
بسم الله الرحمن الرحيم

COURSE CODE: ASC201

COUSE TITLE: PROBABILITY AND STATISTICS

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B.E. (Telecommunication Engineering)
D.A.E (Electronics)

PROBABILITY AND STATISTICS

ASC201

Course Information: Grading

Credit Hours : 3+0

Theory : (100 Marks)

- Two Assignments (10 Marks Each)
- Five quizzes (2 Marks Each)
- One Midterm (20 Marks Each)

Sessional (50 Marks)*

Final Exam (50 Marks)*

Total = 100 Marks

Grade	Grade Point	% Marks	Remarks
A+	4.0	94– 100	Extra Ordinary
A	4.0	85– 93	Excellent
A –	3.7	80 – 84	Very Good
B +	3.4	75 – 79	Very Good
B B	3.0	70 – 74	Good
– C	2.7	67 – 69	Above Average
+ C	2.4	64 – 66	Average
C –	2.0	60 – 63	Satisfactory
D +	1.7	57 – 59	Adequate
D	1.4	54 – 56	Pass
F	1.0	50 – 53	Pass
P	0.0	Below 50	Fail
	-	50 – 100	Pass in non-credit course

STUDENT BEHAVIOR EXPECTATIONS

- All types of academic misconduct will be treated seriously.
- If there are evidences of plagiarism, cheating, or fabrication in any work, the score of that work will be zero.
- Late assignments, project submission will not be accepted, deadline are to be followed and assignments are to be submitted before due date and due time through CR only, no direct submissions to the instructor.
- Full attendance expected, in exceptional cases a maximum of 25% absence is allowed.

PROHIBITED BEHAVIORS

- Any foul language or gestures
- Comments to other students that are discriminatory in any form
- Any harassments as defined by the university
- Academic dishonesty
- Keep at silent mode.
- No chewing is allowed in the class

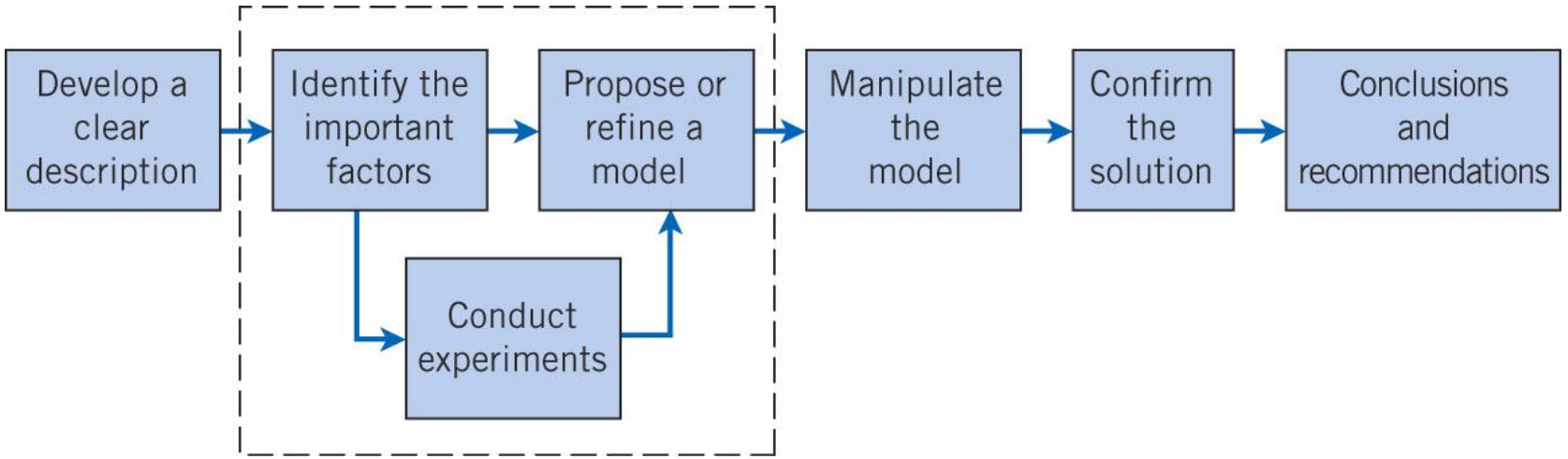
STATISTICS

What Do Engineers Do?

An engineer is someone who solves problems of interest to society with the efficient application of scientific principles by:

- Refining existing products
- Designing new products or processes

The Creative Process



The engineering method

Introduction

The term statistics is generally used to mean numerical facts and figures such as agricultural Production during a year, rate of inflation and so on. However as a subject of study, statistics refers to the body of principles and procedures developed for the collection, classification, summarization and Interpretation of numerical data and for the use of such data. Statistics is a set decision making Techniques which aids businessmen in drawing inferences from the available data.

Features of Statistics

- **Collection of Data**
- **Organization of Data**
- **Presentation of Data**
- **Analysis of Data**
- **Interpretation of Data**

Collection of Data

Collection of relevant data concerning a problem is the first step in statistical method. Depending upon the problem under study.it is decided as to how, when and where and what kind of data are to be collected.

Organization of Data

The second step is to organize the collected data. With a view to rendering The collected data more comparable and simple, it is classified in the basis of time, placed quality, etc.

Presentation of Data

To make the data intelligible, brief and attractive, it is presented in the form of tables, diagram and graphs.

Analysis of Data

To draw conclusions it is necessary to analyze the data. Methods of Analyzing measure of central Tendency, measures of variation, correlation etc.

Interpretation of Data

Conclusions are drawn after analyzing the data. Two or more kinds of data are data are Compared and conclusions

Population:

Population: is the universal set of all objects under study.

A population is any entire collection of people, animals, plants or things from which we may collect data. It is the entire group we are interested in, which we wish to describe or draw conclusions about.

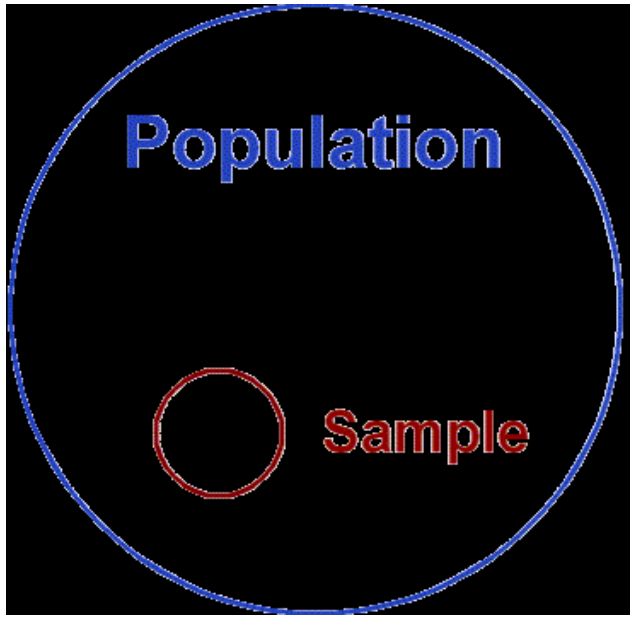
For example: Students of UIT
People living in Karachi
Bulbs made in a factory
Different models of cell phones

Population

- A **population** is a collection of data whose properties are analyzed. The population is the *complete* collection to be studied, it contains *all* subjects of interest

Sample: (Subset of the Population)

- A sample is a group of units selected from a larger group (the population). By studying the sample it is hoped to draw valid conclusions about the larger group.



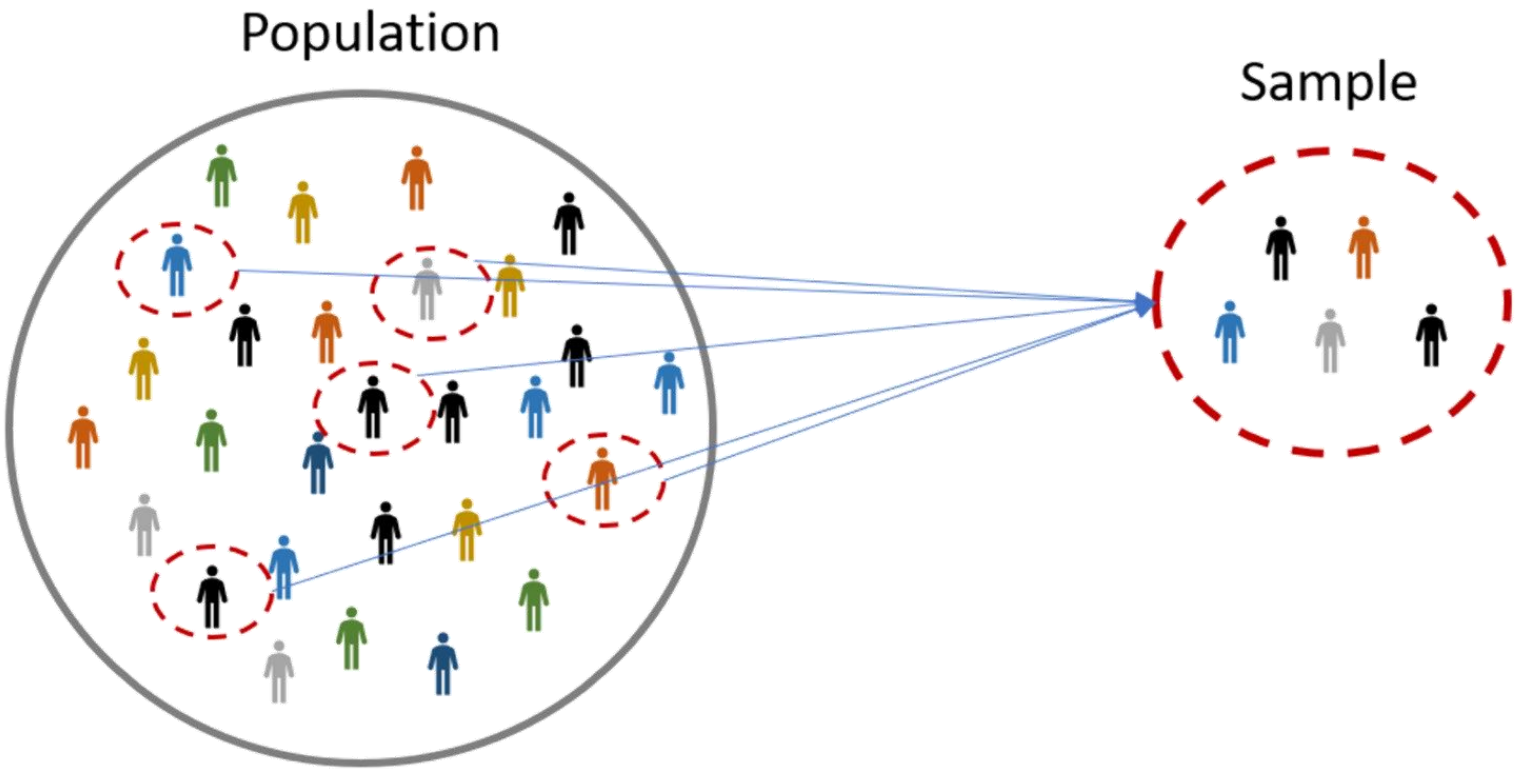
Populations and Samples

Population

*The term "**population**" is used in statistics to represent all possible measurements or outcomes that are of interest to us in a particular study."*

Sample

A subset of the population is known as a Sample.


Population
Sample

Sample Size

- Sample size is the number of observations used for calculating estimates of a given population.
- For example, if we interviewed 30 random students at a given high school to see if they liked a certain movie star, "30 students" would be our sample size.
- All students in the school is Population.

After the data have been collected the next step is to present them in some suitable form. When data are presented in easy to read form, it can help the reader to acquire knowledge much shorter period of time and also facilitate statistical analysis. Presentation can take two basic forms

1. Statistical Table
2. Statistical Chart

Statistical Table

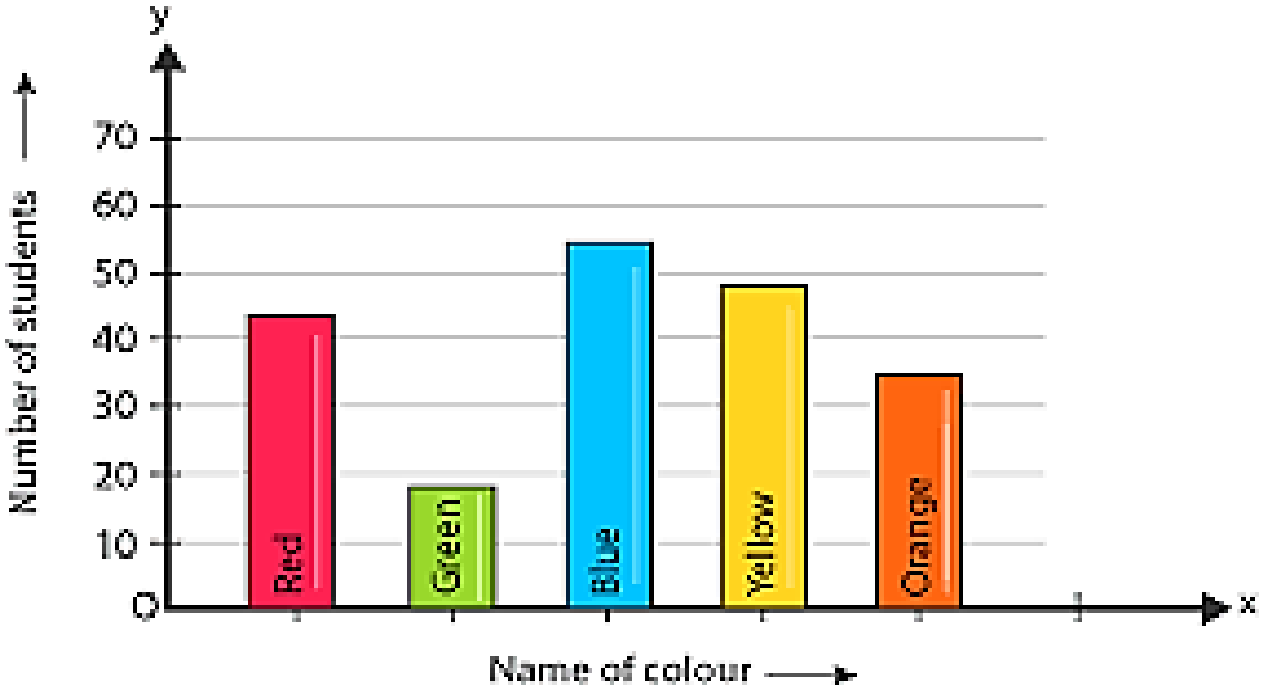
A Statistical table is a presentation of numbers in logical arrangement, with some brief explanation to show what they are.

Marks of Students

Marks	Number of Students		Total
	Males	Females	
30 – 40	8	6	14
40 – 50	16	10	26
50 – 60	14	16	30
60 - 70	12	8	20
70 – 80	6	4	10
Total	56	44	100

Statistical Chart

A Statistical Chart or a graph is a pictorial device for presentation data.

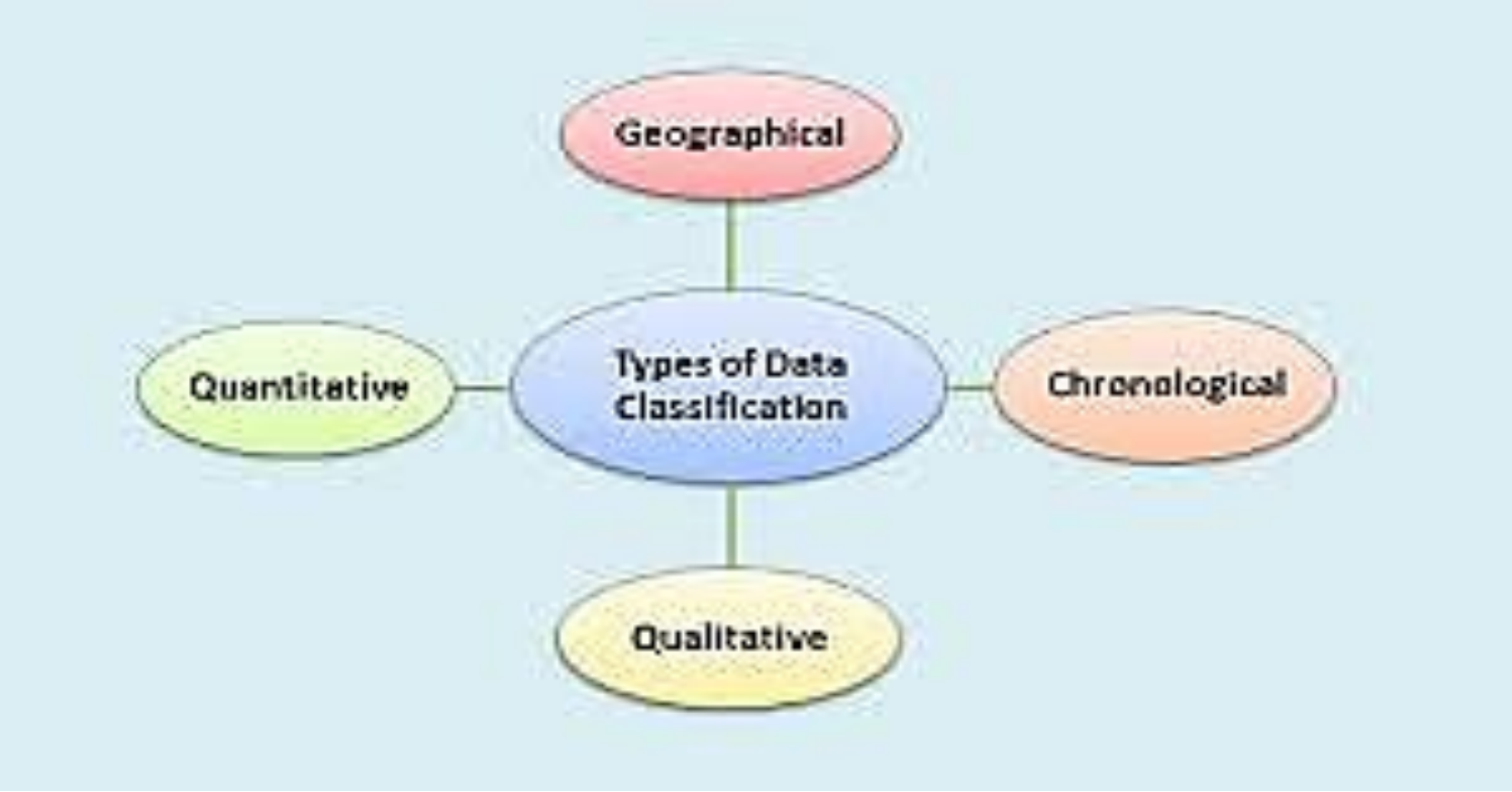


Classification of Data

Classification is the grouping of related facts into different classes. Facts in one class differ from those in another class with respect to some characteristics called a basis of classification.

