



RESEARCH METHODOLOGY AND STATISTICAL TECHNIQUES

M.LIB.-103



DIRECTORATE OF DISTANCE EDUCATION
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Research Methodology and Statistical Techniques

Syllabus

Unit 1: Research

- Concept, Meaning, Purpose of Research ; Types of Research - Fundamental and Applied Including Interdisciplinary and Multidisciplinary Approach ; Trends in LIS Research

Unit 2 : Research Design

- Conceptualization and Operationalization ; Types of Research Design ; Identification and Formulation of Problem ; Hypothesis: Nominal and Operational Definition ; Literature Review

Unit 3 : Research Methods and Techniques

- Scientific Methods ; Historical Methods ; Descriptive Methods ; Survey Methods and Case Study Methods ; Experimental Methods and Sampling ; Data Collection Techniques; Questionnaire; Interview ; Observation ; Schedules

Unit 4 : Data Analysis and Interpretation

- Descriptive Static-measures of Central Tendency: Mean, Mode and Median ; Classification and Tabulation; Standard Deviation ; Graphical Presentation: Bar Diagram, Line Graph, Histograms, Pie-Chart ; Testing of Hypothesis: Z-T test, Chi-Square Test

Unit 5 : Bibliometrics Laws

- Bibliometrics: Bibliometric Laws : Bradford; Zipfs; Lotka Scientometrics ; Informatics ; Webometrics ; Research Report Writing: Structure, Style, Contents

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Research

1.1 Introduction

Man is a curious creature who is always curious to know new facts. As a result of the inquisitive nature of human beings, new ideas are born every day. When a person thinks deeply on these ideas and proves their truth through experiments and analysis, then these ideas are converted into systematic knowledge. Systematic knowledge has played an important role in human development. In the journey from the agricultural age to the industrial age and from the industrial age to the information age, the path has been knowledge. Today whom we call developed nations are information and knowledge based societies. There in the social and economic activities the latest information is generated, exchanged and used. While the majority of the Gross Domestic Product (GDP) comes from the activities of the R & D and services sector. Research and development and academic activities in these countries are encouraged and supported at all levels. At the same time, the latest scientific researches in the fields of science, social sciences and even the humanities have been promoted all around in these nations.

Need is the mother of invention. The ever-increasing needs and demands of society have given rise to new inventions. Today R & D activities have become a collective or organized effort rather than a single effort and research institutes and laboratories have been established to encourage R & D activities and achieve quick results. These institutions are engaged in research work day and night. Governments have also understood the importance of R & D

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activities and encouraged them by providing grants and various types of assistance.

Research work is taking place at two levels; At one university level, in which the student does research through research degrees, such as M.Phil and Ph.D. and at the second level, private and government research institutions sponsor research and development activities for the fulfillment of their objectives.

1.2 Origin of Research

All words like research, search, investigation and exploration etc. are synonyms of Hindi language, which are called Research in English language. The root word is derived from the French word *Cerchier* which means 'to rediscover' to be sure. Research is said to be a systematic process, which is well planned, by which new knowledge is discovered. The literal meaning of the English word 'Research' is; to re-re-explore, to search and to provide information about the latest facts.

1.3 Meaning and Definitions of Research

1.3.1 Meaning of Research

Research is an activity in which an attempt is made to discover new knowledge and verify the available knowledge. It is a highly intellectual activity in which researchers search for new facts and information with the help of available knowledge.

1.3.2 Definition of Research

Various scholars have defined research, the description of which are as follows :

1. According to Webster's New International Dictionary, "In search of facts for research theories a careful, critical search or examination or diligent search is done in order to ascertain something. "
2. According to L.B. Radman, "Systematic efforts to acquire new knowledge is research."



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3. P.M. Kukra has given some characteristics about the initial letters of the word “Research”, which are as follows :

- R – Rational way of thinking
- E – Expert and exhaustive treatment
- S – Search of Solution
- E – Exactness
- A – Analysis
- R – Relationship of facts
- C – Critical observation, careful recording, constructive attitude and condensed generalizations.
- H – Honesty and hard working

On the basis of these above-mentioned research definitions, it can be said that research is not just a discovery, but it is a scientific, purposeful, logical and systematic search. The researcher does this in a critical and reasoned manner.

1.4 Purpose of Research

The research objectives are as follows :

- To search for new knowledge, new findings, new solutions and new facts.
- Verifying available knowledge.
- Finding solutions to new problems being faced by human life.
- Detection of future problems and possible solutions.
- To add onto the collection of knowledge.
- To find work-cause relationships of various events.
- Socio-economic development of the people.
- To find out the complexities of nature and human properties interrelationships and to find solutions for them.

1.5 Characteristics of Research

Characteristics of research are as follows :

- Research design is related to social research.
- Research design gives the researcher an idea of a certain direction of research.

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- The research design presents the complex nature of social events in a simple way.
- Research design would be helpful in achieving the objectives.
- The research design is selected on the basis of the nature of the problem and imagination of the scientific research.
- It is to control the types of situations that arise during the research process and to make the research work easy.
- Research design is the format that is prepared before starting the research work.
- Research design not only reduces human labor but also time and cost.

1.6 Benefits of Research

There are many benefits of research activities, which are described as follows :

1. A topic and case can be studied in depth through research. It has the advantage that new dimensions are added to the related subject and along with the increase in the field of the subject, it also gets recognition in the intellectual world.
2. Research develops scientific temper. Because critical and reasoned thinking is done in research. This encourages scientific thinking. Scientific thinking is what leads humanity towards its origin and emergence.
3. Research activities develop mutual coordination and understanding.
4. It provides an opportunity to make maximum use of the available knowledge and resources. If the researcher does research work, then he reads the knowledge and studies already available in detail. Along with this, he uses the resources of the library, sources available on the Internet, personal scholars etc. Available knowledge is the cornerstone of new knowledge.
5. Research work, assists to develop specific aptitude, ability, competence etc. in the researcher. While conducting research the researcher goes through various situations and these circumstances help him learn.

6. Research work develops an atmosphere of harmony and goodwill towards others.
7. Suggestions regarding changes and additions to the infrastructure of libraries and information centers can be obtained through research.
8. With this, development of new curriculum of library and information science subjects, new techniques of study and teaching development of new techniques can be done.
9. Through research, better solutions can be found to the problems faced by the library and information science.

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1.7 Importance of Research

The importance of research is generally stated by following points :

- Research provides direction to human knowledge and develops and rectifies the collection of knowledge.
- Research solves practical problems.
- Research leads to intellectual development of personality.
- Research is helpful for social development.
- Research satisfies curiosity-oriented tendencies.
- Research develops a number of innovative methods and products.
- Research helps in diagnosing and eliminating biases.
- Research provides depth and minuteness in various aspects of knowledge.
- According to John Best, the secret of cultural advancement lies in research.
- Research with discovery of new facts reduces ignorance. Provides better methods and best results for realization of truth.

1.8 Types of Research

Research can be of the following types :

- (i) Pure Research
- (ii) Applied Research
- (iii) Action Research

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1.8.1 Pure Research

This research is also known as basic, elementary or theoretical. This type of research is theoretical in nature. In this, new principles and rules are discovered. This type of research emphasis is on the generation of new knowledge. The primary objective of this research is to develop new theories through generalizations. It is basically related to the solution of intellectual problems. In fundamental research, research work is done purely for the purpose of acquiring knowledge. Practical usage of this kind of research is not taken into consideration. It does not provide solutions to experimental problems.

Pure research seeks to find answers to intellectual questions and curiosities. In this, old principles, rules and formulas are reinterpreted and verified.

1.8.2 Applied Research

Applied research is basically concerned with solving practical problems. It works in the direction of finding solutions to the problems being faced at the national and international level at present. While theories and formulas are discovered by pure research, applied research deals with the practical side of a specific problem with the help of these formulas. The application of applied research seeks to find solutions to the practical difficulties of human evolution. Through practical research in the field of science, new tools and equipment are manufactured in the interest of human beings. Applied research is useful in solving the problems of society like educational, residential, technical, economic etc.

Research in library and information science is not well established. By the way, the research work of library science comes under the category of applied research. With the help of applied research, practical solutions can be found to the problems of readers, textbooks, lack of funds and library workers. There is a need for continuous level research in the field of library and information science. Research alone can provide solutions to the challenges faced by the library business.

1.8.3 Action Research

It is a type of academic research. This type of research is used to solve the academic problems of a specific academic class. Action



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research shifts from theoretical development to immediate application. Its effect remains on some problems of the local environment. Its results should be evaluated only in the context of local applicability and not in the context of universal truth, through which solutions to the specific problems faced by libraries, information centers, documentation centers etc. in the field of library and information science can be found.

Other Types of Research

Other types of research are as follows :

From the objectives of education research, it is clear that educational research can be classified in many ways. The main classification criteria are listed below :

Contribution Point of View : In terms of contribution to research work, academic research can be divided into two categories :

- 1. Basic or Fundamental Research :** New knowledge is increased by these research works - new theories are presented, new facts are discovered, new knowledge is substituted. Through fundamental research enhancement is done in the field of knowledge. They can be divided into three categories according to objective point of view :
 - (i) Theories and rules are formulated through **experimental research** works. Survey research also makes a similar contribution.
 - (ii) From **historical research work**, new facts are discovered, in which studies are done and on the basis of them, an attempt is made to understand the present.
 - (iii) New truths and values are replaced by **philosophical research** works. The theory of education can be developed in philosophical research.
- 2. Action Research :** This type of research works to study local problems, thereby improving and developing the process of teaching, knowledge is not increased from them. These are also called experimental faith research.

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Research Approaches : Two dimensions are used to study the facts in research work :

- (i) **Longitudinal Approach :** This term is derived from botany. When a study is done from the time of sowing the seed to the time it becomes a fruit, it is called the longitudinal approach. It is also called approach because time is the major component in the study. This approach is used in historical units and genetic research methods.
- (ii) **Cross-sectional Approach :** This term is also derived from botany. When the shape of a plant's stem, leaf or root and any other part is to be studied, then that part of that plant is studied by cutting it, then it is called transverse dimension. Time is not important in this. This approach is used in experimental and survey methods.

Precision in Research Findings : Conclusions of research can be divided into two categories in terms of accuracy :

1. Experimental Research and
2. Non-Experimental Research

The accuracy of the findings of experimental research is high because control, accurate measurement and observation characteristics are taken into account. Non-experimental research findings have low accuracy because the measurement is mostly not accurate, monitoring and control is also not possible.

1.9 Introduction to Interdisciplinary and Multidisciplinary

This unit will look into the need for, characteristics, requirements, applicability and advantages of research. Thereafter, how interdisciplinary approach is helpful in Women's Studies is discussed. This section is followed by some practical issues that make such research a more challenging exercise for researchers. Let us now look at the objectives of this unit.

Research projects that are interdisciplinary or multidisciplinary in nature are considered more suitable to analyze complex patterns of human behaviour. Disciplines are the result of artificial fragmentation

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of knowledge. Modernization developed in an era of specializations that led to the emergence of specialized disciplines with well defined boundaries. A discipline is defined as a specific branch of knowledge, institution learning or a field of study. The knowledge accumulated in these specialised fields is parochial and cannot provide an adequate and holistic explanation about human life. Real world problems are rarely confined to the artificial boundaries of academic disciplines, and therefore, can be fruitfully examined in a multidisciplinary or interdisciplinary frame work.

1.9.1 Multidisciplinarity

Multidisciplinary is the most basic and initial level of involvement of different disciplines that are working on a problem in a parallel or sequential manner without challenging each other's disciplinary boundaries. Multi-disciplinary team work is increasingly being emphasized in health research, health services, gender studies, social work, education and policy.

Multidisciplinarity according to Klein "is a process for providing a juxtaposition of disciplines that is additive, not integrative. The disciplinary perspectives are not changed but only contrasted". (Klein 1990, p. 56) A painting can be studied not only within art history but also within the history of religion, history and geometry, and the different perspectives can be juxtaposed for highlighting similarities and differences.

In a multidisciplinary team dealing with service delivery, each team members is responsible only for the activities related to his or her own discipline. Individuals from diverse disciplines work together on a common problem, but with limited interaction. According to the Gulbenkian Commission 'Area studies' may be cited as the prime example of a multidisciplinary programme (Area studies brings together people from different disciplines within an institutional setting for studying a given geographical or cultural space from different perspectives like sociology, anthropology, history, psychology producing a disciplinary-based understanding of the object of study. This approach assumes that the division between the various disciplines of social sciences is artificial.



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Thus, a multidisciplinary approach evolves new understanding through adapting and modifying existing concepts, methods and theoretical frameworks within a discipline, and borrowing ideas from other disciplines. It draws knowledge from various disciplines without openly violating the boundaries of specific discipline.

1.9.2 Interdisciplinarity

Interdisciplinary implies the emergence of novel insights and understandings of a problem domain through the integration or derivation of different concepts, methods and epistemologies from different disciplines.

Interdisciplinary is a synthesis of two or more disciplines establishing a new level of discourse and integration of knowledge. For example, when nuclear physics is combined with medicine it leads to a new treatment for cancer. Political science is often portrayed as the 'junction subject' of the social sciences, born out of history and philosophy, but also drawing on the insights of cognate disciplines such as economics and sociology, and to some extent, the study of law psychology and geography. This openness to exchange of ideas and concepts between disciplines is the strength for fostering interdisciplinary work within the social sciences.

Interdisciplinary projects involve closer and more frequent collaborative exchanges among researchers drawn from different fields are working together on a common problem. (Rosenfield 1992). In interdisciplinary research, concepts, methodologies are explicitly exchanged and intergraded resulting in a mutual enrichment. Interdisciplinarity, thus, involves interaction among two or more different disciplines, and occurs at the interface between disciplines. This may range from the sharing of ideas to full integration of concepts, methodology, procedures, theory, terminology, data, organisation of research and training.

1.9.3 Transdisciplinarity

Transdisciplinary approach provides holistic schemes that subordinate individual disciplines, looking at the dynamics of whole systems. Transdisciplinary teams, using a shared conceptual framework, draw together discipline-specific theories, concepts and approaches of address a common problem. It is thus holistic in nature. The best examples of this approach examples are Marxism and structuralism.



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Intradisciplinary researchers from different fields not only work closely together on a common problem over an extended period of time but also create a shared conceptual model of the problem that integrates and transcends their separate disciplinary perspectives.

1.9.4 Differences in Multidisciplinary and Interdisciplinary Research

The multidisciplinary and interdisciplinary research are based on different ideologies. The following table identifies the basic differences between the multidisciplinary and interdisciplinary research.

	Multidisciplinary	Interdisciplinary
1.	Working with several disciplines	Working between two or more disciplines
2.	Members from different disciplines work on different aspects of a project or in parallel or sequential manner, and later add up the results.	Members from different disciplines work jointly on the same project and produce integrated outcomes.
3.	Individual goals from different professions are applied to the given problem	Goals are shared among the members.
4.	Participants maintain own disciplinary roles while working together.	Participants accept the common role but still maintain a discipline-specific base.
5.	Disciplinary boundaries remain unchanged.	Blurring of disciplinary boundaries.
6.	External coherence (motivated by a desire to focus on client's needs)	External as well as internal coherence (motivated by a desire to focus on different dimensions of the issue at hand and the needs of the team).
7.	Participants learn about each other about their respective disciplines.	Participants learn about and from each other and develop a common understanding.

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8.	Participants work individually on the specific issue addressed by their respective disciplines, and the results are added up in the final report.	Participants work together and share ideas through mechanisms like meetings, workshops and give a concrete shape to ideas and outcomes. The report includes the analysis in an integrated form.
9.	Methodologies are discipline-specific Common methodologies are framed out of integration of methodologies of different disciplines.	Common methodologies are framed out of integration of methodologies of different disciplines.
10.	Instrumental, supportive and complementary knowledge or perspective to address a question is generated.	Epistemological innovation involving creation of new knowledge or perspective, even new disciplines.
11.	The outcome is the sum of individual parts.	The outcome is more than the sum of the individual parts
12.	Graphically analogous to a horizontal series of compartment, each linked by a vertical unidirectional arrow to a higher 'control compartment above'	Graphically analogous to a horizontal series of compartments each linked by a vertical, unidirectional arrow to a higher 'control' compartment above, and bidirectional arrows between pairs of horizontal compartments.

1.10 Need of Research in Library and Information Science

The subject of library and information science is passing through a period of continuous changes. The ever-increasing development of information and communication technology has influenced the techniques and methodology of this subject the most. Libraries and Information Centers are engaged in activities like selection, acquisition, processing, organisation, exchange, retrieval, conservation of study materials etc. Information and communication technology has brought about a radical change in the methods of selection, acquisition and collection of information. Research is needed in the field of library and information science to find a meaningful solution to all these problems and to keep pace with technological development.

Krishna Kumar writes that "research in science, technology and social sciences is well established whereas the need for research in library and information science is not fully recognized. This is particularly true for developing nations such as India."

The need for research in library and information science is due to the following reasons :

- For the educational structure of library and information science through research.
- To improve the management arrangements of library and information centers and to solve their problems.
- For the establishment of new knowledge in the field of library and information science.
- To give the library and information science reputation of the subject in the academic world.
- To make the professionals of library and information sciences proficient in new techniques and methodology.
- To develop new techniques, methodology and tools in the subject of library and information science.
- To solve the problems of the classroom and the problems of the students and teachers.
- Re-interpretation of the past principles in the field of library and information science in a new information environment.

In today's era, the scenario of information creation, management, exchange, use of services has completely changed. There is continuity in this change and it focuses on the convenience of the reader to gain knowledge. Ranganathan's first sutra of library science is "the book is for use" *example* knowledge and information are for use. Today the Internet is further consolidating the significance of this formula. Today libraries are moving towards electronic libraries and virtual libraries rather than libraries. Librarians are also moving towards Knowledge Navigator. The nature of library text material has changed. The readership is the focal point of the whole concept. In such a situation only research can provide the solution to all these difficulties, problems and curiosities.

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1.11 Current Trends in Research

Research comprises "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications." It is used to establish or confirm facts, reaffirm the results of previous work, solve new or existing problems, support theorems, or develop new theories. A research project may also be an expansion on past work in the field. To test the validity of instruments, procedures, or experiments, research may replicate elements of prior projects, or the project as a whole. There are several forms of research: scientific, humanities, artistic, economic, social, business, marketing, practitioner research, etc.

Research is undertaken within most professions. More than a set of skills, research is a way of thinking: examining critically the various aspects of your day-to-day professional work; understanding and formulating guiding principles that govern a particular procedure; and developing and testing new theories for the enhancement of your practice. It is a habit of questioning what you do, and a systematic examination of the observed information to find answers, with a view to instituting appropriate changes for a more effective professional service.

Research is a means of continuously developing a discipline. It endows a discipline with the ability to utilize the knowledge generated in other disciplines. It makes use of scientific methods. In other words, research means systematic investigations to establish facts and reach new conclusions. Dr. S.R. Ranganathan, the father of library science in India, laid the foundation of research in India with his pioneering efforts. He introduced formal education in library and information science discipline in universities. To strengthen research in library and information science in India, among other things, it is also necessary to know about the areas of research currently being focused on and also identifying emerging areas of research. There are many ways to identifying core research areas of library and information science. Several studies have been carried out on the research productivity in library and information science. Bibliometric study of research output is the most commonly used research method in India. Most of

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these studies used bibliometric techniques such as citation analysis to analysis library and information science research.

Current research trends of doctoral research programs in library and information science and related topic in Indian universities have been analyzed from the year 2008 to 2013 to find out the growth pattern, productivity of the universities, types of works, research areas, and zonal status etc. The Present study is confined to University News: A Weekly Journal of Higher Education, one of the leading journal on higher education in India, being published by Association of Indian Universities, New Delhi on weekly basis, each volume having fifty two issues.

In order to understand the latest trend and pattern of publication distribution in the field of Library and Information Science in India, it was conceived to undertake the bibliometric study on one of the leading and consistent journals on higher education in India and accordingly University News: A weekly journal of higher education was chosen for the purpose and the present study remains confined for the period 2008-2013. Apart from assessing research output of the journal during the last six years the aim was also to analyze the authorship pattern, publication pattern, geographical distribution of authors, and reference analysis. During the period of analysis the journal has covered most of the professional areas and aspects of LIS, with a good number of issues dedicated to topics like, Measurement of Indian Science and Technology, Library Consortia, Library and Information Education in India, Intellectual Property Rights, Open Access, Information Literacy, Online Exhibitions, Knowledge Sharing, e-Learning, Social Science Gateways. Publishing theses of the month in almost each issue of the journal has been the regular feature of the journal.

1.11.1 Definition of Research

Research has been defined in a number of different ways.

A broad definition of research is given by **Martyn Shuttleworth** - "In the broadest sense of the word, the definition of research includes any gathering of data, information and facts for the advancement of knowledge."

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Another definition of research is given by Creswell who states that - "Research is a process of steps used to collect and analyze information to increase our understanding of a topic or issue". It consists of three steps: Pose a question, collect data to answer the question, and present an answer to the question.

The Merriam-Webster Online Dictionary defines research in more detail as "a studious inquiry or examination; especially : investigation or experimentation aimed at the discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts, or practical application of such new or revised theories or laws".

1.11.2 Education

The Library and Information Science (LIS) education in India may be said to have taken place with the introduction of a training course in 1911, in the erstwhile State of Baroda. The real beginning of systematic education in LIS can be traced to the initiatives of Dr. S.R. Ranganathan during the period 1926-1931 at the Madras University Library in association with Madras Library Association. The summer school leading to certificate in library science, which Madras University continued under the stewardship of Dr. S.R. Ranganathan till 1937. Later, Andhra University, Banaras Hindu University, Bombay University, Calcutta University and Delhi University introduced Post -Graduate Diploma Courses in Library Science in the year 1935, 1941, 1944, 1946 and 1948 respectively. Apart from these universities, DRTC in Bangalore and NISCAIR in New Delhi started the library science education programmes. During 1947, altogether 27 universities were offering diploma courses in Library Science. In 1957, for the first time in the country, Aligarh Muslim University started B.L.Sc Course. The courses were offered at different levels such as Certificate, Diploma, Bacheloris, P.G. Diploma, Masteris and research degree programmes i.e. M Phil and Ph. D under different modes (on regular/on campus or distance/ off campus or sometimes both) and schemes (annual or semester). The growth of universities during post-independent India ensured improvement in the quality of education. It is due to the importance of libraries in various institutions, research centres and government

**Note**

departments, the demand for librarians also increased. This actually gave boost to Library Science Education in India.

LIS education in India though started as early as in 1911 & was gradually recognized as a full-fledged discipline. Separate departments were set up in the universities offering courses leading to bachelors & master degrees. This eventually set the stage for formal research activities in the subject. At present, formal research in LIS is conducted at 6 levels, viz. Diploma, BLISc, MLISc, M.Phil, PhD. & D.Litt.

1.11.3 Trends in LIS Research

The research in LIS in the past was considered primarily to provide a theoretical foundation to professional practice. The roots of research in LIS profession appears to be not very deep. In the field of Library Science research, US made the premier attempt. The study entitled 'A Guide to Sources of 17th century English History in Selected Reports of the Royal Commission on Historical Manuscripts' by Eleanor. S. Upton was awarded PhD by the Chicago University in 1930. It is considered as the 1st doctoral degree in Library Science. During 1950s universities namely, Illinois, Michigan, Columbia, Western Reserve, California & Rutgers produced 129 PhD dissertations.

Library science research in UK was started during 1930s. The 1st doctoral thesis accepted by the London School of Economics was on a core Library Science subject in 1935. The title of the thesis was 'The Public library Service under English Local Government'.

1.11.4 Library Science Research in India

The credit for the formal institution of the doctoral degree programme in library science in India goes undeniably to Dr. S.R. Ranganathan (1892–1972). Library Science research in India was initiated by Dr. S.R. Ranganathan in 1931, with the formulation of Five Laws of Library science. He even graded them as Normative Principles, Fundamental Laws, Canons, Principles & Postulates. Dr. S.R. Ranganathan cut new grounds & blazed new trails in Library Science initially by solo- research. Ranganathan's era is characterized by a period of intellectual contribution to the theory of Library Science, particularly library classification.

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The 1st PhD in Library Science was awarded to Dr. D.B. Krishna Rao for his study on 'Facet analysis and depth classification of agriculture under the guidance of Dr. S.R. Ranganathan & S. Dasgupta in 1957'. Dr. J.S. Sharma, was the 1st Indian & one of the 1st few to earn doctorate from USA. He was awarded PhD by Michigan University for his thesis 'Mahatma Gandhi: A Descriptive Bibliography'.

The 2nd PhD in LIS in India was awarded in 1977 to Dr. Pandey S.K. Sharma for his thesis 'Expansion and Modification of Dewey Decimal Classification (18th Ed.) for classifying Indological books with special reference to Indian Philosophy, and Indian religion by Punjab university'.

1.11.5 Current Trends

According to National Knowledge Commission (NKC) report (March 2007), India has a long tradition of libraries & has contributed to the development of basic concepts in the discipline such as fundamental principles of library services & knowledge organization tools, R & D activities in LIS today are extremely limited. This is utmost concern for the growth of LIS profession in India".

The new maladies that have recently inflicted the LIS research are :

- Ghost writing
- Outsourcing of data processing
- Data cooking
- Rampant plagiarism
- Cloud libraries
- Mobile applications
- Expert system
- Web interface
- Paper less library
- Library education in digital or web era etc.

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1.11.6 Objectives of the Study

The study aims at the following objectives :

- To know the current trends in LIS research in India.
- To know about the areas of research in LIS.
- To know about which university given maximum output in LIS research from 2008-2013.
- To know about the research supervisors who mostly supervised the PhD. research.
- To know about the zonal area, which produce the most output in LIS research in India.
- To know the subject wise distribution of research works in LIS.
- To determine the diversity and trends of research in LIS field.

1.11.7 Methodology

The main source of data collection is “University News: A weekly journal of higher education” of “six years, i.e., 2008 to 2013 (All issues included). Data taken from the “Theses of the Month” feature of the said journal which periodically lists out the doctoral theses accepted and awarded by different universities in India.

These doctoral dissertations have been listed out and analysis has been made. The year wise distribution of categories during the study period has also been made. The theses were grouped according to subject categories. Distribution has also been made for universities awarding the number of theses. Region wise and across libraries distribution has also been made to identify the growth pattern of research work.

1.11.8 Scope and Limitations

The study covers research works in LIS at the Ph.D level only accepted for doctoral degree by Indian Universities. The study does not consider the research works in LIS registered in universities. The period of coverage is from 2008 to 2013, a period of six years. It has considered only those titles of doctoral theses appeared in the 'University News' published by Association of Indian Universities (AIU). Theses, which are repeated in the two issues, are excluded from the study.

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Exercises

VERY SHORT ANSWER QUESTIONS

1. At what levels does research work take place?
2. Write the meaning of research.
3. Write any two objectives of research.
4. Write the types of research.

SHORT ANSWER QUESTIONS

1. Describe the objectives of research.
2. Write the advantages of research.

LONG ANSWER QUESTIONS

1. Define research and describe its types.
2. Explain the need for research in library and information science.
3. Explain the new trend in library information science.

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Research Design

2.1 Introduction

Human beings have always been curious to discover new knowledge. New ones have been born out of this relentless curiosity of human beings. New knowledge is the result of research activities. It can also be said that it is an effort of systematic research. Systematization is also a feature of research. As much as the research work is systematic, its result will also be received in a quick and systematic way. When a researcher wants to find a solution to a problem, he is actually trying to organize the knowledge. Whenever research work is done, it has to pass through several stages. These steps are – identification of research problems, survey of related literature, selection of research methodology, data collection, selection of tools, data analysis, writing of research report. In addition, research requires human labour, supportive staff, time, equipment, physical facilities and money. In all these stages and facilities, if the coherence breaks down at any stage, then the research work gets hampered. Stay consistent in all these steps and the research work should be completed smoothly. Research design is very helpful for this.

With the help of research design, the researcher not only completes all the phases of research smoothly, but he is also able to complete the work on time. In this unit, what is the research design? Its definition, need, characteristics, purpose and types have been discussed in detail.

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2.2 Conceptualization and Operationalization in Research Design

Research is the basic tool used virtually in all fields of science to answer questions and expand the frontiers of knowledge. It is through research that researcher describes, explains and predicts the seemingly unrelated events of the real world. Research in social sciences uses concepts, theories and scientific methods to understand and explain the social processes and problems encountered by individuals and groups in society. Concepts are the building blocks of social theories and conceptualization is the process through which a researcher achieves theoretical validity for his research problem. Operationalization enables the researcher to generalize his findings to the defined population. It is through the processes of Conceptualisation and Operationalization that the social scientist is able to develop specific research procedures that will result in empirical observations which links theoretical world with observable reality. Thus, the internal and external validity of any empirical social research findings to a great extent depends on consistent and contextual conceptualisation of relevant concepts and their operationalization. Most of the research papers in social sciences that are being published in National Journals in recent years are giving frightfully little attention to the critical issues of conceptualization and operationalization that forms the basis for empirical investigation and analysis. In this context the present paper is an attempt to highlight the role of conceptualization and operationalization in empirical research process and also argues for consistency of their use in future empirical research.

The paper is organised as follows. Section I, discusses the role of conceptualization and operationalization in the research process. Section II describes how conceptualization is achieved with reference to a research problem. Section III describes the operationalization procedure of a concept into a variable. Section IV illustrates the conceptualization and operationalization process with an example. Section V makes some suggestions to the paper writers and concludes the paper.

2.2.1 Role of Conceptualization and Operationalization in Research Process

Establishing a connection between concepts and data is one of the



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most important and most difficult steps of the empirical research process. Conceptualization and Operationalization are the two processes that the researcher uses to establish this linkage. Generally empirical research in social science begins with a problem or topic. A careful analysis of the research problem results in identifying the concepts that capture the phenomenon being studied. Concepts are the abstract ideas that are supposed to represent the observable social phenomenon. As they are abstract forms they generally have several different meanings. Conceptualization is the process through which the researcher attempts to arrive at a common agreement on the meaning of the concepts under study. It aims at specifying exactly what the researcher mean and don't mean by that concept. It is through conceptualization that the researcher creates a nominal definition of the concept to identify the focus of the study. It follows that without consistent and proper conceptualization of a concept, attempts of describing social phenomena and testing hypotheses does not make much sense. Logically conceptualization leads to operationalization, where the researcher creates an operational definition for the concept and the steps or procedures that can be used in measuring the concept. That means, Operationalization moves the researcher from abstract level to the empirical realm where concepts are replaced by variables and specific research procedures are developed that will result in empirical observations and collection and interpretation of data to answer the original research problem. Thus, it is imperative that systematic conceptualization and operationalization of the research problem is fundamental for any empirical investigation and analysis.

2.2.2 The Conceptualization Process

Concepts are the basic instruments that a researcher employs to describe observable phenomena. They are the foundations on which the researcher builds propositions and theories. At practical level concepts abstract reality. However, these concepts are often used in everyday terms to indicate forms of observable behaviour. Everyday language is often vague and infested with unspecified meanings. Therefore, concepts used in empirical research needs to be clarified with words and examples so as to arrive at a precise verbal definition for them and place cognitive borders around them.

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We may say that arriving at a commonly accepted verbal definition for a concept is the first step in conceptualization process. In this context it is worth noting that familiarity with the most important theories relevant to the research problem is an essential pre condition for conceptualization process. It is through Literature Review that the researcher is able to tolerate his concepts of interest to a theoretical framework and identifies working definition for them to be used in his study.

Next, as the researcher studies the detailed aspects of a concept he observes that it may possess different meanings. These different meanings of a concept are classified into one or more subgroups which are called as dimensions of the concept. Researchers need to be aware of the various dimensions of the concepts that are in vogue and clarify which ones they are interested in the context of a research problem. Dimensions are usually concepts themselves. In practice often the terms : concept and dimension are used interchangeably.

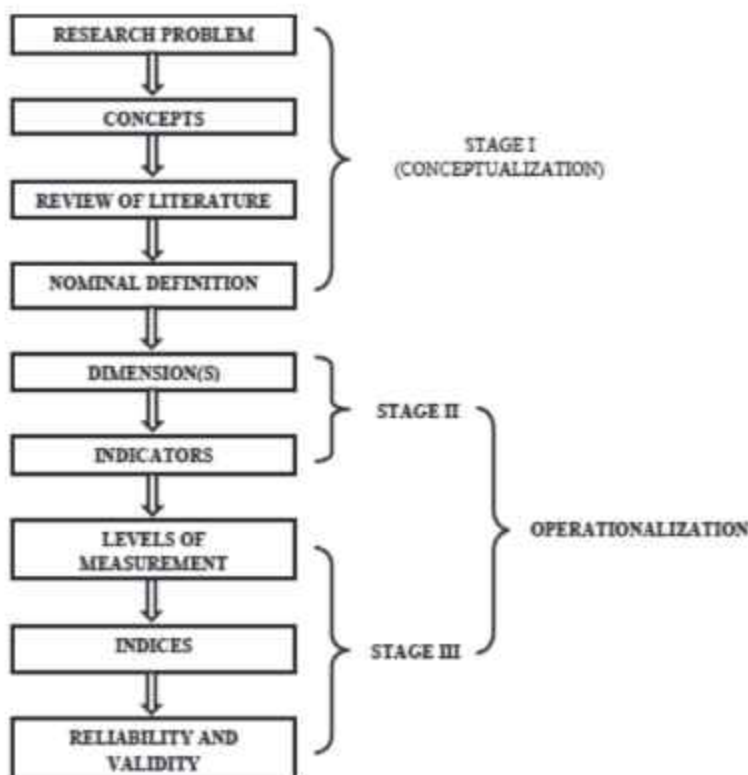


Fig. : Research Process: Conceptualization & Operationalization



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In empirical research we are more interested in dimensions rather than in concepts per se. Concepts having more than one dimension are known as constructs. Once the researcher finalises the relevant concepts (constructs), their working definitions and the theoretical framework which links them, he has to determine the appropriate scales of measuring the variability in them. That is the researcher now has to move to the operationalization or measurement stage of his concepts of interest. Here the researcher has to specify the operations that will indicate the value of cases on a concept (variable).

