency for someone reading the results to say, “Shouldn’t we have had a larger sample?” or “Why didn’t you do it this way?” As a record of the researcher’s obligation, the proposal also provides a standard for determining if the actual research was conducted as originally planned.

When a consultant or an outside research supplier will be conducting the research, the written proposal serves as company’s bid to offer a specific service.

EXHIBIT 3.4: BASIC QUESTIONS TYPICALLY ASKED WHEN PLANNING A RESEARCH DESIGN

Decision to Make in the Research Process	**Basic Questions**
Problem definition	What is the purpose of the study? How much is already known? What is to be measured? How? Can the data be made available? Should research be conducted? Can a hypothesis be formulated?
Selection of basis research design	What types of questions need to be answered? Are descriptive or causal findings required? What is the source of the data? Can objective answers be obtained by asking people? How quickly is the information needed? How should survey questions be worked? How should experimental manipulation be made?
Selection of sample	Who or what is the source of the data? Can the target population be identified? Is a sample necessary? How accurate must the sample be? Is a probability sample necessary? Is a national sample necessary? How large a sample is necessary? How will the sample be selected?

Data gathering	Who will gather the data? How long will data gathering take? How much supervision is needed? What operational procedures need to be utilized?
Data analysis and evaluation	Will standardized editing and coding procedures be utilized? How will the data be categorized? Will computer or hand tabulation be utilized? What questions need to be answered? How many variables are to be investigated simultaneously? What are the criteria for evaluation of performance?
Type of report	Who will read the report? Are managerial recommendations requested? How many presentations are required? What will be the format of the written report?
Overall evaluation	How much will the study cost? Is the time frame acceptable? Do we need outside help? Will this research design attain the stated research objectives? When should the research be scheduled to begin?

Typically, a client will solicit several competitive proposals, and these written offers help management judge the relative quality of alternative researcher suppliers.

One final comment needs to be made about the nature of research proposals: All proposals do not follow the same format. The researcher must adapt his or her proposal to the audience to whom the proposal will be submitted. An extremely brief proposal submitted by an organization's internal research department to its own executives bears little resemblance to a complex proposal submitted by a university professor to an agency of the government (such as UGC) to test a basic theory about international financial market.

3.9 PREDICTION OF OUTCOMES

The presentation of data processing and analysis in Exhibit 3.4 is extremely brief as this topic will be discussed in detail in some subsequent lesson. However, at this stage of our discussion some advice about data analysis needs to be given.

One aspect of problem definition often lacking in research proposals is anticipating the outcome, that is, the statistical findings, of the study. The use of a dummy table in the research proposal often helps the manager gain a better understanding of what the actual outcome of the research will be. Dummy tables are representations of the actual tables that will be in the findings section of the final report. They are called dummy tables because the researcher fill in or "dummies up" the tables with likely, but fictitious, data. In other words, the researcher anticipates what the final research report will contain.

A research analyst can present dummy tables to the decision maker and ask. "Given these findings, will you be able to make a decision to solve your managerial problem?" If the decision maker says "Yes," then the proposal may be accepted. However, if the decision maker cannot glean enough information from these dummy tables to make a decision about what the company would do with the hypothetical outcome suggested by the tables, then the decision maker must rethink what outcomes and data analyses are necessary to solve the problem. In other words, the business problem is clarified by deciding on action standards or performance criteria and by recognizing what type of research finding are necessary to make a specific decision.

3.10 SUMMARY

The first step in any business research project is to define the problem or opportunity. Decision makers must express their objectives to researchers to avoid getting the right answer to the wrong questions. Defining the problem is often complicated in that portions of the problem may be hidden from view. The research must help management isolate and identify the problem to ensure that the real problem rather than a symptom, is investigated.

A variable is anything that changes in value. Variables may be categorical or continuous. One aspect of problem definition is the identification of the key dependent variables and the key independent variables.

Research questions and hypotheses are translations of the business problem into business research terms. A hypothesis is an unproven proposition or a possible solution to be problem. Hypotheses state relationships between variables that can be empirically tested. Research objectives specify information needs. For the research project to be successful, the research must be stated in terms of clear and precise research objectives.

The research proposal is a written statement of the research design that makes the research process operative for the specific problem. The research proposal allows managers to evaluate the details of the proposed research and determine if alterations are needed. Most research proposals will include the following section. Purpose of the research, research design, sample design, data gathering and/or field work techniques, data processing and analysis, budget and time schedule.

3.11 KEYWORDS

Problem Definition refers to a specific managerial decision area that will be clarified by answering some research questions.

Iceberg Principle says that invisible area of business problems cannot and should not be neglected as in case of the sub-merged portion (90%) of the iceberg in quite invisible but dangerous.

Situation Analysis is preliminary investigation of informal collection of background information to help the researchers in problem formulation.

Variable is anything whose values vary or change.

Categorical or classificatory variable is a variable having a limited number of distinct values.

Dependent variable is the variable whose value depends on value of another variable.

Independent variable is the variable which influences the dependent variable.

Hypothesis is a statement or an unproven proposition or possible solution to a problem.

3.12 SELF ASSESSMENT QUESTIONS

1. In its broadest context, what is the task of problem definition?
2. What is the iceberg principle?
3. State a problem in your field of interest and list some variables that might be investigated to solve this problem.

4. Go to the library, find business journals, and record and evaluate some hypotheses that have been investigated in recent years. Identify the key independent and dependent variables.
5. Evaluate the statement of the business problem in each of the following situations:

   a. A farm implement manufacturer: Our objective is to learn the most effective form of capitalization so that we can maximize profits.
   b. An employees' credit union: Our problem is to determine the reasons why employees join the credit union, to determine members' awareness of credit union service, and to measure attitudes and beliefs about how effectively the credit union is operated.
   c. The producer of a television show: We have a problem: The program's ratings are low. We need to learn how to improve our ratings.
   d. A soft-drink manufacturer: the problem is that we do not know if our bottlers are more satisfied with us than our competitors' bottlers are with them.
   e. A women's magazine: Our problem is: to document the demographic charges that have occurred in recent decades in the lives of women and to put these changes in historic perspective; to examine several generations of American women through most of this century, tracking their roles as student, worker, wife, and mother and noting the changes in timing, sequence, and duration of these roles; to examine at what age and for how long a women enters each of the various stages of her life: school, work, marriage.

6. What is the necessity of defining a research problem? Explain.

3.13 REFERENCES/SUGGESTED READINGS

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Lesson No.: **4**	

RESEARCH DESIGN

STRUCTURE

4.0 OBJECTIVES

After reading this chapter, the students would be able to

- Define research design, classify various research designs, and explain the differences between exploratory and conclusive research designs;

- Compare and contrast the basic research designs: exploratory, descriptive, and causal;
- Describe the major sources of errors in a research design, including random sampling error, and the various sources of non sampling error;
- Discuss managerial aspects of coordinating research projects, particularly budgeting, and scheduling; and
- Describe the elements of a marketing research proposal and show how it addresses the steps of the marketing research process.

4.1 INTRODUCTION

A research design is a framework or blueprint for conducting the research project. It gives details, of the procedures necessary for obtaining the information needed to structure or solve research problems. Although a broad approach to the problem has already been developed, the research design specifies the details-the nuts and bolts of implementing that approach. A research design lays the foundation for conducting the project. A good research design will ensure that the business research project is conducted effectively. Typically a research design involves the following components, or tasks.

1. Define the information needed.
2. Design the exploratory, descriptive, and/or causal phases of the research.
3. Specify the measurement and scaling procedures.
4. Construct and pretest a questionnaire (interviewing form) or an appropriate form for data collection.
5. Specify the sampling process and sample size.
6. Develop a plan of data analysis.

First let's classify the different types of research design.

4.2 CLASSIFICATION OF RESEARCH DESIGN

Research design may be broadly classified as exploratory or conclusive (see Figure 4.1). The differences between exploratory and conclusive research are summarized in Table 4. 1. The primary objective of exploratory research is to provide insights into, and an understanding of, the problem confronting the researcher. Exploratory research is used in cases when you must define the problem more precisely, identify relevant courses of action, or gain additional insights before an approach can be developed. The information needed is only loosely defined at this stage and the research process that is adopted is flexible and unstructured. For example, it may consist of personal interviews with industry experts. The sample, selected to generate maximum insights, is small and non representative. The primary data are qualitative in nature arid are analyzed accordingly. Given these characteristics of the research process, the findings of exploratory research should be regarded as tentative or as input to further research. Typically, such research is followed by further exploratory or conclusive research. Sometimes, exploratory research, particularly qualitative research, is all the research that is conducted. In these cases caution should be exercised in utilizing the findings obtained. Exploratory research will be discussed in more detail in the next section.

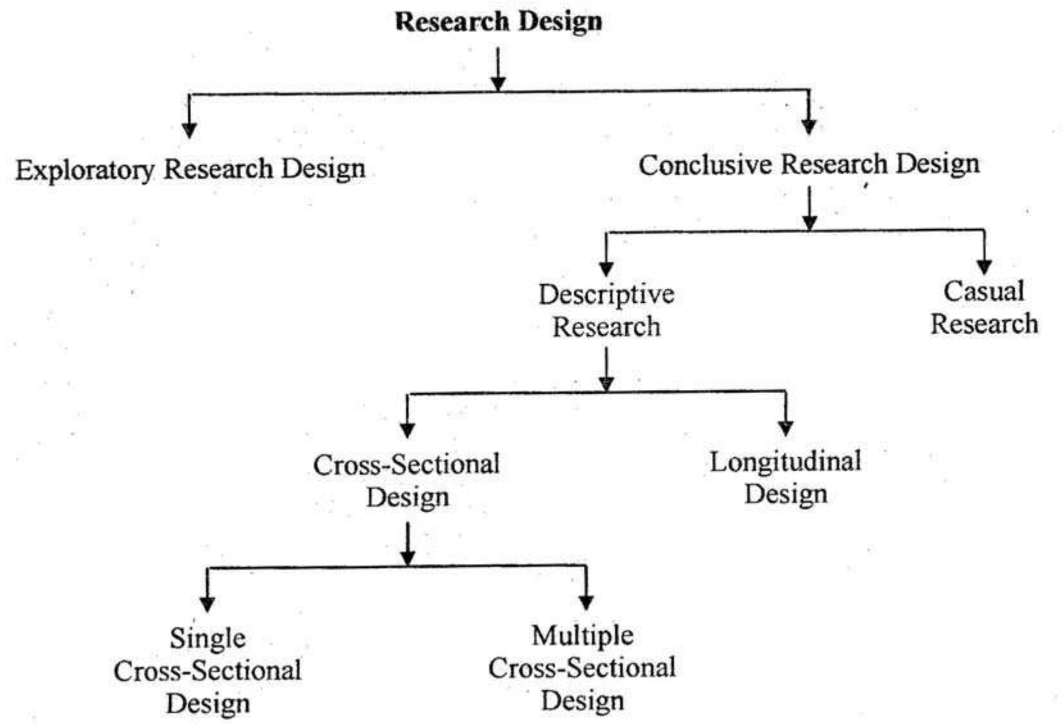

FIGURE 4.1

The insights gained from exploratory research might be verified by conclusive research, as the objective of conclusive research is to test specific hypotheses and examine specific relationships. This requires that the information needed is clearly specified. Conclusive research is typically more formal and structured than is exploratory research. It is based on large, representative samples, and the data obtained are subjected to quantitative analysis. The findings from this research are considered to be conclusive in nature in that they are used as input into managerial decision making. As shown in Figure 4.1, conclusive research designs may be either descriptive or causal, and descriptive research designs may be either cross-sectional or longitudinal. Each of these classifications is discussed further beginning with exploratory research.

TABLE: 4.1
DIFFERENCE BETWEEN EXPLORATORY AND
CONCLUSIVE RESEARCH

	Exploratory	Conclusive
Objectives	To provide insights and understanding.	To test specific hypotheses and examine relationships.
Characteristics	Information needed is defined only loosely. Research process is flexible and unstructured. Sample is small and non-representative. Analysis of primary data is qualitative.	Information needed is clearly defined. Research process is formal and structured. Sample is large and representative. Data analysis is quantitative.
Findings/Results	Tentative	Conclusive
Outcomes	Generally followed by further exploratory or conclusive research	Findings used as input into decision making

4.3 EXPLORATORY RESEARCH DESIGN

When a researcher has a limited amount of experience with or knowledge about a research issue, exploratory research is a useful preliminary step that helps ensure that a more rigorous, more conclusive future study will not begin with an inadequate understanding of the nature of the management problem. The findings discovered through exploratory research would lead the researcher to emphasize learning more about the particulars of the findings in subsequent conclusive studies. Conclusive research answers questions of fact necessary to determine course of action. This is never the purpose of exploratory research.

Much but certainly not all, exploratory research provides qualitative data. Usually, exploratory research provides qualitative data. Usually, exploratory research provides greater understanding of a concept or crystallizes a problem rather than providing precise measurement. A researcher may search for numbers to indicate economic trends, but a rigorous mathematical analysis is not performed. Any source of information may be informally investigated to clarify which qualities or characteristics, are associated with art object, situation, or Issue.

Alternately, the purpose of quantitative research is to determine the quantity or extent of some phenomenon in the form of numbers. Most exploratory research is not quantitative research. Exploratory research may be a single research investigation or a series of informal studies to provide background information. Researchers must be creative in the choice of information sources to be investigated. They must be flexible enough to investigate all inexpensive sources that may possibly provide information to help understand a problem. This need to be flexible does not mean that researchers do not have to be careful and systematic when designing exploratory research studies. Most of the techniques discussed in-this chapter have limitations. Researchers should be keenly aware of the proper and improper uses of the various techniques.

Why conduct exploratory research?

The purpose of exploratory research is intertwined with the need for a clear and precise statement of the recognized problem. Three interrelated forms of exploratory research exist: (1) diagnosing a situation, (2) screening alternatives, and (3) discovering new ideas.

Diagnosing a Situation

Much has already been said about the need for situation analysis to clarity a problem's nature. Exploratory research helps diagnose the dimensions of problems so that successive research projects will be on target. It helps set priorities for research. In some cases exploratory research provides an orientation for management by gathering information on a topic with which management has little experience. Although a research project has not yet been planned, information about an issue is needed before the appropriate action can be developed.

Personnel research managers often conduct exploratory research as a diagnostic tool to point out issues of employee concern' or to generate possible explanations for motivational patterns. For example, preliminary interviews with employees may be utilized to learn current "hot" issues, as well as concerns about bread-and-butter issues such as wages, working conditions, career opportunities, and the like.

Screening Alternative

When several opportunities arise but the budget precludes investigating all possible options, exploratory research may be used to determine the best alternatives. Many crystallizes good investments were not made because a company chose to invest in something better. Some new organizational structures are found t6 be unworkable. In an exploratory look at market data (size, number, and so on), a product alternative, may informally not be feasible because the market is too small. Although this aspect of exploratory research is not a substitute for conclusive research, certain evaluative information can be acquired in exploratory studies.

The need for concept testing is a frequent reason for conducting exploratory research. Concept testing is a general term or many different research procedures, all of which have the same purpose. It refers to those research procedures that test some sort of stimulus as a proxy for a new or revised program, product, or service. Typically, test subjects are presented with an idea and asked if they liked it, and so-on. Concept testing is a means of evaluating ideas by providing a “feel” for the merits and idea prior to the commitment of research and development, manufacturing, or other company resources. Researchers look for trouble in business signals in evaluations of concepts in order to avoid future problems in business research.

Concept testing may portray the functions, uses, and possible situations for a proposed product. For example, Del Monte conducted a concept test to determine if consumers would accept the idea of shelf-stable yogurt. The plan was scrapped after survey showed that buyers refused to accept the idea that yogurt could be kept unrefrigerated. Early research indicated that such a concept was viewed as desirable and unique, but the cost of achieving believability finally judged to be high.

In other cases, when subjects have expressed reservations about certain aspects of the idea but the general concept has not been evaluated negatively, researchers know that the concept needs to be refined. The intangibles influencing brand image, product appearance, name and price– as well as a description of the product simulate reality. Thus, prior to actual product development, the idea expressing the nature of the brand is conveyed to the test subjects.

Discovering New Ideas

Exploratory research is often used to generate new ideas. Perhaps factory workers have suggestions for increasing production, or improving safety. Consumers may suggest hew product ideas, or unthought-of problems might be identified.

For example, an automobile manufacturer might have drivers design their dream influencing cars on video screens using computerized design software adapted from programs used by automotive designers. This exploratory research generates ideas that would never have occurred to the firm's design staff.

Categories of exploratory research

There are many techniques for investigating undefined research problems. Several of the most popular qualitative techniques are discussed in this section. However, the purpose, rather than the technique, determines whether a study is exploratory, descriptive, or causal. The versatile techniques discussed in this chapter allow for intensive, in-depth questioning of respondents, and these techniques tend to be used primarily, though not exclusively, for exploratory purposes.

A manager may choose from four general categories of exploratory research methods: (1) experience surveys, (2) secondary data analysis, (3) case studies, and (4) pilot studies. Each category provides various alternative ways of gathering information.

Experience Surveys

In attempting to understand the problems at hand, managers may discuss issues and ideas with top executives and knowledgeable managers who have had personal experience in the field. This constitutes an informal experience survey.

For example, a chain saw manufacturer received from its Japanese distributor a recommendation to modify its product with a drilling attachment on the sprocket (replacing the chain and guide bar) and use it as a mushroom-planting device. The distributor indicated that many such units had been sold in Japan. However, an experience survey with only one individual, the president of the Mushroom Growers Association, indicated the product was not feasible in the United States. Americans consume a white cultured mushroom grown in enclosed areas or caves rather than the variety of mushrooms grown on wood in Japan. The mushroom expert indicated Americans believe too many old wives' tales about poison mushrooms arid would not change their eating habits to include the Japanese variety.

Exploratory research during the situational analysis may be quite informal. Discussions with knowledgeable people, both inside and outside the company may not be much more than conversations. This activity, intended only to get ideas about the problem, may be conducted by the line manager rather than the research department. The financial research analyst may have within an industry many contacts that he or she relies on for information. Exploratory information from an experience survey is not expected to be conclusive. Often an experience survey consists of interviews with a small number of experienced people who have been carefully selected. Some formal questions may be asked, but the respondents will be allowed to discuss the questions with few constraints. Knowledgeable people should be selected because they are articulate individuals, rather than a representative probability sample. The purpose is to help formulate the problem and clarify concepts, rather than develop conclusive evidence.

Secondary Data Analysis

Another economical and quick source of background information is trade literature in the public library. Searching through such material is exploratory research by means of secondary data analysis. Basic theoretical research is rarely conducted without extensive reviews of the literature in the field or similar research. Using secondary data may be equally important in applied research. For example, a personnel manager may want to evaluate her company's formal training programs. A short time in a library may reveal that in companies with more than 50 employees the average executive receives 41.4 hours of training per year while the average office secretarial worker gets 18.8 hours of training per year. Additional information about the types of training, use of computers in training, industry differences in training, used and the like may help clarify the issues that need to be researched. If the problem is to determine the reasons for a sales decline of an existing product, the manager's situational analysis might begin with an analysis of sales records by region and by customer or some other source of internal data. Investigating data that have been compiled for some purpose other than the project at hand, such as accounting records or trade association data, is one of the most frequent forms of exploratory research.

Once a situational analysis using secondary data or experience surveys has been informally carried out, issues that still need clarification may warrant further exploratory investigation beyond the gathering of background information. At this point the research specialist is needed to design more elaborate exploratory research. A number of exploratory and preliminary research techniques that can aid in the definition of the problem are presented in the following pages.

Case Study Method

The purpose of the case study method is to obtain information from one or a few situations that are similar to the researcher's problem situation. For example, a bank in U.S.A. may intensively investigate the computer-security activities of an innovative bank in California. An academic researcher interested in doing a nation wide survey among union workers-may first look at a few union locals to identify the nature of any problems or topics that should be investigated. A business research manager for Atlas bicycles used observation techniques to conduct an exploratory case study analysis. Here is a description of the case situation in his own words.

We had a very successful dealer in the South Africa. He sold a lot of bicycle. So it occurred to me that we'd go out and find out how he's doing it. We'll use a tape recorder and get in the back room where we'll hear these magic words that he says to people to make them buy bicycles. We'll take that tape back to the factory. We'll have it all typed out. We'll print it in the Reporter [dealer newsletter]. We'll send it to all the other dealers and everybody can say the same words. And, boy, we'll need another factory Right? So we go out. The guy's got a nice store out in a metro of South Africa. We sit in the back room and we listen. The first customers come is a man and a woman with boy about nine or ten years old. The dad says, "Which one is it?" The son says, "This one over here." Dad looks at it. He says to the clerk, "How much is it?" The clerk says, "$119.95." The father, Okay, we'll take it." It blew the whole bit. So we stand there and we listen to some of these conversations going on like this. Sudde1jlly it dawned on us that it was not what they say, it's the atmosphere of the store. Here, it was not Joe's old, dirty bike shop, but here was a beautiful store on the main street. A big sign was in front, "Valley Cyclery," inside [were] fluorescent lights, carpeting on the floor, stereo music, air-conditioning, a beautiful display of bicycles. It was like a magnet. People came in. So, maybe this is the catch. We tried to introduce that idea to other dealers. Put a bigger investment into your store and see what happens. Some of them did, and it happened.

This observation study led to a discovery that would change Atlas's entire channel of distribution strategy. The opportunity was a direct result of being open-minded in the problem discovery stage of business research.

The primary advantage of the case study is that an entire organization or entity can be investigated in depth and with meticulous attention to detail. This highly focused attention enables the researchers to carefully study the order of events as they occur or to concentrate on identifying the relationships among functions, individuals, or entities. A fast-food restaurant may test a new store design, a new operating procedure, or a new menu item in a single location to learn about potential operational problems that could hinder service quality.

Conducting a case study often requires the cooperation of the person whose history is being studied for example, a franchisee who allows the franchiser access to the former's records and reports. Again, intensive interviews or long discussions with the franchisee and his or her employees may provide an understanding of a complex situation. Researchers, however, have no standard procedures to follow. They must be flexible and attempt to glean information and insights wherever they find them. The freedom to search for whatever data an investigator deems important makes the success of any case study highly dependent on the alertness, creativity, intelligence, and motivation of the individual performing the case analysis.

Like all exploratory research, the results from case analysis should be seen as tentative. Generalizing from a few cases can be dangerous because most situations are atypical in some sense. A bank in Montana may not be in a situation comparable to one in California. But even if situations are not directly comparable, a number of insights can be gained and hypotheses suggested for future research.

Pilot Studies for Qualitative Analysis

The term pilot studies cover a number of diverse research techniques. Within the context of exploratory research, pilot study conveys the message that some aspect of the research (e.g., fieldwork) will be on a small scale. Thus a pilot study is a research project that involves sampling, but the rigorous standards used to obtain precise, quantitative estimates from large, representative samples are relaxed.

A pilot study generates primary data, usually for qualitative analysis. This characteristic distinguishes pilot studies from secondary data analysis to gather background information. Some researchers refer to a pilot study that generates qualitative information as qualitative research. The primary data usually, are collected from employees, consumers, voters, or other subjects of ultimate concern rather than from a few knowledgeable experts or from a case situation. This distinguishes pilot studies from experience surveys and case studies. The major categories of pilot studies include focus group interviews, projective techniques, and depth interviews.

Focus group interview

Business executives have been hearing a lot about the focus group interview lately. The focus group interview, is so popular today that many research agencies consider it to be the “only” exploratory research tool. A focus group interview is an unstructured, free-flowing interview with a small group of people. It is not a rigidly constructed question-and-answer session, but a flexible format that encourages discussion of, say, a labor issue, reactions toward a political candidate, or a new-product concept. Participants meet at a central location at a designated time. The group consists of an interviewer or moderator and six to ten participants who discuss a single topic. The participants may be women talking about maternity leave, petroleum engineers talking about problems in the “oil patch” or patients talking about health care. The moderator introduces the topic and encourages the group members to discuss the subject among themselves. Focus groups allow people to discuss their true feelings, anxieties, and frustrations, and to express the depth of their convictions in their own words. Ideally, the discussion proceeds at the group's initiative.

The primary advantages of focus group interviews are that they are relatively brief, easy to execute, quickly analyzed, and inexpensive. In an emergency situation, three or four group sessions can be conducted, analyzed, and reported in less than a week at a cost substantially lower than that of other attitude-measurement techniques. It must be remembered, however, that a small discussion group will rarely be representative sample, no matter how carefully it is recruited. Focus group interviews cannot take the place of quantitative studies.

The flexibility of group interviews is an advantage especially when compared with the rigid format of a survey. Numerous topics can be discussed and many insights can be gained, particularly those involving the contingencies of behavior. Responses, which would be unlikely to emerge in a survey, often come out in a group interview. During a focus group of people who had never visited the J. Paul Getty Museum, a middle-aged man said, "I've been told there's heavy, very classical type of art. Some what stuffy and standoffish. It's the kind of place you wouldn't want to take our kids and let them run around." An older woman agreed, saying, "I get the impression it's a little stuffy, and has old art." A younger man putting in his two cents' worth added, "I was driving up past Malibu and I saw the sign. I'd never heard of it before. 1 thought it was a place where they were going to show you how to refine oil or something."

Group Composition

The ideal size of the focus group is six to ten individuals. If the group is too small, one or two members may intimidate the others. Groups that are too large may not permit adequate participation by each group member. Homogeneous groups seem to work best. Selecting homogeneous groups allows researchers to concentrate on individuals with similar lifestyles, job classifications, experiences, and communication skills. The session thus does not become confused with too many arguments and different, viewpoints stemming from diverse backgrounds of participants. For example, married women who stay home full time to raise their children are often grouped separately from unmarried working women.

Researchers who wish to collect information from different types of people should conduct several focus groups. For example, one focus group consisting only of men and another focus group consisting only of women might be conducted. Thus a diverse sample may be obtained even though each group is homogeneous.

Environmental Conditions

The site of the group session may be at the research agency, an office conference room, a hotel, or one of the subject's homes. One researcher suggests that a "coffee Klatch" or "bull session" atmosphere be established to ensure that the mood of the sessions will be as relaxed and natural as possible.

The Moderator

In a focus group interview the moderator makes sure that everyone "gets a chance to speak and how she contributes by asking questions to clarify topics that have been introduced into the discussion. The moderator's job is to develop a rapport with the group and to promote interaction among its members. The combined effort of the group is likely to produce a wider range of information, insights, and ideas than a number of personal interviews would provide. The moderator should be someone who is really interested in people, who listens carefully to what others have to say, and who can readily establish rapport and gain the confidence of people and make them feel relaxed and eager to talk. Careful listening by the moderator is especially important, because the group interview's, purpose is to, stimulate spontaneous responses. The moderator's role is also to focus the discussion on the problem areas of concern. When a topic is no longer generating fresh ideas, the effective moderator changes the flow of discussion. The moderator does not give the group total control of the discussion, but normally has prepared questions on topics that are of concern to management. However, the timing of these questions and the manner in which they are raised are left to the moderator's discretion.

Shortcoming

The shortcomings of focus groups are similar to those of most qualitative research. However, a specific shortcoming of focus groups should be pointed out here. Without a sensitive and effective moderator, a single, self-appointed participant may dominate the session. Sessions that include a dominant participant may be somewhat abnormal. Participants may react negatively toward the dominant member, causing a "halo" effect on attitudes toward the concept or the topic of discussion. In other words, a negative impression of the individual may be projected to the topic of discussion. Such a situation should be avoided so that a negative impression of an "obnoxious person" does not inhibit other members from being candid and does not influence the statements that other members make.

Word Association

During a word association test the subject is presented with a list of words, one at a time, and asked to respond with the first word that comes to his or her mind. Both verbal and nonverbal responses (such as hesitation in responding) are recorded. A researcher who reads a list of job tasks to employees expects that the word association technique will reveal each individual’s true feelings about the job task. It is assumed that an employee’s first thought is a spontaneous answer because the subject does not have adequate time to think about and avoid making admissions that reflect poorly on himself or herself. This technique frequently used in testing potential brand names. For example, a liquor manufacturer, attempting to market a clear colored, light whiskey, tested the brand names Frost, Verve, Ultra, and Master’s Choice. Frost was seen as upbeat, modern, clean, and psychologically right. Verve was “too modern”, Ultra was “too common,” and Master’s Choice was not upbeat enough.”

Interpreting word association tests is difficult- and researchers should make sure that they avoid subjective interpretations. When there is considerable agreement in the “association” process, the researcher assumes that the test has revealed the person’s inner feelings about the subject. Word association tests are also analyzed by the amount of elapsed time. For example, if the researcher is investigating sexual harassment, a person’s hesitation in responding may indicate that the responses were delayed because the subject is emotionally involved in the expression (possibly, seeking an “acceptable” response). Thus, analysis of projective technique results takes into account not on)y what people say but what they do not say.

Word association tests can also be used to pretest words or ideas to be used in questionnaires. This enables the researcher to know beforehand whether and to what degree the meaning of a word or phrase is understood in the context of a survey.

Third-Person Technique and Role Playing

Almost literally, providing a “mask” is the basic idea behind the third person technique. Respondents are asked why a third person (e.g., one’s neighbour) does or thinks about a person, event, or concept. For example, investors might be told: "We are talking to a number of investors like you about this money market fund. Some men and women like it the way, it is others believe that it should be improved. Please think of some of your friends or neighbours and tell us what it is they might find fault with in this new money market fund." Thus the respondent can transfer his attitudes to his neighbours, to friends, or to people he works with. He is free to agree or disagree with an unknown third party.

Role playing is a dynamic re-enactment of the third-person technique in a given an exploratory research situation. The role-playing technique requires the subject to act out someone else's technique that requires the subject to act out someone behavior in a particular setting. For example, a worker in a role playing situation else's behavior in a particular who is instructed to perform a supervisor's task projects herself into a supervisor's role. This projective technique can be used to determine a true feeling about a supervisor or work situation. In role-playing games, persons may become caught up in acting out the roles and thereby reveal their true feelings.

Role playing is particularly useful in investigating situations where interpersonal relationships are the subject of the research, as, for example, salesperson-customer, husband-wife, and worker-supervisor.

4.4 DESCRIPTIVE RESEARCH DESIGN

As the name implies, the major objective of descriptive research is to describe some thing-usually market characteristics or functions. Descriptive research is conducted for the following reasons:

1. To describe the characteristics of relevant groups, such as consumers, salespeople, organizations, or market areas. For example, we could develop a profile of the "heavy users"

(frequent shoppers) of prestigious department stores such as Saks Fifth Avenue and Neiman Marcus.

2. To estimate the percentage of units in a specified population exhibiting a certain behavior; for example, the percentage of heavy users of prestigious department stores who also patronize discount department stores.
3. To determine the perceptions of product characteristics. For example, how do households' perceive the various department stores in terms of salient factors of the choice criteria?
4. To determine the degree to which marketing variables are associated. For example, to what extent is shopping at department stores related to eating out?
5. To make specific predictions. For example, what will be the retail sales of Neiman Marcus (specific store) for fashion clothing (specific product category) in the Dallas area (specific region)?

Descriptive research assumes that the researcher has much prior knowledge about the problem situation. In fact, a major difference between exploratory and descriptive research is that descriptive research is characterized by the prior formulation of specific hypotheses. Thus, the information needed is clearly defined. As a result, descriptive research is pre-planned and structured.

It is typically based on large representative samples. A formal research design specifies the methods for selecting the sources of information and for collecting data from those sources. A descriptive design requires a clear specification of the who, what, when, where, why, and way (the six Ws) of the research. (It is interesting to note that news reporters use a similar formula for describing a situation.) We illustrate this in the context of the department store patronage project.

These, and other similar questions, should be asked until the information to be obtained has been clearly defined.

In summary, descriptive research, in contrast to exploratory research, is marked by a clear statement of the problem, specific hypotheses, and detailed information needs. The survey conducted in the department store patronage project, which involved personal interviews, is an example of descriptive research. Other examples of descriptive studies are:

- Market studies, which describe the size of the market, buying power of the consumer's availability of distributors, and consumer profiles.
- Market share studies, which determine the proportion of total sales received by a company and its competitors.

DEPARTMENT STORE PATRONAGE PROJECT

The six Ws

1. *Who*: Who should be considered a patron of a particular department store? Some of the possibilities are:
   a) Anyone who enters the department store, whether or not she or he purchases anything
   b) Anyone who purchases anything from the store
   c) Anyone who makes purchases at the department store at least once a month
   d) The person in the household most responsible for department store shopping

2) What: What information should be obtained from the respondents? A wide variety of information could be obtained, including:
   a) Frequency with which different department stores are patronized for specific product categories.

b) Evaluation of the various department stores in terms of the salient choice criteria

c) Information pertaining to specific hypotheses to be tested

d) Psychographics and lifestyles, media consumption habits, and demographics

3) *When*: When should the information be obtained from the respondents? The available options include:

a) Before shopping

b) While shopping

c) Immediately after shopping

d) Sometimes after shopping to allow time for evaluation of their shopping experience

4) *Where*: Where should the respondents be contacted to obtain the required information? Possibilities include contacting the respondents:

a) In the store

b) Outside the store but in the shopping mall

c) In the parking lot

d) At home

5) *Why*: Why are we obtaining information from the respondents? Why is the marketing research project being conducted? Possible reasons. could be to:

a) Improve the images of the sponsoring store

b) Improve patronage and market share

c) Change the product mix

d) Develop a suitable promotional campaign

e) Decide on the location of a new store

6) Way: In what are we going to obtain information from the respondents? The possible ways could be:

   a) Observe respondent's behavior
   b) Personal interviews
   c) Telephone interviews
   d) Mail interviews

- Sales analysis studies, which describe sales by geographic region, product line, type and size of the account
- Image studies, which determine consumer perceptions of the firm and its products
- Product usage studies, which describe consumption pattern
- Distribution studies, which determine traffic flow patterns and the number and locations of distributors
- Pricing studies, which describe the range and frequency of price changes and probable consumer response to proposed price changes
- Advertising studies, which describe media consumption habits and audience profiles for specific television programs and magazines

These examples demonstrate the range and diversity of descriptive research studies. A vast Majority of marketing research studies involve descriptive research, which incorporates the following major methods:

- Secondary data
- Primary Surveys
- Panels
- Observational and other data

4.4.1 Cross-sectional designs and longitudinal designs

The cross-sectional study is the most frequently used descriptive design in marketing research. Cross-sectional designs involve the collection of information from any given sample of population elements only once. They may be either single cross-sectional or multiple cross-sectional. In single cross-sectional designs only one sample of respondents is drawn from the target population, and information is obtained from this sample only once. These designs are also called sample survey research designs. In multiple cross sectional designs, there are two or more samples of respondents, and information from each sample is obtained only once. Often, information from different samples is obtained at different times.

4.4.2 Longitudinal designs

In longitudinal designs, a fixed sample (or samples) of population elements is measured repeatedly. A longitudinal design differs from a cross sectional design in that the sample or samples remain the same over time. In other words, the same respondents are studied over time. In contrast to the typical cross-sectional design, that gives a snapshot of the variables of interest at a single point in time, a longitudinal study provides a series of pictures that give an in-depth view of the situation and the changes that take place over time or example, the question, “How did the American people rate the performance of Bill Clinton immediately after his second term?” would be addressed using cross-sectional design. However, a longitudinal design would be used to address the question, “How did the American people change their view of Clinton’ performance during his presidency?”

‘Often, the term panel is used interchangeably with the term longitudinal design. A panel consists of a sample, of respondents, generally households hat have agreed to provide information at specified intervals over an extended period. Panels are maintained by syndicated firms, and panel members are compensated for their participation with gifts coupons, information, or cash.

4.5 CAUSAL RESEARCH

Causal research is used to obtain evidence of cause-and-effect (causal relationships Managers continually make decisions based on assumed causal relationships. These assumptions may not be justified, and the validity of the causal relationships should be examined via formal research. For example, the common assumption that a decrease in price will lead to increased sales and market share does not hold in certain competitive environments. Causal research is appropriate for the following purposes:

1. To understand which variables are the cause (independent variables) and which variables are the effect (dependent variables) of a phenomenon.

2. To determine the nature of the relationship between the causal variables and the effect to be predicted.

Like descriptive research, causal research requires a planned and structured design. Although descriptive research can determine the degree of association between variables, it is not appropriate for examining causal relationships. Such an examination requires a causal design, in which the causal or independent variables are manipulated in a relatively controlled environment. A relatively controlled environment is one in which the other variables that may affect the dependent variable are controlled or checked as much as possible. The effect of this manipulation on one or more dependent variables is then measured to infer causality. The main method of causal research is experimentation.

We give some examples here regarding experimental research. In the context of the department store patronage project, a researcher wishes to determine whether the presence and helpfulness of salespeople (causal variable) will influence the sales of house-wares (effect variable). A causal design could be formulated in which two groups of otherwise comparable house-wares departments of a particular chain are selected. For four weeks, trained salespeople are stationed in one group of house-wares departments but not in the other. Sales are monitored for both groups, while controlling for other variables. A comparison of sales for the two groups will reveal the effect of salespeople on house-wares sales in department stores. Alternatively, instead of selecting two groups of stores, the researcher might select only one set of department stores and carry out this manipulation for two comparable time periods: salespeople are present in one time period and absent in the other.

4.6 RELATIONSHIPS AMONG EXPLORATORY, DESCRIPTIVE, AND CAUSAL RESEARCH

We have described exploratory, descriptive, and causal research as major classifications of research designs, but the distinctions among these classifications are not absolute. A given research project may involve more than one type of research design and thus serve several purposes. Which combination of research designs to employ depends on the nature of the problem. We offer the following general guidelines for choosing research designs:

1. When little is known about the problem situation, it is desirable to begin with exploratory research. Exploratory research is appropriate when the problem needs to be defined more precisely, alternative courses of action identified, research questions or hypotheses developed, and

key variables isolated and classified as dependent or independent.

2. Exploratory research is the initial step in the overall research design framework. It should, in most instances, be followed by descriptive or causal research For example, hypotheses developed via exploratory research should be statistically tested using descriptive of causal research.

3. It is not necessary to begin every research design with exploratory research. It depends on the precision with which the problem has been defined and the researcher's degree of certainty about the approach to the problem. A research design could well begin with descriptive or causal research. To illustrate, a consumer satisfaction survey conducted annually need not begin with nor include an exploratory phase.

4. Although exploratory research is generally the initial step, it need not be. Exploratory research may follow descriptive or causal research. For example, descriptive or causal research results in findings that are hard for managers to interpret. Exploratory research may provide more insights to help understand these findings.

The relationship between exploratory, descriptive, and causal research is further illustrated by the department store patronage project.

This example involves the use of exploratory and descriptive research but not causal research. This reflects the fact that exploratory and descriptive research are frequently used in commercial marketing research but causal research is not as popular. However, it is possible to combine exploratory, descriptive, and causal research.

Regardless of the kind of research design employed, the researcher should attempt to minimize the potential sources of error.

4.7 BUDGETING AND SCHEDULING THE PROJECT

Once a research design, appropriately controlling the total error, has been specified, the budgeting and scheduling decisions should be made. Budgeting and scheduling help to ensure that the research project is completed within the available resources- financial, time, human resources, and other. By specifying the time parameters within which each task should be completed and the costs of each task, the research project can be effectively managed. A useful approach for managing a project is the critical path method (CPM), which involves dividing the research project into component activities, determining the sequence of these activities, and estimating the total time required for each activity. These activities and time estimates are diagrammed in the form of a network flow chart. The critical path, the series of activities whose delay will hold up the project, can then be identified.

An advanced version of CPM is the program evaluation and review technique (PERT), which is a probability-based scheduling approach that recognizes and measures the uncertainty of the project completion times. An even more advanced scheduling technique is the graphical evaluation and review technique (GERT), in which both the completion probabilities and the activity costs can be built into a network representation.

4.8 RESEARCH PROPOSAL

Once the research design has been formulated and budgeting and scheduling of the project accomplished, a written research proposal should be prepared. The research proposal contains the essence of the project and serves as a contract between the researcher and management. The research proposal covers all phases of the research process. It describes the research problem, the approach, the research design, and how the data will be collected, analyzed, and reported. It gives a cost estimate and a time schedule for completing the project. The format of a research proposal may vary considerably, but most proposals address all the steps of the business research process and contain the following elements.

1) *Executive summary*: The proposal should begin with a summary of the major points from each of the other sections, presenting an overview of the entire proposal.

2) *Background*: The background to the problem, including the environmental context, should be discussed.

3) *Problem definition/objectives of the research*: Normally, a statement of the problem including the specific components, should be presented. If this statement has not been developed (as in the case of problem identification research), the objectives of the business research project should be clearly specified.

4) *Approach to the problem*: At a minimum, a review of the relevant academic and trade literature should be presented, along with some kind of an analytical model. If research questions, hypotheses, and factors influencing the research design have been identified, then these should be included in the proposal.

5) *Research design*: The research design adopted, whether exploratory, descriptive, or causal, should be specified. Information should be provided on the following components: (1) kind of information to be obtained, (2) method of administering the questionnaire (mail, telephone, or personal

interviews), (3) scaling techniques, (4) nature of the questionnaire (type of questions asked, length, average interviewing time), and (5) sampling plan and sample size.

6) *Field work data collection*: The proposal should discuss how the data' will be collected and who will collect it. If the field work is to be subcontracted to another supplier this should be stated. Control mechanisms to ensure the quality of data collected should be described.

7) *Data analysis*: The kind of data analysis-that will be conducted (simple cross-tabulations, univariate analysis, multivariate analysis) and how the results will be interpreted should be described.

8) *Reporting*: The proposal should specify whether intermediate reports will be presented and at what stages, what will be the form of the final report, and whether a formal presentation of the results will be made.

9) *Cost and time*: The cost of the project and a time schedule, broken down by phases, should be presented. A CPM or PERT chart might be included. In large projects, a payment schedule is also worked out in advance.

10) *Appendices*: Any statistical or other information that is of interest to only a few people should be contained in appendices.

Preparing a research proposal has several advantages. It ensures that the researcher and management agree about the nature of the project and helps sell the project to management. As preparation of the proposal entails planning, it helps the researcher conceptualize and execute the research project.

4.9 SUMMARY

A research design is a framework or blueprint for conducting the business research project. It specifies the details of how the project should be conducted. Research designs may be broadly classified as exploratory or conclusive. The primary purpose of exploratory research is to provide insights into the problem. Conclusive research is conducted to test specific hypotheses and examine specific relationships. The findings from conclusive research are used as input into managerial decision making. Conclusive research may be either descriptive or causal.

The major objective of descriptive research is to describe market characteristics or functions. A descriptive design requires a clear specification of the who, what, when, where, why, and way of the research. Descriptive research can be further classified into cross-sectional and longitudinal research. Cross-sectional designs involve the collection of information from a sample of Population elements at a single point in time. In contrast, in longitudinal designs repeated measurements are taken on a fixed sample. Causal research is designed for the primary purpose of obtaining evidence about cause-and-effect (causal) relationships.

