Chapter 17

Action Research

The concept of managing learner, models of teaching and teaching levels has been discussed in earlier chapters. The pupil-teacher can make use of these concepts in planning and organizing effective teaching and realizing the objectives of teaching. A teacher has to see several types of problems in his presentation and achieving the learner objectives. Therefore, it is an essential for a teacher to solve that problem scientifically. The appropriate teaching strategies may not be useful until and unless these problems are solved.

Employing the action research device can solve the classroom problems. It is a method for solving the problems of teaching objectively and systematically. This is useful for improving and modifying the teaching process. The theoretical and practical aspects of action research concept have been discussed in this chapter.

MEANING OF ACTION RESEARCH

Action research is a method for improving and modifying the working system of a classroom in school. The teachers and principal are able to study their problems of teaching scientifically. It is an objective oriented method. The action research project does not contribute in the fund of knowledge but it improves and modifies the current practices. Hence it is necessary to understand the concept of 'Research' to have correct idea of the term 'Action Research'.

MEANING OF RESEARCH

Research is a process to study the basic problems, which contribute in the edifice of human knowledge. The research process established new truth, finds out new facts, formulates new theory and suggests new applications. It is a purposeful activity that contributes to the edifice of knowledge. Random Morey has defined the term 'research'.

"Research is systematized effort to gain new knowledge." P. M. Cook has given a comprehensive and functional definition of the term research:

"Research is an honest, exhaustive, intelligent searching for facts and their meanings or implication with reference to a given problem. The product or findings of a given piece of research should be an authentic, verifiable and contribution to knowledge in the field studied."

He has emphasis on the following characteristics of research in these definitions:
1. It is an honest and exhaustive process.
2. The facts are studied with understanding.
3. The facts are discovered in the light of problem. Research is problem-oriented.
4. The findings are valid and verifiable.
5. Research work should contribute new knowledge in the field studied.

All the definitions of research have some characteristics:

(*i*)   Research arise for contributing new knowledge by studying some problem

(*ii*) Research is objective and scientific process for studying the problems in a discipline.

MEANING OF EDUCATIONAL RESEARCH

The main focus of education is on the development of a child. The teaching process brings the desirable change among learners. The basic problems of teaching and education are studied in educational research. W. M. Traverse has defined the term "educational research." Educational Research is that activity which is directed' towards the development of science of behaviour in educational situation." F. L. Whtney has defined the term educational research comprehensively:

"Educational research aims to make contribution towards the scientific-philosophical method, the method of critical reflective of experience which are organized and evaluated which result in hypotheses and theories each successively subjected to deductive longer generalization constantly approaching truth in the field investigated."

Whitney has stressed on two type of educational research Scientific and Philosophical. The Scientific researches are conducted by experimental method where second type through Philosophical method.

OBJECTIVES OF EDUCATIONAL RESEARCH

The educational -researches are concerned with three goals and educational research activities are oriented to achieve these three Objectives:

1. Theoretical Objectives

This may be referred to the development of theory. The scientific researches may lead to the establishment of new edifice of knowledge or thoughts. The theoretical research always has implications for future action and should allow the prediction of natural phenomenon. In educational, theoretical bases are given for practice. Theory of education deals with entire framework of Education. Theoretical expansion is essential in the field of education.

2. Factual Objectives

A second objective of educational research is to find out-new facts or the accommodation of new facts. This serves descriptive function. An investigator usually concerns with the objective together specific information through surveys or historical studies. The problems of this nature can be solved by scientific enquiry.

3. Practical Objectives

When a theory is applied in a action, it is termed as practical purpose. The third objective is to solve a practical problem, which is of immediate concern with an investigator. The purpose is to improve and modify the practice. The applied research and action research focus the attention towards the practical aspects. This objective may be achieved individually or collectively but the purpose is the improvement of current practices. The result of such investigations does not contribute in the fund of knowledge. These are usually personal projects to bring excellence in their own job. The problems may be solved by scientific procedure but critical thinking or trial error procedure may solve some problems.

TYPE OF EDUCATION RESEARCH

The first two objectives of educational research contribute new knowledge in the form of new theory and facts in a particular field studied. The third objectives do not contribute in knowledge but suggests new application for piratical problems. Thus, the educational researches are classified broadly into two categories:

1. **Fundamental of Basic Research.**
2. **Action Research or Applied Research.**

MEANING AND DEFINITION OF ACTION RESEARCH

The concept of acting research is very old but Stephen M. Corey has applied this concept first time in the field of education. He has defined the term 'Action Research': "The process by which practitioners attempt to study their problems scientifically in order to guide, correct and evaluated their decision and. actions, a number of people have called Action Research".

According to Corey: "Action research is a process for studying problem by part-owners scientifically to take decision for improving their current practices."

"Research concerned with school problems carried on by school personal to improve school practice is action research."

– S. Backwell

According to McTherte:

"Action Research is organized, investigative activity, aimed toward the study and constructive change of given endeavor by individual or group concerned with change and improvement." On the basis of these definitions, the following characteristics may be enumerated of Action Research:

1. It is a process for studying practical problems of education.
2. It is a scientific procedure for finding out a practical solution current problems.
3. The practitioner can only study his problems.
4. The faces is to improve arid modify the current practices.
5. The individual and group problem is studied by action research.
6. It does not contribute in the fund of knowledge.
7. It is personal research.

ORIGIN OF ACTION RESEARCH

The concept of action research is based upon the modern Human Organization Theory'. This organization theory is task and relationship centred. It assumes that workers of the organization have the capacity to solve the problems and take decision. He brings certain values, interests and attitudes in the organization. Therefore, the opportunities should be given to the workers of the organization to study and solve the current problems of their practice so that they can improve and modify their practices. The effectiveness of an organization depends upon the abilities and skills of the workers. They have to encounter some problems and can realize the gravity of the problems. The practitioner can only study and, solve the problems of the current practice. The workers will be efficient when they will be given freedom for improving and modifying their practices.

The origin of action research is also considered from the field of psychology or social psychology. Kurt-Lewin explains life space in terms of person and goal. There is a barrier in between person and goal. He has to over come the barrier to achieve the goal. It depends upon the abilities of a person to achieve the goal. The person's activities are governed by the goal the practitioner has to face this type of situation.

The concept of action research is being used in education since 1926. Backingham has mentioned this concept first time in his book 'Research for Teachers'. But **Stephen M. Corey** has used this concept for solving these problems of education first time.

STEPS OF RESEARCH

The research work is done by reflective thinking and not by traditional thinking. The reflective thinking functions systematically. The steps of research are drawn from reflective thinking process. The following are the six steps of research process:

1. **Selection of problem.**
2. **Formulation of Hypotheses.**
3. **Design of research (Sampling and methodology).**
4. **Collection of Data (Administration of tool and scoring).**
5. **Analysis of data (Use of statistics).**
6. **Formulation of conclusions.**

First Step   :   The problem is selected and defined. The feasibility of the problem depends upon its delimitations. Hence, the problem is also delimited in this step.