2.2.3 The Operationalization Process

Operationalization or measurement is the process through which the researcher attempts to convert the various dimensions of a concept into directly measurable entities. It is the description of the 'operations' that he will undertake to measure the various dimensions of the concept of interest, which enables him to make empirical observations on it. When the dimensions of a concept are not directly observable, the researcher uses indicators. Corresponding to each dimension of a concept the researcher should decide on a specific indicator(s). Indicators indicate the presence or absence of a specific dimension of the concept under study. One concept may have multiple dimensions and one dimension may have multiple indicators. In such a case the researcher needs to develop a unified index which can capture the multiple indicators representing the various dimensions of a concept. The developments of a unified index to represent a particular dimension of concept by synthesising various indicators of it are challenging tasks to the researcher. Generally the purpose of the research study will determine the indexing decisions of the researcher. In this context the relative importance of various dimensions of the concept and the range of variation required in the concept are critical issues that the researcher should take into account.

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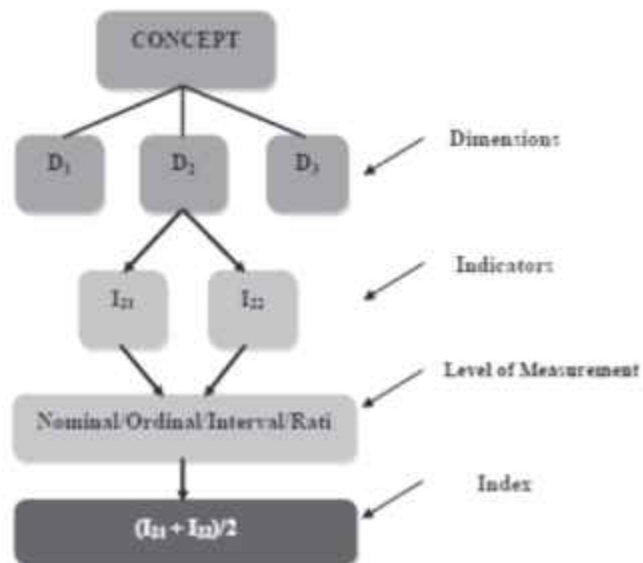


Fig. : Conceptualization and Operationalization

While attempting to measure the concept of interest, the researcher calls it as variable and he identifies the scales that provide the corresponding rules mapping a specific value of a scale to some true value of an Indicator of a dimension of a concept. To be more specific the scales of measurement indicates the mathematical precision with which the values of an indicator can be expressed in numbers or symbols according to some rules.

Depending on the levels at which the indicators can be measured there are four possible scales of measurement ranked in ascending order of sophistication: Nominal, Ordinal, Interval and Ratio. The type of scale of measurement used to measure the indicators will determine the methods of data analysis that can be performed on the empirical observations made on the concept. Once the Operationalization of the concepts is over, the researcher should check the validity and reliability of the measuring instruments used by him, because the internal and external validity of the research results to a great extent depend on these factors. Also the consequences of measurement errors in empirical research are quite serious and cannot be ignored. It is worth noting here that most of the empirical papers that are being published in recent times in reputed National Journals are ignoring this aspect and thus their credibility is at stake. The Operationalization process as explained above is being depicted in Fig 1 and Fig II.

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2.3 What is Research Design?

The research design not only guides the researcher in the right direction but also ensures that the researcher follows the right path continuously. Research design is the planning or strategy of the work to be done by the researcher in the course of research. The research design tells the details of what and how the researcher will decide at every stage of research. The summary of the same is predicated in the research design.

2.4 Definitions of Research Design

The definitions of research design are as follows :

- According to **F.N. Karlinger**, "Research design is a plan, structure and strategy of planned research to obtain answers to research questions. At the same time differences are also controlled."
- In the words of **B.N. Ghosh**, "The research design is the outline of the proposed research work."
- According to **Sabrtij Jahoda**, "A research design is the arrangement of conditions for the collection and analysis of data in a way that aims at incorporating relevance of research objectives in an economic manner."

2.5 Need of Research Design

The need of research design is very important for the smooth flow of the research process. Today the need is that maximum information / knowledge should be acquired in less expenditure because human labor, time and money is spent in the work of research, so it is necessary that maximum result or benefit should be obtained from it. In research work, it is absolutely necessary to have a definite and systematic plan or design for data collection, analysis etc. so that the research work can be completed smoothly and on time. In research, selection of time and sample, determination of data collection techniques and data analysis techniques, complete description of time-table and process of writing research report and research design is absolutely necessary. If the research design is not made, then the research work often not only deviates from its purpose, but all the hard work goes in vain.

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2.6 Characteristics of Research Design

According to Krishna Kumar, a good research design should satisfy these four conditions mentioned below :

- Objective
- Reliability
- Validity
- Generalization

Whatever research design is selected, it should allow the use of measuring instruments and should be completely objective. Reliability refers to the consistency in measurement. For this the answerable is expected to provide the same answer repeatedly to the question asked. Whatever equipment is taken should be valid. A research design should enable a researcher to draw some generalizations from the data collected from the sample. Other features of research design are as follows :

- It should be flexible, efficient and economical.
- It should have maximum reliability and minimum inclination.
- It should be the guide of the researcher.
- Research design simplifies complex research.
- It helps in fulfilling the research objectives.

2.7 Subject Matter of Research Design

In a general research design the following topics are mentioned :

- **The Subject of Research :** By doing this one gets a clear knowledge of the subject of study and its scope and limitations are known. The available literature, journals etc. subjected to the form determination, search etc. have to be studied. Study sources can be government, non-government, personal, libraries or environment related.
- **The Nature of Study :** In this the type of research has to be determined. It can be statistical, personal, comparative, experimental, analytical, exploratory or a mixed type.



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- **The Proposal and Backgrounds:** The background of choosing the subject has to be told and one has to start it. From this it is known how the interest of the researcher was generated in the mentioned subject and what is the nature and condition of the problem. So far, who and what results have been obtained and studied about that problem? What were its shortcomings and flaws? How is it possible and desirable to remove them now?
- **The Social, Cultural, Political and Geographical Reference of Study:** In this the researcher clarifies what kind of society and cultural environment he is living in and what are its root values, traditions, beliefs etc.? It also includes local standards, customs, traditions, etc. In this context, the political system, behavior and values are mentioned. In the geographical context, the factors affecting human behavior include location, climate, natural products, etc. If possible, the economic environment should also be introduced. Psychological research should be adjusted in social, cultural, economic and industrial dimensions.
- **Aim:** The researcher or investigator states his objective. In this, he reveals the sub-objective or goal, that is, mentions the main and auxiliary objectives. These are usually explained in four or five sentences.
- **Time Reference:** In this, the time, era or environment related to the research is told. Time is an extremely important factor in political research.
- **Facts:** Facts are made and determined on the basis of selection of material. Here, their propriety should also be clarified. The basis in this can be predilection, physical, non-ideological, observable, etc. The techniques for target compilation can be humane or mechanical. Facts can be collected by means of observation, questionnaire, interview, supervision etc. Attention should be paid to their suitability.
- **Sub Simple, Variable and Hypothesis:** First of all, if any theory or conceptual framework has been made the base in this field, then it needs to be mentioned. In this context the main concepts should be clarified. To validate them, their working definitions should be given. It can be told that which objects are

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being made the central subject and which hypothesis have been made related to them. The formulation of hypothesis validates the investigation and the direction of research, boundary area etc. are determined in them.

- **Analysis and Selection Material :** After it is collected, its tabulation, classification and analysis systems can be indicated. What methods will be used in its selection? Or what will be the degree of its generality or authenticity? By and large these things can be mentioned in modulated quantities.

2.8 Purpose of Research Design

Karlinger has proposed two basic objectives of research :

- Providing answers to research questions
- Controlling differences

In general, research design does not do all these things but only the researcher does. Design helps the researcher to find answers to the research questions.

The purpose of a research plan is to provide information about :

- What is the subject of research?
- Where is the research being done?
- How is the research being done?
- What is the goal of research?
- What is the research concept?
- What are the procedures being followed in research?
- What is the timing and paradigm of the research?
- What are the data collection methods and techniques?
- When, why and how will the data collection be done?
- How will the data analysis be done?
- What is the research time?

2.9 Elements of Research Design

Following are the basic elements of research design :

1. Introduction, 2. Problem and its Region, 3. Literature related to the Subject, 4. Objective of the topic, 5. Definitions of Terms,

6. Population and Place, 7. Hypothesis, 8. Limitations of Study, 9. Method of Research, 10. Outline of Chapters.

2.10 Types of Research Designs

There are four categories of research design :

2.10.1 Descriptive Research Design

Descriptive research design enables a researcher to describe a picture or scenario of the phenomenon to be explored. The methodology used in this type of research design is qualitative in nature. *For example;* written or spoken-word and observable behavior. The purpose of such research designs is to describe a situation or event. These studies study the whole or part of the life of an individual, community. It describes the characteristics of a group or situations. After this, the frequency of the variables is ascertained and after that the final task is to find about the associativity of the variables. The three methods to analyse and record behavioral patterns basically are :

- (i) Personal Documents,
 - (ii) Unstructured Interview and
 - (iii) Participatory Observation.
- (i) **Personal Documents:** Personal documents are the documents in which the entire life or part of life or the account related to a particular case or business is kept. These personal documents can be in the form of an autobiography, diaries, pages etc. Personal documents are presented in the original format or as an edited version. Researchers can also generate personal documents by in-depth interview.
- (ii) **Unstructured Interview :** Unstructured interview provides more flexibility to the respondent. In fact, in the unstructured interview, there are no predetermined questions, but the questions are provided according to the situation. The conversation is held with the respondent in a very informal room and it is tried that maximum information is collected from him.
- (iii) **Participatory Observations :** In participatory observation, the researcher observes the behaviour of a group conducting study/ observation by becoming a member of that group. In this, the researcher tries to analyze and understand the subject matter

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and activity being observed. Care should be taken that the data collected in participatory observation is collected carefully and systematically. There are three phases of participatory observation as a research design :

- (a) **Pre Field Work :** Pre field work refers to the decisions that the observer or researcher should take before entering the field of work. The researcher must make initial contact to do his research work.
- (b) **Field Work :** There should be comprehensive questions in the mind of the researcher that have to happen in that group and information should be collected only when those events happen. In participatory observation, the researcher should keep in mind that he asks questions in such a way that the same topic emerges in his mind as more answers. Such a situation should be created that without any pressure, those things are presented, whose answers the researcher wants. When that subject matter emerges, the observer can then explore his specific hypothesis.
- (c) **Data Analysis :** Data analysis is the process which we need to make efforts towards making statements formally. Only after this the hypothesis propounded by us is either confirmed or unconfirmed.

In the words of **Krishna Kumar**, "Descriptive research is concerned with functional relationships. It is suitable for applied sciences because many types of behavior cannot be studied in the natural state. It is useful for the study of interactions, hypothesis validation and development of generalizations, formulas or theories, between variables which have global recognition."

2.10.2 Exploratory Research Design

In exploratory research design new facts are discovered. The purpose of this design is to assist in the formulation of research problems and hypotheses. Detailed information is explored about limited knowledge in this type. The exploratory research design is systematic and scientific. The advantage of this research design is that it is studied with precision.



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According to Krishna Kumar, "Exploratory study can provide ideas and hypothesis that cannot be realized in any other way."

According to Saltz and Jahoda, "The exploratory research design is essential to gain experience which will help in formulating related hypotheses for more definitive discovery."

The focus is on discovering new ideas and insights in this research design. C.R. Kothari has given three methods in this research design :

- (i) **Survey of Related Literature :** This method is very simple and beneficial in determining the research problem or development of hypothesis. The hypothesis put forward by previous researchers are reviewed and checked if they can be the base for further research. Along with this, it is also seen that the previously stated hypothesis are giving suggestions in relation to new hypothesis, that is, the researcher reviews and evaluates the literature already presented, after that on the basis of that material, the new hypothesis is presented.
- (ii) **Experience Survey :** Experience Survey means that people having practical experience on the research problem being studied are surveyed. The main objective of this survey is to gain insight into the variables and new ideas related to the research problem. In this, qualified people are selected who can contribute to this new research problem. These selected respondents are interviewed by the research scholar. For the interview the researcher should prepare the interview schedule. In this, while conducting the interview, it should be taken care that there should be enough flexibility in the interview so that the respondent can raise new issues and questions which were not covered by the researcher. It would be good that the researcher should present the interview schedule to the respondent in advance so that after reading it, they become mentally and intellectually prepared for the interview in advance. This type of survey is very beneficial in providing information to the researcher about the practical possibilities in different types of research.
- (iii) **Analysis of Motivation Examples :** Survey of motivation *examples* is a useful method for suggesting hypothesis for

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research. It is especially suitable for areas where experience is lacking to provide guidance. In this, we study in depth about selected *examples* of the phenomena in which we are interested. For this, if any records are available, they can be examined and can conduct unstructured interviews or adopt any other.

2.10.3 Diagnostic Research Design

Diagnostic research design is concerned with the solution of a specific problem. In the words of Krishna Kumar, the diagnostic research design enables the researcher to determine the frequency of occurrence of an event or its association with others. It provides problem solving strategies to the problems faced in the field. Following are its steps :

- (i) **Interview or Case Study** : A skilled interviewer can use his/her skills and experience in order to get maximum useful data and information. He/She must maintain professional objectivity. In this way personal information can be collected through interviews.
- (ii) **Clinical Observation** : Clinical observation can be used for motivational coordination and development and individual adjustment.
- (iii) **Formal Standardized Tests** : Formal standardized tests are used to test different aspects of behaviour. Under this, intelligence tests, attention tests etc. are done.
- (iv) **Informal Testing** : Informal testing and observation of behaviour, provides a way to justify the conclusions drawn from clinical observation and interview.

2.10.4 Experimental Research Design

The experimental research design is based on the concept of experiment. Basically the experiment is a controlled search. The researcher not only controls the variables in the experiment, but also he can increase or decrease them as per his wish. Under this, the researcher can calculate the changes in the dependent variables by increasing and decreasing the independent variables. There are three



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basic principles of experimental design, which are as follows :

- (i) **Principle of Response** : According to this principle, an experiment should be repeated again. Results obtained from repeated experiments are more reliable. These results are more reliable than results that have not been replicated. Therefore, special attention is required while testing this response theory.
- (ii) **The Principle of Randomness** : This principle protects us against the effects of external elements through randomness. In this we should adopt random sampling techniques while doing the experiment. The advantage of this is that if we apply the principle of randomness, then we can protect ourselves from the influence of external elements.
- (iii) **Principle of Local Control** : With the help of the principle of local control, experimental defects which come due to the variability of external factors can be removed.

Research design is a major step in the research process. Which research design should be selected is based on the problem chosen by the researcher, the nature of the problem, utility and ability of the researcher. The selection of a research design or a combination of research design depends exclusively on the fact that they come up with a suitable and correct solution to the research problem taken up. Therefore, the researcher should choose the research design very carefully. The researcher needs to pay adequate attention to each step in the research.

2.11 Research Problem

The research done to solve a problem is known to the researcher as a problem. Which the researcher experiences theoretically, experimentally and wants to find its solution. We can also say it in this way that it is the statement which the researcher has propounded. It is a proposed question whose solution is to be sought or a statement which is to be tested. According to **Karlinger**, "A Problem is an interrogative sentence or statement in which a relationship is established between two or more variables."

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2.12 Components of a Research Problem

Following are the components of a research problem :

- It is necessary that a person or group has a problem. If this person or group wants to solve the problem through research, we will call him Research Consumer.
- The research consumer must have an objective, goal or desire, so that it can be obtained through research.
- To achieve the objective of the research problem, it is necessary to have an alternative medium.
- Doubt must remain in the mind of the researcher regarding the choice of alternatives *example* if there is doubt in the mind of the researcher, then he must decide which way is better and effective.
- The research problem should be such that it requires the researcher to find the best solution to the problem.

2.13 Formulation of a Research Problem

Selecting a research problem is not an easy task. Any research problem to be selected should be selected very carefully. Before selecting the research problem, the researcher should do a thorough study. A comprehensive overview of research reports, research articles, etc. should be done on the research problem being selected. If the researcher does not have the knowledge of scientific method, then he will not be able to perform the research work well. The following criteria should be kept in mind by the researcher while selecting the research problem :

- The problem should express the relationship between two or more variables.
- Avoid selecting too narrow and too vague problems.
- Formulate the problem in such a way that through it the welfare of mankind can be done.
- Such a problem should be selected which can be used for an empirical test.
- While selecting the problem, keep in mind that it should be original. Originality is the basis of research.

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- The researcher should choose the problem according to his/her interest, that is, the research problem should be according to the interest and desire of the researcher so that better results can be obtained.
- While selecting the research problem, information about the studies already being done should be kept in mind.
- The research problem must be significant enough to justify the time, labor and money spent on it.

Gude and **Haat** have given the following criteria for problem selection :

- Interest, intelligence, curiosity and motivation of the researcher.
- Feasibility and Implementation Ability.
- The urgency of the problem.
- Estimation of expected results and their importance to the field being represented.
- Resources, training and individual qualifications of employees, specific equipments, methods, time and availability of sponsor, support of fans.

Cocharan and **Cox** have suggested that the prospective researcher should pose the following questions and choose the problem for research :

- Is the subject area of interest to me?
 - (i) Whether the interest is purely intellectual?
 - (ii) Whether the interest increases the financial rewards, possibility of advancement in position and power?
- Will the results be practical or apt for practical utility?
- Does the subject area present gaps in verified knowledge that need to be filled?
- Does the subject area needs to be reworked or improved?
- Does the subject area allow the expansion of enquiry beyond the current limits of verified knowledge?
- Is the subject area basic and important?

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Therefore, while selecting the problem, it should be kept in mind that the problem should be such that it provides a real solution to the practical and theoretical problems. At the same time, it should increase the current scientific knowledge in the limits or knowledge amount. The problem must be of contemporary importance as well as such, that it provides solutions to major human problems.

Description of some subject areas and topics to search in the subject area of library and information science are as following :

- Library classification and listing usage and application
- Readers' Information Requirement
- Information Seeking Behavior
- Computer Applications
- The Medium of Communication
- Text Material Protection
- Library Collection
- Library Support
- Library Exchange
- Virtual Library
- Application of the Internet
- Electronic Resources
- Teaching Methods
- Library Standards
- Information Consolidation and Repackaging
- Committee Studies
- Marketing of Library and Information Products and Services

2.14 Guidelines and Preparation of Good Research Design

A research design can be defined as the preparation of conditions, for the collection and analysis of data in such a manner, which aims at combining relevance to the research purpose with economy in procedure. In other words, the design arrangement of a research project is commonly known as the "research design". Besides, the decisions like what, where, when, how, etc., in regard to a research

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study, creates a research design. In fact, the research design is the conceptual structure within which a research is conducted. Moreover, it comprises the outline for the collection, measurement and analysis of data. Hence, the design carries a blueprint of what the researcher will do, from composing the hypothesis and its operational implications to the final analysis of data. Overtly, the design decisions happen to be in respect of :

1. What is the research?
2. Where and why will the research be conducted?
3. What data is required for the research?
4. Where can be the data found?
5. What will be the time period of the research?
6. What will be the sample design?
7. What methods will be used for data collection?
8. How will be the data analysed?
9. In which style will be the research report prepared?

Based on the above mentioned design decisions, the complete research design may be divided into the following parts:

- (a) **Sample design** : this deals with the technique of selecting items and thus requires careful observation for the given research study.
- (b) **Observational design** : this relates to the conditions under which the experiments are to be conducted.
- (c) **Statistical design** : this concerns the question of how many items are to be observed, and how are the collected data and information going to be analysed.
- (d) **Operational design** : this deals with the methods by which the procedures specified in the sample, observational and statistical designs can be conducted.

The essential characteristics of a research design are as the following :

- (a) It is a plan, which specifies the sources and types of data relevant to the research problem.

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- (b) It is a strategy, which decides the approach that will be used to collect and analyse the data.
- (c) Since most of the research studies are conducted under these two controls, it also includes the time and cost budgets.

In short, the research design must contain the following :

- (i) A clear and concise statement of the research problem,
- (ii) The population to be studied, and
- (iii) The various procedures, methods, and techniques to be used for collecting and analyzing the data.

2.14.1 Need for Research Design

Research design has a significant impact on the reliability of the results obtained. It thus acts as a firm foundation for the entire research. It is needed because it facilitates the smooth functioning of the various research operations. It makes the research as efficient as possible by giving maximum information with minimal expenditure of effort, time and money. For construction of a house, we need to have a proper blueprint prepared by an expert architect. Similarly, we need a proper research design or plan prior to data collection and analysis of our research project. Preparation of research design should be done carefully as even a minute error might ruin the purpose of the entire project. The design helps the researcher to organize his ideas, which helps to identify and correct his flaws, if any. In a good research design, all the components with each other or go together with each other in a coherent manner. The theoretical and conceptual framework must with the research goals and purposes. Likewise, the data collection strategy must fit with the research purposes, conceptual and theoretical framework and approach to data analysis.

The need for research design is as follows :

- It reduces inaccuracy;
- Helps to get maximum efficiency and reliability;
- Eliminates bias and marginal errors;
- Minimizes wastage of time;
- Helpful for collecting research materials;
- Helpful for testing of hypothesis;



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- Gives an idea regarding the type of resources required in terms of money, manpower, time, and efforts;
- Provides an overview to other experts;
- Guides the research in the right direction.

2.14.2 Features of a Good Research Design

When a researcher has formulated a research problem, he/she has to focus on developing a good design for solving the problem. A good design is one that minimizes bias and maximizes the reliability of the data. It also yields maximum information, gives minimum experimental error, and provides different aspects of a single problem. A research design depends on the purpose and nature of the research problem. Thus, one single design cannot be used to solve all types of research problem, i.e., a particular design is suitable for a particular problem.

A research design usually consists of the following factors :

- (i) The means of obtaining information;
- (ii) The availability and skills of the researcher and his staff, if any;
- (iii) The objective of the problem to be studied;
- (iv) The nature of the problem; and
- (v) The availability of time and money for the research work.

If a research study is an exploratory or formulative one, i.e., it focuses on discovery of ideas and insights, the research design should be flexible enough to consider different aspects of the study. Similarly, if the study focuses on accurate description or association between variables, the design should be accurate with minimum bias and maximum reliability. However, in practice, it is difficult to categorize a particular study into a particular group. A study can be categorized only on the basis of its primary function and accordingly, its design can be developed. Moreover, the above mentioned factors must be given due weight age while working on the details of the research design.

2.14.3 Research Design: Important Concepts

In order to facilitate a clear and better understanding of the different research designs, it is initially necessary to define all the various important concepts of research design itself.

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- 1. Dependent and independent variables :** A variable is a concept that can take on different quantitative values. E.g., weight, height, income, etc. A dependent variable can be defined as the variable, which depends upon or is a consequence of the other variable. On the other hand, an independent variable can be defined as the variable that is antecedent to the dependent variable. E.g., if height depends upon age, then height is a dependent variable, while age is an independent variable.
- 2. Extraneous variable :** Although, the independent variables are unrelated to the study purpose, they might however affect the dependent variables, known as extraneous variables. E.g., When a researcher investigates the hypothesis of the relationship between children's gains in moral studies achievement and their selfconcepts. The self-concept denotes an independent variable, whereas the moral studies achievement denotes a dependent variable. However, intelligence may also affect the moral studies achievement, but as it is unrelated to the study purpose, it will thus be called an extraneous variable.
- 3. Control :** The most significant quality of a good research design is to reduce the influence/effect of extraneous variables. Control is a technical term, which is used while designing the study, by reducing the effects of extraneous independent variables. Besides, in experimental studies, the term control refers to the restraining of experimental conditions.
- 4. Confounded relationship :** In case the dependent variable is bound by the influence of extraneous variable, the relationship between the dependent and independent variables is known to be confused by extraneous variables.
- 5. Research hypothesis :** This can be defined as the prediction or a hypothesised relationship that needs to be tested by scientific methods. Besides, it is a predictive statement, which connects an independent variable to a dependent variable. Moreover, a research hypothesis needs to contain, at least, one independent and one dependent variable.
- 6. Experimental and non-experimental hypothesis-testing research :** When a research aims at investigating a research hypothesis, it is known as the hypothesis testing research.



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However, it can be of the experimental or the non-experimental design. On the other hand, a research in which the independent variable is manipulated is known as the experimental hypothesis-testing research, while the research in which an independent variable is not manipulated is known as the nonexperimental hypothesis-testing research.

7. **Experimental and control groups** : When any group is exposed to the usual conditions of an experimental hypothesis-testing research, it is known as a control group. Whereas, when the group is exposed to some other special condition, it is known as an experimental group.
8. **Treatments** : This can be defined as the different types of conditions under which the experimental and control groups are put. E.g., In order to determine the comparative impact of three varieties of fertilizers on a crop yield, the three different varieties of fertilizers will be treated as three different treatments.
9. **Experiment** : This can be defined as the process of examining the truth of a statistical hypothesis, relating to some research problem. E.g., An experiment conducted in order to research the usefulness of a newly developed medicine. Moreover, experiments can be of two types :
 - (i) **Absolute experiment** The determination of the impact of a fertilizer on a crop yield is an example of absolute experiment.
 - (ii) **Comparative experiment** The determination of the impact of one fertilizer, in comparison to another fertilizer, is an example of comparative experiment.
10. **Experimental units** : These represent the pre-determined plots or blocks, where different types of treatments are used. Moreover, such type of experimental units must be selected, as well as defined, very cautiously and thoroughly.

2.15 Delimitation of the Problem

Delimitation of the problem refers to the determination of the boundaries of the problem or topic selected for research. This

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demarcation can also be from the subject matter, that is, how much of the subject has been taken or it can be demarcated by the geographical boundaries of the study. The geographical boundary can be village, town, district, division, state, etc. It is clearly mentioned in the sample by the researcher that which method of sampling has been taken and which one is to be studied. The demarcation of the problem is done not only from the geographical point of view, but the time period is also determined. Its advantage is that useful data is collected instead of taking applied data. Following steps should be followed for demarcation of research problem :

- (i) **Statement of the Problem in a General Way :** The problem should be presented in a general way. While stating the problem, it must be kept in mind that it should be of practical, scientific or intellectual interest. For this the researcher can do Pilot study. While stating the problem, it should also be kept in mind that the solution to be given must have a feasibility.
- (ii) **Understanding the Nature of the Problem:** While demarcating the problem, its nature and origin should be clearly understood. The easiest way to understand any problem is to find the objectives of that problem. Experts in the subject concerned should be consulted to better understand the nature of the problem. The researcher should take information about the problem to be studied, the nature of the problem, the environment and the area, from the experts having knowledge of that subject.
- (iii) **Surveying the Available Literature :** Before determining or demarcating the boundaries of a specific research problem, the researcher should survey the entire literature available related to that problem. So that the researcher gets knowledge of the principles, research reports, records etc. of the concerned field. He/She should review the research work that is going on or has been done. This will help the researcher to know the gap between the current theories. In addition, he will also know what difficulties he will have to face while studying. Survey of various studies will not only give useful suggestions to the researcher but also new methods or avenues for the present study are also known. Through this research will get a new direction.



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(iv) **Developing Ideas through Discussion:** The researcher should discuss with his colleagues, teachers and experts having expertise on that specific subject. The advantage of this discussion is that many ideas related to the problem are found. We also know it by the name of experience survey, if we talk to people who have experience, then something new comes out there. The advice of these experts is very important for the researcher.

(v) **Rephrasing of the Research Problem :** Lastly, the researcher should rephrase the process of the research problem in the form of a proposal. Once the nature of the problem is understood, the environment has been defined, discussions have been conducted, the available literature has been surveyed, then it is not a difficult task to rephrase the problem in analytical or functional terms. By rephrasing, the researcher presents the research problem in the form of specific terms as far as possible so that it is able to work practically. Also, it can help the researcher in developing the working hypothesis.

In addition, while demarcating the research problem, the following points should be kept in mind :

- (i) Whatever technical terms, words or phrases are used, what do they mean in research? Should be clearly defined?
- (ii) The basic concepts related to the research problem should be clearly stated.
- (iii) A clear statement of the value of the research should be given.
- (iv) While demarcating the problem, the sources of the available facts and the appropriateness of the period should be considered.
- (v) While determining the research problem, the scope of research and its limitations should be clarified.

2.16 Steps in Research Process

Research is a means of acquiring new knowledge. In research, the researcher goes through several stages to complete the research work. The researcher should pay special attention to each step in the research process so that the research can be completed safely. Each

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step of the research process should be planned in detail. At each stage, wherever the researcher feels that there is some deficiency left or there is a need for amendment or change, then necessary changes should be made accordingly. No work in research is final. The research process has to go through the following stages at different levels :

2.16.1 Identifying of the Problem Area

In this first step the researcher identifies the research problem example the specific area in which he/she has to do research. It should be remembered that the research problem should be such that it enhances the knowledge and is of contemporary use. Work can be done in various areas of library and information science, such as classification, indexing, abstraction, reader need perception, etc. The research problem area can be identified by the teacher of library science and the professionals working in the library on the basis of their specific experiences. For teachers, specific methods of teaching-learning may be the problem area, whereas for librarians, the tendency or behavior of the readers to seek information may be the problem area.

2.16.2 Formulation of the Specific Research Problem

In this, the researcher selects a specific research problem, that is, he creates a state of mind to work on a specific area and presents the specific research problem in sophisticated technical terms. The researcher should keep in mind that the research problem should be presented in effective and clear technical terms.

2.16.3 Thorough Review of Relevant Literature

In this, the researcher makes an in-depth study of the work updated by other researchers and scholars on the subject related to his specific research problem. The researcher studies the study material available in research dissertations, articles and other formats related to research. Along with presenting the summary of the research work done so far, the researcher also prepares a summary of the research method, data collection method and technique, data analysis technique, etc. The researcher should also clearly mention at this stage how his research work is different from the previous research work. In this stage, the researcher acquires important information about the relevant subject area.



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2.16.4 Selection of Appropriate Research Method

In this step the researcher has to choose the appropriate research method. Every problem is of a specific type and its solution can also be found with the help of a specific research method. If the time dimension is taken as the basis, then three possibilities are visible :

- Related to the past tense
- Related to the present tense
- Related to the future tense

The following are the research methods to find answers to the problems related to the appropriate three periods :

- Historical Research Method
- Survey Research Method
- Experimental Research Method

Historical research methodology is useful for the research problem in which the researcher has to find answers in the past. *For example*, "Development of libraries during pre-independence era in India", "Contribution of Dr. S.R. Ranganathan to Library and Information Science". In this research method, an attempt is made to find solutions to current situations and problems on the basis of the past.

In survey research methodology, those problems are studied which have to be discovered from these present circumstances. This method is most commonly used in social sciences. It includes reader-surveys, library-surveys, community-surveys, etc. *Examples*, "Rural readers information seeking behavior."

In the experimental research method, those research problems are studied, the answer to which is to be discovered in the future. Under this, if we want to do something new or want to change the present conditions, then the future situation has to be estimated. To estimate the future situation, the experimental method has to be followed and in this, the future situation is estimated on the basis of re-experimentation. This method is mostly used in the natural sciences. *Example*, "Virtual Libraries : Future Libraries".

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2.16.5 Formulation of the Research Hypothesis

In research, the hypothesis is to estimate the results of the research before collecting the data. A hypothesis is an intelligent prediction. Before rendering it, the researcher should think carefully. This hypothesis can be made on the basis of predetermined theories, similes, personal experiences or only hypothetical ideas.

2.16.6 Selection of Data Gathering Techniques and Tools

There are several methods of data gathering. The researcher should use these techniques according to his problem. Each technique is useful for a specific type of research. Therefore, the researcher should choose the research techniques according to his research work. The techniques and tools of data gathering are as follows :

- (i) **Observation** : This technique is used for data gathering in observational research. This technique is very useful if the behavior of an individual or a group is to be studied under certain circumstances. Krishna Kumar has given three components of it : Sensation, Attention, Perception. In cognition, we use sensory organs (like eyes, nose, ears, etc.). Attention refers to the ability to concentrate on the subject matter being studied. Perceptual knowledge enables a person to recognize facts, through experience, self-analysis and cognition.
- (ii) **Measurement** : The researcher uses measurement in research. Various methods of measurement are followed to achieve the objectives set by the researcher.
- (iii) **Questioning** : In asking questions, the researcher uses a questionnaire, schedule or interview technique. In the questionnaire, the researcher prepares a questionnaire and gives it to the respondents by post, e-mail or personally. Respondents read this questionnaire and do the answer book. Whereas in the schedule, the researcher fills the answers himself by asking questions to the respondents, in the interview, the respondents and the researcher sit face to face and communicate.