A research design consists of six components. Error can be associated with any of these components. The total error is composed of random sampling error and non-sampling error. Non-sampling error consists of non-response and response errors. Response error encompasses errors made by researchers, interviewers, and respondents. A written business research proposal including all the elements of the research process should be prepared. In formulating a research design when conducting international research, considerable effort is required to ensure the equivalence and comparability of secondary and primary data obtained from different countries. Every precaution should be taken to insure the respondents' or subjects' right to safety, right to privacy, or right to choose. The Internet and computers can be employed to aid the process of formulating a research design.

4.10 KEYWORDS

Research Design is a framework or blueprint for conducting the research project.

Pilot Study conveys the message of some aspect of research project on a very small scale.

Role Playing is a dynamic enactment of the third person technique in a given an exploratory research situation.

Cross-sectional Design involves the collection of data from any given sample of population elements only once.

Longitudinal Design is a design where a fixed sample (or samples) of population elements is measured frequently.

CPM (Critical Path Method) is a technique which involves dividing the project into component activities, sequencing of activities and measuring the time required for each activity in a networked diagram and flow chart.

PERT (Programme Evaluation & Review Technique) is a probability based scheduling approach which measures uncertainty of project completion time.

4.11 SELF ASSESSMENT QUESTIONS

1. Define research design in your own words.
2. How does formulation of a research design differ from developing an approach to a problem?

3. Differentiate between exploratory and conclusive research.
4. What are the major purposes for which descriptive research is conducted?
5. List the six Ws of descriptive research and give an example of each.
6. Compare and contrast cross-sectional and longitudinal designs.
7. Discuss the advantages and disadvantages of panels.
8. What is a causal research design? What is its purpose?
9. What is the relationship between exploratory, descriptive, and causal research?
10. List the major components of a research design.

4.12 REFERENCES/SUGGESTED READINGS

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Lesson No.: **5**	

METHODS OF DATA COLLECTION

STRUCTURE

5.0 OBJECTIVES

After reading this lesson you should be able to :

- Know the difference between primary and secondary data and their sources.

- Be conversant with the various data collection methods.
- Know the advantages and disadvantages of each method.
- Make logical decisions as to the appropriate data collection method (s) for specific studies.
- Demonstrate your skills in interviewing others to collect data.
- Design questionnaires to tap different variables.
- Evaluate questionnaires, distinguishing the “good” and “bad” questions therein.
- Identify and minimize the biases in various data collection methods.

5.1 INTRODUCTION

The most important aspect of research is data collection. With the help of data, the information can be presented in such a manner so that the same may be useful for decision-making by the managers. While collecting data, reliability and accuracy should be maintained. In the whole process of gathering information, the source of data should be taken care of very seriously.

5.2 SOURCES OF DATA

Data can be obtained from primary or secondary sources. Primary data refer to information obtained firsthand by the researcher on the variables of interest for the specific purpose of the study. Secondary data refer to information gathered from sources already existing.

Some examples of sources of primary data are individuals, focus groups, panels of respondents specifically set up by the researcher and from whom opinions may be sought on specific issues from time to time, or some unobtrusive sources such as a trash can. The internet could also serve as a primary data source when questionnaires are administered over it.

Data can also be obtained from secondary sources, as for example, company records or achieves, government publications, industry analyses offered by the media, web sites, the internet, and so on. In some cases, the environment or particular settings and events may themselves be sources of data, as for example, studying the layout of a plant.

We will first examine the four main primary sources of data-individuals focus groups, panels, and unobtrusive methods- and then discuss the secondary sources.

5.3 METHODS OF COLLECTING PRIMARY DATA

Data collection methods are an integral part of research design as shown in the shaded portion in the figure. There are several data collection methods, each with its own advantages and disadvantages. Problems researched with the use of appropriate methods greatly enhance the value of the research.

Data can be collected in a variety of ways, in different settings-field or lab-and from different sources, as we have just discussed. Data collection methods include interviews-face-to-face interviews, telephone interviews, computer-assisted interviews, and interviews through the electronic media; questionnaires that are either personally administered, sent through the mail, or electronically administered; observation of individuals and events with or without videotaping or audio recording; and a variety of other motivational techniques such as projective tests.

Interviewing, administering questionnaires, and observing people and phenomena are the three main data collection methods in survey research. Projective tests and other motivational techniques are also sometimes used to tap variables. In such cases, respondents are usually asked to write a story, complete a sentence, or offer their reactions to ambiguous cues such as inkblots or unlabeled pictures. It is assumed that the respondents project into the responses their own thoughts, feelings, attitudes, and expectations, all of which can be interpreted by trained psychologists.

Although interviewing has the advantage of flexibility in terms of adapting, adopting, and changing the questions as the researcher proceeds with the interviews, questionnaires have the advantage of obtaining data more efficiently in terms of researcher time, energy, and costs. Unobtrusive methods of data collection such as its extraction from company records have the advantage of accuracy. For instance, attendance records will probably give a truer and more reliable picture of the absenteeism of employees than information elicited directly from the respondents. Projective tests are usually administered by researchers who have had training in administering them and interpreting the results. Though some management research has been done using projective techniques, they are more frequently used in marketing research.

Modern technology is increasingly playing a key role in shaping data collection methods. Computer-assisted surveys, which help both interviewing as well as preparing and administering questionnaire electronically, are on the increase. Computer-assisted telephone interviewing (CATI), interactive electronic telephonic surveys, as well as administering questionnaires through electronic mail (e-mail), are now being used to facilitate data gathering.

The choice of data collection methods depends on the facilities available, the degree of accuracy required, the expertise of the researcher, the time span of the study, and other costs and resources associated with and available for data gathering.

5.3.1 Focus groups

Focus groups consist typically of 8 to 10 members with a moderator leading the discussions for about 2 hours on a particular topic, concept, or product. Members are generally chosen on the basis of their expertise in the topic on which information is sought. For example, computer specialists may be selected to form a focus group to discuss matters related to computers and computing, and women with children may compose the focus group to identify how organizations can help working mothers.

The focus sessions are aimed at obtaining respondents impressions, interpretations, and opinions, as the members talk about the event, concept, product, or service. The moderator plays a vital role in steering the discussions in a manner that would draw out the information sought and keeping the members on track.

Focus group discussions on a specific topic at a particular location and at a specified time provide the opportunity for a flexible, free-flowing format for the members. The unstructured and spontaneous responses are expected to reflect the genuine opinions, ideas, and feelings of the members about the topic under discussion. Focus groups are relatively inexpensive and can provide fairly dependable data within a short time frame.

Role of the moderator

The selection of and role played by the moderator are critical. The moderator introduces the topic, observes, and takes notes and or tapes the discussions. The moderator never becomes an integral part of the discussions, but merely steers the group persuasively to obtain all the relevant information and helps the group members to get through any impasse that might occur. The moderator also ensures that all members participate in the discussion and that no member dominates the group. Someone from the research team may also observe the proceedings through a one-way mirror, listening to the verbal statements and noticing the non-verbal cues of the members.

The nature of data obtained through focus groups

It should be noted that though data obtained through these homogeneous group members are the least expensive of the various data collection methods, and also lend themselves for quick analysis, the content analysis of the data so obtained provides only qualitative and not quantitative information. Also, since the members are not selected scientifically to reflect the opinions of the population at large (see the next chapter on sampling for more details on this), their opinions cannot be considered to be truly representative. However, when exploratory information is collected as a basis for further scientific research, focus groups serve an important function. Consider for example, the value of focus groups in exploring the concept of “intellectual Property”. When animated discussions take place, there is a serendipitous flow of new ideas among the group members who discuss the nuances of each thought process. Researchers are thereby helped to obtain valuable insights from the snowballing effects of the discussions.

In sum, focus groups are used for (1) exploratory studies, (2) making generalizations based on the information generated by them, and (3) conducting sample surveys. Focus groups have been credited with enlightening investigators as to why certain products are not doing well, why certain advertising strategies are effective, why specific management techniques do not work, and the like.

Videoconferencing

If regional variations in responses are expected, several focus groups could be formed including trained moderators at different locations. This process is easily facilitated through videoconferencing. By zooming in on a particular member the non-verbal cues and gestures of that individual can be captured, as and when desired. This also obviates the need for an observer looking through a one-way mirror.

With the great strides in technological advancement, and with the facility for communication with the moderator by relaying instant messages, videoconferencing as a means of gathering information from different groups in distant locations is indeed a promising prospect for the future.

It should be noted that online focus groups are also common. E-mail, web sites, and internet chat rooms facilitate focus group sessions as well.

5.3.2 Panels

Panels, like focus groups, are another source of primary information for research purposes. Whereas focus groups met for a one-time group session, panels (of members) meet more than once. In cases where the effects of certain interventions or changes are to be studied over a period of time, panel studies are very useful. Individuals are randomly chosen to serve as panel members for a research study. For instance, if the effects of a proposed advertisement for a certain brand of coffee are to be assessed quickly, the panel members can be exposed to the advertisement and their intentions of purchasing that brand assessed. This can be taken as the response that could be expected of consumers if, in fact, they had been exposed to the advertisement. A few months later, the product manager might think of introducing a change in the flavour of the same product and explore its effects on this panel. Thus, a continuing set of “experts’ serves as the sample base or the sounding board for assessing the effects of change. Such expert members compose the panel, and research that uses them is called a panel study.

The panels used in marketing research include the national purchase diary panel, the national family opinion panel, and the consumer mail panel.

Static and dynamic panels

Panels can be either static (i.e., the same members serve on the panel over extended periods of time) or dynamic (i.e., the panel members change from time to time as various phases of the study are in progress). The main advantage of the static panel is that it offers a good and sensitive measurement of the changes that take place between two points in time- a much better alternative than using two different groups at two different times. The disadvantage, however, is that the panel members could become so sensitized to the changes as a result of the endless continuous interviews that their opinions might no longer be representative of what the others in the population might hold. Members could also drop out of the panel from time to time for various reasons, thus raising issues of bias due to mortality. The advantages and disadvantages of the dynamic panel are the reverse of the ones discussed for the static panel.

In sum, a panel is a source of direct information. Panels could be static or dynamic, and are typically used when several aspects of a product are to be studied from time to time.

5.3.3 Unobtrusive measures

Trace measures, or unobtrusive measures as they are also called, originate from a primary source that does not involve people. One example is the wear and tear of journals in a university library, which offers a good indication of their popularity, frequency of use, or both. The number of different brands of soft drink cans found in trash bags also provides a measure of their consumption levels. Signatures on checks exposed to ultraviolet rays could indicate the extent of forgery and frauds; actuarial records are good sources for collecting data on the births, marriages, and deaths in a community; company records disclose a lot of personal information about employees, the level of company efficiency, and other data as well. Thus these unobtrusive sources of data and their use are also important in research.

5.3.4 Interviewing

One method of collecting data to interview respondents to obtain information on the issues of interest. Interviews could be unstructured of structured, and conducted either face-to-face or by telephone or online.

Unstructured interviews

Unstructured interviews are so labeled because the interviewer does not enter the interview setting with a planned sequence of questions to be asked of the respondent. The objective of the unstructured interview is to bring some preliminary issues to the surface so that the researcher can determine what variables need further in-depth investigation. Sometime the manager might entertain a vague idea of certain changes taking place in the situation without knowing what exactly they are. Such situations call for unstructured interviews with the people concerned. In order to understand the situation in its totality, the researcher will interview employees at several levels. In the initial stages, only broad, open-ended questions would be asked, and the replies to them would inform the researcher of the perceptions of the individuals. The type and nature of the questions asked of the individuals might vary according to the job level and type of work done by them. For instance, top and middle-level managers might be asked more direct questions about their perceptions of the problem and the situation. Employees at lower levels may have to be approached differently.

Clerical and other employees at lower hierarchical levels may be asked broad, open-ended questions about their jobs and the work environment during the unstructured interviews. Supervisors may be asked broad questions relating to their department, the employees under their supervision, and the organization. The following question, for instance, may be put to them during the unstructured interview stage:

"Tell me something about your unit and department, and perhaps even the organization as a whole, in terms of work, employees, and whatever else you think is important".

Such a question might elicit an elaborate response from some people; others may just say that everything is fine. Following the leads from the more vocal persons is easy, especially when the interviewer listens carefully to the important messages that they might convey in a very causal manner while responding to a general, global question. As managers and researchers, we should train ourselves to develop these listening skills and identify the critical topics that are touched on. However, when some respondents give a monosyllabic, crisp, short reply that is not informative, the interviewer will have to ask questions that would call for details and cannot be answered in one or two words. Such questions might be phrased as the one below:

"I would like to know something about your job. Please describe to me in detail the things you do on your job on a typical day, from eight in the morning to four in the afternoon".

Several questions might then be asked as a follow-up to the answer. Some examples of such follow-up questions include:

"Compared to other units in this organization, what are the strengths and weaknesses of your unit?"

"If you would like to have a problem solved in your unit, or a bottleneck eliminated, or something attended to that blocks your effectiveness, what would that be?"

If the respondent answers that everything is fine and she has no problems, the interviewer could say: "That is great! Tell me what contributes to this effectiveness of your unit, because most other organizations usually experience several difficulties". Such a questioning technique usually brings the respondent's defenses down and makes him or her more amenable to sharing information. Typical of the revised responses to the original question would be something like, "Well, it is not that we never have a problem, sometimes, there is delay in getting the jobs done, crash jobs have some defective items, …" encouraging the respondent to talk about both the good things and those not-so-good in the until can elicit a lot of information. Whereas some respondents do not need much encouragement to speak, others do, and they have to be questioned broadly. Some respondents may show reluctance to be interviewed, and subtly or overtly refuse to cooperate. The wishes of such people must be respected and the interviewer should pleasantly terminate such interviews.

Employees at the shop-floor level, and other non-managerial and non-supervisory employees, might be asked very broad questions relating to their jobs, work environment, satisfactions and dissatisfactions at the workplace, and the like- for example:

What do you like about working here?

If you were to tell me what aspects of your job you like and what you do not, what would they be?

Tell me something about the reward systems in this place.

If you were offered a similar job elsewhere, how willing would you be to take it and why?

If I were to seek employment here and request you to describe your unit to me as a newcomer, what would you say?

After conducting a sufficient number of such unstructured interviews with employees at several levels and studying the data obtained, the researcher would know the variables that need greater focus and call for more in-depth information.

This sets the stage for the interviewer to conduct further structured interviews, for which the variables would have been identified.

Structured interviews

Structured interviews are those conducted when it is known at the outset what information is needed. The interviewer has a list of predetermined questions to be asked of the respondents either personally, through the telephone, or through the medium of a PC. The questions are likely to focus on factors that had surfaced during the unstructured interviews and are considered relevant to the problem. As the respondents express their views, the researcher would note them down. The same questions will be asked of everybody in the same manner. Sometimes, however, based on the exigencies of the situation, the experienced researcher might take a lead from a respondent's answer and ask other relevant questions not on the interview protocol. Through this process, new factors might be identified, resulting in a deeper understanding. However, to be able to recognize a probable response, the interviewer must comprehend the purpose and goal of each question. This is particularly important when a team of trained interviewers conducts the survey.

Visual aids such as pictures, line drawings, cards, and other materials are also sometimes used in conducting interviews. The appropriate visuals are shown to the interviewers, who then indicate the responses to the questions posed. Marketing research, for example, benefits from such techniques in order to capture the likes and dislikes of customers to different types of packaging, forms of advertising, and so on. Visual aids, including painting and drawing, are particularly useful when children are the focus of marketing research. Visual aids also come in handy while endeavouring to elicit certain thoughts and ideas that are difficult to express or awkward to articulate.

When a sufficient number of structured interviews have been conducted and adequate information obtained to understand and describe the important factors operating in the situation, the researcher would stop the interviews. The information would then be tabulated and the data analysed. This would help the researcher to accomplish the task set out to be done, as for example, to describe the phenomena, or quantify them, or identify the specific problem and evolve a theory of the factors the influence the problem or find answers to the research question. Much qualitative research is done in this manner.

Training interviewers

When several long interviews are to be conducted, it is often not feasible for one individual to conduct all the interviews. A team of trained, interviewers then becomes necessary. Interviewers have to be thoroughly briefed about the research and trained in how to start an interview, how to proceed with the questions, how to motivate respondents to answer, what to look for in the answers, and how to close an interview. They also need to be instructed about taking notes and coding the interview responses. The tips for interviewing, discussed later, should become a part of their repertoire for interviewing.

Good planning, proper training, offering clear guidelines to interviewers, and supervising their work all help in profitably utilizing the interviewing technique as a viable data collection mechanism. Personal interviews provide rich data when respondents spontaneously offer information, in the sense that their answers do not typically fall within a constricted range of responses, as in a questionnaire. However, personal interviews are expensive in terms of time, training costs, and resource consumption.

Review of unstructured and structured interviews

The main purpose of the unstructured interview is to explore and probe into the several factors in the situation that might be central to the broad problem area. During this process it might become evident that the problem, as identified by the client, is but a symptom of a more serious and deep-rooted problem. Conducting unstructured interviews with many people in the organization could result in the identification of several critical factors in the situation. These would then be pursued further during the structured interviews for eliciting more in-depth information on them. This will help identify the critical problem as well as solve it. In applied research, a tentative theory of the factors contributing to the problem is often conceptualised on the basis of the information obtained from the unstructured and structured interviews.

Some tips to follow in interviewing

The information obtained during the interviews should be as free as possible of bias. Bias refers to errors or inaccuracies in the data collected. Biases could be introduced by the interviewer, the interviewee, or the situation. The interviewer could bias the data if proper trust and rapport are not established with the interviewee, or when the responses are either misinterpreted or distorted, or when the interviewer unintentionally encourages or discourages certain types of responses through gestures and facial expressions.

Listening attentively to the interviewee, evincing keen interest in what the respondent has to say, exercising tact in questioning, repeating and/or clarifying the questions posed, and paraphrasing some of the answers to ensure their thorough understanding, go a long way in keeping alive the interest of the respondent throughout the interview. Recording the responses accurately is equally important.

Interviewers can bias the data when they do not come out with their true opinions but provide information that they think is what the interviewer expects of them or would like to hear. Also, if they do not understand the questions, they may feel diffident or hesitant to seek clarification. They may then answer questions without knowing their import, and thus introduce biases.

Some interviewees may be turned off because of personal likes and dislikes, or the dress of the interviewer, or the manner in which the questions are put. They may, therefore, not provide truthful answers, but instead, deliberately offer incorrect responses. Some respondents may also answer questions in a socially acceptable manner rather than indicate their true sentiments.

Biases could be situational as well, in terms of (1) non-participants, (2) trust levels and rapport established, and (3) the physical setting of the interview. Non-participation, either because of unwillingness or the inability of the interviewee to participate in the study, can bias data inasmuch as the responses of the participants may be different from those of the non-participants (which implies that a biased, rather than a representative set of responses is likely to result). Bias also occurs when different interviewers establish different levels of trust and rapport with their interviewees, thus eliciting answers of varying degrees of openness. The actual setting itself in which the interview is conducted might sometimes introduce biases. Some individuals, for instance, may not feel quite at ease when interviewed at the workplace and therefore not respond frankly and honestly.

In door-to-door or telephone interviews, when the respondent cannot be reached due to unavailability at that time, callbacks and further contacts should be attempted so that the sample does not become biased (discussed in the next chapter on sampling). The interviewer can also reduce bias by being consistent with the questioning mode as each person is interviewed, by not distorting or falsifying the information received, and by not influencing the responses of the subjects in any manner.

The above biases can be minimized in several ways. The following strategies will be useful for the purpose.

1. Establishing rapport, and motivating individuals to respond

The projection of professionalism, enthusiasm, and confidence is important for the interviewer. A manager hiring outside researchers would be interested in assessing their abilities and personality predispositions. Researchers must establishing rapport with and gain the confidence and approval of the hiring client before they can even start their work in the organization. Knowledge, skills, ability, confidence, articulateness, and enthusiasm are therefore qualities a researcher must demonstrate in order to establish credibility with the hiring organization and its members.

To obtain honest information from the respondents, the researcher/interviewer should be able to establish rapport and trust with them. In other words, the researcher should be able to make the respondent sufficiently at ease to give informative and truthful answers without fear of adverse consequences. To this end, the researcher should state the purpose of the interview and assure complete confidentially about the source of the responses. Establishing rapport with the respondents may not be easy, especially when interviewing employees at lower levels. They are likely to be suspicious of the intentions of the researchers; they may believe that the researchers are on the management's "side", and therefore likely to propose reduction of the labour force, increase in the workload, and so on. Thus, it is important to ensure that everyone concerned is aware of the researchers' purpose as being one of merely understanding the true state of affairs in the organization. The respondents must be tactfully made to understand that the researchers do not intend to take sides; they are not there to harm the staff, and will provide the results of research to the organization only in aggregates, without disclosing the identify of the individuals. This would encourage the respondents to feel secure about responding.

The researcher can establish rapport by being pleasant, sincere, sensitive, and non-evaluative. Evincing a genuine interest in the responses and allaying any anxieties, fears, suspicious, and tensions sensed in the situation will help respondents to feel more comfortable with the researchers. If the respondent is told about the purpose of the study and how he or she was chosen to be one of those interviewed, there would be better communication between the parties. Researchers can motivate respondents to offer honest and truthful answers by explaining to them that their contribution would indeed help, and that they themselves may stand to gain from such a survey, in the sense that the quality of life at work for most of them could improve significantly.

2. The questioning technique

Funneling- In the beginning of an unstructured interview, it is advisable to ask open-ended questions to get a broad idea and form some impressions about the situation. For example a question that could be asked, would be:

"What are some of your feelings about working for this organization"

From the responses to this broad question, further questions that are progressively more focused may be asked as the researcher processes the interviewees' responses and notes some possible key issues relevant to the situation. This transition from broad to narrow themes is called the funneling technique.

Unbiased questions- It is important to ask questions in a way that would ensure the least bias in the response. For example, "Tell me how you experience your job" is a better question than, "Boy, the work you do must be really boring; let me hear how you experience it". The latter question is "loaded" in terms of the interviewer's own perceptions of the job. A loaded question might influence the types of answers received from the respondent. Bias could be also introduced by emphasizing certain words, by tone and voice inflections, and through inappropriate suggestions.

Clarifying issues– To make sure that the researcher understands issues as the respondent intends to represent them, it is advisable to restate or rephrase important information given by the respondent. For instance, if the interviewee says, “There is an unfair promotion policy in this organization; seniority does not count at all. It is the juniors who always get promoted”, the researcher might interject, “So you are saying that juniors always get promoted over the heads of even capable seniors”. Rephrasing in this way clarifies the issue of whether or not the respondent considers ability important. If certain things that are being said are not clear, the researcher should seek clarification. For example, if the respondent happened to say, “The facilities here are really poor; we often have to continue working even when we are dying of thirst”, the researcher might ask if there is no water fountain or drinking water available in the building. The respondent’s reply to this might well indicate that there is a water fountain across the hall, but the respondent would have liked one on his side of the work area as well.

Helping the respondent to think through issues– If the respondent is not able to verbalize her perceptions, or replies, “I don’t know”, the researcher should ask the question in a simpler way or rephrase it. For instance, if a respondent is unable to specify what aspects of the job he dislikes, the researcher might ask the question in a simpler way. For example, the respondent might be asked which task he would prefer to do serve a customer or do some filing work. If the answer is “serve the customer”, the researcher might use another aspect of the respondent’s job and ask the paired-choice question again. In this way, the respondent can sort out which aspects of the job he likes better than others.

Taking notes– When conducting interviews, it is important that the researcher makes written notes as the interviews are taking place, or as soon as the interview is terminated. The interviewer should not rely on memory, because information recalled from memory is imprecise and often likely to be incorrect. Furthermore, if more than one interview is scheduled for the day, the amount of information received increases, as do possible sources of error in recalling from memory as to who said what. Information based solely on recall introduces bias into the research.

The interviews can be recorded on tape if the respondent has no objection. However, taped interviews might bias the respondents' answers because they know that their voices are being recorded, and their anonymity is not preserved in full. Hence, even if the respondents do not object to being taped, there could be some bias in their responses. Before recording or videotaping interviews, one should be reasonably certain that such a method of obtaining data is not likely to bias the information received. Any audio or videotaping should always be done only after obtaining the respondent's permission.

Review of tips to follow in interviewing– Establishing credibility as able researchers with the client system and the organizational members is important for the success of the research project. Researchers need to establish rapport with the respondents and motivate them to give responses relatively free from bias by allaying whatever suspicions, fears, anxieties, and concerns they may have about the research and its consequences. This can be accomplished by being sincere, pleasant, and non-evaluative. While interviewing, the researcher has to ask broad questions initially and then narrow them down to specific areas, ask questions in an unbiased way, offer clarifications when needed, and help respondents to think through difficult issues. The responses should be transcribed immediately and not be trusted to memory and later recall.

Having looked at unstructured and structured interviews and learned something about how to conduct the interviews, we can now discuss face-to-face and telephone interviews.

Face-to-face and telephone interviews

Interviews can be conducted either face to face or over the telephone. They could also be computer-assisted. Although most unstructured interviews in organizational research are conducted face-to-face, structured interviews could be either face to face or through the medium of the telephone, depending on the level of complexity of the issues involved, the likely duration of the interview, the convenience of both parties, and the geographical area covered by the survey. Telephone interviews are best suited when information from a large number of respondents spread over a wide geographical areas is to be obtained quickly, and the likely duration of each interview is, say, 10 minutes or less. Many market surveys, for instance, are conducted through structured telephone interviews. In addition, computer-assisted telephone interviews (CATI) are also possible, and easy to manage.

Face-to-face interviews and telephone interviews have other advantages and disadvantages. These will now be briefly discussed.

Face-to-face interviews

Advantages- The main advantage of face-to-face or direct interviews is that the researcher can adapt the questions as necessary, clarify doubts, and ensure that the responses are properly understood by repeating or rephrasing the questions. The researcher can also pick up nonverbal cues from the respondent. Any discomfort, stress, or problems that the respondent experiences can be detected through frowns, nervous tapping, and other body language unconsciously exhibited by her. This would be impossible to detect in a telephone interview.

Disadvantages- The main disadvantages of face-to-face interviews are the geographical limitations they may impose on the surveys and the vast resources needed if such surveys need to be done nationally or internationally. The costs of training interviewers to minimize interviewer biases (e.g., differences in questioning methods, interpretation of responses) are also high. Another drawback is that respondents might feel uneasy about the anonymity of their responses when they interact face to face with the interviewer.

Telephone interviews

Advantages- The main advantage of telephone interviewing, from the researcher's point of view, is that a number of different people can be reached (if need be, across the country or even internationally) in a relatively short period of time. From the respondents standpoint it would eliminate any discomfort that some of them might feel in facing the interviewer. It is also possible that most of them would feel less uncomfortable disclosing personal information over the phone than face to face.

Disadvantages- A main disadvantage of telephone interviewing is that the respondent could unilaterally terminate the interview without warning or explanation, by hanging up the phone. Caller ID might further aggravate the situation. This is understandable, given the numerous telemarketing calls people are bombarded with on a daily basis. To minimize the type of a non-response problem it would be advisable to call the interviewee ahead of time to request participation in the survey, giving an approximate idea of how long the interview would last, and setting up a mutually convenient time. Interviewees usually tend to appreciate this courtesy and are more likely to cooperate. It is a good policy not to prolong the interview beyond the time originally stated. As mentioned earlier, another disadvantage of the telephone interview is that the researcher will not be able to see the respondent to read the nonverbal communication.

Interviewing is a useful data collection method, especially during the exploratory stages of research. Where a large number of interviews are conducted with a number of different interviewers, it is important to train the interviewers with care in order to minimize interviewer biases manifested in such ways as voice inflections, differences in wordings, and interpretation. Good training decreases interviewer biases.

Computer-assisted interviewing

With computer-assisted interviews (CAI), thanks to modern technology, questions are flashed onto the computer screen and interviewers can enter the answers of the respondents directly into the computer. The accuracy of data collection is considerably enhanced since the software can be programmed to flag the "off-base" or "out-of-range" responses. CAI software also prevents interviewers from asking the wrong questions or in the wrong sequence since the questions are automatically flashed to the respondent in an ordered sequence. This would, to some extent, eliminate interviewer-induced biases.

CATI and CAPI- There are two types of computer-assisted interview programs: CATI (Computer-assisted telephone interviewing) and CAPI (Computer-assisted personal interviewing).

CATI, used in research organizations, is useful inasmuch as responses to surveys can be obtained from people all over the world since the PC is networked into the telephone system. The PC monitor prompts the questions with the help of software and the respondent provides the answers. The computer selects the telephone number, dials and places the responses in a file. The data are analysed later. Computerized, voice-activated telephone interviews are also possible for short surveys. Data can also be gathered during field surveys through hand-held computers that record and analyse responses.

CAPI involves big investments in hardware and software. CAPI has an advantage in that it can be self-administered; that is, respondents can use their own computers to turn the program by themselves once they receive the software and enter their responses, thereby reducing errors in recording. However, not everyone is comfortable using a personal computer and some may not have access to it.

The voice recording system assist CATI programs by recording interviewees' responses. Courtesy, ethics, as well as legal requirements would require that the respondent's permission to record be obtained before the voice capture system (VCS) is activated. The VCS allows the computer to capture the respondents answers, which are recorded in a digital mode and stored in a data file. They can be played back late, for example, to listen to customers by region, industry, or any combination of different sets of factors.

In sum, the advantages of computer-assisted interviews can be stated simply as quick and more accurate information gathering, plus faster and easier analysis of data. The field costs are low and automatic tabulation of results is possible. It is more efficient in terms of costs and time, once the initial heavy investment in equipment and software has been made. However, to be really cost-effective, large surveys should be done frequently enough to warrant the heavy front-end investment and programming costs.

Computer-aided survey services

Several research organizations offer their services to companies who engage in occasional data gathering. For instance, the National Computer Network provides computer survey services for conducting marketing studies. Some of the advantages of using these services are that (1) the researcher can start analyzing the data even as the field survey is in progress since results can be transmitted to clients through modem in raw or tabulated form, (2) data can be automatically "cleaned up" and errors, if any, fixed even as they are being collected; (3) biases due to ordering questions in a particular way (known as the ordering effects) can be eliminated since meaningful random start patterns can be incorporated into the questioning process; (4) skip patterns (e.g., if the answer to this question is No, skip to question #19) can be programmed into the process; and (5) questions can be customized to incorporate the respondents terminology of concepts into subsequent questions.

Computer surveys can be conducted either by mailing the disks to respondents or through online surveys, with the respondents' personal computers being hooked up to computer networks. Survey system provided by Creative Research systems and interview system provided by Compaq Co. are two of the several computer survey systems available in the market.

Advantages of software packages

Field notes taken by interviewers as they collect data generally have to be transcribed, hand-coded, hand-tabulated, and so on- all of which are tedious and time consuming. Computers vastly ease the interviewers' job with regard to these activities. Automatic indexing of the data can be done with special programs. The two modes in operation are (1) indexing such that specific responses are coded in a particular way; and (2) retrieval of data with a fast search speed-covering 10,000 pages in less than 5 seconds. Text-oriented database management retrieval program allows the user to go through the text, inserting marks that link related units of text. The associative links formed are analytical categories specified by the researcher. Once the links are created, the program allows the user to activate them by opening multiple windows on the screen.

We thus see that computers make a big impact on data collection. With greater technological advancement and a reduction of hardware and software costs, computer-assisted interviews promise to become a primary method of data collection in the future.

5.3.5 Observation Method

The observation method is the most commonly used method especially in studies relating to behavioural sciences. In a way we all observe things around us, but this sort of observation is not scientific observation. Observation becomes a scientific tool and the method of data collection for the researcher, when it serves a formulated research purpose, is systematically planned and recorded and is subjected to checks and controls on validity and reliability. Under the observation method, the information is sought by way of investigator's own direct observation without asking from the respondent. For instance, in a study relating to consumer behaviour, the investigator instead of asking the brand of wristwatch used by the respondent, may himself look at the watch. The main advantage of this method is that if observation is done accurately. Secondly, the information obtained under this method relates to what is currently happening; it is not complicated by either the past behaviour or future intentions or attitudes. Thirdly, this method is independent of respondents' willingness to respond and as such is relatively less demanding of active cooperation on the part of respondents as happens to be the case in the interview or the questionnaire method. This method is particularly suitable in studies which deal with subjects (i.e. respondents) who are not capable of giving verbal reports of their feelings for one reason or the other.

"However, observation method has various limitations. Firstly, it is an expensive method. Secondly, the information provided by this method is very limited. Thirdly, sometimes, unforeseen factors may interfere with the observational task. At times, the fact that some people are rarely accessible to direct observation creates obstacle for this method to collect data effectively.

While using this method, the researcher should keep in mind things like: What should be observed? How the observations should be recorded? Or how the accuracy of observation can be ensured? In case the observation is characterized by a careful definition of the units to be observed, the style of characterized by a careful definition of the units to be observed, the style of recording the observed information, standardized conditions of observations and the selection of pertinent data of observation, then the observation is called as structured observation. But when observation is to take place without these characteristics to be thought of in advance, the same is termed as unstructured observation. Structured observation is considered appropriate in descriptive studies, whereas in an exploratory study the observational procedure is most likely to be relatively unstructured.

We often talk about participant and non-participant types of observation in the context of studies, particularly of social sciences. This distinction depends upon the observer's sharing or not sharing the life of the group he is observing. If the observer observes by making himself, more or less, a member of the group he is observing so that he can experience what the members of the group experience, the observation is called as the participant observation. But when the observer observes as a detached emissary without any attempt on his part to experience through participation what others feel, the observation of this type is often termed as non-participant observation. (When the observer is observing in such a manner that his presence may be unknown to the people he is observing, such an observation is described as disguised observation).

There are several merits of the participant type of observation: (i) the researcher is enabled to record the natural behaviour of the group. (ii) the researcher can even gather information which could not easily be obtained if he observes in a disinterested fashion. (iii) The researcher can even verify the truth of statements made by informants in the context of a questionnaire or a schedule. But there are also certain demerits of this type of observation viz., the observer may lose the objectivity to the extent he participates emotionally; the problem of observation-control is not solved; and it may narrow-down the researcher's range of experience.

Sometimes we talk of controlled and uncontrolled observation. If the observation takes place in the natural setting, it may be termed as uncontrolled observation, but when observation takes place according to definite pre-arranged plans, involving experimental procedure, the same is then termed controlled observation. In non-controlled observation, no attempt is made to use precision instruments. The major aim of this type of observation is to get a spontaneous picture of life and persons. It has a tendency to supply naturalness and completeness of behaviour, allowing sufficient time for observing it. But in controlled observation, we use mechanical (or precision) instruments as aids to accuracy and standardization. Such observation has a tendency to supply formalized data upon which generalizations can be built with some degree of assurance. The main pitfall of non-controlled observation is that of subjective interpretation. There is also the danger of having the feeling that we know more about the observed phenomena than we actually do. Generally, controlled observation takes place in various experiments that are carried out in a laboratory or under controlled conditions, whereas uncontrolled observation is resorted to in case of exploratory researches.

5.3.6 Data collection through mechanical observation

There are situations where machines can provide data by recording the events of interest as they occur, without a researcher being physically present. Nielsen ratings is an oft-cited example in this regard. Other examples include collection of details of products sold by types of brands tracked through optical scanners and bar codes at the checkout stand, and tracking systems keeping a record of how many individuals utilize a facility or visit a web site. Films and electronic recording devices such as video cameras can also be used to record data. Such mechanically observed data are error-free.

Projective methods

Certain ideas and thoughts that cannot be easily verbalized or that remain at the unconscious levels in the respondents' minds can usually be brought to the surface through motivational research. This is typically done by trained professionals who apply different probing techniques in order to bring to the surface deep-rooted ideas and thoughts in the respondents. Familiar techniques for gathering such data are word associations, sentence completion, thematic apperception tests (TAT), inkblot tests, and the like.

Word association techniques, such as asking the respondent to quickly associate a word-say, work-with the first thing that comes to mind, are often used to get at the true attitudes and feelings. The reply would be an indication of what work means to the individual. Similarly, sentence completion would have the respondent quickly complete a sentence, such as "work is –". One respondent might say, "Work is a lot of fun", whereas another might say "Work is drudgery". These responses may provide some insights into individuals' feelings and attitudes toward work.

Thematic apperception tests (TAT) call for the respondent to weave a story around a picture that is shown. Several need patterns and personality characteristics of employees could be traced through these tests. Inkblot tests, another form of motivational research, use coloured inkblots that are interpreted by the respondents, who explain what they see in the various patterns and colours.

Although these types of projective tests are useful for tapping attitudes and feelings that are difficult to obtain otherwise, they cannot be resorted to by researchers who are not trained to conduct motivational research.

Consumer preferences, buying attitudes and behaviours, product development and other marketing research strategies make substantial use of in-depth probing. TAT and inkblot tests are on their way out in marketing research since advertisers and others now use the sentence completion tests and word association tests more frequently. Sketch drawings, Collages from magazine pictures, filling in the balloon captions of cartoon characters, and other strategies are also being followed to see how individuals associate different products, brands, advertisements, and so on, in their minds. Agencies frequently ask subjects to sketch "typical" users of various brands and narrate stories about them. The messages conveyed through the unsophisticated drawings are said to be very powerful, helping the development of different marketing strategies.

The idea behind motivational research is that "emotionality" ("I identify with it" feeling) rather than "rationality" ("it is good for me" thought), which is what keeps a product or practice alive, is captured. Emotions are powerful motivators of actions, and knowledge of what motivates individuals to act is very useful. The failure of attempts to trade in the "New Coke" for "Classic Coke" is an oft-cited example of the emotional aspect. Emotionality is clearly at the non-rational, subconscious level, lending itself to capture by projective techniques alone.

5.4 MULTIMETHODS AND MULTISOURCES OF DATA COLLECTION

Because almost all data collection methods have some biases associated with them, collecting data through multimethods and from multiple sources lends rigor to research. For instance, if the responses collected through interviews, questionnaires, and observation are strongly correlated with one another, then we will have more confidence about the goodness of the collected data. If the same question fetches discrepant answers in the questionnaire and during the interview, then an air of uncertainty emerges and we would be inclined to discard both data as being biased.

Likewise, if data obtained from several sources bear a great degree of similarity, we would have stronger conviction in the goodness of the data. For example, if an employee rates his performance as 4 on a 5-point scale, and his supervisor gives him a similar rating, we may be inclined to consider him a better than average worker. On the contrary, if he gives himself a 5 on the 5-point scale and his supervisor gives him a rating of 2, then we will not know to what extent thee is a bias and from which source. Therefore, high correlations among data obtained on the same variable from different sources and through different data collection methods lend more credibility to the research instrument and to the data obtained through these instruments. Good research entails collection of data from multiple sources and through multiple data collection methods. Such research, though, would be more costly and time consuming.

Review of the advantages and disadvantages of different data collection methods and when to use each

Having discussed the various data collection methods, we will now briefly recount the advantages and disadvantages of the three most commonly used data collection methods-interviews, questionnaires, and observation-and examine when each method can be most profitably used.

Face-to-face interviews provide rich data, offer the opportunity to establish rapport with the interviewees, and help to explore and understand complex issues. Many ideas ordinarily difficult to articulate can also be brought to the face and discussed during such interviews. On the negative side, face-to-face interviews have the potential for introducing interviewer bias and can be expensive if a large number of subjects are involved. Where several interviewers become necessary, adequate training becomes a necessary first step.

Face-to-face interviews are best suited at the exploratory stages of research when the researcher tries to get a handle on concepts of the situational factors.

Telephone interviews help to contact subjects dispersed over various geographic regions and obtain immediate responses from them. This is an efficient way of collecting data when one has specific questions to ask, needs the responses quickly, and has the sample spread over a wide geographic area. On the negative side, the interviewer cannot observe the nonverbal responses of the respondents, and the interviewee can block a call.

Telephone interviews are best studied for asking structured questions where responses need to be obtained quickly from a sample that is geographically spread.

Personally administering questionnaires to groups of individuals helps to (1) establish rapport with the respondents while introducing the survey, (2) provide clarifications sought by the respondents while introducing the survey, (3) collect the questionnaires immediately after they are completed. In that sense, there is a 100% response rate. On the negative side, administering questionnaires personally is expensive, especially if the sample is geographically dispersed.

Personally administered questionnaires are best suited when data are collected from organizations that are located in close proximity to one another and groups of respondents can be conveniently assembled in the company's conference (or other) rooms.

Mail questionnaires are advantageous when responses to many questions have to be obtained from a sample that is geographically dispersed, or it is difficult or not possible to conduct telephone interviews without much expense. On the negative side, mailed questionnaires usually have a low response rate and one cannot be sure if the data obtained are biased since the non-respondents may be different from those who did respond.

The mailed questionnaire survey is best suited (and perhaps the only alternative open to the researcher) when information is to be obtained on a substantial scale through structured questions, at a reasonable cost, from a sample that is widely dispersed geographically.

Observational studies help to comprehend complex issues through direct observation (either as a participant or a non-participant-observer) and then, if possible, asking questions to seek clarifications on certain issues. The data obtained are rich and uncontaminated by self-report biases. On the negative side, they are expensive, since long periods of observation (usually encompassing several weeks or even months) are required, and observer bias may well be present in the data.

Because of the costs involved, very few observational studies are done in business. Henry Mintzberg's study of managerial work is one of the best known published works that used an observational data collection method. Observational studies are best suited for research requiring non-self-report descriptive data; that is, when behaviours are to be understood without directly asking the respondents themselves. Observational studies can also capture "n-the-stores buying behaviours".

5.5 SECONDARY SOURCES OF DATA

Secondary data can be used, among other things, for forecasting sales by constructing models based on past sales figures, and through extrapolation.

There are several sources of secondary data, including books and periodicals, government publications of economic indicators, census data, statistical abstracts, databases, the media, annual reports of companies, etc. Case studies, and other archival records-sources of secondary data-provide a lot of information for research and problem solving. Such data are, as we have seen, mostly qualitative in nature. Also included in secondary sources are schedules maintained for or by key personnel in organizations, the desk calendar of executives, and speeches delivered by them. Much of such internal data, through, could be proprietary and not accessible to all.

Financial databases readily available for research are also secondary data sources. The Compustat Database contains information on thousands of companies organized by industry, and information on global companies is also available through Compustar.

The advantage of seeking secondary data sources is savings in time and costs of acquiring information. However, secondary data as the sole source of information has the drawback of becoming obsolete, and not meeting the specific needs of the particular situation or setting. Hence, it is important to refer to sources that offer current and up-to-date information.

Having examined the various sources of data, let us now look into the data collection methods.

Data can be collected in any one of the aforementioned ways in the natural environment of the workplace. Data may also be collected in artificial lab settings where variables are controlled and manipulated, or they can be gathered in the homes of the respondents, on the street, in malls, or in a setting where a LAN (Local Area Network) system is available. It is not unusual to find marketers conducting what are known as intercept interviews in malls and fairs, to obtain vast marketing information.

5.6 INTERNATIONAL DIMENSIONS OF SURVEYS

We have so far discussed instrument development for eliciting responses from subjects within a country. With the globalization of business operations, managers often need to compare the business effectiveness of their subsidiaries in different countries. Researchers engaged in cross-cultural research also endeavour to trace the similarities and differences in the behavioural and attitudinal responses of employees at various levels in different cultures. When data are collected through questionnaires and occasionally through interviews, one should pay attention to the measuring instruments and how data are collected, in addition to being sensitive to cultural differences in the use of certain terms. Surveys should also be tailored to the different cultures as discussed below.

