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STATISTICAL DESCRIPTION OF DATA

MATHS

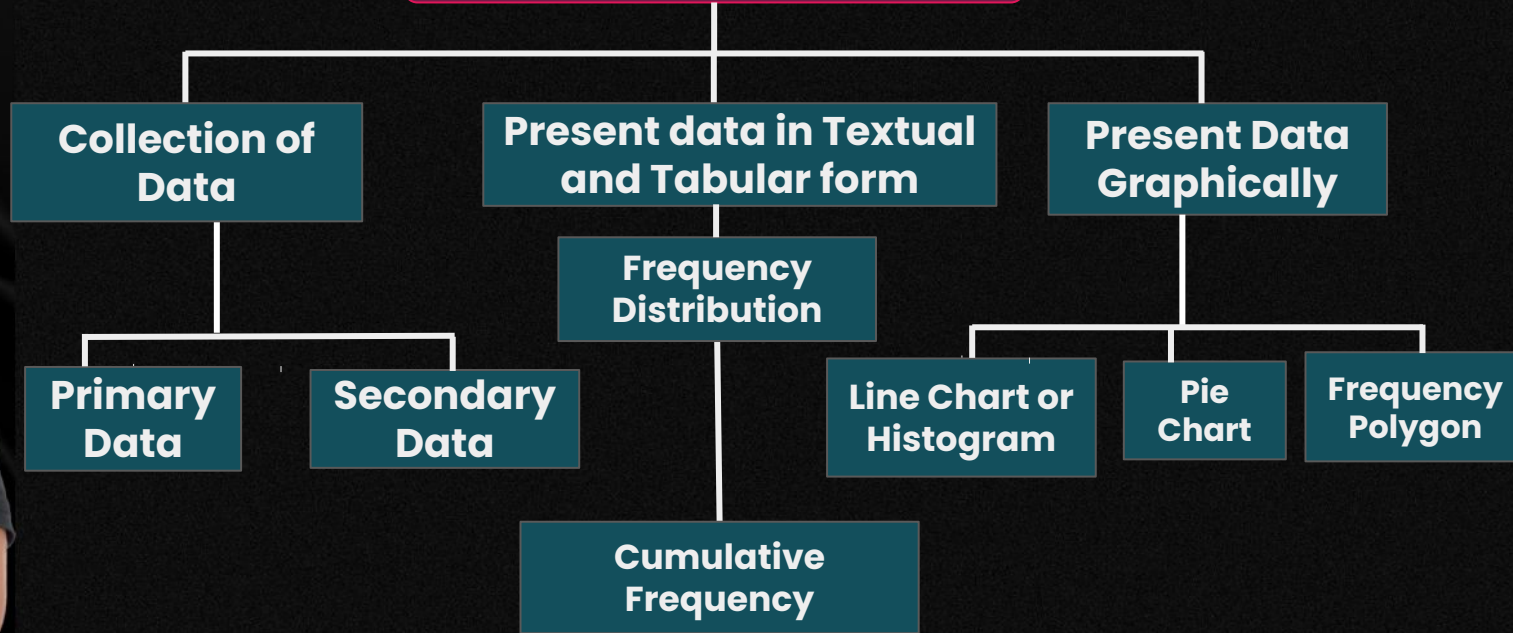
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Applications of Statistics



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DEFINITION OF STATISTICS

PLURAL SENSE

- data qualitative as well as quantitative, that are collected, usually with a view of having statistical analysis.

SINGULAR SENSE

- scientific method that is employed for collecting, analysing and presenting data, leading finally to drawing statistical inferences



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ORIGIN OF WORD - STATISTICS

LATIN - STATUS

ITALIAN - STATISTA

GERMAN - STATISTIK

FRENCH - STATISTIQUE

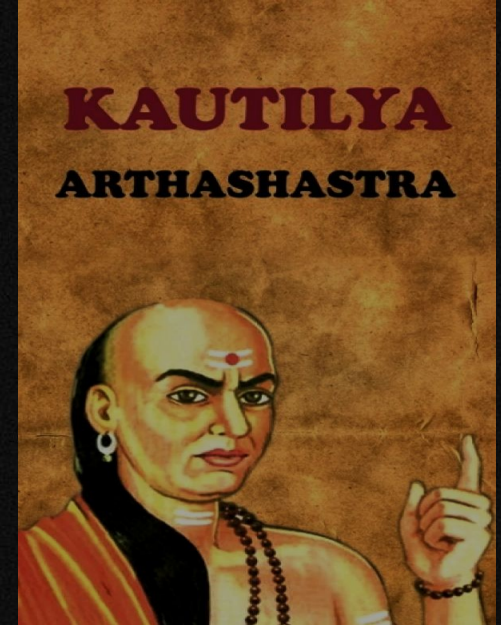
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HISTORY OF STATISTICS

- Kautilya's '**Arthashastra**' has record of births and deaths during Chandragupta's reign in the fourth century B.C.



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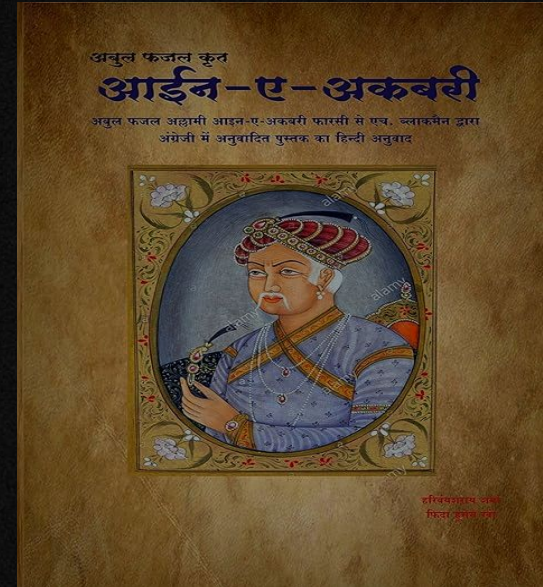
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HISTORY OF STATISTICS

- During the reign of Akbar in the sixteenth century A.D. We find statistical records on agriculture in **Ain-i-Akbari** written by Abu Fazl.
- Referring to Egypt, the **first census** was conducted by the Pharaoh during 300 B.C. to 2000 B.C.



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APPLICATIONS OF STATISTICS

- ❖ Economics
- ❖ Business Management
- ❖ Commerce and Industry



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ECONOMICS

- Modern developments in Economics have the roots in statistics. In fact, Economics and Statistics are closely associated. Time Series Analysis, Index Numbers, Demand Analysis etc. are some overlapping areas of Economics and Statistics.



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ECONOMICS

ECONOMICS

- Conducting socio-economic surveys and analysing the data derived from it are made with the help of different statistical methods. Regression analysis, one of the numerous applications of statistics, plays a key role in Economics for making future projection of demand of goods, sales, prices, quantities etc. which are all ingredients of Economic planning.

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BUSINESS MANAGEMENT



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- **Gone are the days when the managers used to make decisions on the basis of hunches, intuition or trials and errors. Now a days, because of the never-ending complexity in the business and industry environment, most of the decision making processes rely upon different quantitative techniques which could be described as a combination of statistical methods and operations research techniques.**

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BUSINESS MANAGEMENT

- So far as statistics is concerned, inferences about the universe from the knowledge of a part of it, known as sample, plays an important role in the development of certain criteria.



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STATISTICS IN COMMERCE AND INDUSTRY



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- In this age of cut-throat competition, like the modern managers, the industrialists and the businessmen are expanding their horizons of industries and businesses with the help of statistical procedures. Data on previous sales, raw materials, wages and salaries, products of identical nature of other factories etc are collected, analysed and experts are consulted in order to maximise profits.

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STATISTICS IN COMMERCE AND INDUSTRY

- Measures of central tendency and dispersion, correlation and regression analysis, time series analysis, index numbers, sampling, statistical quality control are some of the statistical methods employed in commerce and industry.



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LIMITATIONS OF STATISTICS

- I. **Statistics deals with the aggregates. An individual, to a statistician has no significance except the fact that it is a part of the aggregate.**
- II. **Statistics is concerned with quantitative data. However, qualitative data also can be converted to quantitative data by providing a numerical description to the corresponding qualitative data.**



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LIMITATIONS OF STATISTICS

STATISTICS

- III. Future projections of sales, production, price and quantity etc. are possible under a specific set of conditions. If any of these conditions is violated, projections are likely to be inaccurate.
- IV. The theory of statistical inferences is built upon random sampling. If the rules for random sampling is not strictly adhered to, the conclusion drawn on the basis of these unrepresentative samples would be erroneous.



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DATA



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- Quantitative information shown as number
- We can broadly classify data as

Primary : The data which are collected for the first time by an investigator or agency

1. **Secondary** : collected data used by a different person or agency.

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EXAMPLE

- If Prof. Das collects the data on the height of every student in his class, then these would be primary data for him.
- If, however, another person, say, Professor Bhargava uses the data, as collected by Prof. Das, for finding the average height of the students belonging to that class, then the data would be secondary for Prof. Bhargava.

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VARIABLE

- Variable is a measurable data.
- These are of two types
 - ❑ discrete variable
 - ❑ Continuous variable.

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Discrete VARIABLE

- When a variable assumes a finite or a countably infinite number of isolated values, it is known as a discrete variable.

Examples

- number of petals in a flower,
- the number of road accidents in a particular locality and so on.



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CONTINUOUS VARIABLE

- When a variable assumes any value from a given interval (can also be in decimals , fractions).

Examples height, weight, sale, profit , age and so on.



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MONEY

DISCRETE VARIABLE : Salary of a person
(Personal point of view)

MONEY

CONTINUOUS VARIABLE : Turnover of a
company
(Commercial point of view)

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REMARK

- A qualitative characteristic is known as an attribute.
- The gender of a baby, the nationality of a person, the colour of a flower etc. are examples of attributes.

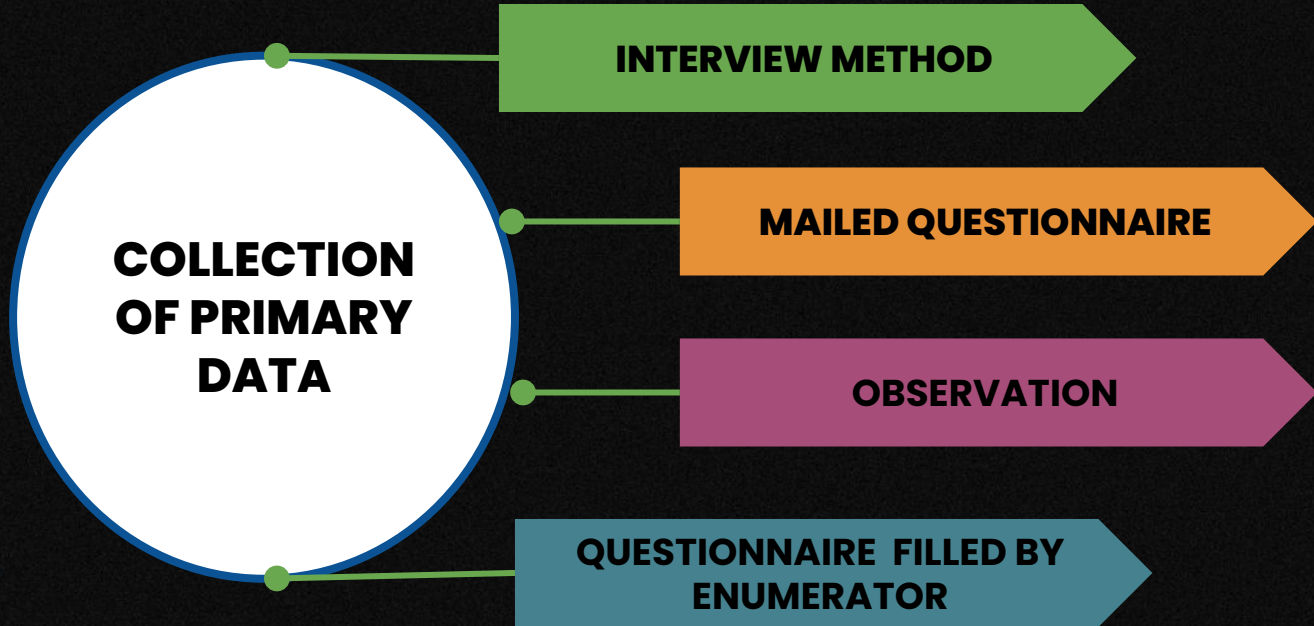
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INTERVIEW METHOD

**PERSONAL
INTERVIEW**

**INDIRECT
INTERVIEW**

**TELEPHONE
INTERVIEW**

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PERSONAL INTERVIEW METHOD

- The investigator meets the respondents directly and collects the required information then and there from them.
- **EXAMPLE** *natural calamity like a super cyclone or an earthquake or an epidemic like plague, we may collect the necessary data much more quickly and accurately by applying this method.*



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INDIRECT INTERVIEW METHOD

- When reaching respondent is difficult, data is collected by contacting associated persons .
- **EXAMPLE:** *rail accident*



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TELEPHONE INTERVIEW METHOD

- Telephone interview method is a quick and non expensive way to collect the primary data where the relevant information can be gathered by the researcher himself by contacting the interviewee over the phone.
- Non-responses is maximum for this method of data collection.