Classification of statistical data is comparable to the sorting operation. The process of classification gives prominence to important information gathered while dropping unnecessary details facilitates comparison enables a statistical treatment of the material collected.

Types of Classification



Geographical Classification

When the data classified according to geographical location or region (Like states ,cities, regions, zones, areas etc.)It is called a geographical classification.

Geographical classifications are usually listed in an alphabetical order for easy reference. Items may also be listed by size of to emphasis the important areas as in ranking the states By population.

Region	Area (In hectares)
Central	150,000
East	230,000
North	250,000
South	310,000
West	200,000

Chronological Classification

When data are observed over a period of time that type of classification is known as chronological classification.

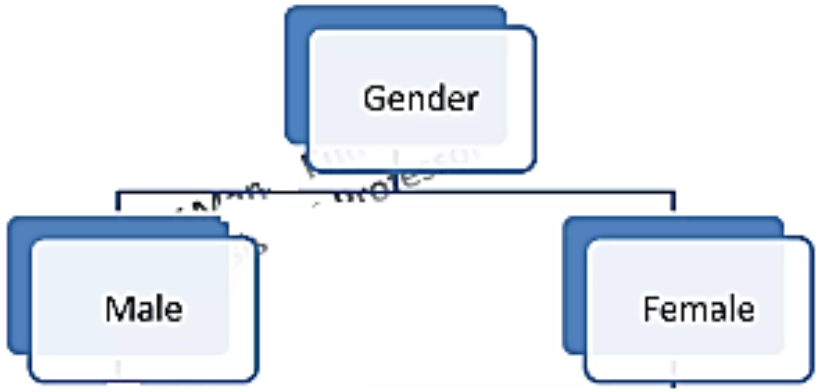
Time series are usually listed in chronological order normally starting with the earliest time period.

Year	Tractor Sales (in units)
2017	1,00,00
2018	1,15.456
2019	1,36.876
2020	1,52.477
2021	1,54,947

Qualitative Classification

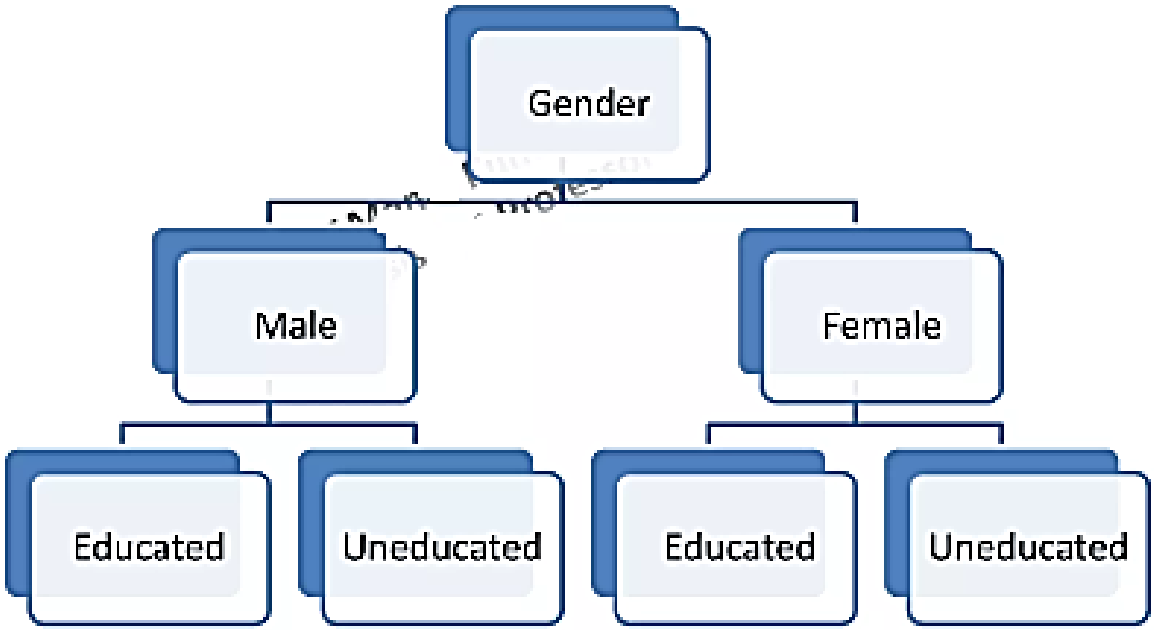
Qualitative classification data are classified on the basis of some attribute or quality such as sex, color , religion , etc. This type of classification is that the attribute under study cannot be measured, one can only find out whether it is present or absent in the units of the population Under study.

Example



Manifold Classification

Example

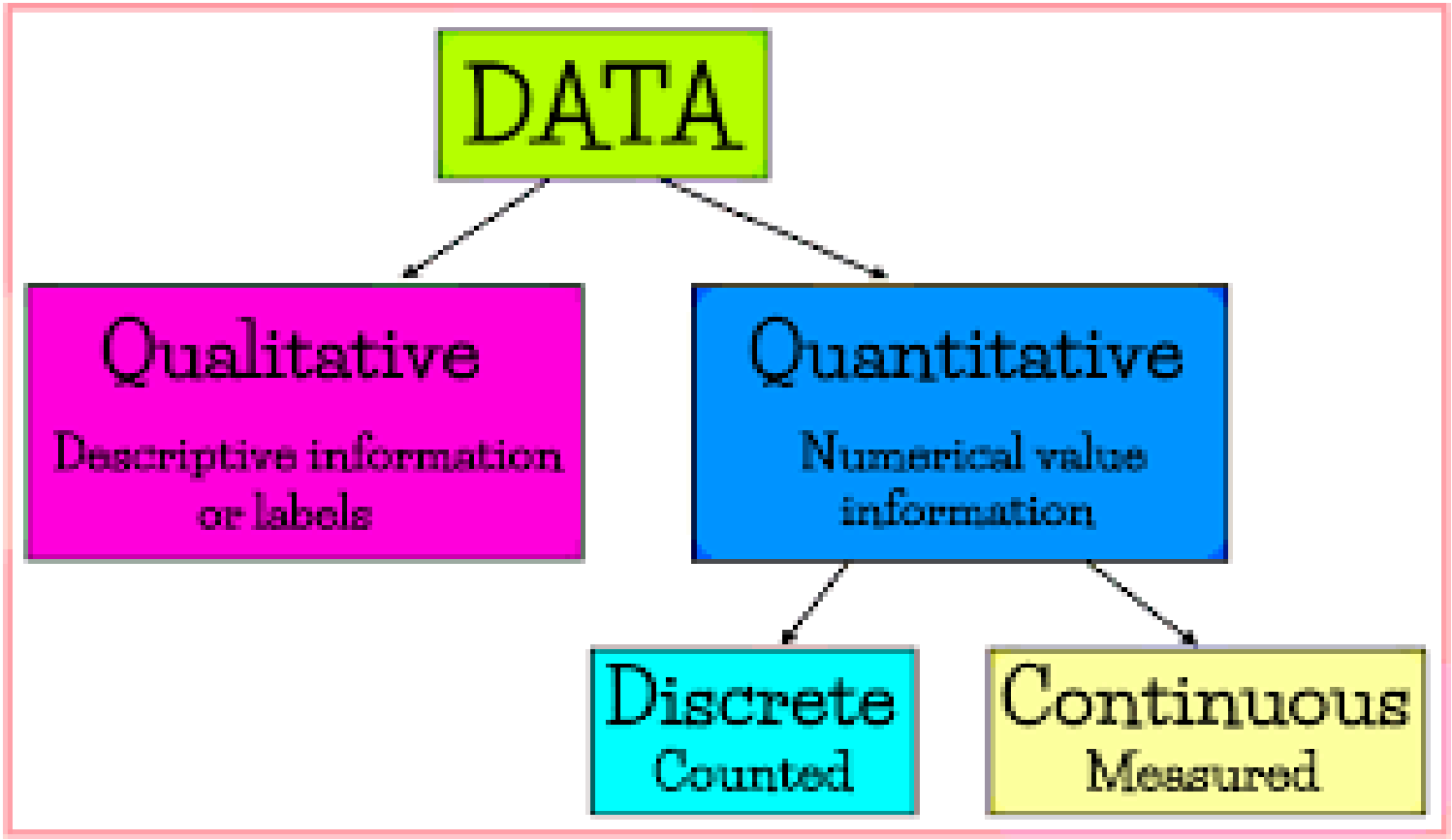


Quantitative Classification

It refers to the classification of data according to some characteristics that can be measured such as height, weight, income sales etc.

In this type of classification there are two elements namely the variable and frequency.
The quantitative classification gives birth to frequency distribution. Variable may be either continuous or discrete(discontinuous).

Continuous data are obtained through measurements. Discontinuous data are derived by counting.
Series which can be described by a continuous variable are called continuous series.
Series represented by a discrete variable are called discrete series.


DATA
Qualitative
Descriptive information or labels
Quantitative
Numerical value information
Discrete
Counted
Continuous
Measured

Discrete and Continuous Data

There are two types of Quantitative Data:

1. Discrete (in whole numbers)

Exp: Number of Questions in Exam 5, 7, 14 Number of cars,
Number of students 3000

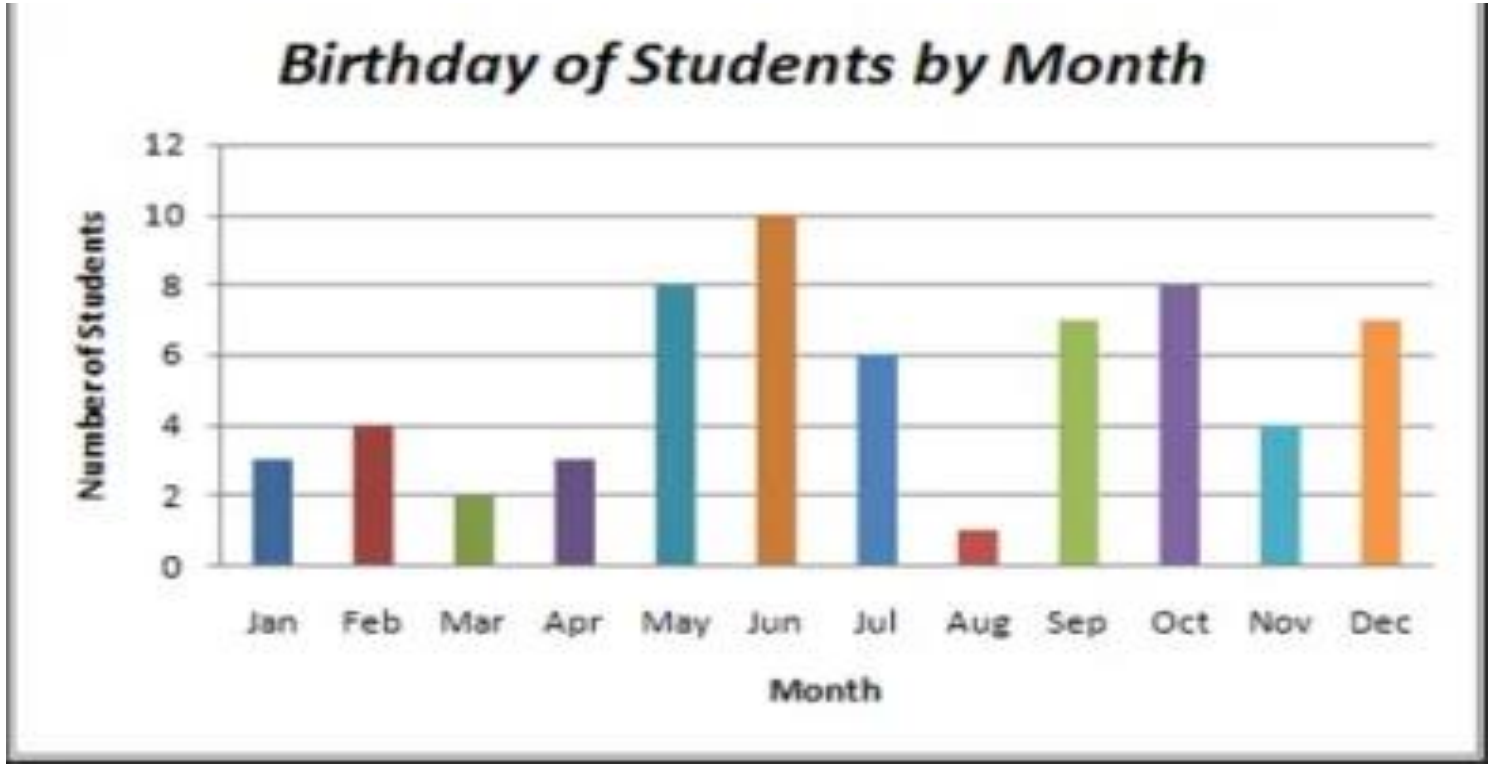
2. Continuous (in decimal points)

Exp: Temperature of Karachi on Sunday 26.5 degrees
Your Height 5.3”
Your Weight 120.5 lbs Shoe size 7.5

Discrete and Continuous Data

Discrete data usually occurs in a case where there are only a certain number of values, or when we are counting something (using whole numbers).

Continuous data makes up the rest of numerical data. This is a type of data that is usually associated with some sort of physical measurement (like feet/inches/kilogram).


Birthday of Students by Month
Number of Students
0
2
4
6
8
10
12
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

Quantitative Data

Quantitative data is a numerical measurement expressed in terms of numbers.

For example:

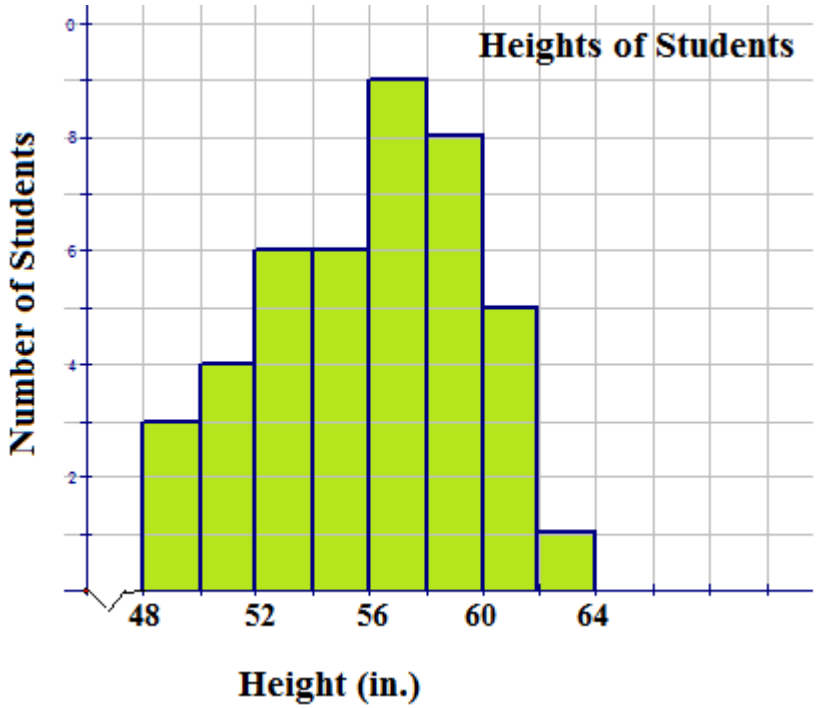
Temperature= “26 degrees"

Height = "1.8 meters"

Length = “2.5 feet”

Age = “9 years”

Note: Quantitative data always are associated with a scale measure (degree/feet/years).



Primary and Secondary Data

No. of Children	No. of Families
0	10
1	400
2	800
3	700
4	150

Income (in Rs.)	No. of Employees
4000 – 4500	50
4500 – 5000	100
5000 – 5500	150
5500 – 6000	40
6000 - 6500	30

Elements **Frequency** **Class intervals.**

Example

The number of washing machines sold on 18 working days by a leading agency house 23,30,20,26,30,30,23,20,30,23,26,28,40,23,20,26,40,40.

No. of Washing Machines	Frequency (No. of days)
20	3
23	4
26	3
28	1
30	4
40	3

In order to make the series more compact so that its characteristics can be easily studied, data may be classified according to class intervals.