Special issues in the instrumentations for cross-cultural research

Certain special issues need to be addressed while designing instruments for collecting data from different countries. Since different languages are spoken in different countries, it is important to ensure that the translation of the instrument to the local language matches accurately to the original language. For this purpose, the instrument should be first translated by a local expert. Supposing a comparative survey is to be done between Japan and the United States, and the researcher is a U.S. national, then the instrument has first to be translated from English to Japanese. Then, another bilinguist should translate it back to English. This back translation, as it is called, ensures vocabulary equivalence (i.e., that the words used have the same meaning). Idiomatic equivalence could also become words used have the same meaning). Idiomatic equivalence could also become an issue where some idioms unique to one language just do not lend themselves for translation to another language. Conceptual equivalence, where the meanings of certain words could differ in different cultures, is yet another issue to which attention has to be paid. As stated earlier, the meaning of the concept “love” may differ in different cultures. All these issues can be taken care of through good back translation by persons who are facile with the relevant languages and are also knowledgeable about the customs and usages in the concerned cultures.

The following examples culled from Business Week show the pitfalls in cross-cultural advertising and emphasize the need for back translation of messages for idiomatic and conceptual equivalence. Not only is the meaning lost in some advertisement messages while literally translating the English words into the native languages, but also in some cases they actually become offensive. Here are some examples:

GM took a step when it tried to market the NOVA in Central and South America. In Spanish, “No va” means “It doesn’t go”.

Peopsi’s “Come Alive With the Pepsi Generation”, when translated into Chinese, emans “Pepsi brings Your Ancestors From the Grave”.

Frank Perdue’s chicken slogan, “It takes a strong man to make a tender chicken” translates in Spanish to, “It takes an aroused man to make a chicken affectionate”.

When American Airlins wanted to advertise its new leather first-class seats to Mexico, its “Fly in Leather” campaign would have literally translated to “Fly Naked” in Spanish.

The “Gpt Milk?” in Spanish would translate to “Are you lactating?”

Issues in Data Collection- At least three issues are important for cross-cultural data collection-response equivalence, timing of data collection, and the status of the individual collecting the data. Response equivalence is ensured by adopting uniform data collection procedures in the different cultures. Identical methods of introducing the study, the researcher, task instructructions, and closing remarks, in personally administered questionnaires, would provide equivalence in motivation, goal orientation, and response attitudes. Timing of data collected across cultures is also critical for cross-cultural comparison. Data collection should be completed within acceptable time frames in the different countries-say within 3 to 4 months. If too much time elapses in collecting data in the different countries, much might change during the time interval in either country or all the countries.

5.7 MANAGERIAL ADVANTAGE OF SURVEYS

As a manager, you will perhaps engage consultants to do research and may not be collecting data yourself through interviews, questionnaires, or observation. However, during those instances, when you will perforce have to obtain work-related information through interviews with clients, employees, or others, you will know how to phrase unbiased questions to elicit the right types of useful responses. Moreover, you, as the sponsor of research, will be able to decide at what level of sophistication you want data to be collected, based on the complexity and gravity of the situation. Moreover, as a constant participant-observer of all that goes around you at the workplace, you will be able to understand the dynamics operating in the situation, Also, as a manager, you will be able to differentiate between good and bad questions used in surveys with sensitivity to cultural variations, not only in scaling but also in developing the entire survey instrument, and in collecting data, as discussed in this chapter.

5.8 SUMMARY

In this chapter we examined various sources of data and several data collection methods. We discussed the advantages and disadvantages as well as the biases inherent in each data collection method. We also examined the impact of technology on data collection. Because of the inherent biases in each of the data collection methods, the collection of data from multiple sources and through multiple methods was recommended. The final decision would, of course, be governed by considerations of cost, and the degree of rigor that the given research goal would call for. We also pointed out some issues in cross-cultural research such as back translation and alerted the reader to the pitfalls while collecting data in a different culture.

5.9 KEYWORDS

Primary Data are the first hand information gathered through interaction or interview is known as primary data.

Secondary data are the information collected from the sources where it is already available.

Unobtrusive Measures also termed as trace measures originate from a primary source that does not involve people.

CAI: This is computer Assisted Interview, where with the help of computer interview is conducted.

CATI: In computer Assisted Telephonic Interview, the computer randomly selects the number, dial and record the responses.

CAPI: In Computer Assisted Personal Interview with the help of VCS (Voice Capture System) captures the response of the respondents.

Observation Method: Under this method, the information is sought by way of investigator's own observation without asking from the respondents.

Projective Methods: The deep rooted idea of the respondents are brought to surface by these methods which are adopted by expert professionals.

5.10 SELF ASSESSMENT QUESTIONS

1. Describe the different data sources, explaining their usefulness and disadvantages.
2. As a manager, you have invited a research team to come in study, and offer suggestions on how to improve the performance of your staff. What steps would you take to allay their apprehensions even before the research team sets foot in your department?
3. What is bias, and how can it be reduced during interviews?

4. Explain the principles of wording, stating how these are important in questionnaire design, citing examples not in the book.
5. What are projective techniques and how can they be profitably used?
6. How are multiple methods of data collection and from multiple sources related to the reliability and validity of the measures?
7. "Every data collection method has its own built-in-baiases. Therefore, resorting to multimethods of data collection is only going to compound the biases". How would you critique this statement?
8. "One way to deal with discrepancies found in the data obtained from multiple sources is to average the figures and take the mean as the value of the variable". What is your reaction to this?
9. How has the advancement in technology helped data gathering?
10. How will you use the data from observational study to reach scientific conclusions?
11. The fewer the biases in measurement and in data collection procedures, the more scientific the research. Comment on this statement?
12. A production manager wants to assess the reactions of the blue-collar workers in his department (including foremen) to the introduction of computer-integrated manufacturing (CIM) systems. He is particularly interested to know how they would perceive the effects of CIM on:
    (a) their future jobs
    (b) additional training that they will have to receive
    (c) future job advancement.

Design a questionnaire for the production manager.

13. Seek permission from a professor to sit in two sessions of his or her class, and do an unstructured, non-participant-observer study. Give your conclusions on the data and include in the short report your observation sheets and tabulations.
14. First conduct an unstructured and later a structured interview, with any professor not known to you, to learn about his or her values and strategy in teaching courses. Write up the results, and include the formats you used for both stages of the research.
15. The president of Serakan Co. Suspects that most of the 500 male and female employees of the organization are somewhat alienated from work. He is also of the view that those who are more involved (less alienated) are also the ones who experience greater satisfaction with their work lives. Design a questionnaire the president could use to test his hypothesis.
16. Design an interview schedule to assess the "intellectual capital" as perceived by employees in an organization-the dimensions and elements for which you had earlier developed.

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Lesson No.: **6**	

QUESTIONNAIRE DESIGNING

STRUCTURE

6.0 OBJECTIVES

After reading this lesson you should be able to

- Explain the purpose of a questionnaire ;

- Describe the process of designing a questionnaire, the steps involved, and the guidelines that must be followed at each step;
- Discuss the observational form of data collection and specify the who, what, when, where, why, and way of behaviour to be observed;
- Discuss the considerations involved in designing questionnaires for international marketing research;
- Understand the ethical issues involved in questionnaire design; and
- Discuss the use of the internet and computers in designing questionnaires.

6.1 INTRODUCTION

A questionnaire is a pre-formulated written set of questions to which respondents record their answers, usually within rather closely defined alternatives. Questionnaires are an efficient data collection mechanism when the researcher knows exactly what is required and how to measure the variables of interest. Questionnaires can be administered personally, mailed to the respondents, or electronically distributed.

When the survey is confined to a local area, and the organization is willing and able to assemble groups of employees to respond to the questionnaires at the workplace, a good way to collect data is to personally administer the questionnaires. The main advantage of this is that the researcher or a member of the research team can collect all the completed responses within a short period of time. Any doubts that the respondents might have on any question could be clarified on the spot. The researcher is also afforded the opportunity to introduce the research topic and motivate the respondents to offer their frank answers. Administering questionnaires to large numbers of individuals at the same time is less expensive and consumes less time than interviewing; it does not also require as much skill to administer the questionnaire as to conduct interviews. Wherever possible, questionnaires are best administered personally to groups of people because of these advantages. However, organizations are often unable or disinclined to allow work hours to be spent on data collection, and other ways of getting the questionnaires back after completion may have to be found. In such cases, employees may be given blank questionnaires to be collected from them personally on completion after a few days, or mailed back by a certain data in collecting primary data, particularly in surveys and descriptive researches.

The main advantage of mail questionnaires is that a wide geographical area can be covered in the survey. They are mailed to the respondents, who can complete them at their convenience, in their homes, and at their own pace. However, the return rates of mail questionnaires are typically low. A 30% response rate is considered acceptable. Another disadvantage of the mail questionnaire is that any doubts the respondents might have cannot be clarified. Also, with very low return rates it is difficult to establish the representativeness of the sample because those responding to the survey may not at all represent the population they are supposed to. However, some effective techniques can be employed for improving the rates of response to mail questionnaires. Sending follow-up letters, enclosing some small monetary amounts as incentives with the questionnaire, providing the respondent with self-addressed, stamped return envelopes, and keeping the questionnaire brief do indeed help.

Mail questionnaires are also expected to meet with a better response rate when respondents are notified in advance about the forthcoming survey, and a reputed research organization administers them with its own introductory cover letter.

The choice of using the questionnaire as a data gathering method might be restricted if the researcher has to reach subjects with very little education. Adding pictures to the questionnaires, if feasible, might be of help in such cases. For most organizational research, however, after the variables for the research have been identified and the measuires therefore found or developed, the questionnaire is a convenient data collection mechanism. Field studies, comparative surveys, and experimental designs often use questionnaires to measure the variables of interest. Because questionnaires are in common use in surveys, it is necessary to know how to design them effectively. A set of guidelines for questionnaire construction follows.

6.2 QUESTIONNAIRES AND OBSERVATION FORMS

As was discussed in lesson 5, survey and observation are the two basic methods for obtaining quantitative primary data in descriptive research. Both these methods require some procedure for standardizing the date collection process so that the date obtained are internally consistent and can be analyzed in a uniform and coherent manner. If 40 different interviewers conduct personal interviews or make observations in different parts of the country, the data they collect will not be comparable unless they follow specific guidelines and ask questions and record answers in a standard way. A standardized questionnaire or form will ensure comparability of the data, increase speed and accuracy of recording, and facilitate data processing.

Questionnaire Definition– *A questionnaire,* whether it is called a schedule, interview form, or measuring instrument, is a formalized set of questions for obtaining information from respondents. Typically, a questionnaire is only one element of a data collection package that might also include (1) field work procedures, such as instructions for selecting, approaching, and questioning respondents; (2) some reward, gift, or payment offered to respondents; and (3) communication aids such as maps, pictures, advertisements, and products (as in personal interviews) and return envelopes (in mail surveys). Regardless of the form of administration, a questionnaire is characterized by some specific objectives.

6.3 OBJECTIVES OF QUESTIONNAIRE

Any questionnaire has three specific objectives. First, it must translate the information needed into a set of specific questions that the respondents can and will answer. Developing questions that respondents can and will answer and that will yield the desired information is difficult. Two apparently similar ways of posing a question may yield different information. Hence, this objective is a challenge.

Second, a questionnaire must uplift. Motivate, and encourage the respondent to become involve in the interview, to cooperate, and to complete the interviews. Incomplete interviews have limited usefulness at best. In designing a questionnaire, the researcher should strive to minimize respondent fatigue, boredom, and efforts to minimize incompleteness and nonresponse.

Third, a questionnaire should minimize response error. The response error may be defined as the error that arises when respondents give inaccurate answers or their answers are misrecorded or misanalyzed. A questionnaire can be major source of response error. Minimizing this error is an important objective of questionnaire design.

6.4 QUESTIONNAIRE DESIGN PROCESS

This section presents guidelines useful to beginning researchers in designing questionnaires. Although these rules can help you avoid major mistakes, the fine-tuning of a questionnaire comes from the creativity of a skilled researcher.

Questionnaire design will be presented as a series of steps (see Figure 6.1). We will present guidelines for each step. Although shown sequentially in Figure 6.1, these steps are interrelated and the development of a questionnaire will involve some iteration and looping. For example, the researcher may discover that respondents misunderstand all the possible workings of question. This may require a loop back to the earlier step of deciding on the question structure.

6.4.1 Specify the information needed

The first step in questionnaire design is to specify the information needed. This is also the first step in the research design process. Note that as the research project progresses, the information needed becomes more and more clearly defined. It is helpful to review components of the problem and the approach, particularly the research questions, hypotheses, and characteristics that influence the research design. To further ensure that the information obtained fully addresses all the components of the problem, the researcher should prepare a set of dummy tables. A dummy table is a blank table used to catalog data. It describes how the analysis will be structured one the date have been collected.

FIGURE 6.1: QUESTIONNAIRE DESIGN PROCESS

Specify the Information Needed
↓
Specify the Type of Interviewing Method
↓
Determine the Content of Individual questions
↓
Design the questions to Overcome the Respondent's Inability and Unwillingness to Answer
↓
Decide on the question structure
↓
Determine the question wording
↓
Arrange the question in proper order
↓
Appearance or "getup"
↓
Eliminate Bugs by protesting

It is also important to have a clear idea of the target population. The characteristics of the respondent group have a great influence on questionnaire design. Questions that are appropriate for college students may not be appropriate for housewives. Understanding is associated with a high incidence of uncertain or no opinion responses. The more diversified the respondent group, the more difficult it is to design a single questionnaire that is appropriate for the entire group.

6.4.2 Type of interviewing method

An appreciation of how the type of interviewing method influences questionnaire design can be obtained by considering how the questionnaire is administered under each method. In personal interviews, respondents see the questionnaire and interact face-to-face with the interviewer. Thus lengthy, complex, and varied questions can be asked. In telephone interviews, the respondents interact with the interviewer, but they do not see the questionnaire. This limits the type of questions that can be asked to short and simple ones (see the department store patronage project). Mail questionnaires are-administered, so the questions must be simple and detailed instructions must be provided. In computer assisted interviewing (CAPI and CATI), complex skip patterns and randomization of questions to eliminate order bias can be easily accommodated. Internet questionnaires share many of the characteristics of CAPI, but e-mail questionnaires have to be simpler. Questionnaires designed for personal and telephone interviews should be written in a conversational style.

Effect of Interviewing Method on Questionnaire Design: Department store patronage project

Mail Questionnaire

Please rank the following department stores in order of your preference to shop at these stores. Begin by picking out the one store that you like most and assign it a number 1. Then find the second most preferred department store and assign it a number 2. Continue this procedure until you have ranked all the stores in order of preference. The least preferred store should be assigned a rank of 10.

No two stores should receive the same rank number.

The criterion of preference is entirely up to you. There is no right or wrong answer. Just try to be consistent.

	Store	Rank Order
1.	Lord & Taylor	____________________
2.	Macy’s	____________________
3.	Kmart	____________________
4.	Rich’s	____________________
5.	J.C. Penney	____________________
5.	J.C. Penney	____________________
6.	Neiman-Marcus	____________________
7.	Target	____________________
8.	Saks Fifth Avenue	____________________
9.	Sears	____________________
10.	Wal-Mart	____________________

Telephone Questionnaire

I will read to you the names of some departmental stores. Please rate them in terms of your preference to shop at these stores. Use a 10-point scale, where I denotes not so preferred and 10 denotes greatly preferred. Numbers between 1 and 10 reflect intermediate degrees of preference. Again, please remember that the higher the number, the greater the degree of preference. Now, please tell me your preference to shop at .... (Read one store at a time)

Store		Not so Preferred								Greatly Preferred
1.	Lord & Taylor	1	2	3	4	5	6	7	8	9	10
2.	Macy's	1	2	3	4	5	6	7	8	9	10
3.	Kmart	1	2	3	4	5	6	7	8	9	10
4.	Rich's	1	2	3	4	5	6	7	8	9	10
5.	J.C. Penney	1	2	3	4	5	6	7	8	9	10
6.	Neiman Marcus	1	2	3	4	5	6	7	8	9	10
7.	Target	1	2	3	4	5	6	7	8	9	10
8.	Saks Fifth Avenue	1	2	3	4	5	6	7	8	9	10
9.	Sears	1	2	3	4	5	6	7	8	9	10
10.	Wal-Mart	1	2	3	4	5	6	7	8	9	10

Personal Questionnaire

(Hand department store cards to the respondent.) Here is a set of department store names, each written on a separate card. Please examine these cards carefully. (Give respondent time.) Now, please examine these cards again and pull out the card that has the name of the store you like the most, that is, your most-preferred store for shopping. (Record the store name and keep this card with you.) Now, please examine the remaining nine cards. Of these remaining nine stores, what is your most-preferred store for shopping? (Repeat this procedure sequentially until the respondent has only one card left.)

1.	1	________________
2.	2	________________
3.	3	________________
4.	4	________________
5.	5	________________
6.	6	________________
7.	7	________________

8.	8	________________
9.	9	________________
10.	10	________________

This question for e-mail and Internet questionnaires will be very similar to that for the mail questionnaire; in all these methods, the questionnaire is self-administered by the respondent.

In the department store project example, ranking 10 stores is too complex a task to be administered over the telephone. Instead, the simpler rating task, in which the stores are rated one at a time, is selected to measure preferences. Note the use of cards to facilitate the ranking task in the personal interview. Interviewer instructions (types in bold letters) are much more extensive in the personal interview. Another difference is that the respondent records the ranks in mail and electronic surveys, whereas the interviewer records the store names in the personal interview. The type of interviewing method also influences the content of individual questions.

6.4.3 Individual question content

Once the information needed is specified and the type of interviewing method decided, the next step is to determine individual question content: what to include in individual questions.

Is the question necessary?

Every question in a questionnaire should contribute to the information needed or should serve some specific purpose. If there is no satisfactory use for the data resulting from a question, that question should be eliminated.

In certain situations, however, questions may be asked that are not directly related to the information that is needed. It is useful to ask some neutral questions at the beginning of the questionnaire to establish involvement and rapport, particularly when the topic of the questionnaire is sensitive or controversial. Sometimes filler questions are asked to disguise the purpose or sponsorship of the project. Rather than limiting the questions to the brand of interest, questions about competing brands may also be included to disguise the sponsorship. For example, a survey on personal computers sponsored by IBM may also include filler questions related to Dell, Compaq, and Apple. Questions unrelated to the immediate problem may sometimes be included to generate client support for the project. At times, certain questions may be duplicated for the purpose of assessing reliability or validity.

Are several questions needed instead of one?

Once we have ascertained that a question is necessary, we must make sure that it is sufficient to get the desired information. Sometimes, several questions are needed to obtain the required information in an unambiguous manner. Consider the question,

"Do you think Coca-Cola is a tasty and refreshing soft drink?" (Incorrect)

A "yes" answer will presumably be clear, but what if the answer is "no"? Does this mean that the respondent thinks that Coca-Cola is not tasty, that it is not refreshing, or that it is neither tasty nor refreshing? Such a question is called a double-barreled question, because two or more questions are combined into one. To obtain the required information, two distinct questions should be asked:

"Do you think Coca-Cola is a tasty soft drink?" and

"Do you think Coca-Cola is a refreshing soft drink?" (Correct)

Another example of multiple questions embedded in a single question is the “why” question. In the context of the department store study, consider the question,

“Why do you shop at Nike Town?” (Incorrect)

The possible answers may include “it is more conveniently located than other stores,” and “it was recommended by my best friend.” Each of these answers relates to a different question embedded in the “why” question. The first answer tells what the respondent likes about Nike Town as compared to other stores, and the second answer reveals how the respondent learned about Nike Town. The two answers are not comparable and any one answer may not be sufficient. Complete information may be obtained by asking two separate questions:

“What do you like about Nike Town as compared to other stores?” and

“How did you first happen to shop in Nike Town?”
(Correct)

Most “why” questions about the use of a product or choice alternative involve two aspects: (1) attributes of the product, and (2) influences leading to knowledge of it.

6.4.4 Overcoming inability to answer

Researchers should not assume that respondents can provide accurate or reasonable answers to all questions. The researcher should attempt to overcome the respondents’ inability to answer. Certain factors limit the respondents’ ability to provide the desired information. The respondents may not be informed, may not remember, or may be unable to articulate certain types of responses.

Is the respondent informed?

Respondents are often asked about topics on which they are not informed. A husband may not be informed about monthly expenses for groceries and department store purchases if it is the wife who makes these purchases, and vice versa. Research has shown that respondents will often answer questions even though they are uninformed, as the following example shows.

Unknown Answers- In one study, respondents were asked to express their degree of agreement or disagreement with the following statement: "The National Bureau of consumer Complaints provides an effective means for consumers who have purchased a defective product to obtain relief." As many as 96.1 percent of the lawyers and 95 percent of the general public who responded expressed an opinion. Even with a "don't know" option in the response set, 51.9 percent of the lawyers and 75.0 percent of the public still expressed an opinion about the National Bureau of Consumer Complaints. Why should these high response rates be problematic? There is no such entity as the National Bureau of Consumer Complaints!

In situation in which not all respondents are likely to be informed about the topic of interest, **filter questions** that measure familiarity, product use, and past experience should be asked before questions about the topics themselves. Filter questions enable the researcher to filter out respondents who are not adequately informed.

The department store questionnaire included questions related to 10 different department stores, ranging from prestigious stores to discount stores. It was likely that many respondents would not be sufficiently informed about all the stores, so information on familiarity and frequency of patronage need to be obtained for each store. This would allow for separate analysis of data on stores about which the respondents are not informed. A “don’t know” option appears to reduce uninformed responses without reducing the overall response rate or the response rate for questions about which the respondents have information. Hence, this option should be provided when the researcher expects that respondents may not be adequately informed about the subject of the question.

Can the Respondent Remember?

Many things that we might expect everyone to know are remembered by only a few. Test this out on yourself. Can you answer the following?

What is the brand name of the shirt you were wearing two weeks ago?

What did you have for lunch a week ago?

What were you doing a month ago at noon?

These questions are incorrect as they exceed the ability of the respondents to remember. Evidence indicates that consumers are particularly poor at remembering quantities of products consumed. In situations in which factual data were available for comparison, it was found that consumer reports of product usage exceeded actual usage by 100 percent or more.

The inability to remember leads to errors of omission, telescoping, and creation. Omission is the inability to recall an event that actually took place. Telescoping takes place when an individual telescopes or compresses time by remembering an event as occurring more recently than it actually occurred. For example, a respondent reports three trips to the super market in the last two weeks when, in fact, one of these trips was made 18 days ago. Creation error takes place when a respondent “remembers” an event that did not actually occur.

The ability to remember an event is influenced by (1) the event itself, (2) the time elapsed since the event, and (3) the presence or absence of events that would aid memory. We tend to remember events that are important or unusual or that would aid memory. We tend to remember events that are important or unusual or that occur frequently. People remember their wedding anniversary and birthday. Likewise, more recent events are remembered better. A grocery shopper is more likely to remember what was purchased yesterday as compared to what was bought three weeks ago.

Can the respondent articulate?

Respondents may be unable to articulate certain types of responses. For example, if asked to describe the atmosphere of the department store they would prefer to patronize, most respondents may be unable to phrase their answers. On the other hand, if the respondents are provided with alternative descriptions of store atmosphere, they will be able to indicate the one they like the best. If the respondents are unable to articulate their responses to a question, they are likely to ignore that question and refuse to respond to the rest of the questionnaire. Thus respondents should be given aids, such as pictures, maps, and descriptions to help them articulate their responses.

6.4.5 Overcoming unwillingness to answer

Even if respondents are able to answer a particular question, they may be unwilling to do so, either because too much effort is required, the situation or context may not seem appropriate for disclosure, no legitimate purpose or need for the information requested is apparent, or the information requested is sensitive.

Effort required of the respondents- Most respondents are unwilling to devote a lot of effort to provide information. Hence, the researcher should minimize the effort required of the respondents. Suppose the researcher is interested in determining from which departments in a store the respondent purchased merchandise on the most recent shopping trip. This information can be obtained in at least two ways. The researcher could ask the respondent to list all the departments from which merchandise was purchased on the most recent shopping trip, or the researcher could provide a list of departments and ask the respondent to check the applicable ones. The second option is preferable, because it requires less effort from respondents.

Context- Some questions may seem appropriate in certain contexts but not in others. For example, questions about personal hygiene habits may be appropriate when asked in a survey sponsored by the American Medical Association, but not in one sponsored by a fast food restaurant. Respondents are unwilling to respond to questions which they consider to be inappropriate for the given context.

Legitimate Purpose- Respondents are also unwilling to divulge information that they do not see as serving a legitimate purpose. Why should a firm marketing cereals want to know their age, income, and occupation? Explaining why the data are needed can make the request for the information seem legitimate and increase the respondents' willingness to answer.

Sensitive Information- Respondents are unwilling to disclose, at least accurately, sensitive information because this may cause embarrassment or threaten the respondent's prestige or self-image. If pressed for the answer, respondents may give biased responses, especially during personal interviews. Sensitive topics include money, family life, personal habits, political and religious beliefs, and involvement in accidents or crimes. The techniques described in the following section can be adopted to increase the likelihood of obtaining information that respondents are unwilling to give.

Increasing the willingness of respondents- Respondents may be encouraged to provide information that they are unwilling to give by the following techniques.

1. Place sensitive topics at the end of the questionnaire. By then, initial mistrust has been overcome, rapport has been created, legitimacy of the project has been established, and respondents are more willing to give information.
2. Preface the question with a statement that the behavior of interest is common. For example, before requesting information on credit card debt, say “Recent studies show that most Americans are in debt.”
3. Ask the question using the third-person technique (see chapter 5): Phrase the question as if it referred to other people.
4. Hide the question in a group of other questions that respondents are willing to answer. The entire list of questions can then be asked quickly.
5. Provide response categories rather than asking for specific figures. Do not ask, “What is your household’s annual income?” Instead, ask the respondent to check the appropriate income category: under 525,000, $25,001-$50,000, $50,001-$75,000, or over $75,000. In personal interviews, give the respondents cards that list the numbered choices. The respondents then indicate their responses by number.
6. Use randomized techniques. In these techniques, respondents are presented with two questions, one sensitive and the other a neutral question with a known probability of “yes” response (e.g., “Is your birthday in March?”). They are

asked to select one question randomly, for example by flipping a coin. The respondent then answers the selected question "yes" or "no," without telling the researcher which question is being answered. Given the overall probability of a "yes" response, the probability of selecting the sensitive question, and the probability of a "yes" response to the neutral question using the law of probability. However, the researcher cannot determine which respondents have answered "yes" to the sensitive question.

6.4.6 Choosing question structure

A question may be unstructured or structured. In the following sections, we define unstructured questions and discuss their relative advantages and disadvantages and then consider the major types of structured questions: multiple-choice, dichotomous, and scales.

Unstructured Questions- Unstructured questions are open-ended questions that respondents answer in their own words. They are also referred to as free-response or free-answer questions. The following are some examples:

What is your occupation?

What do you think of people who patronize discount department stores?

Who is your favorite political figure?

Open-ended questions are good as first questions on a topic. They enable the respondents to express general attitudes and opinions that can help the researcher interpret their responses to structured questions. Unstructured questions have a much less biasing influence on response than do structured questions. Respondents are free to express any views. Their comments and explanations can provide the researcher with rich insights. Hence, unstructured questions are useful in exploratory research.

A principal disadvantage is that potential for interviewer bias is high. Whether the inter-viewers record the answers verbatim or write down only the main points, the data depend on the skills of the interviewers. Tape recorders should be used if verbatim reporting is important.

Another major disadvantage of unstructured questions is that the coding of responses in a costly and time consuming. The coding procedures required to summarize responses in a format useful for data analysis and interpretation can be extensive. Implicitly, unstructured or open-ended questions give extra weight to respondents who are more articulate. Also, unstructured questions are not very suitable for self-administered questionnaires (mail, CAPI, e-mail, and Internet), because respondents tend to be more brief in writing than in speaking.

Precoding can overcome some of the disadvantages of unstructured questions. Expected responses are recorded in multiple-choice format, although the question is presented to the respondents as an open-ended question. Based on the respondent's reply, the interviewer selects the appropriate response category. This approach may be satisfactory when the respondent can easily formulate the response and it is easy to develop precoded categories as the response alternatives are limited.

In general, open-ended questions are useful in exploratory research and as opening questions. Otherwise, their disadvantages outweigh their advantages in a large survey.

Structured Questions- Structured questions specify the set of response alternatives and the response format. A structured question may be multiple-choice, dichotomous, or a scale.

Multiple-Choice Questions- In multiple-choice questions, the researcher provides a choice of answers, and respondents are asked to select one or more of the alternatives given. Consider the following question.

Do you intend to buy a new car within the next six months?

_____ Definitely will not buy

_____ Probably will not buy

_____ Undecided

_____ Probably will buy

_____ Definitely will buy

Several of the issues related to multiple-choice answers, two more important are– the number of alternatives that should be included, and order or position bias.

The response alternatives should include the set of all possible choices. The general guideline is to list all alternatives that may be of importance and include an alternative labeled “Other (please specify),” as shown above. The response alternatives should be mutually exclusive. Respondents should also be able to identify one, and only one, alternative, unless the researcher specifically allows two or more choices (for example, “Please indicate all the brands of soft drinks that you have consumed in the past week”). If the response alternatives are numerous, consider using more than one question to reduce the information processing demands on the respondents.

Order or position bias is the respondents’ tendency to check an alternative merely because it occupies a certain position or is listed in a certain order. Respondents tend to check the first or the last statement in a list, particularly the first. For a list of numbers (quantities or prices) there is a bias toward the central value on the list. To control for order bias, several forms of the questionnaire should be prepared with the order in which the alternatives are listed varied from form to form. Each alternative should appear once in each of the extreme positions, once in the middle, and once somewhere in between.

Multiple-choice question overcome many of the disadvantages of open-ended questions, because interviewer bias is reduced and these questions and administered quickly. Also, coding and processing of data are much less costly and time consuming. In self-administered questionnaires, respondent cooperation is improved if the majority of the questions are structured.

Multiple-choice questions are not without disadvantages. Considerable effort is required to design effective multiple-choice questions. Exploratory research using open-ended questions may be required to determine the appropriate response alternatives. It is difficult to obtain information on alternatives not listed. Even if an "Other (please specify)" category is included, respondents tend to choose among the listed alternatives. In addition, showing respondents the list of possible answers produces biased responses. There is also the potential for order bias.

Dichotomous Questions- A dichotomous question has only two response alternatives: yes or no, agree or disagree, and so on. Often, the two alternatives of interest are supplemented by a neutral alternative, such as "no opinion," "don't know," "both" or "none". The question asked before about intentions to buy a new car as a multiple-choice can also be asked as dichotomous question.

Do you intend to buy a new car within the next six months?

___________ Yes

___________ No

___________ Don't know

The decision to use a dichotomous question should be guided by whether the respondents approach the issue as a yes-or-no question. Although decisions are often characterized as series of binary or dichotomous choices, the underlying decision-making process may reflect uncertainty, which can best be captured by multiple-choice responses. For example, two individuals may be equally likely to buy a new car within the next six months if the economic conditions remain favorable. However, one individual, who is being optimistic about the economy, will answer "yes" while the other, feeling pessimistic, will answer "no."

Another issue in the design of dichotomous questions is whether to include a neutral response alternative. If it is not included, respondents are forced to choose between "yes" and "no" even if they feel indifferent. On the other hand, if a neutral alternative is included, respondents can avoid taking a position on the issue, thereby biasing the results. We offer the following guidelines. If a substantial proportion of neutral respondents is expected to be small, avoid the neutral alternative. If the proportion of neutral respondents is expected to be small, avoid the neutral alternative. As assumed, the researcher often has some knowledge of the proportion of neutral respondents.

The general advantages and disadvantages of dichotomous questions are very similar to those of multiple-choice questions. Dichotomous questions are the easiest type of questions to code and analyze, but they have one acute problem. The response can be influenced by the wording of the question. To illustrate, the statement "Individuals are more to blame than social conditions for crime and lawlessness in this country," produced agreement from 59.6 percent of the respondents. However, on a matched sample that responded to the opposite statement, "Social conditions are more to blame than individuals for crime and lawlessness in this country," 43.2 percent (as opposed to 40.4 percent) agreed. To overcome this problem, the question should be framed in one way on one-half of the questionnaires and in the opposite way on the other half. This is referred to as split ballet technique.

Scales- Scales are discussed in detail in chapter 7. To illustrate the difference between scales and other kinds of structured questions, consider the question about intentions to buy a new car. One way of framing this using a scale is as follows:

Do you intend to buy a new car within the next six months?

Definitely will not buy	Probably will not buy	Undecided	Probably will buy	Definitely will buy
1	2	3	4	5

This is only one of several scales that could be used to ask this question.

6.4.7 Choosing question wording

Question wording is the translation of the desired question content and structure into words that respondents can clearly and easily understand. Deciding on question wording is perhaps the most critical and difficult task in developing a questionnaire. If a question is worded poorly, respondents may refuse to answer it or may answer it incorrectly. The first condition, known as item non-response, can increase the complexity of data analysis. The second condition leads to response error, discussed earlier. Unless the respondents and the researcher assign exactly the same meaning to the question, the results will be seriously biased.

To avoid these problems, we offer the following guidelines: (1) define the issue, (2) use ordinary words, (3) avoid ambiguous words, (4) avoid leading questions, (5) avoid implicit alternatives, (6) avoid implicit assumptions (7) avoid generalizations and estimates, and (8) use positive and negative statements.

Define the Issue- A question should clearly define the issue being addressed. Beginning journalists are admonished to define the issue in terms of who, what, when where, why, and way (the six Ws). These can also serve as guidelines for defining the issue in a question. (See chapter 3 for an application of these guidelines to descriptive research.)

Consider the following question:

Which brand of shampoo do you use? (Incorrect)

On the surface, this may seem to be a well-defined question, but we may reach a different conclusion when we examine it under the microscope of who, what, when, and where. "Who" in this question refers to the respondent. It is not clear, though, whether the researcher is referring to the brand the respondent uses personally or the brand used by the household. "What" is the brand of shampoo. However, what if more than one brand of shampoo is being used? Should the respondent mention the most preferred brand, the brand used most often, the brand used most recently, or the brand that comes to mind first? "When" is not clear; does the researcher mean last time, last week, last month, last year, or ever? As for "where," it is implied that the shampoo is used at home, but this is not stated clearly. A better wording for this question would be:

Which brand or brands of shampoo have you personally used at home during the last month? In case of more than one brand, please list all the brands that apply. (Correct)

Use ordinary words- Ordinary words should be used in a questionnaire and they should match the vocabulary level of the respondents. When choosing words, keep in mind that the average person in the United States has a high school, not a college, education. For certain respondent groups, the education level is even lower. For example, we did a project for a major telecommunications firm that operates primarily in rural areas. The average educational level in these areas is less than high school, and many respondents had only fourth to sixth grade education. Technical jargon should also be avoided. Most respondents do not under stand technical marketing words. For example, instead of asking,

"Do you think the distribution of soft drinks is adequate?" (Incorrect)

ask,

"Do you think soft drinks are readily available when you want to buy them?" (Correct)

Use unambiguous words- The words used in a questionnaire should have a single meaning that is known to the respondents. A number of words that appear to be unambiguous have different meanings to different people. These include "usually," "normally," "frequently," "often," "regularly," "occasionally," and "sometimes." Consider the following question:

In a typical month, how often do you shop in department stores?
______ Never
______ Occasionally
______ Sometimes
______ Often
______ Regularly (Incorrect)

The answers to this question are fraught with response bias, because the words used to describe category labels have different meanings for different meanings for different respondents. Three respondents who shop once a month may check three different categories: occasionally, sometimes, and often. A much better wording for this question would be the following:

In a typical month, how often do you shop in department stores?

______ Less than once

______ 1 or 2 times

______ 3 or 4 times

______ More than 4 times (Correct)

Note that this question provides a consistent frame of reference for all respondents. Response categories have been objectively defined, and respondents are no longer free to interpret them in their own way.

In deciding on the choice of words, researchers should consult a dictionary and thesaurus and ask the following questions of each word used:

Does it mean what we intended?

Does it have any other meanings?

If so, does the context make the intended meaning clear?

Does the word have more than one pronunciation?

Is there any work of similar pronunciation that might be confused with this word?

Is a simpler word or phrase suggested?

Avoid generalizations and estimates- Questions should be specific, not general. Moreover, questions should be worded so that the respondent does not have to make generalization or compute estimates. Suppose we were interested in households' annual per capita expenditure on groceries. If we asked respondents

"What is the annual per capita expenditure on groceries in your household?" (Incorrect)

They would first have to determine the annual expenditure on groceries by multiplying the monthly expenditure on groceries by 12 or the weekly expenditure by 52. Then they would have to divide the annual amount by the number of persons in the household. Most respondents would be unwilling or unable to perform these calculations. A better way of obtaining the required information would be to ask the respondents two simple questions:

"What is the monthly (or weekly) expenditure on groceries in your household?" and

"How many members are there in your household?"
(Correct)

The researcher can then perform the necessary calculations.

Dual statements: positive and negative- Many questions, particularly those measuring attitudes and lifestyles, are worded as statements to which respondents indicate their degree of agreement or disagreement. Evidence indicates that the response obtained is influenced by the directionality of the statements: whether they are stated positively or negatively. In these cases, it is better to use dual statements, some of which are positive and the others are negative. Two different questionnaires could be prepared. One questionnaire would contain half negative and half positive statements in an interspersed way. The direction of these statements would be reversed in the other questionnaire.

6.4.8 Determining the order of questions

Opening questions- The opening questions can be crucial in gaining the confidence and cooperation of respondents. The opening questions should be interesting, simple, and non-threatening. Sometimes such questions are asked even though they are unrelated to the research problem and their responses are not analyzed.

Type of Information- The type of information obtained in a questionnaire may be classified as: (1) basic information, (2) classification information, and (3) identification information. **Basic information** relates directly to the research problem. **Classification information**, consisting of socioeconomic and demographic characteristics, is used to classify the respondents and understand the results. **Identification information** includes name, address, and telephone number, Identification information may be obtained for a variety of purposes, including verifying that the respondents listed were actually interviewed, remitting promised incentives, and so on. As a general guideline, basic information should be obtained first, followed by classification, and, finally, identification information. The basic information is of greatest importance to the research project and should be obtained first, before we risk alienating the respondents by asking a series of personal questions.

Difficult Questions- Difficult questions or questions that are sensitive, embarrassing, complex, or dull should be placed late in the sequence. After rapport has been established and the respondents become involved, they are less likely to object to these questions. Thus in the department store patronage project, information about credit card debt was asked at the end of the section on basic information. Likewise, income should be the last question in the classification section, and telephone number the final item in the identification section.

Effect on subsequent questions- Questions asked early in a sequence can influence the responses to subsequent questions. As a rule of thumb, general questions should precede the specific questions. This prevents specific questions from biasing responses to the general questions. Consider the following sequence of questions:

Q1: "What considerations are important to you in selecting a department store?"

Q2: "In selecting a department store, how important is convenience of location?"

(Correct)

Note that the first question is general but the second is specific. If these questions were asked in the reverse order, respondents would be clued about convenience of location and would be more likely to give this response to the general question.

Going from general to specific is called the **funnel approach**. The funnel approach is particularly useful when information has to be obtained about respondents' general choice behavior and their evaluations of specific products. Sometimes the inverted-funnel approach may be useful. In this approach, questioning starts with specific questions and concludes with the general questions. The respondents are compelled to provide specific information before making general evaluations. This approach is useful when respondents have no strong feelings or have not formulated a point of view.

General appearance or "getup" of the questionnaire- Not only is it important to address issues of wording and measurement in questionnaire design, but it is also necessary to pay attention to how the questionnaire looks. An attractive and neat questionnaire with appropriate introduction, instructions, and well-arrayed set of questions and response alternatives will make it easier for the respondents to answer them. A good introduction, well-organized instructions, and neat alignment of the questions are all important. These elements are briefly discussed with examples.

A good introduction- A proper introduction that clearly discloses the identity of the researcher and conveys the purpose of the survey is absolutely necessary. It is also essential to establish some rapport with the respondents and motivate them to respond to the questions in the questionnaire wholeheartedly and enthusiastically. Assurance of confidentiality of the information provided by them will allow for less biased answers. The introduction section should end on a courteous note, thanking the respondent for taking the time to respond to the survey. The following is an example of an appropriate introduction.

Example Department of Business Management
Guru Jambheshwar University Hisar-125 001
Carbondale, Illinois 62901

Date

Dear Participant,

This questionnaire is designed to study individual investment behaviour. aspects of life at work. The information you provide will help us better understand the investors preferences. Because you are the one who can give us a correct information about your investment pattern, I request you to respond to the questions frankly and honestly.

Your response will be kept strictly confidential. Only members of the research team will have access to the information you give. In order to ensure the utmost privacy, we have provided and identification number for each participant. This number will be used by us only for follow-up procedures. The numbers, names, or the completed questionnaires will not be made available to anyone other than the research team. A summary of the results will be mailed to you after the data are analysed.

Thank you very much for your time and cooperation. I greatly appreciate your help in furthering this research endeavour.

Cordially

(Sd)

Kiran Jindal, Ph.D.

Professor

Organizing questions, giving instructions and guidance, and good alignment

Organizing the questions logically and neatly in appropriate sections and providing instructions on how to complete the items in each section will help the respondents to answer them without difficulty. Questions should also be neatly aligned in a way that allows the respondent to complete the task of reading and answering the questionnaire expending the least time and effort and without straining the eyes.

A specimen of the portion of a questionnaire incorporating the above points follows.

Example: Section two: Investment behaviour

Personal Data- Demographic or personal data could be organized as in the example that follows. Note the ordinal scaling of the age variable.

Example: Section one about yourself

Please circle the numbers representing the most appropriate responses for you in respect of the following items.

1. Your Age (Years)	**2.Your Highest Completed Level of Education**	**3. Your Gender**
1. Under 20	1. Elementary school	1. Female

2. 20-35	2. High school	2. Male
3. 36-50	3. College degree	
4. 51-65	4. Graduate degree	
5. Over 65	5. Other (specify)	
4. Your Marital Status	**5. Number of Preschool Children (under 5 Years of Age)**	**6. Age of the Eldest child in your care (years)**
1. Married	1. None	1. Under 5
2. Single	2. One	2. 5-12
3. Widowed	3. Two	3. 13-19
4. Divorced or separated	4. Three or more	4. Over 19
5. Other (specify)		5. Not applicable

Information on Income and other sensitive personal data- Though demographic information can be sought either at the beginning or at the end of the questionnaire, information of a very private and personal nature such as income, state of health, and so on, if at all considered necessary for the survey, should be asked at the end of the questionnaire, rather than the beginning. Also, such questions should be justified by explaining how this information might contribute to knowledge and problem solving, so that respondents do not perceive them to be of an intrusive or prying nature. Postponing such questions to the end would help reduce respondent bias if the individual is vexed by the personal nature of the question.