Second Step :   Some active solutions are given for the problem. When these solutions are based on certain rationale they are termed as hypotheses.

Third Step   :   Therefore, in this step hypotheses are formulated techniques of research. The appropriate method and techniques are selected for this purpose.

Fourth step :   The research tools are administered on the sample subjects and their responses are scored out. Thus, the obtained date is organized in tabular form.

Fifth Step   :   The appropriate statistical techniques are used to analyze the data so that some decision may be taken about the hypotheses. The result is used to draw some conclusions.

Sixth Step   :   The result is discussed and some conclusions for the practical problems.

These steps are followed in both types of research a fundamental and action research but there is a significant difference between the two. The comparison of fundamental and action research has been provided here in the tabular form.

DIFFERENCE BETWEEN FUNDAMENTAL RESEARCH AND ACTION RESEARCH

Objective of Action Research

1. **Purpose:** The improvement in school and classroom teaching process.
2. **Investigator:** The person in the Job, Teacher, Principal, Inspector, and Administrator. Investigator must be directly associated with the problem. There are no pre-requisites of academic qualification.

3. **Problem:** The form of the problem is very narrow. It is a local problem. It is practical problem. The problem is selected and finalized by the worker.

Objectives Fundamental Research

1. **Contributes of new knowledge in the form of new theory facts and truth:** The investigator should have postgraduate degree in the subject. He should have specialization in the field. He may be or not related with the problem.

2. **The problem is broad and relates to the broad field of education:** The problem may be universal by the research but the external experts approve it. Investigator himself. No external approval is required.

3. **Hypotheses:** The action hypotheses are formulated on the basis of the causes of the problem. An action hypothesis needs one design of research. One hypothesis is tested at a time.

4. **Design:** The design of action research inflexible. It can be changed according to the convenience of the worker. It includes certain steps and measuring tools.

5. **Sampling:** There is no problem of sampling in action research, accidental or incidental sample is used. The students of a class or school are the sample of action research. No parametric techniques are used.

6. **Data Collection:** Observation and teacher made tests are used for collecting data in action research. The standardized too may be used if it is available

7. **Analysis of Data**: The data are analyzed by using statistical techniques to draw some result.

8. **Simple statistics:** percentage, mean, mode, Sd. and graphical .The hypotheses are formulated on the basis of some rationale. All the hypotheses are tested by one design of research. The hypotheses are not essential in all types of research. The design is rigid and it cannot be changed. Theoretical and practical knowledge is essential for the researcher. It involves, method, sample and techniques of research. It is the basis of research and major problem of sampling the knowledge and training of sampling techniques are essential; usually probability-sampling techniques are employed. The true representative sample is selected by using appropriate techniques of sampling from the population.

   Usually the standardized tests are used for collection of data in basic research. If such type of tools is not available, the investigator has to prepare the tools and its reliability and validity are estimated.

   The parametric statistical techniques are used for analyzing the data. The knowledge and understanding are essential. The decision is taken about representation are employed for this purpose. The decision is taken about solution of the problem.

9. **Conclusion:** Some conclusions are drawn about the solution of the problem the conclusions are in the form of remedial measures for improving the current practices. It does not contribute in the fund of knowledge.

10. **Evaluation:** An Action research project is evaluated by, the investigator himself and external evaluation is not required. Its results are in the form of improvement in the job and current practices.

11. **Finances:** Finances for the action research are met out by the school or investigator himself. The extension departments of NCERT are also financing such project.

12. **Training:** The teachers are trained in B.Ed. programmes for the knowledge and skill of action research concept. The extension department is organizing workshops for action research

projects for in-service teachers. The conclusions are in the form of generalization. The generalization may be a new theory, new interpretation. Thus the conclusions may be the new knowledge the field studied, a panel of examiners is appointed for examining the report of fundamental research; it may be approved, revised or rejected. The degree of Ph. D.D. Sc. or D. Phil is awarded for the worth contribution in the field studied.

The, V.G.C. is awarding junior research and senior research fellowship for fundamental research in all the subjects. The NCERT is financing research project of education. The V.G.C. is also giving financial assistance to college teachers for their research work. An investigator bears the expense himself.

This is a compulsory paper of Research Method and Statistics at M. Ed and M. Phil level for the knowledge and understanding of research methodology. During these programmes, the students have submited a dissertation for the practical knowledge of conducting research work. The field for basic research is broad. It deals with the basic problems of educating and teaching learning situations.

13. **Scope:** The field of action research work is very narrow. It deals with the problems of classroom teaching and school. The field is local.

14. **Examples:** The problem of assignment, spellings, pronunciation and poor attendance. The enrollment of school is reducing rapidly is the major problem of action research in the field of education.

15. **Importance:** The major importance for solving the local problems of school and classroom teaching.

   (*a*) **Teaching skills for different subject teachers (languages, social studies, and sciences).**
   (*b*) **Behaviour pattern of effective teachers and creative teacher.**
   (*c*) **Difference between trained and untrained teachers' performance.**
   (*d*) **The major importance is to answer the basic questions and contribute field of knowledge by solving the basic problems of education.**

1. Objectives of Action Research: The action research projects are conducted for achieving the following objectives:

1. To improve the working conditions of school plant.
2. To develop the scientific attitude of teachers and principles of studying their problems.
3. To develop the democratic attitude among students and teachers for understanding and solving their problems.
4. To bring excellence in school workers.
5. To develop the ability and understanding among administrators to improve and modify the school conditions and make it more conducive for learning.

2. Analysis the Causes of the Problem: The causes of the problem are analyzed with the help of some relevance. The nature of the causes is also analyzed whether it is under the control or beyond the control of investigator. This helps in formulating the action hypotheses.

3. Formulating the Action Hypotheses: The basis for the formulation of action hypotheses is the causes of the problem, which are under the approach of an investigator. The studies action hypotheses consist of the two aspects: action and goal. It indicates that the action should be taken for achieving the goal.

4. Design for Testing the Action. Hypotheses: The design is developed for testing the most important action of hypotheses. Some actions may be taken and their results are observed. If the hypotheses are not accepted, second design is developed for testing another hypothesis. In action research on hypotheses is tested at a time. The design of action research is flexible and can be designed at any time according to the convenience of the researcher.

5. Conclusion of Action Research Project: The accepting or rejecting action hypotheses leads to draw some conclusions. The statements conclusion indicates some prescription for the practical problem of school or classroom. The conclusions are useful in modifying and improving the current practices of school and classroom teaching.

National Council of Educational Research and Training has been taken interest in the action research projects. The extension department of NCERT has been conducting seminar and workshops for in-service teachers for imparting knowledge and skill and action research projects. It has developed its own paradigm of action research projects.