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REMARKS

- The first two methods, though more accurate, are inapplicable for covering a large area whereas the telephone interview, though less consistent, has a wide coverage.

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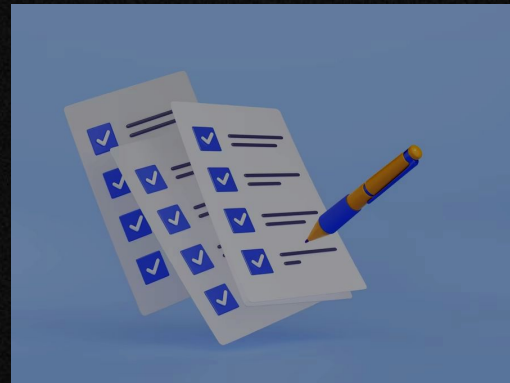
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MAILED QUESTIONNAIRE METHOD

- In this method well-drafted and soundly-sequenced questionnaire covering all the important aspects of the data requirement is sent to the respondents for filling .
- Although a wide area can be covered using the mailed questionnaire method, the amount of non-responses is likely to be maximum in this method.



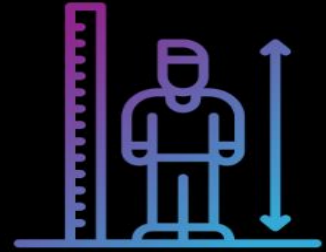
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OBSERVATION METHOD

- In this method data is collected by direct observation or using instrument .
- **Example** *data on the height and weight of a group of students.*
- Although more accurate but it is time consuming, laborious and covers only a small area.



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QUESTIONNAIRE FILLED AND SENT BY ENUMERATORS

- Enumerator means a Person who directly interacts with respondent and fills the questionnaire.
- It is generally used in case of surveys and census.



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SOURCES OF SECONDARY DATA

(a) International sources : WHO, ILO, IMF, World Bank etc.



WHO



IMF



World Bank



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SOURCES OF SECONDARY DATA

(b) Government sources : Statistical Abstract by CSO,



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SEBI



RBI



NSSO

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SOURCES OF SECONDARY DATA

(c) Private and quasi-government sources : ISI, ICAR, NCERT etc.



NCERT

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SOURCES OF SECONDARY DATA

(d) Unpublished sources of various research institutes, researchers etc.



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SCRUTINY OF DATA



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- Checking accuracy and consistency of data
- No hard and fast rules can be recommended for the scrutiny of data. One must apply his intelligence, patience and experience while scrutinising the given information.

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INTERNAL CONSISTENCY

When two or more series of related data are given , we should check consistency among them

Example

Date of birth and Age

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Unit 1 Exercise
Set A
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Que 1. Which of the following statements is false?

- (a) Statistics is derived from the Latin word 'Status'
- (b) Statistics is derived from the Italian word 'Statista'
- (c) Statistics is derived from the French word 'Statistik'
- (d) None of these.

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Que 2. Statistics is defined in terms of numerical data in the

- (a) Singular sense
- (b) Plural sense
- (c) Either (a) or (b)
- (d) Both (a) and (b).



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Que 3. Statistics is applied in

- (a) Economics
- (b) Business management
- (c) Commerce and industry
- (d) All these.



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Que 4. Statistics is concerned with

- (a) Qualitative information
- (b) Quantitative information
- (c) (a) or (b)
- (d) Both (a) and (b).



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Que 5. An attribute is

- (a) A qualitative characteristic
- (b) A quantitative characteristic
- (c) A measurable characteristic
- (d) All these.



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Que 6. Annual income of a person is

- (a) An attribute
- (b) A discrete variable
- (c) A continuous variable
- (d) (b) or (c).



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Que 7. Marks of a student is an example of

- (a) An attribute
- (b) A discrete variable
- (c) A continuous variable
- (d) None of these.



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Que. 8 Nationality of a student is

- (a) An attribute
- (b) A continuous variable
- (c) A discrete variable
- (d) (a) or (c).



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Que 9 Drinking habit of a person is

- (a) An attribute
- (b) A variable
- (c) A discrete variable
- (d) A continuous variable.



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Que 10. Age of a person is

- (a) An attribute
- (b) A discrete variable
- (c) A continuous variable
- (d) A variable.



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Que 11. Data collected on religion from the census reports are

- (a) Primary data
- (b) Secondary data
- (c) Sample data
- (d) (a) or (b).



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Que.12 The data collected on the height of a group of students after recording their heights with a measuring tape are

- (a) Primary data
- (b) Secondary data
- (c) Discrete data
- (d) Continuous data.



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Que 13. The primary data are collected by

- (a) Interview method
- (b) Observation method
- (c) Questionnaire method
- (d) All these.



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Que 14. The quickest method to collect primary data is

- (a) Personal interview
- (b) Indirect interview
- (c) Telephone interview
- (d) By observation.



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Que 15. The best method to collect data, in case of a natural calamity, is

- (a) Personal interview
- (b) Indirect interview
- (c) Questionnaire method
- (d) Direct observation method.



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Que 16. In case of a rail accident, the appropriate method of data collection is by

- (a) Personal interview
- (b) Direct interview
- (c) Indirect interview
- (d) All these.



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Que 17. Which method of data collection covers the widest area?

- (a) Telephone interview method
- (b) Mailed questionnaire method
- (c) Direct interview method
- (d) All these.



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Que 18. The amount of non-responses is maximum in

- (a) Mailed questionnaire method
- (b) Interview method
- (c) Observation method
- (d) All these.



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Que 19. Some important sources of secondary data are

- (a) International and Government sources
- (b) International and primary sources
- (c) Private and primary sources
- (d) Government sources.



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Que 20. Internal consistency of the collected data can be checked when

- (a) Internal data are given
- (b) External data are given
- (c) Two or more series are given
- (d) A number of related series are given.



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Que 21. The accuracy and consistency of data can be verified by

- (a) Internal checking
- (b) External checking
- (c) Scrutiny
- (d) Both (a) and (b).



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PRESENTATION OF DATA

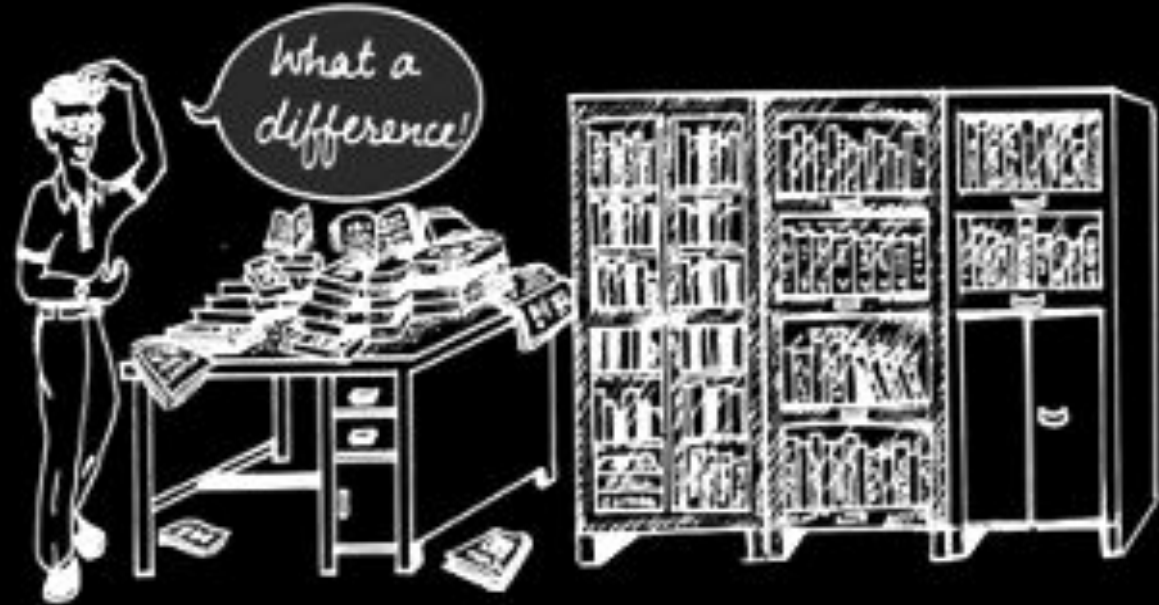
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CLASSIFICATION OR ORGANISATION OF DATA

- It may be defined as the process of arranging data on the basis of the characteristic under consideration into a number of groups or classes according to the similarities of the observations.

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OBJECTIVE OF CLASSIFICATION

- It puts the data in a neat, precise and condensed form so that it is easily understood and interpreted.
- It makes comparison possible between various characteristics,
- Statistical analysis is possible only for the classified data.



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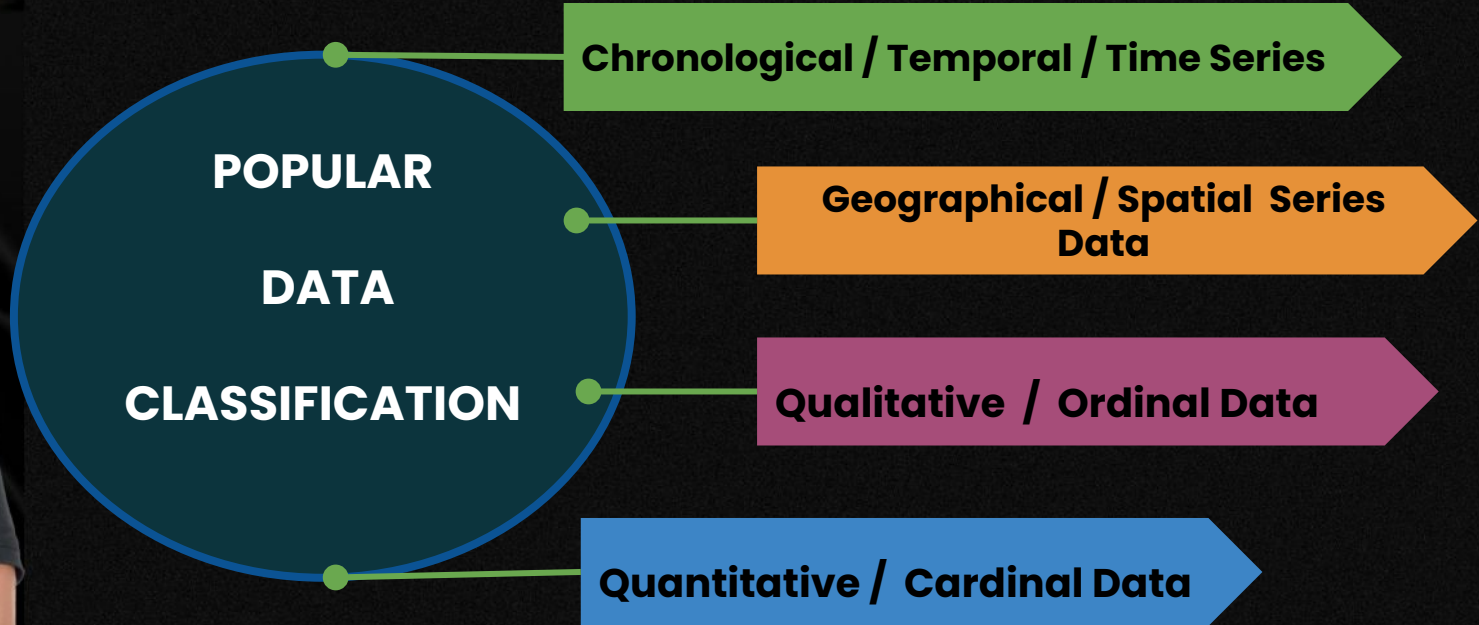
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Chronological / Temporal / Time Series

When the data are classified in respect of successive time points or intervals, they are known as time series data.

EXAMPLE

The following example shows the population of India classified in terms of years.

Population of India (in crores)	
Year	Population (Crores)
1951	35.7
1961	43.8
1971	54.6
1981	68.4
1991	81.8
2001	102.7
2011	121.0



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Geographical / Spatial Series Data

Data arranged region wise are known as geographical data.