Classification according to class-Intervals

Class Limits

Class limits are the lowest and the highest values that can be included in the class. For example take The class 5000 – 6000.The lowest value of the class is 5000 and the highest 6000.The two boundaries of class are known as the lowest limit and upper limit of the class.

Income (Rs.)	No. of Employees
5000 – 6000	50
6000 – 7000	100
7000 – 8000	150
8000 – 9000	40
9000 - 10000	30

Classification according to class-Intervals

Class Frequency

The number of observations corresponding to the particular class is known as the frequency of that class or the class frequency

Income (Rs.)	No. of Employees
5000 – 6000	50
6000 – 7000	100
7000 – 8000	150
8000 – 9000	40
9000 - 10000	30

Classification according to class-Intervals

Class Mid Point

It is the value line halfway between the lower and upper class limits of a class interval

Income (Rs.)	No. of Employees
5000 – 6000	50
6000 – 7000	100
7000 – 8000	150
8000 – 9000	40
9000 - 10000	30

Classification according to class-Intervals

There are two methods of classifying the data according to class intervals

Exclusive Method
Inclusive Method

Exclusive Method

When the class intervals are so fixed that the upper limit of one class is the lower limit of the next class, It is known as the Exclusive method of classification. It is clear that the Exclusive method and ensures Continuity of data in as much as the upper limit of one class is the lower limit of the next class.

Income (Rs.)	No. of Employees
5000 – 6000	50
6000 – 7000	100
7000 – 8000	150
8000 – 9000	40
9000 - 10000	30

Inclusive Method

Under the inclusive method of classification the upper limit of one class is included in That class itself.

Income (Rs.)	No. of Employees
5000 – 5999	50
6000 – 6999	100
7000 – 7999	150
8000 – 8999	40
9000 - 9999	30

PRINCIPLES OF CLASSIFICATION

1

The number of classes should preferably be between 5 and 15.However there in no rigidity about it. The classes can be more than 15 depending upon the total number of observations in the data and The details required but they should not be less than 5 because in that case that classification may Not wile reveal the essential characteristics.

2

As possible one should avoid odd values of class intervals e.g. 3, 7, 11,26,39 etc. .
Preferably one should have class intervals of multiples of 5 like 10,20,25,100, etc. .
However where the data necessitate a class-interval of less than 5 it can be any value between 1 and 4.

3

The starting point that the lower limit of the first class, should either be 0 or 5 or multiple of 5.

4

To ensure continuity and to get correct class interval we should adopt an exclusive method of classification However where an inclusive method has been adopted it is necessary to make an adjust Determine the correct class interval and to have continuity.

Inclusive method

Income (Rs.)	No. of Employees
5000 – 5999	50
6000 – 6999	100
7000 – 7999	150
8000 – 8999	40
9000 - 9999	30

Exclusive method

Income (Rs.)	No. of Employees
4999.5 – 5999.5	50
5999.5 – 6999.5	100
6999.5 – 7999.5	150
7999.5 – 8999.5	40
8999.5 – 9999.5	30

5

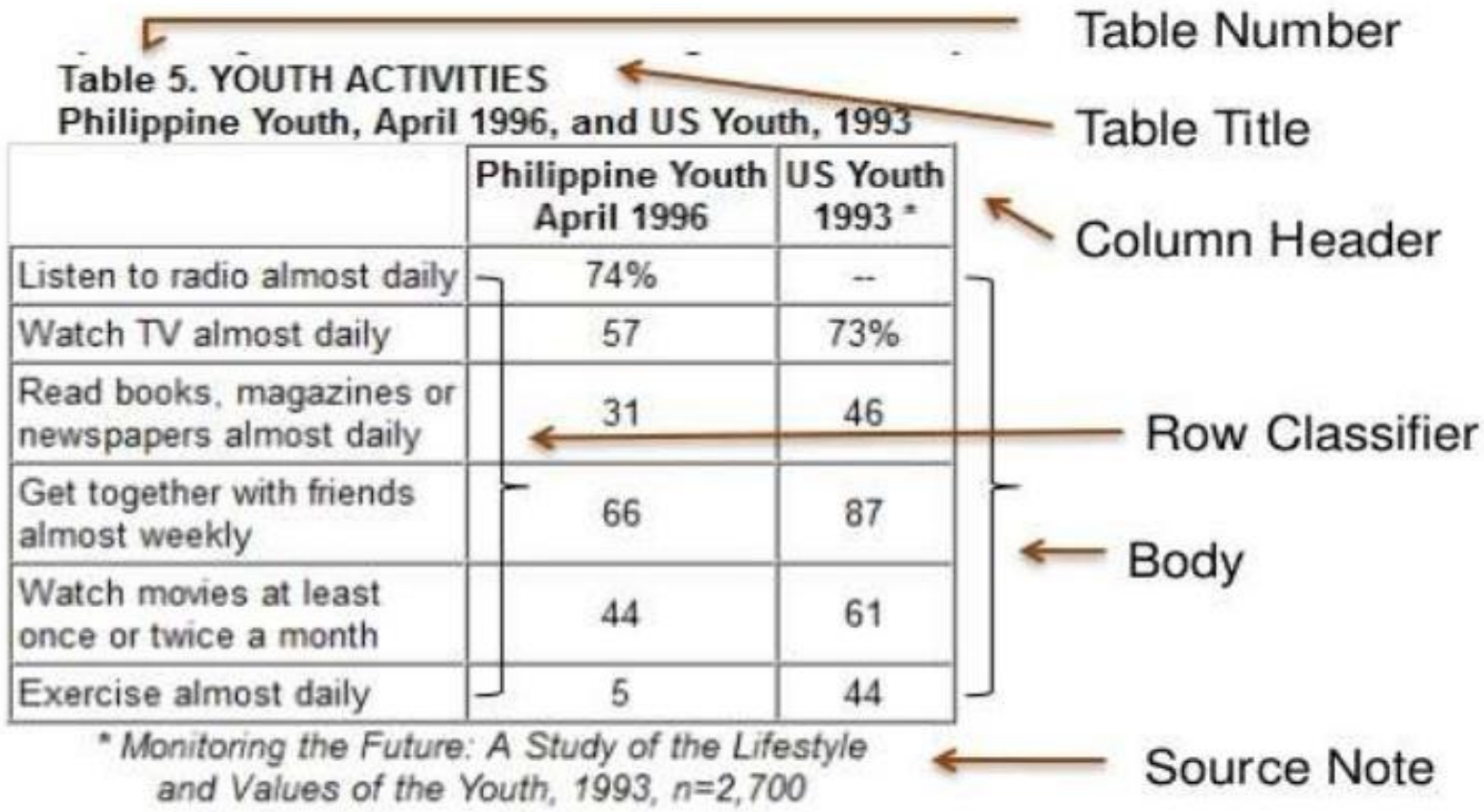
If intervals are not of uniform width. It is difficult to make meaningful comparison between classes.

Tabulation of Data

One of the simplest and most revealing devices for summarizing data is the statistical table. A table is a systematic arrangement of statistical data in columns and rows. Rows are Horizontal arrangements, whereas columns are vertical ones. The purpose of a table is to simplify The presentation and to facilitate comparisons.

Tabular Presentation of Data

Below is a sample of a table with all of its parts indicated:



	Philippine Youth April 1996	US Youth 1993 *
Listen to radio almost daily	74%	--
Watch TV almost daily	57	73%
Read books, magazines or newspapers almost daily	31	46
Get together with friends almost weekly	66	87
Watch movies at least once or twice a month	44	61
Exercise almost daily	5	44

** Monitoring the Future: A Study of the Lifestyle and Values of the Youth, 1993, n=2,700*

Types of Tables

Simple And Complex Table
General Purpose Table And Special Purpose Table

Simple Table

In a simple table only one characteristic is shown. Hence this type of table is also known as one Way table.

Age (in years)	No. of Employees
Below 25	60
25 – 35	65
35 – 45	63
45 - 55	24
55 and above	8

Complex Table

In a complex table two or more characteristics such tables are more popular in practice because they enable full information to be incorporated a facilitate proper consideration of all related facts. When two characteristics are shown a table is known as a two way table or double tabulation.

Age (in years)	Males	Females	Total
Below 25	32	18	50
25 – 35	40	27	67
35 – 45	25	18	43
45 - 55	10	5	15
55 and above	5	0	5

Higher Order Table

When three or more characteristics are represent the same table such a table is called Higher order table. The need for such a table arises when we are interested in presenting a Number of characteristics simultaneously.

Note

It should be remembered that as the number of characteristics represented increases the table becomes more and more confusing and as such normally not more than four(04) characteristics represented in the same table.

General purpose table

General Purpose tables, also known as the reference tables or repository tables, provide Information for general use or reference.
They usually contain detailed information and are not constructed for specific discussion
For Example:
Table Published by government agencies.
Table railway.

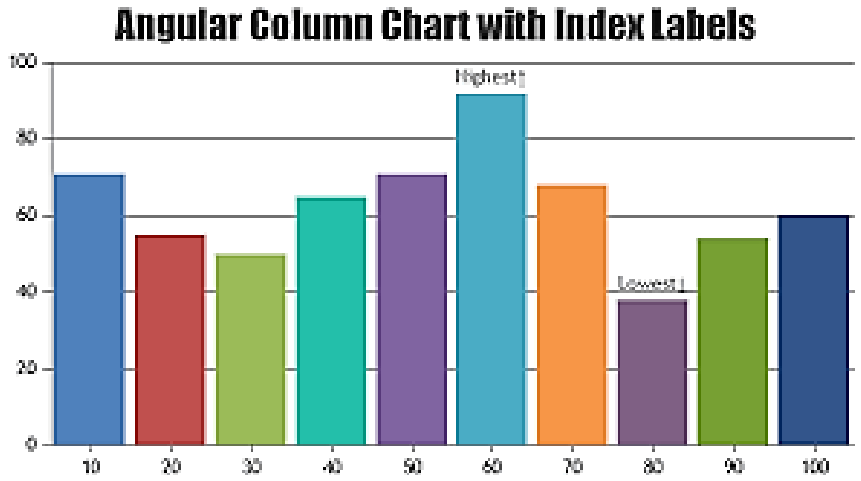
Special purpose table

Special purpose tables, also known as summary or analytical tables, provide information for particular discussion. They show relationship between different groups of figure. These tables are also derivative tables since they are often derived from general table.

The large detailed tables in the census record of the government of Pakistan are general purpose tables. when such data are used, they are ordinarily taken from the general purpose table and presented as special purpose tables which emphasis the relation the user wishes to stress.

Charting Data

One of the most convincing and appealing ways in which data may be presented is through charts. A pictorial presentation helps in quick understanding of the data. As the number and magnitude of figure increases they become more confusing. Through pictorial presentation data can be presented in an interesting form. Not only This, chart have greater memorizing effect as the impressions created by them last much longer than those created by the figures.



employment sector	18-25 age group	25-40 age group	40-65 age group
agriculture	5	7	9
manufacturing	12	15	23
catering	6	8	4
local government	8	12	16
health	12	15	12
retail	23	7	6
law	4	4	4
accountancy	3	2	3
education	9	12	12
other	21	18	9

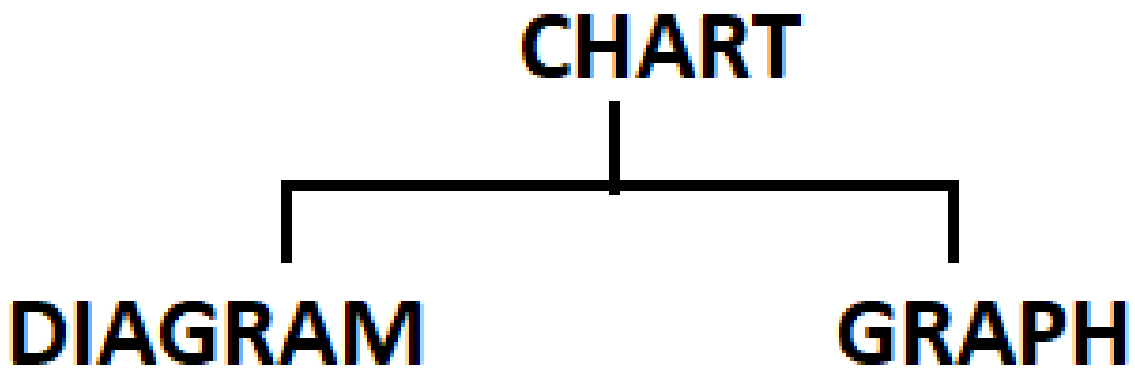


CHART
DIAGRAM
GRAPH

Diagram

General Rules For Constructing Diagrams

Title

Every diagram must be given a suitable title. The title may be given either at the top of the diagram or below it.

Proportion between width and height

A proportion between the height and width of the diagram should be maintained. If Either the height or width is too short or too long in proportion the diagram would give a Ugly look. While there are no fixed rules about the dimensions.

Selection Of Appropriate Scale

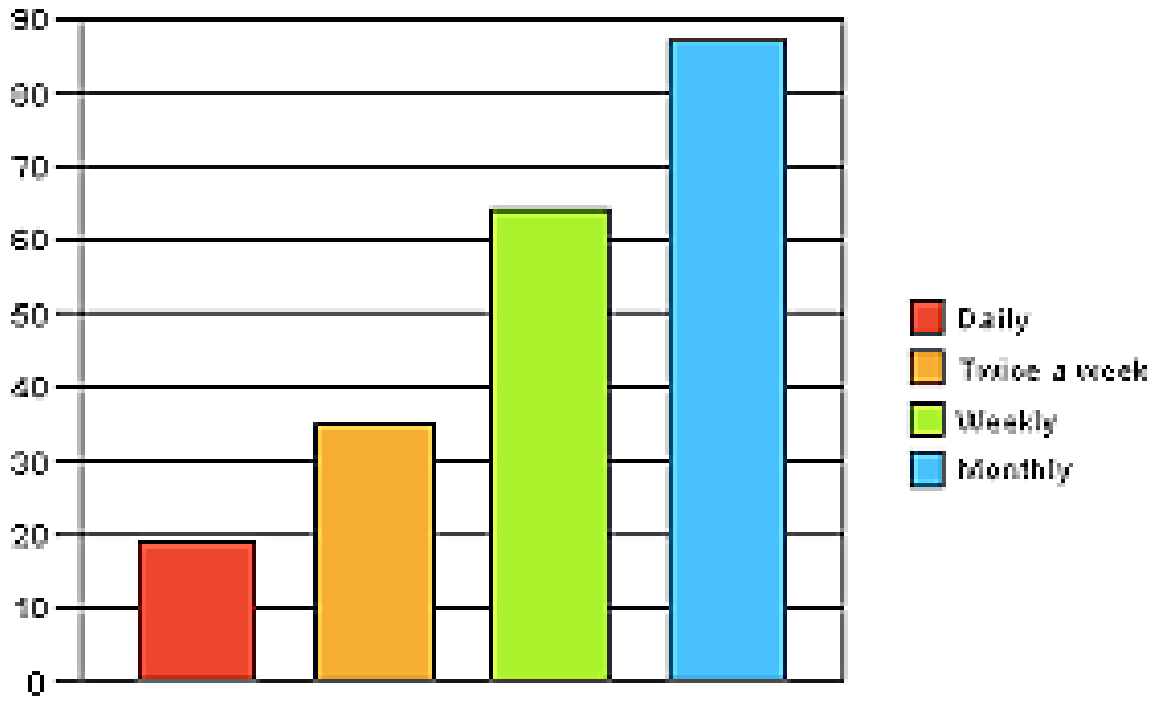
The scale showing the values should be in even numbers or in multiples of 5 or 10 for example 25,50,75 odd values like 1,3,5,7 should be avoided.

Footnotes

An order to clarify certain points about the diagram, footnotes may be given in the bottom of the diagram.

Index

An index illustrating different types of lines or different shades colors should be given so that the reader can easily make out the meaning of the diagram.


90
80
70
60
50
40
30
20
10
0
Daily
Twice a week
Weekly
Monthly

Neatness and cleanliness

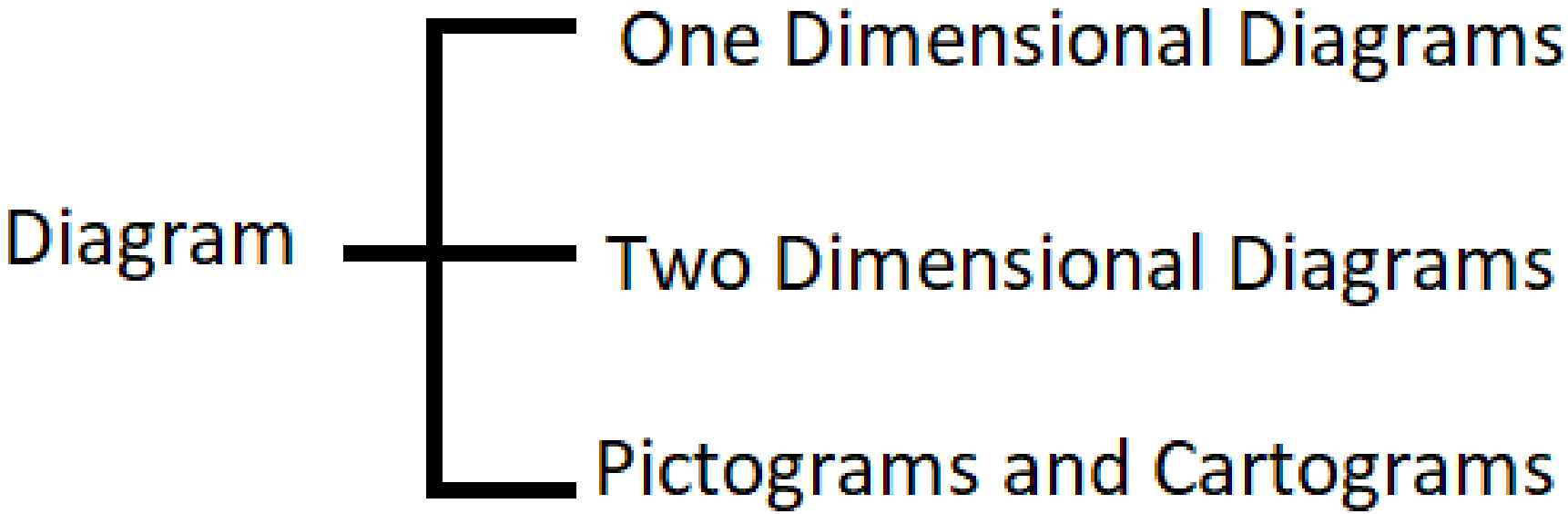
Diagrams should be absolutely neat and clean.

