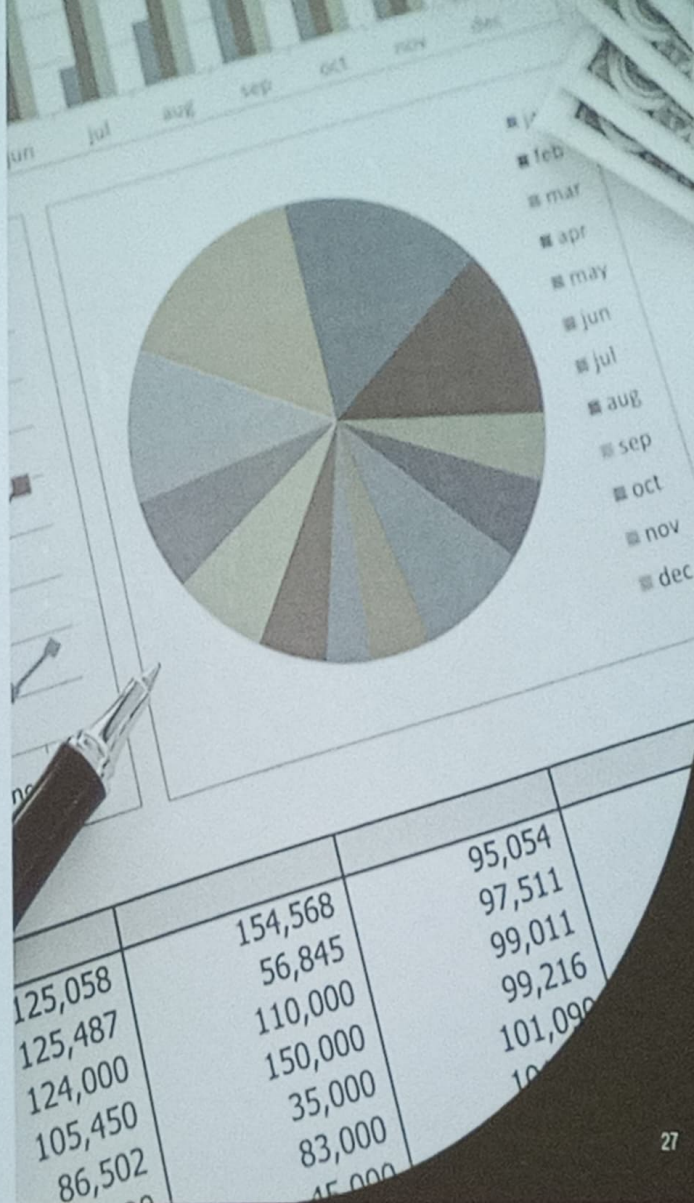
Importance and Scope of Statistics

- In modern times, Statistics is viewed not as a mere device for collecting numerical data but as a means of developing sound techniques for their handling and analysis and drawing valid inferences from them.
- As such it is not confined to the affairs of the State but is intruding constantly into various diversified spheres of life - social, economic and political. It is now finding wide applications in almost all sciences - social as well as physical- such as biology, psychology, education, economics, business management, etc.
- It is hardly possible to enumerate even a single department of human activity where statistics does not creep in. It has rather become indispensable in all phases of human endeavour.

- ***Statistics and Planning*** - Statistics is indispensable to planning. In the modem age which is termed as 'the age of planning', almost all over the world, governments, particularly of the budding economies, are resorting to planning for the econom[illegible]evelopment. In order that planning is successful, it must be based soundly on the correct analysis of complex statistical data.

- Statistics are crucial in a political campaign. Without statistics, no one can run a political campaign with perfection.
- It helps the politicians to have an idea about how many chances they have to win an election in a particular area.
- Statistics also help the news channel to predict the winner of the election.
- It also helps the political parties to know how many candidates are in their support in a particular voting zone.
- In contrast, it helps the country to predict the future government.

- ***Statistics and Economics*** - Statistical data and technique of statistical analysis have proved immensely useful in solving a variety of economic problems, such as wages, prices, analysis of time and demand analysis. Wide applications of mathematics and statistics in the study of economics have led to the development of new disciplines called Economic Statistics and Econometrics.



- Tourism contributes to the GDP of any nation. All the countries can generate revenue through tourism. The statistics used in tourism to find out the number of arrivals, departure, expenditure by the tourist, fatal accidents, facilities, etc.
- The statistics can calc[illegible] all these factors. In addition, statistics help to improve tourism and boost the economy.
- The statistics of how the covid-19 had impacted the hotel occupancy rate in 2020. These statistics help to calculate the market revenue of the USA through tourism.