2.17 Meaning and Structure of Hypothesis

When any difficulty arises in front of a person, then he also starts thinking of ways to solve it. As a result, the solutions that come



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to his mind are the only possible solutions to the problem. It is another matter whether it may not be proved to be true or be proved to be true later. *For example*, a student is repeatedly declared unsuccessful in the examination. To know what is the reason for this, it is handed over to the psychologist for research. To solve the problem, the psychologist imagines the reasons for his failure. Maybe he lacks intelligence, maybe he is already weak in reading and writing, maybe he has become unwell at the time of examination, maybe he is not interested in reading and writing, etc. hypothesis may be possible. Which of these is true and which is false, it will be known later only by testing. Thus hypotheses are, in a way, possible solutions to a problem. If the problem is posed as a question. (*e.g.* Why does a student fail over and over again?) So these hypothesis can be considered as possible answers to this question, but it is at this point that scientific research begins.

In the words of **Townsend**, "Hypothesis is the proposed answer to the problem."

Parikalpna is the Hindi version of the English word 'hypothesis', which means a belief that is still unconfirmed.

In the words of **Hodnett**, hypotheses are the eyes of the researcher by which he peeps into the problematic disorder (disordered facts) and finds solutions to the problem in them. According to **Van Dalen**, hypothesis is an intelligent guess of the researcher about the solution of a problem or the answer to a problematic question. He considers a hypothesis to be a solution to the problem, which is only in the form of a suggestion. **Karlinger** believes that hypotheses is an imaginative statement related to the relation between two or more variables; *for example* : 'intelligence affects the academic achievement of children' it is a hypothesis. It envisages a special kind of relationship between intelligence and academic achievement.

When a problem arises in front of a person and he is trying to find a solution? So first on the basis of his knowledge, experience, study etc. he imagines that what can be its possible solutions? Similarly, when trying to find the answer to a question, first, imagine what its possible answer might be? He presents these possible solutions, possible answers in the form of generalizations, and then tests whether they are true. These general assumptions are called hypotheses. This way hypothesis in words of **Best** (1977) is an inference, which is

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made temporarily to explain the situation, events and circumstances and helps in furthering the research work *i.e.*, later if it is verified by testing then the problem is resolved and the situation becomes clear.

Everyday we solve the problems that arise in our daily life in this way (*i.e.*, formulation of hypothesis and then testing it). The light in the room is suddenly extinguished, immediately the person asks himself "What happened? A problem has arisen. To solve this problem, he formulates and tests one hypothesis each to find answers to these questions." At last, the situation becomes clear. First makes a guess *i.e.*, formulates the hypothesis "Perhaps the electricity has gone from the source itself. He goes out and looks at the houses and finds that electricity is there in everybody else's houses. Hence this hypothesis turns out to be false. Then the second hypothesis states, "The fuse of his own house has blown." He tests the fuse by removing the cut-out and finds that there is no fault in it. This hypothesis also proves to be false. Then the third hypothesis is made "Maybe the bulb has fused". On testing the bulb, it is found that it is fused. This hypothesis proves to be true. By reaching this point, the problem can also be solved and the whole situation is clear. This is the process behind finding a solution to all problems and hypotheses (predictions, possible answers and solutions) play an important role in it. Research is also a specific and scientific process of problem solving. So in research as well hypothesis plays a vital role.

Hypothesis is to make predictions about 'what is', 'why is it' about what is known.

2.17.1 Characteristics of Best and Effective Hypothesis

Following are the characteristics of the best and effective hypotheses :

- (i) It must be testable.
- (ii) Must have an estimate of relationships between two or more variables.
- (iii) It should provide clear answers to the research questions.
- (iv) It should be credible and logical.
- (v) More and more generalization should be possible by hypotheses.



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2.18 Types of Hypothesis

Behavioral scientists use many types of hypotheses in their research. Various authors have classified them in many ways. Their details are mentioned below :

2.18.1 Classification of Gude and Haat

Gude and Haat (1952) have mentioned three types of hypotheses. They have made this classification on the basis of, what is the level of abstraction expressed in the hypothesis? If the level of research is high, then the level of hypothesis will also be high. It depends on how abstract the conclusions or generalizations are of the research. From this point of view hypotheses are of three types : (i) lowest level (ii) higher level, (iii) highest level.

(i) **Lowest Level Hypothesis :** This level of hypothesis is found only in simple level research and portrays some empirical similarities (uniformities). They were very simple in the form of conjectures and statements; like; 'Eleven year old kids are very sensitive, the average of eighth grade students' IQ is between 90-100, the economic social condition of the backward classes of India is not satisfactory etc. These are all hypothesis of ordinary level research.

(ii) **Higher Level Hypothesis :** Higher level hypothesis from above are based on the mutual relations of concepts. The level of abstraction of the similarities is high in this. It expresses an abstract concept embodied in similarities. The purpose of research based on this type of hypothesis is an in-depth study of the phenomena.

For example, eleven-year-old children are more sensitive due to rapid physical changes.

The purpose of research in this hypothesis is not only to know whether children are sensitive or not, but further to know whether their sensitivity is due to the rapid physiological changes taking place within them. Therefore, this hypothesis has become somewhat complex rather than simple.

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- (iii) **Highest Level Hypothesis** : The highest level of abstract thinking is contained in this level of hypothesis. Therefore, this level of research is the most complex. The first and second level hypotheses are concerned with the "what is", while the third (highest) level hypotheses are concerned with the "why". On the basis of these higher level theories and laws are developed. *For example*, speculating as to why and how physiological changes increase sensitivity would lead to the highest level of hypotheses. One has to find that link which is somewhere in some other chain, connecting the under experienced similarities of physical change and sensitivity. In this situation the level of thinking will be the most abstract. The complexity of the research will also be enormous. The formulation of such a hypothesis will depend on the high level of creative ability and imagination of the researcher.

From the point of view of how the hypothesis is stated, there are two types of it. These are : (i) Question form and (ii) Declarative form.

- (i) Questionnaire hypothesis are in the form of questions, such as "Does the home environment affect the psychological development of children?" Some researchers prefer to present the hypothesis in the form of a question itself.
- (ii) Declarative hypothesis is in the form of an assertion. It contains an approximate declaration of a fact. This fact is in the form of a prediction about the state of the event or the traditional relationship of the variables. This is just a simple statement, as 'the home environment affects the psychological development of the children'. Most researchers present hypothesis in this form.

There is no difference between the above two forms. There is only a difference between writing and speaking. From another point of view, hypotheses are divided into two categories : (i) Experimental Hypothesis and (ii) Statistical Hypothesis.

- (i) **Experimental Hypothesis** is also called substantive hypothesis, scientific hypothesis, research hypothesis,



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operational hypothesis, general hypothesis, empirical hypothesis and alternative hypothesis H_1 , they can be expressed in both question form and declarative form. Also they can be of any of the three levels : lower, higher and highest.

- (ii) **Statistical Hypothesis** is also called null hypothesis, H_0 . The experimental hypothesis cannot be tested directly on its own basis. Hence it is tested indirectly by converting it into a statistical hypothesis. Statistical hypothesis is tested by statistical method. In this test, the experimental hypothesis is accepted by rejecting it. *For example*, "Home environment affects children's self-concept." When this experimental hypothesis is converted into a statistical hypothesis, it will be expressed as "the home environment does not affect the self-perception of the children".

Statistical and Experimental Hypothesis are also of two types from another point of view :

- (i) Directional and (ii) Non-directional.

The directional hypothesis is also called the one-tailed hypothesis. It determines the direction of differences of comparable groups, that is, on which side of the probability curve to take the mean of one group above or below the mean of the other group. In this, only one end of the probability curve has to be used, *e.g.*, the educational achievement of boys is better than the educational achievement of girls. Converting this to the null hypothesis, it would be "Scholastic achievement of boys is not better than that of girls". To test this hypothesis, the mean of the educational achievement of the girls will be placed in the middle of the probability curve and the mean of the boys will be placed at the upper right end of it. The difference will be located only at one end of the curve.

The non-directional hypothesis is also called the two-tailed hypothesis. In this, the difference of the mean of the groups will be taken only at one end of the curve, it is not specified. This difference is located at both the ends, that is, the direction of the difference is not specified in it, as in "There is a difference in the intelligence of boys and girls"

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("there is no difference" in statistical terms). In this hypothesis it is not specified how much the mean of an intelligence is greater or less than the mean of another group. Just to see if there is a difference or not. If the mean of children's intelligence is placed at the center of the probability curve, then the mean of girls can be either to the left or right of the center of the curve, if less than the mean of boys, then to the left and if greater then to the right. Whichever side it is, there will be a difference. This has to be tested. That is why this type of hypothesis is called a two-tailed or non-directional hypothesis. It is known only by the statement or writing of the hypothesis whether it is directional or non-directional. These words are used in the non-directional "there is difference" or "no difference", but in the directional "there is less", "is more", "is better", "is good", "is bad" etc. words are used.

2.19 Sources of Hypothesis

It is clear from the various definitions given by different scholars and its analysis that hypothesis is a testable statement made about the possible relationship between two or more variables. It is constructed in the form of a proposed answer to a problem in any type of research experimental or non-experimental. It can be of simple, complex, universal, existential, alternate, null or statistical form. Whatever its form may be, the purpose of hypothesis is to test the theory, to prove new theories, to promote statistical analysis of variables, to give the right direction to research, to describe a phenomenon, etc. What is the source of the hypothesis that is made to solve a problem? What are the supporting elements in the construction of a calculation, which give a researcher an understanding or insight to formulate different types of hypothesis, in this regard scholars, researchers and experts have given the following sources :

- (i) **Cultural Value of Society** : Every society has its own cultural value. *For example*, in American culture, where individuality, mobility, competition and equality are emphasized. Therefore, if a researcher wants to study American culture, then he has to build a hypothesis relative to the values there and if he wants to study Indian culture, then the hypothesis will have to be constructed in the context of the cultural values here. The hypothesis related to the study of Indian culture can be that "voting behavior in India is related to caste."



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- (ii) **Previous Research :** In the formulation of the hypothesis, inspiration comes from the research done in the past. Due to the in-depth study of the results of earlier research, sometimes some such shortcomings are found in them related to calculation, analysis, inference and generalization. On the basis of them, a new calculation can be made and their investigation can be done. *For example*, if a researcher is studying student riots and a gap is found in previous research, it can be calculated that "Students studying in college or university for more than two or three years are more likely to present more interest in study related to students' problems in comparison to students studying in first year." In addition, he/she can also formulate such a hypothesis that students with low ability and high social status participate less in student riot or protest than students with high ability and high social status.
- (iii) **Research Books, Magazines, Journals, Research Abstracts etc. :** Nowadays literature related to research is scattered in every field of knowledge. Research is a journal, there are periodicals related to the topic of research and there is enough literature available on this set as well. By studying the literature related to the problem, the researcher gets comprehensive information about new relations and facts and this facilitates the formulation of hypothesis. In psychology, the "American Psychological Abstract" is published by the "American Psychological Association". In India, Indian Psychological Abstract is published. In different countries different Psychological Abstracts are published.
- (iv) **Personal Experience :** The researcher often looks at ordinary events in a new way. There is often a new creative force, the power of reason, under his/her supervision. Newton's understanding seeing the fruit falling, Darwin's understanding of the relationship between the living beings etc. were related to researchers' personal experiences. These experiences give birth to new hypothesis.

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- (v) **Conversation and Discussion with Experts :** Sometimes researchers have to take help from subject experts in the formulation of the hypothesis. By talking and discussing the problem with those who are authorized persons of any subject the researcher can build hypothesis. On taking guidance from the subject expert the researcher gets convenience in moving towards solving the problem and making a suitable solution.
- (vi) **Understanding or Sudden Inspiration :** If the researcher asks to solve a research problem and has found a solution through his contemplation, then sometimes he gets a sudden inspiration and is engaged in finding the proposed answer to the problem solution and provides the direction to research. This is often seen in exploratory experiments. Newton's experiments were based on a sudden inspiration or understanding of Archimedes' experiments.
- (vii) **Conformity in Study :** Sometimes comparative experience also helps in formulation of the hypothesis. *For example*, the explanation of human behavior through the study of animals and birds behavior is also a type of discovery of new hypothesis. In medical science, psychology, etc. even today, large-scale research on animals, birds is applied to human beings on the basis of analogy, hypotheses are formed.

2.20 Importance or Purpose of Hypothesis

- (i) A hypothesis directs, monitors and controls the research efforts. It provides tentative explanations of facts and phenomena and can be tested and validated. Such explanations, if held valid, lead to generalizations, which help significantly in understanding a problem, and thereby extend the existing knowledge in the area to which they pertain and thus help in theory building and facilitate extension of knowledge in an area.
- (ii) The hypothesis not only indicates what to look for in an investigation but how to select a sample, choose a design of research, how to collect data and how to interpret the results to draw valid conclusions.



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- (iii) The hypothesis orients the researcher to be more sensitive to certain relevant aspects of problem so as to focus on specific issues and pertinent facts. It helps the researcher to delimit his study in scope so that it does not become broad and unwieldy.
- (iv) The hypothesis provides the researcher with rational statements, consisting of elements expressed in a logical order of relationships, which seek to describe or to explain conditions or events that have not yet been confirmed by facts. Some relationships between elements or variables in hypotheses are known facts and others transcend the known facts to give reasonable explanations for known conditions. The hypothesis helps the researcher relate logically known facts to intelligent guesses about unknown conditions.
- (v) Hypothesis formulation and its testing add a scientific rigour to all type of researches. A well thought set of hypothesis places a clear and specific goal before the researcher and equips him with understanding. It provides the basis for reporting the conclusions of the study on the basis of these conclusions. The researcher can make the research report interesting and meaningful to the reader.

The importance of a hypothesis is generally recognized more in the studies which aim to make predictions about some outcome. In an experimental study, the researcher is interested in making prediction about the expected outcomes and, therefore the role of hypothesis is considered to be of utmost importance. In historical or descriptive studies, on the other hand, the researcher is investigating the history of an event, life of a man, or is seeking facts to determine the status quo of some situation and thus may not have a basis for making a basis for making a prediction of results. In such studies when fact finding alone is the aim of the study, a hypothesis may not be required.

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2.21 LITERATURE REVIEW

2.21.1 Purpose of the Review

Review of related literature serves the following specific purposes :

- Review of related literature helps the researcher to determine the limits of his/her field. It also helps him to delineate and define his/her problem. In the example of analogy given by Eric and others, the researcher can say:
- “A, B and C have discovered so much about my question; our investigation of D has increased our knowledge so much. I wish to proceed with the work of 'D' as follows.”
- With the knowledge of related literature, the researcher becomes fully acquainted with the work done by other persons and can describe his objectives clearly and concisely.
- By studying the related literature, the researcher can avoid unprofitable and unhelpful problems, he can choose such areas in which beneficial research can be done and his efforts will lead to meaningful increase in knowledge.
- A review of the relevant literature will help him avoid inadvertently repeating already proven works. If the stability and validity of the results of the study have been well established, then it is pointless to repeat it.
- By reviewing the related literature, the researcher understands the research process, which gives knowledge about how to conduct the study. He also gets information about the instruments and tools used in earlier studies which were successful and useful. He also gets an insight into the statistical methods by which the validity of the results is proved.
- The last and important special reason for reviewing the related literature is to know what recommendations did the previous researchers recommend for further research in their study?

2.21.2 Identification of the Related Literature

The first task in reviewing related literature is to identify what material to read and evaluate. This identification can be done using



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the main and secondary sources available in the library.

In the main sources of information, the author reports his work directly through research articles, books, thematic articles, dissertations or research papers. Such sources provide more information than anywhere else available. From the main sources, the researcher gets the basis of his decision about the study. Although the researcher has to spend a lot of time taking the help of such sources, he gets good information about the research methods adopted.

In secondary sources, the researcher interprets the results obtained from the study by other people in a concise form. In them, the author often discusses all the important studies in that field, 'Encyclopedia of Education', 'Educational Indicators', Summary, List of Books or context and references from quoted statements. Working on secondary sources does not take much time because the material to be read is less. The biggest disadvantage in this is that the reader becomes dependent on someone else's decisions and ideas in the important and meaningful aspects of the study. The decision as to which of the main and secondary sources to use depends on the nature of the study chosen by the researcher. If it is about an area in which a lot of research has been done, then it would be logical to review the main source as the first step. On the other hand, if the study is in an area in which little or no research work has been done, then a review of secondary sources would be more rational. Both the sources of information, whether main or secondary, are found in the library itself. The researcher should acquire proficiency in using the necessary resources without wasting time or energy. A study guide is provided to the researcher to assist him in mobilizing, selecting and utilizing the resources, according to his use in his educational research.

2.21.3 Locating Sources of Information Through Library

The researcher should have complete knowledge of the facilities and services available in the library. He should also be familiar with the rules and regulations for the use and circulation of the material. Printed instructions are available in many libraries in which useful information can be found. It also has a map showing the location of books storage, periodicals section, reference section, study room, special collection of books, microcard device, handwriting texts, small periodicals. The instruction contains a list of periodicals that are taken

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in the library and lists the names of special indices, summaries and other reference materials. The rules for the use of storage places and reserved books, the method of obtaining reference material available in the library or the method of borrowing from any other library are also given in this instruction.

The researcher or other readers are often given a library card so that they can visit the storage site. They can locate the desired books and other reference material with the help of library personnel or independently. After using the books, it is desirable to leave them on the tables so that the personnel there can put them back in their designated place.

Sometimes a reference is not available in the library. In such a situation the reader's 'union' should check out the catalog which lists the references available in other libraries. Such references can be ordered by the library in the following ways :

- (i) **By Inter-library Loan System :** On reader's request from the library superintendent, the loan is taken from the library where it is available.
- (ii) **By Requesting a Photo-static Copy :** In this, the reader requests the library superintendent to get the page or pages that need a copy, from the desired source.
- (iii) **By Requesting an abstract or Translation of the Portion of a Desired Reference :** Some libraries have facilities for extracting summaries or translations from which the required portion of the summary or translation is obtained for a specified fee.
- (iv) **By Requesting Microfilm or Microfiche :** The reader can purchase a microfilm and view it on the library's equipment.

Due to its development, library and information services have received a very important contribution, which provides a system of cheap and convenient storage and distribution of scholarly materials for a long time.

Exercises

VERY SHORT ANSWER QUESTIONS

1. Write the definition of research design.
2. Write two features of research design.
3. Write four basic elements of research design.
4. Write the steps of diagnostic research design.
5. Write the components of the research problem.
6. Name the steps in the research process.
7. Write the definition of hypothesis.
8. How many types of readers are used to read microfilms?

SHORT ANSWER QUESTIONS

1. What is the need of research design?
2. Describe the objectives of the research design.
3. Briefly describe the exploratory research design.
4. Explain the demarcation of the problem.
5. Describe the objectives of literature review.
6. Write the guidelines for searching in the library.

LONG ANSWER QUESTIONS

1. Describe any three types of research designs.
2. Briefly describe the steps in the research process.
3. Explain the meaning of the hypothesis and briefly describe its types.

UNIT-2 Research Design



Note



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Research Methods and Techniques

3.1 Introduction

Research expands the boundaries of existing knowledge. As a result, there is continuous increase and revision in knowledge. Due to the diversity of research work, different research methods are used.

Good and Skateshas has given the following methods of research :

- Historical
- Ideal Survey
- Experimental

In fact, in research work one has to resort to different research methods and techniques at different levels or stages. Here research method refers to the method which is used to complete the research work.

Each research work is divided on the basis of its subject matter and method and techniques used for research. Some research method or combination of methods is used in all research. In this unit, you will be given detailed information about the major research methods- historical research, survey research, descriptive research and experimental research.

3.2 Scientific Method

The term seems misleading as every objective and verifiable method to discover new knowledge is always scientific in nature. Any new



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knowledge is valid only if it is discovered by scientific method. Commonly it means the methods used by the (pure and applied) scientists in their research, laboratory work and writings. Essentially any method of objective research, which attempts to investigate cause-effect relations between two entities, is scientific one. Research methodology, if it does not use the scientific method is not research at all. It means the other methods of research namely, survey, descriptive, case study, historical and of course the experimental method, are essentially scientific methods. Methods of research in social sciences and humanities are also scientific. Commonsense but rational approach used by a layperson in solving day-to-day problems is research. This could be best-applied scientific method to life and society. That is why it is rightly said by a philosopher that every man is a scientist. A crime investigator getting clues from the crime sites coupled with circumstantial evidence can easily reach the criminals. So a systematically and rigorously organised objective method of observation and co-relation of cause-effect between two entities is a scientific method. It is a standardised procedure for generalisation of data to formulate theories or to solve a problem.

3.2.1 Steps in Scientific Method

- Identification and formulation of the problem based on preliminary observations or data; or by doing an exhaustive literature survey on a topic.
- Formation of hypothesis, which requires lot of imagination and fertility of mind. (If it is a status or descriptive research then there is no need of any hypothesis).
- Collection of data, information or verbal opinions by any means (described in survey research).
- Collation, tabulation and classification of data and drawing of inferences in light of the general theory.
- Generalisation of facts and testing of hypothesis, and formulation of a further theory.

Objectivity or verifiability of the data or method is the rule of the game. Everything is transparent and open to questioning. The aim is to discover or create new knowledge, or to correct the existing facts or

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theories; or to generate a theory of cause-effect relation between two variables. Research may also be undertaken to generate information for decision making or solving a local problem. It may be warned that on the surface research, which seems a mechanical and straight process, in reality is complex, complicated and confusing requiring lot of hard work and ingenuity.

3.2.2 S.R. Ranganathan's Spiral of Scientific Method

To demonstrate that librarianship is a science S.R. Ranganathan (1892-1972) in the second edition of his classic *Five laws of library science* (1957) added a chapter entitled "Spiral of Scientific Method" to silence or convince the skeptics of the scientific nature of library science discipline. It is an overview and visual presentation of the method of science, which he says, moves like a spiral. That is it moves clockwise in a circle yet keeps moving onto new places. It means science is always progressive scaling new heights and discovering new knowledge. It accounts for the continuous growth of knowledge.

3.3 Historical Research Methods

History is a precise, detailed and meaningful record of human activities and achievements. History is not merely a description of events, but they are correct and tested records, as well as it presents a reliable explanation of the correlations between the events that happened. It also helps in understanding when, why, how a specific event happened? The researcher tries to understand the present in the context of the past, so that appropriate decisions can be taken for the future. The historical method is often used in research.

3.3.1 Meaning of Historical Research

In the words of F.L. Whitney, "Historical research analyzes the experiences of the past. Its purpose is to present reflection and analysis for the solution of social problems still unresolved by discovering the events, facts and attitudes of the past. Through this, the line and speed of development in human ideology are ascertained on the basis of social actions."

In the opinion of Richard F. Clark, "The method of historical research is the method or correct procedure for the discovery of historical truth."

In the words of Best, "The application of the scientific method of research to historical problems is historical research."

**Note**

3.3.2 Objectives of Historical Research

Historical research has the following objectives :

- (i) To find out the relevance of the present on the basis of the past. This will make it easier for scientologists and librarians to understand the present scenario on the basis of past events and trends.
- (ii) To find out the then library system, policies and ideals through the study of the past, as well as to find out their relevance or utility in the present.
- (iii) Correct the errors of the past in the present.
- (iv) To forecast the direction and development of librarianship.
- (v) To know the shortcomings of the present educational institutions, libraries etc. on the basis of history.
- (vi) To find out how a society or group behaved in a situation in the past? And why did they do it? And what were its consequences?
- (vii) To find out the sequence of events that happened in the past.

3.3.3 Importance of Historical Research

Historical method has an important place in various methods of research, as well as its importance in library and information science research is reflected by the following facts :

- (i) History describes the consequences of the events that happened in the past and introduces its merits and demerits. This helps in solving the unsolved problems of the present.
- (ii) This method explains the historical development of the present form of the subject.
- (iii) This method explains the importance of libraries in society and the relationship between society and libraries.
- (iv) Historical research removes misconceptions and superstitions.

3.3.4 Limitation of Historical Method

The limitation of Historical method are as follows :

- (i) Sources may not be reliable and may represent misleading facts about the events.

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- (ii) Not all past events can be studied because of the lack of evidence and source materials. It gets more challenging to have research if the events are from a more distant past.
- (iii) Finding a reason for certain events does not mean that the same reason can lead to similar events. Because it may have happened in a totally different circumstance in the past.
- (iv) The research may last longer, depending on the historical event and data availability
- (v) May require travels between various destinations.
- (vi) A researcher does not have control over the result.

3.3.5 Types of Historical Research

The types of historical research are as follows :

- (i) **Classical Studies** : Traditional historical studies are done in this.
- (ii) **Documentary Research** : Documentary research is a study based on documents in which records are also included.
- (iii) **Reference Related Study** : In this, the researcher makes a detailed study of the related problem or people and identifies other areas for research in the future.
- (iv) **Legal Research** : In this, the researcher studies the rules and regulations prevailing in libraries or library schools. Legal research for decisions related to a problem can also be used for analysis.

3.3.6 Steps of Historical Research

Following are the steps of historical research :

- (i) Identification and design of the problem
- (ii) Collection of data
- (iii) Formulation of Hypotheses
- (iv) Historical Criticism of Compiled Data
- (v) Interpretation and Analysis of Data
- (vi) Report Writing



Note

The steps of the above historical method are similar to the steps of the scientific method, however, there is no inspection, observation or testing step of events, because events that happened in the past cannot be repeated.

3.3.6.1 Identification and Design of Problems

The researcher should keep in mind that not every problem is suitable for historical research. Therefore, choosing the right problem is also a difficult task. The problem selected by the researcher for research must have historical importance as well as contemporary importance. Also such a problem should be selected on which sufficient facts or data are available. The problem should not be selected in such a detail that the research work cannot be completed. The problem should be selected keeping in mind a specific goal or objective.

3.3.6.2 Collection of data

After selecting the appropriate problem, the researcher collects the data of facts related to the problem. For the collection of data, the researcher uses two types of sources : 1. Primary source, 2. Secondary source.

3.3.6.2.1 Primary Sources

Primary source records are those human remains which are related to any event or are direct witnesses of the fact. They are the source of basic data for historical research. The information available from these sources is called primary data. The data collected by the researcher is also the primary source.

These primary sources are of two types :

- (i) **Remains :** This includes human remains, such as fossils, skeletons, tools, weapons, pictures, clothes, coins, utensils, buildings, food items, furniture, etc.
- (ii) **Oral Records :** This includes those records which are written and kept by the eyewitness or participant of the incident. These records may be in the form of oral or written evidence. It includes : constitution, declaration, laws, court decisions, letters, diaries, autobiographies, books, bills, receipts, magazines, newspapers, office records, maps, catalogues, films, library surveys, statutory records, bibliographies etc.

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The above material is a must for historical research. Historical facts are opened and compiled from the same material.

3.3.6.2.2 Secondary Sources

People who have neither witnessed the actual event nor have been a participant in that event, but have recorded or narrated in their own words the description expressed or narrated by others. The facts or data obtained from them are secondary sources. Although the truth remains present in them, along with the change in the original reality, there is a possibility of being defective. This type of data is rarely used in scientific research, but in historical research these secondary sources are used in abundance. A good researcher is expected to collect facts or data from primary sources as much as possible in his/her research. If facts or data are to be collected from secondary sources, they should be used only after verifying their validity or correctness. *Example*, historical textbooks and reference texts/sources etc.

3.3.6.3 Historical Criticism of Compiled Data

Generally, historical research is dependent on original records and these original records are due to exaggeration of facts due to printing error, because of the wealth, honor or profit of the author or because of personal worship. Or due to interpolation, many parts or facts may be erroneous. Therefore, it is necessary to check the reliability of the facts or data obtained by them, because on the basis of this reliable historical evidence, conclusions are drawn. The process by which the veracity of these facts or figures is checked is called historical criticism :

There are two types of historical criticism :

1. External criticism 2. Internal criticism

- 1. External Criticism :** Its purpose is to check the reality and authenticity of the data. Under this, various types of physical and chemical tests are done to find out the antiquity, reliability, truthfulness and genuineness of documents and remains. *For example*, physical and chemical testing of various types of materials, ink, paint, paper, cloth, stone, metal or wood etc. can be done by carbon-14 and fluorine test. From this the age of these substances can be known.



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Along with this, to find out the authenticity or correctness of the authorship, we can do a visual test of the signature, handwriting, script, type, spelling, language etc. From this their authenticity can be known.

2. **Internal Criticism** : The goal of internal criticism is that the collected facts and data validity should be established. After ascertaining the accuracy and authenticity of historical documents and remains following facts are taken into account :
- (i) Is this fact real?
 - (ii) Do they give a true picture of the event?
 - (iii) Who is the one to write them?
 - (iv) Is the author's attitude towards the incident not biased?
 - (v) Was the author very sensitive to the incident?
 - (vi) Was the author under any fear or pressure?
 - (vii) Was the author himself well acquainted with the incident?
 - (viii) How much time after the occurrence of the incident was it written down?
 - (ix) Did the author remember all the details of the incident?
 - (x) What is the similarity or dissimilarity between the author's writings and other similar articles?

Finding the answers to all the above questions is a difficult task, but it is necessary for the researcher to find that the points given by him are real and correct. Internal critique of historical facts is called internal criticism. Only after internal critique of the internal criticism, the researcher moves towards a conclusion.

3.3.7 Historical Research Method and Library Science

Historical research methods are being used in the field of library and information science. By using this method, we can study what happened in the past in the field of library and information science and what was the effect of those events. In addition to those events, by analyzing today's context, one can present an estimate of the future. Also the history, origin and development, education, working conditions, social impact, problems etc. of library and information science can be studied in depth.

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Researchers of library and information science can present a scientific study of the gradual development of the subject and the causes and consequences of one period on another period by using historical research methods.

3.4 Descriptive Research Method

Descriptive research describes the current conditions, systems, trends, etc., thus it is called the descriptive research method. This method has been used in social sciences. Some scholars do not consider it a separate research method because the use of descriptive methods is visible in all types of research. The main feature of this method is that the researcher does not have control over the variables. In fact, whatever has happened or is about to happen, the researcher just describes it. Many scholars also place the descriptive research method under the survey method. But the descriptive method is not limited only to the collection and presentation of data, but it also provides an important explanation of the facts being described of the variables and the usefulness of the data. In this method, the researcher makes comparisons and evaluations along with the description. By using this method, solutions to many problems of library and information science can be found. In library and information science also this method can be used in reader survey, work and activity analysis, employee reader motivation and other studies. Apart from social sciences, this method can also be used in physical and natural sciences.

Descriptive Method is also very useful for the development of Data Collection Tools and Resources like: interview, questionnaire voting, rating scale etc.

In this method inductive-deductive logic methods are used to arrive at the generalization.

3.4.1 Census Survey

Census survey means gathering pertinent information about all the units of population i.e., people, institutions, householders, etc. As you know, population may consist of persons, institutions, objects, attributes, qualities, families, etc. A population is a well defined group of many of these. For instance, the census survey of India, which takes place once in ten years gathers bench mark data about each and every household of India. Since it concentrates on each and every



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household it restricts its scope to certain surface level demographic data like age, sex, income, education, lands possessed, cattle, nature of house, domestic facilities available, etc. The studies are conducted through quick survey in a stipulated period. However, coverage of units are very exhaustive. The census survey as a method of research in education can be employed to understand educational problems and make policy decisions. For instance, attaining the goal of 'education for all' through 'Sam Siksha Abhiyan' you will have to stress on grass root level planning where the issues concerning accessibility of schooling, retention in classes and success in examinations of every child are to be dealt with systematically. In this context, gathering information about each child enrolled in a primary school would mean a census survey. Let us take another example. In a district, the base line data concerning each primary school on different dimensions like physical facilities, teachers, students, working days, hours of school, curricular practices, examinations and achievement of students can be gathered through a census survey. Gathering detailed information about each unit of population on a continuous basis can constitute a huge database. Such kind of database facilities on school education are encouraged through Education Management Information System (EMIS) at every district level in India. On the basis of hand database, one can establish trends of different events, rate of success or failure of certain programmes over a period of time, intensity of a problem, coverage of target group learners in a school system etc. Such analysis can be useful to frame broad research questions concerning different factors of educational developments, which may be answered through further research.

3.4.2 Sample Survey

Sample survey means gathering relevant information about a smaller representation of the population under study. The data gathered through sample survey are generalized to the population of the study. For example, opinion of a sample of distance learners drawn from a particular district towards usefulness of media in open and distance education can be generalized as opinion of all the distance learners of that district. Educational research invariably makes use of sample surveys.