EXAMPLE

shows the yield of wheat in different countries

Yield of Wheat for Different Countries (2013)

<i>Country</i>	<i>Yield of wheat (kg/ hectare)</i>
Canada	3594
China	5055
France	7254
Germany	7998
India	3154
Pakistan	2787



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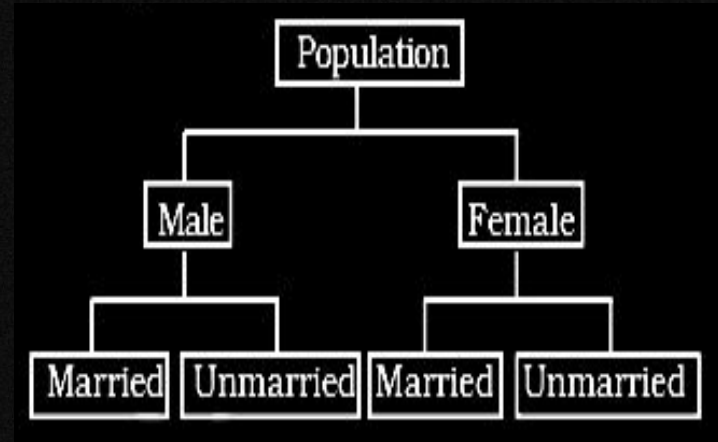
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QUALITATIVE / ORDINAL DATA

- Data classified in respect of an attribute are referred to as qualitative data. Data on nationality, gender, smoking habit of a group of individuals are examples of qualitative data.

EXAMPLE

In the following example, we find population of a country is grouped on the basis of the qualitative variable "gender"



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Quantitative / Cardinal Data

- when the data are classified in respect of a variable, say height, weight, profits, salaries , marks of students etc., they are known as quantitative data.

EXAMPLE

the quantitative
classification of marks in
mathematics

**Frequency Distribution of Marks in
Mathematics of 100 Students**

<i>Marks</i>	<i>Frequency</i>
0-10	1
10-20	8
20-30	6
30-40	7
40-50	21
50-60	23
60-70	19
70-80	6
80-90	5
90-100	4
<i>Total</i>	<i>100</i>

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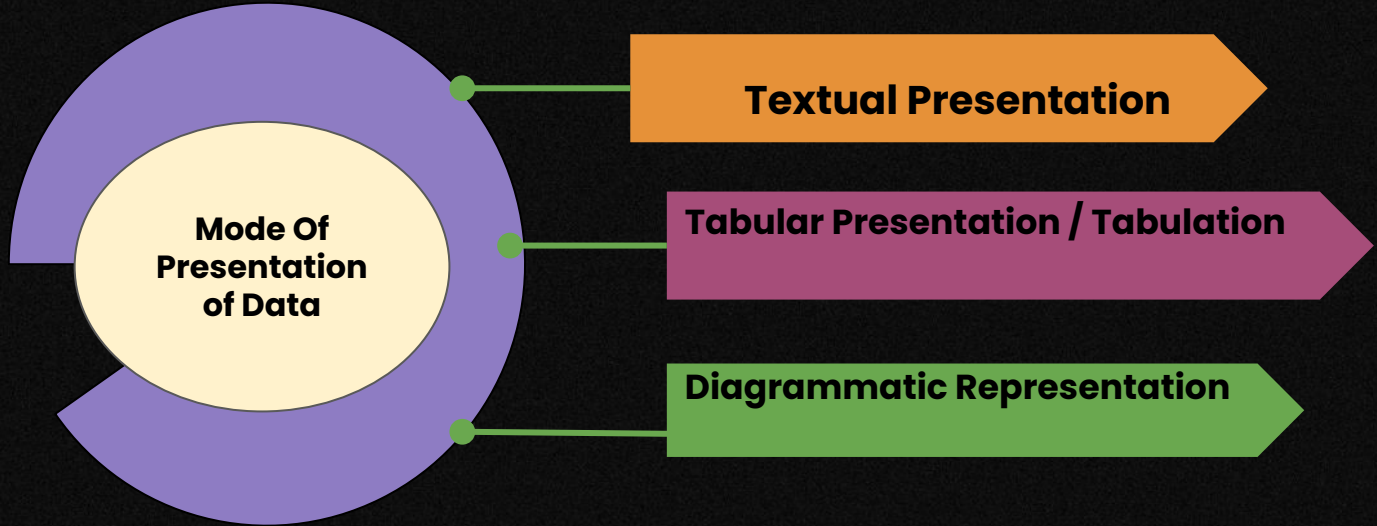
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TEXTUAL PRESENTATION

- This method comprises presenting data with the help of a paragraph or a number of paragraphs.
- **EXAMPLE**
- 'In 2009, out of a total of five thousand workers of Roy Enamel Factory, four thousand and two hundred were members of a Trade Union. The number of female workers was twenty per cent of the total workers out of which thirty per cent were members of the Trade Union.'

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MERITS

- The merit of this mode of presentation lies in its simplicity and even a layman can present data by this method.
- The observations with exact magnitude can be presented with the help of textual presentation.
- Furthermore, this type of presentation can be taken as the first step towards the other methods of presentation.

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DEMERITS

- Textual presentation, however, is not preferred by a statistician simply because, it is dull, monotonous and comparison between different observations is not possible in this method.

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TABULAR PRESENTATION / TABULATION



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- Tabulation may be defined as systematic presentation of data with the help of a statistical table having a number of rows and columns and complete with reference number, title, description of rows as well as columns and foot notes, if any.

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TABULAR PRESENTATION / TABULATION

- The table under consideration should be divided into caption, Box-head, Stub and Body.
- **Caption** is the upper part of the table, describing the columns and sub-columns, if any.
- The **Box-head** is the entire upper part of the table which includes columns and sub-column numbers, unit(s) of measurement along with caption.

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Box Head

Caption

		Member Trade of Union				Not Member Of Trade Union				Total			
Gender		Male		Femal e		Male		Female		Male		Female	
Unit		%	No .	%	No .	%	No .	%	No .	%	No .	%	No.
2009													
2010													

From Annual Report of _ _ _ _ _

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TABULAR PRESENTATION / TABULATION



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- **Stub** is the left part of the table providing the description of the rows.
- The **body** is the main part of the table that contains the numerical figures.
- Notes describing the source of the data and bringing clarity and, if necessary, about any rows or columns known as **footnotes**, should be shown at the bottom part of the table.

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Stub

	Member Trade of Union				Not Member Of Trade Union				Total			
Gender	Male		Female		Male		Female		Male		Female	
Unit	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.
2009												
2010												

Footnote

From Annual Report of _____

Body

Box Head

Caption

Stub

	Member of Trade Union				Not Member Of Trade Union				Total			
Gender	Male		Female		Male		Female		Male		Female	
Unit	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.
2009												
2010												

Footnote

From Annual Report of _ _ _ _ _

Body

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MERITS

- It facilitates comparison between rows and columns.
- Complicated data can also be represented using tabulation.
- It is a must for diagrammatic representation.
- Without tabulation, statistical analysis of data is not possible.



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Que22. The mode of presentation of data are

- (a) Textual, tabulation and diagrammatic
- (b) Tabular, internal and external
- (c) Textual, tabular and internal
- (d) Tabular, textual and external.



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Que23. The best method of presentation of data is

- (a) Textual
- (b) Tabular
- (c) Diagrammatic
- (d) (b) and (c).



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Que24. The most attractive method of data presentation is

- (a) Tabular
- (b) Textual
- (c) Diagrammatic
- (d) (a) or (b).



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Que 25. For tabulation, 'caption' is

- (a) The upper part of the table
- (b) The lower part of the table
- (c) The main part of the table
- (d) The upper part of a table that describes the column and sub-column.



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Que 26. 'Stub' of a table is the

- (a) Left part of the table describing the columns
- (b) Right part of the table describing the columns
- (c) Right part of the table describing the rows
- (d) Left part of the table describing the rows.



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Que 27. The entire upper part of a table is known as

- (a) Caption
- (b) Stub
- (c) Box head
- (d) Body.



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Que28. The unit of measurement in tabulation is shown in

- (a) Box head
- (b) Body
- (c) Caption
- (d) Stub.



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Que 29. In tabulation source of the data, if any, is shown in the

(a) Footnote

(b) Body

(c) Stub

(d) Caption.



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Que 30. Which of the following statements is untrue for tabulation?

- (a) Statistical analysis of data requires tabulation
- (b) It facilitates comparison between rows and not columns
- (c) Complicated data can be presented
- (d) Diagrammatic representation of data requires tabulation.



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DIAGRAMMATIC REPRESENTATION OF DATA

- An attractive representation of statistical data is provided by charts, diagrams and pictures.
- Unlike the first two methods of representation of data, diagrammatic representation can be used for both the educated section and uneducated section of the society.

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DIAGRAMMATIC REPRESENTATION OF DATA

- Any hidden trend present in the given data can be noticed only in this mode of representation.
- However, compared to tabulation, this is less accurate. So, if there is a priority for accuracy, we have to recommend tabulation.



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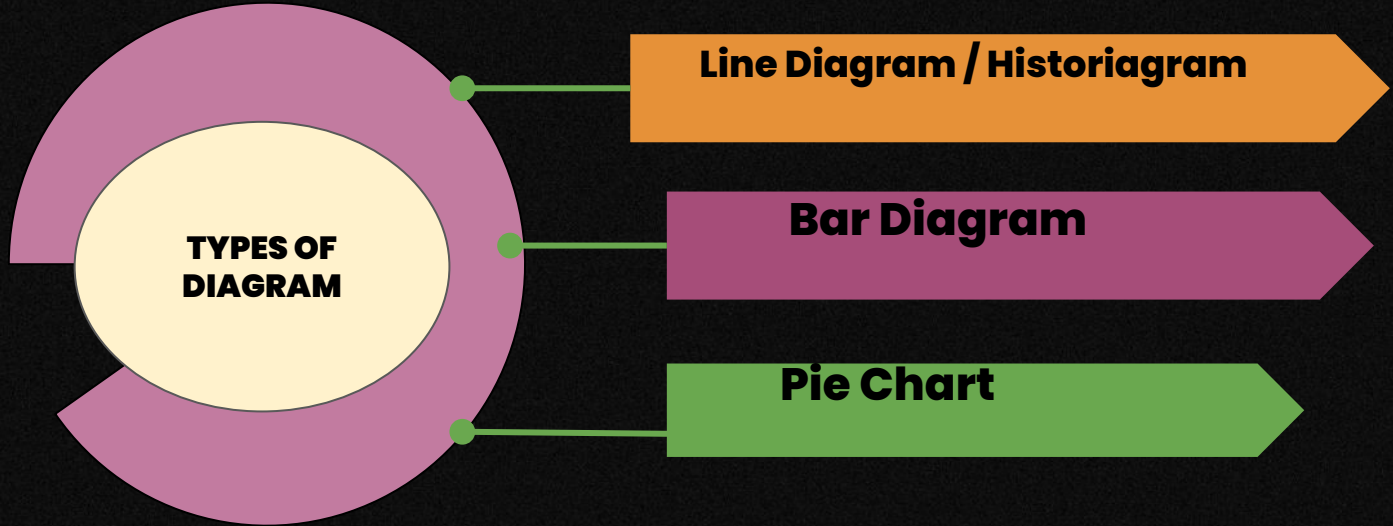
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Line Diagram or Historiagram

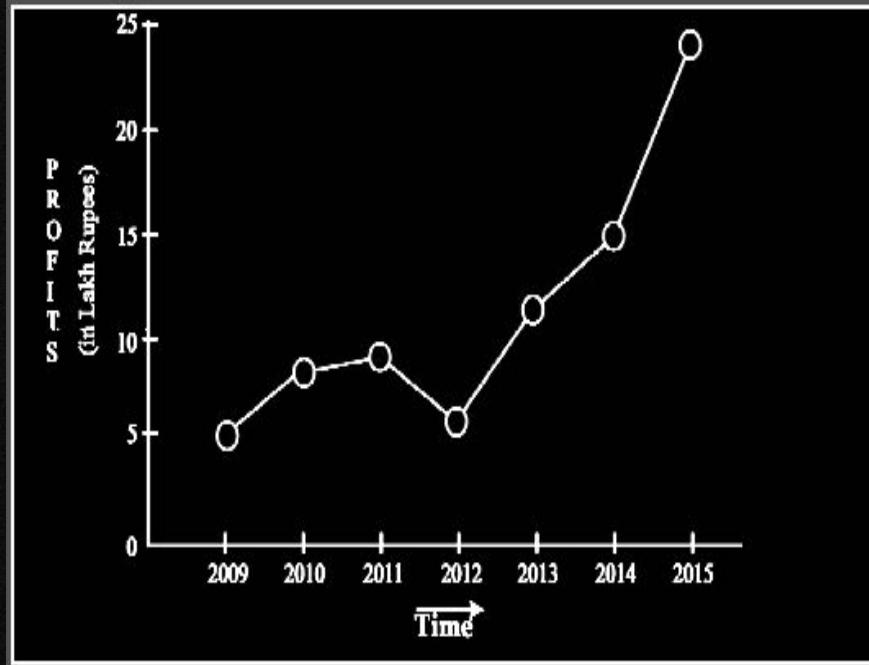
- Generally used for time series .
- First plot points on graph and then join them to make a line .
- For wide fluctuation , **LOG CHART OR RATIO CHART** is used i.e
log y is plotted against time t .
- For two or more series of same unit – **MULTIPLE LINE CHART** is used
- For two or more series of distinct unit – **MULTIPLE AXIS CHART** is used