Open-ended question at the end- The questionnaire could include an open-ended question at the end allowing respondents to comment on any aspect they choose. It would end with an expression of sincere thanks to respondents. The last part of the questionnaire could look like the following.

Example: The questions in the survey may not be all-embracing and comprehensive and may not therefore have afforded you an opportunity to report some things you may want to say about your investments, or yourself. Please make any additional comments needed, in the space provided.

How did you feel about completing this questionnaire?

Check the face in the following diagram that reflects your feelings.

Concluding the questionnaire- The questionnaire should end on a courteous note, reminding the respondent to check that all the items have been completed.

Electronic questionnaire design and surveys- Online questionnaire surveys are easily designed and administered when microcomputers are hooked up to computer networks. Data disks can also be mailed to respondents, who may use their own personal computers for responding to the questions. These will, of course, be helpful only when the respondents know how to use the computer and feel comfortable responding in this manner.

As stated earlier, CAPPA, which facilitates the preparation and administration of questionnaires, is particularly useful for marketing research. The CAPPA system includes 10 programs enabling the user to design a sophisticated computerized questionnaire, computerize the data collection process, and analyze the data collected. More reliable data are likely to result since the respondent can go back and forth and easily change a response, and various on- and off-screen stimuli are provided to sustain respondents interest.

A program is designed into the CAPPA system that checks for syntactical or logical errors in the coding. Even as the survey is in progress, descriptive summaries of the cumulative data can be obtained either on the screen or in printed form. After date collection is complete, a data-editing program identifies missing or out-of-range data. The researcher can set the parameters for either deleting the missing responses where there are too many, or computing the mean on other responses and substituting this figure for the missing response. CAPPA also includes data analytic programs such as cross-tabs, ANOVA, multiple regression, and others (discussed later in the book). Randomization of questions and the weighting of respondents to ensure more representative results (in cases where the sample either over represents or under represents certain population groups-discussed later, in the chapter on Sampling) are some of the attractive features of CAPPA.

Several programs are developed to administer questionnaires electronically. As disks are inexpensive, mailing them across the country is no problem either. The PC medium non- response rates may not be any higher than those of the mail questionnaire response. With increase of computer literacy, we can expect electronic questionnaire administration to take on an increasing role in the future.

SPSS (Statistical Package for the Social Sciences) has several software programs for research purposes including (1) SPSS Data Entry Builder for creating surveys that can be administered over the web, phone, or mail; (2) SPSS Data Entry Enterprise Server for entering the responses; and (3) SPSS 11.0 for data analysis and charts.

The advantages and disadvantages of personal or face-to-face interviews, telephone interviews, personally administered questionnaires, mail questionnaires, and questionnaires distributed through the electronic system are tabulated in Table 10.1.

It should be pointed out that information obtained from respondents either through interviews or questionnaires, being self-report date, could be biased. That is the reason why data should be collected from different sources and by different methods, as discussed later.

EXHIBIT 6.2: ADVANTAGES AND DISADVANTAGES OF INTERVIEWS AND QUESTIONNAIRES

Mode of Data Collection	**Advantages**	**Disadvantages**
Personal or Face-to-Face Interviews	Can establish rapport and motivate respondents. Can clarify the questions, clear doubts, add new questions. Can read nonverbal cues. Can use visual aids to clarify points. Rich data can be obtained. CAPI can be used and responses entered in a portable computer.	Take personal time. Costs more when a wide geographic region is covered. Respondents may be concerned about confidentiality of information given. Interviewers need to be trained. Can introduce interviewer biases. Respondents can terminate the interview at any time.
Telephone Interviews	Less costly and speedier than personal interviews. Can reach a wide geographic area. Greater anonymity than personal interviews. Can be done using CATI	Nonverbal cues cannot be read. Interviews will have to be kept short. Obsolete telephone numbers could be contacted, and unlisted ones omitted from the sample.
Personally Administered Questionnaire	Can establish rapport and motivate respondent. Doubts can be clarified. Less expensive when administered to groups of respondents. Almost 100% response rate ensured. Anonymity of respondent is high.	Organizations may be reluctant to give up company time for the survey with groups of employees assembled for the purpose.

Mail Questionnaires	Anonymity is high. Wide geographic regions can be reached. Token gifts can be enclosed to seek compliance. Respondent can take more time to respond at convenience. Can be administered electronically, if desired.	Response rate is almost always low. A 30% rate is quite acceptable. Cannot clarify questions. Follow-up procedures for non- responses are necessary.
Electronic Questionnaires	Easy to administer. Can reach globally. Very inexpensive. Fast delivery. Respondents can answer at their convenience like the mail questionnaire.	Computer literacy is a must. Respondents must have access to the facility. Respondent must be willing to complete the survey.

6.5 SUMMARY

To collect quantitative primary data, a researcher must design a questionnaire or an observation form. A questionnaire has three objectives. It must translate the information needed into a set of specific questions the respondents can and will answer. It must motivate respondents to complete the interview. It must also minimize response error.

Designing a questionnaire is an art rather than a science. The process begins by specifying the information needed and the type of interviewing method. The next step is to decide on the content of individual questions. The question should overcome the respondents' inability to answer. Respondents may be unable to answer if they are not informed, cannot remember, or cannot articulate the response. The unwillingness of the respondents to answer must also be overcome. Respondents may be unwilling to answer if the question requires too much effort, is asked in a situation or context deemed inappropriate, does not serve a legitimate purpose, or solicits sensitive information.

Then comes the decision regarding the question structure. Questions can be un-structured (open-ended) or structured to a varying degree. Structured questions include multiple-choice, dichotomous questions, and scales.

Determining the wording of each question involves defining the issue, using ordinary words, using unambiguous words, and using dual statements. The researcher should avoid leading questions, implicit alternatives, implicit assumptions, and generalizations and estimates. Once the questions have been worded, the order in which they will appear in the questionnaire must be decided. Special consideration should be given to opening questions, type of information, difficult questions, and the effect on subsequent questions. The questions should be arranged in a logical order.

The stage is now set for determining the form and layout of the questions. Several factors are important in reproducing the questionnaire. These include appearance, use of booklets, fitting entire question on a page, response category format, avoiding overcrowding, placement of directions, colour coding, easy to read format, and cost. Last but not least is pre-testing. Important issues are extent of pre-testing, nature of respondents, type of interviewing method, type of interviewers, sample size, protocol analysis and debriefing, and editing and analysis.

The design of observational forms requires explicit decisions about what is to be observed and how that behaviour is to be recorded. It is useful to specify the who, what, when, where, why, and way of the behaviour to be observed.

The questionnaire or research instrument should be adapted to the specific cultural environment. Also, the questionnaire may have to be suitable for administration by more than one method as different interviewing methods may be used in different countries. For ease of comprehension and translation, it is desirable to have simple rather than complex questions. The internet and computers can greatly assist the researcher in designing sound questionnaires and observational forms.

6.6 KEYWORDS

Questionnaire is a formalized set of questions for obtaining information from respondents.

Double-barreled Question is a question to obtain information by asking two distinct questions.

Funnel Approach is the approach useful when respondents are compelled to provide specific information before making general evaluations.

Filter Questions are asked to make the researcher to filter out respondents who are not adequately informed about the topic.

6.7 SELF ASSESSMENT QUESTIONS

1. What is the purpose of questionnaires and observation forms?
2. Explain how the mode of administration affects questionnaire design.
3. How would you determine whether a specific question should be included in a questionnaire?
4. What is a double-barreled question?
5. What are the reasons that respondents are unable to answer the question asked?
6. Explain the errors of commission, telescoping, and creation. What can be done to reduce such errors?

7. Explain the concepts of aided and unwilling to answer specific questions?
8. What are the reasons that respondents are unwilling to answer specific questions?
9. What can a researcher do to make the request for information seem legitimate?
10. Explain the use of randomized techniques in obtaining sensitive information.
11. What are the advantages and disadvantages of unstructured questions?
12. What are the issues involved in designing multiple-choice questions?
13. What are the guidelines available for deciding on question wording?
14. What is a leading question? Give an example.
15. What is the proper order for questions intended to obtain basic, classification, and identification information?
16. What guidelines are available for deciding on the form and layout of a questionnaire?

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Lesson No.: **7**

ATTITUDE MEASUREMENT TECHNIQUES AND MULTIDIMENSIONAL SCALING

STRUCTURE

7.0 OBJECTIVES

After going through this lesson you should be able to:

- Understand attitude measurement techniques;
- Differentiate between comparative and non-comparative scaling techniques;
- Use arbitrary scale, Thurstone differential scale, Likert type scale and semantic differential scale
- understand the concept of multi-dimensional scaling

7.1 INTRODUCTION

A manager of an organization has to take many management related decisions in his day-to-day life. The decisions may relate to the manufacturing or marketing of products, hiring or firing of employees, and so on. Some of these decisions depend on the' quantitative data for which the units of measurement can be subjected to a statistical analysis. However, there are decisions, which depend on behavioural data, which is not suitable for direct statistical analysis. Thus, for management purposes the manager has to measure physical objects as well as abstract concepts. Measurement IS a relatively difficult when it concerns qualitative or abstract phenomena, Measurement may be defined as the process of assigning numbers to objects or observations, the level of measurement being a function of the rules under which the numbers are assigned. In technical terms, measurement is a process of mapping aspects of a domain onto other aspects of a range according to some rule of correspondence. It is easy to assign numbers in respect of characteristics of some objects, but it is relatively difficult in respect of others. For instance, measuring things like social conformity, intelligence, or marital adjustment is very difficult and requires much closer attention than measuring physical weight, biological age or a person's financial assets. In other words, the quantitative characteristics like weight, height etc., can be measured directly with some standard unit of measurement, but it is not that easy to measure properties like motivation to succeed, ability to stand stress and the like.

7.2 PRIMARY SCALES OF MEASUREMENT

In the process of measurement one has to devise some form of scale in the range and, then map the properties of objects from the domain onto this scale. The scales of measurement can be considered in terms of their mathematical properties. The primary scales of measurement are:

(a) Nominal Scale (b) Ordinal Scale

(c) Interval Scale (d) Ratio Scale

Nominal Scale

Nominal scale is simply a system of assigning numbers or symbols to events in order to label them. These numbers are just convenient labels for the particular class of events and as such have no quantitative value. Thus the nominal scale simply allows the categorization of responses into a number of mutually exclusive categories. We cannot do much with the numbers involved. For example, 'one cannot usefully average the numbers on the back of a group of football players and come up with a meaningful value. Neither can one usefully compare the numbers a5signed to one group with the numbers assigned to another. The typical applications of nominal scale is in classification of responses by a social class, like of dislike, yes or no, male or female and so on. The counting of members in each group is the only possible arithmetic operation when a nominal scale is employed. Accordingly, we are restricted to use mode as the measure of central tendency. There is no generally used measure of dispersion for nominal scales. Chi--square test is the most common test of statistical significance of association and for the measures of correlation we calculate the contingency coefficient.

Nominal scale is the least powerful level of measurement. It indicates no order or distance relationship and has no arithmetic origin. A nominal scale simply describes differences between units by assigning them to categories. In spite their limitations, nominal scales are very useful and widely used in surveys when data are being classified by major sub-groups of the population.

Ordinal scale

The ordinal scale allows the respondents to rank some alternatives by some common characteristics. It simply places events in order, but there is no attempt to make the intervals of the scale equal in terms of some rule. Rank orders represent ordinal scales and are frequently used in research relating to qualitative phenomena. For example, a group of consumers may rank the three brands of toothpaste on the basis of the perceived taste. Ordinal scales only permit the ranking of items from highest to lowest. Ordinal measures have no absolute values, and the real differences between adjacent ranks may not be equal. All that can be said is that one person is higher or lower on the scale than another, but more precise comparisons cannot be made. Thus, the use of an ordinal scale implies a statement of' greater than' or 'less than'. However, the magnitude of difference in ranks cannot be determined. The real difference between ranks 1 and 2 may be more or less than the difference between ranks 5 and 6. Since the numbers of this scale have only a rank meaning, the appropriate measure of central tendency is the positional average i.e. median. A measure of dispersion can be based on the percentiles or quartiles of the distribution. Correlations are restricted to various rank order methods. Statistical significance is tested through the use of non-parametric methods.

Interval scale

In the case of interval scale, the intervals are adjusted in terms of some rule that has been established as a basis for making the units equal. Interval scales can have an arbitrary zero point with numbers placed at equally appearing intervals. Interval scale takes care of the limitations of the nominal and the ordinal scales. Interval scale also incorporates the concept of equality of interval and so provides more powerful measurement than ordinal scales. A number of mathematical and statistical operations in including addition, subtractions and computations of the mean can be performed on the internvlly-scaled data. Mean is the appropriate measure of central tendency, while standard deviation is the most widely used measure of dispersion. The generally used tests for statistical significance are the' Z', 't' test and 'F'. Correlation is studied by the product moment correlation coefficient.

The primary limitation of the interval scale is the lack of an absolute or true zero of measurement. That is it does not have the capacity to measure the complete absence of a characteristic.

Ratio scale

We can conceive of an absolute zero of length or that of time. For example, the zero point on a centimetre scale indicates the complete absence of length or height. But an absolute Zero of temperature is theoretically unobtainable. Ratio scale has an absolute or true zero of measurements. It represents the actual amounts of variables. Measures of physical dimensions such as weight, height, distance etc. come under this category. In general, all statistical techniques are applicable with ratio scales and all mathematical operations that one can carry out with real numbers can also be carried out with ratio scale values. Multiplication and division can only be used with the ratio scale, but not with other scales. Geometric and harmonic means can be used as measures of central tendency and coefficients of variation may also be calculated.

Attitude Measurement And Scaling

Every object or service is supposed to possess some characteristics, which fulfil certain needs of its consumer. These needs may be psychological, physical or social in nature. The characteristics of the product or service under consideration are called its attributes. The judgement of the consumer regarding the product or service possessing certain attributes is termed as his belief. The term attitude refers to the mental state of the individual towards a product or service or its attribute. It implies the mental preparedness to act in a particular manner and influences the individual's behaviour toward the product or service under consideration.

In the process of attitude measurement, the researcher is primarily interested in measuring the mental state of the respondent. It may include the factors like awareness, attitudes and decisions processes. An important characteristic of the measures is that their verification is rather difficult. Since attitudes are affected by attributes and beliefs, so the first step in the attitude measurement is to select the relevant attributes of the object under investigation. Every object is supposed to possess many attributes, so it is advisable to measure only those attributes which can be related to the actions by the respondents.

Age, education, profession etc. of the respondents are also supposed to affect their attitudes. So the second major issue in attitude measurement is the selection of the procedure which can take care of the characteristics of the objects. The third major issue in attitude measurement is the selection of the data collection technique. Questionnaire Methods and observation Methods are the commonly used techniques in attitude measurement related studies.

Scale: While measuring attitudes and opinions, we face the problem of their valid measurement. Similar problems are faced while measuring physical and institutional concepts. Thus we need procedures, which may enable us to measure abstract concepts more precisely. A scale is a continuum consisting of the highest point and lowest point along with several intermediate points between the extreme points. The scale-point positions are so related to each other that when the first point happens to be the highest point, the second point indicates a higher degree in terms of a given characteristics as compared to the third point and so on. Scaling describes the procedures of assigning numbers to various degrees of opinion, attitudes and other concepts. It may be defined as a 'procedure for the assignment of numbers to a property of objects in order to impart some of the characteristics of numbers to the properties in questions.

Scaling can be done in the following two ways:

i) Making a judgment about some characteristic of an individual and then placing him directly on a scale that has been defined in terms of that characteristic.

ii) Constructing questionnaires in such a way that the score of individual's responses assigns him a place on a scale.

In practice the commonly used attitude measurement scales are ordinal in nature. These scales are basically self-report inventories, with a list of favourable and unfavourable statements towards the subject under study. The different types of attitude measurement scales are:

7.3 SCALING TECHNIQUES

Scaling techniques are broadly classified as comparative and non-comparative. Comparative scales involve the direct measurement of stimulus objects and data have only ordinal or rank-order properties.

These scales are further classified as paired comparisons, rank-order and Q-sort procedures. Main advantage of comparative scales is that they are easily understood, easy to apply and involve fewer theoretical assumptions. Non-comparative scaling is the most widely used scaling technique in marketing research. In non-comparative scales each object is scaled independently of the others and the resulting data generally have interval or ratio scales properties. Non-comparative scales include continuous rating and itemized rating scales. Itemized rating scales are further classified as Likert Type and Semantic Differential scales.

7.4 COMPARATIVE SCALING TECHNIQUES

The following scaling techniques are used to do a comparative study among different sets of variables :

7.4.1 Paired Comparisons

In this method the respondent can express his attitude by making a choice between two objects, say between Coke and Pepsi according to some criterion. In general, if there are 'n' stimuli to judge, the number of judgements required in a paired comparison is N= n (n–1)/2. Paired comparison provides ordinal data, but the same may be converted into an interval scale by the method of the 'Law of Comparative Judgement' developed by L.L. Thurstone. This technique involves the conversion of frequencies of preferences into a table of proportions which are then transformed into Z matrix by referring to the table of area under the normal curve.

"For instance, consider the paired comparison data obtained to assess a respondents shampoo preferences for the 5 popular brands denoted as A, B, C, D and E. Since n=5, so the respondent has to make the 5(5–1)/2 = 10 comparisons to evaluate 5 brands. The respondent was given a pairs of shampoo brands and he was asked to record his preference for each pair. The following data were obtained:

BRAND

	A	B	C	D	E
A		0	0	1	0
B	1*		0	1	0
C	1	1		1	1
D	0	0	0		0
E	1	1	0	1	
Total of times referred	**3**	**2**	**0**	**4**	**1**

'*' means that the brand in that column was preferred over the brand in the corresponding row. 0 means that the row brand was preferred over the column brand.

Total number of times a brand was preferred is obtained by summing the 1's in each column.

Limitations

i) Paired comparisons techniques are useful when the number of brands is limited.

ii) The order in which the objects are presented may introduce bias in results.

iii) It does not reflect a true market situation, which involves selection from multiple alternatives.

7.4.2 Rank Order Scaling

Rank order scaling is commonly used to measure preferences for brands as well as attributes. In rank order scaling respondents are presented with several objects simultaneously and asked to rank them according to some criterion.

Ranks are obtained by asking the respondents to assign a rank of 1 to the most preferred brand, 2 to the second most preferred and so on until a rank n is assigned to the least preferred brand.

Like paired comparisons, this approach is also comparative in nature, and it is possible that the respondent may dislike the brand ranked 1 in an absolute sense. The data obtained in rank-order scaling are also ordinal. As compared to paired comparisons, rank-order scaling process takes less time and resembles more closely to the real market environment

7.4.3 Q-Sort and Scaling

Q-Sort scaling discriminate among a relatively large number of objects quickly. This technique uses a rank-order procedure in which objects are sorted into piles based on similarity with respect to some criterion. For example, respondents are given 100 attitude statements on individual cards and asked to place them into 11 piles, ranging from "most highly agreed with" to "least agreed with". The number of objects to be placed in each pile is pre-specified, often to result in a roughly normal distribution of objects over the whole set.

7.5 NON-COMPARATIVE SCALES

In non-comparative scales each object is scaled independently of the others and the resulting data generally assumed to be interval or ratio scaled. Non-comparative scales include continuous rating and itemized rating scales. The rating scale gives a qualitative description of a number of characteristics of an individual. An object is judged in absolute terms against some specified criteria i.e. properties of objects judged without reference to other similar object's. The ratings may be in the forms as 'like. Dislike', 'above average, average, below average', or other classifications with more categories such as 'excellent- good-average- below average- poor', and so on. There is no specific rule whether to use a two-points scale, three-points scale or scale with still more points. Since more points on a scale provide an opportunity for greater sensitivity of measurement so in practice, three to seven points scales are generally used.

Rating scale are further classified as

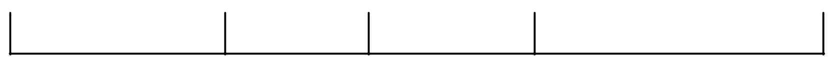
a) Graphic rating scale

b) Itemized rating scale.

7.5.1 Graphic Rating Scale

It is a simple and commonly used scale. Under it, the various points are usually put along the line to form a continuum and the rater indicates his rating by simply making the appropriate point on a line that runs from one extreme to the other. We may consider the following five-points graphic rating scale when we wish to ascertain people's liking or disliking any product:

How do you like the product?



Like very much   Like   Neutral   Dislike   Dislike very much

Limitations of Graphic Rating Scale: The respondents may check at almost any position along the line which fact may increase the difficulty of analysis. The meanings of the terms may depend upon respondent's frame of reference so much so that the statement might be challenged in terms of its equivalency.

7.5.2 Itemized Rating Scales

The itemized rating scale also known as numerical scale, presents a series of statements from which a respondent selects one as best reflecting his evaluation. These statements are ordered progressively in terms of more or less of some property. The respondents are required to select the specified statement that best describes the object being rated. Suppose, a manager wish to inquire as to how well does a worker get along with his fellow workers? In such a situation, he may ask the respondent to select, one of the following statements to express his opinion:

i) He is almost always involved in some friction with a fellow worker.

ii) He is often at odds with one or more of his fellow workers.

iii) He sometimes gets involved in friction.

iv) He infrequently becomes involved in friction with others.

v) He almost never gels involved in friction with fellow workers.

Itemized rating scales are widely used in marketing research and form the basic components of more complex scales, such as multi-item rating scales. The commonly used itemized rating scales are the Likert and Semantic and differential scales.

Merits and Demerits Itemized Rating Scales: The chief merit of itemized scale is that it provides more information and meaning to the rater, and thereby increases reliability. It is relatively difficult to develop this scale and the statements may not say exactly what the respondent would like to express.

7.6 SCALE CONSTRUCTION TECHNIQUES

While measuring attitudes of the people we generally follow the technique of preparing the attitude scale in such a way that the score of the individual responses assigns him a place on a scale. Under this approach, the respondent expresses his agreement or disagreement with a number of statements relevant to the issue. While developing such statements we take care that

a. the statements must illicit responses, which are psychologically related to the attitude being measured;

b. the statements need be such that they discriminate not only between extremes of attitude but also among individuals who differ slightly.

7.6.1 Arbitrary Scales

Arbitrary scales are developed on ad hoc basis and are designed largely through the researcher's own subjective selection of items. The researcher first collects few statements or items, which he believes are unambiguous and appropriate to a given topic. Some of these are selected for inclusion in the measuring instrument and then people are asked to check in a list the statements with which they agree. Arbitrary scales can be developed very easily and quickly and are relatively less expensive. The primary limitation of arbitrary scales is that we do not have objective evidence that such scales measure the concepts for which they have been developed. We have simply to rely on researcher's insight and competence.

7.6.2 Thurstone Differential scale

Thurstone Differential Scales have been developed using consensus scale approach. Under such an approach the selection of items is made by a panel of judges who evaluate the items in terms of whether they are relevant to the topic area and unambiguous in implication. The detailed procedure is as under:

1) The researcher gathers a large number of statements, usually twenty or more, which express various points of view toward a group, institution, idea, or practice.

2) These statements are then submitted to a panel of judges, each of whom is asked to sort the statements into 11 groups

or piles ranging from one extreme to another in position. The extreme piles represent the most favourable and the most unfavourable statements. Each of the-judges is requested to place in. the first pile the statements which he thinks are most unfavourable to the issue, in the second pile to place those statements which he thinks are next most unfavourable and he goes on doing so in this manner till in the eleventh pile he puts the statements which he considers to be the most favourable.

3) This sorting by each judge yields a composite position for each of the items. If there is a marked disagreement between the judges in assigning a position to an item, that item is discarded.

4) For items that are retained, each is given its median scale value between one and eleven as established by the panel of judges.

5) A final selection of statements is then made. For this purpose a sample of statements, whose median scores are spread evenly from one extreme to the other is taken. The statements so selected, constitute the final scale to be administered to respondents. The position of each statement, on the scale is the same as determined by the judges.

Once the scale is developed the respondents are asked to check the statements with which they agree. The median value of the statements that they check is worked out and this establishes their score or quantifies their opinion. In the actual instrument the statements are arranged in random order of scale value. If the values are valid and if the opinionnaire deals with only one attitude dimension, the typical respondent will choose one or several contiguous items to reflect his views. For example, suppose a respondent agrees with items, which have scale values as 9, 10, and 11. This implies that he has a favourable attitude to the object. The 'Thurstone method has been widely used for developing differential scales which are utilized to measure attitudes towards varied issues like war, religion, etc. Such scales are considered most appropriate and reliable when used for measuring a single attitude.

Limitations

1) The cost and time required to develop the scale is large. 2) The scale is that it is not completely objective.
2) The scale is that it is not completely objective.

7.6.3 Likert-type Scales (or Summated Scales)

The summated scales assume that the individual items in t4e scale are monotonically related to the underlying 'characteristics and summation of the item scores is related linearly to the attitude. The summated scales consist of a number of statements, which express either a favourable or unfavourable attitude towards the given object. The respondent indicates his agreement or disagreement with each statement in the instrument. Each response is given a numerical score, indicating its favourableness or unfavourableness, and the scores are totalled to measure the respondent's attitude. The overall score represents the respondent's position on the continuum of favourable-unfavourableness towards an issue. For the statements implying negative attitudes, the scoring is reversed.

Most frequently used summated scales in the study of attitudes follow the pattern devised by Likert. For this reason they are often referred to as Likert type scales. In a Likert scale, instead of having just agree and disagree in the scale we can have intensities varying from strongly agree to strongly disagree. For example, when a respondent is asked to express his opinion whether he considers his job quite pleasant the respondent may respond in any-one of the following ways:

(i) Strongly agree, (ii) agree, (iii) undecided, (iv) disagree, (v) strongly disagree.

These five points constitute the scales. At one extreme of the scale there is strong agreement with the given statement and at the other, strong disagreement, and between them lie intermediate points.

The procedure for developing a Likert-type scales consists of following steps:

1. Write a large number of statements that concern the particular attitudinal object being investigated. For instance, one may be looking at the role of voluntary agencies in providing health services in rural areas. Most of these statements should either be moderately positive or moderately negative. Neutral items are generally avoided in these scales. The items should be evenly divided between positive and negative statements.

2. Administer the pool of statements on a group of respondents who are similar to the population on whom the scale will be used. For example, if we wish to study the attitude of housewives the pool should be administered on a group of housewives with similar background to our final population.

3. Assign scale values to the degrees of agreement or disagreement with each item. The particular values may differ from one researcher to another. Sometimes one may adopt the values 1, 2, 3, 4, 5 and sometimes +2, +1, 0, -1, -2. For negative items the directions should be reversed.

4. Calculate a total attitude score for each respondent using the same scaling procedure. The distribution of total scores is then used to refine the list of items. This step is called item analysis. In this process one analyzes the responses and select for the scale those items, which most clearly differentiate between the highest and lowest scores. Dividing the respondents into the high and the low scoring categories can do this. The high scorers can be assumed to be with favourable attitudes and the low scorers can be taken as having the least favourable attitudes. If the statement is a good one, then it is safe to expect that the mean score for the favourable group would be greater than the mean score for the unfavourable group. If the mean scores across the two groups, for an item, are found nearly equal or equal, then that statement can be dropped from the scale. One can take the high group as the top twenty-five per cent of all total scores and the low group as the lowest twenty-five per cent. Alternatively we can divide the respondents into quartiles and compute the median score for each item for the highest twenty-five per cent and the lowest twenty-five percent of scale scores.

5. The statements remaining in the pruned list are randomly ordered on the scale form. The positive and negative ones are mixed.

6. The scale is now administered on the respondents who are asked to indicate their degree of agreement with the items. A respondent's total score is generated as the sum of his scores on each statement.

Advantages

i) It is relatively easy to construct the Likert-type scale in comparison to Thurstone-type scale because Likert-type scale can be performed without a panel of judges.

ii) Likert-type scale is considered more reliable because under it respondents answer each statement included in the instrument.

iii) 'Each statement, included in the Likert-type scale, is given an empirical test for discriminating ability and as such, unlike Thurstone-type- scale, the Likert-type scale permits the use of statements that have a direct relationship to the attitude being studied.

iv) Likert-type scale can easily be used in respondent-centred and stimulus-centred studies.

v) Likert-type scale takes much less time to construct and is frequently used by the students of opinion research.

Limitations

i) One important limitation is that, with this scale, we can simply examine whether respondents are more or less favourable to a topic, but we cannot tell how much more or less they are.

ii) There is no basis for belief that the five positions indicated on the scale are equally spaced. The interval between 'strongly agree' and 'agree', may not be equal to the interval between "agree" and "undecided". This means that Likert scale does not rise to a stature more than that of an ordinal scale, whereas the designers. of Thurstone scale claim the Thurstone scale to be an interval scale.

iii) The total score of an individual respondent has little meaning, since a given total score can be secured by a variety of answer patterns.

In spite of all the limitations, the Likert-type summated scales are regarded as the most useful in situations where it is possible to compare the respondent's score with a distribution of scores from some well defined group. They are also useful when we are concerned with a programme of change or improvement in which case we can use the scales to measure attitudes before and after the programme of change or improvement in order to assess whether our efforts have had the desired effects. We can as well correlate scores on the scale to other measures without any concern for the absolute value of what is favourable and what is unfavourable. All this accounts for the popularity of Likert-type scales in studies relating to measuring of attitudes.

7.6.4 Semantic Differential Scale

The Semantic Differential is a seven-point rating scale with points associated with bipolar labels. The object being rated is called the concept. The respondents rate objects on a number of itemized seven-point rating scales bounded at each end by one of two bipolar adjectives and central category representing neutral. In this scale only the extremes have names and in between categories have either blank spaces or number. For example-

Cold	—	—	—	—	—	—	—warm
Good	—	—	—	—	—	—	—bad
Strong	—	—	—	—	—	—	—weak
Modem	—	—	—	—	—	—	—old fashioned

The respondents mark the blank that best indicate how they would describe the object being rated. In the preparation of semantic differential scale the negative objective phrase sometimes appears on the left side and sometimes on the right. This controls the tendency of the typical respondents who have very positive and very negative attitudes to mark the right or left hand sides without reading the labels. The individuals on the semantic differential scale may be scored in either a-3 to +3 or a 1 to 7 scale. The resulting data are commonly analyzed through profile analysis i.e. means or median values on each rating scale are calculated and compared by proper statistical analysis. Semantic Differential scale is a popular rating scale in marketing research. It is generally applied in comparing brand, Produ9t and company images etc.

For illustration, we consider the image analysis study of three organizations A, Band C on the basis of a sample of 100 individuals. The average ratings based on scores of each individual on each dimension and the average total score for all the respondents provided the following index of the overall ratings-

	7	6	5	4	3	2	1	
Modern	C	-	A	-	-	B	-	Old fashioned
Progressive	C	A	-	-	-	B	-	Behind the times
Friendly	-	A	B	-	-	-	C	Unfriendly
Cooperative staff	-	-	A	B	C	-	-	Non-cooperative staff
Reliable	-	A	-	B	C	-	-	Unreliable
Quick service	-	-	-	A	-	B	C	Slow service
Neat & Clean	-	A	-	B	-	C	-	Dirty

The maximum possible score for each organization is 49 and minimum possible score is 7. The scores for A, B and C are 38, 23 and 24 respectively.

7.6.5 Multidimensional Scaling

In the earlier attitude measurement scales we have discussed how the object is measured against each characteristics one at time. The measurement process tells little about the relative importance of different characteristics or how the characteristics relate to each other. Multidimensional scaling (MDS) is important when we are interested in the relationship among the characteristics. Multidimensional scaling is relatively complicated scaling device, but with this sort of scaling one can scale objects, individuals or both with a minimum of information.

Multidimensional scaling is a class of procedures for representing perceptions and preferences of respondents spatially by means of a visual display. It can be characterized as a set of procedures for measuring perceptions or affective dimensions of substantive interest. It provides useful methodology for portraying subjective judgements of different kinds. MDS is used when all the variables in a study are to be analyzed simultaneously and all such variables are independent. Through MDS techniques we can represent geometrically the locations and interrelationships among a set of points. We try to locate the points, given the information about a set of interpoint distances, in space of one or more dimensions such as to best summaries the information contained in the interpoint distances. The in the solution space then optimally reflect the distances contained input data.

Applications of Multidimensional Scaling

MDS has been used in marketing research to identify:

i) the number and nature of dimensions consumes use to perceive different brands in the marketplace.

ii) The positioning of current brands on these dimensions.

iii) The positioning of consumers ideal brand on these dimensions.

Assumptions and Limitations of Multidimensional Scaling

The major assumptions of Multidimensional Scaling are:

i) That people perceive a set of objects as being more or less similar to one another on a number of dimensions assumed to be uncorre1ated with one another.

ii) That the similarity of stimulus A to B is the same as the similarity of stimulus B to A

iii) That the distance (similarity) between two stimuli is some function of their partial similarities on each of several perceptual dimensions.

Because of the computational ‘and interpretational complexities MDS is not a popular technique in marketing research.

7.7 SUMMARY

The qualitative or behavioural data are not easy to obtain. The reason behind the fact is that behaviour itself is a complex phenomenon and abstract concept. However, researchers have developed techniques of getting data relating to behavioural aspects like attitude, personality, perception etc. Attitude measurement is one among these. Attributes are the characteristics of the product or service in which researchers aim to measure the mental state of the respondents. Since, behaviour is subjective and the same can be described by the procedures of assigning numbers, degrees, grades, opinion and attitude. In comparative scaling techniques, pair comparisons are measured by the observers. In same order scaling ranks are assigned to the various respondents from lowest number to higher one or vice-versa. Rating may be graphic or itemized with attributes allotted on a scale. In a Likert type scale or summated scale, a number of statements are expressed which may be favourable or unfavourable. The semantic differential scale is a seven-point rating scale with points assigned with bipolar levels. A more complicated scale is multidimensional scaling which is a class of procedures for representing perception and preferred of respondents by means of visual display.

7.8 KEYWORDS

Nominal Scale is simply a system of assigning number or symbols to events in order to label them.

Ordinal Scale allows the respondents to rank some alternatives by some common characteristics.

Interval Scale has arbitrary zero point with numbers placed at equally appearing intervals.

Ratio Scale has an absolute of true zero of measurements.

Arbitrary Scales are developed on ad-hoc basis and are designed largely through the researchers' own subjective selection of items.

Likert Type (Summated Scales) consists of a number of statements which express either a favourable or unfavourable attitude towards the given object.

Multidimensional Scaling is a class of procedure for representing perceptions and preferences of respondents spatially by means of a visual display.

7.9 SELF ASSESSMENT QUESTIONS

1. What is measurement? Why do we need to measure attitudes empirically? What are the intellectual and practical benefits of attitude measurement?
2. What are the major barriers to accurate attitude measurement?
3. What are the primary scales of measurement?
4. Describe the differences between a nominal and an ordinal scale.
5. What is a comparative rating scale?

6. What are the advantages and disadvantages of paired comparison scaling?
7. Describe the Q-Sort methodology.
8. What is a semantic differential scale? For what purposes is this scale used?
9. Describe the Likert scale.
10. What are the major decisions involved in constructing an itemized rating scale?
11. Describe any two methods for scale construction. Also point out merits and demerits for each method.
12. Write a brief note on Multidimensional scaling.

7.10 REFERENCES/SUGGESTED READINGS

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Lesson No.: **8**	

ADMINISTRATION OF SURVEYS

STRUCTURE

8.0 OBJECTIVES

After reading this lesson you will be able to

- Differentiate between sampling and non-sampling errors in a survey.
- Understand the process and administration of survey.
- Describe field organisation and drafting of reports.

8.1 INTRODUCTION

The main objective of a sample survey is to obtain information about population. Population is defined as a group of units defined according to the objectives of the survey. The population may consist of all the households in a village or locality or that of all the fields under a particular crop in a geographical area. The information that we seek about the population is normally, the total number of units, aggregate value of various characteristics, averages of these characteristics, proportions of units possessing specified attributes etc. The data can be collected in two different-ways. The first one is complete enumeration i.e. collection of data on the survey characteristics from each unit of the population. The other approach is based on the use of sampling methods and consists of collection of data through sampling: Sampling is a scientific and objective procedure of selecting units from the population and provides a sample that is expected to be representative of the population.

8.2 ERROR IN SAMPLE SURVEYS

A sample is expected to represent the population from which it comes, however, there is no guarantee that any sample will be precisely representative of the population from which it comes. In practice, it is rarely known when a sample is unrepresentative and should be discarded. The sample may be unrepresentative because of sampling or non-sampling errors.

8.2.1 Sampling Errors

Sampling error comprises the differences between the sample and the population that are due solely to the particular units that happen to have been selected. For example, suppose that a sample of 100 females from Haryana is taken and all are found to be taller than six feet. It is very clear even without any statistical prove that this would be a highly unrepresentative sample leading to invalid conclusions. This is a very unlikely occurrence because naturally such rare cases are widely distributed among the population. But it can occur. Sampling error may be committed due to the chance factor. Unusual units in a population do exist and-there is always a possibility that an abnormally large number of them will be chosen. Sampling error may also be committed due to sampling bias. Sampling bias is a tendency to favour the selection of units that have particular characteristics. Sampling bias is usually the result of a poor sampling plan. The most notable is the bias of non-response when for some reason some units have no chance of appearing in the sample. As an example we would like to know the average income of some community and we decide to use the telephone numbers to select a sample of the total population in a locality where only the rich and middle class households have telephone lines. We will end up with high average income, which will lead to the wrong policy decisions.

8.2.2 Non Sampling Errors

Non-sampling errors occur whether a census or a sample is being used. A non-sampling error is an error that results solely from the manner in which the observations are made. The simplest example of non-sampling error is inaccurate measurements due to malfunctioning instruments or poor procedures. For example, if persons are asked to state their own weights themselves, no two answers will be of equal reliability. An individual's weight fluctuates during the day and so the time of weighing will also affect the answer.

8.3 ADMINISTRATION IN SURVEYS

Sample surveys are widely used as a cost effective instrument of data collection and for making valid inferences about population parameters. Administration of surveys deals with the planning, preparations and execution of surveys such that cost and time for collection of information and errors are minimized to the possible extent. Planning and preparations of the survey precede the actual operation of the survey. This is an extremely important task since the quality of the survey results depends considerably on the preparations made before the survey is conducted. The amount of work needed for planning varies greatly with the type of material available and the nature of the information to be collected.

Some of the important aspects requiring attention at the planning stage are as follows:

1) Objectives of the survey
2) Purpose of Survey
3) The Data to be collected
4) Methods of data collection
5) Questionnaire and schedules
6) Survey, reference and reporting periods
7) Sample size and sampling design
8) Planning of pilot survey

8.3.1 Objectives of the survey

The first step in planning a survey is to formulate its objectives. There must be a need for carrying out the enquiry and it is important to know just what is wanted. Thus the first step in planning a survey is to formulate its objectives. The objectives of the survey must be spelled out clearly along with the manner in which the results are going to be used. Often we do not know precisely what we need or how we are going to use the results. For example, it is not uncommon to be told that the purpose of the survey is to find how agricultural workers live without spelling out exactly who is an agricultural worker, what is meant by living, whether income and expenditure are involved, or whether the number of rooms and the facilities provided are to be considered.

The administrator who is in need of some statistical information is expected to formulate the objectives of a survey. Usually his formulation of the objectives will be rough and vague. It is for the survey statistician to give a clearer formulation of the objectives and get it approved by the administrator. The 'survey statistician's formulation of the objectives should include a clear statement regarding the items of information to be covered, the population to be studied, and the form in which the data would be tabulated and also the accuracy aimed at in the final results. The survey statistician may start with the final tabulation that would be required by the administrator and then specify the items of information which should be collected in the survey for obtaining these tables. As regards the accuracy of the final figures, he may have to take into account the financial and manpower resources that would be available for the survey and the use to which the figures would be put. It may be noted that some compromises may have to be arrived at between the cost of the survey and the accuracy of the results.

8.3.2 Purpose of Survey

The statement of the purpose of the survey should ordinarily indicate the population to be sampled. For example, in a survey of manufacturing establishments the population may be the totality of establishments operating in the country during a certain period. Similarly a survey of opinions on a public issue may be restricted to persons who have passed their eighteenth birthday. The populations intended to be covered by the survey are called target populations. When the sampled population differs from the target population, the results of the survey will apply to the sampled population only.

If there are different agencies which can collect the required information in their fields of specialization as a bye-product of their normal administrative duties, the surveys may be conducted in the form of different uni-purpose surveys, each survey being undertaken by one of the agencies specializing in that field. If there is a permanent sample survey organization with a permanent whole time field staff this question needs careful consideration. The decision about uni-purpose or multi purpose surveys will depend much on the situations under which the survey is to be carried out. If the data for the different subjects of enquiry can be collected by the method of mail enquiry where there is not much journey time involved, uni-purpose surveys may be adopted. On the other hand if the method of interview is adopted and if the same primary stage units are to be used for the different subjects of enquiry, then a multi-purpose survey may be thought of.

8.3.3 The Data to be Collected

It should be possible from the purpose of the survey to derive a fairly broad list of items that would provide information on the problems under investigation. This list should be supplemented by other items that are correlated with the main items and can throw additional light on related questions. For example, in a survey of general attitudes, one may collect information on the related items such as marital status, number of children, religion, occupation etc. When all the items have been assembled, the utility of obtaining information on them should be considered. A number of items can be discarded at this stage and only items relevant to the purposes of the survey should be retained. In this process care should be taken that no important item is missing. Preparing the blank tables that the survey should fill can best do this. This table will eliminate irrelevant information and ensure that all essential items have been included. Since a long list of items overburdens the respondent so the list should be pruned to the possible extent. If the list cannot be cut short then with a slight loss of efficiency, the questionnaire can be splint into two parts, so that the basic items of information appear on each part but not the other items. Then the information on one group of items is collected from one set of respondents and on another group of items from another set.

8.3.4 Methods of Data Collection

Having decided about the items of information that should be collected and the form in which the data collected are to be tabulated, it is necessary to examine the mode of collecting this information. First the survey statistician should consider whether it is necessary to collect the information by complete enumeration or by sample survey. If the objective of the survey is to supply accurate information for each unit and if that unit happens to be the unit of enquiry, then complete enumeration is indispensable. Instead if the objective is to provide estimates of aggregates or ratios at some regional level, then complete enumeration need not necessarily be the best method and the possibility of using sampling methods should be explored. Depending on the nature of information required and the population under study we have the following important methods for collecting information:

i) Director Personal Interview Method
ii) Mail questionnaires Method
iii) Interviews by Enumerators
iv) Interview on Telephone

Direct or Personal Interview

The method of personal interview is widely used in social and economic surveys. In these surveys, the investigator personally contacts the respondents and can obtain the "required data fairly accurately. The interviewer asks the questions pertaining to the objectives of survey and the information so obtained, is recorded on a schedule prepared for the purpose. This method is most suitable for collecting data on conceptually difficult items from respondents. In this method, the response rate is usually good and the information is, more reliable and correct. However, more expenses and, time is required to contact the respondents.