Simplicity

Diagrams should be as simple as possible so that the reader can understand their meaning clearly.

For the sake of simplicity it is important that too much material should not be loaded in a single diagram otherwise it may become to confusing.

Types of Diagrams

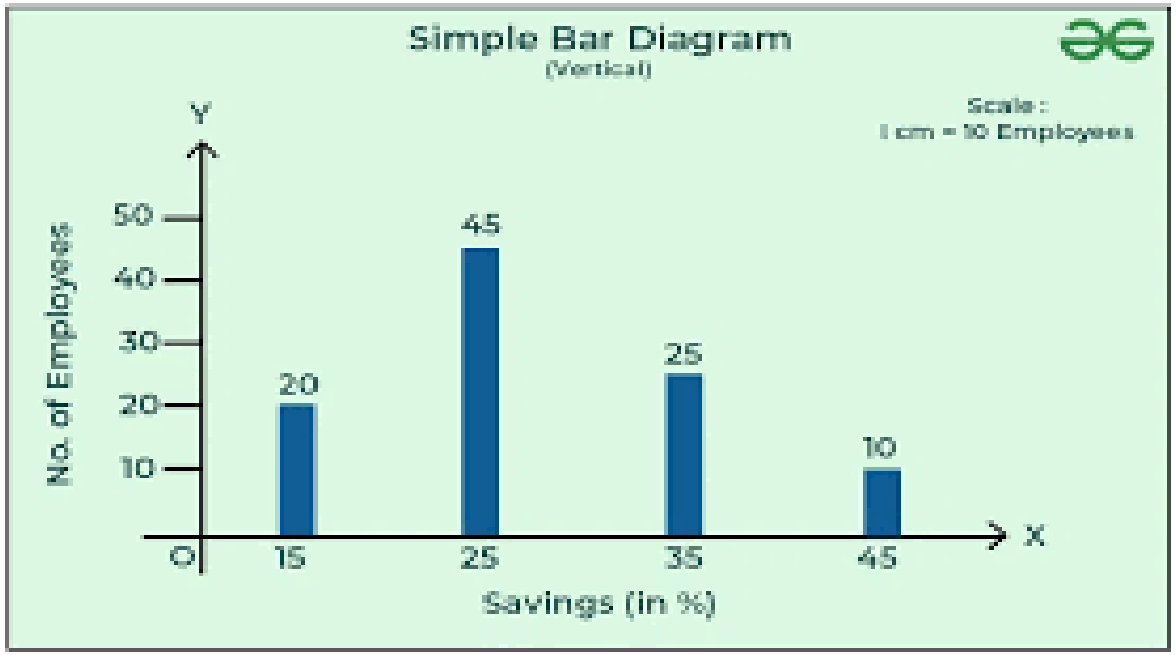


One Dimensional Diagrams (Bar Diagrams)

Bar diagrams are the most common type of diagrams used in practice. A bar is a thick line whose Width is shown merely for attention. They are called one dimensional because it is only the length Of the bar that matters and not the large lies may be drawn instead of bars to economies space.

Merits

- **They are easily understood.**
- **They our simplest and easiest to make.**
- **When a large number of observations are to be compared, they are the only form that can be used effectively.**



Construction of Bar Diagrams

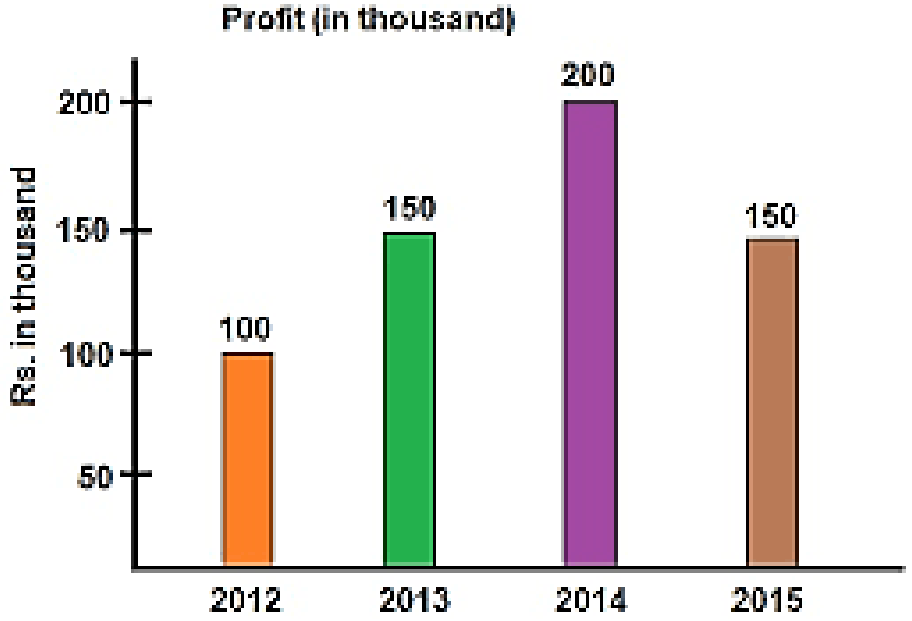
- **The width should be uniform throughout the diagram.**
- **The gap between one bar another should be uniform throughout.**
- **Bars may be either horizontal or vertical. The vertical bar should be preferred because they give a better look and also facilitate comparison.**
- **While constructing the bar diagrams, it is desirable to write the respective figure at the end of each bar so that the reader can know the precise value without looking at the scale.**

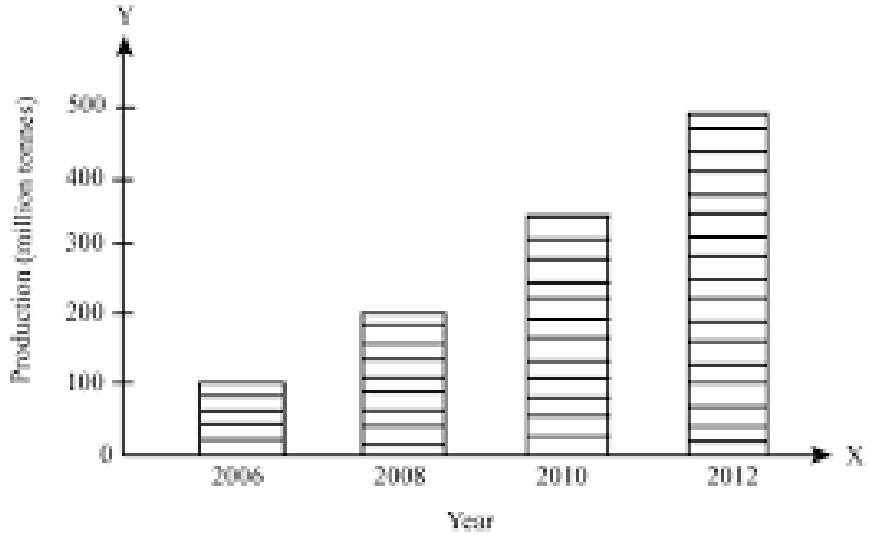
Types of Bar Diagrams

- Simple bar diagram
- Subdivided bar diagram
- Multiple bar diagram
- Percentage bar diagram
- Deviation bars diagram
- Broken bars diagram

Simple bar diagram

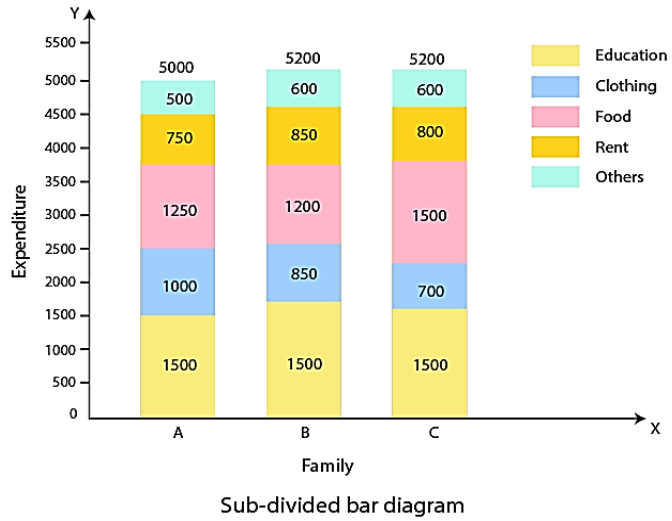
Diagram is used to represent only one variable. For example the figures of sales, production, Population etc. for various years may be shown by means of a simple bar diagram. Since the bars Are of same width and only the length varies, it becomes very easy for the reader to study the relationship.



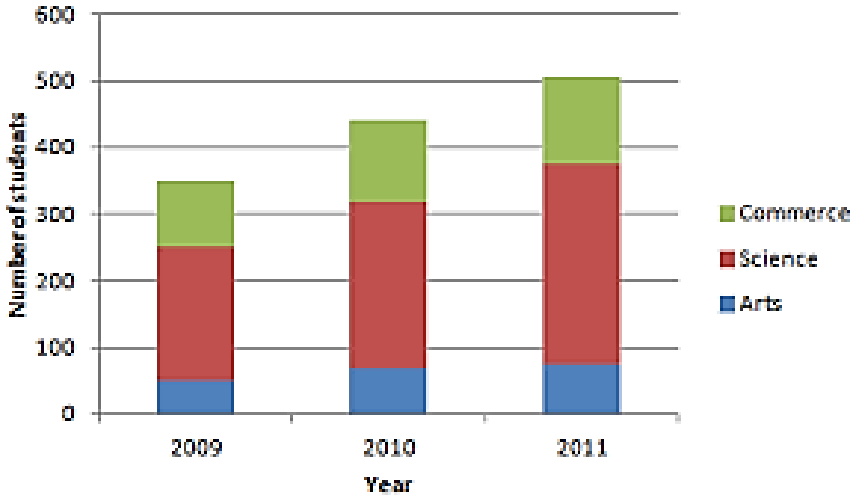


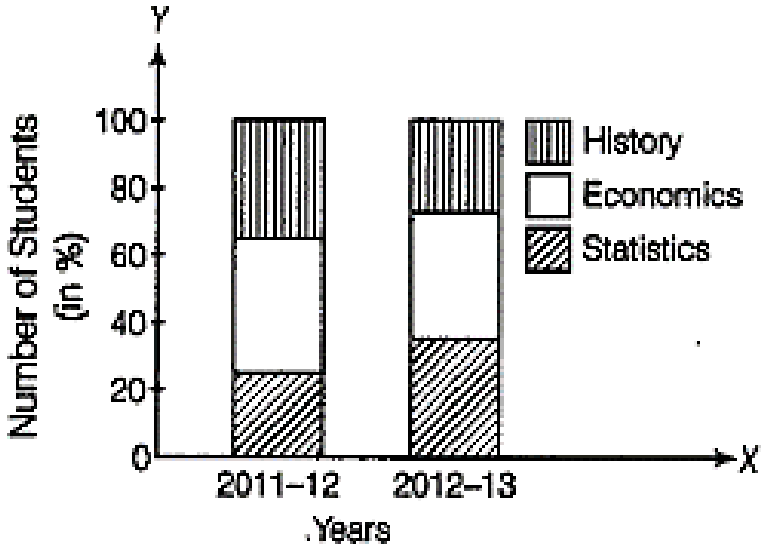
Subdivided bar diagram

These diagrams are used to represent various parts of the total. While constructing such a diagram The various components in each bar should be kept in the same order. To distinguish between the different shades or colors. Index or key should be given explaining these differences. The subdivided bar diagram can be vertical as well as horizontal.



Sub-divided bar diagram





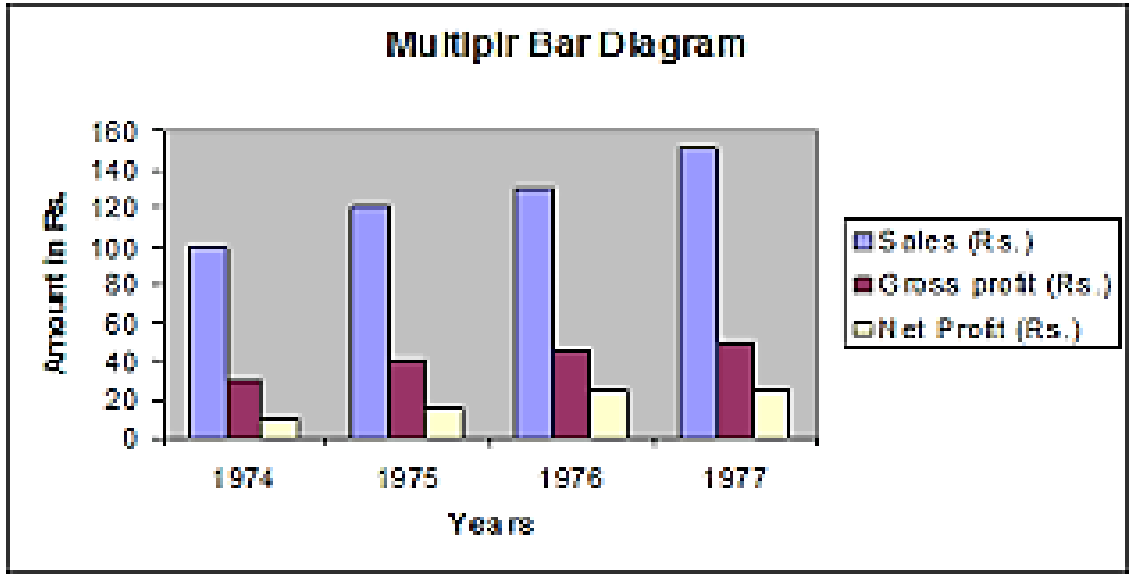
Subdivided bar diagram

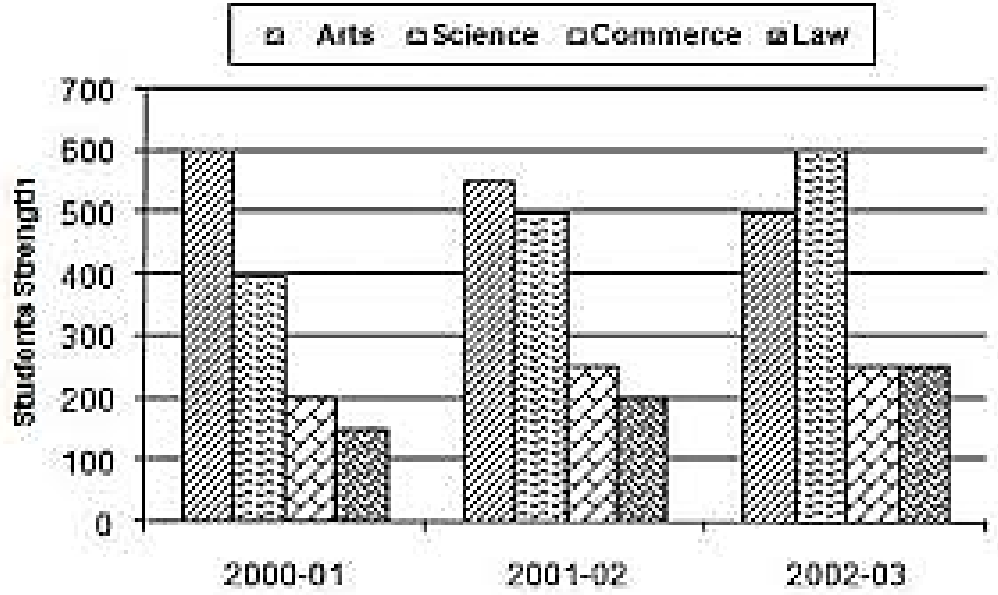
Note:

Subdivided bar diagram should not be used where the number of component more than 10 or , 12,for in that case the diagram would be overloaded with information which cannot be easily compared and understood.