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LINE DIAGRAM



Year	Profit in Rs. Lakhs
2009	5
2010	8
2011	9
2012	6
2013	12
2014	15
2015	24



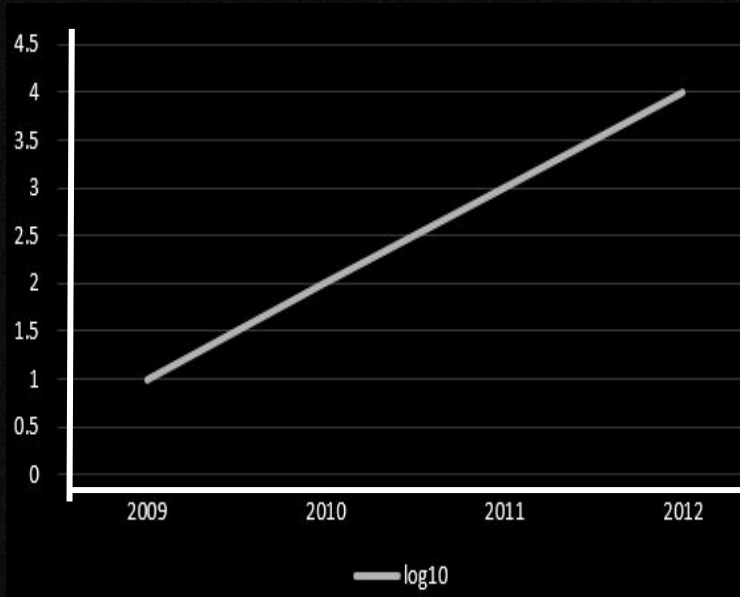
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LOG CHART / RATIO CHART



Year x	Profit in Rs. Lakhs y	$\log_{10} y$
2009	10	1
2010	100	2
2011	1000	3
2012	10000	4

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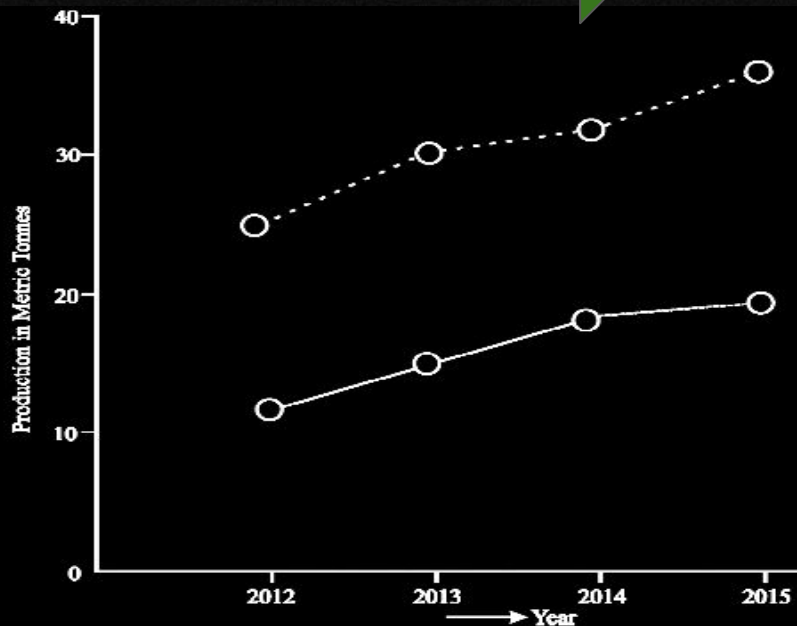
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MULTIPLE LINE CHART



Year	Production in metric tones	
	Wheat	Rice
2012	12	25
2013	15	30
2014	18	32
2015	19	36

**Dotted line represent
production of rice and
continuous line that of
wheat**

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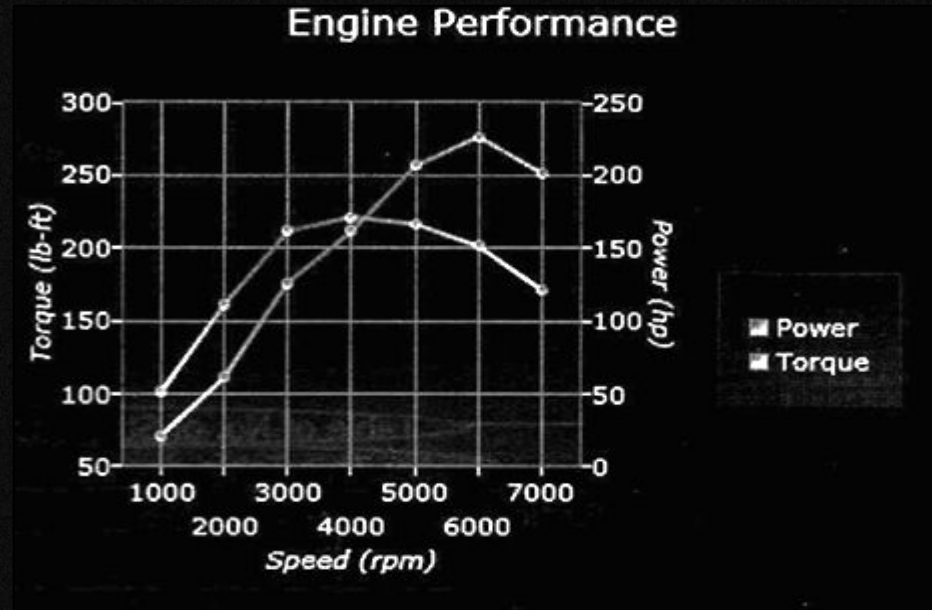
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MULTIPLE AXIS CHART



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BAR DIAGRAM

- Bars i.e. rectangles of equal width and usually of varying lengths drawn either horizontally or vertically.



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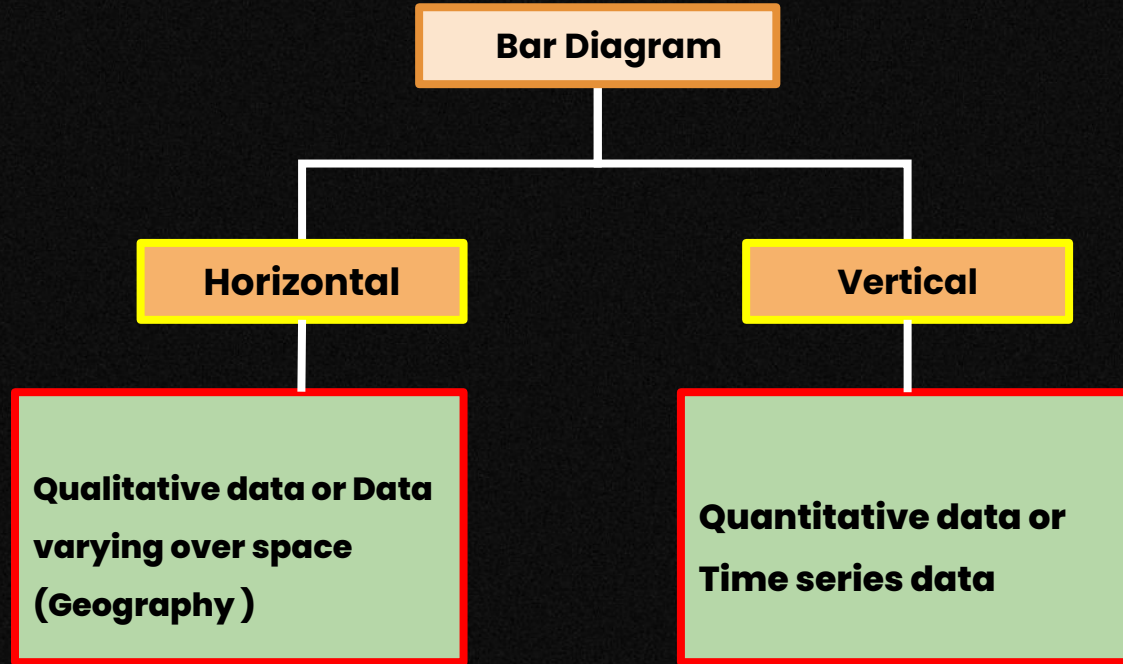
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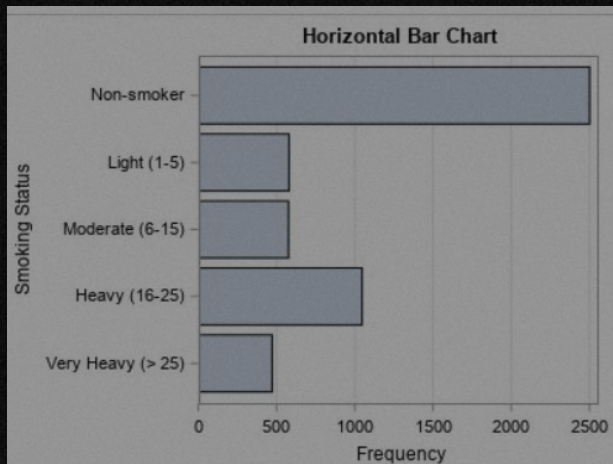


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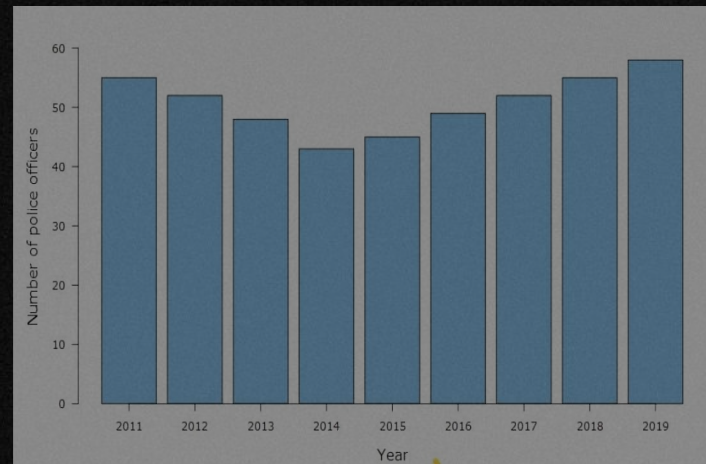
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HORIZONTAL



VERTICAL



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BAR DIAGRAM

- We consider **Multiple or Grouped Bar** diagrams to **compare related series**.
- **Component or sub-divided Bar** diagrams are applied for representing data divided into a **number of components**.
- For relative comparison to whole , **percentage bar diagrams** or **divided bar diagrams** are used

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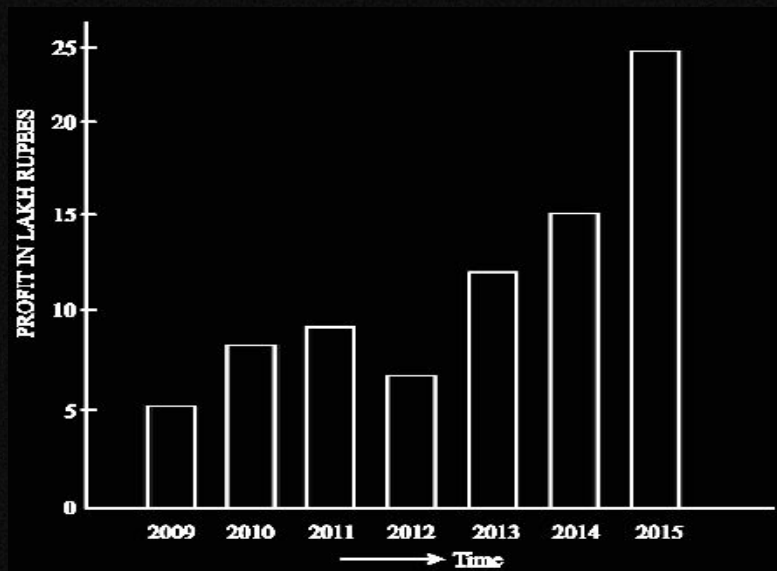
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BAR DIAGRAM