Mail questionnaires Method

In this method, the investigator prepares a questionnaire and sends it by mail to the respondents. The respondents are requested to complete the questionnaires and return them to the investigator within a specified time. This method is suitable where respondents are spread over a wide area. Though the method is less expensive, normally it has a poor response rate. The other problem with this method is that it can be adopted only where the respondents are literate and can understand the questions. The success of the method depends on the skill with which the questionnaire is drafted, and the extent to which willing cooperation of the respondents is secured.

Interviews by Enumerators

This method involves the appointment of enumerators by the surveying agency. Enumerators go to the respondents and fill up the responses in the schedule themselves. For success of this method, the enumerators should be given proper training for soliciting co-operation of the respondents. This method can be usefully employed where the respondents to be covered are illiterate.

Telephone Interview

In case, the respondents in the population to be covered can be approached by phone, their responses to various questions included in the schedule can be obtained over phone. If long distance calls are not involved and only local calls are to be made, this mode of collecting data may also prove quite economical. It is, however, desirable that interviews conducted over the phone are kept short so as to maintain the interest of the respondent. It may be noted that the decision regarding the method of enquiry to be used in a survey should be taken after considering the practicability, accuracy and cost of using the different methods of data collection.

8.3.5 Questionnaire and schedules

The survey statistician should consider whether the questionnaire or a schedule is to be used in the survey for collecting the information. A questionnaire consists of a list of questions which the investigator is expected to read out to the respondents. The responses of the respondents to these questions are recorded. In this case the investigator is not supposed to influence the response, in any way, by his interpretation of the terms in the questions. In mail enquiries usually the questionnaire method is used for collecting the information. A schedule consists of only the items on which the information is to be collected and the actual procedure of collection of data is left to the investigator. In this case proper training in the concepts and definitions and in the technique of interview is to be imparted to the investigators.

It may be seen that the schedule method of enquiry is subject to more investigator bias than the questionnaire method of enquiry. Though this may be true in case of items of information which may be easily understood and may be reported accurately, this is not likely to be true when more complicated items of information are to be canvassed. It may be noted that the questionnaire is likely to be familiar to the respondents and a schedule is to be preferred when the items of information are complicated and need considerable explanation. Preparation of a schedule or a questionnaire with suitable instructions needs to be given considerable attention in designing a survey as the utility of the results of the survey depends to a large extent on this. The order of presenting the questions is important. The questions which are likely to help the investigators in establishing cordial relations with the respondents should be put first. The questions on similar subjects should come together in the questionnaire or schedule. Sometimes the questions should be arranged in such a way that it is suitable for tabulation. If this procedure of arranging the questions is unsuitable for the investigators as to the sequence in which the questions are to be put. It may be noted that the wording of the questions should not lead to ambiguous answers. As far as possible they should be such that the answers can be recorded in terms of numbers, dates or in specific codes.

The method of tabulation should be visualized at the time of preparing the questionnaire or schedule. If machine equipment's are going to be used, it will be desirable to have the data collected in the form of codes. The investigators to some extent so as to reduce the cost of the tabulation stage may do this part of the work. For this purpose it would be necessary to have a code list giving the code numbers for possible descriptive answers to particular items. It is desirable to have a schedule to keep a record of time spent on different operations by the investigators. This would help in building up cost estimates that can be used in planning future surveys.

To reduce the non-sampling errors that would arise due to ambiguous definitions and misunderstanding of the questions by the investigators or respondents, it is necessary to give detailed explanatory notes and instructions of the items of information included in the questionnaire or schedule. The instructions should include the concepts and definitions that are to be used in the survey and the method of enquiry. Clarification of the doubts by the investigators is to be. so done that there is uniformity in the concepts and definitions used by the different investigators. If the data are being collected by the method of mail enquiry the explanatory notes and instructions should be unambiguous, comprehensive and as brief as possible. If the data are being collected by the method of interview or by actual physical observation, the instructions can be made more detailed. In this case also instructions should be unambiguous and clear.

8.3.6 Survey and reference periods

The objectives of the survey should also specify whether the survey is to be an isolated one or a periodically repeated one. In case of repeated surveys, the series of surveys should be so planned as to minimize the overall cost, ensuring a specified precision for the estimates or to maximize the precision of the estimates for a given fixed cost.

Another aspect which needs careful consideration is the period of the survey together with the reference period (time period to which the information refers) for the different items of information. The reference period depends much on the items of information and the conditions under which the survey is to be conducted. It may be necessary to have different reference periods for different items of information. The reference period may be taken as one year in case of rare items which occur only once or twice in a year and which are usually remembered well.

For items of information subject to seasonal fluctuations it is desirable to stagger the survey over the whole year and collect data every month or season from the same or a different set of sample units. The same set of sample units may be used, if the main objective is to study the seasonal variation in the estimates and a different set of sample units may be used, if the main objective is to obtain a picture for the year as a whole, provided the data collected in the successive periods have a positive correlation. In the latter case data collected at one point of time may be misleading because they are subject to seasonal effects and the seasonal variation is not reflected. Further, staggering the survey has the advantage of enabling us to use a smaller number of survey personnel over a longer period instead of having to use a larger number of survey personnel for a shorter period.

8.3.7 Sample Size and Sampling Design

The question of how large a sample should be is a difficult one. Sample size can be determined by various constraints. In general, sample size depends on:

i) The nature of the analysis to be performed

ii) The desired precision of the estimates one wishes to achieve

iii) The kind and number of comparisons that will be made

iv) The number of variables that have to be examined simultaneously and how heterogeneous a universe is sampled.

For example, the available funding may prefix the sample size. When research costs are fixed, a useful rule of thumb is to spend about one half of the total amount for data collection and the other half for data analysis. This constraint influences the sample size as well as sample design and data collection procedures. More technical considerations suggest that the required sample size is a function of the precision of the estimates one wishes to achieve, the variability or variance, one expects to find in the population and the statistical level of confidence one wishes to use.

Having decided the items of information to be collected and the method of enquiry an adequate sampling frame is to be procured. The frame is to be carefully examined for possible errors of omission and duplication. The information available for the sampling units for groups of sampling units should be collected and the survey design should make use of this information to the fullest in improving the efficiency of the survey: A rational choice is to be made from the possible sampling designs taking into consideration sampling error, non-sampling errors and cost. In this connection the results of past surveys, if any, may be of help. If no past experience is available it is necessary to conduct empirical studies with some past census data or to carry out pilot surveys with a view to compare the efficiencies of possible sampling designs. The survey design should have built-in-devices to assess and control non-sampling errors. In this connection it may be noted that use of the technique of interpenetrating sub-samples, will be of considerable help. The possibility of using statistical quality control techniques for controlling non-sampling errors at different stages of survey should also be explored.

8.3.8 Pilot Surveys

Pilot surveys can be used for many purposes. They can be used for obtaining information regarding the variability in the population and the cost of survey under various sampling schemes and to build up cost and variance functions, which can be used for planning future surveys. It will also help to develop the field procedure, to test the schedule for assessing the possibility of getting accurate information on the items included and to train the investigators as to how they should fill up the schedule. In some surveys answers to certain questions required for a fixed time period such as a day, a week, a month or a year. Sometimes, it may not be possible to take a decision regarding the time to which the question should relate. In such cases, the questionnaire can be put to test in a pilot survey. Pilot surveys may not be required in situations where there is already some information on the various points form previous surveys. Pilot surveys should also be suitably planned to give the required information. The planning of pilot a survey will depend on the purpose for which it is intended. The extent and the scope of the pilot survey will also depend on the amount of money one is prepared to spend for this purpose. In sample surveys where no prior information is available, it is worthwhile to spend a certain amount of expenditure on a pilot survey.

8.4 FIELD ORGANIZATION

One way of organizing the work of data collection in a particular subject is to make use of an already existing agency, which can collect this information as a bye-product of their normal administrative duties. In this case the cost is likely to be only marginal because the agency will be having their normal duties or at a nominal additional cost. But the quality of work in this case may not be satisfactory because the main interest of the survey personnel is likely to be in their normal work and not in this survey. Further in this system there may not be much scope for selection of investigators suitable for this work, since one has to make use of the available personnel. An alternative system is to have a permanent field organization with a permanent field staff. The experience gained by the investigators in such an organization in earlier surveys may be of much help in efficiently carrying out future surveys. With such an organization it is possible to develop a suitable method of supervision and field scrutiny for improving the quality of the data.

The survey personnel intended for collection of data should have a sound physique to endure long journeys under trying circumstances. If it is intended to collect data by actual inspection of sample units and taking measurements counting or using measuring instruments or be eye estimation, the investigator should be capable of taking measurements with instruments or by eye estimation fairly accurately. He must know well the language in which the schedules and instructions are printed. If the data are going to be collected by interrogating an informant, the investigator must be able to put respondents at ease and to persuade them to give the required information. The investigators should have a good deal of patience. He should not get annoyed easily and should not annoy the informants. While selecting men for field survey, attempts should be made to test for these qualities with the help of objective tests. Before the selected survey personnel are sent out for field work they should be given sufficient training on the methods of approaching the informant, putting questions, and identifying and selecting sample units.

In order to make sure that the data collected are accurate, it is desirable to get some schedules checked by an independent batch of workers. It will have a favourable psychological effect on the investigators, if they are told that their work is being checked by an independent batch of workers. If possible some sample units can be made common to two investigators without letting them know as to which are the common sample units. They might be told that some units are common. This will also have a favourable psychological effect on them.

8.5 DRAFTING OF REPORTS

General guidelines for preparing a survey report may be stated as follows:

1. The problem under investigation and the purpose of the survey should be clearly explained.
2. An exact description of the material and regions covered by the survey should be included.
3. Method adopted in collecting data should be described.

4. All difficulties faced during the collection of data and how they were overcome should be explained.
5. A description of the sample unit, population of sampled units, sampling frame, sampling method, number of sample unit's chosen and the procedure in choosing the units should be given.
6. Point or period of time to which the data refer should be given.
7. A brief-description of the organization employed for the survey, cost of the survey under broad heads like preliminary work, field investigation, analysis, overhead etc., should be given.

8.6 SUMMARY

To obtain information about a population sample survey is conducted and a sample should have the quality of representing the whole population. For administering a sample survey planning, preparation and execution is required. The process of data collection and the methods of data collection should be done systematically and scientifically and sampling errors should be taken care of wherever applicable. Data can be collected either through the process of direct/personal interview, mail questionnaire, interview by enumerators or on telephonic interview. Size, design and reference period of sampling depends upon the nature and objective of research. Pilot surveys are used to check the viability of the accurate sampling methods and the information sought under the process. After survey is committed, a report is prepared to highlight in detail the findings and suggestions. In the survey reports there should be description of sample size, sampling design, method, cost, field investigation, analysis, interpretation and time and resources.

8.7 KEYWORDS

Sampling is a scientific and objective approach of selecting units from population for the purpose of a survey.

Sampling Errors refer to differences between sample and the population due to some bias.

Non-Sampling Error is an error occurred due to procedure of taking observations.

Survey is an instrument of data collection to make valid inference about population parameters.

Pilot Survey is conducted to get the prior information regarding the variability in the population and testing the feasibility of the survey.

8.8 SELF ASSESSMENT QUESTIONS

1. What is a sampling error? How is it different from non-sampling error?
2. Explain the various steps involved in planning of surveys.
3. What are various methods of data collection? Discuss the main features of data collection tools.
4. Describe sample size and sample design.
5. What are prerequisites of drafting of a survey report?

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Course Code: **CP-206**	*Author*: **Dr. B.K. Hooda**
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Lesson No.: **9**	

SAMPLING DESIGNS

STRUCTURE

9.0 OBJECTIVES

After going through this lesson you should be able to :

- Understand the meaning and characteristics of a sample design.
- Classify and differentiate between probability and non-probability sampling designs.
- Understand the procedure of selecting a research sample.

9.1 INTRODUCTION

You have got an idea of sampling errors and data collection in the previous lesson. In this lesson you will study framework of a sampling design with some defined terms. A sampling design in a framework of sampling in which features, classification, procedure etc. is given in detail. Numerical constants of population are called parameters which of a sample are known as statistic. Standard error of estimates is called precision. In probability sampling methods each sample of the population has equal probability to get selected while non-probability or judgement sampling depends purely on discretion or judgement of the investigator. In stratified sampling method heterogeneous population is sub-divided into homogeneous strata. Cluster sampling is done by selecting a sample of clusters (groups).

9.2 SAMPLING AND COMPLETE ENUMERATION

The word population or universe in Statistics is used to refer to any aggregate collection of individuals or of their characteristics which can be numerically specified, e.g. population of weights, heights, teachers in GJU etc. Depending upon the number of elements a population may be fine or infinite. A population containing a limited number of individuals or members is called a finite population, for example the population of books in a library, population of Indian students in New York etc. are finite populations. A population with unlimited number of individuals or members is known as infinite population, e.g. the population of pressures at various points in the atmosphere, number of stars in the sky etc. A sample is a finite part of a statistical population whose properties are studied to gain information about the whole. When dealing with people, it can be defined as a set of respondents selected from a larger population for the purpose of a survey.

The recording of all the units of a population for a certain characteristic is known a complete enumeration. It is also termed as census. Sampling on the other hand is the act or process of selecting a suitable sample, or a representative part of a population for the purpose of determining parameters or characteristics of the whole population. The study population may be regarded as consisting of units which are to be used for the purpose of sampling. Each unit is regarded as an individual or an indivisible part, when the selection is made. Such a unit is known as sampling unit, e.g. a person, an animal, a household, a village etc. A list all of the sampling units in the population with proper identification particulars is called a sampling frame. Sampling frame provides the basis for the selection and identification of the units in the sample. As the sampling frame forms the basic material from which a sample is drawn. The frame often contains information about the size and structure of the population, which is used in sample survey in a number of ways. Also the fraction of the population selected in the sample is called the sampling fraction.

9.3 ADVANTAGES OF SAMPLING OVER COMPLETE ENUMERATION

Major advantages of sampling over complete enumeration are reduction .in cost, greater speed, wider scope, and greater accuracy. Since a sample is only a part of the population, obviously it is less costly as compared to a census. A sample may provide you with needed information quickly. For example, you are a Doctor and a disease has broken out in a village within your area of jurisdiction, the disease is contagious and it is killing within hours nobody knows what it is. You are required to conduct quick tests to help save the situation. If you try a census of those affected, they may be long dead when you arrive with your results. In such a case just a few of those already infected could be used to provide the required information. Many populations about which inferences must be made are quite large. But the big size of the population makes it physically impossible to conduct a census. In such a case, selecting a representative sample may be the only way to get the information. Also there are some populations that are so difficult to get access and so only a sample can be used. The inaccessibility may be economic or time related. Like a particular study population may be so costly to reach like the population of planets that only a sample can be used. In addition, sometimes the very act of observing the desired characteristic of a unit of the population destroys it for the intended use. In such cases only a sample should be used. A sample may be more accurate than a census. A census can provide less reliable information than a carefully obtained sample.

9.4 PARAMETER AND STATISTICS

Parameter are the numerical constants of the population, e.g. population mean (m), population variance (s^2) etc. If X_1, X_2, ..., X_3 be a random sample the any function of sample observations is called a statistic. Its value may vary from sample to sample, e.g. sample mean (x) and, sample variance (s^2). A statistic used for obtaining an estimate of a population parameter from a set of observations is called its estimator, whereas the value of an estimator for a given sample is known as the estimate of the unknown parameter.

9.5 ACCURACY AND PRECISION

Accuracy refers to the amount of deviations of the estimate from the true value where as, the precision refers to the size ofthi8 deviation by repeated applications of the sampling procedure. Precision is usually expressed in terms of the standard error of the estimator. Less precision is reflected by a larger standard error.

9.6 SAMPLING DESIGNS

A sampling design is a definite plan for obtaining a sample from a given population. It refers to the technique or the procedure the researcher would adopt in selecting items for the sample. Sampling design is determined before any data are collected. While developing a sampling strategy, the researcher must pay attention to the following points:

i) The first step in developing any sample design is to clearly define the population to be sampled.

ii) A decision has to be taken concerning a sampling unit before selecting sample. Sampling unit may be of some geographical area such as a state, district, village, etc., or construction units such as house, flat, etc. It may be a social unit such as family, club, school, etc., or an individual.

iii) Frame should be comprehensive, correct, reliable and appropriate. It is extremely important for the frame to be as representative of the population as possible.

iv) The size of sample should neither be excessively large, nor too small. It should be optimum. An optimum sample is one which fulfils the requirements of efficiency, representativeness, reliability and flexibility.

v) In determining the sample design, one must take into consideration the specific population parameters, which are of interest.

vi) Cost considerations, from practical point of view, have a major, impact upon decisions relating to not only the size of the sample but also to the sample design. Cost constraint can even lead to the use of a non-probability sample.

9.6.1 Characteristics of a Good Sample Design

A good sampling design is said to posses the following characteristics:

i) It should result in a truly representative sample.

ii) I should result in a small sampling error

iii) It should be within budget available for the research study.

iv) It should be such so that systematic bias can be controlled in a better way.

9.6.2 Classification of Sampling Designs

The technique of selecting a sample is of fundamental importance in sampling theory and usually depends upon the nature of investigation. Sampling designs may be broadly c1assjfied as (i) Probability or random sampling designs (ii) Non-probability sampling designs.

Probability sampling designs are the methods of selecting samples in which each unit of the population has some definite probability of its being selected in the sample. In other words, each possible sample has assigned to it, a known probability of selection. Sampling units are selected in a random manner, and hence it is possible to determine the precision of the estimates and construct confidence interval for the parameters. Simple random sampling, stratified random sampling and systematic sampling the most commonly used probability sampling designs.

In case of non-probability sampling designs or methods the selection of sampling units depends entirely on the discretion or judgment of the investigator. In these methods, the investigator inspects the entire population and selects a sample of typical units that he considers as representative of the population. Often the non-probability sampling designs or methods are also called purposive or judgment sampling methods. A major disadvantage of these' methods is that they lack a proper mathematical foundation and hence are not amenable to the development of sampling theory.

9.6.3 Simple Random Sampling

The simplest of the methods of probability sampling is known as the method of simple random sampling, often known as the method of random sampling. In this method an equal probability of selection is assigned to each available unit of the population at the first and each subsequent draw. Thus, if the number of units in the population is N, the probability of selecting any unit of the first draw is 1/N and the probability of selecting any unit from among the available (N–1) units at the second draw is 1/(N–1) and so on. Simple random sampling may also be defined as a method of selecting n units out of N units in the population such that each possible sample among the total possible ${}^{N}c_{n}$ samples has an equal chance of its being selected. In case of simple random sampling the probability of a specified unit of the population being selected at any given draw is equal to the probability of its being selected at the first draw. The successive draws may be made with or without replacing the units selected in the preceding draw. The fanner is called the procedure of sampling with replacement, the latter is called sampling without replacement. The basic assumption for simple random sampling is that the population can be subdivided into a finite number of distinct and identifiable units and sampling frame is available.

Procedure of Selecting a Random Sample

Commonly used procedures for selecting a random sample are: (i) Lottery Method, and (ii) Random Number Tables Method.

- **Lottery Method**: Each unit in the population of N units may be associated with a chit or ticket such that each sampling unit has its identification mark from 1 to N. All the chits or tickets are placed in a container, in which a thorough mixing is possible before each draw. Chits or tickets may be drawn one by one and may be continued until a sample of the desired size is obtained. The main demerit of this method is that when the size of population is large, it may be too difficult to achieve a thorough reshuffling of units before each draw.

- **Use of Random Number Tables**: A random number table is an arrangement of digits from 0 to 9, in either a linear or rectangular pattern, where each position is filled with one of these digits. A table of random numbers is so constructed that all digits 0, 1, 2, 9 appear independent of each other. A practical method of selecting a random sample is to choose units one-by-one with the help of a table of random numbers. By considering two-digit numbers, we can obtain numbers from 00 to 99, all having the same frequency. Similarly, three or more digit numbers may be obtained by combining three or more rows or columns of random number Tables. The simplest way of selecting a sample of the required size is by selecting a random number from 1 to N and then taking the unit bearing that number. This procedure involves a number of rejections since all numbers greater than N appearing in the table are not considered for selection.

Stratified Sampling

Simple random sampling is the most appropriate when the entire population from which the sample is taken is homogeneous. Stratified sampling techniques are generally followed when the population is heterogeneous and where it is .possible to divide it into certain homogeneous sub-populations, which are called strata. The strata differ from one another but each is homogeneous within itself. The units are selected at random from each of these strata. The number of units selected from different strata may vary according to their relative importance in the population. The sample, which is the aggregate of the sampled units of each of the stratum, is called a stratified sample and the technique of drawing this sample is known as stratified sampling.

Advantages of Stratified Sampling Over Random Sampling

i) The cost per observation in the survey may be reduced.

ii) Estimates of the population parameters may be obtained for each sub-population.

iii) Have increased accuracy at given cost.

iv) Have better administrative control.

Allocation of Sample in Different Strata

For management purposes the most effective utilization of resources is achieved if the variance of the estimator is minimized for a fixed budget or the cost of sampling is minimized for a fixed variance of the estimator. Keeping in view the stratum size, the variability within stratum and the cost per observation the techniques of proportional allocation and optimum allocation are commonly used.

(a) Proportional Allocation: In this procedure the number of sampling units n_i allocated to the i-th stratum is proportional to the number of units in the population.

Thus $n_i = \frac{N_i}{N} \times n$; i = 1, 2, ..., k

Proportional allocation is an efficient and suitable design when the cost of selecting a unit is equal for each stratum and there is no difference in within stratum variance.

(b) Optimum Allocation: Let C_i be the cost of sampling one unit from the i-th stratum having variance σ_i^2. Assuming σ_i^2 to be known, n_i is given by

$$n_i = n\frac{N_i\sigma_i / \sqrt{C_i}}{\sum N_i\sigma_i / \sqrt{C_i}}; \qquad i = 1, 2, ..., k$$

Thus, the sample size would larger if

i) the stratum size is larger

ii) stratum variance is larger

iii) The sampling cost in the stratum is lower

Illustration 7.1: Using proportional allocation, allocate the sample of size 30 to be drawn from a population of 800 units divided into 3 strata of sizes $N_1 = 400$, $N_2 = 240$ and $N_3 = 160$.

Solution: $N = 800$, $n = 30$, $N_1 = 400$, $N_2 = 240$ and $N_3 = 160$

$$n_1 = n \times \frac{N_1}{N} = 30 \times \frac{400}{800} = 15$$

$$n_2 = n \times \frac{N_2}{N} = 30 \times \frac{240}{800} = 9$$

$$n_3 = n \times \frac{N_3}{N} = 30 \times \frac{160}{800} = 6$$

Illustration 7.2: A population of 1000 units is divided into three strata so that $N_1 = 500$, $N_2 = 200$ and $N_3 = 300$ having standard deviation of 15, 18 and 5 respectively. Assuming cost per unit sampling same for each stratum, allocate a sample of size 84 using optimum allocation.

Solution: N = 1000, n = 84

Stratum size (N_i)	Stratum standard deviation (σ_i)	$N_i\sigma_i$
500	15	7500
200	18	3600
300	5	1500
		126000

Since, $n_i = n \times \dfrac{N_i\sigma_i / \sqrt{C_i}}{\sum N_i\sigma_i / \sqrt{C_i}} \sqrt{C_i}$;   i = 1, 2, ..., k

Therefore,

$$n_1 = n \times \frac{N_1\sigma_1}{\sum N_i\sigma_i} = 84 \times \frac{500 \times 15}{12600} = 50$$

$$n_2 = n \times \frac{N_2\sigma_2}{\sum N_i\sigma_i} = 84 \times \frac{200 \times 18}{12600} = 24$$

$$n_3 = n \times \frac{N_3\sigma_3}{\sum N_i\sigma_i} = 84 \times \frac{300 \times 5}{12600} = 10$$

A Systematic Random Sample

. If the sampling units are arranged in a systematic manner, then sample is drawn not at random but by taking sampling units systematically at equally spaced intervals along same order. The sample obtained in this manner is called a systematic sample and the technique is called the systematic sampling. A systematic random sample is obtained by selecting one unit on a random basis and then choosing additional elementary units at equi-spaced intervals until the desired number of units is obtained. For example, suppose there are 100 students in your class and you want select a sample of 20 students.

Further suppose that the names are listed on a piece of paper in an alphabetical order. If you choose to use systematic random sampling, divide 100 by 20, you will get 5 as the sampling interval. Randomly select any number between 1 and 5. Suppose the number you have picked is 4, that will be your starting number. So student number 4 has been selected at random and then you will select every 5^{th} name until you reach the last one. You will end up with 20 selected students.

Cluster Sampling

In some situations the elementary units are in. the form of groups, composed of smaller units. A group of elementary units is called a cluster. Sampling is done by selecting a sample of clusters and then carrying out the complete enumeration of clusters. This is called cluster sampling. For example in taking a sample of households we select a few villages and then enumerate them completely. The systematic sampling may also be taken as the cluster sampling in which a sample of one cluster is taken and then it is completely investigated. Cluster sampling is typically used when the researchers cannot get a complete list of the members of a population they wish to study but can get a complete list of groups or 'clusters' of the population. It is also used when a random sample would produce a list of individuals so widely scattered that surveying them would prove to be much expensive. This sampling technique may be more practical and/or economical than simple random sampling or stratified sampling. For example, a cluster may be some thing like a village or a school in a state. So you decide all the schools in Hisar are 'clusters. You want 20 schools selected. You can use simple or systematic random sampling to select the schools, then every school selected becomes a cluster. If your interest is to interview teachers on their opinion of some new program, which has been introduced, then all the teachers in a cluster must be interviewed. Though very economical cluster sampling is very susceptible to sampling bias. Like for the above case, you are likely to get similar responses from teachers in one school due to the fact that they interact with one another.

Quota Sampling

Quota sampling is a method of sampling widely used in opinion poll surveys and market research. The quota sampling starts with the idea that a sample should be well spread geographically over the population and that it should contain the same fraction of individuals having a certain characteristics, as does the population. In this technique the population is divided into a number of strata whose weights are obtained from a recent census or a large-scale survey. Interviewers are then assigned quotas for the number of interviews to be taken from each stratum. For example, an interviewer might be told to go out and select 20 adult men and 20 adult women, 10 teenage girls and 10 teenage boys so that they could interview them about their television viewing. The interviewer is free to choose his sample provided the quota requirements are fulfilled. The main difference between quota sampling and the stratified simple random sampling is that in quota sampling the selection of the sample within strata is not strictly random. The interviewer may omit certain section of individuals or may discard certain of the area entirely according to his convenience. Quota sampling suffers from the drawback that the sample is not a random sample and therefore the sampling distributions of any statistics are unknown.

9.7 SUMMARY

Based on nature and purpose of research and availability of data, sampling designs are formulated. There are two types of sampling: probability and non-probability. In simple random sampling the data is simply selected either by way of lottery method or by number table methods. A sampling design should be determined keeping in view size, parameters of population, statistic of sample, cost, assessment of impact upon decisions etc.

9.8 KEYWORDS

Sampling Design is a parameter describing plan, nature, features, size, methods of sampling.

Probability Sampling is a technique where there exists equal channel of each sample of the population to be achieved.

Non-probability Sampling is the method of sampling based on some judgement or bias by the investigator.

Parameter is the numerical constant describing the characteristics of a population.

Statistic is the numerical constant describing characteristic of a sample.

Estimator is a statistic used for obtaining an estimate of a population parameter from a set of observations.

Stratified Sampling is the method of sampling heterogeneous population divided into homogeneous sub-groups caused strata.

Quota Sampling is a method of sampling where selection of sample within strata is not strictly random.

9.9 SELF ASSESSMENT QUESTIONS

1. What do you mean by sample design? What points should be taken into consideration by a researcher in developing a sample design for his research project.

2. What are probability and non-probability sampling designs? Why probability sampling is generally preferred in comparison to non-probability sampling?
3. How would you differentiate between simple random sampling and a stratified random sampling designs? Explain clearly giving examples.
4. What is simple random sampling? Explain the concept of sampling with and without replacement.
5. Explain the procedures of selecting a simple random sample.
6. A certain population is divided into five strata with sizes 2000, 2000, 1800, 1700, and 2500 respectively. Respective standard deviations are 1.6, 2.0, 4.4, 4.8, and 6.0 and further the expected sampling cost in the first two strata is Rs. 4 per interview and in the remaining three strata the sampling cost is Rs. 6 per interview. How should a sample of size n = 226 be allocated to five strata if we adopt proportionate sampling design; if we adopt disproportionate sampling design considering (i) only the differences in stratum variability (ii) differences in stratum variability as well as the differences in stratum sampling costs.

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Lesson No.: **10**	

ANALYSIS AND INTERPRETATION OF DATA

STRUCTURE

10.0 OBJECTIVES

After learning this lesson you will be able to:

- Understand the concept of hypothesis testing;
- Describe and apply various techniques of data analysis;
- Use z and t tests for testing a hypothesis;
- Learn the application of Chi square test and measures of association.

10.1 INTRODUCTION

Theoretical aspects of research have been adequately discussed to enable the readers to understand norms in their true spirit. This chapter is intended to focus on basic statistical techniques and their applicability in research.

As has already been pointed out, social science research, or to be more particular, research on commerce and management, mostly deals with qualitative variables. Unless qualitative impressions are duly quantified, research findings may not be clearly understood and may even be questioned by others as to their authenticity. Statistical techniques help the researcher to counter this problem. In fact, it is being increasingly felt that understanding basic statistical norms is a prerequisite for the success of a researcher.

Stuart A Rice put forth the following arguments to justify quantitative expressions of research findings:

- It reduces individual bias to a minimum.
- Permits verification by other investigators.
- Reduces and at the same time makes evident the margin of error.
- Replaces the less exact meaning of descriptive words with the precision of mathematical notation.

Data collected from secondary sources may be compiled with great ease in the form of tables. Data from secondary sources enables us to define the characteristics of phenomena we try to investigate in the light of our own findings based on data collected from primary sources.

In some researches, however, where we do not collect or compile data from primary sources, we generally base our arguments by mere analysis of data from secondary sources. For example, an investigation on the 'structural change of occupational pattern in India' may be made based on analysis of census data over decades. Similarly, changing pattern of sectoral distribution of Net Domestic Product (NDP) in India may be analysed in the light of secondary data alone. Use of secondary data in direct form may not always help a researcher to relate such quantitative trends to his research problem. For example, an absolute analysis of wage cost and its shares in total cost of production in comparison with other countries may certainly lead a researcher to conclude that labour wage costs in India are relatively poor. But if a researcher, with some amount of inquisitiveness, goes into the depth of problem and tries to compare the per capita share of wages as percentage to the per capita share of NDP, the picture will be totally different. In fact, Indian workers, in this respect, are more privileged to gain a higher stake than workers in UK, USA and Japan. Readers here are requested to refer the World Development Reports published by the World Bank.

Again, while using data from secondary sources, the researcher should thoroughly check the background of such data collection, its methodology and limitations, etc. The methodology of data collection varies even for same data provided by different governmental agencies in India. For example, data related to labour matters as made available in Indian Labour Year Books and Annual Survey of Industries widely varies for obvious differences in methodology followed in collection and compilation. Even the same source may use different methodologies in different years of publications. The census data is a glaring example in this respect.

Collection of data from primary sources involves survey which may be carried out either by interviewing the samples in person or by mailing questionnaires to samples. Since mailing response is alarmingly poor, the researchers here are advised to follow the interview methods for carrying out the survey. In selecting samples, thus, he should be cautious. If he is unable to visit areas widely dispersed, sample should be chosen from those areas where he can afford personal visits. Similarly, he should also consider other constraining factors like time and money while deciding the number of samples.

Usually in case of structured questionnaire, samples are interviewed. Structured questionnaire ensures easy quantification.

After necessary collection of data from primary sources, with the help of tabulation, the researcher arranges these in some concise and logical order. And for such purpose he or she needs to classify the data. The basis of classification depends on the characteristics of data collected. In most cases such classification scheme is pre-determined. However, such scheme may get altered or modified after data collection.

Following criteria are generally considered for statistical classification:

- Geographical
- Chronological
- Qualitative
- Quantitative

Under geographical classification, data are organised in terms of geographical division as country, state, region, city, village, block, ward etc. Similarly, century, decade, year, month, week, day, etc., is considered while arranging data chronologically. Qualitative attributes such as sex, religion, literacy, occupation, marital status, etc., are also considered in data classification. Distribution of data by size and magnitude (frequency distribution as for example) is done through quantitative classification. After determining the classification, the collected data are sorted and counted as per various categories. For handling large data, hand tabulation may not always be possible. When mechanical tabulation is used, data are first transferred to punch cards by punching holes for each item. Then with the help of sorting machine and tabulation machine, data are finally arranged in the form of tables as per the above classification.

But in our country, it is not always possible for a researcher to avail such mechanical facilities and in most cases tabulation part is completed manually.

Assigning numerical values to each variable is a difficult task for a researcher. Quantitative variables, i.e., variables which have a certain number of defined units may either be cardinally (explicit) or ordinary (implicit) manipulated by simple mathematics. But qualitative variables may be manipulated only by defined characteristics. Similarly, the researcher should also understand the basic difference between continuous and discrete variables while arranging data.

With the help of frequency distribution, variables are classified according to magnitude or size. After necessary tabulation, the next task of the researcher is to arrange them in statistical tables. There are certain standard norms, which usually are followed in constructing tables. For simple understanding it should be remembered that such tables should be able to reveal significant relations among the data or should be able to emphasise certain facts.

The frequency distributions may also be presented in the form of graphs. Histogram, frequency polygon, smoothed frequency curve are the commonly used curves.

After necessary frequency distributions to represent the characteristics of entire series by few significant figures, we take the help of averages. Mean, median and mode are three of the most commonly used averages.

Here we have discussed various statistical models for research.

10.2 HYPOTHESIS TESTING

Inferences on population characteristics (or parameters) are often made on the basis of sample observations, especially when the population is large and it may not be possible to enumerate all the sampling units belonging to the population. In doing so, one has to take the help of certain assumptions (or hypothetical values) about the characteristics of the population if some such information is available. Such hypothesis about the population is termed as statistical hypothesis and the hypothesis is tested on the basis of sample values. The procedure enables one to decide on a certain hypothesis and test its significance. "A claim or hypothesis about the population parameters is known as Null Hypothesis and is written as, H_0."

This hypothesis is then tested with available evidence and a decision is made whether to accept this hypothesis or reject it. If this hypothesis is rejected, then we accept the alternate hypothesis. This hypothesis is written as H_1.

For testing hypothesis or test of significance we use both parametric tests and nonparametric or distribution free tests. Parametric tests assume within properties of the population, from which we draw samples. Such assumptions may be about population parameters, sample size, etc. In case of non-parametric tests, we do not make such assumptions. Here we assume only nominal or ordinal data.

Important parametric tests used for testing of hypothesis are:

(i) z-test

(ii) t-test

(iii) χ^2 test; and

(iv) f-test

When χ^2 test is used as a test of goodness of fit and also as a test of independence, we use non-parametric tests.

As has been stated earlier all parametric tests used for testing of hypothesis are based on the assumption of normally, i.e., population is considered to be normally distributed.

Procedure for testing of hypothesis

1. State the null hypothesis as well as the alternate hypothesis

For example, let us assume the population mean = 50 and set up the hypothesis $\mu = 50$. this is called the null hypothesis and is denoted as;

Null hypothesis,	H_0: $\mu = 50$
Alternative hypothesis	H_1: $\mu \neq 50$
	Or $\mu > 50$
	$\mu < 50$

2. Establish a level of significance (prior to sampling)

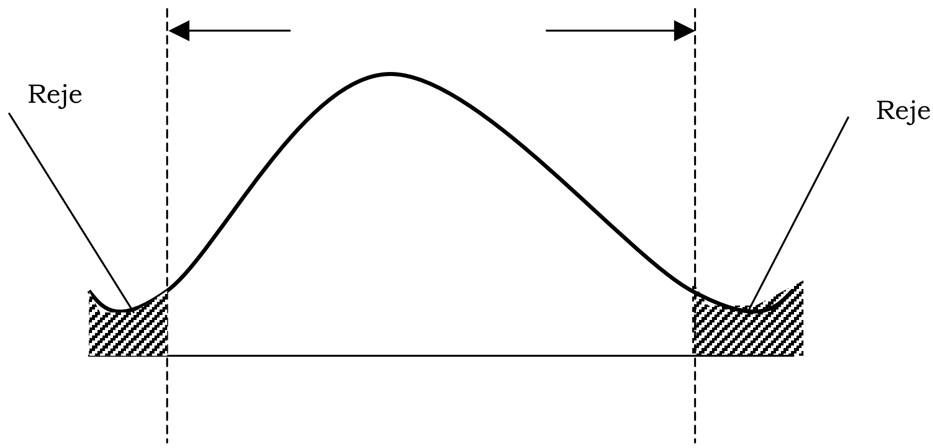
The level of significance signifies the probability of committing Type 1 error α and is generally taken as equal to 0.05. Sometimes, the value α is established as 0.01, but it is at the discretion of the investigator to select its value, depending upon the sensitivity of the study. To illustrate per cent level of significance indicates that a researcher is willing to take 5 per cent risk of rejecting the Null Hypothesis when it happens to be true.

3. Choosing a suitable test statistic

Now the researcher would choose amongst the various tests (i.e. z, t, $\chi 2$ and f-tests). Actually, for the purpose of rejecting or accepting the null hypothesis, a suitable statistics called 'test statistics' is chosen. This means that H_0 is assumed to be really true. Obviously due to sampling fluctuations, the observed value of the statistic based on random sample will differ from the expected value. If the difference is large enough, one suspects the validity of the assumption and rejects the null hypothesis (H_0). On the other hand, if the difference may be assumed due to sampling (random) fluctuation, the null hypothesis (H_0) is accepted.

4. Defining the critical rejection regions and making calculations for test statistics

If we select the value of α = Level of significance = 0.05, and use the standard normal distribution (z-test) as our test statistic for testing the population parameter u, then the value of the difference between the assumption of null hypothesis (assumed value of the population parameter) and the value obtained by the analysis of the sample results is not expected to be more than 1.96 σ at α = 0.05. This relationship can be shown by the diagram given below;



$$z = \frac{\text{Observed value of the statistic (x) – Expected value (u)}}{\text{Standard error of the estimate}}$$

Calculated value of z as given by the formula above, = [Absolute value]

Now find out the critical (or tabulated) value of the statistic (z or t or f, etc.).

10.3 USAGE OF *'Z'* AND *'T'* TESTS

The z-Test is used to measure the difference between any variable value (x) and the mean of all variable values or 'x' values, which is indicated by 'μ', divided by the standard deviation(s). It is based on the normal probability distribution. In following cases, we find the usage of z-test:

i) To judge the significance of statistical measures, particularly the mean. This is done by comparing the observed value (test statistic) with the probable value (table value) at a specified level of significance.

ii) It is used to compare the mean of a sample with some hypothesized mean of the population.

iii) It is also used to judge the significance of difference between means of two independent samples.

iv) It can also be used for judging the significance of difference between sample and population proportion or proportions of two independent samples.

v) Finally this test can also be used for measuring the significance of medium, mode, coefficient of correlation and other measures.

We shall now illustrate usage of z-tests in testing hypothesis with some real life examples. In case of small sample and in cases when sample variance is taken as population variance (population variance, being not known) we use t-test based on t-distribution to judge the significance of sample mean or significance of difference between two sample means. Normally when sample size is less than 30 we use t-test.

Illustration 10.1: A company manufacturing automobile tyres finds that tyre life is normally distributed with a mean of 40,000 kms and standard deviation of 3,000 kms. It is believed that a change in the production process will result in a better product and the company has developed a new tyre. A sample of 64 new tyres has been selected. The company has found that the mean life of these new tyres is 41,200 kms. Can it be concluded that the new tyre is significantly better than the old one?

Solution– In a problem of this type, we are interested in testing whether or not there has been an increase in the mean life of the tyre. In other words, we would like to test whether the mean life of new tyres has increased beyond 40,000 kms.

The various steps in testing the hypothesis are:

i) Null hypothesis and alternative hypothesis are:

H_0: μ = 40,000 kms

H_1: $\mu \neq$ 40,000 kms

ii) The significance level is taken as 0.05. That is, in 5 out of every 100 occasions, there is a risk of being error in accepting or rejecting the hypothesis.

iii) The test criterion is the z-test.

iv) Computations: Substituting the value of standard deviation, s = 3000 kms in the formula:

Standard error of mean ($\sigma_{\bar{x}}$) = $\frac{\sigma}{\sqrt{n}}$

$= \frac{3000}{\sqrt{64}}$

$= 375$

$z = \frac{x - \mu}{\sigma_{\bar{x}}}$

$= \frac{41200 - 40000}{375}$

$= 3.2$

v) Decision: At 0.05 level of significance, the critical (table) value of Z = $\pm$ 1.64.

As the computed value of $Z = 3.2$ is smaller than the table value of $z = \pm 1.64$, we reject the null hypothesis that $\mu = 40{,}000$ kms. That is, the alternative hypothesis that $\mu > 40{,}000$ kms is accepted. We, therefore, conclude that the new tyre is significantly better than the old one.

Illustration 10.2: Assuming that the average annual income of low level group is Rs. 18,750 at national level with standard, deviation of Rs. 2610. A random sample of 100 employees of this group was taken and it was found that their average salary was Rs. 19,240.

At a level of significance $\alpha = 0.05$ (95% confidence limit), can we conclude that the average salary of this group is representative of the national (salary) average?

Solution

i. Null Hypothesis H_0 : m = Rs. 17,750 n = 100,

Alternative Hypothesis H_1: m # Rs. 18,750 $\bar{x}$ = Rs. 19,240

ii. Level of significance as given $\alpha = 0.05$ s = Rs. 2,610

iii. Test statistics $Z = \frac{\bar{x} - \mu}{SE}$

$SE = \frac{\sigma}{\sqrt{n}}$ Where, $\bar{x}$ = Sample mean

μ = Population mean

s = Standard deviation of population mean

Z calculated

iv. As it is a Two-Tailed Test, the rejection region will be on both sides, i.e., 2.5% on RH and 2.5% on LH.

Region of Acceptance = 95% $z = \pm 1.96$ (From Table)

$z = \text{calculated} = \frac{19240 - 18750}{2610/\sqrt{100}} = 1.877$

Since the calculated value of z is lower than the tabulated value, the null-hypothesis stands accepted.

∴ The sample average income is a representative of the national average income.

Illustration 10.3: A manufacturer of light bulbs claims that a light bulb lasts on an average 1600 hrs. We want to test his claim. Here, we can reject the hypotheses if the average life of bulb is much less but we cannot reject it if it is greater than 1600 hrs. (Whatever big value it may be). A sample of 100 light bulbs was taken at random and the average life was computed to be 1570 hrs with a standard deviation of 120 hrs. at α = 1%, test the validity of the claim of the manufacturer.

Solution: As number of observations per sample is very large, we can take s = σ

Null hypothesis, H_0: $\mu > 1600$

Alt hypothesis, H_1: $\mu < 1600$

at 99% confidence limit ($\alpha = 0.01$)

Z (Tabulated) = –2.33 on the left tail of the standardised normal curve

$$Z = -2.33 \text{ and SE } \frac{s}{\sqrt{n}} = \frac{120}{\sqrt{100}} = 12$$

$$z = \frac{'x - \mu}{\sigma/\sqrt{n}} = \frac{1570-1600}{12} = \frac{-30}{12} = -2.5 |Z| = 2.5$$

As calculated value of $|z|$ > Tabulated value of $|z|$, H_0 stands rejected, i.e., management claim is not valid.