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Reasons for Conducting Sample Surveys

Sample surveys are preferred to census surveys on the following rounds :

- (i) **Reduced Cost:** Data collected from a small fraction of population involves lesser expense than that of census survey.
- (ii) **Greater Speed:** Since the size of respondents is smaller than the whole population, the volume of data are smaller. Hence, it is economical in terms of gathering evidence, tabulating them and processing them quickly.
- (iii) **Greater Scope:** Unlike census studies where limited information is gathered from the whole population the sample surveys cover a wide range of data on different dimensions of the study.
- (iv) **Greater Accuracy:** With reduced volume of work using expert and trained personnel, and application of appropriate monitoring mechanism of data collection and analysis there is a greater chance of gathering valid data and its appropriate processing. Moreover, sampling is particularly more important in obtaining accurate results about phenomena which are undergoing rapid changes such as opinions about political and social issues and their impact on education.

3.4.3 Characteristics of Sample Surveys

Sample surveys have specific characteristics viz., application of appropriate sampling techniques with a view to ascertaining representativeness of units under investigation; use of appropriate data gathering tools, mainly, questionnaires, interview schedules, observation schedules and checklists/proforma for record surveys; and use of appropriate techniques of data analysis for drawing inferences about population.

You will study about the nature of sampling, data gathering tools and data analysis techniques separately in Block 3 and 4 respectively. However, you are required to keep in mind the following things while undertaking sample surveys :

- Whether the sample drawn from the population represents the same with high probability or not?



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- Whether the tools employed for data collection are specifically designed to gather evidence from identified group of sample units or not?
- Whether appropriate analysis techniques are applied or not in the context of specific objectives or not?
- With what probability the findings are generally stable to the population?

Examples of Sample Surveys

You may come across a number of studies in education, which are of status survey nature like :

1. Attitude of parents towards mid day meal scheme in primary schools.
2. Causes of dropouts among distance learners as perceived by teachers of IGNOU.
3. Attitude of university students towards Information and Communication Technology based education.
4. Teaching competencies of Primary school teachers.
5. Physical facilities of primary schools in backward districts of a state.

3.4.4 Cross Sectional Survey

Cross sectional survey can be understood as a kind of sample survey where standardized information is gathered from a sample drawn from a cross section of pre-determined population at one point of time. Hence, the sample respondents must represent different distinct segments of population or stages of development of events.

The segments may indicate different stages of school education like primary, secondary and higher or different modes of education like face to face mode and distance mode. It may cover the schools covered under a specific scheme like mid day meals and the schools yet to be covered under the scheme. It may also cover a sample of train teachers and inservice teachers yet to be trained etc.

The sampling techniques like random, stratified and cluster sampling are used in identifying cross sectional representation of population

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of the study. Hence the basic feature of cross sectional survey is associated with varieties of respondents covering different stages/status in the study. Another main feature of cross sectional study is that the information is collected at one point of time. Here one point of time refers to single slot of data collection stretching over a few days or months or more.

Types of Cross Sectional Surveys

Cross sectional surveys are classified into two types. These include :

- (i) Description of status of single variables
- (ii) exploring relationships between two or more variables.

3.4.5 Longitudinal Survey

Through longitudinal surveys one explores the status of variables as investigated on different points in time in order. Through such studies the changes in the status of the variables over a period of time are explored. Time-ordered associations of one variable's status at different period of time are also studied.

Unlike cross sectional study where past data are recollected by the respondents at one point in time, the longitudinal study deals with gathering actual evidences at different points in time in order. Hence, it is assumed that accuracy of data is ascertained to a higher level in longitudinal studies than that of cross sectional time-ordered study.

There are three kinds of longitudinal surveys viz.

- (i) Trend studies
- (ii) Panel studies
- (iii) Cohort Studies

1. Panel studies

In such studies the same group of sample respondents is studied over a period of time. For example, the attitude of a particular group of students towards school education is studied over a period of time. In another case the attendance rate and the achievement level of students enrolled in class I can be studied longitudinally till the same group of students clear the class V examination in a school. The problem of retention of sample respondents is associated with absentism or non-



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availability/non-cooperation of the same group of sample respondents in different phases of data collection.

2. Cohort studies

In the cohort study method a specific population is taken for study over a period of time. Different samples are drawn from a specific population over different phases of data collection corresponding to different phases/stages of development of events. For example, in a district prior to introduction of decentralized management system of primary education, the teachers' attitude towards management of the school system was studied. In the second phase, immediately after introduction of the new management system the attitude of teachers was studied. In the third phase, the attitude of the teachers was studied after completion of 5 years of introduction of the new management system.

In this case the teacher population was restricted to all the primary schools of a district covered under District Primary Education Project. (DPEP) Even though the population of the study was specific the sample respondents representing the population varied from one phase of study to another.

3. Comparative Survey

In comparative survey the purpose is to compare the status of two or more number of variables, institutions, strategies adopted or groups of respondents etc. In other words, you may be interested in comparing the achievement level of students enrolled in two different institutions assuming that the students of the two different institutions belong to the same population. In another study, you may like to compare the reaction of teachers serving in government and private management schools towards the leadership behaviour of their principals. Moreover, you may be interested to determine the superior nature of an innovative teaching-learning strategy adopted in certain schools with a traditional approach of teaching adopted in the same institutions in terms of achievement of learners.

4. Evaluative Survey

Evaluative survey is conducted with the purpose of evaluating a programme, a curriculum, policy etc. As you know evaluation

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means making judgment using terms like "Effective", "Fruitful", "Appropriateness", "Suitability" etc. Hence, when you intend to conduct empirical studies on identifying effectiveness of any programme functioning or programme output you may undertake an evaluative survey. Evaluation studies lead towards arriving at a value judgment about the worthwhileness of a programme or policy or institution. Two purposes can be served in the evaluation of programmes through surveys: (i) judging the effectiveness of the programme and (ii) taking decision for future course of action.

As a researcher you may be interested in studying judgment about the effectiveness of a programme or you want to undertake a decision-oriented study. You may present relevant facts about the status and functioning of a programme through evaluative survey. On the basis of such a study, policy makers or decision-making bodies may identify the strength and loopholes of a programme and take an appropriate decision to improve the situation.

You may come across a number of evaluative surveys conducted in the field of education. For example, "Impact study of children's radio broadcast programme on development of general awareness of primary students", "Effectiveness of adult literacy programmes in a district", "Impact of mid-day meal programme on enrolment, retention and achievement of primary schools" etc.

You may note that evaluation is done with the help of criterion measures. When we are interested to answer the question "how effective is it?", we come to a criterion issue: "effective" in terms of what? For example, effectiveness of adult literacy programme needs to be judged on the basis of a set criteria. The criteria may include the rate of participation of adult illiterates in a programme, reaching a minimum level of achievement by adult learners, satisfaction of participants about the functioning of a programme etc. Hence, you must take note of identification of appropriate criteria of evaluation which is followed by the selection of appropriate measures of criterion variables.

3.4.6 Documentary Survey

Various research questions need to be answered through analysis of data already available in the form of printed text viz., books, official



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records, research reports, review articles, research papers, information bulletins, handouts, prospectus, annual reports, periodicals, progress reports, experience of individuals, news items etc. For instance, the researcher is interested in comparing the existing status of teacher education programmes in SAARC countries. The researcher makes an analysis of available literature on teacher education programmes of countries under investigation like policy documents on education in general, and teacher education in specific, cumculum frameworks of teacher education, role and functions of quality control bodies on education, planning documents on teacher education, researches conducted on existing practices of teacher education, evaluation reports on teacher education programmes, committee reports, minutes of meetings, recommendations of education commissions, guidelines and norms prescribed by statutory bodies in education, recommendations of professional organizations and forums, seminar reports and proceedings on teacher education etc. There can be innumerable sources of obtaining documentmy evidences and conducting relevant studies.

3.4.7 Difference Between Documentary Survey and Historical Survey Descriptive Research

You may be curious to know how documentary survey is different from historical research since a historian makes a similar kind of analysis. The difference is simple and is seen in the context of time of occurrence of events under investigation. As a documentary surveyor you are interested in analysing present events from available records whereas as a historical researcher you may analyze past records to explore the incidences which occurred in the distant past. The similarity of both the approaches exists in the context of analysis procedure adopted in historical documents and present documents. For instance, the surveyor as well as the historian follow similar approaches of identifying relevant records for investigation, judging authenticity of documents, doing content analysis of evidence, codifying and organizing contents/information, reviewing the content, making interpretations etc.

3.5 Survey Research Method

The nature of uncontrolled events is studied by the survey method. In the survey method, the subject matter acts in an open

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form according to its behavior or nature and the researcher himself observes this natural form of the subject matter by going to the field. Mainly used to understand general or complex problems or to make a descriptive study of a community or group. Champin named it "Natural Experimentation Method." This research method is used the most in social sciences and applied sciences. This method is being used in the field of user study, community survey, employee survey in the field of library and information science. In this method, the answers of the questions are obtained from the respondents and they are used to solve the problem.

3.5.1 Definitions

- According to F.N. Karlinger, "Survey research studies, study large and small populations (or all-populations) on the basis of selected samples from them so that the related phenomena, distributions, and interrelationships of the social and psychological households embedded in them are to gain knowledge."
- According to Donald S. Tull and Gerald S. Albeam, "Survey method is the art and science of asking questions to obtain information and/or observing behavior."

Krishna Kumar has given three common elements in different forms of survey research, they are as follows :

- The method of gathering information is always systematic.
- It is always related to the population which is represented by the sample.
- It is always related to the behavior of the members of the population.

3.5.2 Features

The features of the survey method are as follows :

- It is related to contemporary and present circumstances.
- In this the target is always a group or a whole. The units of this group or whole are represented by a model.
- It is not related to individual characteristics, but the generalization of the characteristics of the whole is done on the basis of the model.



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- Through this method the solution of local and social problems is found.
- It is a scientific method of research because by selecting the correct model, by minimizing the errors, reliable data can be obtained.
- The scope of the survey is wide.
- Study by survey is more economical than laboratory based study. Because more information is available in the study by survey at relatively less cost and in less time.

3.5.3 Area

This method can be used in the following areas of library and information science :

- Reader Survey
- Community Survey
- Library Survey
- Information Requirement
- Information Seeking Behavior of Users
- User Studies and Trend Studies
- Means of Communication
- Mode to Use Information
- Elements Hindering the Dissemination of Information
- Process Analysis
- Evaluation of Library Services and Systems

3.5.4 Types of Surveys

Krishna Kumar has given the following types of surveys :

- Descriptive Survey
- Comparative Survey
- Evaluative Survey

The following are the types of other Survey :

- Social Survey
- Educational Survey

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- Market Survey
- Opinion Polls
- Diagnostic Survey
- Library Survey

3.5.4.1 Descriptive Survey

In a descriptive survey, facts are described at a given point in time. The descriptive method can be used to test theories.

3.5.4.2 Comparative Survey

In comparative survey, two or more research situations or facts are compared on the basis of some criteria.

3.5.4.3 Evaluative Survey

Based on the criteria or standards set earlier, evaluative survey for facts and research situations is done.

3.5.4.4 Social Survey

Social Survey is done keeping in mind any contemporary social problem.

3.5.4.5 Educational Survey

In this survey problems related to classroom, curriculum, teacher-learner relationship and educational environment are conducted.

3.5.4.6 Market Survey

Various companies to assess the status and extent of their products takes the help of a market survey.

3.5.4.7 Opinion Polls

Nowadays opinion polls are conducted to know the opinion of the people keeping in mind various objectives and the results obtained from them are published and disseminated by the media.

3.5.4.8 Diagnostic Survey

Diagnostic survey is used to diagnose a problem.

3.5.4.9 Library Survey

In this libraries, their activities, readers, staff, services etc., are surveyed.

3.5.5 Utilities or Importance

Survey method is of great importance in the field of library and information science because :



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- User status, attitude, inclination, difficulties, tendency to find information, information needs etc. can be studied.
- In this, the solution of various problems of the library can be found.
- The validity of various sources and principles of library and information science can be checked.
- The cause and solution of various problems of librarians can be found.
- Solutions to the difficulties in dissemination of information can be found.
- The difficulties in using new technologies and tools are understandable.

3.5.6 Steps of the Survey Method

The main steps of the survey method are as follows :

- **Identification of Problem Areas :** Identification and selection of research problem areas.
- **Statement of Objectives :** In this stage the researcher should formulate the objectives of the research. The research objectives should be based on the problem to be explored.
- **Formulation of Hypothesis :** Taking adequate care while presenting the hypothesis to the researcher needed.
- **Selection of Data Collection Method :** In this, it should be ensured that out of observation, measurement and question, which method is to be used.
- **Selection of Data Collection Technique :** Whatever method of data collection we use, we should ensure the technology under it. *For example*, observation includes direct observation, indirect observation, structured observation, unstructured observation, participatory observation, non-participatory observation, etc. Similarly questions should have a questionnaire schedule, interview (direct, telephone etc.).
- **Selection of the Whole :** The entire units or areas of research is a whole. It should be selected.

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- **Selection of the Sample :** Out of the whole, the researcher should select the sample by following the appropriate method of sampling. The sample should be such that it represents all the characteristics of the whole.
- **Data collection :** If a questionnaire, interview or schedule has been used in data collection and the area of the sample is wide, then the researcher should take the help of colleagues. Care should be taken that allies are given adequate training before they are sent to the field. Personal interest, disinterest should not affect collection anywhere. Researchers should maintain honesty. While collecting the data, it should be checked from time to time whether the data is accurate, reliable or not.
- **Data Analysis :** After data collection, prepare a code book for their analysis. The answers received from the respondents should be written in it. This work can also be done with the help of a computer. It should then be analyzed by application of computational and statistical methods. Adequate care should be taken while doing this work.
- **Interpretation of Findings :** The findings obtained from data analysis should be explained in the present context and reference. Any similarity or dissimilarity between the previously known findings and the findings of the present research should be clarified. It is very important to have a lot of skill and experience to do this work.
- **Report Writing :** Report writing should conform to the research criteria. The language should be simple and concise. In the research the figurative language should be avoided.

3.5.7 Limitations

Although the survey method is very useful in the social sciences, there are limitations to its successful implementation. The survey method is costly and time consuming. If the area is large then many workers have to be hired for the survey and expenditure has to be incurred on their training etc. At the same time, creating questionnaires for data collection, means of transport in remote areas and implementation takes more time and cost.

**Note**

3.5.8 Instruments of Survey Research

In the survey method, data and facts are collected by direct method. Care should be taken that the data should be collected from direct observation or from the original source only. Since these are primary sources, they should be collected from reliable and original sources only. The assessment of primary data and facts can be done by the following methods :

- Overview
- Interview
- Questionnaire
- Telephonic Survey
- Electronic Survey
- Combination of the above methods

The work of data collection should be done very carefully. Because the conclusions are based on these original data. The work of data collection can be done by the researcher himself or with the help of electronic devices. For this the help of any one, two or more methods can be taken.

3.5.8.1 Observation

Observation method is used in the social sciences to collect primary data. In this, the researcher studies a research situation. This can be done in many ways. *For example*, participatory observation, non-participatory observation, structure observation, unstructured observation, controlled observation and uncontrolled observation.

In participatory observation, the researcher observes the behavior of the group by becoming a member of the group being observed or studied. In this, the researcher does not join the group as an investigator but joins as a member of that group. It is very useful for studying the behavior of the readers. The behavior being done by the reader with the books in the store room can be observed. The drawback of participatory observation is that sometimes the researcher becomes emotionally involved with the group and there is no objectivity in observation.

In non-participatory observation, the researcher observes the group as an outsider. That is, the researcher observes the events happening away from the group. The drawback is that the group can change its behavior as soon as the presence of a different person from the group

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is perceived. Researchers can take help from modern equipment; *for example*, tape recorders, video cameras etc.

The units being observed in structural observation are well defined. Similarly, in non-structural observation, phenomena are observed in natural conditions without predetermined and well-defined conditions. Controlled observation is usually done in laboratories where the subject is kept under controlled observation conditions and observed. Uncontrolled observation is one where the situation is observed in the natural environment itself.

3.5.8.2 Interview

Interview has been considered as a primary data collection technique. Through this technology, the researcher collects facts and information by talking to a person.

There are many types of interview: structured interview, unstructured interview, clinical interview, centralized, telephone Interview, personal interview and group interview.

3.5.8.3 Questionnaire

Questionnaire technique is used to collect primary information on subjects like information needs of the users, method of information search, information seeking behaviour, reader satisfaction, dissemination of library products and services etc. In questionnaire technique, facts are collected by asking questions to the users. There are many types of Questionnaire Techniques : Structured Questionnaires and Unstructured Questionnaires Based on the nature of questions, it can be divided into limited, open, graphical, mixed questionnaires.

3.5.8.4 Telephonic and Mobile Surveys

Telephones are being used today to collect and to gather information in social and business surveys. Today, due to the expansion and cheapness of telecommunication technology, this technology is being used to collect information from the respondents. This technique is economical as well as saves time. It is a good medium to collect information from the respondents spread in remote areas and to know their opinion. In this, information is collected from the respondent through telephone or mobile. This technology is being extensively used in the service sector, entertainment sector and educational sectors.

**Note****Benefit**

- Live communication with the respondent is possible.
- In case the question is not clear, an explanation can be given.
- People prefer to speak rather than reply in writing.
- The response rate is high.
- Respondents and interviewers can do hospitality according to their convenience.

Fault

- Detailed discussion is not possible.
- Respondents can retract his statement if the statements are not tapped.
- Respondents must have a telephone or mobile facility.

3.5.8.5 Electronic Surveying

The development and availability of information technology has made the survey work simpler, cheaper and easier. Today survey work can be done with the help of the internet and e-mail. Formation of questionnaire in electronic form, sending it, receiving it back from the respondent, classification, analysis and presentation of data has become easy. Also this process can be done with precision and speed.

Benefit

- Web based survey is easy for both the respondent and the questioner.
- The cost is very low.
- Respondent can answer as per his convenience.
- No fear of missing the questionnaire.
- No restriction of geographical boundaries.

3.5.8.6 Combination of the above methods

Two or more of the above methods techniques are used.

3.6 Experimental Research Method

Experimental research is one such advanced scientific method, under which we have some subtle problem solutions that can be

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offered. This research method is also known as experimental research. This method is very practical from the point of view of meaning and utility because this study is done under controlled conditions. This research clarifies the fact that what will be the conclusion when the experimental variable is changed by carefully controlling all the related variables or conditions? Such tests are carried out in scientific laboratories under controlled conditions because adequate control can be done on the conditions in the laboratory. But here the students need to keep in mind that it can also be used outside the laboratories and provide accurate predictions of the future of a subject or fact.

In fact, the experimental research method is a very scientific research method through which new knowledge can be discovered. In this, the cause and effect relationship between two variables is studied through direct observation and measurement. Study of working and causal relationship between these variables can be done both in laboratories and in natural conditions. The laboratory is an ideal and convenient place to conduct tests. Here according to the need of the researcher, future situations can be created and the variables can also be controlled.

3.6.1 Definition

According to **Greenwood**, “Experiment is a method of testing hypothesis which is a causal relationship. In this, the cause-effect relationship is assessed under controlled conditions.”

J.W. Best has defined the experimental research method in this way, “Experimental research is the description and analysis of what will happen or when an event will occur under carefully controlled conditions. This is the most reliable but difficult method among all the research methods.”

3.6.2 Areas of Application of the Experimental Research Method

Experimental research methods are applied for the creation of new knowledge. Its application has been described in the following areas of library and information science by Krishna Kumar :

- To Identify Emergent Relationships between Variables.



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- To Test Hypotheses.
- To Test Theories.
- To Establish Principles.
- To Test new Techniques of Acquisition, Classified Collection and Retrieval of Documents/information.
- To Test new Libraries and Information Services.
- To Identify Previously Studied or Under-defined Library and Information Topics.
- For Library and Information Associations and to Satisfy the Curiosity of a Researcher.
- To Test the new Library and Information science educational programme.
- To Test the new Library and Information science syllabus.
- To Test a new Method for Organizing Classes.

3.6.3 Variables

A variable is a changeable element in a phenomenon or subject that is observed or measured in all types of research. In the experimental research method, the researcher controls and influences some variables and the main objective of the experimental research method is to find out the correlation of the variables. In research, variables or facts are those elements whose action-cause relationships are tried by the researcher. These variables are different in different situations and their value varies, it is very important for the researcher to understand these variables.

3.6.3.1 Independent Variable

The independent variable refers to the amount that the experimenter influences to observe an event. That is, it increases and decreases. The aspects, factors or circumstances which affect them are called independent variables. Examples of independent variables are age, income, sex, education, level of motivation, intelligence available etc.

3.6.3.2 Dependent Variable

The dependent variable is the variable that increases with increasing the degree of independence. example appear on the display of the

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independent variable and disappear on removal, change on the change of travel.

3.6.4 Steps of Experimental Research Method

- Selection and Demarcation of Problem
- Survey of related Literature
- Preparation of Experimental Design
- Rendering of research hypotheses
- Selection of experiment group, this includes- location of the experiment, duration, determination of the subject matter
- Conducting the test
- Observe and measure the experiment.
- Classification and analysis of data.
- Interpretation of Findings
- Report Writing.

Along with this, the following information is given in the primary part of writing the report:

- Home Page
- Researcher's Manifesto
- Certificate of Director of Research
- Estimates
- Table of Contents
- Table List
- List of Pictures

At the end the reference part is given which includes:

- Footnote
- Bibliography
- Appendix
- Index

The researcher should choose the appropriate problem for the experimental research method very carefully. The literature related to



Note

the research problem should be surveyed in detail. The independent variables should be selected carefully. New technologies, services can be tested in the field of library and information science. New teaching methods and courses may also be tested.

3.6.5 Experimental Design

It consists of a group of students or readers who are selected for the test. In this, if the test is to be done in the laboratory then there is an automated environment and if the field test is to be done then the natural environment should be selected. In general, there are three main aspects of experimental design:

- Reader or a group experiment
- Parallel or equivalent group experiment
- Experiment by sequential group method

3.6.5.1 Pilot Study

The researcher must do a pilot study before using the experimental method. Its advantage is that many errors and doubts related to the test can be removed and pilot study is also necessary from the point of view of quality and success.

3.6.5.2 Organizing the Test

While conducting the test, the researcher should take the following precautions :

- The non-experimental elements or variables should be controlled.
- The selection of the sample should be done very carefully.
- The independent variables should be controlled.
- The test must be done before and after the test.
- Measurement of experimental findings.
- The discovered findings should be analyzed and interpreted.
- The conclusions drawn should be matched with the present facts.
- The facts obtained from the test should be verified.
- Report writing.

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3.6.6 Features

Krishna Kumar has given three main features of the experimental research method. These are : 1. Control, 2. Repetition, 3. Randomization. Control is dependent on precise measuring instruments. Repetition is necessary to check the validity of tests. Randomization is necessary to ensure that the results obtained after the test are not due to elements that are not related to the independent variable.

Other features are as follows :

- This research method is based on J.S. Mill's single variable law. According to this law, if any one element is added or removed in two similar situations, then the change in it is the result of the action of that removed or added element.
- It can be used to some extent in libraries and information science.
- While doing experiments in this, an attempt is made to have complete control over the variables so that the research results can be found accurately.
- Apart from other research methods, casual relationships in variables can be determined better.
- In this research method, situations can be created and tested.
- In this, human errors and intentions can be removed with scientific instruments and modern instruments.
- In this the experiments can be repeated again and again.
- The results obtained by this method are of high level scientifically and they can be measured accurately.

Fault

- In the field of library and information science, the readers can be used by placing them in situations which are harmful.
- Experimenting with humans is a difficult task.
- The explanatory method can be used for the present study but the past circumstances cannot be studied.

3.6.7 Experimental Research Design

Experimental research design is based on the concept of experiment. Basically experiment is a controlled search. The researcher



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not only controls the variables in the experiment, but he can increase or decrease them as per his wish. Under this, the researcher can measure changes to the dependent variables by increasing and decreasing the independent variables. There are three basic principles of experimental design which are as follows :

- The Principle of Replication
- The Principle of Randomization
- The Principle of Local Control

3.6.7.1 The Principle of Replication

According to this principle, an experiment should be repeated again. Results obtained from repeated experiments are more reliable. These results are more reliable than results that have not been replicated. Therefore, while testing this answer theory, care must be taken so that the best results can be obtained.

3.6.7.2 The Principle of Randomization

This principle protects us against the influence of external elements through randomness. In this we should adopt random sampling techniques while doing the experiment. The advantage of this is that if we apply the principle of randomness, we can protect ourselves from the influence of external elements.

3.6.7.3 The Principle of Local Control

With the help of the principle of local control experimental defects which come due to variability of external elements can be removed.

3.6.8 Application of Experimental Method in the Field of Library and Information Science

Experimental Methods can be used in the field of Library and Information Science. Krishna Kumar writes that “Whenever a library does something new or different, it actually creates a situation or condition for doing an experiment. Therefore, it appears that there is a subject area of experimental methodology in library and information science.” Actually it is correct. The use of experimental methods in social sciences is not as easy as in physical and chemical sciences. In the

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physical and chemical sciences, re-testing can be done under controlled conditions in laboratories, whereas in library and information science, the study of human behavior of readers and employees is a major area. It is not possible to control the feelings, emotions and desires.

3.7 Questionnaire

It is necessary for the researcher to have extensive knowledge of tools, methods and instruments. He/She should also know what kind of data will be obtained from these instruments. What are their characteristics and limitations? What are the requirements on which their use is based and what is their reliability, validity and objectivity? Along with this, he/she should also have the skills to make, use the equipment and analyze the data obtained from them.

Questionnaire is a set of questions to be asked on a certain topic through which factual information is obtained in writing from the respondent either individually or in a group together, individually or by mail.

According to **Lund Class**, "Basically a questionnaire is a set of stimuli to which educated persons are shown to observe their verbal behavior towards these stimuli."

According to **Bogardus**, "A questionnaire is a table of questions given to different persons to answer them, which gives definite standardized results which can be tabulated and statistical use is also possible."

It is clear from the above definition that a questionnaire is a purposefully organized table of questions which acts as a motivator to get the answer and the arrangement and statistical analysis of the answers obtained from it is possible. Therefore, it is logical to say that it is the easiest means of surveying the conditions, in fact, as a tool to obtain data, they are used a lot in education psychology, social science and library science etc. It should be noted that its criticism is not of use but of misuse.

3.7.1 Properties of the Questionnaire

- Information can be obtained from a wide area through questionnaires.
- Through this, information can also be taken from other people of the geographical area, who cannot be contacted.



Note

- Can also receive information that cannot be obtained by other means, while protecting confidentiality.
- People give their answers after getting enough time.
- The flaws in the interview are avoided.
- A good questionnaire is short while covering a wide area.
- Its printing etc. is attractive.
- Completely clear instructions are given in it.
- Important questions are clearly analyzed and only one idea is contained in a question divided into categories.
- Questions to facilitate proper arrangement and analysis.
- Good questionnaire questions are objective.
- The sequence of questions is from easy to difficult and from general to specific.
- Questions are such that the respondent does not get annoyed.
- Good questionnaires are reliable and valid.

3.7.2 Defects of the Questionnaire

- Often the questionnaire is very detailed.
- The terminology of the questionnaire is confusing.
- The questions are mostly not objective.
- The sequence of questions is not consistent.
- Printing of questions is not correct.
- There is a lack of comprehensiveness in the questions.
- The sequence of questions is such that assessment and evaluation are difficult.

3.7.3 Advantages in the use of the Questionnaire

- With this, you can get information about every corner of the world sitting at home.
- Can give information to thousands of people at once.
- Its use saves time, labor and money.
- In comparison, information is more objective and valid.
- It is easy to make, administer and give marks.

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3.7.4 Disadvantages of using the Questionnaire

- If there is any confusion in the questions then it is difficult to solve it.
- There is some more answer by matching the answer as expected by the questioner.
- Sometimes answering is outside the respondent's strength.
- Some respondents do not want to give the correct answer
- Some questions are missed which are impossible to fulfill.
- It cannot be used on children and illiterate people.
- Knowing emotional things is difficult.
- Answers are not natural.
- People do not return even after praying many times.

3.7.5 Methods

- There are generally two methods of using questionnaire:
- **Direct Method :** When the entire population is in one place, the researcher establishes contact with them and gives them a questionnaire and clarifies its importance and if there is any doubt, removes it.
- **By Post :** When the population is not available at one place, try to get the answer sending questionnaire by post but most of the researchers complain that people do not cooperate or answer carelessly or do not reply at all.

3.7.6 Types of Questionnaires

There are many types of questionnaires. We can divide them into the following headings :

- **Restricted Questionnaire :** In this type of questionnaire, the arrangement of questions is in such a way that the respondent can answer only in a controlled way. The respondent has to tick one of yes or no. One answer has to be marked or one has to be struck off.
- **Open Questionnaire :** In the open questionnaire, the respondents are asked to give their desired answers in their own words. The respondent has the opportunity to express his



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motivation and tendency and the circumstances on which the answer is based.

- **Pictorial Questionnaire :** In some questionnaires, pictures are given in place of questions from which the respondent has to choose. They may also be given oral instructions. This type of questionnaire is especially useful for children and less educated people. Pictures quickly grab attention and prompt you to answer.
- **Mixed Questionnaire :** In this both types of questions are placed first, hence avoiding defects of both.

3.7.7 Formation of Questionnaire

The following points should be kept in mind while preparing the questionnaire :

- **Purpose and Form Determination**

- (i) Before preparing a questionnaire, a detailed list of its various parts should be prepared by clearly writing the objective. The more thoughtful and detailed this analytical list, the better will be the questionnaire.
- (ii) Determine the type of questionnaire, what type it will be.

- **Questionnaire Writing**

- (i) Questionnaire must not be too long.
- (ii) Only essential questions should be placed in the questionnaire.
- (iii) There should be clear instructions for each part of the questionnaire.
- (iv) The questions should be from easy to difficult and general to specific.
- (v) There should be a mixture of both restricted and open types of questionnaires.
- (vi) Misleading and difficult language should not be used.
- (vii) Double questions should not be asked.

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- (viii) Negative questions should be avoided.
- (ix) The question should not be based on unfamiliar assumptions.
- (x) If a word has to be given special emphasis, then underline it.

- **Consultation with Colleagues and Experts :** After formulating questions, opinion should be taken from colleagues and experts about them. From this discussion questions can be improved, reduced or enhanced.
- **Preliminary Test :** After preparing the questionnaire, taking a small sample and experimenting on it, it should be decided how far the questions are understood and how the answers are obtained, and what are the difficulties.
- **Printing of Questionnaire :** After deciding the printing instructions and main page etc. of the questionnaire, the questionnaire should be printed attractively and accurately.

3.8 Interview

Interview is the process carried out at the educational or psychological level, in which two strangers come in contact with each other. **Good** and **Hatt** have clarified that reliability and detail cannot be found until it is clear in the mind that interview is not a separate method of research but a major complete tool for obtaining data, which complements other tools.

According to **John W. West**, "Interview in a way is an oral type of questionnaire. Under this, instead of writing the answer, the subject gives oral answers in a face-to-face situation."

3.8.1 Reasons for Superiority of Interview

- People prefer to talk than to write.
- Confidential information can also be obtained by being friendly in the interview.
- If the subject has misinterpreted a question, then the interviewer can use a supplementary question to clarify it.



Note

- Through interviews, information can also be obtained from children, illiterate, having low language ability and low intelligence.
- The information obtained from the interview is reliable, valid, objective and useful for research.

3.8.2 Objective of Interview

interview has two objectives (a) discovery and, (b) measurement.

(a) Discovery :

- (i) discovery indicates gaining new knowledge, new consciousness or new enlightenment of certain unexplored qualitative aspects of the problem which is the primary objective of the interview.
- (ii) one can interview all the members of a group, or community or all the persons selected under sample or only some selected persons.
- (iii) in specific type of problems there is no need of interviewing all informants of the community or the units of the sample. Interviewing few experienced people may provide sufficient information e.g. a labour leader or an inspection can give sufficient information in relation to problems faced by both labourers and administrative personnel in running of a factory.
- (iv) interview method thus helps in identifying new variables and sharpening of conceptual clarity.
- (v) interview gives something more than pure statistical descriptions achieved through mail surveys.
- (vi) while statistical studies and descriptions tells us as to what percentage of people from which class are in favour of a given topic.
- (vii) the interview method, on the other hand provides us with additional qualitative description of the people, how they feel and why they do so.
- (viii) It enhances the understanding of sociological nature of the facts.

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(b) Measurement :

- (i) this is the second major objective of the interview.
- (ii) often in one project we find both the objectives, discovery and measurements. But as more emphasis is placed upon one objective the other one is subordinated.

Usually the research work in which measurement is the predominating objective, scheduled interviews are used. But in several situations non scheduled interviews provide more valid measurements.

3.8.3 Merit of Interview

- (i) there are some kind of information which are virtually impossible to be obtained by any other means e.g. person's past experiences, his anticipated future behaviour, etc. such information can be obtained only by asking for verbal report from persons concerned.
- (ii) a second advantage is the direction involved . As long as researcher is assured that the respondents do not distort their description of attitude and perception, the interview method is the most simple, direct and valid approach to use.
- (iii) the interviewers can modify the situation whenever necessary. He can clear up a mis-understanding about a question and keep the respondent on the track of providing only essential informations.