Multiple bar diagram

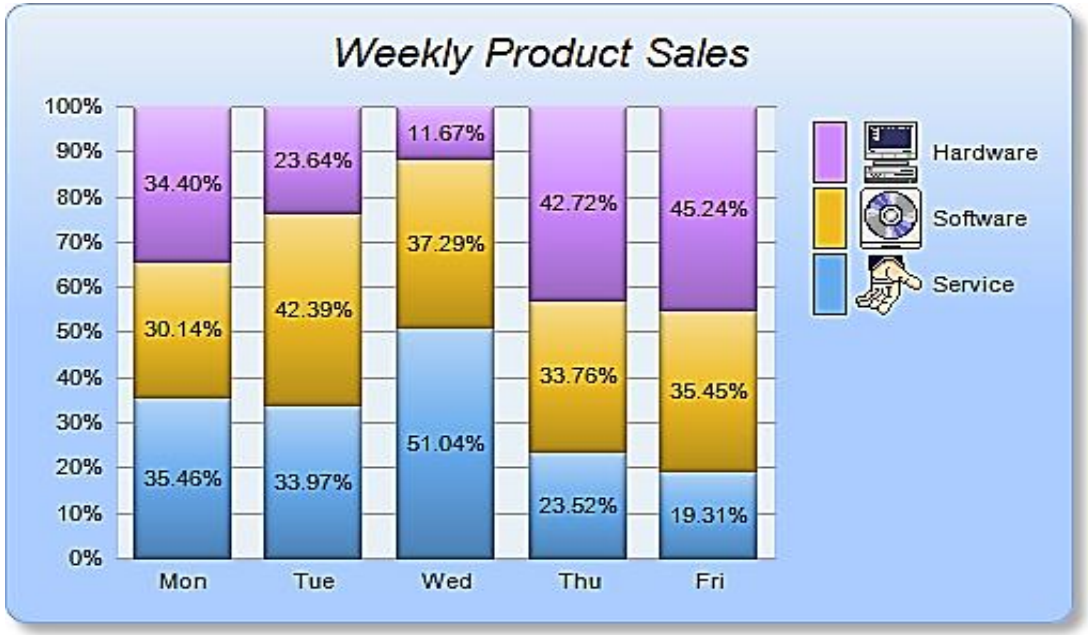
In multiple bar diagrams two or more sets of interrelated data are represented.
The technique of drawing such a diagram is the same as that of simple bar diagram.
Only difference is that since more than one phenomenon is represented, different shades, colors,
Dots or crossings are used to distinguish between the bars.





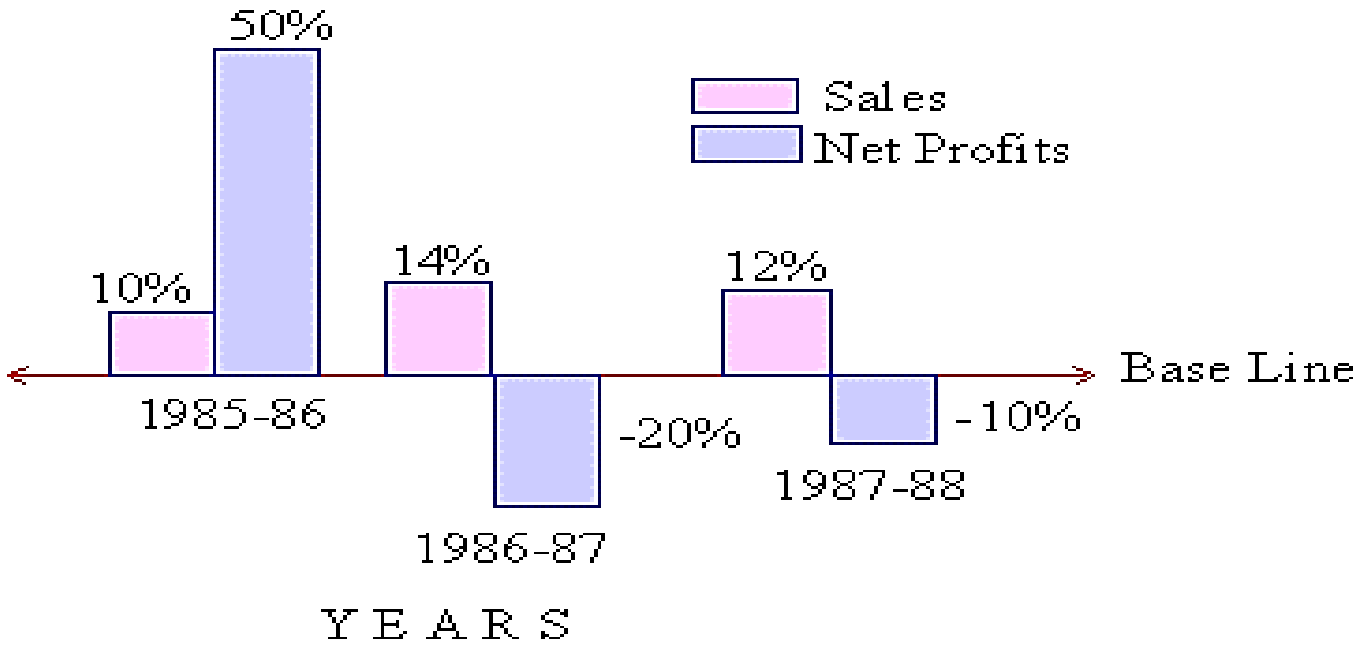
Percentage bar diagram

Percentage bar diagrams are particularly useful in statistical work which requires the portrayal of Relative changes in data. When such diagrams are prepared, the length of the bars is kept equal to 100 and segments are cut in these bars to represent the components of an aggregate.



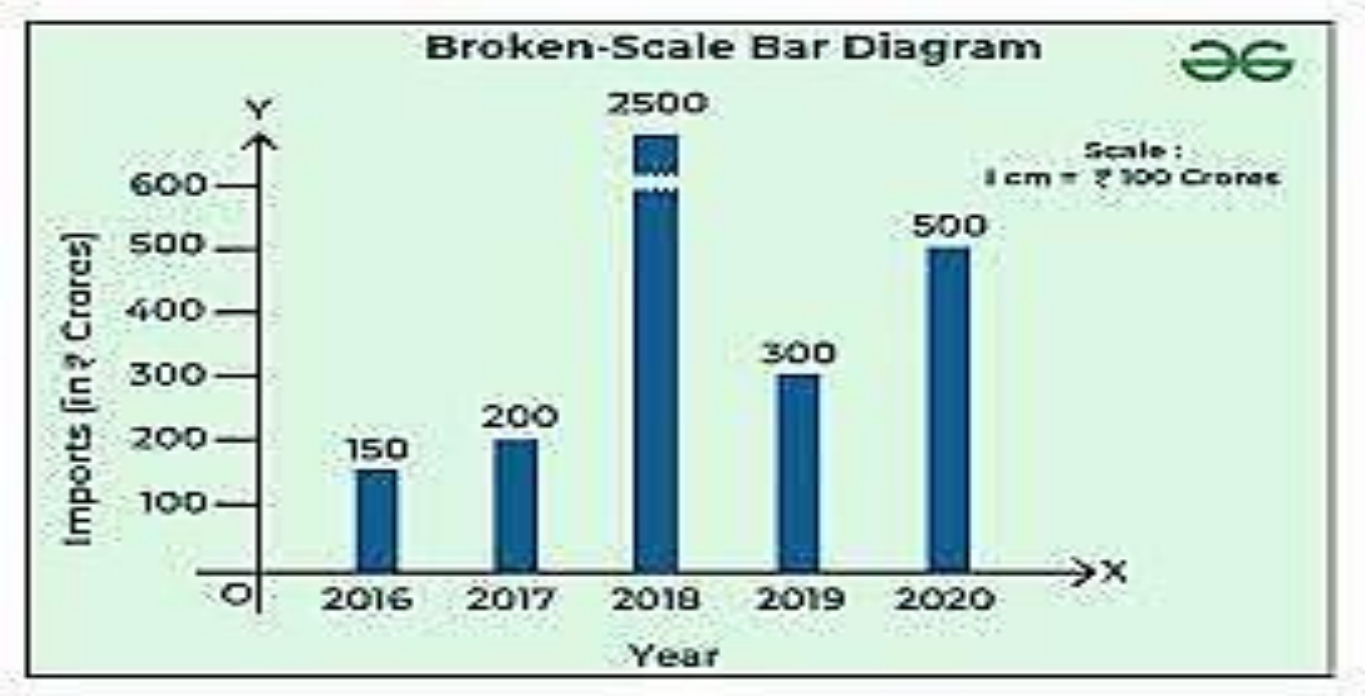
Deviation bars diagram

Deviation bars are popularly used for representing net quantities that are not net profit, net loss, Net exports or imports etc. Such bars can have both positive and negative values. Positive values are shown above the baseline and negative values below it.



Broken bars diagram

In certain type of data there may be wide variation in values some values may be very small Other very large. In order to gain space for the smaller bars of the data the large bars may be broken.

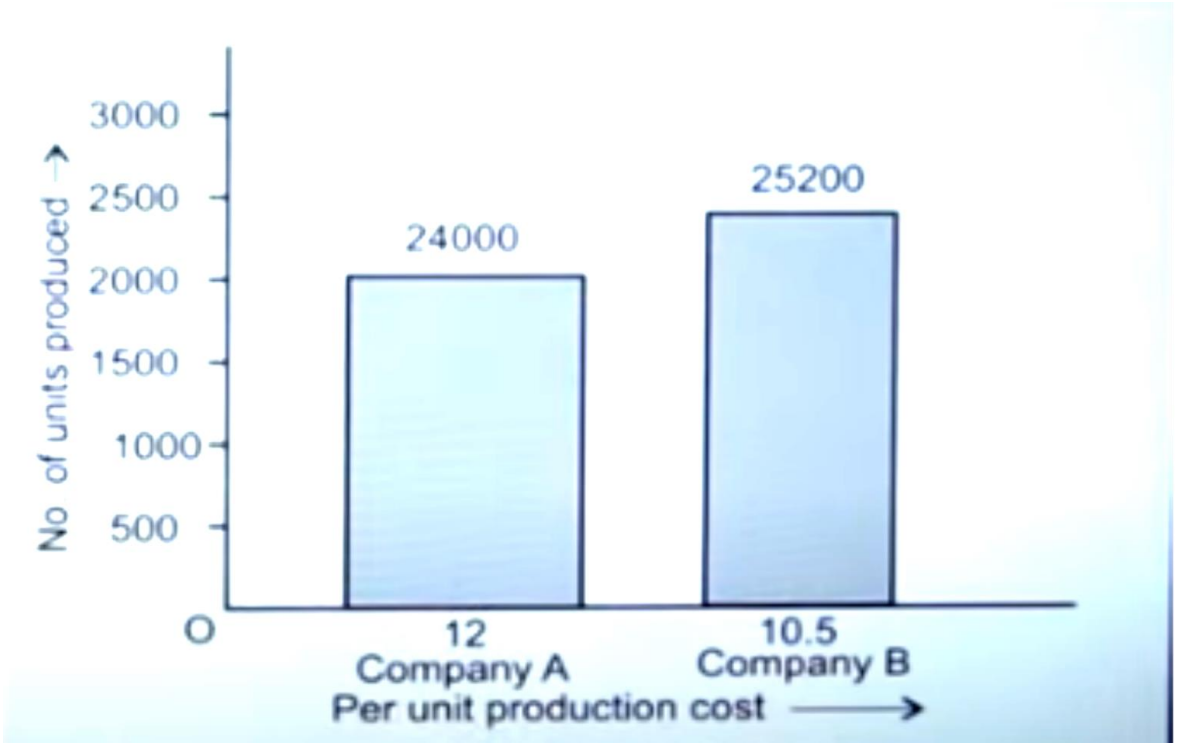


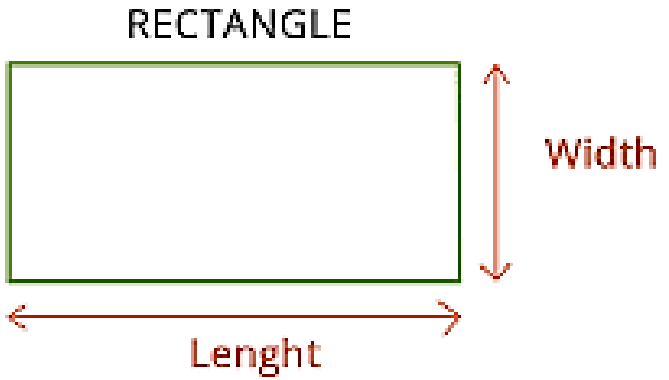
Two Dimensional Diagrams

In two dimensional diagrams the length as well as the width of the bars is considered. Thus the area Of the bar represents the given data. The two dimensional diagrams are also known as surface diagrams or area diagrams. The important type of such diagrams are

- Rectangles
- Squares
- Circles

Rectangles





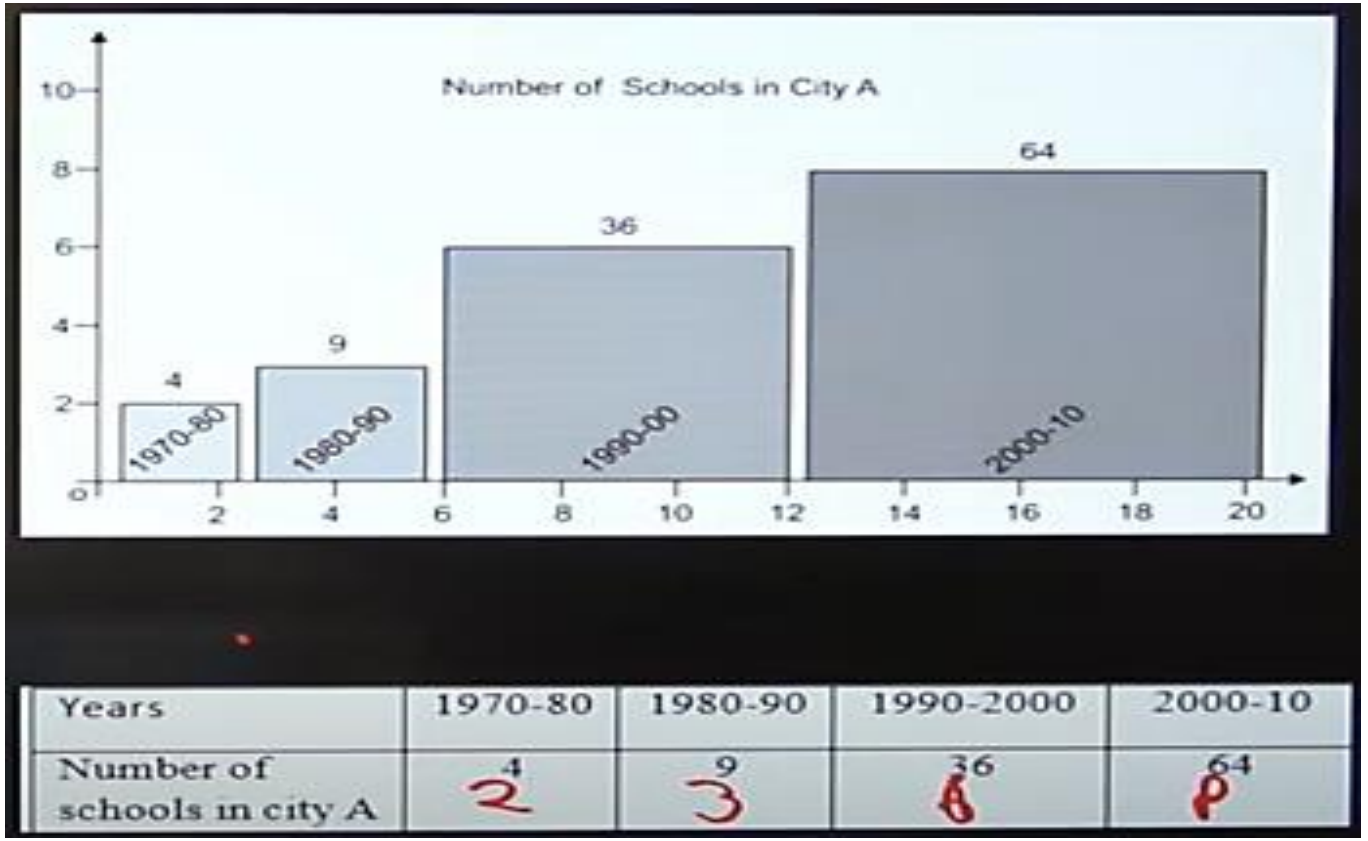
Area of rectangle = length x width

Squares

The rectangular method of diagrammatic presentation is difficult to use where the values of items vary widely. For example if the ratio of width is weird the diagram would look very ubwieldy.It is in Order to overcome the difficulty that squares are used.

Method of drawing a square diagram is very simple. One has to take the square root of the values Of various items that are to be shown in the diagram and then select a suitable scale to draw the squares.