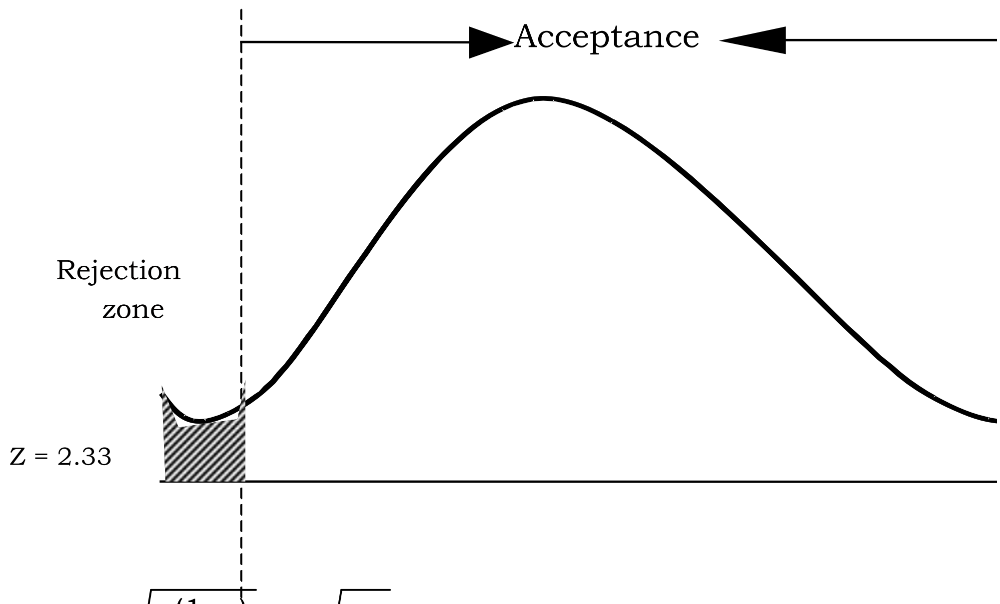
Illustration 10.4: The supporters of a party, claim that their party has 60% following in Delhi. To test this claim a city paper undertakes a test sample of 400 persons on the Internet, 220 people support this claim. Test at 1% level of significance whether the supporters claim is correct or not.

Solution:. It is a one tailed test

H_0: p = 0.6

H_1: $p < 0.6$

Sample Proportion $P_x = \frac{220}{400} = 0.55$



$$SE = \sqrt{\frac{p(1-p)}{n}} = \sqrt{\frac{pq}{n}}$$

$$= \sqrt{\frac{0.6(0.4)}{400}} = 0.0245$$

$$z = \frac{P_x - P}{\sqrt{pq/n}} = \frac{0.55 - 0.6}{0.0245} = -2.04$$

$|z|$ tabulated = –2.33 at 1% level of significance.

As, calculated value < tabulated, null hypothesis is accepted.

∴ Claim of the party is valid.

Illustration 10.5: An airline claims that at most 8% of its lost luggage is never found. A consumer advocacy agency wants to test the claim at 99% confidence level. Study of 200 random cases was taken and found that for 22 cases, the luggage was never found?

Solution: Clearly, it is one tailed test;

H_0: p = 0.08

H_1: p > 0.08

$P_x = \frac{22}{200} = 0.11$ (Sample proportion)

$$SE = \sqrt{\frac{pq}{n}} = \sqrt{\frac{.08 \times .92}{200}}$$

= 0.019

$$z = \frac{p_{\bar{x}} - p}{SE} = \frac{0.11 - 0.08}{0.019} = 1.58$$

Z tabulated = 2.33 at a 0.01

Z calculated = 1.58

As calculated value of Z < Tabulated value of Z,

H_0 stands accepted.

Illustration 10.6: Tensile strength of carbon steel samples in kg weight as recorded by a operator using UTS matrix is given below:

15, 20, 18, 16, 17, 21, 20, 19, 17, 15

At 5% level of significance find out whether the mean breaking strength of the lot can be considered 18 kg weight.

Solution: Null hypothesis that the population mean is equal to hypothesised mean of 18 kg. Weight can be written as under:

H_0: μ = 18 kg.

H_1: $\mu \neq$ 18 kg.

Here sample size being small, we can use t-test assuming normal distribution, population standard deviation being not known. Test statistic (computed value of 't') is obtained using following formula.

$$T = \frac{\bar{x} - \mu_{H0}}{\sigma s/\sqrt{n}}$$

To find out $\bar{x}$ and s, we make following calculations:

Sl. No.	x_1	$(x_1 - \bar{x})$	$(x_1 - \bar{x})^2$
1	15	-2.8	7.84
2	20	2.2	4.84
3	18	0.2	0.04
4	16	-1.8	3.24
5	17	-0.8	0.64
6	21	3.2	10.24
7	20	2.2	4.84
8	19	1.2	1.44
9	17	-0.8	0.64
10	15	-2.8	7.84
N = 10	$\sum x_i = 178$		$\sum(x_1 - \bar{x})^2 = 41.6$

$$\bar{x} = \frac{\sum xi}{n} = \frac{178}{10} = 17.8 \text{ kg}$$

ii. $\sigma s = \sqrt{\frac{\sum(xi - \bar{x})^2}{n-1}} = \sqrt{\frac{41.6}{10-1}} = 2.15$ kg

iii. $t = \frac{17.8 - 18}{2.15/\sqrt{10}} = -0.294$

iv. Degree of freedom = (n–1)

= (10–1) = 9

v. At 5 per cent level of significance with 9 d.f., table value of t-distribution = 2.262

vi. As the observed value of t (i.e. –0.294) is smaller than tabulated value (2.262), we accept H_0 at 5 per cent level and conclude that the mean breaking strength of carbon steel may be taken as 18 kg. weight.

10.4 CHI-SQUARE TEST

A chi-square (χ^2) test can be used when the data satisfies four conditions.

i. There must be two observed sets of data or one observed set of data and one expected set of data (generally, there are n-rows and c-columns of data)

ii. The two sets of data must be based on the same sample size.

iii. Each cell in the data contains the observed or expected count of five or large?

iv. The different cells in a row of column must have categorical variables (male, female or younger than 25 years of age, 25 year of age, older than 40 years of age etc.)

Application areas of chi-square test

The χ^2 distribution typically looks like a normal distribution, which is skewed to the right with a long tail to the right. It is a continuous distribution with only positive values. It has following applications:

- To test whether the sample differences among various sample proportions are significant or can they be attributed to chance.
- To test the independence of two variables in a contingency table.
- To use it as a test of goodness of fit.

χ^2 test has the following steps:

i. State the null hypothesis and calculate the numbers in each category.

ii. Determine the level of significance (i.e., how much risk of type I error) the researcher is prepared to take.

iii. Calculate χ^2, as follows:

$$\chi^2 = \sum \frac{(O_i - E_j)^2}{E_j}$$

where, O_i = Observed frequency.

E_j = Expected frequency in the category.

iv. Find the critical value of χ^2 against the number of degrees of freedom for the specified level of significance.

v. Compare the calculated value of χ^2 with the tabulated (critical) value and determine the region of rejection.

Solved questions on χ^2 test

Illustration 10.7: A company is engaged in the manufacturing of ice-cream which is sold in three sizes- large, normal and small. It has been observed that it sells the ice-cream in large, normal and small size in the ratio of 3:5:2.

The company has been thinking of introducing a different flavour and has conducted a test market for two weeks in a certain territory. The results of the test market show that it has sold 250 large packs, 400 normal packs and 350 small packs of the newly developed ice cream.

The company is now interested in knowing whether the consumption pattern of new ice-cream is different from that of the earlier one. If so, it may have to change the percentage of three different packs for the new ice-cream.

Solution: H_0: Null Hypothesis, "Present consumption is not different from earlier one".

Packing size	Observed frequency	Expected frequency	O-E	$(O-E)^2$	$\frac{(O-E)^2}{E}$
Large	250	300	-50	2500	8.33
Normal	400	500	-100	10000	20.00
Small	350	200	150	22500	112.50
	1000			χ^2	140.83

Degree of freedom = (3-1) = 2

$$\chi^2 = \sum \frac{(0-E)^2}{E} = 140.83$$

At 5% level of significance, value of χ^2 for df (2) = 5.991

As χ^2 calculated > χ^2 tabulated, we reject the null hypothesis "The consumption pattern of new ice-cream is not different" from the earlier one.

Illustration 10.8*:* In winter season, a study has been made for 10 days to see whether the distribution of daily reservation is uniform or not, and the results are tabulated hereunder.

Find whether the distribution is uniform or not.

Distribution of actual number of reservations

S.No.	1	2	3	4	5	6	7	8	9	10
No. of reservations	65	80	100	98	75	80	82	70	60	90

Solution. H_0: Distribution of daily reservation is uniform in winter season.

Test the validity of the assumption.

H_0: $p_1 = p_2 = p_3 = \ldots = p_{10}$

H_1: $p_1 \# p_2 \# p_3 \# \ldots \# p_{10}$

$$\text{Average value} = \frac{65 + 80 + 100 + 98 + 75 + 80 + 82 + 70 + 60 + 90}{10}$$

$$= \frac{800}{10} = 80$$

$$\chi^2 = \sum \frac{(O_i - E_j)^2}{E_j} = \frac{(65 - 80)^2}{80} + \frac{(80 - 80)^2}{80} + \ldots + \frac{(90 - 80)^2}{80}$$

$= 19.72$

$df = (c-1)\ (r-1) = (2-1)\ (1-1) = 9$

value at 5% level of significance = 16.919

As calculated χ^2 > tabulated χ^2, we reject the null hypothesis, i.e., the reservation in winter season is uniform.

10.5 MEASURES OF ASSOCIATION

Research questions in business frequently revolve around the study of relationship between two or more variables. Various objectives may be served by such an analysis. The strength, direction, shape and other features of the relationship may be discovered. Or tactical and strategic questions may be answered by predicting the values of one variable from those of another.

With correlation, one estimates the degree and nature of the relationship between variables calculated. With regression, an equation is developed to predict the values of the dependent variable. Both are affected by the assumptions of measurement level and the distributions that underline the data.

Bivariate correlation analysis

Bivariate correlation analysis differs from non-parametric measures of association and regression analysis in two important ways. First, parametric correlation requires two continuous variables measured on an interval or ratio scale. Second, the coefficient does not distinguish between independent and dependent variables. It treats the variables symmetrically since the coefficient r_{xz} has the same interpretation as r_{yx}.

Linear regression equation

The pattern of the scatter diagram, in most cases, is linearly related. The line which runs through most of the points, (if not all), is known as the 'line of regression'. This line should be the most representative of the data, i.e., most suitable and is thus popularly known as the 'line of best fit'.

The best line would be the one which passes through all the points. But this is not possible in most situations. The next step is to find the line which is closest to all the points, i.e., the distance between the line and points is minimum. As some points shall be above the line and some below the line, therefore, we take the square of deviations and hence the line of best fit would be one which gives the minimum differences:

$Y = a + bx$

Where Y = Dependent variables

X = Independent variables

A and b are constants which determine the completed line.

Illustration 10.9: A researcher wants to find if there is a relationship between the heights of sons and fathers. In other words, do tall father have tall sons?

Their heights in inches is given below in an ordered arrangement.

Father (X)	**Son (Y)**
63	66
65	68
66	65
67	67
67	69
67	69
68	70

a. For this data compute the regression line.

b. Based upon the relationship between the heights, what would be the estimated height of the son if the father's height is 70".

Solution: We can solve the problem as under:

Let the line be Y = a + bx

$$b = \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2}$$

$= \bar{Y} - b\bar{X}$

TABLE

X	Y	X^2	XY	Y^2
63	66	3969	4158	4356
65	68	4225	4420	4629
66	65	4356	4290	4225
67	67	4489	4489	4489
67	69	4489	4623	4761
68	70	4624	4760	4900
$\sum X = 396$	$\sum Y = 405$	$\sum X^2 = 26152$	$\sum XY = 26740$	$\sum Y^2 = 27355$

$$b = \frac{6(26740) - 396(405)}{6(26740) - 396(396)} = \frac{160440 - 16038}{156912 - 156816}$$

$$= \frac{60}{96} = 0.625$$

$$a = \frac{405}{6} - 0.625\ (396/6)$$

$= 67.5 - 41.25 = 26.25$

Hence, the regression line would be

Y = a + bx

$= 26.25 + 0.625x$

if fathers height is 70", height of son will be (X–70)

$y = 26.25 + 0.625\ (70)$

$= 26.25 + 43.75 = 70$

Expected height of son is also 70”

Standard error of the estimate

How good is this fit? The closer these values are to each other, the better the fit. Accordingly, a measure of the variability of the scatter around the regression line would determine the reliability of this estimate. The smaller this estimate, the more dependable the prediction will be.

For our problem standard error of the estimate would be:

$$S_{yx} = \frac{\sqrt{\Sigma(y)^2 - a(\Sigma y) - b(\Sigma xy)}}{n-2}$$

$$= \frac{\sqrt{27355-26.25(405)-0.625(26740)}}{4}$$

$$= \frac{\sqrt{11.25}}{4} = \sqrt{2.8125} = 1.678$$

The coefficient of determination (r^2)

The square of the coefficient of correlation is called the coefficient of determination (r^2).

It is a more precise measure of the straight relationship between the two variables and lends itself to more precise interpretation because it can be represented as a proportion or as a percentage. The coefficient of determination can be defined as a proportion of the variation in the dependent variable y, that is explained by the variation in independent variable x, in the regression model.

$$r^2 = \frac{\text{Explained variation}}{\text{Total variation}}$$

$$= \frac{\dfrac{a\sum y + b\sum xy - (\sum y)^2}{n}}{\dfrac{\sum(y)^2 - (\sum y)^2}{n}}$$

for the above illustration (9) under discussion

$$r^2 = \frac{\dfrac{26.25(405) + 625(26340)-(405)^2}{6}}{\dfrac{27355-(405)^2}{6}}$$

$$= \frac{6.25}{17.5}$$

$= 0.357$ (35.7% of variation in y)

and $r = \sqrt{r^2} = \sqrt{0.357}$

$= 0.597$

Rank correlation

For the two variables x and y whose distribution is unknown, the degree of association between x and y is ascertained by the Spearman's Rank Correlation. As the name suggests, this method is based on the rank (or order) of the observations rather than on a specific distribution of x and y.

In marketing research, the ranking or ordering of alternative preferences is quite common.

The method is very handy and involves simple calculations only.

The rank correlation coefficient is a measure of correlation that exists between two sets of ranks. In other words, it is a measure of association that is based on the ranks of the observations and not on the numerical values of the data. It was developed by the famous statistician, Charles Spearman, in the early 1900s and as such, it is also known as Spearman's Rank Correlation Coefficient.

For calculating Spearman's rank correlation coefficient, first of all the actual observation has to be replaced by their ranks, giving rank 1 to the highest value, rank 2 to the next highest value and following this very order, ranks are assigned for all values.

The second step is to record the difference between ranks (or 'd') for each pair of observations. Spearman's rank correlation coefficient, r_s, is worked out as under:

$$R_s = 1 - \frac{6\sum d^2}{n(n^2-1)}$$

Where n = number of paired observation.

The value of Spearman's rank correlation will always vary between + 1 indicating a perfect positive correlation and −1, indicating perfect negative correlation between two variables.

This is a measure of correlation that exists between two sets of ranks, a measure of degree of association between variables that we would not have been able to calculate otherwise.

This method helps to simplify the process of computing correlation coefficient from a very large set of data for each of the two variables. We can compute measure of association that is based on ranks of observations, not the numerical values of the data.

These values are rather quick and easy to use and can be applied to ordinal or nominal scale data.

They do not presuppose any particular distribution and consequential assumptions.

There are many situations in which the various assumptions required for standard tests of significance cannot be met. We can use this method under such situations as it is easier to explain and understand.

Illustration 10.10: Suppose 10 salesman employed by a company were given a month's training. At the end of the specified training they took a test and were ranked on the basis of their performance. They were then posted to their respective areas. At the end of six months they were rated in respect of their sales performance. The data are given in the table below:

Salesman	**Rank obtained in training**	**Rank on the basis of sales performance**	**Difference**	**Difference squared**
#	X	Y	d	d^2
1	4	5	-1	1
2	6	8	-2	4
3	1	3	-2	4
4	3	1	+2	4
5	9	7	+2	4
6	7	6	+1	1
7	10	9	+1	1
8	2	2	0	0
9	8	10	-2	4
10	5	4	=1	1

Here $\sum d^2 = 248$. Using the formula, we get

$$R_s = 1 - \frac{6\sum d^2}{n(n^2-1)} = \frac{1-6(24)}{10(10^2-1)} = 1 - \frac{144}{990}$$

$= 1-0.145$

$= 0.855$

This shows that there is a very high correlation between performance in training and the sales performance of the ten salesmen.

10.6 SUMMARY

After the collection of data from primary or secondary sources, arrangement is done so that the same may be analysed and interpreted with the help of statistical tools. Based on sample observation inferences on population characteristics (parameters) are made for the large population. Some pre-assumed statement is made about the characteristics of population, which is known as statistical hypothesis and is tested on the basis of sample values. There are two hypotheses: one is called *Null* and the other one is known as *Alternate* hypothesis. To test the hypotheses both parametric and non-parametric tests are used. Parametric tests assume within properties of the population from which samples are drawn. In non-parametric tests only nominal or ordinal data are taken. 'Z', 't', χ^2 and F-tests are useful parametric tests used for testing a hypothesis. All parametric tests are based on the assumption of normal distribution of frequency. While choosing a test, level of significance is taken which denotes that the researcher is willing to take some specified (0.01, 0.05, etc.) risk of rejecting the Null hypothesis. Z-test is used to measure the different between any variable value (x) and the mean of all variable values 'λ' values, which is indicated by 'μ' divided by standard deviation (S). χ^2-test is also called 'goodness of fit'. This test is done for two observed sets of data or one observed and one expected set of data. Measure of association is necessary to find out relationship between two or more variables. While correlation estimates the degree and nature of the relationship between variables, regression is developed to predict the value of the dependent variable. For comparison purpose, rank correlation is done by taking the number of paired observation.

10.7 KEYWORDS

Hypothesis is an assumption (or hypothetical) value about the characteristics of the population.

Parametric Test assume within properties of the population from which samples are drawn.

Non-Parametric Tests are distribution free tests devised to measure the association.

Chi-square Test is designed to test the significant difference between the observed and expected values.

Bivariate Correlation is the correlation between two variables.

Coefficient of Determination is the square of coefficient of correlation expressed to measure the straight relationship between the two variables.

Rank Correlation is the measure of correlation that exists between two sets of ranks.

10.8 SELF ASSESSMENT QUESTIONS

1. What do you mean by data analysis?
2. Explain the important stages in data analysis. Give examples.
3. Explain the importance of graphs, diagrams, averages, standard deviation, correlation coefficient and tests of hypothesis in data analysis. Give examples.
4. Define hypothesis and describe the steps in testing a hypothesis.
5. What are the applications of *t, z,* $\alpha\nu\delta\,\chi^2$ tests in business researches? Discuss with illustrations.

10.9 REFERENCES/SUGGESTED READINGS

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Lesson No.: **11**	

MULTIVARIATE STATISTICAL TECHNIQUES

STRUCTURE

11.0 OBJECTIVES

After reading this lesson you should be able to :

- Describes the important multivariate statistical techniques
- Differentiate among univariate, bivariata and multivariate analysis
- Apply factor analysis, cluster analysis and discriminant analysis.

11.1 INTRODUCTION

The entire gamut of statistical techniques can be broadly classified into univariate and multivariate, based on the nature of the problem.

Univariate techniques are appropriate when there is a single measurement of each of the n sample objects, or when there are several measurements of each of the n observations but each variable is analysed in isolation. On the other hand, multivariate techniques are appropriate for analysing data when there are two or more measurements of each observation and the variables are to be analysed simultaneously. Based on the type of data, univariate techniques can be further classified into non-metric or metric. The non-metric data are measured on a nominal or ordinal scale, whereas metric data are measured on an interval or ratio scale. Non-parametric statistical tests can be used to analyse non-metric data. Non-parametric tests do not require any assumptions regarding the distribution of data.

For both non-metric and metric data, the next level of classification involves determining whether a single sample or multiple samples are involved. Further, in the case of multiple samples, the appropriate statistical test depends on whether the samples are independent or dependent. For metric data, t-tests and z-tests can be used for one or two samples. For more than two samples, the analysis of variance (ANOVA) is used. For non-metric data, with a single sample, chi-square, Kolmogorov-Smirnov (K-S), and RUNS tests can be used. For two or more independent samples, chi-square, rank sum tests, K-S, and ANOVA (Kruskal-Wallis ANOVA) should be used. For two or more dependent samples, sign test, Wilcoxon test, McNemar and Cochran Q-tests can be used. A detailed discussion of non-parametric statistics is beyond the scope of this lesson.

11.2 UNIVARIATE, BIVARIATE AND MULTIVARIATE ANALYSIS

All statistical techniques that simultaneously analyse more than two variables on a sample of observations are multivariate statistical techniques. We may as well use the term 'multivariate analysis', which is a collection of methods for analysing data in which a number of observations are available for each object. In analysing many problems, it is helpful to have a number of scores for each object. All such analyses are termed as multivariate analyses or multivariate techniques. In brief, techniques that take account of the various relationships among variables are termed multivariate analyses or multivariate techniques. Multivariate techniques are largely empirical and deal with reality; they possess the ability to analyse complex data. Accordingly, in most applied and behavioural research, we generally resort to multivariate analysis techniques for realistic results. Besides being a tool for analysing data, multivariate techniques also help in various types of decision-making. If a researcher is interested in making probability statements on the basis of sampled multiple measurements, then the best way to analyse data is through some suitable multivariate statistical technique.

11.3 MULTIVARIATE STATISTICAL TECHNIQUES

These can be broadly defined as a collection of procedures for analysing the association between two or more sets of measurements that were made on each object in one or more samples of objects. If only two sets of measurements are involved, the data typically are referred to as bivariate. Multivariate techniques can be classified in the following ways:

Can the data be partitioned into dependent and independent variable sets? If so, classify according to the number of variables in each set. If not, classify the technique as an interdependence technique.

In the case of interdependence techniques, classification is done based on the principal focus of the analysis. Is the focus on the object (person/thing/event) or is it on the variable?

Based on the first factor, multivariate techniques can be broadly classified as dependence techniques or interdependence techniques. Dependence techniques are appropriate when one or more variables can be identified as dependent variables and the remaining as independent variables. The appropriate choice of dependence techniques further depends on whether there are one or more dependent variables involved in the analysis. In interdependence techniques, the variables are not classified as dependent or independent, rather, the whole set of interdependent relationships is examined. Interdependence techniques can be further classified as focussing on variables or objects; that is, as variable interdependence or inter-object similarity techniques.

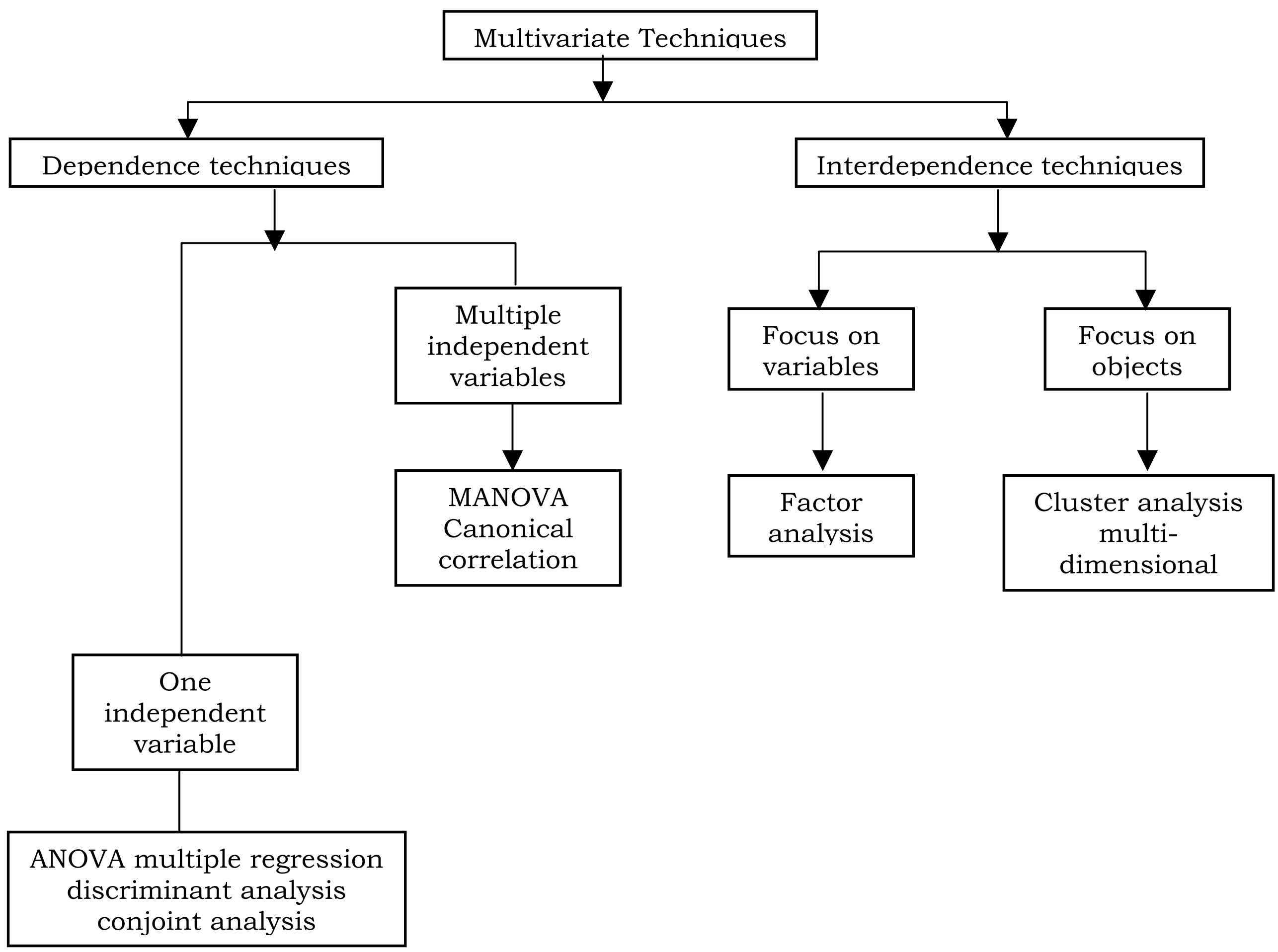


FIGURE 11.1: MULTIVARIATE TECHNIQUES

For better appreciation and understanding of multivariate statistical techniques, one must be familiar with the fundamental concepts of linear algebra, vector spaces, orthogonal and oblique projections and univariate analysis. Even then, before applying multivariate techniques for meaningful results, one must consider the nature and structure of the data and the real aim of the analysis. We should also not forget that multivariate techniques do involve several complex mathematical computations and hence may need computer facilities. We have two types of multivariate techniques: one type for data containing both dependent and independent variables, and the other type for data containing several variables without dependency relationship. In the former category are included techniques like multiple regression analysis, multiple discriminant analysis, multivariate analysis of variance and canonical analysis. In the latter category we put techniques like factor analysis, cluster analysis, multidimensional scaling or MDS (both metric and non-metric) and the latent structure analysis.

11.4 FACTOR ANALYSIS

This is one of the popular multivariate techniques widely used by researchers. It is an extremely powerful and useful analytic approach to psychological, behavioural, financial and other types of data. It is a statistical technique to determine the underlying factors or forces among a large number of interdependent variables or measures. It is a method to extract common factor variance from a set of observations. It groups the number of variables into a smaller set of uncorrelated factors potentially conveying a great deal of information. It tells us which variables belong together, which ones virtually measure the same thing. Factor analysis is an appropriate technique in cases where the variables have a high degree of intercorrelation. A factor is a construct, a hypothetical entity, which is assumed to underlie tests, scales, items or any other measures. For example, a number of factors underlie intelligence: verbal ability, numerical ability, reasoning, memory and others. If a test measures one factor only, it is said to be factorially 'pure'. To the extent that a test measures a factor, it is said to be loaded on the factor or saturated with the factor. Some measures are so complex that it is difficult to tell just what they measure, e.g., grades secured by students. If a test contains more than one factor, it is said to be factorially complex. We need an objective method to determine the number of factors, the variables loaded on the various factors and the magnitude of the loadings.

(i) Factor analysis methods

There are two important methods:

Principle component method– This was developed by H. Hotelling and is well sited to computer applications.

Centroid method– This method was devised by L.L. Thurstone. I would prefer to confine our discussion on factor analysis by illustrating this method in detail. Let us first state the meanings of some of the basic concepts relating to factor analysis.

Factor- A factor is an underlying dimension of several related variables. There can be one or more factors in a phenomenon depending upon its nature and the number of variables involved in it.

Factor loadings– These are values that explain how closely the variables are related to each one of the factors discovered. They are factor-variable correlations. It is the absolute size of the loadings that is important in the interpretation of a factor.

Communality (h^2)– This shows how much of each variable is accounted for by the underlying factors taken together. It is computed as under:

H^2 of a variable = (its factor loading of factor A)^2

= (its factor loading of factor B)^2

Eigen value (or) latent root– This is the sum of squared values of factor loadings relating to a factor. It indicates the relative importance of each factor in accounting for the particular set of variables under study.

Total sum of squares– When Eigen values of all factors are totalled, the resulting value is called the total sum of squares.

Rotations– These reveal different structures in the data. If the factors are independent, orthogonal rotation is done, and if they are correlated, an oblique rotation is made.

Factor score– This represents the degree to which each respondent gets high scores on the group of items that load high on each factor. Factor scores are used in several other multivariate analyses.

(ii) Variables in multivariate analysis

Before we describe the various multivariate techniques, it seems appropriate to have a clear idea about the term 'variables' used in the context of multivariate analysis. Variables used in multivariate analysis can be classified into different categories. The important ones are as under:

Explanatory variables and criterion variables– If X is considered to be the cause of Y, then X is the explanatory variable (also termed causal or independent variable) and Y is the criterion variable (also termed resultant or dependent variable). In some cases both explanatory and criterion variables may consist of a set of many variables. The set X_1, X_2, X_3, …, X_p may be called a set of explanatory variables and the set Y_1, Y_2, Y_3, …, Y_q may be called a set of criterion variables if variation in the former is supposed to cause variation in the latter as a whole. In economics, explanatory variables are called external or exogenous variables and criterion variables are called endogenous variables. Some people use the term external criterion for an explanatory variable and internal criterion for a criterion variable.

Observable variables and latent variables– When explanatory variables are directly observable, they are termed observable variables. However, some unobservable variables may influence criterion variables, in which case they are called latent variables.

Discrete variables and continuous variables– Discrete variables are those that take only the integer value when measured. Continuous variables are those that, when measured, can assume any real value (even in decimal points).

Dummy variables (or pseudo variables)– This term is used in a technical sense and is useful in algebraic manipulations in the context of multivariate analysis. We call X_i (I = 1, ..., m) a dummy variable if only one of X_i is 1 and the others are all zero. To guide the factor analyst in his rotations, Thurstone has laid down five principles or rules of simple structure. The rules are applicable to both orthogonal and oblique methods of rotations. The rules are as follows:

- Each row of the factor matrix should have at least one loading close to zero.
- For each column of the factor matrix, there should be at least as many variables with zero or near zero loadings as there are factors.
- For every pair of factors (columns), there should be several variables with loadings in one factor (column) but not in the other.
- When there are four or more factors, a large proportion of the variables should have negligible (close to zero) loadings on any pair of factors.

- For every pair of factors (columns) of the factor matrix there should be a small number of variables with appreciable loadings in both columns.

These criteria call for variables that are as 'pure' as possible, i.e., each variable loaded on as few factors as possible. In this way, the simple possible interpretation of the factors can be achieved. Thus, rotation to achieve a simple structure is a fairly objective way of ensuring simplicity or reducing variable complexity.

(iii) R-type and Q-type Factor analyses

Factor analysis may be of the R-type or the Q-type. In R-type analysis, there is high correlation when respondents who score high on variable 1 also score high on variable 2, and respondents who score low on variable 1 also score low on variable 2. Factors emerge when there is high correlation within groups of variables. In Q-type factor analysis, correlation is computed between pairs of respondents, instead of pairs of variables. High correlation occurs when respondent 1's pattern of responses on all variables is much like respondent 2's. Factors also emerge when there is high correlation within groups of people. Q-type analysis is useful when the objective is to sort out people into groups based on their simultaneous responses to all the variables. Factor analysis is used in developing psychological tests, media readership profiles of people, for condensing and simplifying multivariate data, for providing a classification scheme for clustering products, media or people, and so on.

Ramanathan and Krishnaswami (1985) used factor analysis as a part of multivariate analysis employed for a study to predict the financial health of business corporations. In order to determine what particular profitability measure can serve as the best predictor of sickness, 25 different profitability ratios— representing different dimensions of the earnings position— were empirically tested for their predictive accuracy. Another set of 31 balance sheet ratios were also selected for testing and experimentation. Each ratio measures directly or indirectly the strength of the equity base, liquidity, intensity of asset utilisation or asset condition. Thus a total of 56 ratios were tested.

EXHIBIT 11.1: COMPUTER PROGRAMS FOR FACTOR ANALYSIS

SPSS Factor	Produces principal component analysis results and factor analysis results. There are six extraction techniques and several orthogonal and oblique rotation techniques. Factor scores can be calculated.
SAS Factor	Performs principal component and common factor analysis with orthogonal and oblique rotations. Factor scores are computed by a general SAS scoring program SCORE.
Princomp	Performs principal component analysis only and computes principal component scores
BMDP P4M	Performs factor analysis of a correlation or covariance matrix. It is similar to the SPSS FACTOR procedure in having alternative extraction and rotation techniques.

Illustration 11.1*:* A study conducted on 144 management students to find out what factor influenced them the most while selecting electives at the ICFAI Business School, Chennai in 2003.

	Descriptive statistics		
	Mean	**Std. Deviation**	**Analysis N**
Pay and incentives	4.2917	.63549	144
Advancement	4.7917	.40753	144
Working conditions	4.2639	.70944	144
Recognition	4.5556	.60044	144

Superior	4.0833	.66375	144
Feedback	4.0833	.79772	144
Coworker	4.2222	.71394	144
Autonomy	4.0278	.90023	144
Company policy	3.8889	.79431	144
Responsibility	4.3611	.71557	144
Stock options	3.5972	.89536	144
Challenging work	4.3056	.74117	144
Travel opportunities	3.8333	1.10940	144
Learning new skills	4.3611	.82455	144

Basic details of the sample and criteria/critical elements chosen for the study:

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of sampling adequacy		.711
Nartlett's Test of sphericity	Approx. Chi-Square	491.249
	Df	91
	Sig.	.000

Adequacy of the sample is tested using SPSS and its validity established.

Commonalities

	Initial	**Extraction**
Pay and incentives	1.000	.419
Advancement	1.000	.556
Working conditions	1.000	.228
Recognition	1.000	.342
Superior	1.000	.131
Feedback	1.000	.376
Coworker	1.000	.322

Autonomy	1.000	,245
Company policy	1.000	.487
Responsibility	1.000	.535
Stock options	1.000	.339
Challenging work	1.000	.595
Travel opportunities	1.000	.234
Learning new skills	1.000	.580

Extraction method: Principal component analysis.

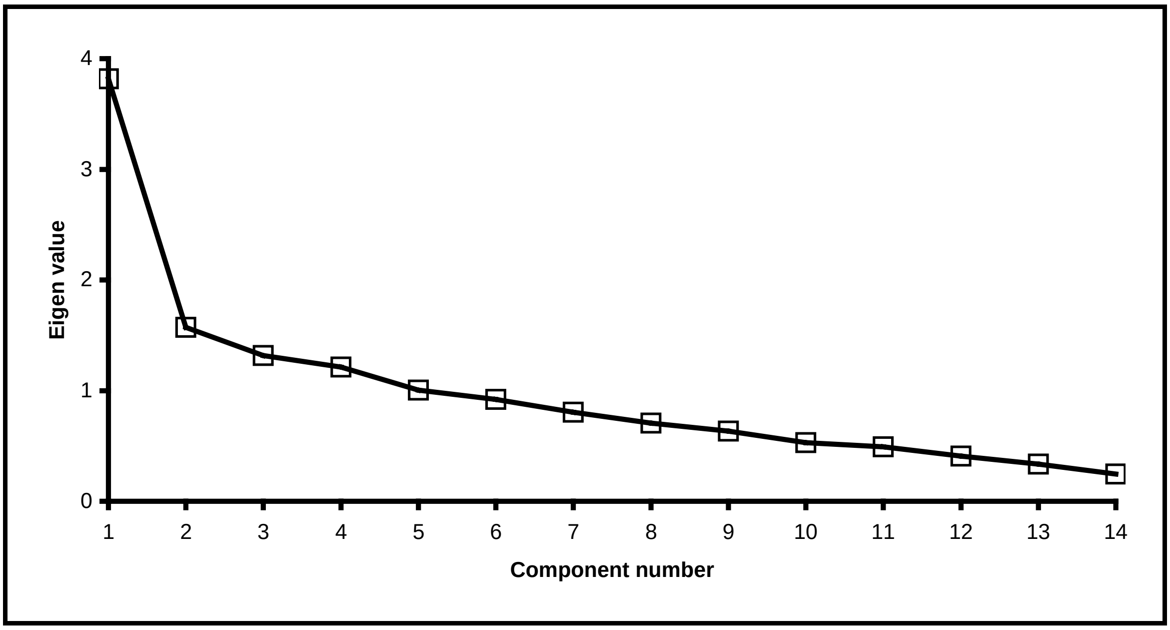
Commonalities explained the extent of extractions (coverage) included in the factors represented during the analysis.

	Initial Eigen values			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	3.818	27.273	27.273	3.818	27.273	27.273	3.188	22.828	22.626
2	1.571	11.218	38.491	1.571	11.218	38.491	2.221	15.266	38.491
3	1.317	9.410	47.901						
4	1.212	8.657	58.559						
5	1.004	7.173	63.732						
6	.919	6.588	70.298						
7	.805	5.751	76.049						
8	.705	5.033	81.082						
9	.635	4.533	85.615						
10	.531	3.794	89.409						
11	.492	3.514	92.923						
12	.408	2.915	95.839						
13	.337	2.410	98.249						
14	.245	1.751	100.000						

Extraction method: Principal component analysis

The above table shows that two factors have emerged and the event of variations explained the factors.

Screen plot



Eigen value represents the coverage of critical factors included in the factor analysis.

Component matrix[a]

	Component	
	1	**2**
Pay and incentives	.731	-3.15E-02
Advancement	.682	-.339
Working conditions	.669	-.330
Recognition	.609	-.474
Superior	.588	.175
Feedback	.570	.402
Coworker	.513	-.281
Autonomy	.512	.276
Company policy	.495	2.283E-02
Responsibility	.450	.158
Stock options	.361	2.735E-02

Challenging work	.131	.634
Travel opportunities	.227	.427
Learning new skills	.398	.404

Extraction method: Principal component analysis

[a]2 components extracted

Rotated component matrix[a]

	Component	
	1	**2**
Challenging work	.768	-7.17E-02
Learning new skills	.757	8.100E-02
Advancement	.741	8.163E-02
Responsibility	.633	.367
Recognition	.583	3.922E-02
Autonomy	.405	.285
Superior	.289	.217
Company policy	.265	.645
Pay and incentives	-.230	.605
Coworker	.118	.555
Stock options	.283	.508
Travel opportunities	-3.83E-02	.483
Feedback	.401	.464
Working conditions	.295	.376

Extraction method: Principal component analysis.

Rotation method: Varimax with Kaiser Normalisation.

[a]Rotation convergent in 3 iterations.

This table shows that only the loading factor in the iteration is different.

Component Transformation Matrix

Component	1	2
1	.843	.538
2	-.538	.843

Extraction method: Principal component analysis.

Rotation method: Varimax with Kaiser normalisation.

11.5 CLUSTER ANALYSIS

The basic idea of cluster analysis is to group similar objects together. Some measure of similarity (or distance) is used to do this. It is a method for classifying variables into clusters. There are two basic types of clustering methods: hierarchical and non-hierarchical. A cluster consists of variables that have high correlation with one another and comparatively low correlation with variables in other clusters. The objective of cluster analysis is to determine how many mutually and exhaustive groups or clusters, based on the similarities of profiles among entities, really exist in the population and then to state the composition of such groups. Cluster analysis is useful in market research studies. This analysis is useful for segmenting the market for a product on the basis of the various characteristics of the customers.

There are two approaches to clustering: hierarchical and non-hierarchical. Hierarchical clustering can start with all objects in one cluster and divide and subdivide them until all objects are in their own single object cluster. This is called the 'top-down', or decision, approach. In contrast, the bottom-up— or agglomerate— approach can start with each object in its own (single-object) cluster and systematically combine clusters until all objects are in one cluster. When one object is associated with another in a cluster, it remains clustered with that object. We first start with a hierarchical method, and try to identify the number of clusters in the data. This can be done by looking at one of the following:

The agglomeration schedule, or the order in which variables combine with each other. If we use this, we can find from the bottom two rows going up the maximum difference between the coefficients at each stage. The last row indicates one cluster, the row before that indicates a two-cluster section, and so on. Wherever the maximum difference between coefficients occurs, the lower row indicates the number of clusters.

Another way is to look at the dendrogram, and define a cutoff point for the rescaled distance given at the top. Based on this, the grouping of variables looking from the left indicate the number of clusters in the data. Generally, the cut off point is subjective, but it is based on the distance between two successive cluster formation points, as indicated by the small vertical lines.

Once the number of clusters is identified, we can use a k-means clustering algorithm (a non-hierarchical method). We have to specify that we want a particular number of clusters for this to work. Once we specify this, we ask for a k-means clustering solution. We get the initial cluster centres, and the final cluster centres. The final cluster centres contain the mean values for each variable in each cluster. By combing the information on all variables for each cluster, we interpret the cluster and give it a descriptive name. Cluster analysis can produce different results when different methods are used, or when different distance measures are used in the same method. One way of checking for stable cluster is to split the sample into two parts and see if similar clusters emerge from both sub-samples.

(i) Hierarchical clustering

There are several methods of grouping objects into clusters. In the hierarchical approach, the commonly used methods are single linkage, complete linkage, average linkage, Ward's method and the centroid method.

Single linkage: This procedure is based on the shortest distance. It finds two individuals (objects) separated by the shortest distance and places them in the first cluster. Then the next shortest distance is found, and either a third individual joins the first two to form a cluster or a new two-individual cluster is formed. The process continues until all individuals are in one cluster. This procedure is also referred to as the 'nearest-neighbour' approach.

Average linkage: This method starts out the same as single linkage and complete linkage, but the clustering criterion is the average distance from individuals in one cluster to individuals in another. Such techniques do not use extreme values, as do single linkage or complete linkage, and partitioning is based on all members of the clusters rather than on a single pair of extreme members.