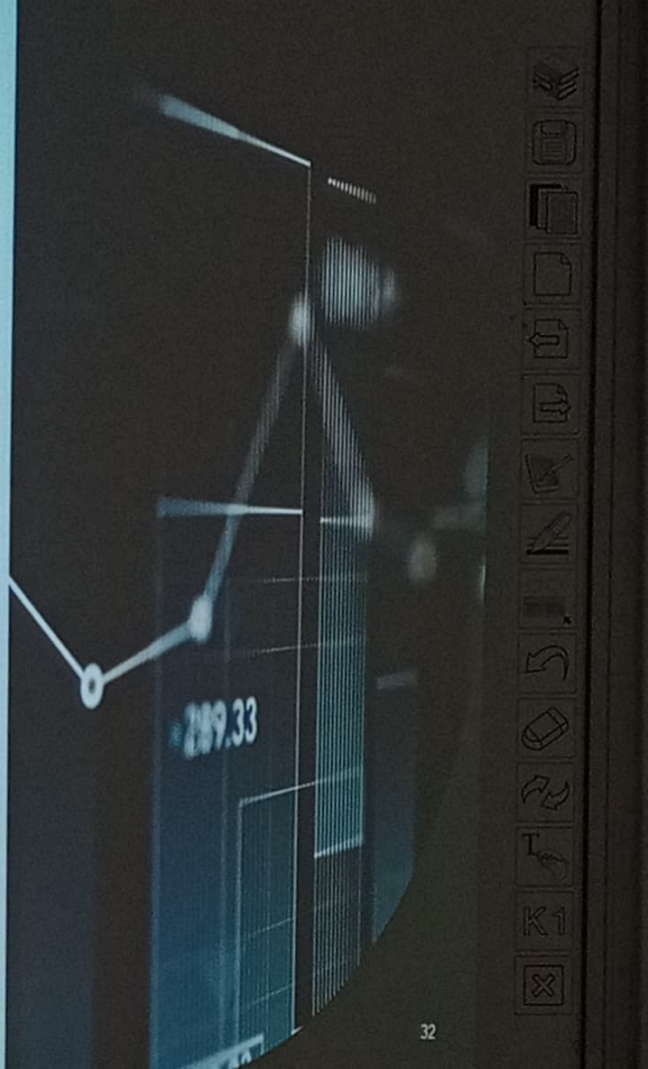
more on statistical techniques for studying the needs and the desires of the consumers and for many other purposes.

Suppose a businessman wants to manufacture readymade garments. Before starting with the production process he must have an overall idea as to how many garments are to be manufactured, how much raw material and labour is needed for that, and what is the quality, shape, colour, size, etc., of the garments to be manufactured. Thus, the formulation of a production plan in advance is a must which cannot be done without having qualitative facts about the details mentioned above. As such most of the large industrial and commercial enterprises are employing trained and efficient statisticians.

Statistics and Industry - In industry, Statistics is very widely used in 'Quality Control' in production engineering, to find whether the product is conforming to specifications or not, statistical tools, viz. inspection plans, control charts, etc., are of extreme importance.

- ***Statistics and Mathematics*** - Statistics and mathematics arc very intimately related. Recent advancements in statistical techniques are the outcome of wide applications of advanced mathematics.

- Statistics may be rega as that branch of mathematics which provided us with systematic methods of analysing a large number of related numerical facts. According to Connor, " Statistics is a branch of Applied Mathematics which specialises in data." Increasing role of mathematics in statistical analysis has resulted in a new branch of Statistics called Mathematical Statistics.



- For instance, statistics can be applied in data acquisition, analysis, explanation, interpretation, and presentation.
- The **uses of statistics** in research can lead researchers to summarization, proper characterization, performance, and description of the outcome of the research.
- Besides this, the medic[illegible] would be less effective without the research to recognize which drugs or interventions run best and how the individual groups respond to medicine.
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- For example, researchers use statistics to know which country did the most test of Covid-19 and how much people got affected with Covid-19. After this, they work as per the protocols of the WHO. And various labs are made for the research of Corona vaccination development.

- Amid the second wave of the coronavirus, India witnessed two cyclones in May 2021, “Tauktae” and “Yaas” in the Gujarat state and West Bengal, respectively.
- The Indian Meteorological Department alerts the citizens before it happens and also announces w places they can affect. All these alerts and announcements they do with the help of statistics.
- Statistics help in disaster management. The response and recovery teams always prefer statistics for getting the population data, services, and infrastructure present in the affected area.

- ***Statistics and Psychology and Education -*** In education and psychology, too, statistics has found wide applications, e.g., to determine the reliability and validity of a test, 'Factor Analysis', etc., so much so that a new subject called 'Psychometry' has come into existence.
- ***Statistics and War -*** In war, the theory of 'Decision Functions' can be of great assistance to military and technical personnel to plan 'maximum destruction with minimum effort'.

- ***Statistics does not study individuals***

Statistics deals with an aggregate of objects and does not give any specific recognition to the individual items of a series. Individual items, taken separately, do not constitute statistical data and are meaningless for any statistical enquiry.

For example, the individual figures of agricultural production, industrial output or national income of any country for a particular year are meaningless unless, to facilitate comparison, similar figures of other countries or of the same country for different years are given.

- ***Statistical laws are not exact***

Unlike the laws of physical and natural sciences, statistical laws are only approximations and not exact. On the basis of statistical analysis we can talk only in terms of probability and chance and not in terms of certainty. Statistical conclusions are not universally true - they are true only on an average.