A PARADIGM OF ACTION RESEARCH PROJECT

The steps and sub-steps are proposed by NCERT for conducting action research project:

1. Topic of the project.
2. Objectives of the project.
3. The system of the project work.
4. Evaluation of the project.
5. Estimate of expenditure for the project.
6. Name of the instruction number of students enrolled with sections.
7. Number of teachers in different subjects.
8. The available facilities in school for the project work.
   (*a*) Background for the project work.
   (*b*) The importance of the project for the school.
   (*c*) Identification of problem.
   (*d*) Defining and delimiting the problem.
   (*e*) Formulation of action hypotheses.
   (*f*) Testing the action Hypotheses.
   (*g*) Conclusions of the project work.
   (*h*) Remark by an investigator.

On the lines the teacher plans an experimental project after conducting the experiment, he writes a reports of the project work.

EXPERIMENTAL PROJECT OF ACTION RESEARCH

1. **Topic of the Project:** The geography students are not using maps and atlas in school.
2. **The Investigator:** An experience geography teacher.
3. **The Background for the Project Work:** During the last years, it has been observed that students are not using maps and atlas in their geography classes. The concepts of geography are not clear to the students.

4. **Objectives of Project work:** This project is taken for achieving the following objectives:
    (*a*) To develop the interest in using the maps atlas in geography class.
    (*b*) To develop understanding about the use of maps and atlas in geography study.
    (*c*) To develop the feelings among the students that geography content can be best understood by the use of maps and atlas.
    (*d*) To raise the level of performance in geography.
5. **Importance of the Project for the School:** The study of geography is very essential and useful for .the students. It provides the general knowledge about the human phenomenon. The standard of geography may be raised and it may attract student for admission. The result of geography examination may be upgraded.
6. **Field of the problem:** The problem concerns with the classroom- teaching. It will promote leading aspect of management learning the field of problem is the proper use of teaching aids in geography.
7. **The Specification of the Problem:** The problem is located in Govt. Inter College, Chitrakoot, Dist. Banda, U.P., Class VIII B Period VI Subject geography. The students of the class are not using maps and atlas in geography subject.
8. **Analysis of the Problem:** The causes of the problem may be analyzed with the help of the following table:

Sl.No .	Causes	Evidences	Nature	Solution
1.	The teachers do not stress on the use map and atlas.	Teacher experience and observation	Fact	Control
2.	The geography maps are not available in the entries.	No geography room and stock book entire	Fact	Under control of the teacher
3.	Most of the students do not have the atlas	Enquiring from the students	Fact	Beyond the control of teacher.
4.	The geography teacher is not using maps in their teaching.	Student's opinion and teacher observation and experience.	Fact	Under the approach of teacher

9. **Formulation or Action Hypotheses:** The action hypotheses are formulated for the problem. Generally the causes, which are under the approach of the teacher, are considered for this purpose. The following two important action hypotheses are developed.
    First Action Hypotheses: The tendency of using maps and atlas is promoted by giving the adequate stress on the use of maps and atlas in geography teaching. The first part is the later part is action to be taken for Promoting interest in using maps and atlas.
    Second Action Hypotheses: using the proper teaching aids in teaching geography class may develop the interest of using, maps and atlas.
10. **Design for Testing Action Hypotheses:** The action hypotheses are tested separately by employing different designs. A design has been given for testing the first action hypotheses.

The Design for First Action Hypotheses

	Initiation of Activities	Techniques	Source	Time
1.	A list is prepared of students who have the atlas.	Enquiring from the geography student during teaching period	Teacher provide a atlas name	Four days
2.	The students who do not have the atlas will be asked to purchase it.	Teacher will enquire from students	Teacher will locate the poor students.	Three days
3.	The atlas may be given to poor students from the Book Bank	He will send this test of information to parents also.	He will request the principal for purchasing more copies of atlas from Book Bank	Three days
4.	During geography class teacher will regularly ask the students to bring and use atlas.	The Teacher will supervise the use of atlas by students	He will note the two names of these students who do not purchase atlas	Two weeks

The Data collected by observation and maintaining record of students, who have used the atlas. An achievement test may be and interned to measure their level performance. These evidences show the improvement in the teaching practices, and then the conclusion may be grown. If the evidences do not show significant improvement in the problem.

The Design for Second Hypotheses

Initiation of Activities	Techniques	Source	Time
1. The teacher will provide the awareness about the available maps in the school.	1. From the record and availability of maps in geography room.	1. Teacher will contact to the in change the geography room	Two days
2. The teacher will arrange the required maps in teaching geography.	2. The teacher will review course and content prescribed for Glass VIII in geography subject.	2. The teacher will request the principal and contact nearby extension service centers.	Four days
3. He will select related maps for the content of geography.	3. The teacher will consider the content of his lesson.	3. He can borrow from geography room in charge.	Three weeks
4. He will use proper maps; charts and models in his teaching.	4. The lesson will be developed with the help of teaching aids.	4. Teacher will locate the poor students.	Three Weeks (The teacher will arrange the maps himself with three weeks and the students are asked to bring required maps in geography period.)
5. He will ask the students to enter the required places after his presentation	5. Teacher will show these places on map and will supervise the students map work.	5. Teacher will locate the poor students.	Three weeks

In implementing the design, the data is gathered by observation, student's reactions and achievement test of geography may be administered. The decision may be taken regarding the action hypotheses.

11. Evaluation: The criterion of evaluating the action research project is the workability of the action hypotheses. Using observation technique, attitude scale, interest inventory, opinion reactions and scores on achievement test collects the data. The obtained data may be presented graphically to show the rate of development and data is analyzed by calculating percentage and other appropriate statistical techniques. Some conclusions' may be drawn on the basis of statistical analysis.

12. Comments of the Investigator: The investigator will draw some conclusions about the workability of action hypotheses. This may provide some basis for suggesting prescription or remedy for solving the problem. The use of maps and atlas is very essential for teacher as well as students to understand the concepts of geography.

SUGGESTIONS FOR ACTION RESEARCH PROJECT

In developing an action research project the following suggestions should be kept in view:

1. The nature of the project should be decided whether it is developmental project or experimental project.
2. An investigator must be directly associated with the problem to be studied.
3. The form of problem should be real.
4. The project should be so planned that it should not intervene the function of schoolwork.
5. The project should be concerned directly with qualitative improvement and level of performance of the students.
6. The project should be evaluated objectively by employing reliable and valid tools.
7. The action hypotheses should be formulated by considering the causes of the problem, which are under the approach of the teacher or worker.
8. The design of Action Research project should be economical from money, time and energy point over view.
11. The problem should be selected objectively and studied scientifically.
12. The causes of the problem should be isolated objectively on the basis of some evidences.

$$\boxed{\textbf{EXERCISES}}$$

1. Define the term 'Research' and give the meaning of Educational Research.
2. Differentiate between Action Research and Fundamental Research or Basic Research.
3. Explain the concept of 'Action Research' and discuss its importance for the teacher.
4. Select one problem and prepare an Action Research project of the same.