3.8.4 Limitations of Interview

Interview has the following limitations :

- In the interview, the researcher has to rely heavily on the oral report of the subject.
- Difficulty in getting information may occur if there is difficulty in speaking etc.
- The subject may knowingly hide certain informations.
- Even a biased view of the subject will not give correct information.
- One has to depend on the memory of the subject in the interview.
- Behavior of the interviewer, his attitude and appearance also hinder in answering.

**Note**

3.8.5 Types of Interviews

Interviews can be of many types. Its classification is as follows :

- **According to Function :** It has the following three parts :
 - (i) Diagnostic
 - (ii) Treatment
 - (iii) Research
- **According to Participant**
 - (i) Individual
 - (ii) Group
- **According to Length of Contact**
 - (i) Short contact
 - (ii) Prolonged contact
- In relation to the interviewer and the subjects, therefore can clarify it according to the verb :
 - (i) **Over-directed Interview :** In this, direct and complete set questions are not used often. The informant is encouraged to reveal his/her subtle permission through normal conversation.
 - (ii) **Focused Interview :** It is also called in-depth interview. Its purpose is to test the validity of the hypothesis which has been replaced on the basis of a fully analyzed system of human behavior. Under this, the focus is on the source of inspiration and other deeper things.
 - (iii) **Repetition Interview :** It is used to study the progressive actions and attitudes that determine a particular behavior of a human being. With the help of this, the study of progressive actions and events is done easily and it determines the reliability.

3.8.6 Interview Process

In the foregoing sections you have learnt about the interviewing and its different types. In this section we will focus our attention to the process of conducting interview, which involves the preparation of plan of action to meet all types of contingencies, training of interviewers or field staff, preparation of interview schedule, selection of data recording system, pilot run of the interview, modifications for the final interview, conducting interview sessions and finally the data analysis.

Plan : In this stage the researcher plans the whole interview process, which includes the training of interviewer, time to be taken in the

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interview and the venue of the interview. It also takes into account the cost factor, travel time and wait around time. Field staff is required when number of interviewees is more. One principal interviewer/research assistant is not sufficient for the large number of respondents. Training of field staff/ enumerator or research assistant is needed to successfully manage the interview session. In this process the interviewer will become aware of the questions and the instructions to be followed in the session.

Preparation of Interview Schedule : Interview schedule is a list of printed questions, set in some order or sequence, and the interviewer records the answers on the printed schedule during the interview session. Interview schedule is prepared in advance. People (researcher, interviewer, or simply the enumerator) who are going to take this assignment need practical training to conduct the interview smoothly. However, we cannot ignore the interviewer's bias towards the interpretation of answers. Through interview schedule the identity of the respondent is known to the researcher. The problem of low response rate is not faced in this method. However, information received from the respondent is recorded there only the ones which prove to be highly accurate. Through Interview schedules personal contact with the respondent can be established. This method can prove successful even when the target population is not educated. This method has some drawbacks also. Interviewer may be biased, if he/she is not well trained, then it will hamper the investigation and this method is not feasible when target population is geographically wide spread.

The researcher must keep in mind certain points while preparing interview schedule.

The researcher should be clear in mind regarding the objectives, scope of the research area under study.

The choice of closed or open-ended questions should be made.

Complex, emotional and sensitive type of questions should be avoided. Format of the interview schedule should be attractive and it leaves sufficient place to enter the answers.

The sequence of questions should be finalised before conducting the interview session. It is preferable to put questions in logical order.



Note

Relevant questions should be drafted on the basis of area of research. Please refer to Unit no. 11 of this course to get detailed information on construction, and selection of open and close-ended questions. The Unit also discusses the relative advantages and disadvantages of both the types of questions.

Pilot Test of the Schedule : Before the actual interview process starts it is advisable to pre test the interview questions. A group of interviews should be selected for pilot study. This group should not be included in the proper study. Interviewer should request the selected respondents to give their suggestions/observations to improve the interview schedule. After getting the responses from the pilot study group the researcher should modify it accordingly. This practice is very important to get proper responses from the respondents.

Conducting the Interview : We all know that interview is an art. But for researcher it is the most difficult task. The researcher/interviewer has to manage multiple tasks at one time. For example he/she is putting questions to the respondent, listening to the Interview Method answers carefully, giving clarification, sometimes explanations, directions to clear the doubts of the respondents and recording the answers manually, or with the help of any electronic device (i.e., tape recorder). The interviewer is also keeping tap on time, the questions to be covered in the session, etc. It is a skilled job. The interviewer should be trained to undertake such job. Experience shows that this skill can be improved over time.

How an interviewer is conducting himself/herself in the interview session is very important. His/Her appearance, pleasing personality, behaviour, use of words, and knowledge of the area can make a lot of difference to the results. Body language can also affect the communication process. It may increase the level of comfort or ease of respondent.

Interviewer should not keep waiting the respondent. He/she should be punctual, polite and courteous. Before starting the actual interview session he/she should introduce the objective of the study and clearly explain the importance of contribution of the respondent in the research. The interviewer should listen more than talk. He/She should have listening skills. The main objective of the interview is to facilitate

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respondents to answer. So it is important that the interviewer should ask right types of questions prompting the respondent to answer and then properly recording the answers.

Guidelines for Conducting Interviews

- (i) Interviewer should plan in an advance the venue, time, etc. of the interview session.
- (ii) He/She should have the friendly approach so that a proper understanding/rapport can be established between the interviewer and interviewee.
- (iii) He/She should have the ability to mobilise the respondent to answer freely and frankly on the subject.
- (iv) Questions should be well framed. Complex questions should be avoided. Such questions should be added which will elicit the desired answers.
- (v) He/She should be properly trained to have proper control of the interview session. He/She should be responsible for creating a friendly atmosphere of mutual trust and confidence.
- (vi) He/She should not show any surprise or disapproval to the answers of the respondent but at the same time he/she should be supportive of the respondent answers.
- (vii) He/She should have friendly, courteous, unbiased approach.
- (viii) He/She should be non judgemental and should not try to change or influence the reactions or opinions of the respondents.
- (ix) The interviewer should not indulge in any argument, even though he/she may know that respondent's replies are not accurate.
- (x) At the end of the interview session the interviewer must show gratitude for their cooperation. The respondent should get the feeling that they are actively participating in the research process and their views are valuable and important to research.

In addition to this Adams (1985) suggested three factors, which make an interview successful. They are :

“having a thoroughly tested questionnaire or interview form which to work;



Note

being familiar and “wise” in the interview process; treating respondents with trust, respect and courtesy”.

Recording the Interview : In the structured interviews where mostly the questions are closed ended, it is easy to record the responses on the interview schedule. This method is called Note Taking method. It is difficult for the interviewer to remember all the responses and enter at the end of the day. It is advisable for he/she to record accurately and fully whatever responses emerge after the session. In the Note Taking method no answer should be left blank if the respondent did not answer. In such situations it should be written “not responded”, etc. Some explanation should be recorded against unanswered questions Interviewer should also note the comments made by the respondent on the margin area near the questions. The explanations given by the interviewer should also be recorded separately question wise. These noting will prove highly useful at the time of data analysis.

In this method the interviewer should be extra careful. He/She should be questioning, listening, and recording the answers simultaneously. In the case of highly structured interviews use of tape recorder is not required. It may prove helpful in the case of open-ended questions.

For open-ended questions, writing the responses, which may be long, is not only difficult but time consuming also. In order to get the main substance of the answer recording of exact wordings is required. In such situation interviewer may make use of the Tape Recording method to have the verbatim copy of the answers. Data generated through audio recordings can be preserved and used later. The use of this method saves the time of the interviewer and the same can be utilised for further analysis and report writing. The only disadvantage of this method is that it may put respondents at unease.

At the end or in between the interview session if time and other conditions permit the respondents should be shown the marked responses. The openness, truthfulness and trust on the part of the interviewer may generate confidence in the respondent and he/she is prompted to cooperate with the interviewer. If the marked responses are not shown to them then they may get the feeling that something is being concealed from them and they may not continue the interview session. Such situations may play havoc not with the interview but

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with the research as such. For the case of tape recorded responses the transcripts of the recordings in verbatim should be shown to them for the confirmation of accuracy. It is expected from the respondent that he/she should not revise the answers.

3.8.7 Important Points at Different Stages of Interview

- (i) **Pre-Interview Preparation :** Determination of the scope of the interview before the interview, the information that is to be obtained, the type of interview and the method of writing the information received from the interview, etc.
- (ii) **Favorable Opportunity and Suitable Location :** Suitable place and the right choice of opportunity is very important for the success of the interview.
- (iii) **Mutual Introduction :** After coming for the interview, the first thing to do is to do mutual introduction to establish a strong intimate relationship.
- (iv) **Conduct of Interview :** After all arrangements are made, the interview will start after the intimate relationship is established. The following points must be kept in mind while asking questions for the interview :
 - (i) The questionnaire is not broad.
 - (ii) The question is simple and clear.
 - (iii) Emotional questions should be avoided.
 - (iv) If the respondent moves the interviewer away from the original subject, then in such a situation he has to be careful and concentrate on the objective.
- (v) **Answer Writing and Analysis :** The most important method of answer writing is to record the entire conversation in the taperecorder, but if the tape record is not available then it is written in two ways:
 - (i) Keep writing along with the interview.
 - (ii) Write after the end of the interview.

3.8.8 End of Interview

In the end, the interview should end in a happy atmosphere with two words of thanks.

**Note**

3.9 Observation

We keep seeing the behavior, events and situations of individuals in our daily life. In other words, we keep observing them, but in this general way the observation and technique based research is a lot different. The observation to be made for research work is ensured and organized, whose objectives and recording process are determined in advance. At the same time, full care is taken of its substance, validity and reliability. Observation is not only an important function of our daily life, but it is also a major tool of scientific information. It becomes a scientific method, if :

- They are helpful in determining the problem of research.
- Its planning should be systematic.
- It should be a means of checking validity and reliability.

In fact, as a tool in research, it is concerned with behavior of the individual. It is not related neither with the written expression, nor with the answer given by him in the interview, but with his observation in the natural situation.

According to **Good & Hatt**, “Science begins with observation and for its confirmation, one has to return to observation.”

As the oldest and most modern system of observation from now on, scientific observation must have the following characteristics :

- Skilled observation
- Objective observation
- Systematic observation
- Careful observation
- Carefully made accurate, valid and reliable observations

Observation becomes the basis of scientific research only when the above characteristics are present.

3.9.1 Characteristics

- It is the main tool of descriptive research.
- The particular qualities of personality can be best known with this direct system, not others.

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- A number of facts can be obtained by observing the curricular activities. The behavior of the students in the classroom, their position in the group and their response to stimuli can be known naturally.
- Behavior of students in the classroom, their position in the group and their response to stimuli can be known naturally.
- It is the best source for people speaking different languages or for those who cannot read-write and speak.

3.9.2 Writing of Observed Data

Following tools are used for systematic writing of observed data :

1. Registration list, 2. Assessment scale, 3. Fill in the blanks sheet, 4. Mark card

The researcher can use any of these according to the nature and purpose of the problem.

3.9.3 Essential Elements of Observation

Four important elements of good observation are :

- **Proper Planning :** The basic requirements of proper planning are as follows :
 - (i) Analysis of observational behavior (which behavior?)
 - (ii) Determination of pattern (observation of that?)
 - (iii) Observation area (of individual or group?)
 - (iv) Fixation of time for observation.
 - (v) Fixation of instruments for observation.
 - (vi) Determination of special circumstances which have to be arranged.
 - (vii) Arrangement of necessary training for observation.
- **For Systematic Operation :** It is necessary to pay attention to the following points :
 - (i) Creation of suitable conditions.
 - (ii) Concentration of attention on a particular aspect of a particular action.
 - (iii) Direct inspection and multiple inspections.



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(iv) Proper use of writing tools.

(v) Vigilant observation will be better in a barrier-free environment.

- **Proper Writing :** This writing can be done with observation as well as after it. It is good to observe together because later many things are forgotten.
- **Scientific Analysis :** Only by doing tabulation, arrangement and analysis of the observed material in a scientific way, proper results can be obtained.

3.9.4 Types of Observation

Observation is of two types :

Direct Observation : It is of two types : (i) Participatory Observation, (ii) Non-participatory Observation.

- (i) **Participatory Observation :** It is possible to obtain detailed information through this method. In this there is direct and natural knowledge of community behavior and this method is achievable with little expenditure.

Through this, deep information can also be obtained which is not possible by other methods.

- (ii) **Non-participatory Observation :** In this the observer is present only among the group to be studied but does not participate in the activities of the community. It is used in the study of children, infants and abnormal individuals. The observer observes such places so that the group cannot be affected.

Observers also classify observations as regular and irregular observations. By creating the conditions, with the help of the objective scientific instrument go on observing and writing.

3.9.5 Merits and Demerits of Observation

The observation method has several advantages and disadvantages. The advantages are :

- (i) It is direct and helps to study the behaviour as it appears / occurs (collected in natural environment). One need not ask any one about the behaviour but can do self watching and collect the data.

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- (ii) The data collected in a natural environment or situations is reliable.
- (iii) The data may be much more accurate as it is collected out of intimate and informal relationship.
- (iv) It is one of the best methods which can be adopted in a situation where people are unable to state meaningfully, e.g. studies about the children, tribal, animals etc.
- (v) It helps to study the whole event and therefore, may provide the opportunity to study the insights or all aspects.
- (vi) It is easy to observe in disguising rather than disguised questioning.
- (vii) It helps to collect when the respondents are unwilling to cooperate for giving information.
- (viii) It is expensive but it is also possible to collect the data on emotional reactions.
- (ix) It helps to analyse the contextual background also.

The disadvantages are :

- (i) This method is not useful to study the past events.
- (ii) It will not help to study the opinions. It may be difficult to structure the situation.
- (iii) Another limitation is stability of the conditions. Observation is difficult under unstable conditions.
- (iv) The collected data may not be possible to quantify.
- (v) Most difficult could be how to get entry in the group being observed, i.e., how to become participant?
- (vi) It may not be possible to study or observe everything simultaneously, and the study could be limited.
- (vii) The internal attitudes and opinions are difficult to study.
- (viii) The sample may have to be limited; unlike the questionnaire-where in number of respondents from different places is difficult to study.
- (ix) It may be essential to wait till the event takes place. For example-



Note

to study the marriage customs, one has to wait till such an event takes place.

- (x) It is a slow, time consuming and expensive process.
- (xi) This method is difficult to apply in large social settings and there is no set procedure for observation.
- (xii) It does not offer control measures.
- (xiii) Some types of behaviours are too private or personal in nature. These types of behaviours are difficult to observe. For example: participating in criminal activity or sexual behaviour etc.
- (xiv) The observer's ability, consistency, knowledge, bias and familiarity influences the data collected.

3.10 Schedule

In research work, the importance of direct means is increasing in comparison to indirect means of collecting information. The information accumulated by direct observation of the problem is very useful and reliable, in this context the schedule is especially important.

The researcher using the schedule himself presents himself in the study area and asks questions and fills the schedule. Questionnaire is also a type of schedule, but the difference between the two lies in the way they are used. Questionnaires are used when information is to be obtained from a wide area far and wide. They can also be sent by post and when the information has to be taken from nearby, they go to the field themselves and get the information and use the schedule. Many questions are left out in the questionnaire but it is not possible in the schedule. Schedule is a better tool than questionnaire because of personal use.

According to **Good and Hatt**, "Schedule is the name used for a set of questions which the other person is asked and filled in by the interviewer in a face-to-face situation."

According to **Bogardus**, "Schedule is a composition of short questions which is usually placed by the surveyor himself and filled in as he advances in his investigation."

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Note

The similarity between the questionnaire and the schedule is that both of them require questions for all the respondents.

3.10.1 Importance of Schedule in Research

The importance of schedule in research is as follows :

- By its use, real facts are obtained.
- Ambiguous questions are clarified and the answer found is correct.
- There is enough opportunity to change the question as required.
- The background of the subject matter can also be studied.
- Also saves necessary study and detail.
- Authentic observation gives reliable information.

3.10.2 Characteristics of a Good Schedule

A good schedule has the following characteristics :

- (i) The questions are clear and simple.
- (ii) Questions are short.
- (iii) A good schedule is reliable, valid, objective and comprehensive.
- (iv) Questions are mutually confirmatory.
- (v) The questions are organized in such a way that the answers of one category are related to the other.
- (vi) The nature of questions is systematic, objective and logical.
- (vii) The physical form of the schedule is universal and attractive.
- (viii) The nature of the schedule is structured.

3.10.3 Benefits from Schedule

There are many benefits of the schedule, which we clearly point out in the following way :

- A good relationship is established between the researcher and the respondent.
- Answers to all questions in the schedule can be filled in.
- It is easy to motivate the respondent.
- The work gets completed quickly and easily.
- Labor and money are saved.
- The objective data is obtained by the schedule.
- Accurate and in-depth information is obtained through schedule.



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- Possibility of being involved in the study of trained persons.
- Comparative and reliable data is obtained.
- The level of validity of the responses received is high.

3.10.4 Limitations of Schedule

- It is difficult to get information from far away.
- The presence of the researcher affects the respondents.
- Difficulty is experienced in arranging scheduled administrative plants.
- The difficulty comes in the formulation of universal questions.
- There are more chances of personal bias.
- Incomplete and inadequate answers are received.
- It requires skilled and trained workers.
- It is a more expensive method of study.
- Relatively more work has to be done than to achieve the objective.

3.10.5 Types of Schedule

- **Observation Schedule :** It is used for observation or observation of any event.
- **Interview Schedule :** It is used for interviews when the data is qualitative. It is more prevalent in social research. There are spaces in front of the questions. The interviewer fulfills them himself.
- **Document Schedule :** There is no need to ask in this. On the basis of the data obtained from the records, the schedule is fulfilled. It is more useful for historical, developmental and survey type research.
- **Rating Schedule :** It is used where evaluation, quality assessment or its comparative ability has to be determined on the basis of schedule. It is successfully used to study attitude, opinion, custom, fashion, quality etc.
- **Institution Survey Schedule :** The main purpose of this type of schedule is to survey and evaluate the general problems of a particular institution. In this, various aspects of various problems related to the organization are studied systematically and specifically.

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3.10.6 Objectives of the Schedule

The study of a research problem by schedule should be more systematic and balanced. The use of a schedule has many purposes. The main objectives are the following :

- The main purpose of using a schedule is to collect objective data.
- The second main purpose of the use of schedule is the use of definite, systematic and logical data.
- Every effort is made in the study by the schedule so that no essential aspect related to the study should be missed. Therefore, a complete study of the problem is done under the study.
- Another purpose of the use of schedules is the compilation of comparative and reliable data.
- The main goal of the schedule is not only to obtain external answers to the questions composed towards the related problem, but also to obtain valid answers based on the actual mindsets, attitudes and reactions of the informant by the study researcher under the interview in the use of the schedule.

3.10.7 Schedule Preparation Method

The following are the stages in making a schedule :

- Determining the type of information desired for each organ.
- Marking each part by analyzing the area of study.
- Assigning importance to each part.
- Creating a specialization table.
- Formulation of questions.
- Organizing and arranging questions.
- To know the opinion of experts.
- Pre-test.
- Finalization.
- Use



Exercises

VERY SHORT ANSWER QUESTIONS

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1. Write the objectives of the historical research method.
2. Write the types of historical research methods.
3. Define survey research method.
4. Write three features of the survey research method.
5. Write an electronic survey.
6. Write the definition of an experimental method.
7. Write the steps of the experimental method.
8. Write the demerits of the questionnaire method.
9. Name the types of questionnaire methods.
10. Give reasons for the superiority of the interview.

SHORT ANSWER QUESTIONS

1. Is the historical research method scientific? Explain.
2. Write the features and scope of the survey method.
3. Write the merits and demerits of experimental research methods.
4. Write a note on 'Techniques'.
5. Write a note on 'Observation'.

LONG ANSWER QUESTIONS

1. Describe the steps of the historical processing method.
2. Explaining the meaning of the schedule method, also throws light on its importance and characteristics.
3. Describe the definition and scope of experimental research methods.



Data Analysis and Interpretation

4.1 Introduction

After selection of research problem, selection of research method, hypothesis formulation and collection of data for research, the work of analysis and selection of these data is done because by collecting only data and evidence, in the direction of solving any problem cannot be increased. In order to reach conclusions in research, the researcher analyzes the data and facts collected by him. In this process, the disorganized data is given a systematic form so that their meaningful selection can be done. The selection of data can be done qualitatively or quantitatively or both. In this unit, the type of analysis required for data analysis and selection, types of measurements under statistical analysis and organization and tabulation of data, etc. have been discussed in detail.

4.2 Definition of Data Analysis

Data analysis is a practice in which raw data is ordered and organized so that useful information can be extracted from it. The process of organizing and thinking about data is key to understanding what the data does and does not contain. There are a variety of ways in which people can approach data analysis, and it is notoriously easy to manipulate data during the analysis phase to push certain conclusion or agenda. For this reason, it is important to pay attention when data analysis is presented and to think critically about the data and the conclusions which were drawn.

**Note**

4.2.1 Work Expected for Data Analysis and Interpretation

According to the nature of the data, before analyzing and interpreting them, the researcher should do the following five tasks :

1. **Organizing the data**, collecting the data or evidence necessary for the research. They are in their original form disorganized, disjointed and not overly meaningful. The first thing to do is to arrange them according to a specific order and arrangement to make them related and more meaningful.
2. **Assessing the consistency of systematic data with research objectives** should assess the relevance keeping in view the objectives of the research, from which it is known to what extent they satisfy the criteria of suitability and adequacy.
3. **Identifying the salient features of the data**, It is necessary to identify the main features of the data before the analysis and selection of the data.
4. **Determination of the relationship between the main features of the data**, Under this, the researcher determines the relationship between the main features of the data and gives them a fair arrangement in sequence.
5. **Present the data in headings and sub-headings for the purpose of analysis**, In this fifth step, the researcher presents the data under headings and sub-headings for the purpose of analysis.

4.3 Data Interpretation

Data interpretation is the process of reviewing data through some predefined processes which will help assign some meaning to the data and arrive at a relevant conclusion. It involves taking the result of data analysis. Data analysis is the process of ordering, categorizing, manipulating, and summarizing data to obtain answers to research questions. It is usually the first step taken towards data interpretation.

It is evident that the interpretation of data is very important, and as such needs to be done properly. Therefore, researchers have identified some data interpretation methods to aid this process.

4.3.1 Data Interpretation Methods

Data interpretation methods are how analysts help people make sense of numerical data that has been collected, analyzed and presented.

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Data Analysis and Interpretation



Note

Data, when collected in raw form, may be difficult for the layman to understand, which is why analysts need to break down the information gathered so that others can make sense of it. For example, when founders are pitching to potential investors, they must interpret data (e.g. market size, growth rate, etc.) for better understanding. There are 2 main methods in which this can be done, namely; quantitative methods and qualitative methods.

4.3.2 Qualitative Data Interpretation Method

The qualitative data interpretation method is used to analyze qualitative data, which is also known as categorical data. This method uses texts, rather than numbers or patterns to describe data.

Qualitative data is usually gathered using a wide variety of person-to-person techniques, which may be difficult to analyze compared to the quantitative research method.

Unlike the quantitative data which can be analyzed directly after it has been collected and sorted, qualitative data needs to first be coded into numbers before it can be analyzed. This is because texts are usually cumbersome, and will take more time and result in a lot of errors if analyzed in its original state. Coding done by the analyst should also be documented so that it can be reused by others and also analyzed.

There are 2 main types of qualitative data, namely; nominal and ordinal data. These 2 data types are both interpreted using the same method, but ordinal data interpretation is quite easier than that of nominal data.

In most cases, ordinal data is usually labelled with numbers during the process of data collection, and coding may not be required. This is different from nominal data that still needs to be coded for proper interpretation.

4.3.3 Quantitative Data Interpretation Method

The quantitative data interpretation method is used to analyze quantitative data, which is also known as numerical data. This data type contains numbers and is therefore analyzed with the use of numbers and not texts.



Note

Quantitative data are of 2 main types, namely; discrete and continuous data. Continuous data is further divided into interval data and ratio data, with all the data types being numeric.

Due to its natural existence as a number, analysts do not need to employ the coding technique on quantitative data before it is analyzed. The process of analyzing quantitative data involves statistical modelling techniques such as standard deviation, mean and median.

Some of the statistical methods used in analyzing quantitative data are highlighted below:

4.3.3.1 Mean

The mean is a numerical average for a set of data and is calculated by dividing the sum of the values by the number of values in a dataset. It is used to get an estimate of a large population from the dataset obtained from a sample of the population.

4.3.3.2 Standard deviation

This technique is used to measure how well the responses align with or deviates from the mean. It describes the degree of consistency within the responses; together with the mean, it provides insight into data sets.

4.3.3.3 Frequency distribution

This technique is used to assess the demography of the respondents or the number of times a particular response appears in research. It is extremely keen on determining the degree of intersection between data points.

4.3.4 Advantages of Data Interpretation

- (i) It helps to make informed decisions and not just through guessing or predictions.
- (ii) It is cost-efficient
- (iii) The insights obtained can be used to set and identify trends in data.

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Data Analysis and Interpretation



Note

4.4 Types of Analysis

There are usually two types of analysis used in research. It is the following :

- (i) Qualitative Analysis (ii) Quantitative Analysis

4.4.1 Qualitative Analysis

Qualitative analysis is applied to such data as verbal interviews, dispatch, are collected through individual studies.

Form of Qualitative Analysis : It is often used in three ways:

1. **Molecular Analysis :** In this, the main aspects of the data are divided into different thought units, facts and concepts, their forms and meanings is determined.
2. **Conceptual Analysis :** In this, both the aspects of analysis and synthesis importance is given.

Precautions Required in Qualitative Analysis : The following precautions should be taken by the researcher while doing qualitative analysis :

1. The mainstay of qualitative analysis must be clearly supported by a formal method of reasoning. So that it does not contain logical flaws.
2. Under the qualitative analysis, the headings, sub-headings and the main points to be included under them should be clearly marked.
3. Keeping in view the uniqueness of the data, the qualitative analysis should be done with the help of precision and depth. The required level should be ensured.
4. There should not be any kind of ambiguity / dual meaning in terms of meaning in the words, concepts and paragraphs used under qualitative analysis.
5. An accurate analysis of the research problem, its objectives and hypotheses and the areas and content of qualitative analysis is the direct responsibility of the researcher. Any discrepancy in this can put a question mark on the quality of the research.

**Note**

4.4.2 Quantitative Analysis

Quantitative analysis in academic research usually takes two forms, First A Frequency Count and Second Parameter Test.

1. **Frequency Count** : In frequency count, the frequency of an event or scene is kept or counted. This includes statistical methods, such as ratios. The data is analyzed with the help of percentages or other mathematical formulas.
2. **Parametric Tests** : In this, an attempt is made to understand and clarify the data with the help of descriptive and inferential statistics.

4.5 Types of Measures Under Statistical Analysis

The following measures are used for statistical analysis, they can generally be kept in four classes, which are described as follows :

4.5.1 Nominal Measures

It is a low level measurement in which statements are given on the basis of only 'similarities' and 'differences' *i.e.*, in this it is possible to say that how can a person differ from another person in terms of a particular quality similarities and differences. This equality can be on the basis of gender, race, origin etc.

4.5.2 Ordinal Measures

Such measurements are indicative of such properties by which the members of the group have only similarity and not only on the basis of difference but they are also arranged in a particular order from least to maximum or maximum to least and it is possible to be arranged, like first, second and third in the merit list.

4.5.3 Interval Measures

In such measurements, statements are presented on the basis of similarity and difference and similarity to additional intervals of more or less. In these, random (arbitrary) zero is assumed rather than the actual zero. *For example*, in the physical sciences temperature expressed in Fahrenheit or Centigrade.

4.5.4 Ratio Measures

Under this, in addition to equality of ratios, the type of statements that are possible in all the three types of measurements

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mentioned above can be given. Such measurements assume absolute zero. *For example*, the measure known by the scale used to measure elongation, weight and accentuation and strength.

4.6 Analysis of Data through Descriptive Statistics

Descriptive statistics are often used to analyze the data obtained by sampling and the frequency analysis presented by it. Statisticians have mentioned five important elements of frequency distribution.

These are the following :

1. Central Tendency or Location
2. Relative Position
3. Variability
4. Skewness
5. Kurtosis

1. Central Tendency or Location : It is an indicator of the value of the central tendency variable which is located near the center of the frequency distribution. This is the middle point. The measures of central tendency are also called by the value of average and they are mainly of five types :

- | | |
|-------------------|---------------------|
| (i) Mean | (ii) Median |
| (iii) Mode | (iv) Geometric Mean |
| (v) Harmonic Mean | |

2. Relative Position : Relative position refers to the point under the distribution of points below which some members are. Chief among the scales of relative space. It is Centiles, Hundredth Absence or Tenth value and Quadrant value.

3. Variability : Variability or deviation means the amount of clustering of scores around the central value. If most of the scores of a group are clustered around the centripetal value, then the degree of deviation or variance will be less. The greater the distance between these scores from the central value, the greater the deviation value. Its four main parameters are the extension quadrant, the deviation value, the mean deviation and authentic deviation value.

**Note**

4. **Skewness :** Skewness gives information about the symmetry or asymmetry present in the frequency distribution. When a distribution suffers from asymmetry and most of the frequencies are centered at the lower end of the scale, it is called a positive skewness or distortion. Conversely, when most of the frequencies are centered at the upper end of the scale, it is termed as negative skewness or distortion.
5. **Kurtosis :** Kurtosis refers to the presence of relatively greater flatness or curvature in one distribution than in the other.

There is often a need to represent the relationship between two or more variables under correlation coefficient research. This is commonly referred to as co-relation or association. It is always calculated between bi-variate data. The indicator value of the quantity of relation between the variables is called the coefficient of correlation.

Three types of situations can be seen in the relations found between the dual base materials, which are as ahead :

1. An increase in one variable can be found as a concurrent increase in another variable. This is called a positive correlation.
2. An increase in one variable can be seen as a concurrent decrease (decreasing) in another variable or a decrease (decreasing) in one variable as a concurrent increase in the other variable. This is called negative correlation.
3. The increase or decrease in one variable is not found in the form of increase or decrease in the other variable according to any particular arrangement, it is called zero correlation.

4.6.1 Measures of Central Tendency

The values which are used to summarize the central tendency of a group are called central values. The central value of a group is the representative score of that group, most of the scores of the group are around it, some are less than that and some are more than that. Thus, there are scores that represent the scores for that whole group, reflecting the characteristics of that whole group. We can define it as follows :

The center value is that representative score of an entire group, around which most of the scores of that group are centered.

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4.6.2 Types of Measures of Central Tendency

There are three types of central value, mean; median and multiple. In this chapter, the meaning, use and methods of calculation of these three have been discussed.

Meaning and Definition of Mean : In the language of arithmetic, which is called mean value, in the language of statistics it is called mean value or mean. It explains the central tendency of the scores of a group and all its scores represents. Its biggest feature is that both the sides (get more than this on the lesser side). The sum of the deviations of the scores on the side and is zero. One let us make it clear by example,

Suppose the marks of 5 students in an examination of 50 marks are as follows :

15 37 23 28 and 17

$$\begin{aligned}\therefore \text{Average of scores} &= \frac{15 + 37 + 23 + 28 + 17}{5} \\ &= \frac{120}{5} = 24\end{aligned}$$

\therefore Their deviation from the mean value by placing the scores in ascending order:

Score	Average Value	Deviation	Sum of Deviations
37	24	+ 13	0
28		+ 4	
23		- 1	
17		- 7	
15		- 9	

Then the mean can be defined as:

The mean is the mean value of the scores of a group whose scores on both sides have the same deviation.

4.6.3 Methods of Calculating Mean from Ungroup Data

The mean is determined by the method of finding the mean. The following is the formula for this in statistics:

Mean,
$$M = \frac{\sum x}{N}$$

**Note**

where M denotes the mean, Σ denotes the sum, x denotes the scores and N denotes the number of students signal.

For example,

The marks obtained by 10 students in an examination of 50 marks are 23, 15, 8, 30, 31, 21, 19, 24, 26 and 33 respectively, find the mean.

$$\begin{aligned}\text{Mean} &= \frac{\Sigma x}{N} = \frac{23 + 15 + 8 + 30 + 31 + 21 + 19 + 24 + 26 + 33}{10} \\ &= \frac{230}{10} = 23\end{aligned}$$

Finding the Mean by Distribution Table

In an examination of 50 marks in Hindi, 20 students obtained the ahead marks:

8, 21, 17, 17, 13, 32, 28, 24, 17, 22, 24, 28, 20, 17, 31, 27, 20, 7, 36 and 31

On arranging the scorer in ascending rank order:

7, 8, 13, 17, 17, 17, 20, 20, 21, 22, 24, 24, 27, 28, 28, 31, 31, 32 and 36.

Frequency Distribution Table

Scores (x)	Frequencies (f)	Scores \times frequencies
36	1	36
32	1	32
31	2	62
28	2	56
27	1	27
24	2	48
22	1	22
21	1	21
20	2	40

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17	4	68
13	1	13
8	1	8
7	1	7
	N = 20	$\Sigma fx = 440$

$$\text{Mean, } M = \frac{\Sigma fx}{N} = \frac{440}{20} = 22$$

Special

This question can be solved in a more simple way by using the following formula:

$$\text{Mean, } M = A.M. + \frac{\Sigma fd}{N}$$

In this, $M = \text{Mean}$

A.M. = Assumed Mean.