Squares



Years	1970-80	1980-90	1990-2000	2000-10
Number of schools in city A	2^4	3^9	6^{36}	8^{64}

Square

$A = x^2$

x

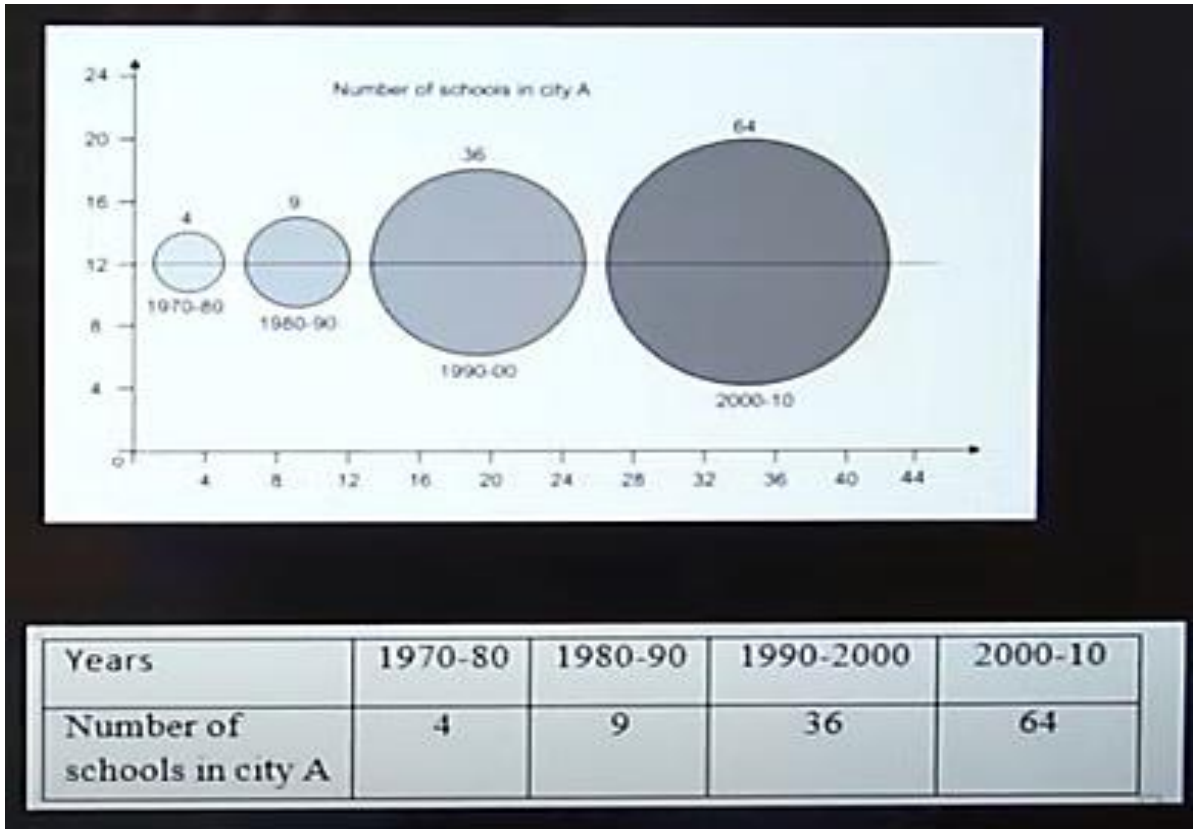
0.2------2.2
2.5-----5.5
5.8-----11.8
12-----20

Circles

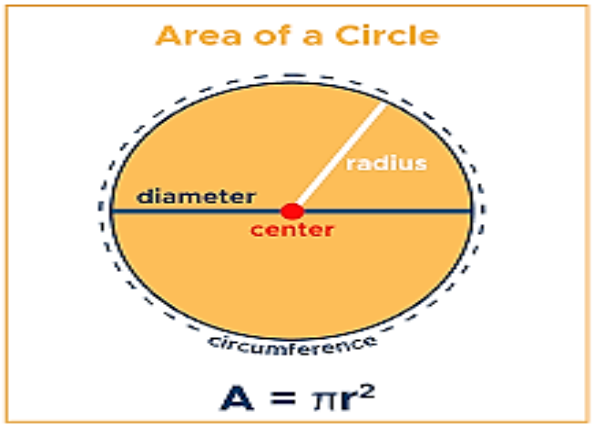
In such diagrams both the total and the components parts of the sector can be shown.
In these diagrams the radius of the circles are proportional to the square roots of the figure.
Circles can be used in all those cases in which squares are used.

Circles are difficult to compare and as such they are not very popular in statistical work. When it is Necessary to use circles they should be compared on a area basis rather than on a diameters.
Compared to the rectangles circles are more difficult to construct and interpret.

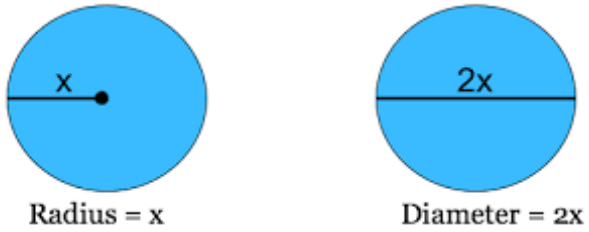
Circles



Years	1970-80	1980-90	1990-2000	2000-10
Number of schools in city A	4	9	36	64



Radius vs Diameter



Pie Diagrams

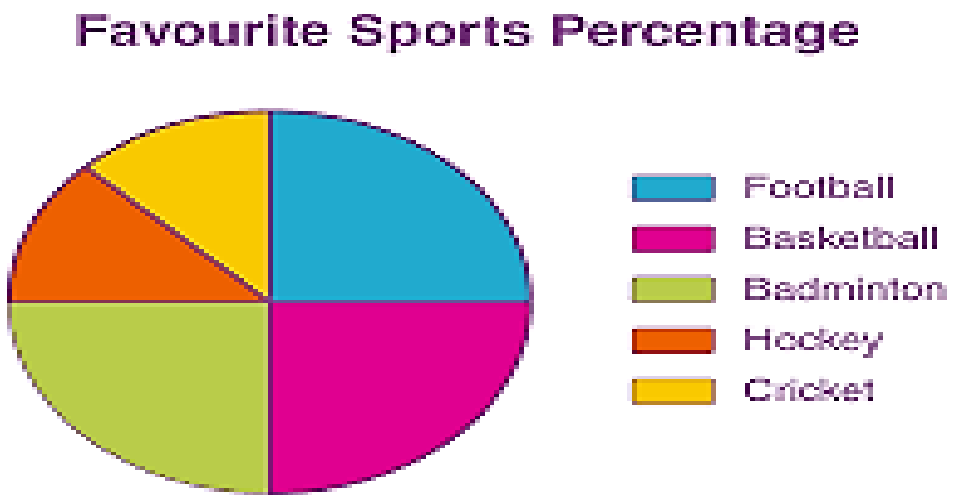
Type of diagram enables us to show the partitioning of a total into component parts. A very common Use of the pie chart is to represent the division of a sum of money into components.

For example the entire pie may represent the budget of a family for a month and the sections may represent the portions of the budget allotted to rent, food, clothing and so on.

The pie chart is so called because the entire graph look like a pie and the components resemble slices Cut from it.

Construction Of Pie Diagram

- Convert Absolute values to percentage values.
- Convert percentage values to Degrees.
- Draw the diagram with the help of a protractor.
- Arrange the sectors according to size, with the largest at the top and others in sequence running clockwise.



Example

A company is started by the four persons A,B,C and D and they distribute the profit or loss between them in proportion of 4:3:2:1. In year 2010 company earned a profit of Rs. 14400.
Represent the shares of their profits in a pie chart/Diagram.

Solution:

Convert Ratio to Absolute values

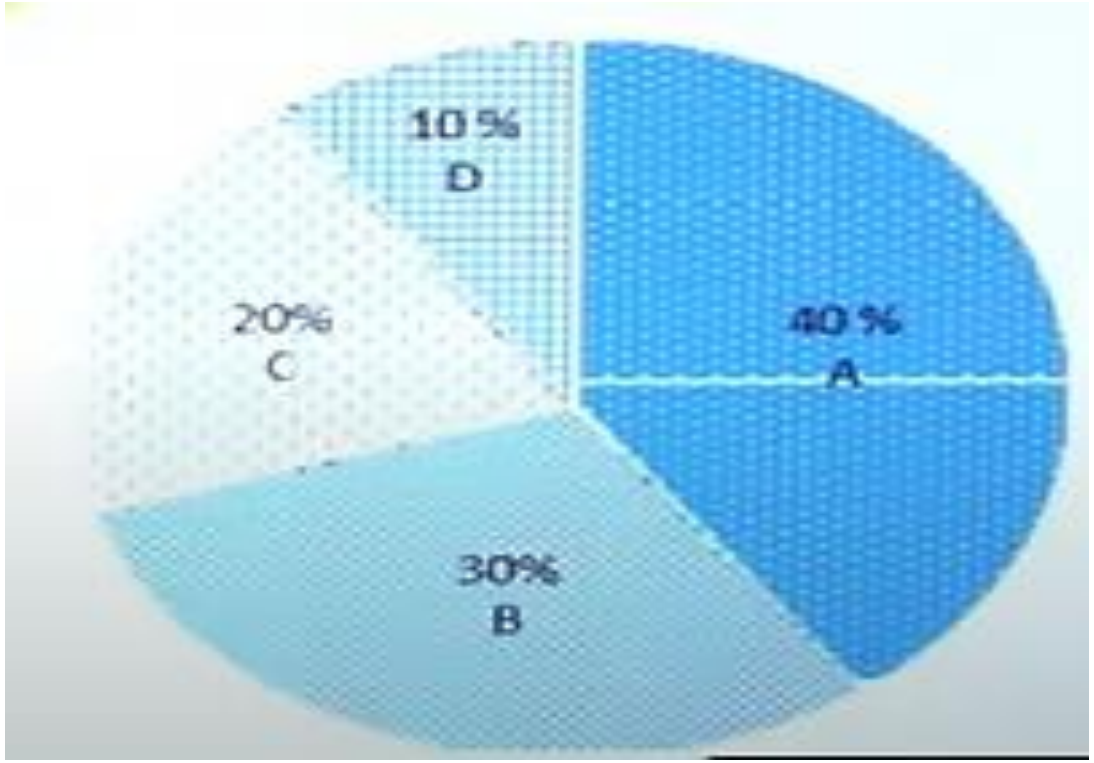
A=4/10 *14400=5760
B=3/10 *14400=4320
C=2/10 *14400=2880
D=1/10 *14400=1440

Convert Absolute to percentage values

5760/14400 *100=40%
4320/14400 *100=30%
2880/14400*100=20%
1440/14400*100=10%

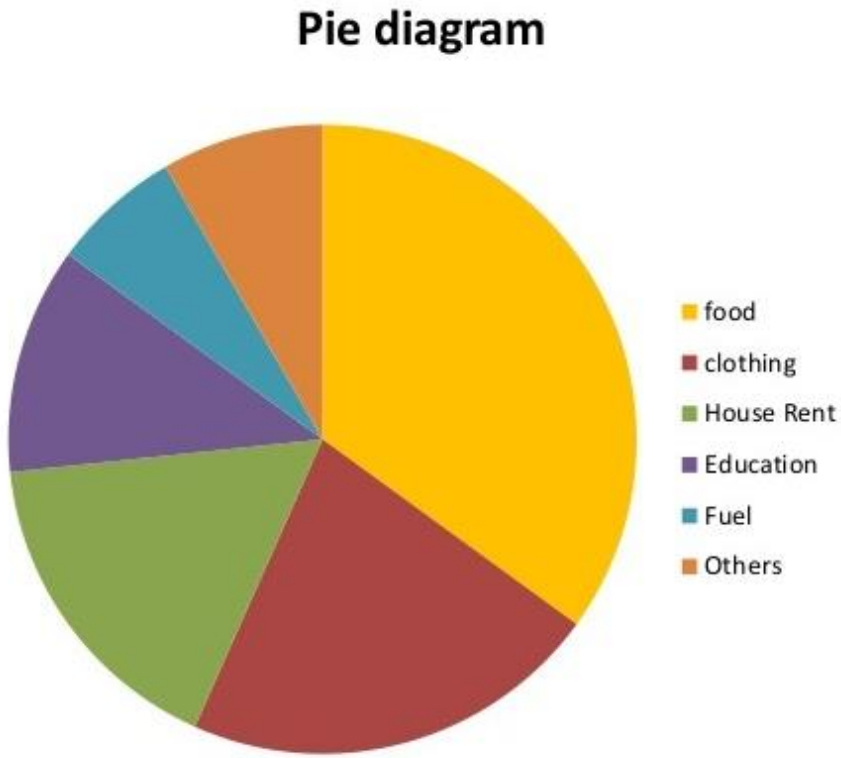
Convert percentage to Degree values

40/100*360=144
30/100*360=108
20/100*360=72
10/100*360=36



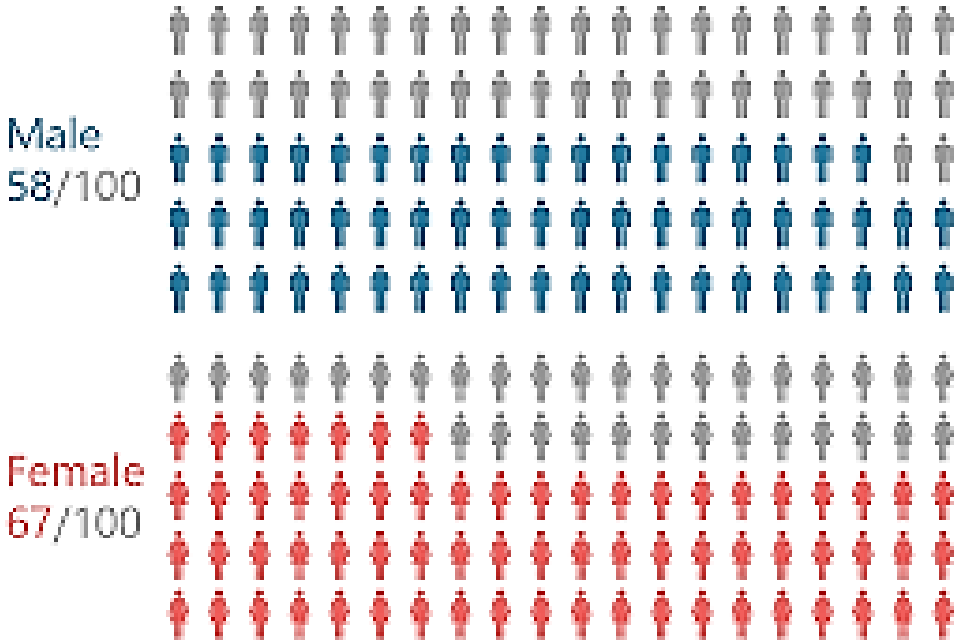
Eg: The following table gives the monthly expenditure of a family. It can be represented by means of a pie diagram.

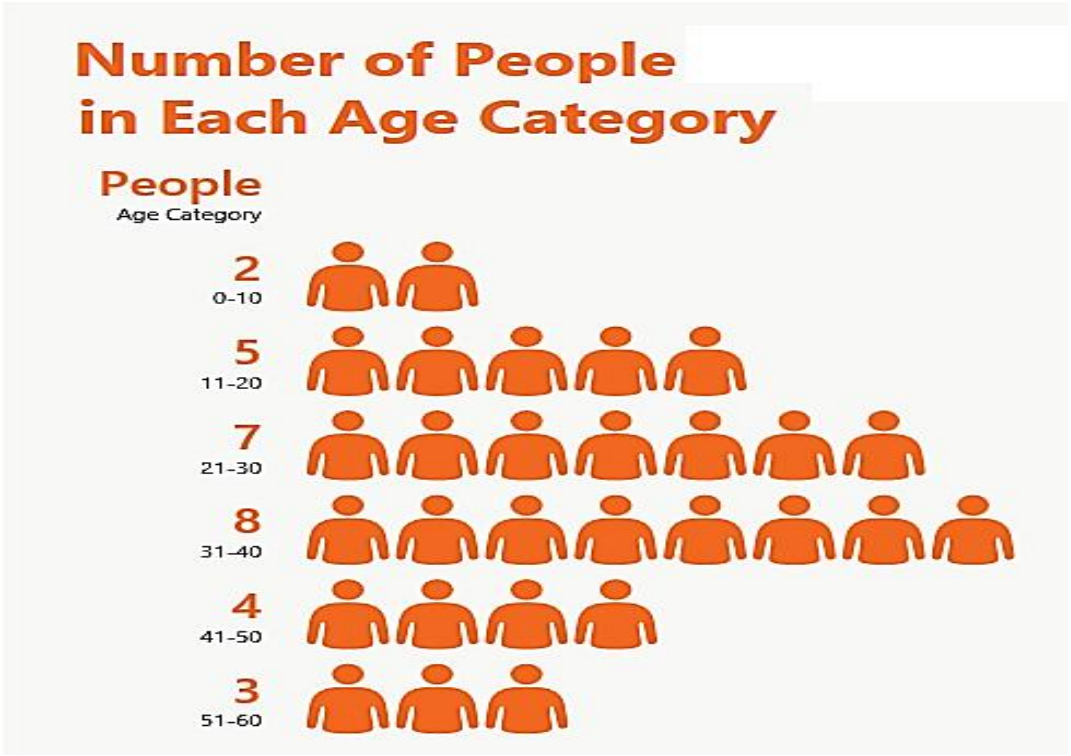
Items	Expenditure (Rs)	Degree measurement
Food	1050	126^0
Clothing	650	78^0
House rent	500	60^0
Education	350	42^0
Fuel	200	24^0
Others	250	30^0



Three Dimensional Diagram
Pictogram Diagrams

Pictogram





Cartograms

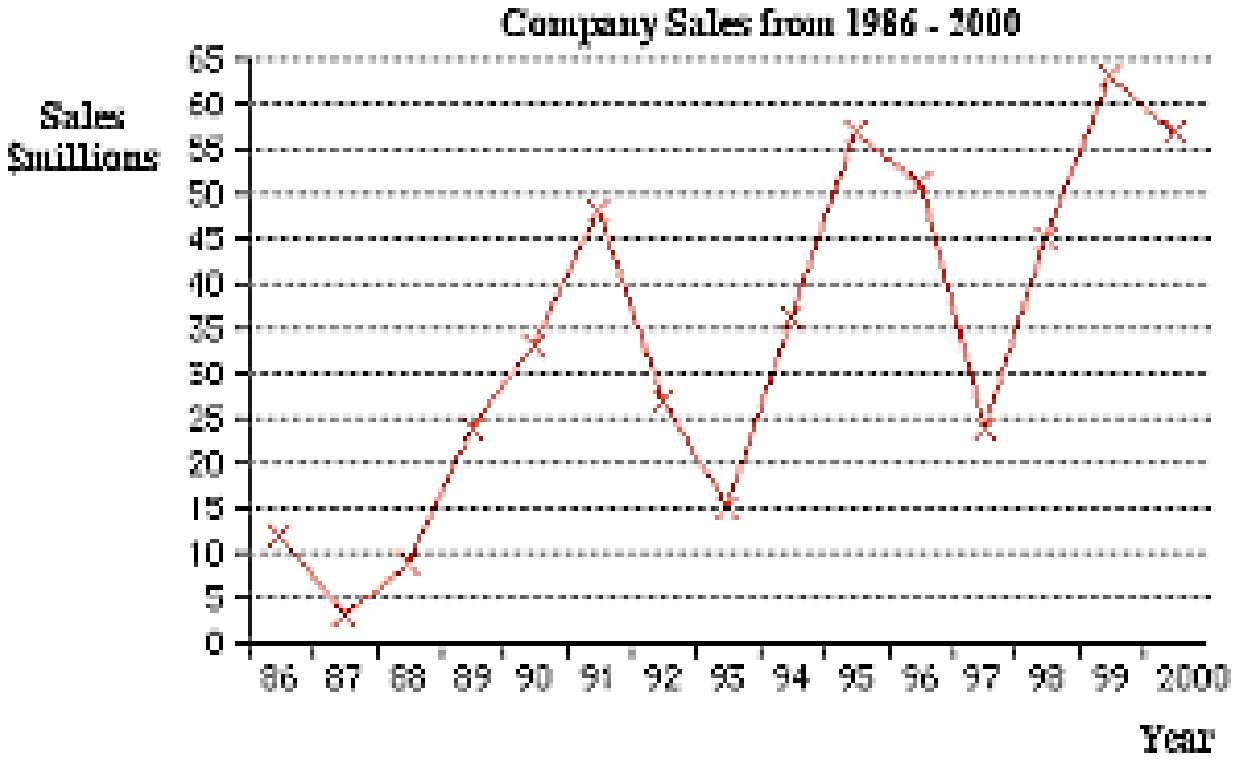
Cartograms or statistical maps are used to give quantitative information on a geographical basis.
The quantities on the map can be shown in many ways such as, through shades of colors, by dots, By placing pictograms in each geographical units and by placing the appropriate numerical figure in each geographical unit.