Chapter 18

Presentation of Statistical Data

MEANING OF THE TERM STATISTICS

Usually word statistics carries the following three common meanings:

1. In first place, it refers to numerical facts. State as well as Central, Statistical department and various other agencies can be seen engaged in collecting valuable statistics (numerical facts concerning the birth and death, school attendance, employment market, output of Industrial plants and Agriculture fields etc.

2. As a second meaning, word statistics refers. to the method or methods of dealing with numerical facts. In this sense, statistics is taken as science of collecting, classifying, summarizing, analysing and, interpreting of numerical facts.

3. In its third meaning, statistics refers to the summarized figures of numerical facts such as percentage, averages, means, medians, modes, standard deviations etc. Each of these figures separately, (average or mean etc.) is referred to as 'Statistics' .

In this way, the word statistics can be referred to numerical facts or science or methodology of dealing with numerical facts or summarized figures of numerical facts. Tate has beautifully summarized these different-meanings of the word statistics in the following witty comments, "It's all perfectly clear; you compute statistics (mean, median, mode etc.) from statistics (numerical facts) by statistics (statistics as a science or methodology)" (1955, p. 5)

THE MEANING OF TERM DATA

The dictionary meaning of the word data is facts (plural of datum, meaning fact). Thus, in wider sense the term data designates the evidence or facts for describing a group or a situation, but in a particular sense it is generally used for numerical facts such as heights, weights, scores on achievement tests and intelligence test, etc.

METHODS OF ORGANISING AND PRESENTING DATA

The data from tests and experiments in the form of scores need to be classified and organised in a systematic way fro understanding the meaning and deriving some useful conclusions, in general the following four methods are used for organizing and presenting statistical data:

A. Presentation in the form of Statistical Tables.
B. Presentation in the form of Frequency distribution.
C. Graphical presentation of ungrouped data.
D. Graphical presentation of Frequency distribution (Grouped data).

A. Statistical Tables

In this form of presentation, data are tabulated or arranged in some properly selected classes and the arrangement is described by title and sub-titles. Such tables can list the original raw scores as well as the percentages, means, standard deviations etc. Below we give a sketch of a table for illustration.

Table 18.1

Pass Percentage of High Schools of Rohtak City in the High School Public Examination

High School of Rohtak	*Name of School*	*Pass percentage*	*Girls Pass percentage*	*Boys Pass percentage*
	A			
	B			
	C			
	D			
	E			

The Frequency Distribution

In this form of presentation, we group the quantitative data into some arbitrarily chosen classes. For this purpose, usually, the scores are distributed into groups of scores (classes) and each score is allotted a place in the respective group or class. It is also, seen how many: times a particular score or group of scores occurs in the given data. This is known as the frequency of a score or group of scores. In this way, Frequency distribution may be considered as a method of presenting a collection of groups of scores in such a way as to show the frequency in each group of scores or class. Various steps for presenting quantitative data by a frequency distribution can be understood properly with the help of the following example-

> **Example–**The marks obtained by 50 students in an Achievement test are given below:
>
> 62, 21, 26, 32, 56, 36, 37, 39, 53, 40, 54, 42
> 44, 61, 68, 28, 33, 56, 57, 37, 52, 39, 40, 54
> 43, 43, 63, 30, 34, 58, 35, 38, 50, 38, 52, 41
> 51, 44, 41, 42, 43, 45, 46, 45, 47, 48, 49, 45
> 46, 48.

Tabulate these scores in Frequency distribution by clearly explaining the various steps involved.

Steps for Grouping Data into Frequency Distribution

1. **Finding the range–** First of all the range of the series to be grouped is found out. It is done by subtracting the lowest score from the highest. In this present problem the range of the distribution is 68–21 i.e. 47.

2. **To determine the class interval or grouping interval–**After finding out the range, the number and size of the classes or groups to be used in grouping the data are decided.

There exists two different for this purpose.

First Rule–For gaining an idea of the size of the classes i.e. Class interval, the range is divided by the number of classes desired. Class interval is usually denoted by the symbol "i" and is always a whole number. Thus the formula for deciding the class interval is

Now the question arises in how many classes or groups one should distribute a given data. As a general rule Tate writes, "If the series contains fewer than about 50 items, more than about 10 classes are not justified. If the series contains from about 50 to 100 items. 10 to 15 classes tend to be appropriate; if more than 100 items; 15 or more classes tend to be appropriate. Ordinarily not fewer than 10 classes or more than 20 are used." (1955, p. 44).

If by dividing Range by number of classes we do not get whole number, the nearest, appropriate number is taken as class interval.

Second Rule–According to second rule class interval (i) is first decided and then the number of the classes is determined. For this purpose, usually, the class intervals of 2,3,5 or 10 units in length are used.

Both of the above mentioned rules are practised. In our opinion, it is better to use a combined procedure made out of both the rules. Actually the range, the number of classes and the class interval- all should be taken into consideration while planning for a, frequency distribution and we must aim to select a proper class interval (i) that can yield, appropriate categories (number of classes) as mentioned above by Tate.

Considering in this way, proper interval (i) in the present example is 5.

[Here Range = 47. Scores are 50 in number and thus about 10 classes are sufficient. Therefore i = 47/10 = 47 i.e. Nearest whole number = 5]

3. **Writing the Content of Frequency Distribution**–After deciding the size and number of the class interval and locating the highest and lowest scores of the given data, we proceed to write down the content of the Frequency distribution. For this purpose 3 columns are drawn and work is carried out as under.

(*a*) *Writing the classes of distribution*–In the first column, we write down all the classes of distribution. For this purpose first of all the lowest class is settled down and afterwards other subsequent classes are written down. In the present problem 20-24 can be taken as the lowest class and then we can have classes as 25-29, 20-34 etc. Upto 65-69.

(*b*) *Tallying the Scores into proper classes*–Under this step, the scores given in the data are taken one by one and tallied in their proper classes as shown in the 2nd column of the table given below. These tally marks against each class are then counted. These counted numbers are respectively called the frequencies of that class. These are written in the third column as shown below:

Table 18.2

Class of Scores	Tallies	Frequency
65–69		1
69–64		2
55–59		4
50–54		7
45–49		9
40–44		11
35–39		8
30–34		4
25–29		2
20–24		1
	Total Frequencies (N)	50

(*c*) *Checking the tallies* – The total or 3rd column should be equal to the number of individuals whose scores have been tabulated. Under the above the tabulation total of frequencies Le. 50 agrees with the total number of students given in the problem.

Some More things to be known Regarding a Frequency Distribution

1. *Class limits of the frequency distribution* – The designation of classes i.e. 20~24, 25-29, 30-34 etc. are called the indicated or written class limits. The actual class limits are always taken as 0.5 units below and 0.5 units above the written class limits. For example the actual limit of class 20-24 is 19.5-24.5 (19.5 as lower and 24.5 as higher class limits).