Σfd = The sum of the deviations from the assumed mean

N = sum of all frequencies example total score

Calculation

First Term : First the frequency distribution table is made.

Second Term : After this the assumed mean is fixed. The mean value can be estimated only by looking at the table at a glance. In this example, we have taken 22 as the assumed mean.

Third Term : After this, the deviation (d) of all the other scores of the assumed mean is found and recorded in the table.

Fourth Term : After this, by multiplying the deviations and the frequencies, the sum of all of them is found to be Σfd .

Fifth Term : In the end, the correct mean is determined by using the formula.

Frequency Distribution and Calculation Tabulation

Obtained (x)	Frequencies (f)	Deviation by Assumed Mean (d)	Deviation (fd)
36	1	+ 14	+ 14
32	1	+ 10	+ 10
31	2	+ 9	+ 18
28	2	+ 6	+ 12
27	1	+ 5	+ 05
24	2	+ 2	+ 04
22	1 A.M. 22	0	
21	1	- 1	- 1
20	2	- 2	- 4
17	4	- 5	- 20
13	1	- 9	- 9
8	1	- 14	- 14
7	1	- 15	- 15
	$N = 20$		$\Sigma fd = 63 - 63 = 0$

Here, we have taken the assumed mean as 22.

$$\begin{aligned} \text{Mean, } M &= A.M. + \frac{\Sigma fd}{N} \\ &= 22 + \frac{0}{20} \\ &= 22 + 0 = 22 \end{aligned}$$

Note By this method, the calculation does not have to be very long. So, we should use this method when there are more frequencies.

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Note

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Note

4.6.4 Methods of Calculating Mean from Grouped Data

It is very difficult to calculate the mean by either of the above two methods when the number of students is more. In that case, we first make the classes of the scores and then make its frequency distribution table and calculate the mean with the help of that. They also have two methods : one Long Method and the other Short Method. Let us explain both the methods with an example :

Example : In an examination of Mathematics 30 students obtained the following marks. Convert these numbers in the form of a frequency distribution table. The class interval or class size should be 5. With the help of this table, find the mean in both long and simple methods.

48	12	20	32	33	25	34	22	24	36
18	25	15	27	22	32	26	29	32	31
31	44	14	45	47	41	28	38	30	26

Calculating Mean by Long Method

In this method all the scores are arranged in proper classes by taking appropriate class interval and then the frequencies of each class are found. In this, instead of multiplying all the scores and their frequencies, the mid-points of the classes and their frequencies are multiplied. Here we are working out the mean by this method by making a table like this.

The maximum score in this group is 48 and the minimum score is 12.

$$\begin{aligned}\therefore \text{Scored Expansion} &= (48 - 12) + 1 \\ &= 36 + 1 = 37\end{aligned}$$

\therefore It would be better to take the class expansion 5 only. In that case 8 classes will be formed. The minimum score is 12, so the first class will be started from 10.

**Note****Frequencies Distribution Table**

Classes	Frequencies (f)	Mid-points of Classes (x)	Frequencies \times Mid points
45 - 49	= 3	47	141
40 - 44	= 2	42	84
35 - 39	= 2	37	74
30 - 34	= 8	32	256
25 - 29	= 7	27	189
20 - 24	= 4	22	88
15 - 19	= 2	17	34
10 - 14	= 2	12	24
$Ci = 5$	$N = 30$		$\Sigma fx = 890$

$$\begin{aligned} \therefore \text{Mean, } M &= \frac{\Sigma fx}{N} \\ &= \frac{890}{30} = \frac{89}{3} = 29.67 \end{aligned}$$

Calculating Mean by Short Method

Finding the mean by the long method requires a lot of multiplication and addition and hence it takes a lot of time. A simple method has been devised to calculate the mean from the point of view of efficient use of time and power. In this method, the correct mean is determined by taking an assumed mean. That's why it is also called the Assumed Mean Method. Following is the formula for this:

$$\text{Mean, } M = A.M. + \frac{\Sigma fd}{N} \times Ci$$

where the symbols of $A.M.$ the assumed mean, Σfd the frequency and the multiplication of the deviations from the assumed mean, N the number of students, and Ci the size of the class interval.

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Note

Frequency Distribution Table

Classes	Frequencies (f)	Deviation from A.M. (d)	Frequencies \times Deviation from (fd)
45 - 49	= 3	3	9
40 - 44	= 2	2	4
35 - 39	= 2	1	2
30 - 34	= 8	(A.M. = 32)0	0
25 - 29	= 7	-1	-7
20 - 24	= 4	-2	-8
15 - 19	= 2	-3	-6
10 - 14	= 2	-4	-8
$C_i = 5$	$N = 30$		$\Sigma fd = 14$

$$\begin{aligned}
 \therefore \text{Mean} &= A.M. + \left(\frac{\Sigma fd}{N}\right) \times C_i \\
 &= 32 + \left(\frac{-14}{30}\right) \times 5 \\
 &= 32 + \left(\frac{-70}{30}\right) \\
 &= 32 - \frac{7}{3} \\
 &= 32 - 2.33 = 29.67
 \end{aligned}$$

Precautions

1. The assumed mean should be considered in some middle class which has the highest number of frequencies.
2. As the mid point of the class is the assumed mean.
3. The deviation of the classes above the assumed mean in the ascending series is positive and that of the lower ones is negative.

**Note**

4.6.5 Characteristics of Mean

1. The mean is the mean value of the scores, it can be easily found by mathematical methods.
2. The mean value is such a focal value whose gravitational value (deviation) is the same on both sides.
3. The mean is very sensitive, changes in the value of any of the scores in the group. This changes the value of the mean. Hence it is correct for the scores of a group is considered a representative value.
4. Mean is more reliable than other centroids such as median and mode.

4.6.6 Limitations of Mean

1. The mean represents the scores of a group only if the distribution of scores is normal.
2. If the value of some scores of a group is very high or very less than the value of other scores, then in that case also the mean value does not represent the group correctly.

4.6.7 Meaning and Definition of Median

Median is the central value that divides the scores of a group into such two equal parts that all the scores of one part are greater than that and all the scores of the other part are less than that. We make it clear with an example. Suppose the marks of 5 students in an examination of 50 marks are as follows:

17 40 38 21 and 41

then the scores in rank

17 21 38 40 and 41

Now just look at these five scores. Of these, 38 is such a score, which is less than two marks and more than two marks. Hence the median of this group is 38.

Then the median can be defined as follows :

The median is the score of a group that, when placed in their rank order, falls exactly in the middle of them and on either side of which half (50-50 percent) of the group's scores are distributed.

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Note

4.6.8 Methods of Calculating Median from Ungroup Data :

The most straightforward method of finding the median value is to arrange the scores of the students of the group in the rank order, *i.e.* to be arranged from minimum to maximum and then take the middle score from it.

Example : The marks of 7 students in an examination of 50 marks are 15, 8, 30, 21, 19 and 33 respectively. Find the median.

Calculation : On arranging the scores in rank order

$$8, 15, 19, 21, 24, 30, 33$$

The middle score in this is the median number (*mdn*) 21, above which there are three scores and there are three marks below.

Note When the number of students is even, then the average of the middle two marks is taken.

Example : In an examination of 50 marks, 8 students got 23, 15, 8, 12, 24, 26, 33 and 31 marks respectively. Find the median.

Calculation : On putting the scores in the rank order

$$8, 12, 15, 23, 24, 26, 31, 33$$

\therefore In these the middle scores are both 23 and 24, they have 3-3 scores here and there.

$$\therefore \text{Median} = \frac{23 + 24}{2} = \frac{47}{2} = 23.5$$

Note Look at the above two examples. In these, the median value is half of the middle score or the sum of the two middle scores. If we want to express it in formula form, we can do it as follows :

$$\text{Median, } Mdn = \frac{N+1}{2} \text{th score}$$

where *Mdn* is the sign of the median and *N* is the number of students. In the first *example*,

$$\begin{aligned} \text{Median, } Mdn &= \frac{N+1}{2} \text{th score} \\ &= \frac{7+1}{2} = \frac{8}{2} = 4\text{th score} \\ &= 21 \end{aligned}$$

**Note**

In the Second *Example*,

$$\begin{aligned}\text{Median, } Mdn &= \frac{N+1}{2} \text{th score} \\ &= \frac{8+1}{2} = \frac{9}{2} = 4.5 \text{th score}\end{aligned}$$

i.e., average of 4th and 5th scores

$$\begin{aligned}&= \frac{23+24}{2} = \frac{47}{2} \\ &= 23.5\end{aligned}$$

4.6.9 Methods of Calculating Median from Group Data

When the number of students is very large, it becomes a bit difficult to organize their scores. In that case, we prepare the frequency distribution table and calculate the Median value with the help of frequency distribution table.

In this, we first calculate the cumulative frequencies in the frequency distribution table and then calculate with the help of this table we find out the class in which the $\frac{N}{2}$ th score is given. After this, with the help of following formulas, the median of the marks obtained is determined.

$$1. \text{ Median, } Mdn = L + \frac{\left(\frac{N}{2} - Fb\right)}{f} \times Ci$$

Where,

L the class with the median just below it indicates the lower limit.

N denotes the total number of students.

Fb is the sign of the sum of the frequencies before the class with the median.

f denotes the frequency of the class with the median and

Ci is an indication of the class interval, that is, the size of the classes.

Or

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Note

$$2. \text{ Median, } Mdn = U + \frac{\left(\frac{N}{2} - Fa\right)}{f} \times Ci$$

Where,

U denotes the upper limit of the class with the median.

N denotes the number of students.

Fa is the sign of the sum of all the frequencies above the class of the median.

f denotes the frequency of the class with the median and

Ci is an indication of the class interval, that is, the size of the classes. We make this method clear with an *example*.

Example : Find the Median of the scores from the following frequency distribution table :

Classes	Frequencies	Cumulative Frequency (cf)
45-49	3	40
40-44	2	37
35-39	5	35
30-34	11	30 (Median value square)
25-29	8	19
20-24	5	11
15-19	4	6
10-14	2	2
$Ci = 5$	$N = 40$	

Calculation

According to the first formula,

$$Mdn = L + \frac{\left(\frac{N}{2} - Fb\right)}{f} \times Ci$$



Note

Before using this formula we should first find out in which class the median value. For this we have to find the value $\frac{N}{2}$ and the class it comes in is the $\frac{N}{2}$ median class.

$$\begin{aligned}\text{Median score, } Mdn &= \frac{n}{2} \text{th score} \\ &= \frac{N}{2} = 20 \text{th score}\end{aligned}$$

In this, 20th are falling 30-34 class-interval. Therefore, we consider this class as a median class.

Then,

L i.e., its lower limit = 29.5

N i.e., the number of students = 40

Fb i.e., the sum of the frequencies before the class with the median value = 19

f i.e., the frequency of the class with the median value = 11

Ci i.e., the class size = 5

$$\begin{aligned}\therefore \text{Median, } Mdn &= 29.5 + \frac{\left(\frac{40}{2} - 19\right)}{11} \times 5 \\ &= 29.5 + \frac{(20 - 19)}{11} \times 5 \\ &= 29.5 + \frac{1}{11} \times 5 \\ &= 29.5 + 0.45 = 29.95\end{aligned}$$

According to another formula,

$$Mdn = U + \frac{\left(\frac{N}{2} - Fa\right)}{f} \times Ci$$

Where,

U means the upper limit of the class with the median value = 34.5

N means number of students = 40

Fa means upward frequencies of the class having median value = 11

f means the frequencies of the class with the median value = 5

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Note

and C_i means class size = 5

$$\begin{aligned}\therefore \text{Median, } Mdn &= 34.5 - \frac{\left(\frac{40}{2} - 10\right)}{11} \times 5 \\ &= 34.5 - \frac{(20 - 10)}{11} \times 5 \\ &= 34.5 - \frac{10}{11} \times 5 \\ &= 34.5 - \frac{50}{11} \\ &= 34.5 - 4.55 \\ &= 29.95\end{aligned}$$

4.6.10 Characteristics of Median

1. The median is in the middle of the arrangement of the scores of a group in the order of rank, so this group is suitable for comparison and interpretation of other scores.
2. When the deviation of the scores in a group is abnormal or the value of some of its scores is very high or very less than the other scores, then in that case the median is more useful than the mean.
3. Median score is more useful for qualitative interpretation of scores of a group than other centroids such as mean and mode.
4. Interpretation of other scores of the group from the median score displayed by the graph of scores of a group can be done.

4.6.12 Limitations of Median

1. The median can be calculated for scores of the same group, not for the scores of two groups.
2. The median is the rank of the scores of a group, so to find the median, it is necessary to arrange the position of all the scores of the group. When there is a large group, it takes more time and energy to do all this.

4.6.13 Uses and Importance of Median in Field of Education

In the field of Education, the maximum use is of Mean but there are

**Note**

some situations in which Median is used such as;

1. When the distribution of scores of a group is not normal.
2. When all the scores of a group are not obtained.
3. When we have to find out the position of a particular person in a group that he is visually comes in the first 50% or comes in the last 50%.
4. When there is no time to calculate the mean.
5. When it is needed in the conclusion rendering of academic researches.

4.7 Meaning and Definition of Mode

The score which has the highest frequency in the scores of a group is called the score of that group called mode.

For example, look at the following scores :

5 4 3 4 6 4 5 7 3 and 6

Of these, 5 has a frequency of 2, 4 has a frequency of 3, 3 has a frequency of 2, 6 has a frequency of 2, and 7 has a frequency of 1.

So the mode of these scores will be 4 as it has the highest frequency in the group. Then the mode can be defined in the following way :

Mode is the score of a group which has the highest frequency among the scores of that group.

4.7.1 Methods of Calculating Mode from Ungroup Data

The most straightforward method of finding the mode value is to arrange the scores of the students of the group in the order of rank *i.e.*, from lowest score to highest score and then observe the frequency of scores. The score with the highest frequency will be the mode value.

Example : 10 students got the following marks in an examination of 50 marks. Find the Mode.

40 11 17 18 8 17 24 37 18 17

Calculation : Arranging the scores in rank order,

8 11 17 17 17 18 18 24 37 40

\therefore Mode = 17

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Note

Note Sometimes it happens that the frequencies of two or more scores are the same, in that case the following rules are there to find the mode value :

1. The group in which the frequencies of two adjacent scores are highest and mutually exclusive. is equal to, the average of these two scores in that group is the mode.

For example: 8 11 17 17 17 19 19 19 24 and 37

$$\text{Mode, } Mo = \frac{17 + 19}{2} = \frac{36}{2} = 18$$

2. The group in which the frequency of two such scores is highest and equal among themselves, which are not close to each other, then both the scores are mode in that group. Such groups are called Bi-Modal.

For example: 8 11 17 17 17 18 24 24 24 and 26

Mode, $Mo = 17$ and 24

3. In a group in which many or all of the scores have the same frequency, the question of finding the mode in that group does not arise.

For example: There is no mode in 11 11 11 16 16 16 17 17 17 19 19 23 23 23.

4.7.2 Methods of Calculating Mode from Group Data

When the number of students is very large, it is difficult to arrange the scores in rank order and there is a possibility of error. In that case, the frequency distribution table is prepared and with the help of that the mode value is extracted. There are also two methods for this : one is to find the approximate mode and from the second the correct mode is taken.

4.6.3 Method of Calculating Crude Mode

To work out for the approximate mode, first let's make a frequency distribution table. Then find the mid-point of the class in which the frequencies of the scores are highest. This midpoint is the approximate mode of that group.

Example : Find the polynomial of the scores from the ahead frequency distribution table :

**Note****Frequency Distribution Table**

Classes	Frequencies
90 - 99	2
80 - 89	5
70 - 79	8
60 - 69	9
50 - 59	12
40 - 49	4
30 - 39	5
20 - 29	3
10 - 19	2

Calculation

Look at the frequency distribution table carefully. The highest frequency of scores in this is in the 50 - 59 class.

$$\therefore \text{Approximate mode, } Mo = \frac{50 + 59}{2} = \frac{109}{2} = 54.5$$

4.7.4 Method of Calculating True Mode

To find the correct mode, first the mean is taken, then the median and then twice the mean is subtracted from three times the median. It is expressed in the formula as follows :

$$Mo = 3 \times Mdn - 2 \times M$$

We have already told the method of finding the mean and median. Here, after completing the above table, calculating them and extracting mode numbers :

Frequency Distribution Table

Classes	Frequencies (<i>f</i>)	Cumulative Frequencies	Deviation from A.M. (<i>d</i>)	Frequencies × Deviation
90 - 99	2	50	4	8
80 - 89	5	48	3	15

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Note

70 - 79	8	49	2	16
60 - 69	9	35	1	9
50 - 59	12	26	0 (A.M.)	0
40 - 49	4	14	-1	-4
30 - 39	5	10	-2	-10
20 - 29	3	5	-3	-9
10 - 19	2	2	-4	-8
$Ci = 10$	$N = 50$			$\Sigma fd = 17$

$$\begin{aligned} \therefore \text{Mode, } M &= A.M. + \frac{(\Sigma fd)}{N} \times Ci \\ &= \frac{50 + 59}{2} + \left(\frac{17}{50}\right) \times 10 \\ &= \frac{109}{2} + \frac{17}{50} \times 10 \\ &= \frac{109}{2} + \frac{17}{5} \\ &= 54.50 + 3.40 = 57.90 \end{aligned}$$

$$\begin{aligned} \text{Median, } Mdn &= L + \frac{\left(\frac{N}{2} - Fb\right)}{f} \times Ci \\ &= 49.5 + \frac{\left(\frac{50}{2} - 14\right)}{12} \times 10 \\ &= 49.5 + \frac{25 - 14}{12} \times 10 \\ &= 49.5 + \frac{11}{12} \times 10 \\ &= 49.5 + \frac{11}{6} \times 5 \\ &= 49.5 + \frac{55}{6} \\ &= 49.5 + 9.17 = 58.67 \end{aligned}$$

$$\therefore \text{Mean } Mo = 3 \times Mdn - 2 \times M$$

**Note**

$$\begin{aligned}
 &= 3 \times 58.67 - 2 \times 57.90 \\
 &= 176.01 - 115.80 \\
 &= 60.21
 \end{aligned}$$

Comment

1. The predicted mode of this frequency distribution is 54.5 and the correct mode is 60.21. Although there is a slight difference between these two, but this difference makes the decisions of evaluation different. Therefore, as far as possible, we should find the correct mode.
2. When the distribution forms an approximately normal probability curve, there is little difference between the mean value, median value and mode value. In the above example the mean value 57.90, median value 58.67 and the mode value is 60.21. There is very little difference between these three.
3. There are also separate formulas for finding the mode, by which the mode can be found directly without the mean and median.

$$(i) \text{ Mode, } Mo = L + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times Ci$$

$$(ii) \text{ Mode, } Mo = L + \frac{f_2}{f_0 + f_2} \times Ci$$

Where,

 L = Net lower limit of modal class f_0 = Frequency of the class preceding the modal class f_1 = Frequency of the modal class f_2 = Frequency of the class immediately following the modal classIn this $L = 49.5$, $f_0 = 4$ and $f_2 = 9$

$$\begin{aligned}
 \text{Mode, } Mo &= L + \frac{f_1 - f_0}{2f_1 - f_0 - f_2} \times Ci \\
 &= 49.5 + \frac{12 - 4}{2 \times 12 - 4 - 9} \times 10
 \end{aligned}$$

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Note

$$\begin{aligned} &= 49.5 + \frac{8}{11} \times 10 \\ &= 49.5 + \frac{8}{11} \\ &= 49.5 + 7.27 = 56.77 \end{aligned}$$

In second formula,

$$\begin{aligned} \text{Mode, } Mo &= L + \frac{f_2}{f_0 + f_2} \times Ci \\ &= 49.5 + \frac{9}{4 + 9} \times 10 \\ &= 49.5 + \frac{90}{13} \\ &= 49.5 + 6.92 = 56.42 \end{aligned}$$

Note

1. If only mode has to be done, then it remains to use the above formula because in the first method, if by mistake, the mean or one of the middle values, then the mode will automatically be wrong.
2. The estimated mode from this iteration is 54.5 and the pure mode from the first and second methods is 60.21, 56.21 and 56.42 respectively. This difference is due to the use of different methods. Usually it is more useful to find the pure mode.

4.6.5 Characteristics of Mode

1. The mode of scores of a group can be found very easily, of non-general scores too.
2. The value of mode of the scores of a group can also be found by graphing the scores.
3. If the value of some scores of a group is much more or less than the value of other scores, then in that case also the mode of the scores of that group is not affected.
4. It is more useful for qualitative interpretation of scores of a group.

**Note**

4.7.6 Limitations of Mode

1. When none of the scores in a group are mode or more than two such scores with a large difference, come in the category of mode, then in that case the mode will be meaningless.
2. The mode is an approximate centroid value and therefore less useful for statistical calculations.

4.8 Standard Deviation (SD)

While finding the mean deviation, no attention is paid to the plus and minus signs of the deviation, and this is the biggest limit of mean deviation. Therefore, to remove this defect, calculate the standard deviation. In other words, we can say that standard deviation is an improved form of mean deviation.

To overcome the problem of markings under the standard deviation, the deviations are squared due to which the minus sign also turns into a plus sign, then the average of these squared deviations is taken and their square root is taken. This is called the standard deviation. According to **Reichmann**, "The standard deviation is also known as root mean square deviation. It is the square root of the mean value of all deviation squared taken from the distribution mean."

In simple words, the standard deviation can be defined as :

Very generally, the standard deviation is a measure of how the scores cluster or disperse around the mean and is conventionally represented by the Greek letter sigma.

Symbolically,
$$\sigma = \sqrt{\frac{\sum d^2}{N}}$$

Calculation : The following three types of questions are used to calculate the standard deviation :

Case I : When only unclassified data is given.

Case II : When unclassified data along with their frequencies are also given.

Case III : When classified data is given.

Case I : When only unclassified data is given.

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Note

These type of questions are solved by two methods : Actual Mean Method and Assumed Mean Method. The formulas used in these methods are as follows :

$$S.D. = \sqrt{\frac{\sum d^2}{N}} \quad (\text{Actual mean method})$$

and
$$S.D. = \sqrt{\frac{\sum d^2}{N} - \left(\frac{\sum d}{N}\right)^2} \quad (\text{Assumed mean method})$$

Example : Find the standard deviation from the following data by the actual mean method.

Table

S.No.	X	$d = (X - M)$	d^2
1	10	$10 - 18 = -8$	64
2	15	$15 - 18 = -3$	9
3	10	$10 - 18 = -8$	64
4	20	$20 - 18 = 2$	4
5	25	$25 - 18 = 7$	49
6	15	$15 - 18 = -3$	9
7	25	$25 - 18 = 7$	49
8	20	$20 - 18 = 2$	4
9	17	$17 - 18 = -1$	1
10	23	$23 - 18 = 5$	25
$N = 10$	$\sum X = 180$		$\sum d^2 = 278$

$$M = \frac{\sum X}{N} = \frac{180}{10} = 18$$

Now,
$$\sigma = \sqrt{\frac{\sum d^2}{N}}$$

$$= \sqrt{\frac{278}{10}}$$

$$\sqrt{27.8} = 5.27$$

Example : Find the assumed deviation from the following data by the actual mean method.

**Note**

S.No.	X	$d = (X - M)$	d^2
1	10	$10 - 17 = -8$	49
2	15	$15 - 17 = -2$	4
3	10	$10 - 17 = -7$	49
4	20	$20 - 17 = 3$	9
5	25	$25 - 17 = 8$	64
6	15	$15 - 17 = -2$	4
7	25	$25 - 17 = 8$	64
8	20	$20 - 17 = 3$	9
9	17	$17 - 17 = 0$	0
10	23	$23 - 17 = 6$	36
$N = 10$		$\Sigma d = 10$	$\Sigma d^2 = 288$

$$\begin{aligned}\sigma &= \sqrt{\frac{\Sigma d^2}{N} - \left(\frac{\Sigma d}{N}\right)^2} \\ &= \sqrt{\frac{288}{10} - \left(\frac{10}{10}\right)^2} \\ &= \sqrt{28.8 - 1} \\ &= \sqrt{27.8} \\ &= 5.27\end{aligned}$$

Important Steps

1. Arrange points distribution.
2. Find the actual mean from the score distribution.
3. Find the deviation using the formula $d = X - M$.
4. Find the class d^2 of the deviation.
5. Find Σd^2 by adding up the deviation squares obtained.
6. Substituting all these values in the formula and calculate S.D.

Case II : When unclassified data along with their frequencies are given.

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Note

Example : Find the standard deviation from the following data by assumed mean method.

Table

S.No.	X	f	$d = (X - M)$	fd	fd^2
1	65	3	$65 - 75 = -10$	-30	300
2	68	4	$68 - 75 = -7$	-28	196
3	70	4	$70 - 75 = -5$	-20	100
4	72	5	$72 - 75 = -3$	-15	45
5	74	6	$74 - 75 = -1$	-6	6
6	75	7	$75 - 75 = 0$	0	0
7	78	6	$78 - 75 = 3$	18	54
8	80	5	$80 - 75 = 5$	25	125
9	82	4	$82 - 75 = 7$	28	196
10	84	6	$84 - 75 = 9$	54	486
		$N = 50$		$\Sigma fd = 26$	$\Sigma fd^2 = 1508$

Now, S.D. or $\sigma = \sqrt{\frac{\Sigma d^2}{N} - \left(\frac{\Sigma d}{N}\right)^2}$

$$= \sqrt{\frac{1508}{50} - \left(\frac{26}{50}\right)^2}$$

$$= \sqrt{30.16 - (0.52)^2}$$

$$= \sqrt{3.16 - 0.27}$$

$$= \sqrt{29.89}$$

$$= 5.47$$

Note

1. If the data is in the range of 10-20, then the actual mean method is convenient.
2. If the actual mean comes in decimal point, then the assumed mean method should be used.
3. The assumed mean data should be selected carefully.

**Note**

Case III: When classified data is given.

The standard deviation of questions related to classification data is done by two methods : Long Method and Short-cut Method. Following are the formulas used in these methods :

$$\sigma = \sqrt{\frac{\sum fd^2}{N}} \quad (\text{long method})$$

and
$$\sigma = \sqrt{\frac{\sum fd^2}{N} - \left(\frac{\sum fd}{N}\right)^2} \times Ci \quad (\text{short method})$$

Example : Find the standard deviation from the following grouped data by long method.

S.No.	C.I.	f	X	$d(X - M)$	fd	fX	fd^2
1	40 - 44	3	42	14.3	42.9	126	613.47
2	35 - 39	4	37	9.3	37.2	148	345.96
3	30 - 34	4	32	4.3	17.2	128	73.96
4	25 - 29	7	27	0.7	4.9	189	3.43
5	20 - 24	3	22	5.7	28.5	110	162.45
6	15 - 19	3	17	10.7	32.1	51	343.47
7	10 - 15	2	12	15.7	31.4	24	492.98
		$N = 28$	$\sum fX = 776$				$\sum fd^2 = 2035.72$

$$M = \frac{\sum fX}{N} = \frac{776}{28} = 27.7$$

Now,

$$S.D. = \sqrt{\frac{\sum fd^2}{N}}$$

$$= \sqrt{\frac{2035.72}{28}}$$

$$= \sqrt{72.71} = 8.52$$

Important Steps:

1. Find the midpoint (X) of each C.I. Related formula is :

$$X = \frac{x_1 + x_2}{2}$$

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Note

2. Find the fX in the mid-points of all the class intervals by multiplying them by the respective frequency.
3. Find the sum of all the fX values thus obtained.
4. Calculate the mean using the formula $(M = \Sigma fX/N)$.
5. Find the deviation (d) using the formula $d = X - M$.
6. Find the fd by multiplying the frequency of each class interval by the deviation of the same class.
7. Find fd^2 by multiplying fd and d .
8. Find the sum of all the fd^2 values thus obtained.
9. Divide the Σfd^2 value by N .
10. Find the square root of the obtained quotient. This will be the intended standard deviation.

Example: Find the standard deviation of the following data by the abbreviation method.

S.No.	C.I.	f	d	fd	fd^2
1	90 - 99	1	+4	4	16
2	80 - 89	4	+3	12	36
3	70 - 79	7	+2	14	28
4	60 - 69	10	+1	10	10
5	50 - 59	9	0	0	0
6	40 - 49	9	-1	-9	9
7	30 - 39	4	-2	-8	16
8	20 - 29	3	-3	-9	27
9	10 - 19	3	-4	-12	47
		$N = 50$		$\Sigma fd = 2$	$\Sigma fd^2 = 190$

Now, S.D. or $\sigma = \sqrt{\frac{\Sigma fd^2}{N} - \left(\frac{\Sigma fd}{N}\right)^2} \times C.I.$

Applying the formula, we get,

$$\sigma = \sqrt{\frac{190}{50} - \left(\frac{2}{50}\right)^2} \times 10$$



Note

$$\begin{aligned} &= \sqrt{3.8 - (0.04)^2} \times 10 \\ &= \sqrt{3.8 - 0.016} \times 10 \\ &= \sqrt{3.7984} \times 10 \\ &= 1.95 \times 10 \\ &= 19.50 \end{aligned}$$

4.9 Graphical Representation of Data

In research, data can be presented in many ways. Dot graphical representation of data can show important facts easily and simply. In fact, it is a meditative method as well as an effective and economical method from the point of view of making the results clear, simple, understandable and alive. Line drawings also make complex and monotonous subject matter simple and alive. With the help of diagrams, even complex subjects can be presented in an easy way.

Benefit

1. It describes the correlations.
2. It helps in forecasting the future.
3. Helps in comparing two or more variables or situations.
4. Complex things can be explained easily.
5. It is easy for the learners.

4.10 Methods of Graphical Representation

For graphical representation, the researcher can make a graphical representation of the data compiled by him himself or with the help of MS Excel in the computer. One can use Chart Wizard for this. MS Excel has this nice feature that on inputting the data, it can display any type of chart or graph immediately. It has different types of charts as follows :

- Column
- Bar
- Line

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Note

- Pie
- XY (Scatter)
- Area
- Doughnut
- Lader
- Surface
- Bubble
- Stock
- Cylinder
- Cone
- Pyramid

4.10.1 Line Graph

It is easy to make and present. See Figure 1 In this, the educational status of the readers has been displayed in a diagram.

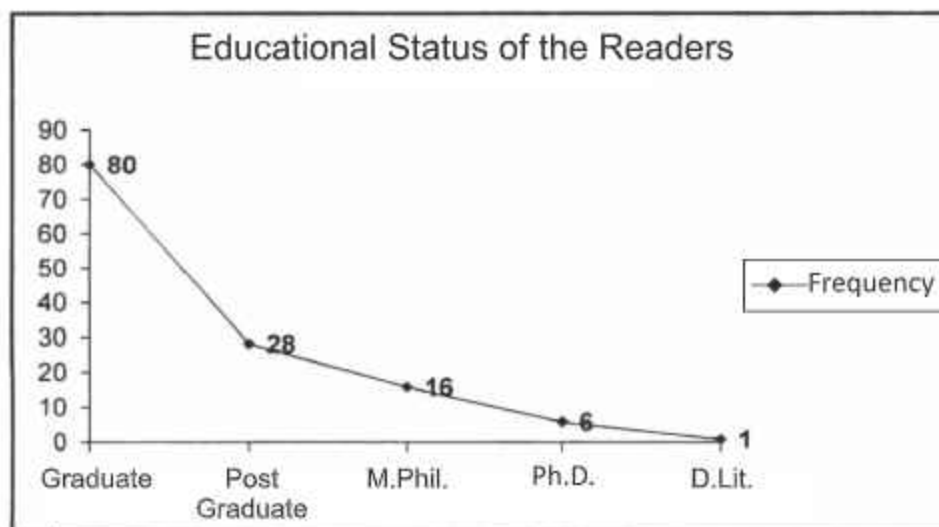


Figure1

4.10.2 Circle Graph or Pie Diagram

This type of diagram is used to display data where an information is displayed as a percentage. Its construction method is simple since the circle is 360 degrees. Therefore, as a percentage, the whole circle will be considered equal to 100.

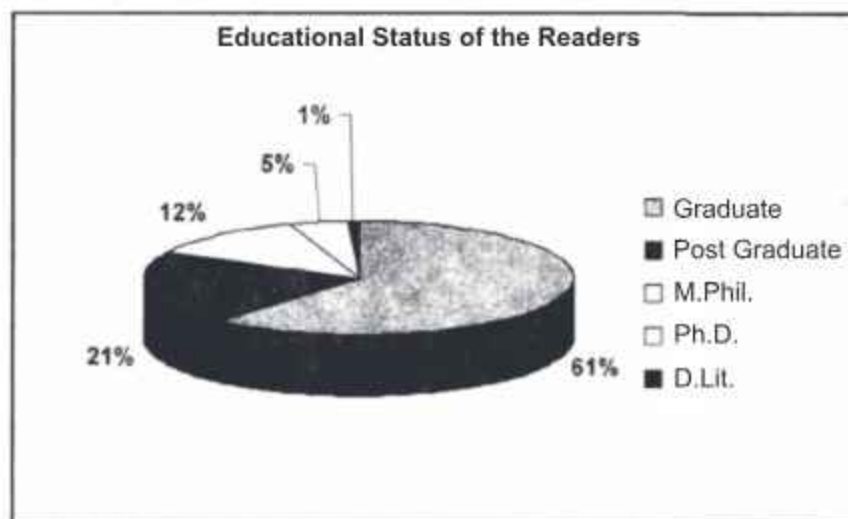


Figure 2

4.10.3 Column Chart

The data is also displayed through the bar. In this bar means bar or stripe, in which the stripes are drawn horizontally in proportion to the value of the variables. It should be noted that the width of the bars is the same. With the help of computer it becomes very easy.