Year	Profit in Rs. Lakhs
2009	5
2010	8
2011	9
2012	6
2013	12
2014	15
2015	24

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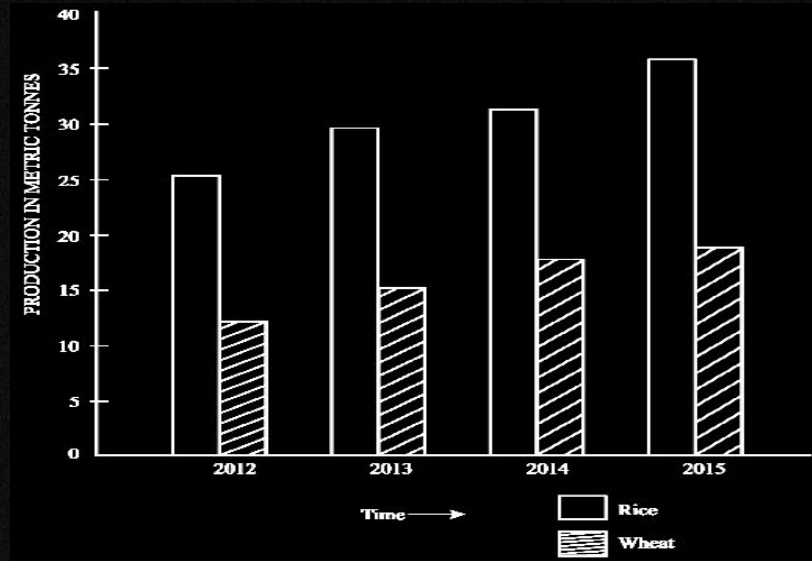
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MULTIPLE / GROUPED BAR DIAGRAM



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Year	Production in metric tones	
	Wheat	Rice
2012	12	25
2013	15	30
2014	18	32
2015	19	36

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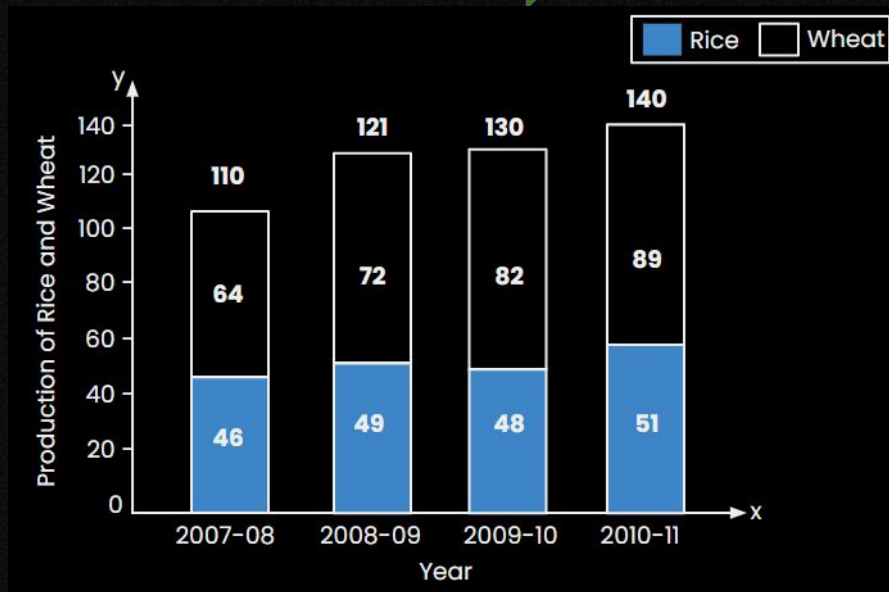
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COMPONENT BAR DIAGRAM



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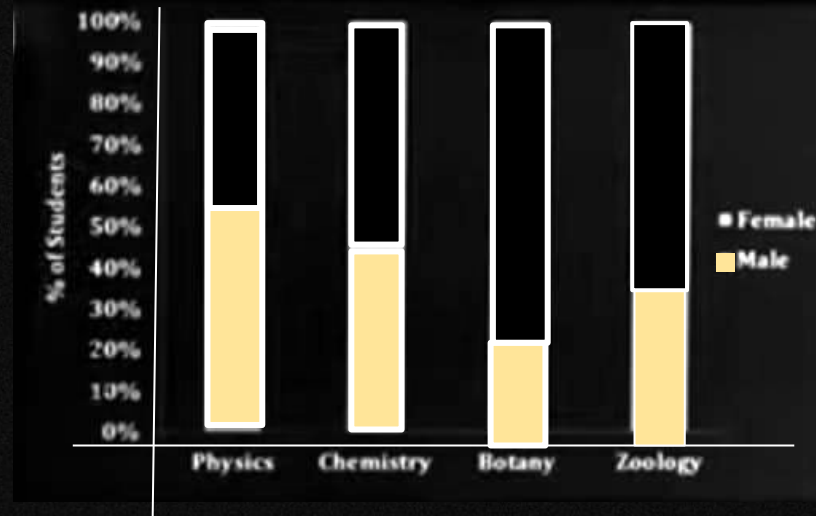


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Percentage BAR DIAGRAM



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Pie chart

It is used for circular presentation of relative data

$$\text{Segment angle} = \frac{(\text{segment value} \times 360^{\circ})}{(\text{total value})}$$



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Example: Draw an appropriate diagram with a view to represent the following data :

Source	Revenue in millions of (₹)
Customs	80
Excise	190
Income Tax	160
Corporate Tax	75
Miscellaneous	35



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Solution: Pie chart
or divided bar chart
would be the ideal
diagram to
represent this data.
We consider Pie
chart.



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Source (1)	Revenue in Million rupees (2)	Central angle $= \frac{(2)}{\text{Total of (2)}} \times 360^\circ$
Customs	80	$\frac{80}{540} \times 360^\circ = 53^\circ$ (approx.)
Excise	190	$\frac{190}{540} \times 360^\circ = 127^\circ$
Income Tax	160	$\frac{160}{540} \times 360^\circ = 107^\circ$
Corporate Tax	75	$\frac{75}{540} \times 360^\circ = 50^\circ$
Miscellaneous	35	$\frac{35}{540} \times 360^\circ = 23^\circ$
Total	540	360°

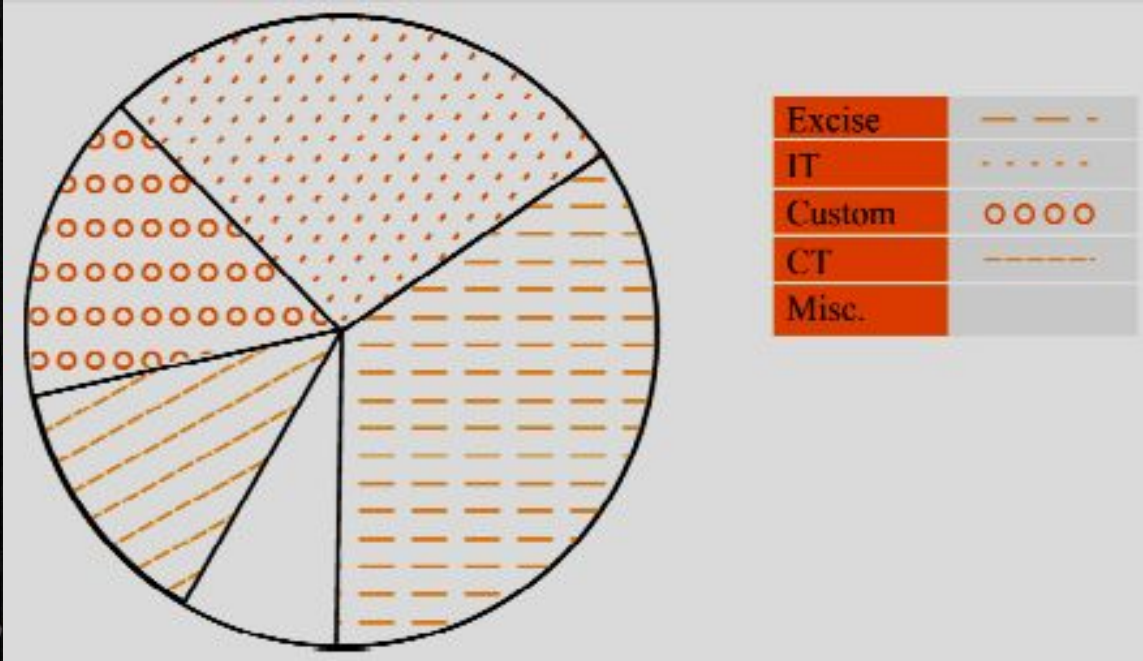
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Pie chart showing the distribution of Revenue

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Que 31. Hidden trend, if any, in the data can be noticed in

- (a) Textual presentation
- (b) Tabulation
- (c) Diagrammatic representation
- (d) All these.



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Que. 32 Diagrammatic representation of data is done by

- (a) Diagrams
- (b) Charts
- (c) Pictures
- (d) All these.



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Que33. The most accurate mode of data presentation is

- (a) Diagrammatic method
- (b) Tabulation
- (c) Textual presentation
- (d) None of these.



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Que 34. The chart that uses logarithm of the variable is known as

- (a) Line chart
- (b) Ratio chart
- (c) Multiple line chart
- (d) Component line chart.



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Que 35. Multiple line chart is applied for

- (a) Showing multiple charts
- (b) Two or more related time series when the variables are expressed in the same unit
- (c) Two or more related time series when the variables are expressed in different unit
- (d) Multiple variations in the time series.



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Que 36. Multiple axis line chart is considered when

- (a) There is more than one time series
- (b) The units of the variables are different
- (c) (a) or (b)
- (d) (a) and (b).



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Que 37. Horizontal bar diagram is used for

- (a) Qualitative data
- (b) Data varying over time
- (c) Data varying over space
- (d) (a) or (c).



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Que 38. Vertical bar diagram is applicable when

- (a) The data are qualitative
- (b) The data are quantitative
- (c) When the data vary over time
- (d) (b) or (c).



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Que 39. Divided bar chart is considered for

- (a) Comparing different components of a variable
- (b) The relation of different components to the table
- (c) (a) or (b)
- (d) (a) and (b).



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Que 40. In order to compare two or more related series, we consider

- (a) Multiple bar chart
- (b) Grouped bar chart
- (c) (a) or (b)
- (d) (a) and (b).



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Que 41. Pie-diagram is used for

- (a) Comparing different components and their relation to the total
- (b) Representing qualitative data in a circle
- (c) Representing quantitative data in circle
- (d) (b) or (c).