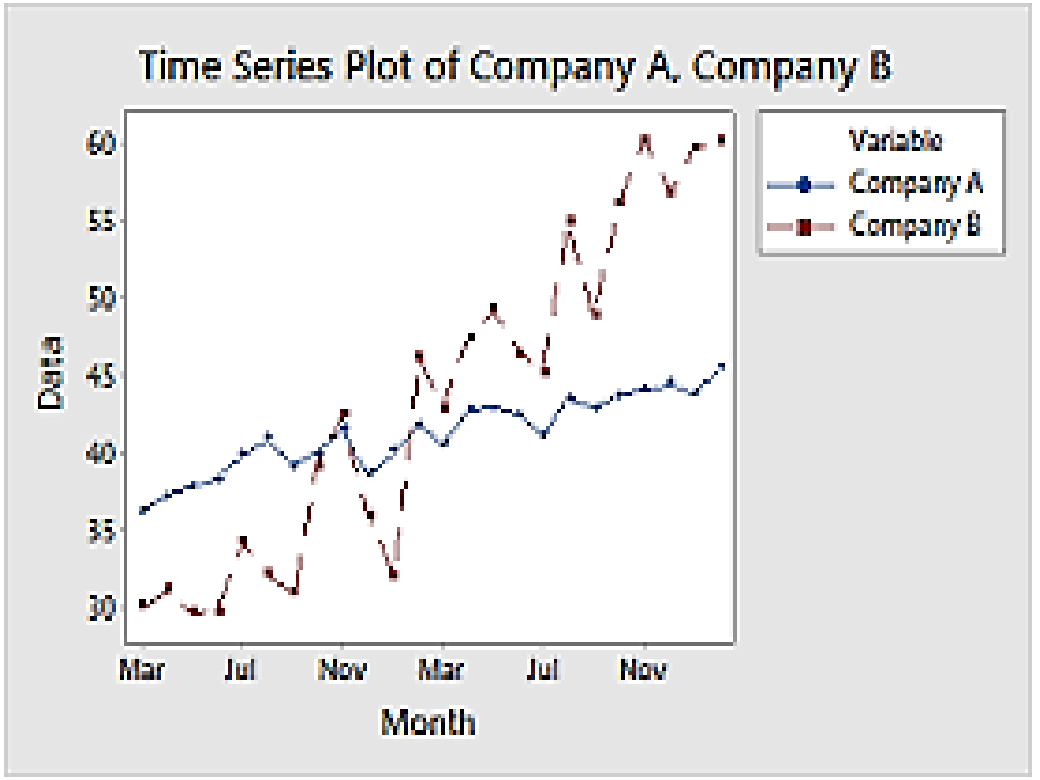
CARTOGRAM

Graphs

- Graphs of time series or line graphs
- Graphs of frequency distributions.

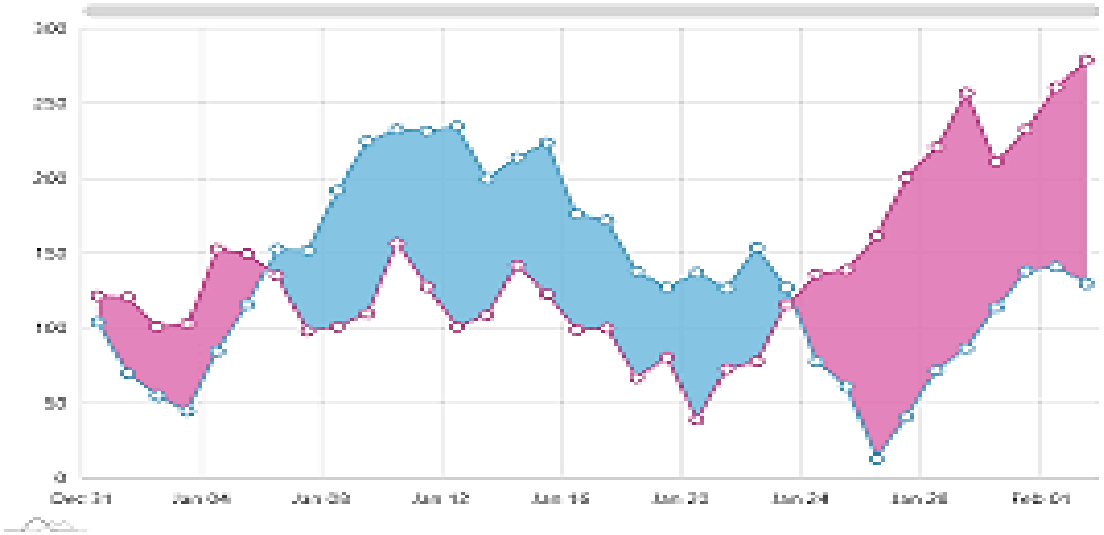
Graphs of time series or line graphs



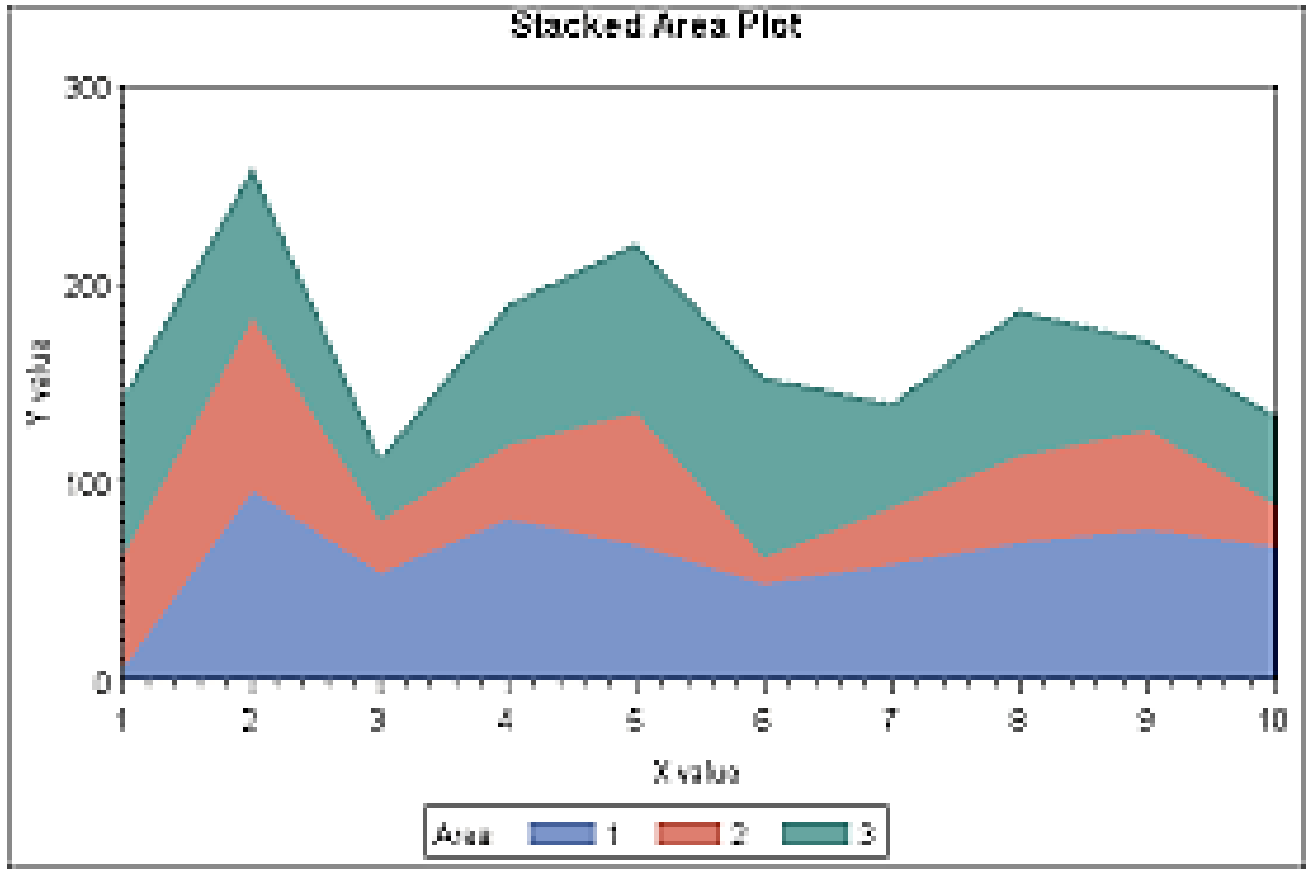


Range Chart

It is a very good method of showing the range of variation that is the minimum and maximum values of a variable. For example if we are interested in showing the minimum and maximum temperature or the minimum and maximum prices of shares of company for different periods, the range chart Would be very appropriate.



Band Graphs


Stacked Area Plot
300
200
100
0
Y value
1
2
3
4
5
6
7
8
9
10
X value
Area
1
2
3

Graphs Of Distribution

- **Histogram**
- **Frequency Polygon**
- **Smoothed Frequency curve**
- **Cumulative frequency curve**

Histogram

The statistical meaning of histogram is that it is a graph that represents the class frequency in frequency distribution by vertical adjacent rectangle. While constructing histogram the variable is always taken on X-axis and the frequency depending on it on the Y-axis.
Each class is then represented by a distance that is proportional to its class interval.
The distance for each rectangle on x-axis shall remain the same in case the class intervals are uniform through out, if they are different the width of the rectangle shall also vary.

Limitations

Histogram cannot be constructed for distributions with open end classes.

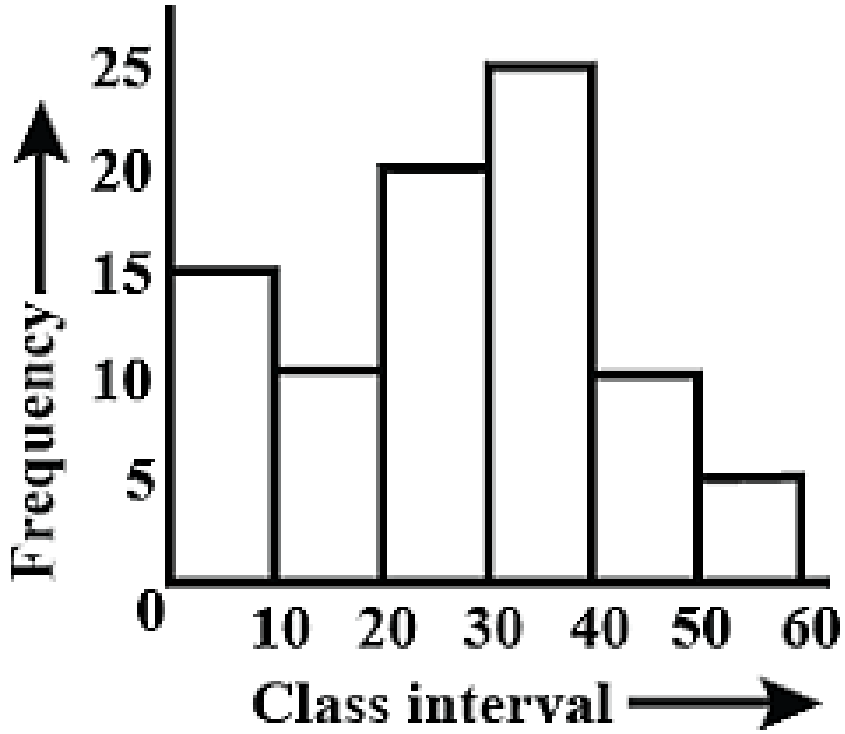
Difference between Bar Diagram and Histograms

Bar diagram is one dimensional that is ,only the length of the bar is important and not the width.

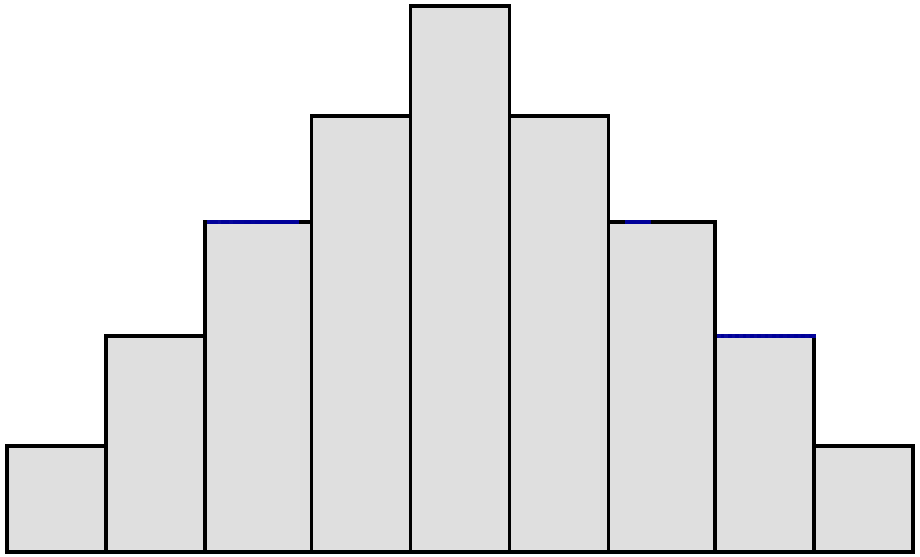
Histogram is two dimensional that is both the length as well as width are important.

Construction of Histogram when class intervals are equal

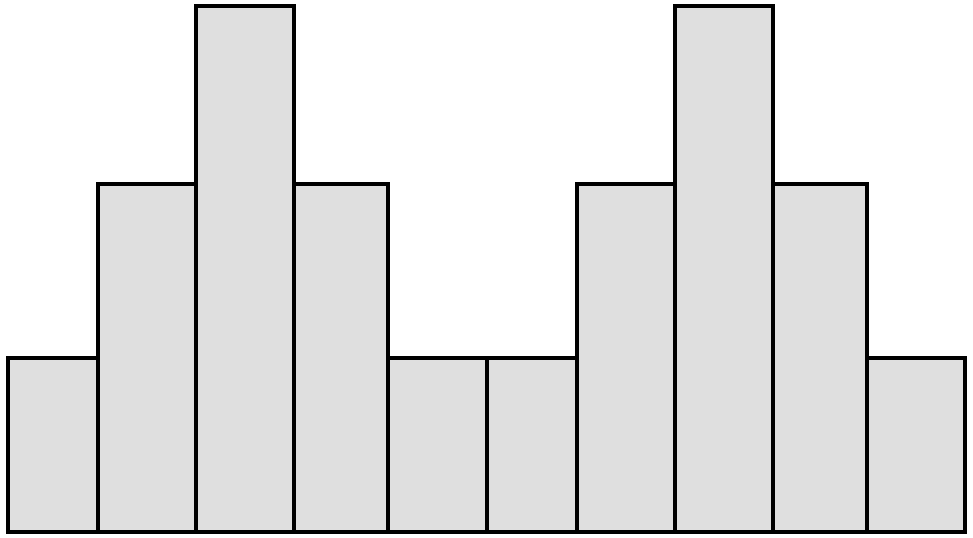
In such case, the heights of the rectangles will be proportional to the frequencies.