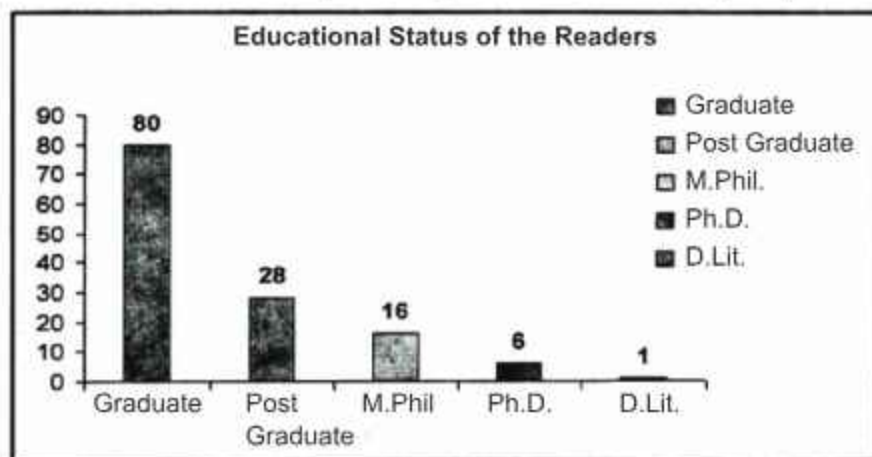


Figure 3

Testing of Hypothesis : T-test and chi square test have been expanded as follows :

T-test : T-test has been described under primary examinations. If only groups are formed at independent variable, *i.e.*, independent variable is manipulated in only two categories and only these two

Note



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groups are to be compared at dependent variable then in that case T-test is used goes. The T-test is a systematic test and consists of a single independent variable that is handled in two or more categories. Such research designs are called "single variable designs". From this point of view there are two types of T-test :

- (i) Independent group and
- (ii) Co-related or reconstructed.

In case of free group the units of both the groups are different. In the case of correlative groups, units of the same group are subjected to two treatments. If the units are equalized and distributed in both the groups, then even though the units of the groups are different, they are considered to be correlated. The T-test can be used in both the inferior conditions, but the formula for both is different.

From a second point of view, both the above types of T-tests have two forms :

1. Micro-specimen and 2. Macro-specimen

Different formulas are used in these two situations as well. Thus the total of T-test are four types :

- 1. Large-sample Independent Group T-test :** This test is used where the number of groups is two, the group is independent, the sample is large and the condition of the parameter tests is satisfied. In this, groups are compared on the basis of difference of their mean. The hypothesis that it is tested is as follows, "There is no significant difference in the mean between the groups." For this, the difference of the mean values is converted into T-value or C.R. Value. The obtained t or C.R. is compared with the value given in the T-table at the pre-selected significance level (.05 or 01). While looking at the value of T in the table, the degrees of freedom also have to be taken into account. If the obtained t value is equal to or greater than the table value at that significance level and at that degree of freedom, the non-substantiated hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted. If this obtained value is found to be less than the table value, then H_1 is rejected by not rejecting H_0 . Thus, indirectly *i.e.*, by not rejecting H_0 , conclusion is

**Note**

drawn about the research hypothesis. It will be clear by the *i.e.*, given below :

Analysis Option : 11 years old with high achievement motivation and low achievement motivation. By forming two independent groups of children, separate mean and deviation values of their academic achievement (test scores) are derived. The following *example* table presents the contents of :

Table
Relation between achievement motivation
and educational achievement

	Group-I (low motivation)	Group-II (high motivation)
Mean	88.80	90.5
Mean scale	7.80	11.56
No. (<i>N</i>)	83	97

This is an *i.e.*, of a large sample independent group. In this, the process of finding the C-Ratio (C.R. or T) is as follows :

Gradation 1 : Find the S.E. of each mean. Its formula is :

$$S.E. = \frac{S.D.}{\sqrt{N}}$$

So $S.E._1 = \frac{7.81}{\sqrt{83}} = 0.857$

Similarly, $S.E._2 = \frac{11.56}{\sqrt{95}} = 1.86$

Gradation 2 : Now on the basis of these, find the S.E._D (S.E. of difference), its formula is :

$$S.E._D = \sqrt{[(S.E._1)^2 + (S.E._2)^2]}$$

According to this formula,

$$\begin{aligned} S.E._D &= \sqrt{[(0.857)^2 + (1.86)^2]} \\ &= 1.463 \end{aligned}$$

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Gradation 3 : Now find the value of T. Its formula is :

$$t = \frac{D}{S.E._D} = \frac{1.70}{1.463} = 1.162$$

Gradation 4 :

Test of Significance : For this the t-value obtained at 196 *df* and 0.5 level has to be compared with the team value (1.97) given in Table (B). It is clear that the obtained T value of 1.162 is less than the tabular T value of 1.97. Hence, this difference is not significant at 0.05 level. If it is not meaningful at this level then it will not be meaningful even at 0.01 level. Hence H_0 cannot be rejected. As a result H_1 , (there is a difference) is rejected.

Gradation 5 :

Conclusion : So it was concluded that there is no real difference between the mean values of both the groups. That is, there is probably no relation between achievement motivation and academic achievement.

2. **Large-sample Correlation Group T-test :** The method given in the example 1 is used where the groups are independent, but when the groups are correlated or matched, the following method is used. In this, the formula for finding the quantifier (S.E) remains the same as in *example 1*, but the formula for extracting $S.E._D$ is as follows :

$$S.E._D = (S.E._1^2 + S.E._2^2 - 2r_{12} S.E._1 S.E._2) \dots \text{Formula (2)}$$

$$\text{Or} \quad \sqrt{\left[\frac{1}{N} (S.D._2^2 - 2r_{12})(S.D._1 \times S.D._2) \right]}$$

Using the second formula, the $S.E._D$ value will be the same.

$$t = \frac{D}{S.E._D}$$

This is made clear by the example given below :

Example 2 : A personality balance test was given to a group of 625 eleven year old boys. On this their mean and S.D. were found to be 96.7 and 8.0 respectively. After this he was given

**Note**

group counselling treatment for two months. After two months, he again gave the same balance test. This time the mean value of their balance was found to be 106.7 and S.D. 10.0. The correlation between the two time balance tests was 0.52. Was the group counselling treatment effective? To get an answer to this question, one has to test the significance of the difference between the mean values of the balance test for both the times, because both the groups are correlated. Therefore, formula-2 has to be used to find the S.E._D of the difference of their mean values. The whole process will be like this :

(i) S.E.₁ (Mean of the first time)

$$= \frac{\text{S.D.}}{\sqrt{N}} = \frac{8}{\sqrt{625}} = \frac{8}{25} = 0.32$$

(ii) S.E.₂ (Mean of second time)

$$\frac{\text{S.D.}}{N} = \frac{10}{\sqrt{625}} = \frac{10}{25} = 0.40$$

(iii) S.E._D = $\sqrt{(\text{S.E.}_1^2 + \text{S.E.}_2^2 - 2r_{12} \text{S.E.}_1 \text{S.E.}_2)}$

$$= \sqrt{[(0.32)^2 + (0.40)^2 - 2 \times 0.52 \times 0.32 \times 0.40]}$$

$$= 0.3596$$

Using the second option formula, the S.E._D value will be the same.

$$\begin{aligned} \text{(iv)} \quad t &= \frac{D}{\text{S.E.}_D} = \frac{106.7 - 96.7}{0.3596} \\ &= \frac{10}{0.3596} = 27.80 \end{aligned}$$

This t-value is much higher than the value given in the table at 624 *df* (*N* - 1) at each level. Hence H_0 is rejected and it is concluded that group counseling treatment has a definite effect on the balance.

Calculation of Independence : It is necessary to remember that in the case of independent groups, the calculation of independence is done on the basis of $n_1 + n_2 - 2$ formula. The

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reason for this is that in the case of correlated and equalized groups, the same person is tested twice, so a correlation is established between their modulus. The freedom to change the scores obtained on the second test decreases because the group's second time achievement cannot be completely different, independent of the first time, as the group remains the same. Therefore, the modulus of the second time cannot be completely independent from the one which came for the first time. Therefore, the modulus of both the times of a person is given as one df instead of two df. Thus to find in the position of the correlated df groups only $N - 1$ formula is used.

3. **Small-sample Independent Group T-test :** If the sum of the units of both the independent groups is less than 30, then it is considered as small sample. In this situation S.D. and S.E._D extraction formulas vary. The rest of the process remains undone. S.D. and the formulas for extracting S.E._D are as follows :

$$(i) \text{ S.D.} = \sqrt{\left(\frac{\Sigma x^2 + \Sigma y^2}{N_1 + N_2 - 2}\right)}$$

In which Σx^2 and Σy^2 are taken from the respective mean of the scores of both the groups respectively is the sum of the squares of the differences.

$$(ii) \text{ S.E.}_D = \text{S.D.} \sqrt{\left(\frac{N_1 + N_2}{N_1 \times N_2}\right)}$$

The whole process of estimation is explained by the example given below :

Table

Group X			Group Y		
X	x	x ²	Y	y	y ²
110	4.5	20.25	115	2.0	4.0
112	6.5	42.25	112	-1.0	1.0
95	-10.5	110.25	109	-4.0	16.0
105	-0.5	0.25	112	-1.0	1.0



Note

111	5.5	30.25	117	+4.0	16.0
97	-8.5	72.25			
112	6.5	42.25			
102	-3.5	12.25			
Sum = 844		330	565		38
N 8		Σx^2	5		Σy^2
Mean = 105.5			Mean = 113.0		

Steps:

$$(i) \text{ Pooled S.D.} = \sqrt{\left(\frac{\Sigma x^2 + \Sigma y^2}{N_1 + N_2 - 2}\right)}$$

$$= \sqrt{\left(\frac{330 + 38}{8 + 5 - 2}\right)} = 5.78$$

$$(ii) \text{ S.E.} = \text{Pooled S.D.} \times \left(\frac{N_1 + N_2}{N_1 \times N_2}\right) = 5.78 \times \sqrt{\left(\frac{13}{40}\right)} = 3.302$$

$$(iii) \text{ C.R. } (t) = \frac{\text{Diff.}}{3.302} = \frac{7.5}{3.302} = 2.271 \text{ for } df 11$$

This method of analysis is very important in the context of laboratory studies because in these studies the result of the sample is small, but in this situation it is necessary to check the homogeneity of the groups. This method can be used only if there is homogeneity of variance.

4. Small Sample Correlated Group T-test : In this case also the formula for finding $S.E._D$ remains same as that used in case of large sample correlation group *i.e.*, this situation,

$$S.E._D = \sqrt{S.E._1^2 + S.E._2^2 - 2r_{12} \times S.E._1 \times S.E._2}$$

But there is another way to get it. Its basis is the distribution of the difference of the modulus of both. The mean and S.D. of the differences are derived. These are named as D and S_D respectively. Based on these $S.E._D$ is derived whose formula is

$$S.E._D = \frac{S_D}{\sqrt{N}}$$

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Note



This S.E._D is converted to T value by the formula $\frac{D}{S.E._D}$. From the following example it will become clear :

Table

<i>X</i>	<i>Y</i>	<i>D</i>	<i>D</i> ²
100	105	- 5.0	25
90	96	- 5.0	25
106	100	+ 6.0	36
95	105	- 10.0	100
102	99	+ 3.0	9
104	98	+ 6.0	36
90	110	- 20.0	400
105	106	- 1.0	1
99	100	- 1.0	1
		$\Sigma D = - 27.0$	$\Sigma D^2 = 633$

$$(i) \quad \bar{D} = \frac{-27}{9} = 3.0$$

Let $d = (D - \bar{D})$, a deviation score in D. Then:

$$(ii) \quad \Sigma d^2 = \Sigma D^2 - \frac{(\Sigma d)^2}{n} = 633 - \frac{(-27)^2}{9} = 552.00$$

$$(iii) \quad S_D = \sqrt{\left(\frac{\Sigma d^2}{n-1}\right)} = \sqrt{\left(\frac{552.0}{8}\right)} = 8.306$$

$$(iv) \quad S.E._D = \frac{S_D}{\sqrt{N}} = \frac{8.306}{\sqrt{9}} = 2.768$$

$$(v) \quad Z(t) = \frac{D}{S.E._D} = \frac{-3.0}{2.768} = 1.08$$

If the value of t is calculated using formula 2, then the same will come as above obtained method.

The value of T at 8 *df* ($N-1$) and 0.05 is found to be 2.31 in the table. The obtained T value is 1.08 which is less than the table value. Hence H_0 cannot be rejected. That is why the research hypothesis (H_1) *i.e.*, "there is a difference" is rejected and the

**Note**

conclusion is established that there is no significant difference between X and Y modulus.

This method can also be used in case of large sample co-related groups. This method is very simple from the point of view of estimation, but very little information is obtained on its basis. This does not give knowledge of the correlation between the modulus of the two groups, nor does it reveal the mean values and scores of S.D. the groups.

But it should be remembered that the methods of finding the value of T in both the case of large and small sample correlated groups are the same, but if the groups are made equal on the basis of mean and S.D., then the formula to calculate S.E._D is as follows :

$$\text{S.E.}_D = \sqrt{[\text{S.E.}_1^2 + \text{S.E.}_2^2 \times (1 - r_{xy}^2)]}$$

The rest of the process remains the same even in this situation.

Chi-Square Test :

Chi-square (χ^2) is a nonparametric statistical method to test whether a distribution of frequencies obtained from a research is significantly different or not from the distribution of frequencies expected on the basis of a hypothesis. If not different then both of them are considered related. Thus, chi-square is a test method for the mutual relationship of two variables or between two frequency-variables. This analysis method is also used to find out whether the differences between the received and expected frequencies are just accidental or real. Also to find out, this Analysis Method is resorted/used. There are many types of this option. Mainly used in four different situations goes. These are :

1. Single group position.
2. Position of two independent groups.
3. Contingency Analysis
4. Position of more than two independent groups.

1. Single Group Position : This method is used where the obtained frequency distribution is compared with a distribution

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which is a standard distribution and which is based on a certain hypothesis such as hypotheses of an even distribution or similar is expected based on the hypothesis of distribution. It will be clear from the below example:

Example 1 : A researcher wants to know whether educated women really like to work. To find out, he selected 48 educated women and asked them whether they would like to work. They were asked to choose one option out of three options ('yes', 'no', 'neutral'). The frequencies of each answer he got 24, 12, 12. On the basis of the uniform distribution he tested whether the distribution obtained (24, 12, 12) differs significantly from the uniform distribution (16, 16, 16). His belief was that if women actually like to work, then this distribution should be different from the expected distribution (16, 16, 16) example in other words, if they want to work or not, their particular inclination towards someone. If not, then the distribution of 48 women should be equal (16, 16, 16) under all three option answers. He tested whether the distribution obtained from this distribution is significantly different or not by chi-square. For this, he first prepared the table as follows and based on that the value of chi-square was derived. The complete method of this calculation is given in the below :

Table
One Sample Chi-Square Test

	Preferred	Not-perferred	Indifferent	Total
F_o	24	12	12	48
F_e	16	16	16	48
$F_o - F_e$	8	4	4	
$(F_o - F_e)^2$				
$\frac{(F_o - F_e)^2}{F_e}$	64	16	16	
	4	1	1	
				$6 = X^2$ value

In the above table, F_o means received frequencies, F_e means expected frequencies. This single sample is an *i.e.*, of chi-square because research material has been collected from only one sample (48 females) *i.e.*,

**Note**

only one sample has been used. The formula for finding the chi-square is :

$$X^2 = \sum \frac{(F_o - F_e)^2}{F_e}$$

In which F_e means expected frequencies and F_o means received frequencies.

The chi-square value of each cell of the table has been derived by the above formula. Later the values of all the cells are added up. This whole chi-square came to be 6.0.

If the chi-value obtained is equal to or more than the value given in the table, then it is considered as a meaningful is believed. Rest of the problem procedure and logic remain exactly like T-test.

Calculation of Independence (df) : The concept of df is also used in the use of table of calculation of degrees of freedom (df). The formula to find it is $(p - 1) \times (k - 1)$ i.e., subtracting one each from the number of rows and columns multiply the remainder by each other. In the given example, there are 3 columns and rows. Thus, $df(3 - 1) \times (2 - 1) = 2$.

Significance : In table 2 df and at 0.5 level the value of chi is 5.991. The value obtained is 6.0 which table value exceeds. Therefore, rejecting the hypothesis H_o that "there is no difference between the two distributions", it will be concluded that there is a significant difference between the distributions. In other words, women prefer to work because the frequency of "yes" answers is highest. If the frequency of "no" answers were high, then the conclusion would be that they did not like to do the job. So what exactly will be the conclusion, it depends on the observation of the frequencies of the cells. If a one-sided test is to be done, then the value of Chi in the table, for level 0.05 should be seen in column 0.01 and for 0.01 in column 0.02.

Hypotheses of Expected Frequencies : Hypothesis of "Equal Distribution" can be used to find the expected frequencies in case of a single sample as explained in the *example* given below. Apart from this "Even-Distribution" Hypothesis can also be used. Which one should be used depends on the research situation. *For example*, if we want to know whether the marks distribution of a class is even or not then

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the expected frequencies have to be worked out on the basis of even distribution.

Limitations of Chi-Square: The use of Chi-square test is prohibited in the following circumstances :

- (i) When df is only 1 *example* k (group) = 2 and any expected frequency is less than 5.
- (ii) When df is greater than 1, but more than 20% of the frequencies are less than 5 or any expected frequency is less than 1.

2. Two Independent Group Algorithm : In this case two independent groups are compared on the basis of chi-square, just like in t-test by taking the value of t . The difference is that in this, its significance is tested by taking the value of chi-square in place of t and the conclusion is reached whether the two groups are different from each other from the point of view of any characteristic or dependent variable. "The two groups are not different from each other" is the basis of the hypothesis (H_0) test. Therefore, the chi-squared parameter test is the only non-parametrical alternative to T . Where t-test conditions are not met, chi-squares can be used where they cannot be used. *For example*, suppose a researcher wants to know whether "there is a difference between men and women in their willingness to work". He asks such a question to some women and men and receives research material in the form of three answer options "yes", "no" and "neutral". In this situation the chi-square test can be used.

Method of Use : In this case of using chi-square also the same method as described earlier in case of single group will be followed. The difference between the two is that in this case instead of a group There are two groups. By preparing the table, the value of the chi-square of each cell has to be worked out and at the end all chi-squares will have to be obtained by adding them all. The formula for finding the chi-square of the square is also the same as before happens *i.e.*,

$$\text{Chi-square} = \sum \frac{(F_o - F_e)^2}{F_e}$$

**Note**

The method of computation is explained by the example given below :

Example 2 : Suppose the above question was asked by the researcher 90 men and 100 women and got answers in the form of three types of options 'yes', 'no' and "neutral". A table was prepared by preparing the frequency distribution of those answers and to test the hypothesis that "there is no significant difference in the job desire of men and women." The following table shows the research material and the process of computing.

Table
The relationship between employment needs and sexuality

		Response		Mode	
		Yes	No	Indifferent	Total
Male	F_o	14.0	66.0	10.0	90
	F_e	19.42	62.52	8.05	
	$F_o - F_e$	5.42	3.48	1.95	
	$\frac{(F_o - F_e)^2}{F_e}$	1.51	0.20	0.47	
Female	F_o	27.0	66.0	7.0	100
	F_e	21.57	64.44	9.0	
	$F_o - F_e$	5.43	3.49	2.0	
	$\frac{(F_o - F_e)^2}{F_e}$	1.30	0.18	0.49	
Total		41	132	17	190

The solution to this problem is to calculate the frequency of each cell in the chi-square value and finally, all the obtained values will be solved by the following procedure :

- (i) $F_e(1)$ i.e., cell-1 = $\frac{41}{190} \times \frac{90}{0} = 19.42$ (out of 190 total F_e for 'yes' response = 41; how many out of 90, total of first now).

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- (ii) $Fe(2)$ i.e., for cell-2 = $\frac{132}{190} \times \frac{90}{1} = 62.52$ (out of 190 total Fe for 'No' response = 132; how many out of 90).
- (iii) $Fe(3)$ i.e., for cell-3 = $\frac{17}{190} \times \frac{90}{1} = 8.05$ (out of 190 total Fe for total cell-3, indiff. response = 17; how many out of 90).
- (iv) $Fe(4) = \frac{11}{190} \times \frac{100}{2} = 21.57$ (same argument).
- (v) $Fe(5) = \frac{132}{190} \times \frac{100}{1} = 64.44$ (same argument).
- (vi) $Fe(6) = \frac{17}{190} \times \frac{100}{1} = 9.00$ (same argument).

After this, we find out $(Fo - Fe)$ for each cell. These values are also given in the table for each cell.

After this, take the square of each $(Fo - Fe)$ and divide it by Fe and convert it into a chi-square. These come to $1.51 + 20 + 0.47 + 1.30 + 0.18 + 0.49$ respectively. The sum of all these means $\Sigma X^2 = 4.51$.

Significance of Chi-Square : In the table, the value of chi at $(2 \times 1 = 2df)$ and at level 0.05 is 4.991, but the value obtained is 4.15 which is less than the table value. Therefore, the hypothesis of H_0 , i.e., "no difference" at level 0.05, cannot be rejected. Consequently "there is no difference" has to be accepted because the value of the chi-square is not significant. It could also happen by chance.

Conclusion : So it was concluded that sex has no relation with job desire.

3. **Contingency Analysis (Table 2×2) :** If the distribution of frequencies is presented 2×2 in a table, there is another method of chi-squared calculation, which is much simpler and is used in most situations. In this, the number of rows (r) is also 2 and the number of columns (k) is also 2. So, in this $df = (r - 1)(k - 1)$ i.e., $(2 - 1)(2 - 1) = 1$. The formula for finding chi-square is as follows :



Note

$$X^2 = \frac{N \left[|AD - BC| - \frac{N}{2} \right]^2}{(A+B)(C+D)(A+C)(B+D)}$$

In which $|AD - BC|$ means that AD can be subtracted from either BC or BC from AD . In the above formula $\frac{N}{2}$ is subtracted ($AD - BC$) which is called Yates-Correction. The reason for this is to make the obtained chi-values according to their actual, that is, theorized and expected chi-square distribution. According to **Morone** (1954), a tabular distribution is a binomial distribution that is not continuous, whereas a chi-square distribution is continuous. So this correction is done to make the binomial distribution similar to the chi-square distribution.

Example 3: A researcher wants to know whether the economic and social status of students affects their academic achievement. He selected 48 students from low level economic social level and collected their academic achievement by dividing them into successful or unsuccessful two categories. He arranges this research material in a table of 2×2 and tests the hypothesis by finding the value of chi-square on the basis of contingency formula. The following table and the corresponding computation are given below :

Table : Exam Results

	Failed	Passed	Total
High SES	36 (A)	12 (B)	48
Low SES	32 (C)	16 (D)	48
Total	68	28	96

To find the answer to the question present in this problem, a chi-square test can be adopted. In this, by making the data a contingency table of 2×2 , then putting the values in the formula :

$$X^2 = \frac{N \left(|AD - BC| - \frac{N}{2} \right)^2}{(A+B)(C+D)(C+A)(B+D)}$$

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Data Analysis and Interpretation



Note

$$\begin{aligned} &= \frac{[96|(36)(16) - (12)(32)| - 96/2]^2}{48 \times 48 \times 68 \times 28} \\ &= \frac{96[576 - 384 - 48]^2}{4386816} \\ &= \frac{1990656}{4386816} = 0.4537 \text{ for } df \end{aligned}$$

Significance and Conclusion : In the table, the value of chi square at 1 *df* and 0.05 level is 3.84 obtained.

The chi-square value is 0.4537 which is much less than the table value. Therefore, *H₀*. Hypothesis "There is no difference in academic achievement of both the groups (HSES and LSES)" cannot be rejected. Obtained chi-square is not significant *i.e.*, it could also happen by chance. The economic social level of the students did not affect their educational achievement. There does not seem to be any relationship between the economic social level and the educational achievement.

Limitations of the 2 × 2 Contingency Method : If this condition is not met, the frequencies of the 2 × 2 table can be reduced by adding nearby frequencies and reducing the number of cells can be increased, even then it is important to keep in mind the following points :

- (i) When the size of *N* is more than 40, then purification must be used for integrity.
- (ii) When *N* is between 20-40, use the above formula only if all the expected frequencies of the cells are 5 or more than 5.

Caution : Chi-square should not be used when *N* is less than 20.

4. **More than Two Independent Groups :** Even if more than two independent groups are to be compared Chi-square can be used. In this case the frequencies are arranged in the *K* × *r* table. The irreputable hypothesis (*H₀*) remains as before that the samples are not different from each other. The chi-square test is also done in the same way as described back, but the method of finding the expected frequencies of each cell is different. This will be described further by an *example*.

**Note**

This method is a nonparametric alternative to the one-way analysis of variance. If in a research situation more than two groups have to be compared but the conditions of the F-test are not fulfilled, then it can be used there.

Example 4 : A researcher measures the intelligence of 100 students in a class and divide them into three categories to find out whether there is a relationship between intelligence and academic achievement; Such as, more intelligent, simply intelligent and less intelligent. Similarly divides their academic achievement into four categories; *For example*, taking first, second, third and failing grades in which all the students come, prepares a table of 4×3 whose format and the calculation of the chi-squares are presented below it.

		Failed	III division	II division	I division	Total
Less intelligent	O	5	6	9	8	28
	E	5.88	8.40	7.84	5.88	
	O-E	0.88	2.40	1.16	3.88	
Ordinary intelligent	O	5	16	13	8	42
	E	8.82	12.00	11.76	8.82	
	O-E	3.82	3.40	1.24	0.82	
Intelligent Less intelligent	O	11	8	6	5	30
	E	6.30	9.0	8.40	6.30	
	O-E	4.70	1.0	2.40	1.30	
Total		21	30	28	21	100

In the table, the received frequencies of each cell are given against O and the expected frequencies against E. To find the expected frequencies, multiply the row sum and column sum of each cell and divide by the total number of frequencies (N). There is such a logic behind it. Take the first cell. In this, all the persons are those who come in the first row and first column. The probability of any one person being in this row will be that sum of the total number (N) of this row will be

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Note

divided by 100 *i.e.*, it will be 28/100. Similarly the probability of that person being in the first column will be 21/100. So the probability of it being in the first row and column will be $\left(\frac{28}{100} \times \frac{21}{100}\right)$. This is the probability that happens out of one. The total frequencies are 100.

So to find out how many they will be out of 100, the probability is $\left(\frac{28}{100} \times \frac{21}{100}\right)$ multiply by 100.

Thus, the total expected frequencies of the first cell will be $\frac{28}{100} \times \frac{21}{100} \times \frac{100}{1} = 5.88$. Similarly, the expected frequencies of all other cells can be multiplied by their row sum and column sum and divided by 100. These are listed in the table. Based on the following formula, we can find the chi-square of each cell :

$$\chi^2 = \frac{(O-E)^2}{E} \text{ or}$$

$$\begin{aligned} & (0.88)^2/5.88 + (2.40)^2/8.40 + (1.16)^2/7.84 + (3.88)^2/5.88 \\ & + (3.82)^2/8.82 + (3.40)^2/12.60 + (1.24)^2/11.76 + (0.82)^2/8.82 \\ & + (4.70)^2/6.30 + (1.0)^2/9.0 + (2.40)^2/8.40 + (1.30)^2/6.30 \end{aligned}$$

Finding the value of the above chi-square =

$$\begin{aligned} & 0.774 + 0.686 + 0.172 + 2.560 + 1.654 + 0.917 + 1.538 + 0.76 \\ & + 0.506 + 0.111 + 0.686 + 0.268 = 12.948. \end{aligned}$$

Significance and Conclusion

In this example, $df = (4 - 1)(3 - 1) = 6$.

The chi-square at df 6 and 0.05 level in the table is 12.59. The value obtained in the *example* is 12.948, which is greater than the table-value. Therefore, I reject that "IQ does not affect academic achievement or that intelligence has no relation with academic achievement" and the conclusion is established that intelligence affects academic achievement or that both are related to each other.

Very Short Answer Questions

1. Write the types of analysis.
2. Write the types of measurements under statistical analysis.
3. How many types of measures are there in central tendency?
4. What is the mean?
5. Write the formula to find the mean by averaging method.
6. Write the precautions to be taken while calculating the mean.
7. Write the meaning of median.
8. Write the formula for finding the median.
9. Write the utility and importance of median in the field of education.
10. Write the definition of standard deviation.

SHORT ANSWER QUESTIONS

1. Describe qualitative analysis.
2. Describe the analysis of data by descriptive statistic.
3. How to calculate the mean of unsorted scores? Explain.
4. Describe the graph, circle and bar method followed in dot-line representation.
5. What is T-test? How many types are these?

LONG ANSWER QUESTIONS

1. Write the meaning of mode. Describe the method of finding the mode from the ungrouped scores.
2. Describe the types of T-test.
3. Describe in detail the chi-square test.

**Note**

Note



Bibliometric Law

5.1 Introduction

Statistical or computational methods are being used continuously in many subject areas, mainly in the social sciences and natural sciences. The use of statistical methods in library and information science is also a link in this chain. Bibliometrics, Scientometrics, Informatics, Webmetrics, Cybermetrics, etc. are different names for the use of statistics in the fields of library and information science. Bibliometric acts as a guide for proper management of texts etc. The use of these statistical calculations has also become possible in computerized information technology. The related terms of bibliography are Scientometrics, Informatics, Webmetrics, Cybermetry, Socimetrics.

5.2 Origin of the Bibliometrics Term

Origin of Bibliometrics Term with the development of library and information science as a subject, librarians started using mathematical or statistical methods in one way or the other and they gave many names. F. J. Cole and N. B. Eales analyzed books published between 1550 AD and 1860 AD in the development of subjects in 1917. They called it "Statistical Analysis". E.W. Hulme named statistical calculations in the library as Statistical Bibliography in 1922. Alan Pritchard first used the term Bibliometrics in 1969 in his article 'Statistical Bibliography or Bibliometrics'. In this way the word Granthamiti originated which is valid even today. Many new words have also been used as its branch. Scientometrics by Russians, Informatics by FID and in addition Socimetrics, Webmetrics,

Cybermetrics etc. are prominent. In India also, D. Ranganathan used librmetry in 1948.

5.3 Definition of Bibliometrics

The term bibliometrics is derived from the combination of two words Biblio + Metrics. The word Biblio is derived from the Greek compound word Biblion which means text or paper and Metrics is derived from the Greek word Metrikos, which means the science of measurement or measurement. In a general sense, the term Granthamiti be used for any form of quantitative analysis related to the production, distribution and use of published and semi-published literature.

Many scientists have defined bibliometrics in different ways. According to **Alan Prichard**, Application of Mathematics and Statistical methods to books and media of communication. **Potter** has defined bibliography as "The study and measurement of the publication patterns of all forms of their authorship". According to **Sengupta**, bibliography is the study of the publication, organization, classification and quantitative evaluation of patterns of all types of long and subtle communications in which they are characterized by their creativity Arithmetic and Statistical calculations.

Thus we can summarize that the quantitative analysis of the characteristics, behavior and presentation of all aspects of written communication is called bibliography. Now electronic medium has also been included in the written communication medium, due to which it has come to be known by new names like Webmetrics and Cybermetrics etc.

5.4 Need and Objective of Bibliometrics

5.4.1 Need of Bibliometrics

A librarian, like a manager of an industry, is a manager of a library. He also needs objective data for decision making. Statistical references, Cost of library collection (Value distribution of documents), Cost and replacement of both documents and non-book material, Library performance indicators, Circulation statistics, Library timings, Number of readers and references, Date and place

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of publication, Educational program, Publication Such basic bibliographic data, distribution etc. is useful for policy making. Therefore, bibliography is an essential quantitative data in libraries, which libraries are always in need of.

5.4.2 Objective of Bibliometrics

Bibliometrics includes the development of published literature in all subjects and the amount of literature publications contributed by individuals, groups, institutions or nations. In this, the volume and scattering of publications in different languages and subjects (types of documents, languages, journals) and out of date etc. are also studied. Along with this, the study of the sources referenced by the authors is also a part of the first initiative, from which information about the most cited authors and magazines etc. can also be obtained.

In bibliography, special emphasis is placed on quantitative calculation and not qualitative evaluation. On the objective of bibliometrics **Hume**, clearly said that this spot the light on the four written process and nature direction of development of any subject.