2. *The mid-point of a class in a frequency distribution* – In a frequency distribution classes are sometimes indicated by their mid-values or mid-points. The formula of determining the mid-point of a class is–

Mid-point of a class = Indicated or written lower limit
+ [(upper limit -lower limit) /2]

[**Note**. We don't consider actual class limits in calculating mid-point. Thus of the class 20-24 the mid-point is 20+[24–20/2] =20+2 =20]

The Graphical Presentation of Ungrouped Data

For the data which is not grouped into a frequency distribution we use the following common graphs or diagrams.

(*i*)   Pictographs or Pictograms.
(*ii*) Bargraphs on Bar Diagrams.
(*iii*) Circle or pie graphs/diagrams.
(*iv*) Line graphs.

Let us have an idea of all these four types of graphical representation.

Pictographs or Pictograms

Pictographs or pictograms are the graphs or diagrams used for presenting an ungrouped statistical data in pectoral (picture like) form: A picture is said to be worth more than 100 words spoken or written. Thereby the pictorial representation of the data is always considered better than its description in the words and figures. Let us illustrate this fact through an example.

Example 18.1: In a data collection process it was found that there are 100 students in class VI; 85 students in Class VII, 80 Students in VIII, 90 Students in IX and 70 Student in X. Present this data first into a tabular form and then in pectoral form.

Solution

Presentation of data in a Tabular Form

Class	*VI*	*VII*	*VIII*	*IX*	*X*
Number of Students	100	85	80	90	70

Presentation of Data in the pictorial form

Step 1 : Let us decide to represent a student with a picture (indicative of a student figure)

Step 2 : For the sake of brevity and simplicity let us have a scale, a picture (of student) equal to 20 students in number.

Following these steps the pictorial presentation (pictograph) of the given data will be as under–
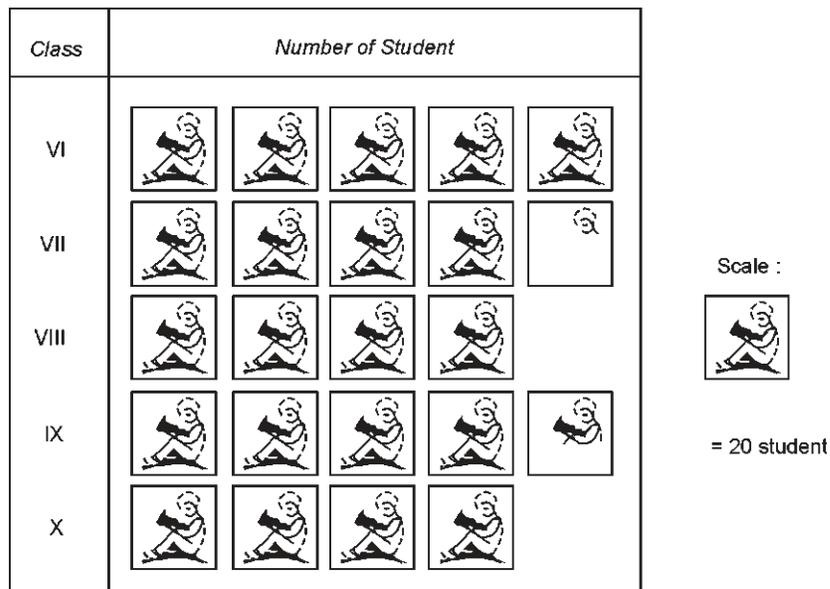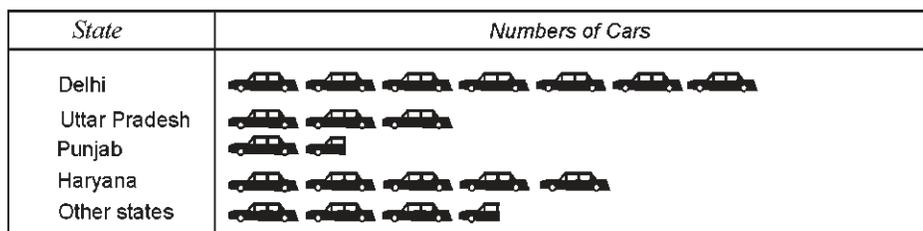

Fig. 18.1

Example 18.2: On a parking place at new Delhi Railway Station the following statistical data (about the number of cars from different states) was collected and arranged in tabular form. Make a pictogram of this tabular data.

State	Number of Cars
Delhi	140
Uttar Pradesh	60
Punjab	30
Haryana	100
Others	70

Fig. 18.2

The pictograph showing the number of cars belonging to different states is presented below:

Each 🚗 stands for 20 cars.

Fig. 18.3

You can now very well imagine the merits and advantage of a pictograph. A mere glimpse of the pictograph reveal that there were maximum number of a cars parked at the Railway Station from Delhi State.

It was followed by Haryana and other states. The minimum number of cars parked were from Punjab and in this way valuable statistical information maybe easily gathered in an interesting and pleasing way from a pictograph.

However, there lies some difficulties in the pictorial presentation of data especially in choosing a suitable scale (picture for a given number of units) and its comprehension. In the above two examples we have chosen figure of student and a car representing strength 20. In both these pictograph we may easily notice the difficulties encountered in representing the numbers not wholly divisible by 20 i.e. 30, 50, 70, 85, 90 etc. We have represented the strength of 85 (in the first example) students with four complete pictures and fraction (only head). Similarly in the case with the incomplete pictures of cars. Here we just have approximation and not the exact measurement of the pictorial figures for representing the scaled fractions numerical data. This difficulty can be somewhat removed in other forms of graphical representation of data as will be noticed soon.

Bar Graphs or Bar Diagrams

In stead of using pictures we can: use bars (rectangles of similar breadth) for the representation of numerical data. this mode of presentation of statistical data through bars is known as bargraphs or bar diagrams. As example let us try to have a bar graph of the tabulated data given in example 18.1. It may take the following shape given in the Fig. 18.3 .

How to draw bar graph?

(*i*) Try to use a graph paper for drawing the bar graph.

(*ii*) On one of the axes X or Y try to plot numerical data by choosing a proper scale and have the other variable like classes in this example on the other axis. Here in this example the numerical strength of students has been plotted on the *y*-axis. Here the number of students in the different classes are thus represented by the bars (rectangles of similar breadth) constructed all, the X-axis.

What can be Inferred from the Bar Graph?

A bar graph just shown above may provide the following information in a quite simple and quick way.

It shows the strength of students in a particular class of the school i.e. there are 70 students in class X.

- The class having highest strength i.e. class VI.
- The class having lowest strength i.e. class X.
- It also reveals that the strength of students gets decreased as we pass through the classes VI to VIII. It once again gets increased in class IX but soon lowers down again in class X.
- The relative strengths of the students studying in different classes of the school may also be adjudged easily for one or the other type of comparisons.