Complete linkage: An agglomerative algorithm in which inter-object similarity is based on the maximum distance between objects in two clusters (the distance between the most dissimilar members of each cluster). At each stage of the agglomeration, the two clusters with the smallest maximum distance (most similar) are combined the maximum.

Ward's method: This method is based on the loss of information resulting from grouping objects into clusters, as measured by the total sum of squared deviations of every object from the mean of the cluster to which the object from the mean of the cluster to which the object is assigned. As more clusters are formed, the total sum of squared deviations (known as the error sum of squares) increases. At each stage in the clustering procedure, the error sum of squares is minimised over all partitions (the complete set of disjoint or separate clusters) obtained by combining two clusters from the object's previous stage. This procedure tends to combine clusters with a small number of observations. It is also biased as it tends to combine clusters with a small number of observations.

Centroid method: Agglomerative algorithm in which similarity between clusters is measured as the distance between cluster centroids. The centroid is the point whose coordinates are the means of all the observations in the cluster. When two clusters are combined, a new cluster is computed. Thus cluster centroids migrate, or move, as the clusters are combined.

(ii) Non-hierarchical clustering

This differs from hierarchical clustering only in that it permits objects to leave one cluster and join another as clusters are being formed, if the clustering criterion is improved by doing so. Instead of using the tree-like construction process found in hierarchical clustering, cluster seeds are used to group objects within a pre-specified distance of the seeds. Cluster seeds are initial centroids or starting points of the cluster. Hence, in this approach, a cluster centre is initially selected, and all objects within a pre-specified threshold distance are included in that cluster.

Each approach has its advantages. Hierarchical clustering is relatively easy to read and interpret. The output has a logical structure that theoretically should always exist. Its disadvantage is that it is relatively unstable and unreliable. The first combination or separation of objects, which may be based on a small difference in the criterion, will constrain the rest of the analysis. In hierarchical clustering, it is sound practice to split the sample into at least two groups and do two independent clustering runs to see if similar clusters emerge in both runs. If they are entirely different, there is an obvious cause for caution.

In non-hierarchical methods (also known as iterative partitioning), the three most commonly used approaches are: sequential threshold, parallel threshold, and optimising procedures.

Sequential threshold: In this case, a cluster centre is selected and all objects within a pre-specified threshold value are grouped. Then a new cluster centre is selected and the process repeated for the unclustered objects, and so on. Once objects enter a cluster, they are removed from further processing.

Parallel threshold: This method is similar to the preceding one except that several cluster centres are selected simultaneously, and objects within the threshold level are assigned to the nearest centre; the threshold levels can then be adjusted to admit fewer or more objects to the cluster.

Optimising: This method modified the previous two procedures in that objects can later be reassigned to clusters by optimising some overall criterion measure, such as the average within-cluster distance for a given number of clusters.

Measures of similarity: In order to group objects together, some kind of similarity or dissimilarity measure is needed. Similar objects are grouped together and those farther apart are put in separate clusters. The commonly used measures for cluster analysis are: distance measures, correlation coefficients and association coefficients. The most popular distance measure is the Euclidean distance. The formula for squared Euclidean distance is:

$$d^2_{\eta} \ldots \sum_{m-1}^{p}(X_{im}-X_{jm})^2$$

where X_{im} and X_{jm} represent the standardised (to mean zero and unit standard deviation) values of the mth attribute for objects I and j and d_{ij}, the Euclidean distance.

Inasmuch as the variables in a data matrix are often measured in different units, the formula above usually is applied after each variable has been standardised to zero mean and unit standard deviation. Standardisation can remove the influence of the unit of measurement; however, it can also reduce the differences between groups on variables that may best discriminate clusters. Observations with extreme values (outliers) should be removed. A major drawback of the distance measure is that variables with both large size differences and standard deviations can essentially swamp the effects of other variables with smaller absolute sizes and standard deviations.

The advantage of non-hierarchical clustering is that it tends to be more reliable; that is, split-sample runs will tend to look more similar than those of hierarchical clustering. If the program makes a close decision early in the analysis that subsequently proves wrong with respect to the clustering criterion, it can be remedied by moving objects from cluster to cluster. The major disadvantage is that the series of clusters is usually a mess and very difficult to interpret. The fact that it does look messy is sometimes good in that the analysis does not convey a false sense of order when none exists. But the fact remains that it can be very difficult to work with. Further, we have to choose the number of clusters a *priori,* which could be a difficult task.

Actually, both approaches can be used in sequence. First a hierarchical approach can be used to identify the number of clusters and any outliers, and to obtain cluster centres. The outliers (if any) are removed and a non-hierarchical approach is used with the input on the number of clusters and the clusters centres obtained from the hierarchical approach. The merits of both approaches are combined, and hence the results should be better.

11.6 DISCRIMINANT ANALYSIS

How can individuals or members of a sample be best assigned to groups on the basis of a set of independent variables? Discriminant analysis deals with this question. A discriminant function is a regression equation with a dependent variable that represents group membership. This function maximally discriminates between members of the group; it tells us to which group each member probably belongs. It can be used to assign individuals to groups on the basis of their scores on two or more measures. From those scores, the 'best' composite score based on least squares is calculated. Then the higher R^2 is the better predictor of the group membership.

One can use discriminant analysis to classify objects into two groups: delinquent/non-delinquent, success/failure, default/non-default, etc. One can extent it to more than two groups. Cooley and Lohnes, for example, describe the discrimination among three career-plan groups. For the application of discriminant analysis, the discriminatory variables must be normally distributed. Discriminant analysis has been applied in various empirical studies in psychology, behavioural sciences, finance and so on. In finance, it has beenused in consumer credit evaluation, earnings ratio classification, standard investment categories, rate of return prediction, and prediction of corporate failure. Discriminant analysis has been used in the prediction of corporate success/failure by Altman, Deakin, Blum, Taffler and Tisshaw, Kaveri, Sarma and Rao, Ramanathan and Krishnaswami and so on.

Michael Edgar (1976) made a comparative study of the operational efficiencies of administratively coordinated and market-based vertical market systems in the property and causalty insurance industry. The market-based system operates through ‘independent insurance agents’ and the centrally coordinated vertical marketing system will exhibit:

1. Less intensive contacts among system members.
2. Less duplication of activities.
3. Higher degree of standardisation of activities.
4. Reliance on fewer product lines.
5. Faster intrasystem flows.
6. Better intra-system communications.
7. Lower risk of operation for system members.
8. More adoption of advanced technologies.
9. Higher productivity.

Discrete independent variables—like degree of duplication, degree of similarity in record-keeping between insurers and distributors, extent of use of managerial techniques, use of mass media in promotion, and use of electronic data processing— were analysed using discriminant analysis. This analysis was designed to achieve two goals: (1) to indicate the overall power of all to differentiate between the two groups of distributors— independent agents and direct writing distributors— and (2) to find out the relative importance of each of those variables in describing the two groups of distributors. Twenty measurement components of the variables were introduced into the discriminant function. The discriminant coefficients were computed for all the measurements, the centroid value for each of the two groups was arrived at, and significance was tested by Wilk’s Lambda. The derived discrimination function reflects a relatively high differentiating power. The results show that 18 measurements have signs as predicted by the hypotheses. Of them nine were found to have significant coefficients.

Illustration: A discriminant model

Equation is built, and tested for its usefulness based on-

1. **Its significance:** A low value of Wilk's Lambda indicates high significance. The F-test should show p-value of less than .05.

2. **Which variables are relatively better at predicting the dependent?**

   This is judged by looking at the standardised coefficient of the independent variables. The larger the absolute value of the standardised coefficient the better the predictive or explanatory power of the variable.

3. **The number of data points from the original dataset the model classifies correctly:** This is given on the classification matrix or can be computed by adding the diagonal numbers on it and dividing by the total number of cases. This yields a percentage. The closer it is to 100, the better is the model, but with the caution that its classification accuracy will probably reduce when applied to fresh data.

Application of SPSS

Illustration 11.3: A study conducted among 144 students of management to find out what factor influenced them most while selecting electives in the ICFAI Business School, Chennai in 2003 (see illustration 11.1 earlier):

Group Statistics

	Electives chosen		Mean unweighted	Std. Deviation weighted	Valid N (listwise) marketing
Marketing	Pay and incentives	4.1667	.69693	36	36.000
	Advancement	4.7778	.42164	36	36.000
	Working conditions	4.2222	.63746	36	36.000
	Recognition	4.6111	.49441	36	36.000
	Superior	4.0000	.58554	36	36.000
	Feedback	4.1111	.74748	36	36.000
	Co-worker	4.3333	.58554	36	36.000
	Autonomy	4.1111	.82038	36	36.000
	Company policy	4.0000	.75593	36	36.000
	Responsibility	4.3333	.75593	36	36.000
	Stock options	3.5000	.91026	36	36.000
	Challenging work	4.3333	.75593	36	36.000
	Travel opportunities	3.2778	1.00317	36	36.000
	Learning new skills	4.1667	1.02817	36	36.000
Finance	Pay and incentives	4.4545	.58883	44	44.000
	Advancement	4.8182	.39015	44	44.000
	Working conditions	4.2727	.62370	44	44.000
	Recognition	4.3636	.71823	44	44.000
	Superior	4.0455	.83400	44	44.000

	Electives chosen		Mean unweighted	Std. Deviation weighted	Valid N (listwise) marketing
	Feedback	4.0909	.85775	44	44.000
	Co-worker	4.1364	.82380	44	44.000
	Autonomy	4.0000	.80695	44	44.000
	Company policy	3.7273	1.01989	44	44.000
	Responsibility	4.3182	.82892	44	44.000
	Stock options	3.4545	.90102	44	44.000
	Challenging work	4.1818	.84283	44	44.000
	Travel opportunities	4.1364	1.02506	44	44.000
	Learning new skills	4.3182	.82892	44	44.000
Infotech	Pay and incentives	4.2500	.61721	64	64.000
	Advancement	4.7813	.41667	64	64.000
	Working conditions	4.2813	.80610	64	64.000
	Recognition	4.6563	.54098	64	64.000
	Superior	4.1563	.56957	64	64.000
	Feedback	4.0625	.79433	64	64.000
	Co-worker	4.2188	.7076	64	64.000
	Autonomy	4.0000	1.00791	64	64.000
	Company policy	3.9375	.61399	64	64.000
	Responsibility	4.4063	.60994	64	64.000
	Stock options	3.7500	.87287	64	64.000
	Challenging	4.3750	.65465	64	64.000

	Electives chosen		Mean unweighted	Std. Deviation weighted	Valid N (listwise) marketing
	work				
	Travel opportunities	3.9375	1.12511	64	64.000
	Learning new skills	4.5000	.66667	64	64.000
Total	Pay and incentives	4.2917	.63549	144	144.000
	Advancement	4.7917	.40753	144	144.000
	Working conditions	4.2639	.70944	144	144.000
	Recognition	4.5556	.60044	144	144.000
	Superior	4.0833	.66375	144	144.000
	Feedback	4.0833	.79772	144	144.000
	Co-worker	4.2222	.71394	144	144.000
	Autonomy	4.0278	.90023	144	144.000
	Company policy	3.8889	.79431	144	144.000
	Responsibility	4.3611	.71557	144	144.000
	Stock options	3.5972	.89536	144	144.000
	Challenging work	4.3056	.74117	144	144.000
	Travel opportunities	3.8333	1.10940	144	144.000
	Learning new skills	4.3611	.82455	144	144.000

Tests of equality of group means

	Wilk's Lambda	F	df1	df2	Sig.
Pay and incentives	.968	2.321	2	141	.102
Advancement	.998	.133	2	141	.875
Working conditions	.999	.084	2	141	.920
Recognition	.954	3.413	2	141	.036
Superior	.990	.739	2	141	.479
Feedback	.999	.045	2	141	.956
Co-worker	.989	.752	2	141	.473
Autonomy	.997	.203	2	141	.816
Company policy	.981	1.390	2	141	.252
Responsibility	.997	.231	2	141	.794
Stock options	.976	1.720	2	141	.183
Challenging work	.987	.918	2	141	.402
Travel opportunities	.910	6.975	2	141	.001
Learning new skills	.972	1.996	2	141	.140

Box's test of equality of covariance matrices

Electives chosen	Rank	Log determinant
Marketing	14	-19.626
Finance	14	-16.365
Infotech	14	-16.379
Pooted within groups	14	-12.409

The ranks and natural logarithms of determinants printed are those of the group covariance matrices.

Test results

Box's M		672.869
F	Approx.	2.719
	df1	210
	df2	36786.833
	Sig.	.000

Tests null hypothesis of equal population covariance matrices.

EXHIBIT 11.3: COMPUTER PROGRAMS FOR DISCRIMINANT ANALYSIS

SPSS discriminant	A general program that handles two or more groups in computing a canonical discriminant function. Direct entry of all variables and step-wise entry of variables are possible. There are five alternative methods of variable selection for the step-wise procedure. The program also performs classification analysis.
SAS DISCRIM	Classifies observations assuming a multivariate normal distribution within each class. It is not necessary to assume the classes have equal covariance matrices. The procedure computes linear or quadratic discriminant functions for classifying observations into two or more groups.
Neighbour	Is used for the same purpose as DISCRIM when the classes do not have multivariate normal distributions. A non-parametric nearest-neighbour method is used to classify observations.
CANDISC	Finds linear combinations of the variables that best summarise the differences among the classes and computes scores for each observation on the linear combination. The technique performs canonical discriminant analysis and is related to both principal components and canonical correlation.
Stepdisc	Performs a step-wise discriminant analysis to find a subset of variables that best reveals differences among the classes. Variables identified by this procedure can be used in any of the other procedures for more detailed analysis.
BMDP P7M	Performs only stepwise discriminant analysis. A major emphasis is placed on developing classification functions. Also computed are coefficients for canonical variables (functions). Standardised coefficients are not computed.

11.7 SUMMARY

Factor analysis is used to identify underlying dimensions or constructs in the data and to reduce the number of variables by eliminating redundancy. The input to factor analysis is usually a set of variable values for each individual or object in the sample. It is possible instead to input the matrix of correlations between the variables. Actually, any type of square matrix whose components provide a measure of similarity between variables could be factor analysed. The similarity measure does not have to be a correlation, although most often it is.

The most important outputs are the factor loading, the factor scores, and the variance- explained percentages. The factor loading: that is, the correlation between the factors and the variables— are used to interpret the factors. Sometimes an analyst will pick one or two variables that load heavily on a factor to represent that factor in subsequent data collection or analysis. It is also often appropriate and useful to calculate the factor score and use that as a variable in the subsequent data analysis.

The most important assumption is that there are factors underlying the variables and that the variables completely and adequately represent these factors. In practical terms, this assumption means that the list of variables should be complete; that is, each factor among them is measured at least once and, hopefully, several times from several different perspectives. If for some reason the variable list is deficient from the beginning, it will take a large dose of luck to emerge with anything very useful.

Cluster analysis is used to group variables, objects, or people. For example, people can be grouped into segments. The input is any valid measure of similarity between objects, such as correlations. It also is possible to input the number of clusters or the level of clustering.

The output is a grouping of objects into clusters. Associated with each set of clusters will be the value of the clustering criterion. Some programs also output diagnostic information associated with each object. For example, they may provide the distance from each object to the centre of its cluster and to the centre of the next closest cluster. This information can help determine in more depth the cluster cohesion and the level of association between an object and a cluster.

The most important assumption is that the basic measure of similarity on which the clustering is based is a valid measure of the similarity between the objects. A second major assumption is that there is theoretical justification for structuring the objects into clusters. As with other multivariate techniques, there should be theory and logic guiding and underlying cluster analysis.

Discriminant analysis is used primarily to identify variables that contribute to differences in the *a priori* defined groups with the use of discriminant functions. The analysis is also used for classifying objects into one or more groups that are already defined.The model requires variable values for the independent variables and the dependent variable (non-metric). Discriminant analysis provides the characteristics of the discriminant function, such as the variables that contribute to each discriminant function (through discriminant loading). The significance of the function is also given. The raw and standard discriminant weights are given to assist in the classification of objects. Finally, the usefulness of the discriminant analysis for classification is evaluated through the hit ratio.

The significance of the discriminant function (through Wilk's Lambda) and the variables are evaluated through an F-statistic.

11.8 KEYWORDS

Univariate Analysis is single or several measurements of each of the sample objects.

Bivariate Analysis is analysis of measurement of two variables.

Multivariate Analysis is a collection of methods for analysing data in which a number of observations are available for each object.

Factor Analysis is a statistical technique to determine the underlying factors or forces among a large number of interdependent variables or measures.

Factor is an underlying dimension of several related variables.

Factor Loadings are the values that explain how closely the variables are related to each other.

Explanatory Variable is causal or independent variable and is also called extragenous variable.

Criterion Variable is resultant or dependent variable and is also called endogenous variable.

Observable Variable is directly observable.

Latent Variable is unobservable variable which may influence criterion variable.

Discrete Variable takes only integer value when measured.

Continuous Variable can assume any real value.

Cluster Analysis is a technique of measuring some measures of similarity.

Discriminant Analysis is used primarily to identify variables that contribute to differences in the prior defined groups with the use of discriminant functions.

11.9 SELF ASSESSMENT QUESTIONS

1. What is multivariate analysis? How does it differ from bivariate analysis?
2. What is factor analysis? What are its purposes? What are its research applications?
3. Distinguish between R-type and Q-type factor analysis.
4. What is discriminant analysis? When and why is it made? Illustrate.
5. What are (a) cluster analysis and (b) canonical analysis?

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Lesson No.: **12**	

ANALYSIS OF VARIANCE (ANOVA) AND MULTIPLE REGRESSION

STRUCTURE

12.0 OBJECTIVES

After going through this lesson you will be able to :

- Describe meaning and application of ANOVA ;
- Describe meaning and application Multiple Regression Analysis.

12.1 INTRODUCTION

Analysis of variance (ANOVA) enables us to infer whether population from which we have drawn more than two samples are having the same mean values. By testing the significance of difference between more than two sample means we make such inferences. To test the equality of variances, we use 'F' test. By comparing the observed 'F' value with table value of 'F' and analyzing the significance of differences (if any) we test our hypothesis. Before elaborating on the 'F' test, it is important for us to understand the principles and techniques of analysis of variance (ANOVA). Only after analysis of variance, we can submit it to 'F' test to make necessary inferences.

12.2 APPLICATION OF ANOVA

To test the equality of variances for two sample data, we use 'F' test, the formula for which is

$$F = \frac{\sigma^2_{s1}}{\sigma^2_{s2}} = \text{with d.f. } (n_1 - 1) \text{ for sample 1.}$$

$(n_2 - 1)$ for sample 2.

σ^2_{s1} = variance of sample 1

calculated as $\frac{\sum(X_{1i} - \overline{X}_1)^2}{(n_1 - 1)}$

We can also use n_1 when sample size is 30 or more.

σ^2_{x2} = variance of sample 2

calculated as $\frac{\sum(X_{2i} - \overline{X}_2)^2}{(n_2 - 1)}$

X_{1i} = is the observed frequencies of sample 1.

X_{2i} = observed frequencies of sample 2. and $\overline{x}_1$ and $\overline{x}_2$ are the respective mean values of samples 1 and 2.

But ANOVA technique is important to compute variances when we want to compare more than two samples to infer whether the said samples have been drawn from population having the same mean values. Without going into the trouble of considering all possible combinations of populations, ANOVA technique enables the researcher to investigate the mean differences of all the populations simultaneously.

We have introduced the term dependent variable and independent variable with an example earlier. ANOVA enables a researcher to investigate factors which influence a dependent variable. Let us assume productivity rate as a dependent variable. We know that productivity usually depends on multiple factors like level of technology used in production, workers' skill, incentives and gain sharing, training, supervision and industrial relations. For us all these factors are independent variables. Now a researcher may be interested in knowing the differences amongst these factors, i.e. which one of the above factors is more effective in raising productivity (by studying their respective differences at various level of significances) or he may be interested in investigating the differences amongst various categories of same factor (for example various methods on incentive and gain sharing) which influence productivity. When we investigate various categories of one factor only, we carry out one-way ANOVA.

But when we are interested in investigating two factors at a time, we carry out two-way ANOVA. Likewise with the help of ANOVA, we can investigate, in general any number of factors and also various categories within each factor to study their respective influences. Thus we find following steps are usually involved in analysis of variance.

i) Estimation of population variance based on variance between the sample means.

ii) Estimation of population variance based on variance within the sample means.

iii) The third step is to compare the obtained F value with the respective F table value at given degrees of freedom and to judge the differences at desired levels of significances. The formula for computing 'F' value takes the following shape.

$$F = \frac{\text{MS between}}{\text{MS within}}$$

Now unless the above steps are explained with a practical example, it would be difficult for readers to understand F test in its true spirit. Let us first have an example of one-way ANOVA.

Illustration 12.1 In a company there are four shop floors. Productivity rate for three methods of incentives and gain sharing in each shop floor is presented in the following table. Analyse whether various methods of incentives and gain sharing differ significantly at 5% and 1% F-limits.

Shop Floor	**Productivity rate data for three methods of incentives and gain sharing**		
	X_1	**X_2**	**X_3**
1	5	4	4
2	6	4	3
3	2	2	2
4	7	6	3

Solution

Step 1. Calculate mean of each of the three samples (i.e., x_1, x_2 and x_3, i.e. different methods of incentive gain sharing).

$$\overline{X}_1 = \frac{5 + 6 + 2 + 7}{4} = 5$$

$$\overline{X}_2 = \frac{4 + 3 + 2 + 3}{4} = 3$$

$$\overline{X}_3 = \frac{4 + 3 + 2 + 3}{4} = 3$$

Step 2. Calculate mean of sample means i.e.,

$$\overline{X} = \frac{\overline{X}_1 + \overline{X}_2 + \overline{X}_3}{K}$$

Where, K denotes 'number of samples'

$$= \frac{5 + 3 + 3}{3} = 4 \text{ (approximated)}$$

Step 3. Calculate sum of squares (s.s.) for variance between and within the samples.

$$\text{Ss between} = n_1\,(\bar{x}_2 - \bar{x})^2 + n_2\,(\bar{x}_2 - \bar{x})^2 + n_3\,(\bar{x} - \bar{\bar{x}})^2$$

$$\text{Ss within} = \sum(x_{1i} - \bar{x}_1)^2 + \sum(x_{2i} - \bar{x}_2)^2 + \sum(x_{3i} - \bar{x}_3)^2$$

Sum of squares (ss) for variance between samples is obtained by taking the deviations of the sample means from the mean of sample means ($\bar{\bar{x}}$) and by calculating the squares of such deviation, which are multiplied by the respective number of items or categories in the samples and then by obtaining their total. sum of squares (ss) for variance within samples is obtained by taking deviations of the values of all sample items from corresponding sample means and by squaring such deviations and then totalling the. For our illustration then

$$\text{ss between} = 4\,(5 - 4)^2 + 4\,(4 - 4)^2 + 4\,(3 - 4)^2$$

$$= 4 + 0 + 4 = 8$$

$$\text{ss within} = \underbrace{\{(5-5)^2 + (6-5)^2 + (2-5)^2 + (7-5)^2\}}_{\sum(x_{1i}-\bar{x}_1)^2}$$

$$+ \underbrace{\{(4-4)^2 + (4-4)^2 + (2-4)^2 + (6-4)^2\}}_{\sum(x_{2i}-\bar{x}_2)^2}$$

$$+ \underbrace{\{(4-3)^2 + (3-3)^2 + (2-3)^2 + (3-3)^2\}}_{\sum(x_{3i}-\bar{x}_3)^2}$$

$$= (0 + 1 + 9 + 4) + (0 + 0 + 4 + 4) + (1 + 0 + 1 + 0)$$

$$= 14 + 8 + 2$$

$$= 24$$

Step 4. ss. of total variance which is equal to total of s.s. between and ss within and is denoted by formula as follows:

$$\sum (X_{ij} - \bar{X})^2$$

where, $i = 1.23,\ j = 1.23$

for our example, total ss will thus be:

$$\{(5 - 4)^2 + (6 - 4)^2 + (2 - 4)^2 + (7 - 4)^2\}$$

$$+ \{(4 - 4)^2 + (4 - 4)^2 + (2 - 4)^2 + (6 - 4)^2\}$$

$+ \{(4-4)^2 + (3-4)^2 + (2-4)^2 + (3-4)^2\}]$

$= \{(1 + 4 + 4 + 9) + (0 + 0 + 4 + 4) + (0 + 1 + 4 + 1\}$

$= 18 + 8 + 6 = 32$

We will, however, get the same value if we simply total respective values of ss between and ss within. For our example ss between is 8 and ss within is 24, thus ss of total variance is 32 (8 + 24).

Step 5: Ascertain degrees of freedom and mean square (MS) between and within the samples. Degrees of freedom (df) for between samples and within samples are computed differently as follows.

For between samples, df, is (k – 1), where k' represents number of samples (for us it is 3). For within samples df is (n–k), where 'n' represents total number of items in all the samples (for us it is 12).

Mean squares (MS) between and within samples are computed by dividing the ss between and ss within by respective degrees of freedom. Thus for our example:

(i) $\text{MS between} = \dfrac{\text{ss between}}{(K-1)}$

$\dfrac{8}{2} = 4$

where (K–1) is the df.

(ii) $\text{MS within} = \dfrac{\text{ss within}}{(n-k)} = \dfrac{24}{9} = 2.67$

where (n–k) is the df.

Step 6. Now we will have to compute F ratio by analysing our samples. The formula for computing 'F' ratio is: $\dfrac{\text{MS between}}{\text{MS within}}$

Thus for our example F ratio

$= \dfrac{4.00}{2.67} = 1.5$

Step 7. Now we will have to analyse whether various methods of incentives and gain sharing differ significantly at 5% and 1% 'F' limits. For this, we need to compare observed 'F' ratio with 'F' table values. When observed 'F' value at given degrees of freedom is either equal to or less than the table value, difference is considered insignificant. In reverse cases, i.e., when calculated 'F' value is higher than table- F value, the difference is considered significant and accordingly we draw our conclusion.

For example, our observed 'F' ratio at degrees of freedom (v_1[1] & v_2[2], i.e., and 9) is 1.5. The table value of F at 5% level with df 2 and 9 ($v_1 = 2$, $v_2 = 9$) is 4.26. Since the table value is higher than the observed value, difference in rate of productivity due to various methods of incentives and gain sharing is considered insignificant. At 1% level with df 2 and 9, we get the table value of F as 8.02 and we draw the same conclusion.

We can now draw an ANOVA table as follows to show our entire observation.

Variation	**SS**	**df**	**MS**	**F-ratio**	**Table value of F**	
					5%	**1%**
Between sample	8	(k–1) = (3–1) = 2	ss between	MS between	F (v_1, v_2) = F (2,9) = 4.26	F (v_1, v_2) = F (2, 9) 8.02
Within sample	24	(n–k)= (12–3)= 9	ss within (n–k) = 24/9 = 2.67	= 1.5		

[1] V_1 = d.f. for greater variance (between samples)
[2] v_2 = d.f. for smaller variance (within samples)

Two-way ANOVA technique is used when our data are divided to both columns and rows and we want to study the effects. Let us assume that our dependent variable productivity rate is classified on the basis of incentives and gain sharing and on level of technology used in production (independent variables). To study the effects of independent variables on dependent variable, under the above assumptions, we use two way classification of ANOVA.

Again there may be repeated measurements of all categories where we need to study even the interaction variation or there may not be any such repeated measurement. Based on such differences in data collection and presentation, our computational method differs.

When we do not have repeated measurement, we follow the following steps for two-way classification of ANOVA.

Step 1. Calculate total values of individual items in all samples and indicate it by T.P. So T stands for total value of all samples.

Step 2. Calculate correction factor using following formula:

$\frac{T^2}{n}$ where n denotes number of samples.

Step 3. Calculate total ss and subtract the correction factor to obtain sum of squares of deviation for total variance. Total ss is denoted by $\sum \chi^2_{ij} - \frac{T^2}{n}$. Thus our formula for step 3 takes the following shape.

$$\sum \chi^2_{ij} - \frac{T^2}{n}.$$

Step 4. Compute total ss between columns and subtract the result from the correction factor. Total ss is computed by obtaining the square of each column total and subsequently dividing such squared values by number of items and totalling the result. Thus we denote step 4 by following formula–

$\sum\frac{(T_j)}{n_i}-\frac{T^2}{n}$, (where j = 1, 2, 3, ... i.e. individual column value n_j denotes total number of items in the column) = sum of squares of deviations of variance between columns.

Step 5. Compute total ss between rows and subtract the result from correction factor to obtain sum of squares of deviation for variance between rows. Total ss between rows is calculated by squaring each row total by dividing squared values by respective number of items in the row and finally by taking the total of the results. Thus we can denote step-5 by the following formula:

$\sum\frac{(T_j)}{n_i}-\frac{T^2}{n}$, (where I = 1, 2, 3 (individual row values) n_j denotes total number of items in the row.

Step 6. Compute sum of squares of deviations for residual or error variance by subtracting the sum of ss between columns and ss rows variance from total variance (ss total).

SS for residual variance = Total ss – (ss. Between columns + ss. Between rows).

Step 7. Next task for us is to ascertain the degrees of freedom and mean square. Mean square (MS) as we know is obtained by dividing ss values by respective degrees of freedom. In two way ANOVA, we need to compute three MS as under:

(i) MS between column variance = $\frac{\text{ss between columns}}{(c-1)}$

where (c–1) is the df

C = total number of columns.

(ii) MS between column variance = $\frac{\text{ss between rows}}{(r-1)}$

where (c–1) is the df

r = total number of rows.

(iii) MS of residual or error variance = $\frac{\text{ss residual}}{(c-1)\ (r-1)}$

where (c–1) (r–1) is the df.

Step 8. This step involves computation of F ratio. Here also for two-way ANOVA, we will have to compute two F-ratios as under for having two independent variables to measure the significance of differences for each independent variable on dependent variable.

F ratio for column independent variation = $\frac{\text{MS between columns}}{\text{MS residual}}$

F-ratio for row independent variation = $\frac{\text{MS between rows}}{\text{MS residual}}$

To compare table value of F with our observed F ratios for drawing necessary conclusion at defined level of significance, we consider respective df of SS between columns and df of MS residual to find out table value of F for column independent variation and df of SS between rows and df of MS residual for row independent variation.

Illustration 12.2 Let us now frame a problem to study the effects of incentive and gain sharing and level of technology (independent variables) on productivity rate (dependent variable).

Productivity rate data of workers of M/s ABC and Co.

Incentives and gain sharing / Level of technology	A	B	C
W	4	3	3
X	5	3	2
Y	1	1	1
Z	6	5	2

Solution

1. Total values (T) of individual item = 36, n = 12

2. Correction factor = $\frac{(T)^2}{n} = \frac{36 \times 36}{12} = 108$

3. Total ss = (16 + 9 + 9 + 25 + 9 + 4 + 1 + 1 + 1 + 36 + 25 + 4)

   = 140 – 108 = 32

4. ss between columns:

   $= \left[\frac{10 \times 10}{3} + \frac{10 \times 10}{3} + \frac{3 \times 3}{3} + \frac{13 \times 13}{3}\right] - 108$

   $= \left[\frac{100}{3} + \frac{100}{3} + \frac{9}{3} + \frac{169}{3}\right] - 108$

   = [33.33 + 33.33 + 3 + 56.33]– 108

   = 126 – 108

   = 18 (after adjusting fraction)

6. ss residual

   = Total ss – (ss between column + ss between rows)

   = 32 (8 + 18) = 6

Now we need to set up ANOVA table

Variation source	**Ss**	**d.f.**	**M.S.**	**F ratio**	**5%**	**1%**
Between columns	8 = 2	(c–1)	$\frac{8}{2} = 4$	$\frac{4}{1} = 4$	F (2,6) = 5.14	F (2, 6) = 10.92
Between rows	18	(r–1) = 3	$\frac{18}{3} = 6$	$\frac{6}{1} = 6$	F (3, 6) = 4.76	F (3, 6) = 9.78
Residual	6	(c–1) × (r–1) = 6	$\frac{6}{6} = 1$			

From the ANOVA table, we find that differences related to varieties of incentives and gain sharing are insignificant at 5% level as the calculated F-ratio, i.e., 4 is less than table value of F, which is 5.14. However, differences are significant for different levels of technology at

5% level as the observed F ratio is higher than table value of F. at 1% level, however, differences are insignificant.

Now coming to the problem of two-way classification of ANOVA in case of repeated measurements apart from the earlier steps, we need to calculate interaction variation also as it enables us to measure the interrelationship among the two different classifications. For example, we may classify our productivity rate data in two groups of workers, assuming our company is having two separate production units.

We follow upto step-5, as elaborated earlier for two-way ANOVA without repeated measurements. Rest of the steps are as follows:

Step 6. For having two different classifications of data (for us productivity rate), apart from computing total SS, SS between columns and between rows, we need to work out ss within samples, i.e. sum of squares of deviations between two samples classifications.

Step 7. Our next task is to compute ss for interaction variation (within sample error). For this we subtract total ss from the sum of ss between columns, ss between rows and ss within samples.

Step 8. In this step, we need to calculate degrees of freedom and mean squares (MS) For this ANOVA too we should compute three mean squares as under:

(i) MS between column variation = $\dfrac{\text{ss between columns}}{(c-1)}$

Where 'c' represents total number of column and (c–1) represent degree of freedom.

(ii) MS between rows = $\dfrac{\text{ss between rows}}{(r-1)}$

where 'r' represents total number of rows and (r–1) represents degree of freedom.

(iii) MS for interaction variation = $\dfrac{\text{ss Interaction variation}}{(c-1)\ (r-1)}$

where (c–1) and (r–1) are the degrees of freedom.

(iv) MS for within samples variation = $\dfrac{\text{ss between samples}}{(n-k)}$

where 'n' is the total number of samples (all observations are included) and 'k' represented total number of samples group.

Step 9. This final step involves calculations of 'F' ratio. For having repeated values, in addition to measurement of significance of differences for each independent variables on dependent variable, we need to measure significance of such differences between groups, i.e., how different groups of people (based on our sample observations) are affected differently (it terms of variation in productivity rate for our example) for independent variables. Thus we compute following F ratios:

(i) 'F' ratio for column independence variation = $\dfrac{\text{MS between columns}}{\text{MS within samples}}$

(ii) 'F' ratio for row independence variation = $\dfrac{\text{MS between rows}}{\text{MS within samples}}$

(iii) 'F' ratio for interaction variation = $\dfrac{\text{MS for interaction variation}}{\text{MS within samples}}$

We then compare the observed 'F' ratios with table values of 'F' at given degree of freedom and draw our conclusions. Degree of freedom is determined by same principles followed earlier.

12.3 MULTIPLE REGRESSION ANALYSIS

When there are two or more than two independent variables, the equation describing such a relationship is the multiple regression equation. In this situation, the results are interpreted as shown below.

Multiple regression equation assumes the form:

$$\hat{Y} = a + b_1X_1 + b_2X_2$$

Where X_1 and X_2 are independent variables, Y being the dependent variable. The constants, a, b_1 and b_2 can be solved by solving the following three normal equations:

$$\sum Y_i = na + b_1\sum X_{1i} + b_2\sum X_{2i}$$

$$\sum X_{1i}Y_i = a\sum X_{1i} + b_1\sum X_{1i}^2 + b_2\sum X_{1i}X_{2i}$$

$$\sum X_{2i}Y_i = a\sum X_{2i} + b_1\sum X_{1i}X_{2i} + b_2\sum X_{2i}^2$$

Please note the fact that the number of normal equations would depend upon the number of independent variables. If there are two independent variables, then three equations, if there are three independent variables then four equations and so on, are used.

In multiple regression analysis, the regression coefficients (viz., b_1, b_2) become less reliable as the degree of correlation between the independent variables (viz., X_1, X_2) increases. If there is a high degree of correlation between independent variables, we have what is commonly described as the problem of multicollinearity. In such a situation we should use only one set of the independent variable to make our estimate. In fact, adding a second variable, say X_2, which is correlated with the first variable, say X_1, distorts the values of the regression coefficients. Nevertheless, the prediction for the dependent variable can be made even when multicollinearity is present, but in such a situation care should be taken in selecting the independent variables to estimate a dependent variable so as to ensure that multicollinearity is reduced to the minimum.

With more than one independent variable, we may make a difference between the collective effect of the two independent variables and the individual effect of each of them taken separately. The collective effect is given by the coefficient of multiple correlation

$R_{y.\, x1 \times x2}$ defined as under:

$$R_{y.\, x1 \times x2} = \sqrt{\frac{b_i\sum Y_iX_{1i} - n\bar{X}\bar{Y}_1 + b_2\sum Y_iX_{2i} - n\bar{X}\bar{Y}_2}{\sum Y_i^2 - n\bar{Y}^2}}$$

Alternatively, we can write

$$R_{y.\, x1 \times x2} = \sqrt{\frac{b_i\sum X_{1i}Y_i + b_2\sum X_{2i}Y_i}{\sum Y_i^2}}$$

12.4 SUMMARY

In case of population from which two means are drawn having the same mean values, the significant difference between these two can be found with the help of analysis of variance technique i.e. ANOVA. F-test is applied to check significant difference between the means. The value of F is the ratio of variance of the two samples. ANOVA is important in computing variances when there is comparison between more than two samples to inform whether the said samples have been drawn from population having the same mean values. The first step in ANOVA is the estimation of population variance based on variance between the sample means then the estimation of population variance based on variance within the sample means is done. The next step is to compare the obtained value of F with respect to F tabular value at given degree of freedom and to judge the differences at desired levels of significance. In multiple regression technique, two or more than two independent variables describe a relationship. In problem of multicollinearity, there exists a high degree of correlation between independent variables or measures.

12.5 KEYWORDS

Factor is an underlying dimension of several related variables.

Factor loadings are the values that explain how closely the variables are related to each other.

Explanatory variable is causal or independent variable and is also called extragenous variable.

Criterion variable is resultant or dependent variable and is also called endogeneous variable.

Observable variable is directly observable.

Latent variable is unobservable variable which may influence criterion variable.

Discrete variable takes only integer value when measured.

Continuous variable can assume any real value.

Cluster analysis is a technique of measuring some measure of similarity.

Discriminant analysis is used primarily to identify variables that contribute to differences in the priory defined groups with the use of discriminant functions.

ANOVA is analysis of variance, where the comparison between means of samples drawn from some population having same mean values by testing the significance of difference between more than two sample means and inferences are made.

F-Ratio is the ratio between mean square between columns and mean square of residual.

Multiple Regression describes the relationship between two or more independent variables.

12.6 SELF ASSESSMENT QUESTIONS

1. Explain the meaning of the analysis of variance. Write down the one way analysis of variance table for testing the homogeneity of k-groups.

2. Explain the significance of ANOVA. What is the role of F-distribution in this analysis.

3. Explain the two-way ANOVA with example.

4. Give the multiple regression equation. Discuss its importance in research studies.

12.7 REFERENCES/SUGGESTED READINGS

- Churchill, Gilbert A (1983) Marketing Research: Methodological Foundations, The Dryden Press, New York.
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Course Code: **CP-206**	*Author*: **Kiran Jindal**
Subject: **Research Methodology**	*Vetter*: **Dr. B.S. Bodla**
Lesson No.: **13**	

REPORT WRITING

STRUCTURE

13.0 OBJECTIVES

After reading this lesson you must be able to:

- Understand the meaning, purpose, types and contents of a research project report;
- Plan and organize an academic report;
- Evaluate an academic report.

13.1 INTRODUCTION

Research reporting is the oral or written presentation of evidence and the findings in such a way that it is readily understood and assessed by the reader and enables him to verify the validity of the conclusions. Research report writing is the culmination of the research investigation. It is at the stage of reporting that the researcher assembles the findings of the study, draws conclusions and evaluates his own findings. Report writing is the end product of research activity. It is highly skilled work; it is an interesting, fascinating, challenging, gruelling and sometimes even exasperating experience. Writing a research report is a technical activity that demands all the skills and patience of the researcher. It requires considerable thought, effort, patience and penetration and an overall approach to the problem, data and analysis. Also needed is firm control over language and great objectivity. A vast amount of planning and preparation is necessary for organising and writing the report. Perfection in a research report is achieved by continuous and persistent thought and creative and intelligent writing. Only hard and patient work on the facts, careful and critical assessment and intelligent planning in organising the report can facilitate communication. There are no standard criteria for the organisation of a report, popular or technical. They depend on each investigation, problem, the novelty or familiarity of the methods, nature and volume of facts, techniques of analysis and so on.

No research project is complete without a report. The nature of the report is determined by the project itself and to whom it is addressed. Academic research is expected to produce lengthy reports, or theses, covering all aspects of the research and reporting on them in a precise and rather formal manner. But no matter what the size or formality of the report, it is reasonable to expect it to convey information on a fairly standard set of topics. First, it must say why the work was done, what events led up to it and what other work was found to be relevant. This is usually contained in the introduction, which should also include the precise statement of the objective and aims of the project.

Generally, there should be a section describing what work was done. This should cover the methods used, their selection and any problems experienced in their application. From this it is easy to move on to what was found out, or the results. In turn, these lead on to the conclusions, which are a statement of what the researcher deduced from the results, and then on to the recommendations, which set out what the researcher feels should be the action taken as a result of the conclusions. Writing is not an activity that can be allocated an odd half-hour whenever it is convenient. It requires sustained concentration. The amount of time needed to make real progress in your writing depends on the way you prefer to work. Most people find that it takes a day to write about 2,000 words. But we all work in different ways. Some people, once they get started, prefer to continue until they drop from exhaustion! Others like to set a strict timetable, devoting three or four hours a day to writing. Whichever category you fall into, make sure you have time for writing allocated in your diary. We have found that it is helpful to have blocks of time where writing can take place on successive days. This ensures a degree of continuity of ideas, which isn't easy to maintain if you keep having to 'think your way back' into your research.

13.2 TYPES OF REPORTS

Research reports may differ in length and form. Generally, business firms prefer reports in the form of letters. Banks, insurance companies and financial institutions require short balance-sheet type of tabulation in their annual reports to customers and shareholders. The results of a research investigation can be presented in a number of ways: as a technical report, a popular report, an article, a monograph or at times even in the form of an oral presentation. A technical report is used whenever a full written report of the study is required whether for record-keeping or for public dissemination. A popular report is used if the research results have policy implications.

A. Technical report

A technical report is written for fellow researchers and therefore should be organised on a different footing altogether. In such a report, the researcher is expected to give a full account of the technical aspects, both in the sampling methods and the subject matter. Fellow professionals are more concerned about the methods employed. In fact, the value of the findings depends on the techniques adopted. The conceptual and analytical framework sample design should be adequately explained. A technical report consists of the following aspects.

1. **Major findings and contents:** A technical report will contain the main findings just in two or three pages.

2. **Nature of the research work:** This describes the general objectives of the study, formulation of the problem in operational items, the working hypothesis, the type of analysis, data required, etc.

3. **Research methodology:** This explains the various methods used in the study and their limitations. For instance, sample size, sample selection, etc.