Types of Histogram

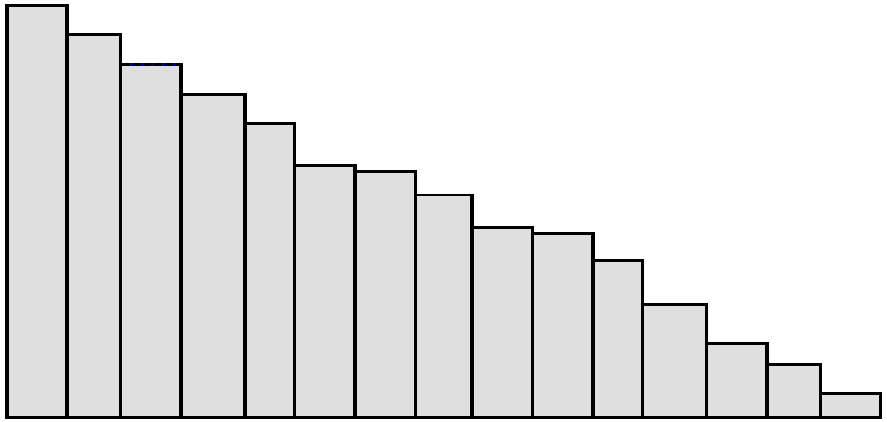


Bell-shaped

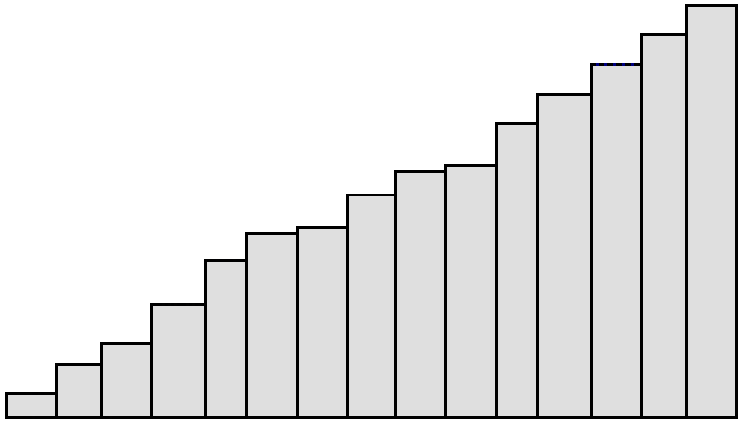


Bimodal

Types of Histogram

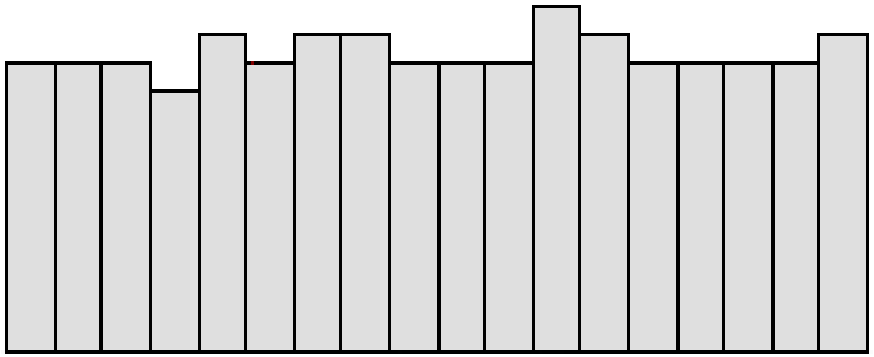


Skewed right

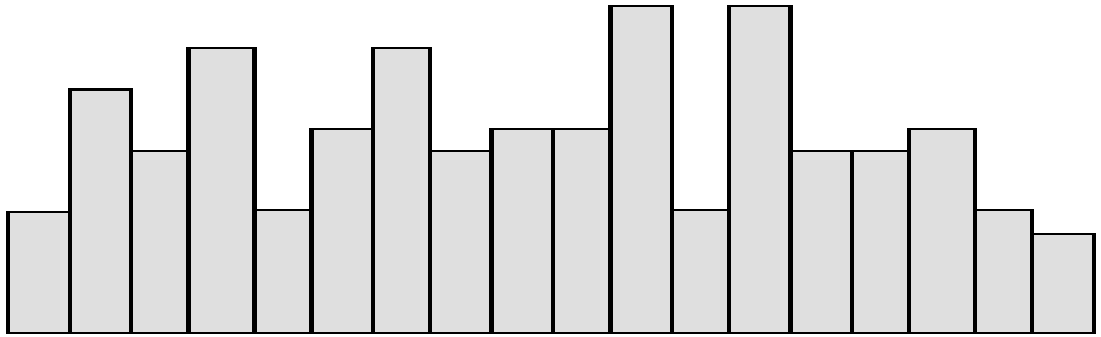


Skewed left

Types of Histogram



uniform



random

Construction of Histogram when class intervals are unequal

When class intervals are unequal the frequencies must be adjusted before constructing the histogram. For making the adjustment we take that class which has the lowest class interval and adjust the frequencies of order classes in the following manner. If one class interval is twice as wide as the one having lowest class interval, we divide the height of its rectangle by 2 if its three times more, we divide the height of rectangle by 3,etc.

Weekly Profits (in 000's Rs)		No. of Shops	
110 – 115	5	7	
115 – 120	5	19	
120 – 125	5	27	
125 – 130	5	15	
130 – 140	10 =5*2	12	12/2=6
140 – 160	20 =5*4	12	12/4=3
160 - 180	20 =5*4	8	8/4=2

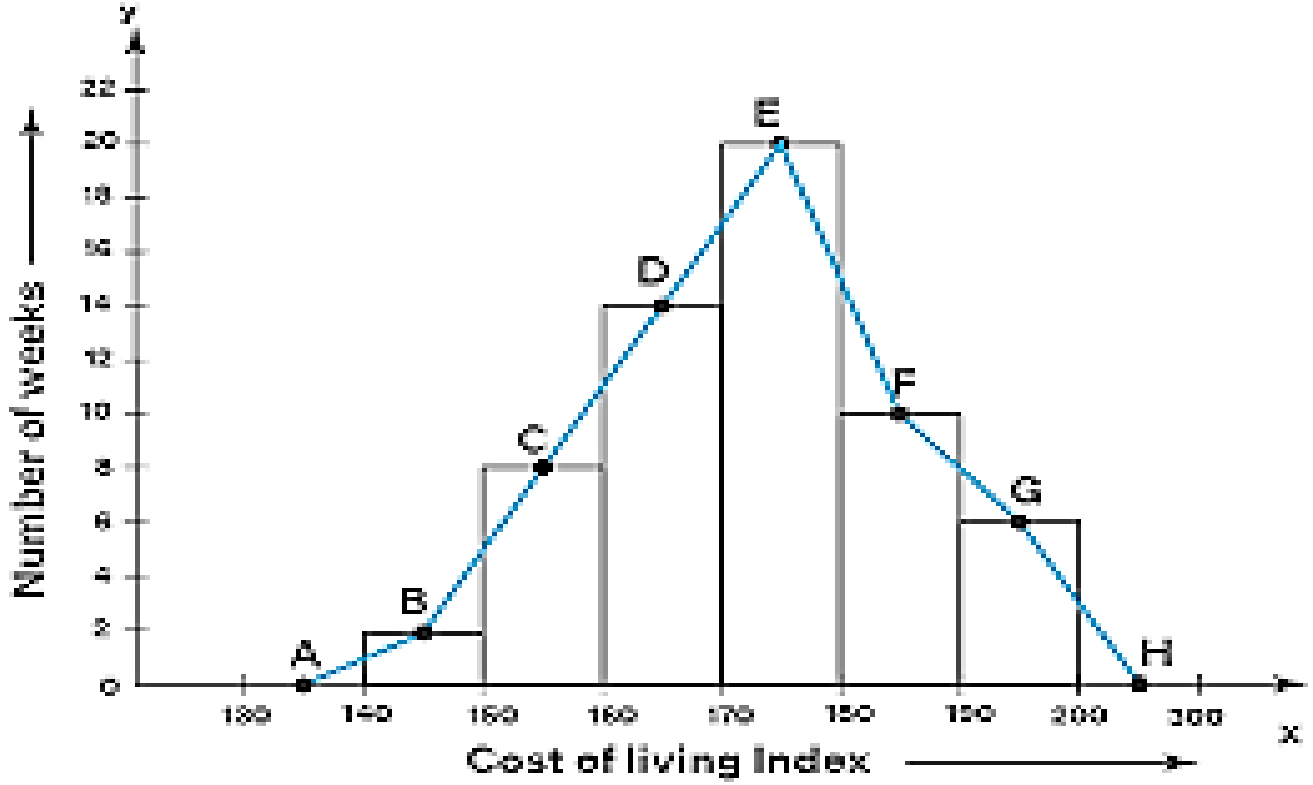
Frequency Polygon

Frequency polygon is a graph of frequency distribution. There are two ways in which a frequency Polygon may be constructed.

We may draw a histogram of the given data and then join by straight lines the mid points of the upper horizontal side of each rectangle with the adjacent rectangle. The figure formed are called frequency polygon. However it is prefer to close both the ends of the polygon by extending them to the baseline.

Another method of constructing frequency polygon is to take the mid points the various class Intervals and then prove the frequency corresponding to each point end to join all these points by straight Line. In this method the construction of histogram is not required.

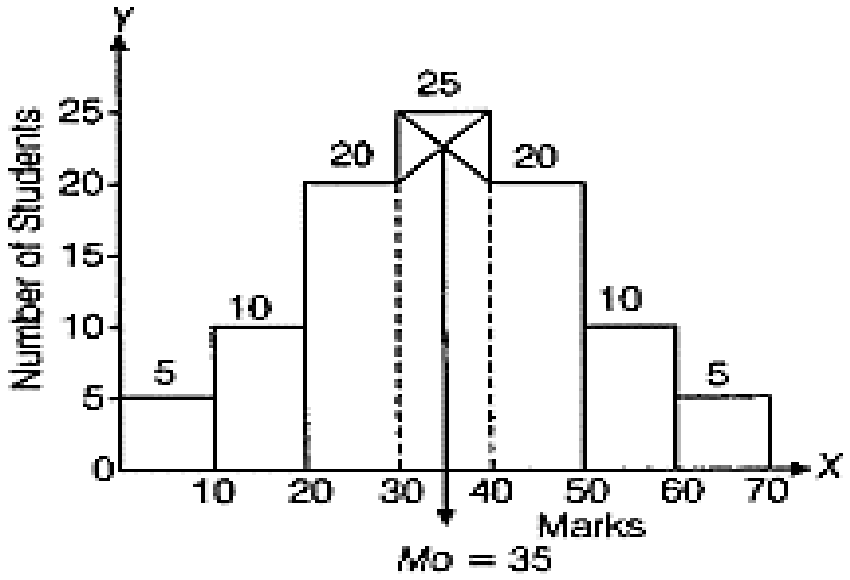
Frequency Polygon



Frequency Polygon

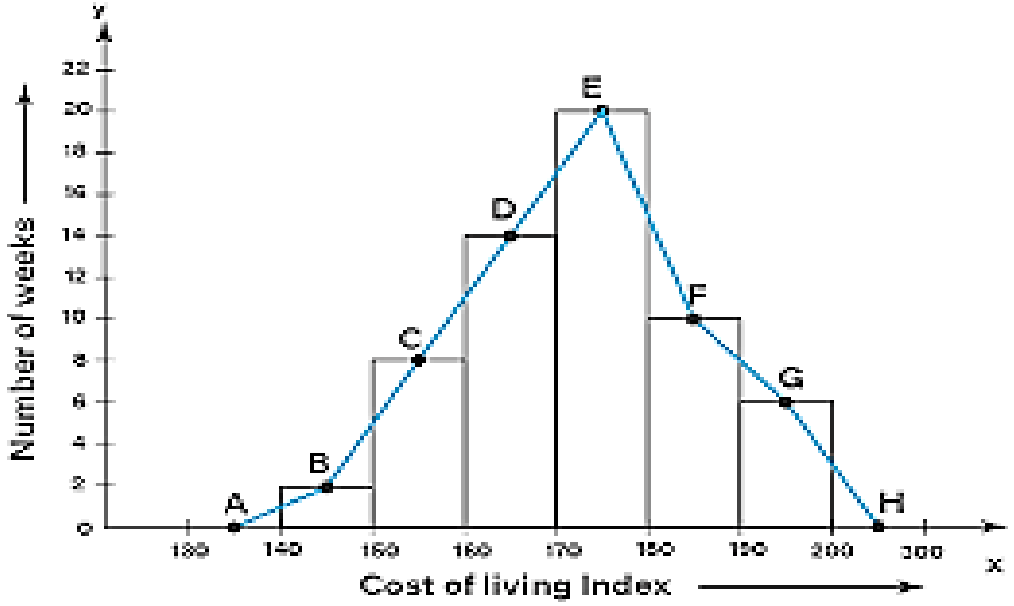
Note:

By constructing a frequency polygon the value of mode can easily be calculated if from the Top of the polygon a perpendicular is drawn on the x-axis, we get the value of mode.



Smoothed Frequency Curve

Frequency curve can be drawn through the various points of the polygon. The curve is drawn free hand in such a manner that the area included under the curve is approximately the same as that of the polygon.



Cumulative Frequency Curve

When frequencies are added they are called cumulative frequencies. These frequencies are then listed in a table called the Cumulative frequency table. The graph of such a distribution is Called a cumulative frequency curve .

Two methods of constructing frequency curve.

- **The 'less than' method**
- **The 'more than ' method**

Class	No. of students
0-20	7
20-40	12
40-60	13
60-80	8
80-100	10
	50

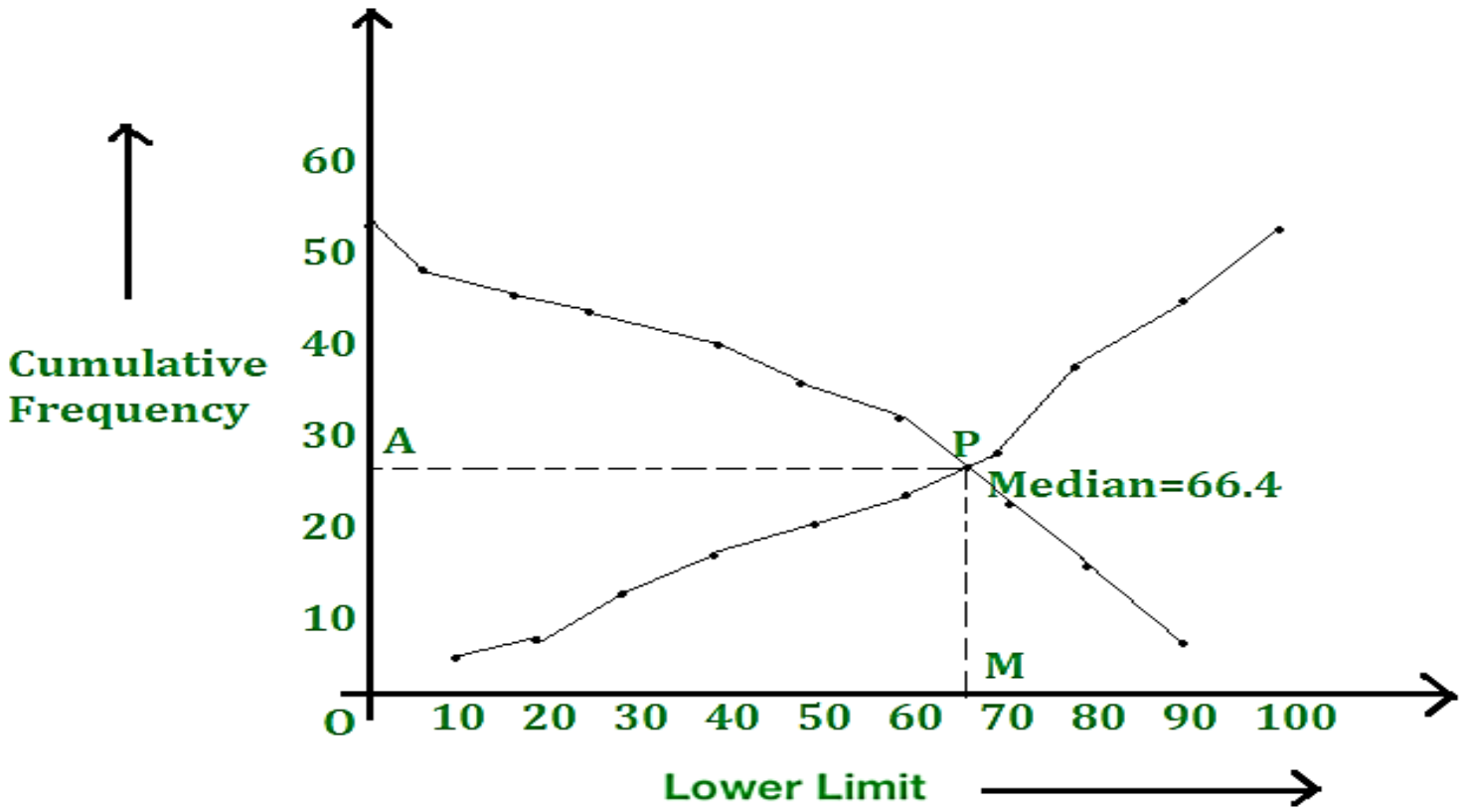
Class	Cumulative Frequency
Less than 20	7
Less than 40	19
Less than 60	32
Less than 80	40
Less than 100	50

when these frequencies are plotted we get our rising curve.

Class	No. of students
80-100	10
60-80	8
40-60	13
20-40	12
0-20	7
	50

Class	Cumulative Frequency
More than 80	10
More than 60	18
More than 40	31
More than 20	43
More than 0	50

When these frequencies are plotted, we get a declining curve


Cumulative Frequency
60
50
40
30
20
10
A
P
Median=66.4
M
O
10 20 30 40 50 60 70 80 90 100
Lower Limit