Example 18.3: Let us have another bar graph for further illustration. Can you think about various types of information revealed to you just through its glimpse and useful interpretation?
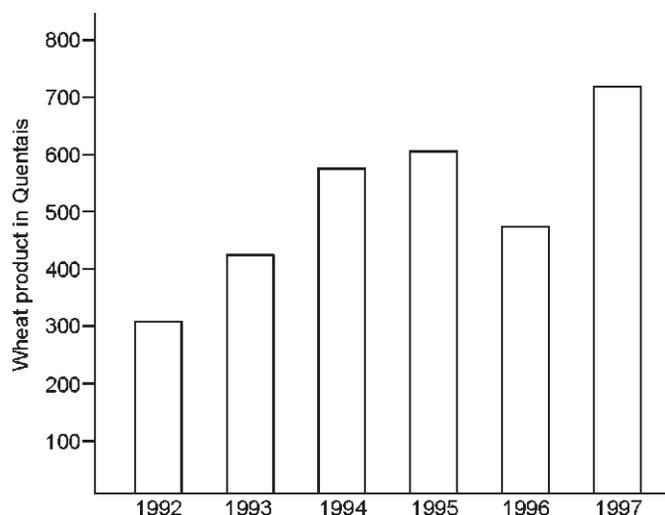
Fig. 18.4 Bar graph showing Wheat production during different years.

We think you can easily infer from the above bargraph that the years of the highest and the lowest yields are 1997 and 1992 respectively and in comparison to the yield of the year 1992. There is approximately double production in the year 1995.

Circle graph or Pie diagrams

Circle or pie graphs/diagrams provide us an opportunity to represent statistical data through the figure or a circle and its constituents Le. proportionate sub-divisions. These are specifically helpful in the case for which the question of proportion is of much interest. To construct them requires a working knowledge of angle measurement and percentages.

The process of the construction of a pie graph may be understood with the help of an example given below.

Example 18.4: 200 B.Ed. Students of a College of Education were asked to give their options for the participation in one or the other types of co-curricular activities. The preferences data was tabulated as under–

Activities	Debate	Dance	Music	Painting	Models	Excursion
Number of students	42	36	36	12	6	68

Present this data through a pie diagram.

Solution: The steps for the construction of the required pie diagram may be outlined as below-

(*i*) A circle has the value of 2π (2 pie) i.e. 3600. In the present example the total sample is 200 which has to be represented through a complete circle having 3600.

(*ii*) The various constituents of the collected data i.e. preferences for the one or the other co-curricular activities then may be assigned by varying values of pie in terms of the degrees as computed below-

Debate: Number of students = 42 out of 200

Proportion out of 200 = 21%

$$\text{Proportion out of } 360° = \frac{42}{200} \times 360° = 75.6\%$$

Dances and Music: No. of Students = 3 6 out of 200

$$\text{Proportion out of } 200 = \frac{36}{200} \times 200 = 18\%$$

$$\text{Proportion out of } 360° = \frac{36}{200} \times 360° = 64.8\%$$

Painting: No. of Students = 12 out of 200

$$\text{Proportion out of } 200 = \frac{12}{200} \times 100 = 6\%$$

$$\text{Proportion out of } 360° = \frac{12}{200} \times 360° = 21\%$$

Modeling: No. of students 6 out of 200

$$\text{Proportion out of } 200 = \frac{6}{200} \times 100 = 3\%$$

$$\text{Proportion out of } 360° = \frac{6}{200} \times 360° = 10.8\%$$

Excursion: No. of Students = 68 out of 200

$$\text{Proportion out of } 200 = \frac{68}{200} \times 100 = 34\%$$

$$\text{Proportion out of } 360° = \frac{68}{200} \times 360° = 122.4\%$$

(*iii*) Now all these above proportions 75.6°, 64.8°, 64.8°, 21.6°, 10.8° and 122.4° may be represented as the different sectors of a whole circle with the help of the knowledge concerning measurement of angels.

(*iv*)   These may take the final following form for making the required pie diagram.
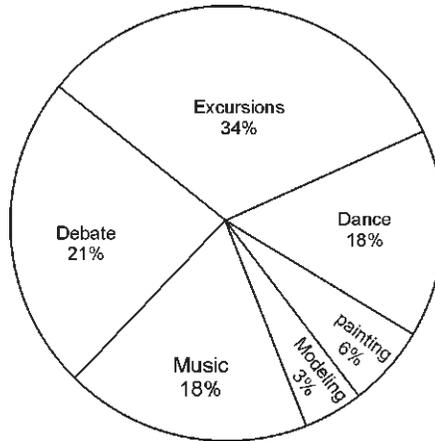

Fig. 18.5 Pie graph showing preferences of B.Ed showing for the co-curricular activities.

Example 18.5: A researcher collected the data from the 100 people fond of pets and tabulated the findings as under:

	Cats	Dogs	Snakes	Turtles	Fish	Parrots	Other birds
No. of People	180	320	50	50	90	180	130

Represent the above data through a pictograph.

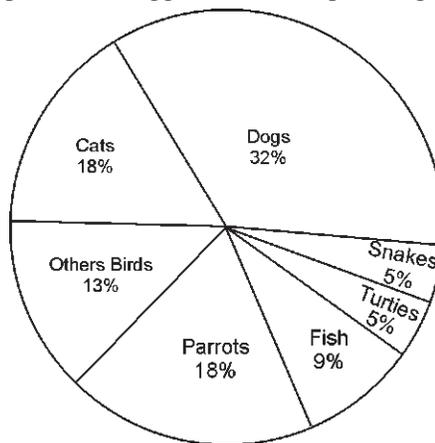**Solution:** Following the procedure suggested in examples diagram may take the following shape.

Fig. 18.6 Pie graph showing people fond of different pets.

Line Graphs

Line graphs can be better used in describing the Con-committed relationships between two variables by plotting their respective values on the *x* and *y* axes of a graph paper (After choosing appropriate scales). Let us illustrate this fact through examples.

Example 18.6: Science students of the IX class of a school collected data about weather on a cold day of the month December by recording the room temperature at various hours of the day and obtained the following line graph of the results of their survey.
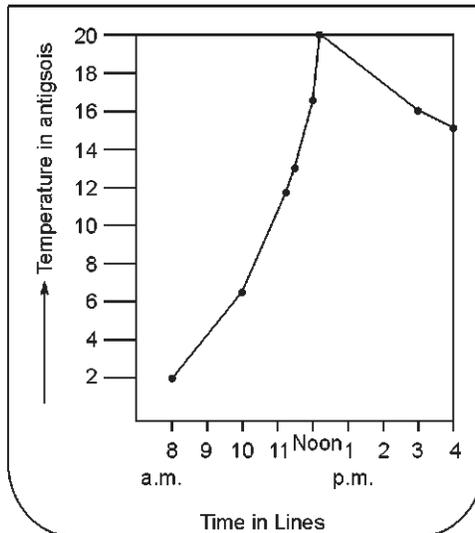
Fig. 18.7 A line group showing the temperature on a December day.

Process of Construction

(*i*)   Here time in house has been plotted on X-axis and the corresponding temperature in centigrade have been plotted on y-axis.