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FREQUENCY DISTRIBUTION

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FREQUENCY

Number of times a particular observation is repeated

FREQUENCY DISTRIBUTION TABLE

It is a table which contains observation or class intervals in one column and corresponding frequency in the other

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TYPES OF FREQUENCY DISTRIBUTION

Ungrouped / Simple Frequency Distribution

*When there are limited number
of distinct observations ,
frequency can be assigned to
each one of them*

Grouped Frequency distribution

*When there are large number of
observations , grouping is done
among them , each group is called
class interval and frequency is
assigned to group and not individual
value .*



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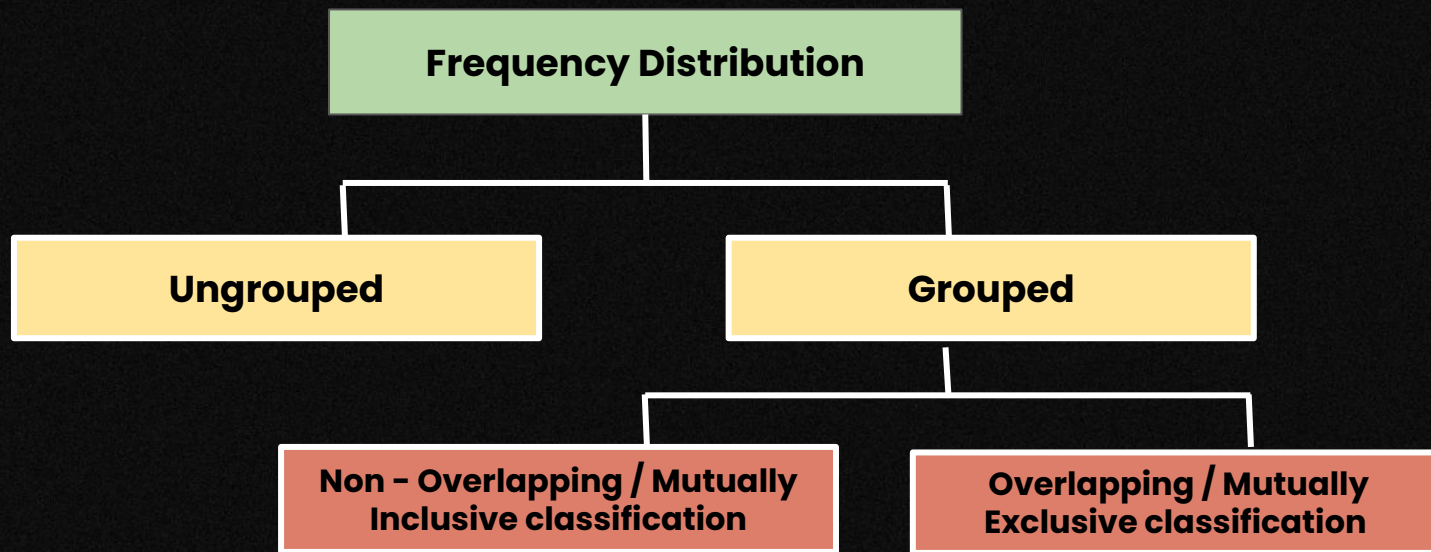
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Example: A review of the first 30 pages of a statistics book reveals the following printing mistakes:

0	1	3	3	2	5	6	0	1	0
4	1	1	0	2	3	2	5	0	4
2	3	2	2	3	3	4	6	1	4

Make a frequency distribution of printing mistakes.



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Ungrouped Frequency Distribution



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Printing Mistake	Tally marks	Frequency (No. of Pages)
0		5
1		5
2	I	6
3	I	6
4		4
5		2
6		2
Total	-	30

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Example: Following are the weights in kgs. of 36 BBA students of St. Xavier's College.

70	73	49	61	61	47	57	50	59
59	68	45	55	65	68	56	68	55
70	70	57	44	69	73	64	49	63
65	70	65	62	64	73	67	60	50

Construct a frequency distribution of weights, taking class length as 5.



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Solution: We have, Range = Maximum weight – Minimum weight

$$= 73 \text{ kgs.} - 44 \text{ kgs.} = 29 \text{ kgs.}$$

$$\text{No. of class interval} \times \text{class lengths} \approx \text{Range}$$

$$\text{No. of class interval} \times 5 \approx 29$$

$$\text{No. of class interval} = 29/5 \approx 6$$

(We always take the next integer as the number of class intervals so as to include both the minimum and maximum values).



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Grouped Frequency Distribution



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Weight in kg (Class Interval)	Tally marks	No. of Students (Frequency)
44-48	III	3
49-53	IIII	4
54-58	IIII	5
59-63	IIII II	7
64-68	IIII IIII	9
69-73	IIII III	8
Total	—	36

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Frequency Distribution

- Frequency data occur when we classify statistical data in respect of either a variable or an attribute .
- A frequency distribution may be defined as a tabular representation of statistical data , usually in an ascending order , relating to a measurable characteristic according to individual value or group of values of the characteristic under study

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Frequency Distribution

- In case, the characteristic under consideration is an attribute, say nationality, then the tabulation is made by allotting numerical figures to the different classes the attribute may belong like, in this illustration, counting the number of Indian, British, French, German and so on.

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Example: Following are the records of babies born in a nursing home in Bangalore during a week (B denoting Boy and G for Girl) :

B	G	G	B	G	G	B	B	G	G
G	G	B	B	B	G	B	B	G	B
B	B	G	B	B	B	G	G	B	G

Construct a frequency distribution according to gender.



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Solution: In order to construct a frequency distribution of babies in accordance with their gender, we count the number of male births and that of female births and present this information in the following table.

Frequency distribution of babies according to Gender

Category	Number of births
Boy (B)	16
Girl (G)	14
Total	30



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Frequency Distribution

- When tabulation is done in respect of a discrete random variable, it is known as Discrete or Ungrouped or simple Frequency Distribution
- When the characteristic under consideration is a continuous variable, such a classification is termed as Grouped Frequency Distribution.

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Frequency Distribution

- In case of a grouped frequency distribution, tabulation is done not against a single value as in the case of an attribute or a discrete random variable but against a group of values.

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Frequency Distribution of a Variable

For the construction of a frequency distribution of a variable, we need to go through the following steps :

1. Find the largest and smallest observations and obtain the difference between them, known as **Range**, in case of a continuous variable.
2. Form a number of classes depending on the number of isolated values assumed by a discrete variable. In case of a continuous variable, find the number of class intervals using the relation,
 $\text{No. of class Interval} \times \text{class length} \approx \text{Range}.$



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3. Present the class or class interval in a table known as frequency distribution table.
4. Apply 'tally mark' i.e. a stroke against the occurrence of a particulars value in a class or class interval.
5. Count the tally marks and present these numbers in the next column, known as frequency column, and finally check whether the total of all these class frequencies tally with the total number of observations.

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Class Limit

- Corresponding to a class interval, the class limits may be defined as the minimum value and the maximum value the class interval may contain.
- The **minimum value** is known as the **lower class limit** (LCL)
- The **maximum value** is known as the **upper class limit** (UCL).



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CLASS LIMIT



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CLASS INTERVAL	FREQUENCY	LCL	UCL
44-48	3	44	48
49 - 53	4	49	53
54 -58	5	54	58

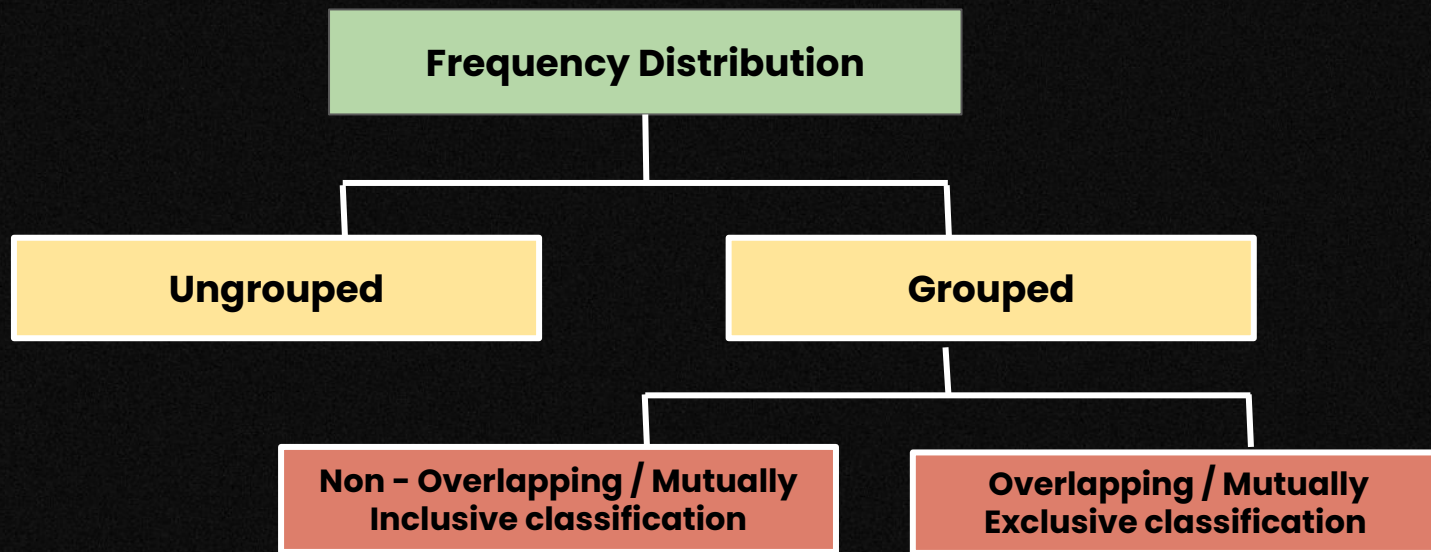
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Non - Overlapping / Mutually Inclusive classification

Usually applicable to discrete variable .

CLASS INTERVAL	LCL	UCL
44-48	44	48
49 - 53	49	53
54 -58	54	58

Includes UCL

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Overlapping / Mutually Exclusive classification

Usually applicable to continuous variable .

CLASS INTERVAL	LCL	UCL
40 – 50	40	50
50 – 60	50	60
60 – 70	60	70

Excludes UCL



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CLASS BOUNDARY

OVERLAPPING / MUTUALLY EXCLUSIVE

CLASS INTERVAL	LCL	UCL	LCB	UCB
40 – 50	40	50	40	50
50 – 60	50	60	50	60
60 – 70	60	70	60	70

Class limit = Class boundary

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CLASS BOUNDARY

NON-OVERLAPPING / MUTUALLY INCLUSIVE

CLASS INTERVAL	LCL	UCL	LCB	UCB
44-48	44	48	43.5	48.5
49 - 53	49	53	48.5	53.5
54 -58	54	58	53.5	58.5

$$\text{LCB} = \text{LCL} - 0.5$$

$$\text{UCB} = \text{UCL} + 0.5$$

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CLASS LENGTH

Class length = UCB - LCB

CLASS INTERVAL	LCL	UCL	LCB	UCB	CLASS LENGTH
44-48	44	48	43.5	48.5	5
49 - 53	49	53	48.5	53.5	5
54 -58	54	58	53.5	58.5	5



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Mid-Point or Mid-Value or Class Mark

$$\begin{aligned}\text{mid-point} &= \frac{\text{LCL} + \text{UCL}}{2} \\ &= \frac{\text{LCB} + \text{UCB}}{2}\end{aligned}$$

CLASS INTERVAL	LCL	UCL	LCB	UCB	MID POINT
44-48	44	48	43.5	48.5	46
49 - 53	49	53	48.5	53.5	51
54 -58	54	58	53.5	58.5	56



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Que 43. The frequency distribution of a continuous variable is known as

- (a) Grouped frequency distribution
- (b) Simple frequency distribution
- (c) (a) or (b)
- (d) (a) and (b).



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CUMULATIVE FREQUENCY

- These are of two types -

Less than type cumulative frequency

More than type cumulative frequency

- At any class interval

Less than type CF + More than type CF = Total frequency



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Class Interval	Frequency	UCB	Less than type CF (A)	More than type CF(B)	Total A+B
44 - 48	3	48.5	3	33	3 + 33=36
49- 53	4	53.5	3+4=7	33-4=29	7+29=36
54- 58	5	58.5	7+5=12	29-5=24	12+24=36
59 -63	7	63.5	12+7=19	24-7=17	19+17=36
64 - 68	9	68.5	19+9=28	17-9=8	28+8=36
69 -73	8	73.5	28+8=36	8-8=0	36+0=36
TOTAL	36				

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Class Interval	Frequency	CB	Less than type CF	More than type CF
44 - 48	3	43.5	0	36
49- 53	4	48.5	3	33
54- 58	5	53.5	7	29
59 -63	7	58.5	12	24
64 - 68	9	63.5	19	17
69 -73	8	68.5	28	8
		73.5	36	0

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FREQUENCY DENSITY

- It may be defined as the ratio of the frequency of that class interval to the corresponding class length.

- $$\text{Frequency Density} = \frac{\text{Class Frequency}}{\text{Class Length of Class}}$$



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Class Interval	Frequency	Class Length	Frequency Density
44 - 48	3	5	$3/5 = 0.6$
49- 53	4	5	$4/5 = 0.8$
54- 58	5	5	
59 -63	7	5	
64 - 68	9	5	
69 -73	8	5	
Total	36		

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RELATIVE FREQUENCY

- Relative frequency of a class interval may be defined as the ratio of the class frequency to the total frequency.

$$\text{Relative frequency} = \frac{\text{Class Frequency}}{\text{Total Frequency}}$$

- Relative frequencies add up to unity



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PERCENTAGE FREQUENCY

- Percentage frequency of a class interval may be defined as the ratio of class frequency to the total frequency, expressed as a percentage.
- $$\text{Percentage Frequency} = \frac{\text{Class Frequency}}{\text{Total Frequency}} \times 100$$
- percentage frequencies add up to one hundred.

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Class Interval	Frequency	Relative Frequency	Percentage Frequency
44 - 48	3	$3/36 = 0.083$	$3/36 \times 100 = 8.33 \%$
49- 53	4	$4/36 = 0.111$	
54- 58	5	$5/36$	
59 -63	7	$7/36$	
64 - 68	9	$9/36$	
69 -73	8	$8/36$	
Total	36	1	100 %

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Que42. A frequency distribution

- (a) Arranges observations in an increasing order
- (b) Arranges observation in terms of a number of groups
- (c) Relates to a measurable characteristic
- (d) All these.