The objectives of bibliography are as follows :

1. To create a more economical and important system.
2. Improving the efficiency rate of information processing.
3. To identify and measure the defects in the functional services.
4. To discover and explain the Empirical Laws that of informatics to provide the basis for developing theories.

Qualitative experiments emphasize the practical use of study findings. Some important findings useful for Library management are as follows :

1. Identification of major publications.
2. Sorting the publications in order of decreasing importance.
3. Establishing transition point between zones of higher and lower utility.
4. To find the impact value of documents etc.

5.5 Types of Bibliometrics

Bibliometric is mainly of two types :

5.5.1 Descriptive Studies

It includes measurement of characteristics of documents or publishers, such as nature, quantity, time and frequency of information, study of origin and geographical scattering or distribution, etc.

5.5.2 Behavioural Studies

Under this, the Authorship of the documents, the Title Statement, the bibliography history (version, change in the number, date etc.), the frequency of publication (in relation to the current publication), the Form, Place, Language, Subject, Related document, Content Analysis, Physical Make-up, Shape. Publication, Quality, Price, Circulation, Translation, Formats, Citation, etc. are studied.

5.6 Utility of Bibliometrics

Bibliography is used for the following purposes :

1. To calculate the productivity of literature.
2. Area of study, quantity and type of research in different branches, different parts of the regions, different for comparative study of publications derived over time period.
3. For the type and amount of publications.
4. For scattering and pattern of publications.
5. For Impact of Publications.
6. To identify social change etc.

5.7 Uses of Bibliometrics

The use of bibliography can be cited as follows :

1. The aim of the study of bibliography is to improve the vocal control. Vocabulary analysis helps in knowing the size and characteristics of literature (publications) in different fields. The growth and quantity of primary literature directly affects the structure of secondary literature. Therefore, computed growth rate and change direction can provide important help



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- in determining the future approach and coverage of secondary service editors.
2. A major area of bibliography study is the statistical determination of the origin, nation, subject, form and language of documents as well as translations of related literature. These data provide useful information related to the determination of scope and may suggest improvements in the assessment of possible improvement of secondary services.
 3. The study of bibliography derives the relatedness of the subjects, which are similar to those of common patterns can give the required suggestions for the secondary service area (Coverage). Such bibliographic studies can also help establish a roadmap for service in a specific subject area.
 4. Use of citation analysis data and year wise publication volume to make Vocallist can be done in the plan.
 5. Bibliographic analysis helps in comparative evaluation of secondary services. It can also shed light on the achievements of publishers.
 6. Bibliographic data are also helpful in taking some managerial decisions. *For example*, it is helpful in the selection of specialized primary and secondary journals and helps in the improvement of future requirement, staff, building requirement and library services.
 7. Citation data also determines the highly cited periodicals or books which are available in the library can also be useful in decision making for collection.
 8. Bibliography provides subject relatedness through citation analysis which also helps in suggesting publications of journals by specific subject in a particular library. The study of bibliography also provides information about the structure of knowledge and the nature of communication.

Thus, the analysis of the size and growth of bibliography publications can identify the growth in the Decling area and the growth of literature (publications) method can be known.



Note

Bibliography also has the following other uses:

1. To provide quantification of research and enhancement of various fields of knowledge.
2. To estimate the prevalence of secondary journals.
3. To identify the authorship and user of documents in different subjects.
4. To measure the utility of Ad-hoc and Retrospective Selected Extension Service (SDI).
5. For need based acquisition policy within limited budget without any impact on the research interest of the parent institution.
6. To identify leading journals in various disciplines.
6. To usher in an effective multi-layered network mechanism.
8. To regulate the flow of information and communication
9. To develop norms for standardization etc.

5.8 Problems and Limitations of Bibliometrics

Through bibliometrics we can evaluate the effectiveness of research and paper productivity etc., but bibliometrics judges have their own problems and limitations as follows :

1. Full address of the authors of the main article, details of institutional affiliations etc. Opportunity which makes analysis difficult.
2. Institutions do not give full details of the publications of their scientists in the annual progress report.
3. Research scientists do not deliberately give complete information about their research publications, due to which Productometric study becomes difficult.
4. Reference lists are not always accurate and complete, so there is a need to include many incorrect data there is a possibility.
5. Actually the citations are not used at all and are cited in the reference list as they are done in some other article. *For example*, old citations are given for definitions when in reality they are not quoted at all.

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6. Often the paper from which the main part of the article is taken is deliberately hidden in the reference list, making the analysis misleading.
7. Often the name of the first author is given in the quotation and sometimes 'and others' is also not given, due to which the information of all the authors is incomplete, the correct analysis cannot be done.
8. Often the quotations get scattered due to the difference in the chromaticity of the authors or in the story.
9. Often the articles themselves are cited unnecessarily. Quotes from friendly authors are also given to oblige.

5.9 Laws of Bibliometrics and Their Use

In addition to Percentage, Mean, Mode and Median, some bibliographic rules have also been prepared. Two of these rules are used for the first count of publications, while the third rule is used for the analysis of references. Some other rules have also been formulated. The details of the three main rules are as follows :

5.9.1 Bradford's Law

Samuel Clement Bradford's law governs the scattering of articles of a specific type in different journals. Hence it is also called the Law of Scattering.

In his paper in Bradford, two rhetorical lists prepared in the Science Library, Britain, in the source of information in the subject-specific, Applied Geophysics Year 1928-31 and Lubrication Year 1931- 32 and arranged the referenced research journals in these hierarchical lists in the decreasing order of the number of references cited. By studying the list of referenced research journals, he found that only a few journals are mostly referenced, *i.e.*, very productive, whereas in most of the remaining journals this productivity is very low and they are referred very rarely. On this basis, Bradford also prepared a graph which he named as Bibliography. He prepared three zones by dividing the total references into three parts almost equally.

Bradford found a relationship between them which was called Bradford's law. $1 : n : n^2$ according to them.



Note

Here 1 means the number of research journals referred for 1/3 of the references in the first zone. Similarly, here n is the ratio obtained by dividing the number of periodicals referred to the first zone by the number of journals referred to the second zone. The number of magazines required in the third zone should be n^2 of the value of n thus obtained.

It is sometimes difficult to apply this rule in research. Actually it is very simple. First of all, arrange the reference numbers of all the referenced journals in descending order and add the cumulative references from these tables. Then take the value of 1/3 of some of the references. Then note down the number of magazines referred to in the three zones in the above table.

By following this rule, we can divide the research journals of any subject into three parts and the library can acquire research journals of the first group. If the budget is available, we can buy some magazines in the second zone also and decide not to buy the magazines in the third zone, we can ask for some photocopies of them if needed of papers.

Bradford showed with the help of graph which we call Bradford Bigliograph. For this, on line 'A' the log of the cumulative number of referenced magazines is shown and on line 'B' the log of the cumulative number of the number of magazines received in Zone 1, 2, 3 is shown. It should be obtained in a straight line. Each zone is represented by parallel and horizontal lines.

Similarly, other formulas such as the square root formula of Price's productivity, Smarfield's formula for concentration and Sen's formulas are also used in bibliography, which can be studied in detail from the reference texts.

5.9.2 Zipf's Law

This rule was propounded by George Kingsley Zipf. Hence it is called Zipf's rule. This rule is related to the frequency of words used in the text of publications and in the title. The frequency of occurrence of words in a text / title is counted as the number of times a word appears in a text / text. It is also called minimum effort (Law of least efforts).

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According to Zipf's law, the words used in a long text content are arranged in decreasing order of frequency, then the position (r) of any given word in the text is opposite to the frequency of the word (f) (Frequency of occurrence) or will be proportional. Zipf's rule can be written mathematically in the following way :

$$r = 1/f$$

or $rf = c$

or $\log f(r) + \log n = c$

Where,

r = Ranks of word

f = frequency word and

c = is a constant.

We can easily find its value using log table. For this, the frequency of words used in a research publication is counted and arranged in decreasing order and the constants are obtained from the above bibliography formula.

5.9.3 Lotka's Inverse Square Rule

This rule was given by Alfred J. Lotka in 1926. It is also called Inverse Square Formula. According to this rule, the bibliographic calculation of the Productivity of Research Papers is done.

The scholarly productivity of scientists can be measured by the number of published papers according to the general prevailing rules of the research field. Initially, not much attention is paid to other factors. It has been concluded from the preliminary research by Lotka that the articles published in any research journal in this the contribution of maximum writers is very less and there are very few highly productive writers. Lotka propounded a formula for this. According to this formula, if the number of authors who have published only one paper is n , then the number of authors who have published two papers should be equal to the inverse square of this number n , *i.e.*, $1/n^2$, that is, the scientist who has published two papers. ($n = 2$), it will be only $n = 3$ of the number of scientists who publish a paper. Similarly, if $1/n^2$ is $1/3^2$ *i.e.*, $1/9$ and similarly the value obtained from $1/4^2$, $1/5^2$, $1/6^2$ will be equal to the number of authors who have published



Note

three, four, five or six papers, *i.e.*, one or the number of scientists who have published a large number of papers will continue to decrease in proportion to the number of scientists who have published one paper. By this formula we can find out how much more or less the required number of high productivity scientists is than the actual number and thus we can know the latest trend of publications.

5.10 Some Other Laws

Other Laws

Apart from bibliometrics, some other rules have also emerged, which are described below. Cybermetrics is not in the syllabus but still it is given for the students to understand.

5.10.1 Scientometrics

The term was first used by T. Braunin in 1977 from a journal "Scientometrics" published in Hungary and presently in Amsterdam. The scope of this journal publishes all those studies of the quantitative aspects of science as a discipline or as an economic activity in order to measure the effectiveness of what is achievable from the expenditure incurred in developing it.

Scientometry is part of the sociology of science and 'science' is used for policy making. Scientometrics covers the quantitative study of scientific activities which includes publications. Therefore, to some extent it also includes the bibliometrics. Thus we can say that scientometrics is the branch of "science of science".

The main goal of scientometrics is to determine the state and prospect of a subject and its further development. For this, many Scientometric indicators are used. Out of this the most significant indicator is the publication number. This indicator can be a standard tool of evaluation and analysis in the research management of scientometrics making.

At present, special importance has been given to the measurement of scientific information so that information search can be regularized. Mathematical and statistical techniques have made it possible for science to quantify the social structure or process of quantifying the number of individuals and publishers interested in research.

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5.10.2 Informatics

In 1979, Otto Nacke of Germany proposed the term informatics for the first time. The FID Committee then gave this name. The term was not widely accepted until 1987. Theoretical aspects of information retrieval and bibliometrics but at the First Conference on Bibliometrics and Theoretical Aspects of Information Retrieval, Diepenback Belgium it was suggested that the name of Informatics be included in the name of the Second International Conference. In the proceedings of the conference it was said that the word Informatics is more effective than the words bibliometrics and scientometrics. Therefore, for the promotion of a new name, it was decided that the use of the word informatics with the name of bibliometrics should be used in the report of the next conference and in the report of the proceedings of the published conference. Thus the second conference was named International Conference on Bibliometrics, Informatics and Scientometrics. Thus the word "informatics" is being used continuously. Two of its conferences have also been organized in India.

Tagui Sutcliffe defined the term as "the study of the quantitative aspects of any form of information. It is not limited to the study of mere inscriptions or vandalism lists or only scientists in any social group. It also extends beyond the fields of scientometrics and bibliometrics to the quantitative study of information."

5.10.3 Webmetrics Webmetrics

The term Webmetrics was first used by Almind and Ingewerson in 1997. The web appeared in the 1990s. The term netometrics was also used in 1995. The University of Berkeley developed the term by studying the size of documents available on the web, the number and type of tags, the number of additional links, file extension, etc.

Thus, webmetrics is the study of quantitative aspects of the creation, use, structure and technology of information sources on the web (www). Webmetrics is used to study both the construction and use of the web. The main areas of study are webpage content analysis, weblink structure analysis (web usage analysis) and web technology analysis.

5.10.4 Cybermetrics

The word cyber was first used as a prefix to the word cybermetrics by Norbert Weiner in his book in 1948. The word cyber, originating from the Greek language, means a person operating or operating man in which the idea of control is also embodied. Thereafter, William Gibson used this word in a story published in 'Omni Magazine'. He also used the term again in his 1984 novel Neuromancer. In the novel this word meant electronic space. Over time the meaning of this word evolved and now it includes information technology, words like Internet, Virtual Reality etc. are also included.

The term cyberculture, cybernate, cybernation, cybermetrics, cybermetical, cybermetrically, cybermetician, cybermetacist etc. came into use. Similarly Cyber crime, Cyber reference, Cyber Library, Cyber Librarian Cyber marriage, Cyber love etc. have also been originated. The word Metrics is derived from Meter. The word Cyber Matrix consists of two words Cyber and Matrix, which are respectively derived from the Latin word Metrum and the Greek word Meteron which means 'measure'. Combining this word with cyber means 'the science of measuring cyber objects'. It also involves the use of arithmetic and statistical methods. In this, instead of documents, statistical calculations are used in the website.

According to B.K. Sen, it is the branch of knowledge that uses mathematical and statistical techniques to measure websites or their elements and concepts and measures their growth, stability, propagation and usage and checks the authenticity of the content. To control these factors, it studies the rules, cyber information systems, services and products and studies the effects of cyber age on society.

Similar words to this word are also used such as cybermetric *i.e.*, based on cybermetrics and cybermetician and cybermetacist which means-specific person in cybermetrics. The word wavemetrics is synonymous with the word cybermetrics.

The geographical area in the field of study of cybermetrics is the entire cyber universe and time from the birth of the website to the end of the cyber world. All languages in which the website is available all the formats and all the subjects in which the website is made come under the domain of cyber studies.

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5.10.5 Components of Cybermetrics

Cybermetrics has the following five components :

- **The First Component :** This component is Cyber Concepts. Cyber Space, Cyber Crime, e-Law, e-Books, e-Commerce, e-Government, e-Magazines, e-Journals, Digital Libraries Origin, Rate of Origin, Change in Format, Quantity of Use of Obsolescence Rates etc. are also part of cybermetrics.
- **The Second Component :** This component is websites. There is a website in cybermetrics. Everyday many new websites are created. Some change very quickly, some change very little, some do not change and some disappear. Websites of one subject vary in quality among themselves. Methods are being developed to rank these websites, so that the Web Impact Factor and the cited site can be studied.
- **The Third Component :** This component is Co-citation and Cyber Coupling. Co-citation and web coupling are also studied like bibliomatrices in web study.
- **The Fourth Component :** This component is the Search Engine. Investigator engines play a major role in the cyber space. Several exploratory engines have emerged over the years and have varied capabilities. The capabilities of these probe engines can be measured and thus the exploration engine is also a part of cybermetrics.
- **The Fifth Component:** This component is Cyber Information. Cyber universe is absolutely free. Anyone can enter and enter any information they want without any restrictions. There is no one to check the quality and authenticity of cyber information. Cyber information travels at a much faster rate than any other medium. Cyber information multiplies at a higher rate and can be retrieved at a higher speed and updated easily. These information can range from incorrect spelling to incorrect data and incorrect information. They can be used for free or even for a very small fee. In this way cyber information can be compared with printed information and statistical analysis can be done. Thus, cyber information is an important study area of cybermetrics.



Note

In the end we can say that all online information systems, services and products are in the cyber universe. Just as traditional systems, services and products are studied in bibliometrics, they are also studied in cybermetrics. For this, the structure of the system, the organization of the content, the data security, the period of update, the reproducibility and the ability to provide the service, etc. can be made parameters of comparison and compare with the traditional information system, services and products comparison can be made.

Exercises

VERY SHORT ANSWER QUESTIONS

1. Who first used the term bibliometrics?
2. Who and when used the term librarianship in India?
3. The word Biblio is derived from which language word?
4. Write a definition of the term bibliometrics.
5. Write two purposes of bibliometrics.
6. Write the utility of bibliometrics.
7. What are the laws of bibliometrics?

SHORT ANSWER QUESTIONS

1. Describe the need and objectives of bibliometrics.
2. Describe the types of bibliometrics.
3. Write the experiments of bibliometrics.
4. Describe the breadboard rule.
5. Write the problems and limitations of bibliometrics.

LONG ANSWER QUESTIONS

1. Describe the Zipf and Lotka rule of bibliometrics.
2. Description of Scientometrics, Informetrics and Webmetrics Rules Briefly.
3. Describe the components of Cybermetrics Rules.

Note



Research and Report Writing

6.1 Introduction

The final stage of the entire research work is the preparation of the research report. After the research is completed, the researcher has to be inclined to give a proper description of the hypotheses tested under his research and the related results and the undertaking, methods and tools used to reach them. In this, applying the style of scientific writing, the whole description is presented in a systematic manner through appropriate headings and subheadings divided into appropriate chapters. This type of report has been named as thesis or dissertation. Terms such as thesis or dissertation are sometimes used synonymously.

According to **Good and Haat**, "Preparing a scientific report is fundamentally different from argument-oriented essays or literary writings. There is a conscious presentation of affirmative and injunctive evidence, as well as the method by which the evidence is derived."

In the Indian academic context, dissertations presented for achievements of Ph.D., D.Litt. or D.Sc. level are often referred to as thesis and short dissertations submitted for the degrees of Master's level and M.Phil level are often termed as dissertation. But in this regard, no very strict and strong tradition can be followed. The reality is that the research report can be presented in the form of thesis



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(dissertation), dissertation (short dissertation), articles to be published in journals or papers read under seminars. In this context, there is a slight difference in the methods of presentation of research reports. In this unit, detailed information about report presentation is given.

6.2 Components of a Thesis Dissertation

A dissertation or short dissertation can be called a comprehensive report about the entire research. Under this, the background of the research, its problem-issue or question, the objectives of the study, the hypotheses formulated and evaluated in it, the sample in respect of which the research has been completed, the design of the research which has been followed, the research tool formed or selected for the compilation of the base materials, which has been applied in research, used for the analysis of base materials, qualitative or quantitative rendering method, selection of base material and generalizations and conclusions drawn through it and suggestions regarding future research possibilities, a clear description of related research literature and references from which appropriately cited etc. is presented. In this way, there are three main components of dissertation, the following elements come under the initial part.

6.2.1 Preliminaries

1. Title Page
2. The Researcher's Declaration
3. The Certificate of the Research Supervisor
4. Acknowledgment
5. Table of Contents
6. List of Tables
7. List of Figures

Initial parts are often represented by Roman numerals. This is called the title page. It is given "Title of Study" at the top of the page, while in the middle the name of the university and faculty where the dissertation is being presented, the degree or course requiring presentation of the dissertation in whole or in part, and the session of study in which it is being deposited is marked. In the lower part

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of this page, the researcher's name, with educational qualification, on the right side and the name of the guide (supervisor) on the left, his educational qualification and his post and the name of the institution in which that supervisor is posted.

In the next pages of the dissertation, the certificate of the researcher and after this the certificate of the guide or supervisor of the research is attached. It is presented in the form of a certificate given by the guide and is a proof of the proper completion of the entire research and its authenticity. The guide marks his signature to do the memorandum of acceptance of the research work.

The third page of the introductory pages is known as the foreword. It can run for two or three pages in a row. Under this, a very brief description of the main issues of research and various chapters of the report is presented. At the end a memorandum of gratitude or a show of gratitude is also marked. Sometimes there is a tradition to express it separately. In this, gratitude is expressed to the individuals, authors or experts who have been genuinely helpful for the research. Apart from this, it is also considered necessary to thank those institutions and authorities who have encouraged or helped the researcher in a formal or informal manner. Normally the size of the statement should not exceed two or three pages.

The next page is of the Table of Contents, in which the chapters, their contents and page numbers are given for the whole report in a chronological order so that the reader of the dissertation can easily find the appropriate page. In this, the title of the chapter is marked with capital letters and its sub-sections with small letters. Each chapter and its sub-sections are represented by the correct page.

The next page in this sequence shows the table, pictures. It starts from a new page. Under this, the title of the table and the page of the dissertation report on which it is available is marked.

On completion of this tabular list, a list of diagrams or drawings presented in the report. This list is also given on the new page. The title of the diagram or drawing under it, its abbreviation, statement and the page of the report where it is displayed.

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6.2.2 Main Body of the Report

It consists of the following chapters :

1. Introduction
 - (i) Role or Preface
 - (ii) Problem Statement
 - (iii) Limitation of Study
 - (iv) Conceptual Definitions of Fundamentals
 - (v) Abbreviation, if any
 - (vi) Requirement Statement
2. Review of Related Literature
3. Methodology
4. Data Presenting and Analysis
5. Conclusions and Summary
6. Recommendations

The main content of the report is presented in several chapters immediately after the opening pages.

Logically, its main sub-sections are as follows :

1. **Introduction** : In the first chapter, the introduction of the study area and its importance in the course of education are highlighted. Accordingly, the problem is presented as its main component. Before the statement of the problem, it is appropriate to mention the theories related to it and the conclusions of some previous research, so that it can be clear that there are some important questions related to the problem, which are still unanswered and naturally to find answers to these questions. For this the problem presented has emerged. Hypotheses should be formulated in the same order and if the main problem is in question form, then only those sub-questions should be given the answers to which it is desired to be obtained. The significance of the problem and the purpose of the study should also be given in a concise and clear form. Limits, limitations should be mentioned in point form. This chapter is very important. Therefore, the expression of ideas should be in simple and flowing language, that is, in

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brief, the background of the research related issues, the concept of research and the limitations of research are mentioned.

- 2. Survey or Review of Related Literature :** Review of literature related to chapter II. This part serves as a background for the present study. In this chapter, the researcher mentions the work done by other researchers, scholars and scientists updated on his research problem. The researcher studies journals, books and dissertations related to research because on the basis of this study, he is able to demarcate the problem properly. It also determines how the related work is different from other tasks. Through this, knowledge and guidelines of useful elements of problem solving would be obtained. This should also be written by the researcher in a systematic and logical manner and in the end, the related literature which has been used in this chapter should be referenced along with the page, that is, in short we can say that in this the researcher should refer to the work done by other scholars related to his research problem.
- 3. Research Method :** Under this, the method used in research, the process of selection or manufacture of research equipment used for collecting the sample base material selected for it, and the research design which has been followed, are mainly discussed.
- 4. Presentation and Analysis of Data :** This is an important chapter of the research report. In this chapter, the collected data is systematically arranged and analyzed and interpreted. After analyzing the data, the conclusions or results obtained from it are compared with other research results and it is seen that the result is consistent or opposite, then the reasons of these should be described. In short, it can be said that in this chapter, the systematic form, analysis and selection of base materials are presented in a systematic manner.
- 5. Conclusion and Summary :** In this chapter, the researcher mentions the result of his work and in this he shows the solution of his problem which he had made the focal point in the introductory statement. In this chapter the researcher also



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tells about the acceptance or rejection of his hypothesis. If there is a conflict of his conclusions with any previous theory or opinion, as well as it makes it clear that what is the contribution of his research to the development of knowledge. This chapter is a summary of the entire research.

- 6. Recommendations :** This is the last chapter of the research. In this chapter, the researcher makes recommendations based on his findings, which are useful for policy makers and readers. The recommendations should clearly reflect what the researcher wants to say. In this chapter, the researcher also indicates the related subject and in which areas work should be done.

6.2.3 Reference part

1. Foot notes
2. Bibliography
3. Appendix
4. Index

The detailed description of the above is as follows :

- 1. Footnote :** In this footnotes are written at the bottom of the page or at the end of the chapter.
- 2. Bibliography :** After the main content of the report is presented, further bibliography from the new page is given. In this list, such texts whose references have come directly or indirectly under the report, are mainly included.
- 3. Appendix:** Under this, such relevant material used in research is presented, which increases the size of the dissertation by linking the report with the main subject. Some of the main materials to be included in the Appendix can be as follows. A copy of the questionnaire used in the research, randomly provided base material used in the research, special types of tables obtained by statistical analysis, etc.
- 4. Index :** If there is a plan to publish the dissertation in book or monograph form, the researcher has to prepare an index

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immediately after the appendix. Two types of indexes are often formed. Subject matter index in which the posts related to the topic and author-index in which the authors referred on different pages are mentioned. It is presented at the end of the dissertation. It is also common practice to give a brief introduction of the researcher under the cover pages.

6.3 Features of Scientific Writing in Thesis Dissertation

First of all, we have to remember that there is enough difference in the style of scientific writing and literary writing.

"Here the object of the researcher is not to entertain or persuade the readers of the dissertation, or to simply express his opinion about a problem, make suggestions about its solution, and give reasoning on the basis of general observations not interested. On the contrary, he proposes hypotheses, cites base materials supported by facts and advertises whether they prove or disprove the hypothesis. Scientific reporting requires a clear, objective and logical presentation and analysis of evidence, not exaggerated arguments or exaggerations (translated) by emotions.

The characteristics of scientific writing under dissertation presentation are as follows :

1. **Language** : Application of common and familiar terminology in scientific and Emphasis is placed on clear expression.
2. **Organization** : The law chapters of the report and the sub-headings in them are kept in a logically related perspective. The whole content is presented under headings and sub-headings, keeping in mind the logical relationship of ideas and concepts from one chapter to another and within each chapter.
3. **Unity and Clarity** : Under scientific writing, there is an emphasis on unity and clarity. To ensure that the researchers presents ideas in a coherent and coherent form. The application of short but mutually logical sentences to express them is considered. Thus the article is constituted by such hoaxes. As pointed out by **Bon Dalen**, the researcher keeps on evaluating



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his chapters, paragraphs and sentences from this point of view again and again. From this it can be decided whether similar ideas can be presented together or not, whether one idea naturally adds to another idea, how to cut inconsistent and repetitive terminology and express the whole content how to increase the required fluency and comprehension in the language used to deliver, etc. In all, the researcher has to see that the words, sentences and paragraphs used under the dissertation are logically related to each other and there is a kind of ease in the communication of the whole report.

4. **Proportion and Emphasis :** It is necessary to organize the entire dissertation in such a way that the ratio of the chapters involved and the ideas described in them and the emphasis placed on them appears to be justified.
5. **Use of Conventions :** Under dissertation writing, some special conventions are used to place and mark the citations, authors and material taken from other researches or texts in the report. These can be classified into the following sections for convenience :

(i) **Page and Chapter Format :** Pages are often given three types of headings : central headings, marginal headings which are called at the beginning of the paragraphs and paragraph headings which are called denoting small subsections. Each chapter starts on a new page. Even if the last page of the preceding chapter is of two or three lines, the subsequent chapter is started on a new page. Each chapter number is fixed and to be displayed in capital letters without punctuation.

It is customary to number each page of the dissertation by a page number, but on many pages this number is not displayed. The page numbers are expressed differently in the two sequences. There is a practice of marking the opening pages by letters of Roman (i, ii, iii, iv etc.) or Hindi. The title page is denoted by (i) or the first letter but it is not marked or typed on that page.

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(ii) **Use of Quotations :** The consistency of citations is very important in dissertations. Its size should not be so long that the reader of the report forgets whose views he is assessing. The following customs are generally prevalent in this regard :

- (a) Direct citations are used only when the original words used by the author have been presented in such an effective and restrained manner that the dissertation author is not in a position to improve them easily or the researcher wants to comment on them or their tending to refute or of the ideas referred to in them interested in analysis.
- (b) The exact nature of the words of the author or of quotations taken from any official record should be presented.
- (c) If the tense given in the quotation does not match with its preface, a pronoun that is not specific is used and if the need is felt, the subject 'Sesame' can be used in the quoted subjects.
- (d) When a quote is too lengthy, some part of the original article may be omitted.
- (e) When quoted as a footnote, the double quotation mark is always used.

(iii) **Footnotes :** Footnotes are used immediately at the bottom of a page or at the end of a chapter or at the end of a dissertation or research paper. It is applied for the authenticity of a point, or statement so that they can freely take advantage of the appropriate sources. Particularly notable among the information provided under footnotes are the source of the information, usually the author's name, the title of the source, the actual page in the referenced source, publication date, publisher and publication location, year. Some conventional traditions for footnotes are as follows :

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When the footnote is first introduced then the full name of the author, the year of publication, the name of the book, the publisher and the page number as displayed next when referring to it.

Generally a footnote should contain the following informations :

1. Name of the author,
2. Explanation of the source,
3. Version
4. Place of publication,
5. Name of the publisher,
6. Date of publication,
7. Page number.

There are many traditions of writing footnotes, which are described as follows :

- (a) A general work should be written in footnotes as follows:

Krishan Kumar, Library Manual, New Delhi, Vikas, 1985, p. 77.

- (b) Once the reference is given in the footnote, if it is coming again, there is no need to write the name of the author, publisher etc. again. For this the acceptance abbreviation *ibid i.e.*, 'same context' can be used. This will avoid duplication of documents. *For example,*

Ranganathan, S.R., Library manual, 2n ed., Bombay, Asia Publishing House, 1960, p. 190.

Ibid, p. 200

- (iv) **Abbreviation :** Some Anglo and Latin word abbreviations which are used in footnote, bibliography etc. from the point of view of saving space, the following is a list of :

Abbreviations	Word	Abbreviations	Word
annon.	anonymous	loc. cit	the place cited
ante	before	mimeo	miemeographed
bk., bks.	book, books	m.s.	manuscript
chap.	Chapter	n.	number

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col., cols.	column, columns	n.d.	no date given
conn.	Commentary	n.n.	no name given
diss.	Dissertation	n.p.	no place given
ed., eds	editor, editors	NB.	(Note bene) taken notice
eng.	Enlarged	o.p.	out of print
et.al	and others	op.cit	Previously cited
e.g.	(exempli gratia) for example	p., p.p.	page, pages
et alibi	and elsewhere	pt., pts.	part, parts
et. Seq	and the following	Passim.	here and there
fig., figs.	figure, figures	rev.	revised
fn.	Footnote	supra.	above
ibid.	same reference	tr.	Translation
idem.	the same	tr.	Translator
i.e.	that is	vide.	see, refer to
illus.	illustrated	viz.	namely
infra.	Below	vol.	volume
introd.	Introduction	vs.	against

(v) Tables and Figures : The information which is given by tables, they are presented through tables and those which are presented through pictorial media like graphs, pictures, charts, diagrams and maps etc. are called diagrams. It has to be remembered here that tables and diagrams cannot be considered an indispensable medium for presenting information in every dissertation. Under certain researches, only proper verbal descriptions may be expected to be communicated. It is considered necessary to follow the following conventions while writing tables and diagrams in dissertations :

- (a) It is useful to display tables and diagrams closely under the main object of the thesis so that the required information can be understood accurately with the help of each other.



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- (b) If the display of a table or diagram takes more than half a page if there is a possibility, they should be given some subject matter in between on different pages. It would be more expedient to submit without.
 - (c) Every table or diagram has to be presented under the heading. The title under which the information is displayed is given in a very brief form like a picture introductory description rather than sentence by sentence. It is self sufficient from the point of view of meaning.
 - (d) All the tables in a consecutive order and the diagrams in a different consecutive order to be marked with number signs. Tables and diagrams are sometimes accompanied by footnotes to explain a point in them or to define the abbreviations or symbols available under them.
- (vi) Reference Memorandum:** The research report includes those texts, articles, documents and manuscripts under the references which have been used by the researcher in completing his research and writing the dissertation. It is generally customary to display such references under 'bibliography'.
- (a) The works from which quotations are taken in the dissertation may be included within the main subject matter or as footnotes.
 - (b) The source materials that have been used in research have to be presented in a comprehensive bibliography and books and research papers are also included in this.
 - (c) Specific bibliography which specifically mentions those sources which the researcher has used specially for his research.
 - (d) A concise attested bibliography regarded as such a list of referenced literature in which the contents of texts and compositions (which have been used) and a brief note about usability is infrequent.

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(vii) **Use of Appendix :** Such supporting evidences are included under the Appendix, which, if presented along with the main subject matter of the report, may hinder its legibility and make the whole subject comprehensible or complicated. Each appendix is separately marked with a special number. It is customary to mention it within the main subject or under the footnote.

6. **Size of the Report :** The size of the dissertations presented for the degrees of Ph.D., D.Lit. or D.Sc. in the Indian context is slightly larger (about 200-400 pages) and minor research at the level of M.A., M.Ed. and M.Phil. It is a common practice to keep the size of the arrangements relatively small (about 60 to 150 pages).

7. **Type-script of the Report :** Before typing the dissertation, read and edit the first motion of the pre-written draft very carefully.

One should neither rely on typing nor relying on it for correction of inaccuracies. This action is required to prevent or prevent errors.

8. **Mechanical Aspect of the Report :** The dissertation is never submitted in unbounded pages. The typed copies are arranged in first, second, third and fourth copies and they are bound with proper get-up. It is common practice to have the cover page printed. It should not be an attempt to make it unnecessarily attractive. Submitting the entire dissertation with binding in a very clean manner. It is considered appropriate.

Exercises

VERY SHORT ANSWER QUESTIONS

1. State the main components of a dissertation.
2. What is included in the preliminary part of the dissertation?
3. What is presented in the body of the report?
4. What is presented in context?

SHORT ANSWER QUESTIONS

1. Write the characteristics of scientific writing.
2. What is a footer note?
3. Explain the Appendix.

LONG ANSWER QUESTIONS

1. What do you understand by research report? Explain its need.
2. Create a short research report on your selected topic.
3. Describe in detail the main components of the dissertation.
4. Write a short note on the footnote bibliography, appendix.

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