(*ii*) The five small squares of the graph paper have been taken equivalent to 1 hour on X-axis and 2 centigrade on Y-axis.

(*iii*) The facts like 2°C was recorded at 8.00 a.m 0.6ºC was recorded at 10.00 a.m. etc. have been plotted as the varying points and then these points have been joined by continuous straight lines (see the placing of the points P, Q, Q, S, T, U, W as the intersection points of paired data and their joining).

What can be inferred from the line graph?

Line graphs like above can reveal many facts and information about the collected data and consequently we may be able to get answers of the queries like below-

1. For which hours during the day did the students collect data?
2. What was the high temperature of the day according to the graph?
3. Between what hours was the temperature increasing? Decreasing?
4. About what time in the morning was the temperature about 10ºC?
5. What do you predict the temperature might be at 5.00 p.m. lower than or higher than 16°C?

Example 18.7: The line graph given below in Fig. 15.8 depicts mastery of multiplication facts by a particular student in the course of learning. Here the time spent in weeks for having mastery over the

multiplication facts is shown on X-axis and the achievement in terms of mastery (known through the percentage of facts mastered) is shown on Y-axis by choosing appropriate scales.
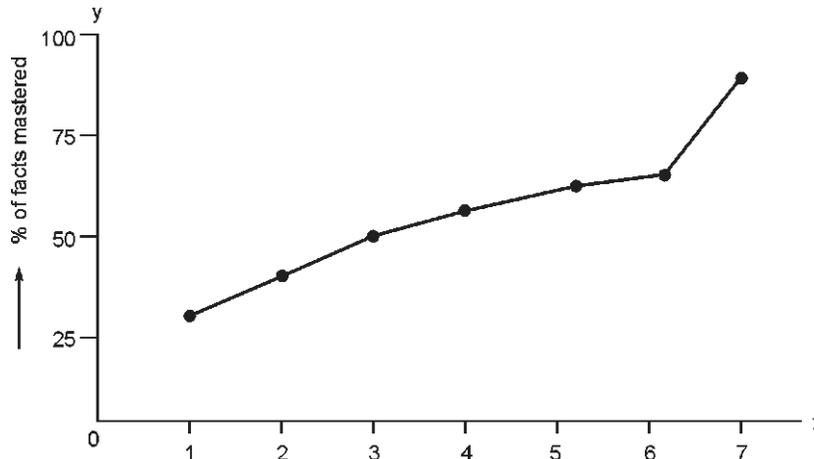
Fig 18.8 Line graph showing progress about mastery over the multiplication facts

Conclusion about choosing a particular graphical mode for the representation of ungrouped data

Each of the graphical mode, pictograph, pie graph and line graph, described above have their own merits and limitations of being utilised in the representation of a given ungrouped data at a particular occasion to furnish useful information. Therefore, a wise decision should always be made before the employment of a particular graphic mode in a particular situation. Take the last example of representing the data concerning mastery over the multiplication by a line graph. Here it would make no I sense whatever to turn these weekly mastery figures into a pie or bar chart. There is also no possibility of representing these through pictograph. Similarly in the case of I representing facts concerning the percentage of pets, there will be no sense in displaying them through a line graph. Here the decision for representing them through a pie graph seems quite appropriate as there stands a whole of which the different figures concerning pets choices are collectively a part.. Contrarily in the case, showing concommitant changes occurred in a one variable, relation to the changes introduced in the other, it is always advisable to use line graph as the mode of representation. In this way, while trying to determine how to best display the particular data one must decide whether to graph the data, and if so, what kind of graph to use.

A. THE GRAPHICAL PRESENTATION OF FREQUENCY DISTRIBUTION (GROUPED DATA)

There are four methods of representing a frequency distribution graphically:

1. The Histogram or column diagram
2. The Frequency Polygon.
3. The Cumulative Frequency Graph.
4. The Cumulative Frequency Percentage Curve or Ogive.

Out of these methods we would take up the most common ones namely the Histogram and the

Frequency Polygon for discussion in the following below:

1. **The Histogram–**A histogram or column diagram is essentially a bar graph of a frequency distribution. The following points are to be kept in mind while constructing the histogram for a frequency distribution.

    (*i*) The scores in the form of actual. class limits as 19.5-24.5,24.5-29.5 etc. are taken in the construction of a histogram.

    (*ii*) It is Customary to take two extra intervals (classes) one below and other above the given grouped intervals or classes (with zero frequency). In the case of frequency distribution given in Table 18.2, we can take 14.5-19.5 and 69.5-74.5 as the two required extra-intervals.

    (*iii*) Now we take the actual lower limits of all the class intervals (including the extra-intervals) and try to plot them on X-axis. The lower limit of the lowest intervals (one of the extra intervals is taken at the intersecting point of X-axis and Y-axis.)

    (*iv*) Frequencies of the distribution are plotted on Y-axis.

    (*v*) Each class or interval with its specific frequency is represented by a separate rectangle. The base of each rectangle is the width of the interval (i) and the height is the respective frequency of that class or interval.

    (*vi*) It is not essential to project the sides of the rectangles down to the base line.

    (*vii*) Care should be taken to select the appropriate units of representation along the X-axis and Y-axis. Both X-axis as well as Y-axis should not be either too short or too long. "A good general rule for this purpose" as suggested by Garrett is to select X and Y units which will make the height of figures approximately 75% of its width. (1971, p. 11).
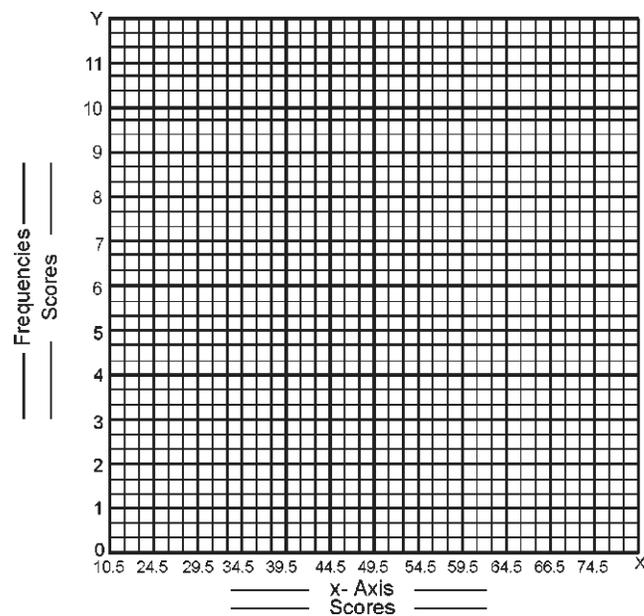

Fig. 18.9 The Histogram of Frequently distribution given in the Table 18.2.