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Que 44. The distribution of shares is an example of the frequency distribution of

- (a) A discrete variable
- (b) A continuous variable
- (c) An attribute
- (d) (a) or (c).



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Que 45. The distribution of profits of a blue-chip company relates to

- (a) Discrete variable
- (b) Continuous variable
- (c) Attributes
- (d) (a) or (b).



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Que 46. Mutually exclusive classification

- (a) Excludes both the class limits
- (b) Excludes the upper class limit but includes the lower class limit
- (c) Includes the upper class limit but excludes the upper class limit
- (d) Either (b) or (c).



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Que 47. Mutually inclusive classification is usually meant for

- (a) A discrete variable
- (b) A continuous variable
- (c) An attribute
- (d) All these.



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Que 48. Mutually exclusive classification is usually meant for

- (a) A discrete variable
- (b) A continuous variable
- (c) An attribute
- (d) Any of these.



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Que 49. The LCB is

- (a) An upper limit to LCL
- (b) A lower limit to LCL
- (c) (a) and (b)
- (d) (a) or (b).



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Que 50. The UCB is

- (a) An upper limit to UCL
- (b) A lower limit to LCL
- (c) Both (a) and (b)
- (d) (a) or (b).



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Que 51. length of a class is

- (a) The difference between the UCB and LCB of that class
- (b) The difference between the UCL and LCL of that class
- (c) (a) or (b)
- (d) Both (a) and (b).



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Que 52. For a particular class boundary, the less than cumulative frequency and more than cumulative frequency add up to

- (a) Total frequency
- (b) Fifty per cent of the total frequency
- (c) (a) or (b)
- (d) None of these.



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Que 53. Frequency density corresponding to a class interval is the ratio of

- (a) Class frequency to the total frequency
- (b) Class frequency to the class length
- (c) Class length to the class frequency
- (d) Class frequency to the cumulative frequency.



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Que 54. Relative frequency for a particular class

- (a) Lies between 0 and 1
- (b) Lies between 0 and 1, both inclusive
- (c) Lies between -1 and 0
- (d) Lies between -1 to 1.



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Que 55. Mode of a distribution can be obtained from

- (a) Histogram
- (b) Less than type ogives
- (c) More than type ogives
- (d) Frequency polygon.



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Que 56. Median of a distribution can be obtained from

- (a) Frequency polygon
- (b) Histogram
- (c) Less than type ogives
- (d) None of these.



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Que 57. A comparison among the class frequencies is possible only in

- (a) Frequency polygon
- (b) Histogram
- (c) Ogives
- (d) (a) or (b).



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Que 58. Frequency curve is a limiting form of

- (a) Frequency polygon
- (b) Histogram
- (c) (a) or (b)
- (d) (a) and (b).



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Que 59. Most of the commonly used frequency curves are

- (a) Mixed
- (b) Inverted J-shaped
- (c) U-shaped
- (d) Bell-shaped.



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Que 60. The distribution of profits of a company follows

- (a) J-shaped frequency curve
- (b) U-shaped frequency curve
- (c) Bell-shaped frequency curve
- (d) Any of these.



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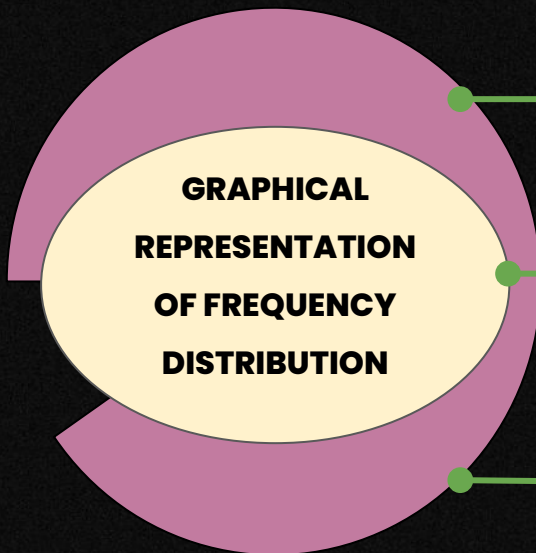
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Histogram / Area Diagram

Frequency Polygon

**Ogives / Cumulative Frequency
Graphs**

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HISTOGRAM / AREA DIAGRAM

- This is a very convenient way to represent a frequency distribution.
- Comparison between frequency of two different classes are possible
- It is used to calculate **MODE**.



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HISTOGRAM / AREA DIAGRAM

STEPS

- ❖ Convert Class limit into Class boundary and plot in X axis .
- ❖ Form rectangles taking class interval as base .
- ❖ Plot Frequency on Y axis .

Take Frequency Density on Y axis in case of Uneven length



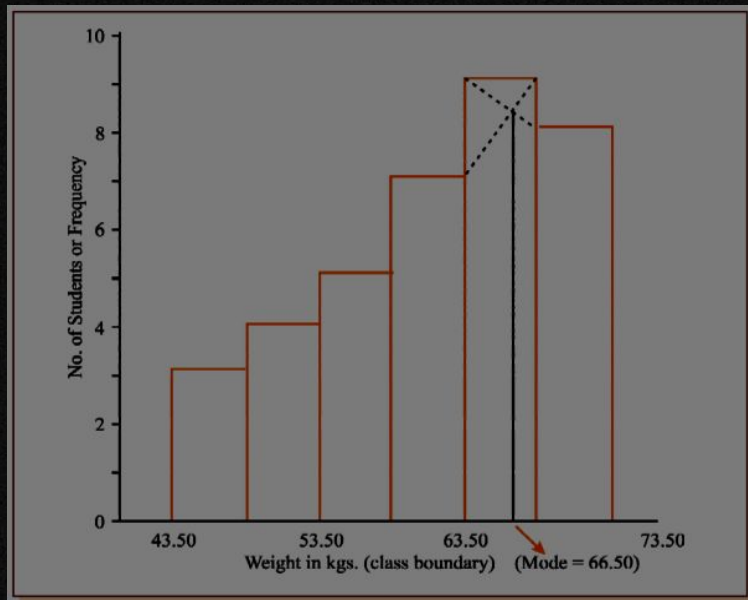
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HISTOGRAM / AREA DIAGRAM

Class Interval	Frequency	LCB	UCB
44 - 48	3	43.5	48.5
49- 53	4	48.5	53.5
54- 58	5	53.5	58.5
59 -63	7	58.5	63.5
64 - 68	9	63.5	68.5
69 -73	8	68.5	73.5
Total	36		



MODE

- **Mode = 66.50 kgs.**

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FREQUENCY POLYGON

- Usually frequency polygon is meant for simple / Ungrouped frequency distribution.
- However, we also apply it for grouped frequency distribution provided the width of the class intervals remains the same.

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FREQUENCY POLYGON

STEPS

- Plot (x_i, f_i) where x_i = class value (ungrouped data) , mid value (grouped data) and f_i is the corresponding frequency .
- Join all plotted points to make line segments which eventually will become a polygon .



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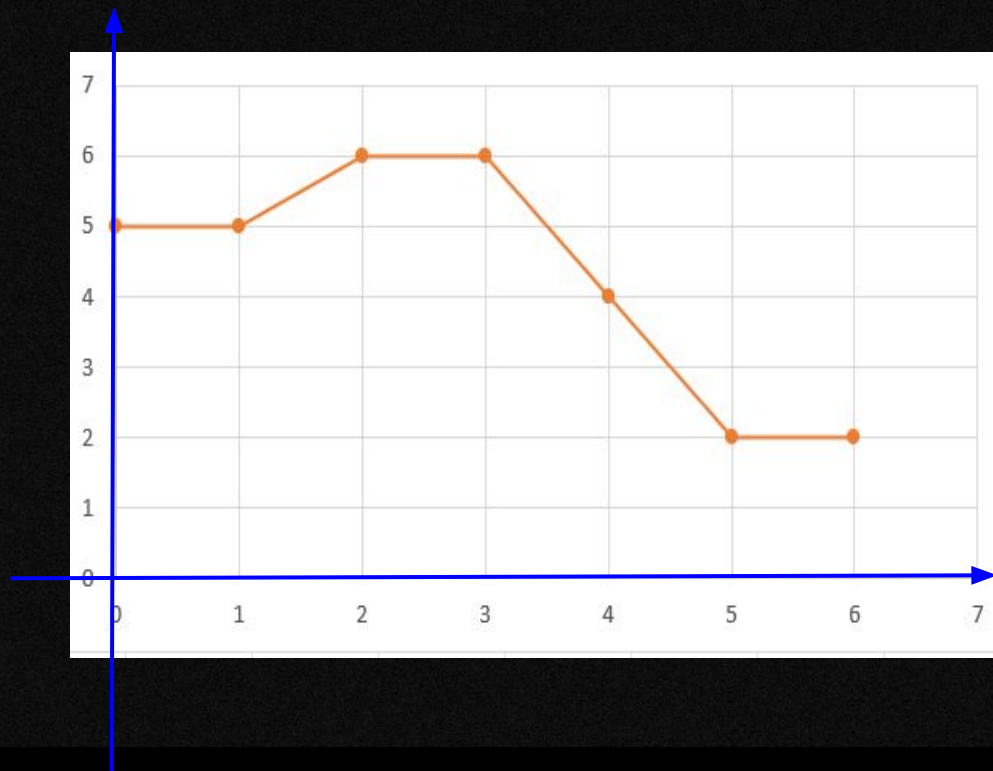
FREQUENCY POLYGON

- We can also obtain a frequency polygon starting with a histogram by adding the mid- points of the upper sides of the rectangles successively and then completing the figure by joining the two ends as before.

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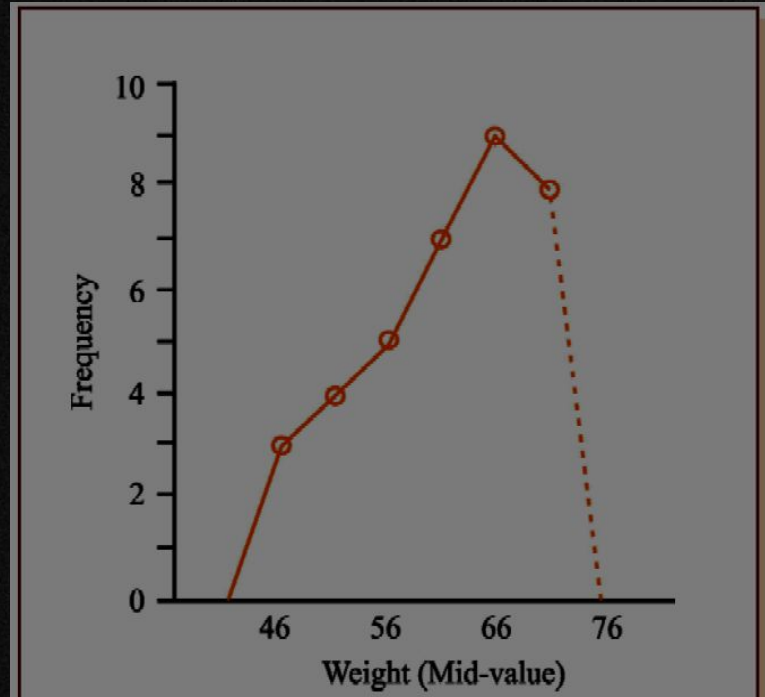
FREQUENCY POLYGON - UNGROUPED FREQUENCY DISTRIBUTION

Observation (x)	Frequency
0	5
1	5
2	6
3	6
4	4
5	2
6	2



FREQUENCY POLYGON - GROUPED FREQUENCY DISTRIBUTION

Mid-points	No. of Students (Frequency)
46	3
51	4
56	5
61	7
66	9
71	8



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OGIVES / CUMULATIVE FREQUENCY GRAPH

- By plotting cumulative frequency against the respective class boundary, we get ogives
- As such there are two ogives – less than type ogives, obtained by taking less than cumulative frequency on the vertical axis and more than type ogives by plotting more than type cumulative frequency on the vertical axis and thereafter joining the plotted points successively by line segments.