4. **Data analysis:** The report analyses the data and their sources, characteristics and limitations. If secondary data are used, their suitability to the problem at hand is fully assessed. In case of a survey, the manner in which data were collected should be fully described.

5. **Presentation of findings:** The researcher presents his main findings of the study with supporting data in the form of tables and charts. This part is the main body of the report, usually extending over several chapters.

6. **Main conclusion:** Here, the main findings of the research are presented and the main body of the report, usually extending over several chapters.

7. **Bibliography:** This contains the main sources of secondary data.

8. **Technical appendices:** These contain all technical matters relating to questionnaires, mathematical derivations, elaboration on particular techniques of analysis and the like.

The above format provides a general idea of the nature of a technical report; the order of presentation may not necessarily be the same in all technical reports. Therefore, the presentation may differ; the different sections outlined above will not always be the same, nor will all these sections appear in any particular report.

B. Popular report

This stresses on simplicity and attractiveness. Its writing is clear, with minimum statistical details and the liberal use of charts and diagrams. It has an attractive layout, large print size, many sub-headings, and may be even some cartoons. Besides, it emphasises on the practical aspects and policy implications. The following is the general outline of a popular report:

1. **Major findings and conclusions:** The report will have findings of practical interest and their implications.

2. **Follow-up action:** It will suggest follow-up action on the basis of the findings of the study in this section.

3. **Objectives of the study:** Here the problem is presented, along with the specific objectives of the study.

4. **Methodology:** Here, a description of the methods and techniques used, including a short review of the data on which the study is based, is provided.

5. **Results:** This is the main body of the report, presented in clear and non-technical terms with the liberal use of all sorts of illustrations such as charts, diagrams and the like.

6. **Appendices:** This consists of detailed information on the methods used, forms, etc. Appendices are generally not included if the report is meant for the general public. A popular report emphasises on simplicity and policy implications from the operational point of view, avoiding technical details.

The following outline may be adopted while preparing the research report:

(I) The preliminaries

Title page.

Preface or foreword, acknowledgements.

Graphs or illustrations, tables, charts.

Table of contents.

(II) Contents of the report:

1. **Introduction**

   Objectives of the study, statement of the problem, hypotheses and definition of concepts.

   Review of literature and research studies.

   Time, place and materials of the survey.

   Scope, assumptions and limitations.

   Organisation and sampling procedures.

   Methods, tools and techniques employed for data collection.

2. **Analysis and presentation of results:**

   Report of facts— nature, volume and dimension.

   Statistical analysis of data.

   Summary of findings and recommendations.

3. **The reference materials:**

   Bibliography.

   Appendices— questionnaires/statistical tables etc.

   Glossary of terms

   Index

13.3 PHYSICAL LAYOUT OF THE REPORT

The manuscript should be typed or printed on unruled white paper, leaving one-and-a-half-inch margins on both the right and left sides (lateral sides) of the paper. There should also be a one-inch margin, top and bottom (vertical margin/header and footer). The paper should be neat, legible and printed in double-spaced lines preferably in the Times New Roman font with 12 point letter size. The physical arrangement of the paper gives a better appearance, which elicits more interest among readers.

13.4 PLANNING AND ORGANISATION OF AN ACADEMIC REPORT

Proper planning and organisation of study materials are important while preparing the research report. At the writing stage, a researcher will have accumulated a mass of data and information that will have to be prudently and carefully used. Well-conceived planning and organisation facilitates the writing of the report, with a proper emphasis on the different aspects of the study. Planning involves each chapter and aspect of the report. It is nothing but the arrangement of ideas in a logical and coherent manner within the framework of the overall structure laid down.

13.4.1 Stages of writing an academic report

In general, there are six stages in writing a report. They are:

- Systematic analysis of the subject.
- Drawing the outline of the report.
- Preparation of the rough draft.
- Enrichment of the final draft.
- Preparation of the final bibliography.
- Finalising the complete draft.

Now we will discuss some of the important stages:

(a) Finalising the complete draft: This is the first step in writing a report. The final draft should be written in simple language and in a concise and condensed form. The researcher must avoid vague expressions such as 'it seems', 'may be' and 'could be', abstract terminology and technical jargon. At the outset, the report should reflect the study's intention to solve some intellectual problem and adding to the knowledge of both the researcher and the reader. At the same time, it should be written in such a way that it attracts the readers' interest and shows some originality in presentation. Some researchers may incorporate the current trends in the field, common experiences, critical incidents etc. to strengthen and reinforce the findings of the research.

(b) Formation of an outline: An outline is a must while writing a report; it is like the skeleton in a human body. The outline of the study is made at two stages: once at the beginning of the study, which serves as a design of the study, and once before writing the report. The outline prepared for writing the report should be elaborate so as to include all important aspects that should find a place in the report. The outline should be prepared at three stages: topical outline, paragraph outline and sentence outline.

Topical outline: This includes the chapters and broad aspects to be included in each chapter. It is a skeleton outline.

Paragraph outline: This includes all major paragraphs, indicating the central idea of each paragraph.

Sentence outline: This does not imply writing of sentences. It merely involves points to be covered in sentences.

The following points need to be observed while planning an outline:

- It should be as detailed as possible and should enable continuous writing.
- It should not be vague and should not include such value phrases as 'body', 'facts and figures', etc, which give no direction to the report writing.

- It should fulfil the considerations of chronology, topical unity, coherence and transition.
- Each paragraph should contain one major idea.

(c) Important parts of a report

1. The preliminaries: The following aspects should be highlighted in the first part of the research report:

- Title of the report.
- Acknowledgement
- Preface
- Foreword
- Contents
- List of tables and illustrations

2. The abstract: This is probably the most important part of the report because it may be the only part that some will read. It is a short summary of the complete project report. This enables those who are not sure whether they wish to read the complete report to make an informed decision. For those who intend to read the whole report, the abstract prepares them for what is to come. An abstract should contain four short paragraphs with the answers to the following questions:

- What are my research questions and why are they important?
- How did I go about answering the research question(s)?
- What did I find out?
- What conclusions do I draw regarding my research question(s)?

Smith (1991) lists five characteristics of a good abstract:

- It should be short. Try to keep it to a maximum of two sides of an A4-size paper sheet.

- It must be self-contained. Since it may be the only part of your report that some people see, it follows that it must summarise the complete content of your report.
- It must satisfy your reader's needs. Your reader must be told about the problem or central issue that the research addresses and the method adopted to solve it. It must also contain a brief statement of the main results and conclusions.
- It must have the same emphasis as the report, with the consequence that the reader should gain an accurate impression of the report's content from the abstract.
- It should be objective, precise and easy to read. The project report contents page should give you the outline structure for the abstract. Summarising each section should give you an accurate resume of the content of the report. Do ensure that you stick to what you have written in the report. The abstract is not the place for elaborating any of your main themes. Be objective. You will need to write several drafts before you eliminate every word that is not absolutely necessary. The purpose is to convey the content of your report in as clear and brief a way as possible.
- Writing a good abstract is difficult. The obvious thing to do is to write it after you have finished the report. We suggest that you draft it when you start writing the report so that your storyline is abundantly clear in your mind. You can then amend the draft when you have finished the report so that it conforms to the five principles above.

3. *Research design:* The researcher should highlight the research design of the project. The researcher should answer the following questions:

- What is its basic design?
- What are the methods adopted to collect data?
- How is the study carried out?
- Is it an experimental/survey/historical data research method?
- If the study is an experimental one, what are the experimental manipulations?
- What type of questionnaire/interview/observations is used?
- If measurements were based on observation, what instructions are given to the observers?
- Who are the subjects?
- How many of them have been selected?
- How have they been selected?
- How have they been selected?
- Are the research instruments reliable?
- Do the research instruments have validity?

All these questions, when properly answered, can be used to estimate the probable limits of the findings' generalisability. The researcher has to take proper care to develop a well-planned research design, which is free from errors and limitations. To ensure the reliability and validity of the tools and instruments, a pilot study can be conducted to verify its strengths and utility.

4. *Analysis of data:* Here, the researcher has to highlight the type of statistical analysis adopted to analyse the data. The analysis can be listed from simple descriptive analysis to complex multivariate analysis.

5. *The results:* Once the analysis is over, the results can be depicted in a tabulated form, with appropriate illustrations. A detailed presentation of the findings of the study is a major part of the research report. These can be supported in the form of tables and charts together with a validation of results. Since it comprises the main body of the report, it generally extends over several chapters. It is advisable to project summarised results rather than raw data. All the results should be presented in logical sequence and split into readily identifiable sections. All relevant results must find a place in the report. All the results of the report should address the research problems stated earlier in the report, illustrating whether the results support or reject the hypothesis. But ultimately the researcher must rely on his own judgement in deciding the outline of his report.

Interpretation of results— some hints

- To find the relationships among the variables that are studied and observing the commonality, uniqueness, diversity etc. among them.
- To observe the role of extraneous variables. How they affect the various phenomena studied.
- To ensure validity; the results can be cross-checked with others through consultation.
- To consider all the relevant factors affecting the problem before generalising it to the whole population.

The prime tasks of interpretation is to bring to the surface the gist of the findings. A researcher should explain why the findings are so, in objective terms. He should try to bring out the principles involved in the observations. He can also make reasonable prediction. On the basis of interpretation of an exploratory study, a new hypothesis can be formulated for experimental research. During interpretation, unconnected, isolated facts should not be discarded, but should be explained properly. Interpretation leads to the establishment of some explanatory concepts arising out of the connection between the underlying processes and principles, and the observed facts from a working model. A researcher's task is to identify and disengage such principles and processes. Interpretation can also provide a theoretical conception, which can be the basis of further researcher and new knowledge. Thus, continuity in research can be established and the quest for knowing the unknown can be sustained.

Prerequisites for good interpretation: some guidelines

— While drawing inferences from the analysis of data, the researcher has to ensure that the inferences are free from any biases and mistakes that may arise due to both subjective and objective factors. This can be minimised by: checking whether (a) the data are appropriate, trustworthy and adequate for drawing inferences b) the data reflect good homogeneity and (c) proper analysis has been done through statistical methods.

— The researcher should also check for personal bias (subjective element) while interpreting the results. There are so many pitfalls that have to be avoided while observing and interpreting the results. Some of them are: stereotyping (conforming with existing results), preoccupation with set results, projecting his own views on the subject, snap judgements, lack of appreciation for others' feelings, prejudicial treatment and so on. The researcher must remain vigilant about all such things so that false generalisations may not take place. He should be well-equipped with statistical measures and must know their correct use for drawing inferences concerning his study.

— The researcher must always keep in view that the task of interpretation is very much intertwined with analysis and cannot be separated. He should take precautions about the reliability of data, computational checks, validation and comparison of results.

— The researcher should also pay attention to the hidden factors underlying the results. Broad generalisations should be avoided because the coverage may be restricted to a particular time, area and conditions.

— Originality and creativity are critical in interpreting the results. While linking the relationship between theoretical orientation and empirical observation, the researcher has to make use of his originality and creativity in developing concepts and models. He must pay special attention to this aspect while engaged in the task of interpretation.

6. *Summary:* It is a generally practice to conclude the report with a very brief summary. In business reports, it is called an executive summary. Here, all the aspects of the research report are given in capsule form.

7. *Reference material:* The listing of reference material comes at the end of any research report. Appendices with all technical data such as questionnaires, sample information, mathematical derivations etc. should be included at the end. The bibliography, listed in alphabetical order, should be added in the last section. Similarly, the researcher has to prepare an index (an alphabetical listing of names, places and topics along with the page numbers in the book or report in which they are mentioned). That should invariably be given at the end of the report.

8. *Other considerations:*

Use of quotations: The appropriate use of quotations will enrich the effective presentation of research reports. Quotations should be placed within quotation marks and double-spaced. In case the quotation is lengthy, it can be typed in single space and indented at least half an inch to the right of the normal text margin.

Punctuation and abbreviations: The researcher has to take care to check punctuation marks such as commas, full stops, colons, semicolons etc. these punctuation marks can be checked and verified in listing the bibliography, references, citations, documentations etc. For example, in listing the reference, the author's name is followed by a comma. After the comma, the title of the book is given; the article (such as 'a', 'an', 'the' etc.) is omitted and only the first word, proper nouns and adjectives are capitalised. A comma follows the title. Information concerning the edition is given next. This entry is followed by a comma. The place of publication is then stated; it may be mentioned in an abbreviated form. For example, London is abbreviated as Lond, New York as N.Y. and so on.

13.5 REFERENCING IN THE TEXT

The Harvard system, which we have adopted in this book, uses the author's name and data of publication to identify cited documents within the text. For example:

- It has been shown that… (Saunders, 1993).
- When referring generally to work by different authors on the subject, place the authors in alphabetical order: (Baker, 1991; Lewis, 1991; Thornhill, 1993).
- When referring to dual authors: (Saunders and Cooper, 1993).
- When there are more than two authors: (Bryce et al., 1991).
- For corporate authors, for instance a company report: (Hanson Trust Plc, 1990).
- For publications with no obvious author; for example an employment gazette: (Employment Gazette, 1993).

- When referring to different publications by the same author, the works should be arranged according to date in ascending order: (Lewis, 1989, 1991).
- To differetiate between publications by the same author in the same year use a, b, c etc., (Forster, 1991a). Make sure that this is consistent throughout the research project and corresponds with the bibliography.
- To reference an author referred to by another author where the original publication has not been read: (Granovetter, 1974, cited by Saunders, 1993). In this case the author who cites and the original document's author should both appear in the bibliography.

13.6 REFERENCING IN THE BIBLIOGRAPHY

In the bibliography, the referenced publications are listed alphabetically by author's name. All the author's surnames and initials are listed in full. If there is more than one work by the same author, these are listed chronologically.

- An example of a reference to a book would be: Saunders, M.N.K. and Cooper, S.A., (1993) *Understanding Business Statistics,* London, DP Publciations.
- A reference to a book other than the first edition would be: Morris, C., (1993) *Quantitative Approaches to Business Studies* (3rd ed.,) London, Pitman Publishing.
- A reference to a book with no obvious author would be: Department of Trade and Industry (1992). *The Single Market: Europe open for Professions, UK Implementation,* London, HMSO.
- A reference to a particular chapter in a book would be: Robsoon, C., (1993) *Real World Research,* Oxford, Blackwell, Chapter 3.

- A reference to a particular chapter in an edited book would be: Graig, P.B. (1991) '*Designing and Using Mail Questionnaires',* in Smith, N.C. and Dainty, P. (eds) *The Management Research Handbook, London,* Routledge, pp. 181-89.
- An example of a reference to an article in a journal (in this example volume 20, part 6 would be): Brewster, C. and Bournois, F., (1992) '*uman Resource Management: A European Perspective', Personnel Review,* 20: 6, 4-13.

13.7 FOOTNOTES

Researchers must insert footnotes in the appropriate places. These fulfil two purposes:

- The proper identification of materials used in quotations in the report.
- The footnotes provide supplementary value to the main body of the text. Based on the footnotes' description, one can easily refer the cross references, citation of authorities and sources, acknowledgement and elucidation or explanation of a point of view. The recent trend is to avoid footnotes. Some people feel that they enhance display of the scholarship of the researchers. But it is neither an end nor a means of displaying scholarship.

13.7.1 Referencing in the Text

When using footnotes, a number shows references within the research report. For example: 'Recent research[1] indicates that…' This number refers directly to the references.

13.7.2 Referencing in the reference

These list the referenced publications sequentially in the order they are referred to in your research report. This can be useful as it enables you to include comments and footnotes as well as references.

- The layout of individual references in the bibliography is the same as that for the Harvard system.
- If you find that your refer to the same item more than once you can use standard bibliographic abbreviations to save repeating the references in full.
- The publications referred to only include those you have cited in your report. They should therefore be headed 'References' rather than 'Bibliography' as shown below:

Abbreviation	**Explanation**
Op. cit. (opere ciato)	Meaning, in the work cited. This refers to a work previously referenced and so you must give the author and date and if necessary the page number, like: Robson (1993) op. cit. pp. 23-4.
Loc. Cit. (loco ciato)	Meaning, in the place cited. This refers to the same page of a work previously referenced. So you must give the author and date, like: Robson (1993) loc. Cit.
Ibid. (ibidem)	Meaning, the same work given immediately before. This refers to the work referenced immediately before and replaces all details of the previous reference other than a page number if necessary.

13.8 PRECAUTIONS IN PREPARING REPORT

1. A report is an important way of communicating research findings to others. A good research report is one that does this task efficiently and effectively. Hence, the following precautions must be taken while preparing it:
2. While determining the length of the report, one should keep in mind the fact that it should be long enough to cover the subject but short enough to maintain interest. In fact, report writing should not be a means to learning more and more about less and less.
3. Abstract terminology and technical jargon should be avoided. The report should be able to convey the matter as simply as possible. In other words, this means that reports should be written in an objective style in simple language, avoiding expressions such as 'it seems', 'there may be' and the like.
4. Readers are often interested in acquiring quick knowledge of the main findings and as such the report must make the findings readily accessible. For this purpose, charts, graphs and statistical tables may be used for the various results in the main report in addition to summaries of important findings.
5. The layout of the research should be well thought out. It must be appropriate and in accordance with the objective of the research problem.
6. The report should be free from grammatical mistakes and must be prepared strictly according to the rules of composition of research reports such as the use of quotation marks, footnotes, documentation, punctuation and use of abbreviations in footnotes and the like.

7. The report must present a logical analysis of the subject matter. It must reflect a structure wherein the different pieces of analysis relating to the research problem fit well.
8. A research report should show originality and should necessarily be an attempt to solve some intellectual problem. It must contribute to the solution of a problem and must add to the store of knowledge.
9. Towards the end, the report must also state the policy implications of the problem under consideration. It is usually considered desirable for a report to make a forecast of the probable future of the subject concerned and indicate the kind of research that still needs to be done in that particular field.
10. Appendices should be enlisted for all the technical data in the report.
11. Bibliography of sources consulted is a must for a good report.
12. An index is also considered an essential part of a good report and as such must be prepared and appended at the end.
13. The report must have an attractive appearance. It should be neat and clean, whether typed or printed.
14. Calculated confidence limits must be mentioned and the various constraints experienced in conducting the research study stated.
15. The objective of the study, the nature of the problem, the methods employed and the technique of analysis adopted must all be stated at the beginning of the report in the form of an introduction.

13.9 EVALUATION OF A REPORT— SOME CONSIDERATIONS

The evaluator has to give a report on the thesis or dissertation evaluated by him. There is no standard format for this report. The evaluator is expected to comment on (1) the importance of the study; (2) soundness of the methodology; (3) quality of analysis; (4) significance of the findings, and (5) format and style of presentation. It is not necessary for him to summarise the contents of the thesis. But he must point out the strengths and weaknesses of the work. He should give his final recommendation— whether the thesis should be accepted or rejected— in clear terms. If the thesis needs revision and re-submission, the evaluator should recommended that these be done. In this case, he should offer specific suggestions for revision.

13.9.1 Evaluation Criteria

There is no universally accepted set of standards for evaluating a research report. However, the following checklist will serve as a general guideline for a critical evaluation or analysis of a research report:

1. The appropriateness of the title

(a) Does it exactly indicate the core of the study?
(b) Is it clear and concise?
(c) Does it promise no more than what the study can provide?

2. Importance of the problem

(a) Is the research problem topically important?
(b) Is it socially relevant in terms of its contribution to knowledge and/or solution to the burning problem of the day?
(c) Are the research questions (objectives) clearly stated?
(d) Are they specific and related to the selected theme?

(e) Are the hypotheses pertinent to the research questions?

(f) Are they clearly stated and testable?

(g) Are the concepts in the title, objectives and hypotheses operationally defined?

(h) Are the operational definitions valid and reasonable?

(i) Are assumptions and limitations stated?

(j) Does the problem formulation reflect the researcher's mastery of the subject matter of the study?

3. *Review of related literature and earlier studies*

(a) Is this review covered adequately?

(b) Is it well-organised and documented?

(c) Has the research gap been identified?

(d) Does the present study fill in the gap?

4. *Soundness of the methodology:*

(a) Are the type of research and sources and methods of data collection described in detail?

(b) Are the above methods appropriate to the problem under study and the respondents?

(c) Is the research design appropriate to test adequately the hypothesised relationships?

(d) Is the sampling design appropriate and described in detail?

(e) Are the methods adopted for sampling scientific?

(f) Is the sample size adequate?

(g) Are relevant variables recognised, defined, inter-related and measured?

(h) Are the data-gathering instruments appropriate?

(i) Are the validity and reliability of the instruments established?

(j) Are the details of the methodology adequate for replicability?

5. ***Data analysis***

(a) Is the analysis objective and deep?
(b) Is the statistical treatment appropriate?
(c) Is appropriate use made of tables and charts?
(d) Is their format proper and complete?
(e) Have the hypotheses been adequately tested?
(f) Is the analysis of data relationship logical and perceptive?
(g) Is the significance of statistical results tested properly?
(h) Are the statistical results interpreted and presented without any bias?

6. ***Contribution of the study and conclusions and recommendations***

(a) Are the findings of the study stated clearly?
(b) Are the findings generalisable?
(c) Does the study test a theory or develop a new theory, a new model or new tool or contribute to methodology in any other way?
(d) Are the conclusions logical and justified by the empirical evidence?
(e) Are the implications of the results for policy and action explicitly pointed out?
(f) Do the recommendatiosn flow from the findings?
(g) Are the recommendatiosn specific and practical?

7. ***Presentation***

(a) Is the format of the report appropriate?
(b) Does the report have headings and sub-headings that facilitate reading and understanding it?
(c) Is the chapter scheme based on the objective of the study?

(d) Is the textual discussion clear, concise and convincing?

(e) Is the style of writing smooth and simple?

(f) Is it free from spelling and grammatical errors?

(g) Do the footnotes/references contain full details of the sources?

(h) Is the bibliography exhaustive?

13.10VIVA VOCE EXAMINATION

The student is expected to defend his thesis in a *viva voce* examination. This examination has several purposes:

- To establish the authenticity of the thesis, i.e., that the student has in fact carried out the research described in the thesis. (to this end he may be questioned closely on the problem formulation, methodology and other aspects of the study).
- To test the student’s knowledge of his subject.
- To seek clarification or explanation from the student upon the points made in his thesis.
- To provide the student with an opportunity to know the weaknesses and shortcomings of his thesis.

To prepare for the *viva voce*, the student should re-read the thesis, anticipate any points the examiners are likely to make and plan the defences to be offered for them. During the *viva,* the student should stay confident and relaxed and should answer all questions as fully and clearly as possible. But he should not, research systematically and presented the results carefully, the oral examination does nto pose any problem. It may turn out to be a pleasant exchange of thoughts between the student and experts in the field.

13.11SUMMARY

Finally, we come to a conclusion of our exercise of familiarising you with the art of planning and organising a research programme by describing various stages with clarity of concepts and illustrations. We advise readers to resort to IT-enabled techniques for exploring the various possibilities and arriving at a final conclusion. In this context, the author will extend all possible assistance, especially for finalisation of tests, hypotheses, sample size determination, mode of analysis and interpretation by utilising his personal network of global consultants and professors. Further, economic considerations— i.e., cost of production— prevents the author from presenting the entire concepts fully. After all, the world of research and business will always be dynamic, and it is impossible for anyone to present it in a static mode.

13.12KEYWORDS

Research Reporting is culmination of research investigation.

Technical Report is written for fellow researchers in which the researchers are expected to give a detailed account of the technical aspects both in sampling methods and subject matter.

13.13SELF ASSESSMENT QUESTIONS

1. Define a research report and explain its purpose.
2. What are the characteristics of a research report? What functions does it perform?
3. What are the format requirements of a research article to be published in a professional journal?
4. Describe the considerations and steps involved in planning report writing work.
5. What are the various kinds of target audience for research reports? What may be their requirements?

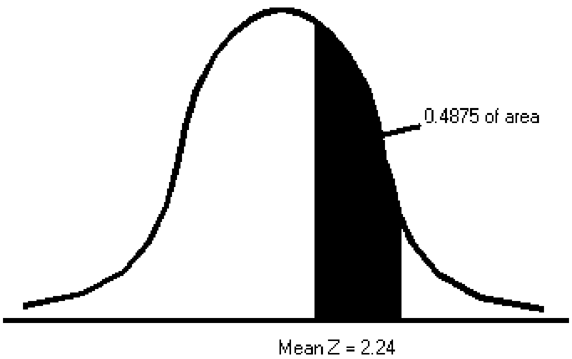
6. Describe the layout or format of a research report.
7. Why is a ‘review of literature’ included in a research report? What is its purpose?
8. Describe briefly the various elements included in a research report.
9. Compare and contrast the findings and the conclusions of a research study.
10. What precautions should a researcher take while interpreting his findings?
11. What is a bibliography? What is its purpose?
12. What are the principles for the organisation of a research report?
13. What style characteristics are desirable while writing a research report?
14. Why are quotations used in a research report?
15. What are the two forms of quotations? When are they used? How?

13.14REFERENCES/SUGGESTED READINGS

- Churchill, Gilbert A (1983) Marketing Research: Methodological Foundations, The Dryden Press, New York.
- Kothari C.R. (1990) Research Methodology: Methods and Technique. Wishwa Prakashan, New Delhi.
- Mahalotra N.K. (2002) Marketing Research: An Applied Orientation. Pearson Education Asia.
- Mustafi, C.K. 1981. Statistical Methods in Managerial Decisions, Macmillan: New Delhi.
- Singh, D. and F.S. Chaudhary, 1986. Theory and Analysis of Sample Survey Designs, Wiley Eastern: New Delhi.
- Yates, E (1960), “Sampling Methods for Censuses and Surveys,” Charles Griffin & Company, Ltd., London.

Statistical Tables

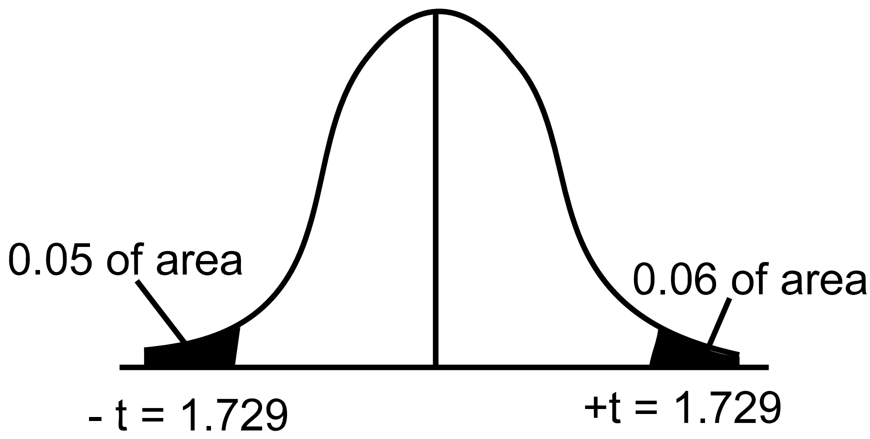
Table 1: Areas under the standard normal probability distribution between the mean and positive values of z



Example: To find the area under the curve between the mean and a point 2.24 standard deviation to the right of the mean, look up the value opposite 2.2 and under 0.04 in the table; 0.4875 of the area under the curve lies between the mean and z value of 2.24.

%	0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0750
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.0137	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3848	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4335	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4549	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4939
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4926	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990

Table 2: Areas in both tails combined for Student's 't' distribution

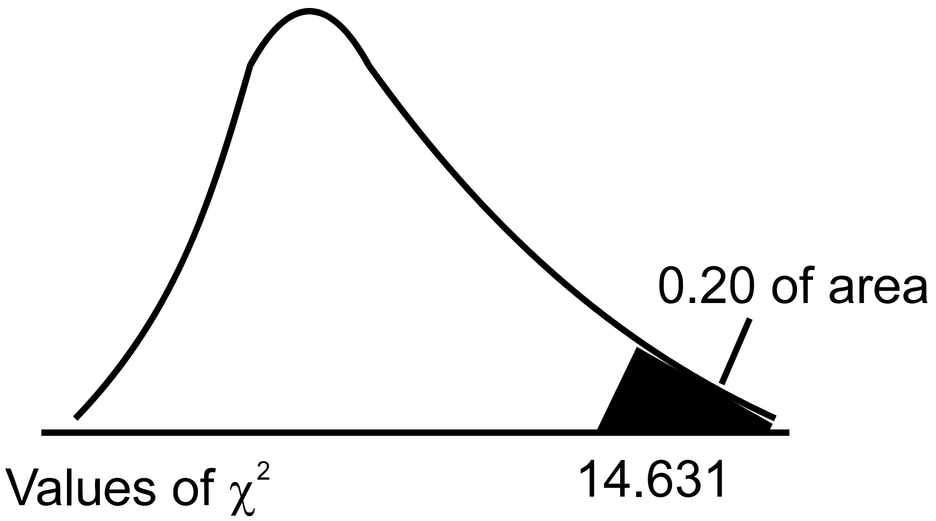


Example: To find the value of 't' that corresponds to an area of 0.10 in both tails of the distribution combined, when there are 19 degrees of freedom, look under the 0.10 column and proceed down to the 19 degrees of freedom row; the appropriate 't' value there is 1.729.

Degree of freedom	**0.10**	**Area in both tails combined**		
		0.05	**0.02**	**0.01**
1	6.314	12.706	31.821	63.657
2	2.920	4.303	6.965	9.925
3	2.353	3.182	4.541	5.841
5	2.015	2.571	3.365	4.032
6	1.943	2.447	3.143	3.707
7	1.895	2.365	2.998	3.499
8	1.860	2.306	2.896	3.355
9	1.833	2.262	2.821	3.250
10	1.812	2.228	2.764	3.169
11	1.796	2.201	2.718	3.106
12	1.782	2.179	2.681	3.055
13	1.771	2.160	2.650	3.012
14	1.761	2.145	2.624	2.947
15	1.753	2.131	2.602	2.947

16	1.746	2.120	2.583	2.921
17	1.740	2.110	2.567	2.898
18	1.734	2.101	2.552	2.878
19	1.729	2.093	2.539	2.861
20	1.725	2.086	2.528	2.845
21	1.721	2.080	2.518	2.931
22	1.717	2.074	2.508	2.819
23	1.714	2.069	2.500	2.807
24	1.711	2.064	2.492	2.797
25	1.708	2.060	2.485	2.787
26	1.706	2.056	2.479	2.779
27	1.703	2.052	2.473	2.771
28	1.701	2.048	2.467	2.763
29	1.699	2.045	2.461	2.756
30	1.697	2.042	2.457	2.750
40	1.684	2.021	2.423	2.704
60	1.671	2.000	2.390	2.660
120	1.658	1.980	2.358	2.617
Normal distribution	1.645	1.960	2.326	2.576

Table 3. Area in the right tail of a Chi-square (χ^2) distribution

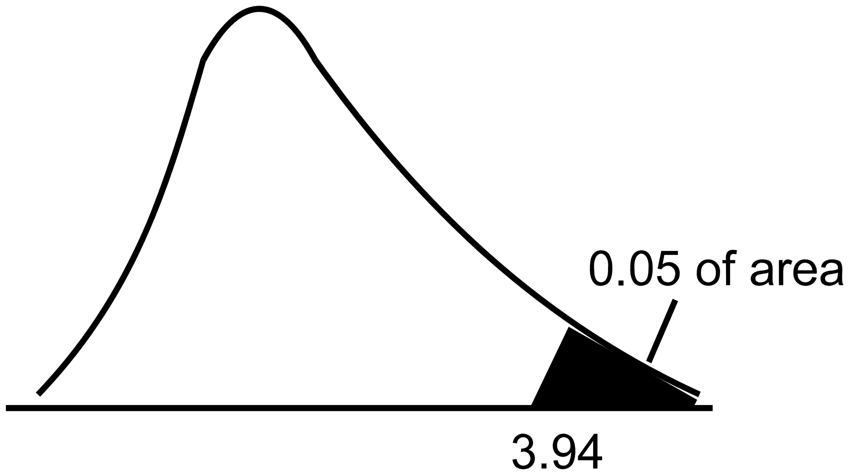


Example: In a chi-square distribution with 11 degrees of freedom, to find the chi-square value for 0.20 of the area under the curve (the colored area in the right tail) look under the 0.20 column in the table and the 11 degrees of freedom row; the appropriate chi-square value is 14.631.

Degrees of freedom	0.99	Area in right tail			
		0.975	**0.95**	**0.90**	**0.800**
1	0.00016	0.00098	0.00398	0.0158	0.0642
2	0.0201	0.0506	0.103	0.211	0.446
3	0.115	0.216	0.352	0.584	0.005
4	0.297	0.484	0.711	1.064	1.649
5	0.554	0.831	1.145	1.610	2.343
6	0.872	1.237	1.635	2.204	2.070
7	1.239	1.690	2.167	2.833	2.822
8	1.646	2.180	2.733	3.490	4.594
9	2.088	2.700	3.325	4.168	5.380
10	2.558	3.247	3.940	4.865	6.179
11	3.053	3.816	4.575	5.578	6.989
12	3.571	4.404	5.226	6.304	7.807
13	4.107	5.009	5.892	7.042	8.634
14	4.660	5.629	6.571	7.790	9.467
15	5.229	6.262	7.261	8.547	10.307
16	5.812	6.908	7.962	9.312	11.152
17	6.408	7.564	8.672	10.085	12.002

18	7.015	8.231	9.390	10.085	12.002
19	7.633	8.907	10.117	11.651	13.716
20	8.260	9.591	10.851	12.443	14.578
21	8.897	10.283	11.591	13.240	15.445
22	9.542	10.982	12.338	14.041	16.314
23	10.196	11.689	13.091	14.848	17.187
24	10.856	12.401	13.848	15.658	18.062
25	11.524	13.120	14.611	16.473	18.940
26	12.198	13.844	15.379	17.292	19.820
27	12.879	14.573	16.151	18.114	20.703
28	13.565	15.308	16.928	18.939	21.588
29	14.256	16.047	17.708	19.768	22.475
30	14.953	16.791	18.493	20.599	23.364

Table 4. Values of F-distributions with 0.5 of the area in the right tail

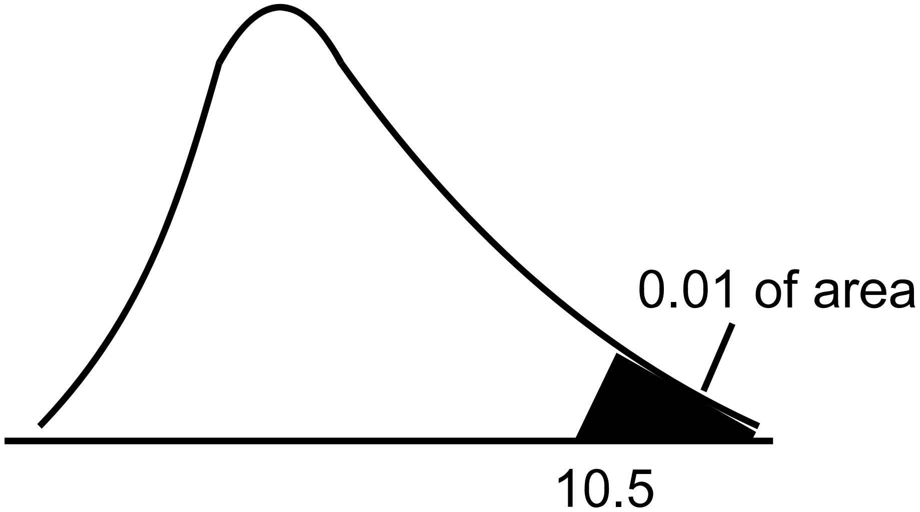


Example: In an F-distribution with 15 degrees of freedom for the numerator and 6 degrees of freedom for the denominator, to find the F-value for 0.05 of the area under the curve, look under the 15 degrees of freedom column and across the 6 degrees of freedom row; the appropriate F-value is 3.94.

Degrees of freedom for numerator																			
	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	16.1	20.0	21.6	225	23.0	23.4	23.7	23.9	24.1	24.2	24.4	24.6	24.8	24.9	25.0	25.1	25.2	25.3	25.4
2	18.5	19.0	19.2	19.2	19.3	19.3	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.5	19.5	19.5	19.5	19.5	19.5
3	10.1	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.53
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.63
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.37

6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.67
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.23
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.93
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.71
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	2.02	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.54
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.40
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.;75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21
14	4.60	3.74	3.34	33.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.13
15	4.54	3.68	33.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.07
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.36	2.28	2.24	2;.19	2.15	2.11	2.06	2.01
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.31	223	2.19	2.15	2.10	2.06	2.01	1.96
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.92
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.88
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.96	1.90	1.84
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.81
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.78
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.76
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18	2.11	2.03	1.98	1.94	1.89	1.84	1.79	1.73
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.71
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.7	2.21	2.16	2.09	2.01	1.93	1.89	1.84	1.79	1.74	1.68	1.62
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.00	1.92	1.84	1.79	1.74	1.69	1.64	1.58	1.51
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.39
120	3.92	3.07	2.68	2.45	2.29	2.18	2.09	2.02	1.96	1.91	1.83	1.75	1.66	1.61	1.55	1.50	1.43	1.35	1.25
∞	384	300	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.75	1.67	1.57	1.52	1.46	1.39	1.32	1.22	1.00

Table 5. Values of F for F-distributions with 0.01 of the area in the right tail



Example: In an F distribution with 7 degrees of freedom for the numerator and 5 degrees of freedom for the denominator, to find the F-value for 0.01 of the area under the curve look under the 7 degrees of freedom column and across the 5 degrees of freedom row; the appropriate F value is 10.5.

	Degrees of freedom for numerator																		
	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	4.052	5.000	5.403	5.625	5.764	5.859	5.928	5.982	6.023	6.056	6.106	6.157	6.209	6.235	6.261	6.287	6.313	6.339	6.366
2	98.5	99.0	99.2	99.2	99.3	99.3	99.4	99.4	99.4	99.4	99.4	99.4	99.4	99.5	99.5	99.5	99.5	99.5	0.05
3	34.1	30.8	29.5	28.7	28.2	27.9	27.7	27.5	27.3	27.22	27.1	26.9	26.7	26.6	26.5	26.4	26.3	26.2	26.1
4	21.2	18.0	16.7	16.0	15.5	15.2	15.0	14.8	14.7	14.5	14.4	14.2	14.0	13.9	13.8	13.7	13.7	13.6	13.5
5	16.3	13.3	12.1	11.4	11.0	10.7	10.5	10.3	10.2	10.1	9.89	9.72	9.55	9.47	9.38	9.29	9.20	9.11	9.02
6	13.7	10.9	9.78	9.15	8.75	8.47	8.26	8.10	7.98	7.87	7.72	7.56	7.40	7.31	7.23	7.14	7.06	6.97	6.88
7	12.2	9.55	8.45	7.85	7.46	7.19	6.99	6.84	6.72	6.62	6.47	6.31	6.16	6.07	5.99	5.91	5.82	5.74	5.65

8	11.3	8.65	7.59	7.01	6.63	6.37	6.18	6.03	5.91	5.81	5.67	5.52	5.36	5.28	5.20	5.12	5.03	4.95	4.86
9	10.6`	8.02	6.99	6.42	6.06	5.80	5.61	5.47	5.35	5.26	5.11	4.96	4.81	4.73	4.65	4.57	4.48	4.40	4.31
10	10.0	7.56	6.55	5.99	5.64	5.39	5.20	5.06	4.94	4.85	4.71	4.56	4.41	4.33	4.25	4.17	4.08	4.00	3.91
11	9.55	7.21	6.22	5.67	5.32	5.07	4.89	4.74	4.63	4.54	4.40	4.25	4.10	4.02	3.94	3.86	3.78	3.69	3.60
12	9.33	6.93	5.85	5.41	5.06	4.82	4.64	4.50	4.39	4.30	4.16	4.01	3.86	3.78	3.70	3.62	3.54	3.45	3.36
13	9.07	6.70	5.74	5.21	4.86	4.62	4.44	4.30	4.19	4.10	3.96	3.82	3.66	3.59	3.51	3.43	3.34	3.25	3.17
14	8.86	6.51	5.56	5.04	4.70	4.46	4.28	4.14	4.03	3.94	3.80	3.67	3.52	3.37	3.29	3.21	3.13	3.05	2.96
15	8.68	6.36	5.42	4.89	4.56	4.32	4.14	4.00	3.89	3.80	3.67	3.52	3.37	3.29	3.21	3.13	3.05	2.96	2.87
16	8.53	6.23	5.29	4.77	4.44	4.20	4.03	3.89	3.78	3.69	3.55	3.41	3.26	3.18	3.10	3.02	2.93	2.84	2.75
17	8.40	6.11	5.19	4.67	4.34	4.10	3.93	3.79	3.68	3.59	3.46	3.31	3.16	3.08	3.00	2.92	2.83	2.75	2.65
18	8.29	6.01	5.09	4.58	4.25	4.01	3.84	3.71	3.60	3.51	3.37	3.23	3.08	3.00	2.92	2.84	2.75	2.66	2.57
19	8.19	5.93	5.01	4.50	4.17	3.94	3.77	3.63	3.52	3.43	3.30	3.15	3.00	2.92	2.84	2.76	2.67	2.58	2.49
20	8.10	5.85	4.94	4.43	4.10	3.87	3.70	3.56	3.46	3.37	3.23	3.09	2.94	2.86	2.78	2.69	2.61	2.52	2.42
21	8.02	5.78	4.87	4.37	4.04	3.81	3.64	3.51	3.40	3.31	3.17	3.03	32.88	2.80	2.72	2.64	2.55	2.46	2.36
22	7.95	5.72	4.82	4.31	3.99	3.76	3.59	3.45	3.35	3.26	3.12	2.98	2.83	2.75	2.67	2.58	2.50	2.40	2.31
23	7.88	5.66	4.76	4.26	3.94	3.71	3.54	3.41	3.30	3.21	3.07	2.93	2.78	2.70	2.62	2.54	2.45	2.35	2.26
24	7.82	5.61	4.72	4.22	3.90	3.67	3.50	3.36	3.26	3.17	3.03	2.89	2.74	2.66	2.58	2.49	2.40	2.31	2.21
25	7.77	5.57	4.68	4.18	3.86	3.63	3.46	3.32	3.22	3.13	2.99	2.85	2.70	2.62	2.53	2.45	2.36	2.27	2.17
30	7.56	5.39	4.51	4.02	3.70	3.47	3.30	3.17	3.07	2.98	2.84	2.70	2.55	2.47	2.39	2.30	2.21	2.11	2.01
40	7.31	5.18	4.31	3.83	3.51	33.29	3.12	2.99	2.89	2.80	2.66	2.52	2.37	2.29	2.20	2.11	2.02	1.92	1.80
60	7.08	4.98	4.13	3.65	3.34	3.12	2.95	2.82	2.72	2.63	2.50	2.35	2.20	2.12	2.03	1.94	1.84	1.73	1.60
120	6.85	4.79	3.95	3.48	3.17	2.96	2.79	2.68	2.56	2.47	2.34	2.19	2.03	1.95	1.86	1.76	1.66	1.53	1.38
∞	6.63	4.61	3.78	3.32	3.02	2.80	2.64	2.51	2.41	2.32	2.18	2.04	1.88	1.79	1.70	1.59	1.47	1.32	1.00