2. **The Frequency Polygon–**A frequency polygon is essentially, a line graph for the graphical representation of the frequency distribution. We can get a frequency polygon from a histogram, if the mid points of the upper bases of the rectangles are connected. But it is not essential a

plot histogram first to draw a frequency polygon. We can construct it directly from a given frequency distribution. The following points are helpful in constructing a frequency polygon

SCALE: ON X-AXIS → 3 SCORES = 5 SMALL SQUARES = 0.5"

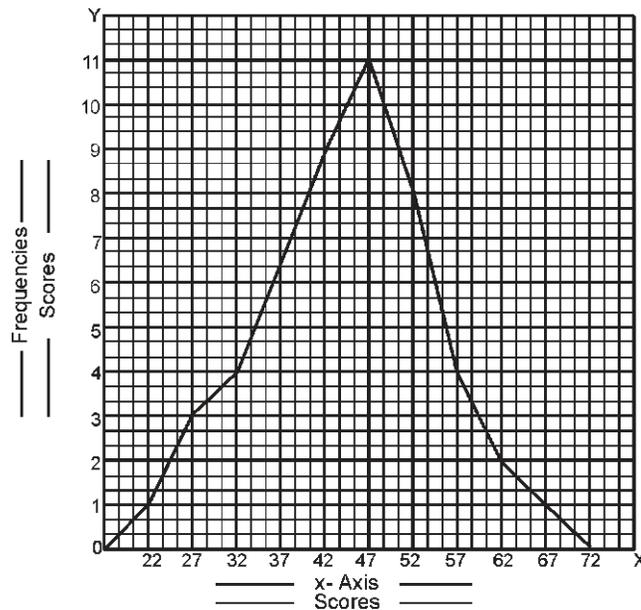ON Y-AXIS → FREQUENCY = 3 SMALL SQUARES = 0.3"

Fig. 18.10 The Frequency Polygon of the Frequency distribution given in Table 18.2

   (*i*)   Like histogram two extra intervals classes one above and the other below the given intervals are taken.

 (*ii*)   The mid-points of all the classes or intervals (including two extra intervals) are calculated.

(*iii*)   The mid-points are Marked along the X-axis and the corresponding frequencies are plotted along the Y-axis by choosing suitable scales on both axes.

(*iv*)   The various points obtained by plotting the mid-points and frequencies are joined by straight line to give the frequency polygon.

 (*v*)   For the approximate height of the figure and selection of X and Y units the rule emphasized earlier in the case of histogram should be followed.

Comparison Between the Histogram and the Frequency Polygon

Although Histogram and Frequency polygon-both are used for the graphic representation of the frequency distribution and are alike in many aspects yet they posses points of differences. Some of these differences can be cited as below–

1.   Where Histogram is essentially the bar graph of the given frequency distribution, the Frequency polygon is a line graph of this distribution.

2.   In Frequency polygon we assume frequencies to be concentrated at the mid-points of the class interval. It points out merely the graphical relationship between mid-points and frequencies and thus is unable to show the distribution of frequencies within each class interval. But the Histogram gives a very clear as well as accurate picture of the relative proportions of frequency from interval to interval. A mere glimpse of the figure answers such questions as–

   (*i*)   Which group of Class-interval has the largest or smallest frequency?

  (*ii*)   Which pair of groups or class intervals has the same frequency?

 (*iii*)   Which group has its frequency double that of another?

3.   In comparing two or more distributions by plotting two or more graphs on the same axes, Frequency polygon is more useful and practicable than the Histogram as in such cases vertical and horizontal lines in the histogram tend to coincide.

4.   In comparison to Histogram, Frequency polygon gives a much better conception of the contour of the distribution. With a part of the polygon curve, it is easy to know the trend of the distribution but a Histogram is unable to tell such a thing.

EXERCISES

1. Discuss in brief the different methods of organising and presenting statistical data.

2. What is Frequency distribution? How can you present a data in the form of a frequency distribution? Illustrate your answers with an example.

3. Tabulate the following 25 scores into a frequency distribution using a appropriate interval-

   72, 75, 77, 67, 72, 81, 68, 65, 86, 73, 67, 82, 67, 70, 76, 70, 83, 71, 63, 72, 72, 61, 67, 84, 69, 64.

4. What is a Histogram? How does it differ from a Frequency polygon?

5. Plot Histogram and frequency polygons separately on the different axes for the following distribution.

(*a*)		(*b*)		(*c*)	
Scores	*f*	*Scores*	*f*	*Scores*	*f*
75–79	1	60–69	1	37–39	2
70–74	3	70–79	2	34–38	4
65–69	5	80–89	3	31–33	6
60–64	8	90–99	4	28–30	10
55–59	11	100–109	7	25–27	12
50–54	18	110–119	12	22–24	7
45–49	10	120–129	8	19–21	7
40–44	8	130–139	5	16–18	3
35–39	6	140–149	3	13–15	2
30–34	3	150–159	3	10–12	1
25–39	1				
20–24	1				
	N = 75		N = 50		

6. Name the different graph or diagrams used for the graphical presentation of ungrouped data. Discuss anyone of them by taking a hypothetical data.

7. What are pictographs or pictograms? Illustrate the procedure of drawing a pictograph with the help of an example.

8. What is a bar graph or bar diagram? Illustrate the procedure of representing ungrouped data through a bar diagram with the help of some hypothetical data.

9. What is a circle or pie diagram? Illustrate the. procedure of representing ungrouped data through a pie diagram with the help of some hypothetical data.

10. Make a pictograph of the following tabular data.

Name of Work Experience	Gardening	Book Binding	Cooking	Clay Modelling	Art and Painting
No. of students opted	60	30	40	45	25

11. The data shown in the given table presents the figure of the merit positions earned in the X and XII classes by a school in different years. Draw a bar graph for representing this data.

Year	1997–98	1998–99	1999–2000	2000–01	2001–02
No. of Merit positions	4	1	24	13	16

12. Draw a line graph for the data presented in the problem 11.

13. Draw a pie diagram for representing the data presented in the problem 10.

14. What is a line graph? How can it be used for representing an ungrouped data? Illustrate the process by taking some hypothetical data.

15. Name the various, methods used for presenting a frequency distribution (grouped data) in a graphical form. Discuss anyone of them in detail.

16. What is a histogram? Illustrate the procedure of drawing histogram for the presentation of a given frequency distribution with the help of an example.

17. What is a frequency polygon? Discuss the procedure of its construction with the help of an example.

Short Answer Type Questions (Answer in 100–120 Words)

1. Explain the meaning of the 'term' statistics.

2. What is data? Name the various methods used for the organisation and presentation of data.

3. How can the data be presented through a statistical table? Illustrate with the help of a hypothetical example.

4. What is a frequency distribution?

5. What do you mean by class interval of a frequency distribution? How is it computed? Illustrate with example.

6. What is a pie graph? Explain with the help of hypothetical diagram.

7. What is a bar graph? Explain with the help of hypothetical diagram.

8. What is a histogram?

9. What is a frequency polygon?

10. Distinguish between the histogram and frequency polygon.