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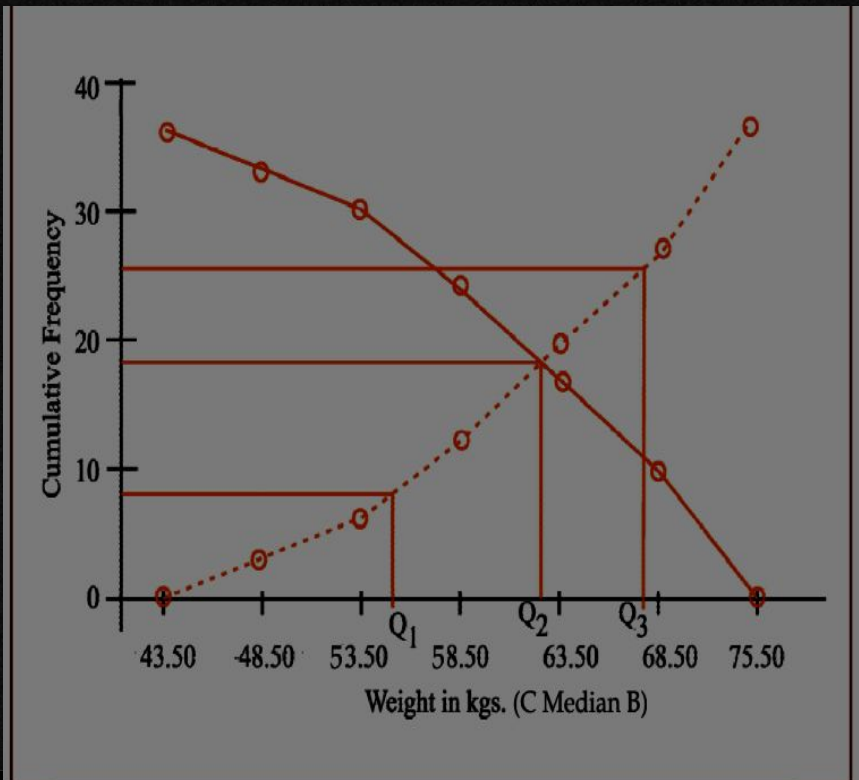
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OGIVES / CUMULATIVE FREQUENCY GRAPH

- **Ogives** may be considered for obtaining **quartiles** graphically.
- If a perpendicular is drawn from the point of intersection of the two ogives on the horizontal axis, then the x-value of this point gives us the value of **median**

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Class Interval	Frequency	CB	Less than type CF	More than type CF
44 - 48	3	43.5	0	36
49- 53	4	48.5	3	33
54- 58	5	53.5	7	29
59 -63	7	58.5	12	24
64 - 68	9	63.5	19	17
69 -73	8	68.5	28	8
		73.5	36	0



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FREQUENCY CURVE

- It is a limiting form of a histogram or frequency polygon.
- The frequency curve for a distribution can be obtained by drawing a smooth and free hand curve through the mid-points of the upper sides of the rectangles forming the histogram.



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FREQUENCY CURVE

BELL SHAPED CURVE

4

J - SHAPED CURVE

U - SHAPED CURVE

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S**

MIXED CURVE



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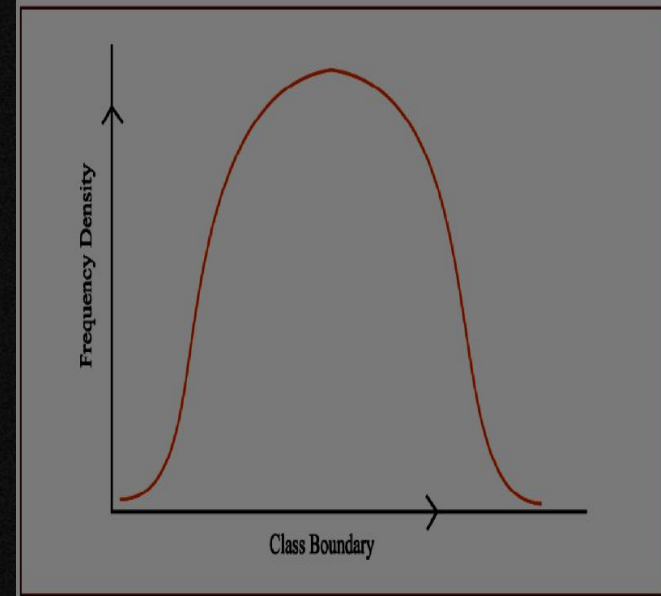
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BELL SHAPED CURVE

- Most of the commonly used distributions provide bell-shaped curve, which, as suggested by the name, looks almost like a bell.
- The distribution of height, weight, mark, profit etc. usually belong to this category.



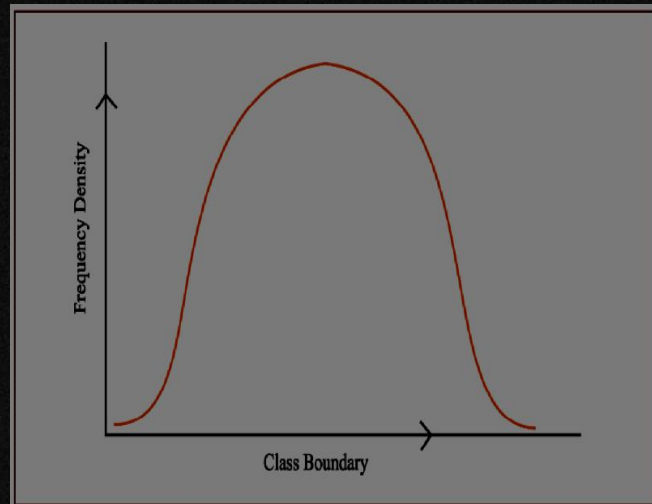
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BELL SHAPED CURVE

On a bell-shaped curve, the frequency, starting from a rather low value, gradually reaches the maximum value, somewhere near the central part and then gradually decreases to reach its lowest value at the other extremity.



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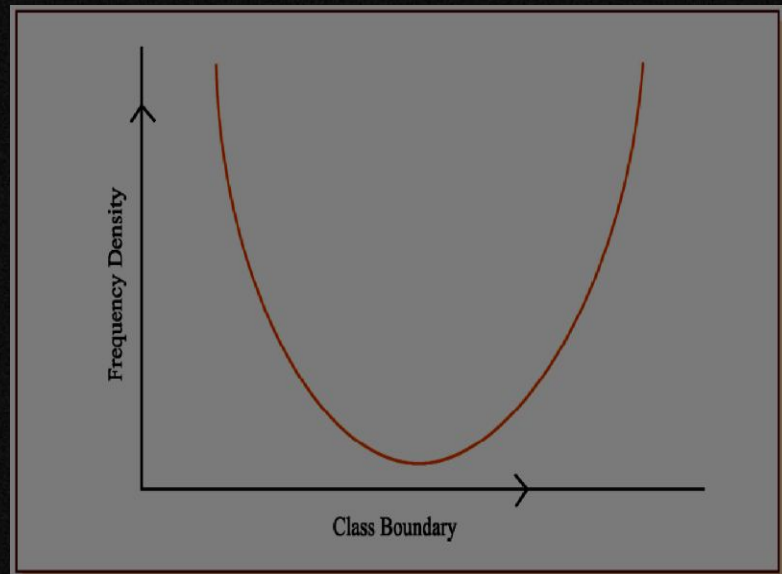
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U - SHAPED CURVE

For a U-shaped curve , the frequency is minimum near the central part and the frequency slowly but steadily reaches its maximum at the two extremities .



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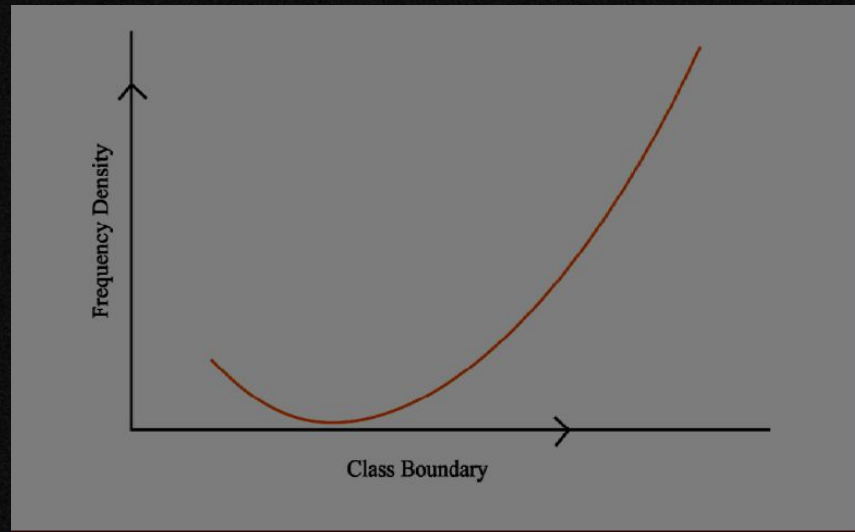
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J - SHAPED CURVE

The J-shaped curve starts with a minimum frequency and then gradually reaches its maximum frequency at the other extremity .



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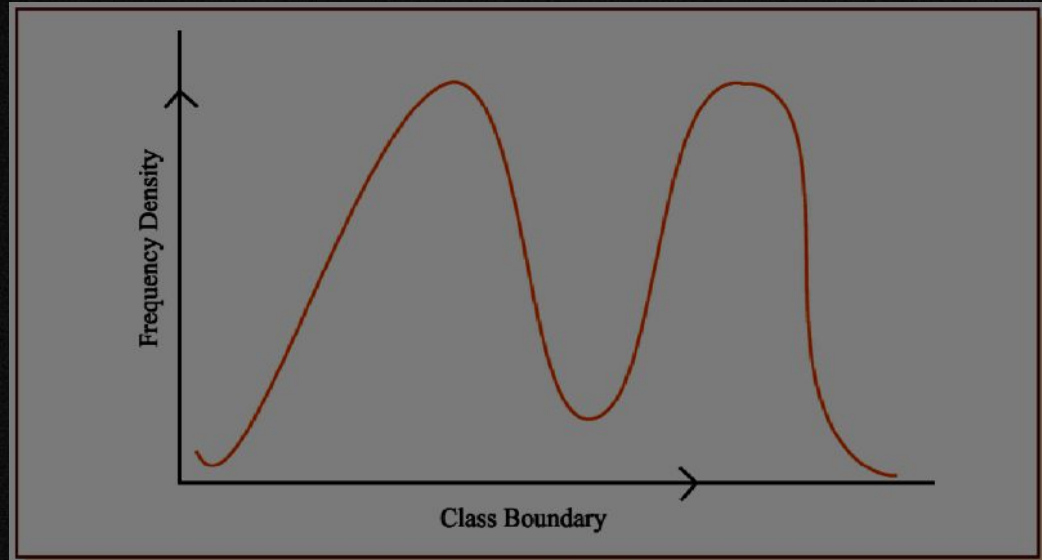
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MIXED CURVE



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SET B

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Que. 1 Out of 1000 persons, 25 per cent were industrial workers and the rest were agricultural workers. 300 persons enjoyed world cup matches on TV. 30 per cent of the people who had not watched world cup matches were industrial workers. What is the number of agricultural workers who had enjoyed world cup matches on TV?

(a) 260

(b) 240

(c) 230

(d) 250

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Que. 2 A sample study of the people of an area revealed that total number of women were 40% and the percentage of coffee drinkers were 45 as a whole and the percentage of male coffee drinkers was 20. What was the percentage of female non-coffee drinkers?

(a) 10

(b) 15

(c) 18

(d) 20

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Que. 3 Cost of sugar in a month under the heads raw materials, labour, direct production and others were 12, 20, 35 and 23 units respectively. What is the difference between the central angles for the largest and smallest components of the cost of sugar?

(a) 72°

(b) 48°

(c) 56°

(d) 92°

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Que. 4 The number of accidents for seven days in a locality are given below :

No. of accidents :	0	1	2	3	4	5	6
Frequency :	15	19	22	31	9	3	2

What is the number of cases when 3 or less accidents occurred?

- (a) 56
- (b) 6
- (c) 68
- (d) 87



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Que. 5 The following data relate to the incomes of 86 persons :

Income in Rs. : 500–999	1000–1499	1500–1999	2000–2499
No. of persons : 15	28	36	7

What is the percentage of persons earning more than Rs. 1500?

- (a) 50
- (b) 45
- (c) 40
- (d) 60



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Que. 6 The following data relate to the marks of a group of students:

Marks :	Below 10	Below 20	Below 30	Below 40	Below 50
No. of students :	15	38	65	84	100

How many students got marks more than 30?

(a) 65

(b) 50

(c) 35

(d) 43



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Que. 7 Find the number of observations between 250 and 300 from the following data :

Value :	More than 200	More than 250	More than 300	More than 350
No. of observations :	56	38	15	0

(a) 56

(b) 23

(c) 15

(d) 8



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