For example, let us consider the statement:" It has been found that 20 % of a certain surgical operations by a particular doctor are successful." The statement does not imply that if the doctor is to operate on 5 persons on any day and four of the operations have proved fatal, the fifth must be a success. It may happen that fifth man also dies of the operation or it may also happen that of the five operations on any day, 2 or 3 or even more may be successful. By the statement we mean that as number of operations becomes larger and larger we should expect, on the average, 20 % operations to be successful.

- ***Statistics is liable to be misused***
- Perhaps the most important limitation of Statistics is that it must be used by experts. As the saying goes, " Statistical methods are the most dangerous tools in the hands of the inexperts. Statistics is one of those sciences whose adepts must exercise the self-restraint of an artist."
- The use of statistical tools by inexperienced and untrained persons might lead to very fallacious conclusions. One of the greatest shortcomings of Statistics is that they do not bear on their face the label of their quality and as such can be moulded and manipulated in any manner to support one's way of argument and reasoning.
- As King says, " Statistics are like clay of which one can make a god or devil as one pleases." The requirement of experience and skin for judicious use of statistical methods restricts their use to experts only and limits the chances of the mass popularity of this useful and important science.

We discuss below a few interesting examples of misrepresentation of statistical data -

(i) A statistical report: "The number of accidents taking place in the middle of the road is much less than the number of accidents taking place on 'its side. Hence it is safer to walk in the middle of the road." This conclusion is obviously wrong since we are not given the proportion of the number of accidents to the number of persons walking in the two cases.

(ii) "The number of students taking up Mathematics Honours in a University has increased 5 times during the last 3 years. Thus, Mathematics ·is gaining popularity among the students of the university." Again, the conclusion is faulty since we are not given any such details about the other subjects and hence comparative study is not possible.

In statistics, the term measurement is used more broadly a
is more appropriately termed scales of measurement.

Scales of measurement refer to ways in whi
variables/numbers are defined and categorized.

Each scale of measurement has certain properties which
turn determines the appropriateness for use of certa
statistical analyses.

The four scales of measurement are nominal, ordin
interval, and ratio.

Properties of Measurement

Identity: Identity refers to each value having a unique meani

Magnitude: Magnitude means that the values have an ord

one another, so there is a specific order to the variables.

- Equal intervals: Equal intervals mean that data points a

equal, so the difference between data points one and two

the difference between data points five and six.

Properties of Measurement

Identity: Identity refers to each value having a unique meaning.

Magnitude: Magnitude means that the values have an ordered relationship to one another, so there is a specific order to the variables.

- Equal intervals: Equal intervals mean that data points along the scale are equal, so the difference between data points one and two will be the same as the difference between data points five and six.
- A minimum value of zero: A minimum value of zero means the scale has a tru zero point. Degrees, for example, can fall below zero and still have meanin But it is not true in case of weight measurement.

- Examples of nominal data include eye colour and country of birth. Nominal data can be broken down again into three categories:
- **Nominal with order:** Some nominal data can be sub-categorised in order, such as "cold, warm, hot and very hot."
- **Nominal without order:** Nominal data can also be sub-categorised as nominal without order, such as male and female.
- **Dichotomous:** Dichotomous data is defined by having only two categories or levels, such as "yes' and 'no'.

2. Ordinal scale of measurement

- Ordinal Scale is defined as a variable measurement scale used to simply depict the order of variables and not the difference between each of the variables. These scales are generally used to depict non-mathematical ideas such as frequency, satisfaction, happiness, a degree of pain, etc. It is quite straightforward to remember the implementation of this scale as 'Ordinal' sounds similar to 'Order', which is exactly the purpose of this scale.
- An ordinal scale of measurement represents an ordered series of relationships or rank order.

- Fundamentally, these scales do not represent a measurable quantity. An individual may respond 8 to this question and be in less pain than someone else who responded 5. A person may not be in half as much pain if they responded 4 than if they responded 8. All we know from this data is that an individual who responds 6 is in less pain than if they responded 8 and in more pain than if they responded 4. Therefore, Likert-type scales only represent a rank ordering.
- The ordinal scale defines data that is placed in a specific order. While each value is ranked, there's no information that specifies what differentiates the categories from each other. These values can't be added to or subtracted from.

1. Here, the order of variables is of prime importance and so is the labeling. Very unsatisfied will always be worse than unsatisfied and satisfied will be worse than very satisfied.

2. This is where ordinal sca[illegible] step above nominal scale – the order is relevant to the results and so is their nam[illegible]

3. Analyzing results based on the order along with the name becomes a convenien process for the researcher.

4. If they intend to obtain more information than what they would collect using a nomina scale, they can use the ordinal scale.

This scale not only assigns values to the variables but also measures the rank or ord of the variables, such as:

3. Interval scale of measurement

- The interval scale contains properties of nominal and ordered data, but the difference between data points can be quantified. This type of data shows both the order of the variables and the exact differences between the variables. They can be added to or subtracted from each other, but not multiplied or divided. For example, 40 degrees is not 20 degrees multiplied by two.

- This scale is also characterized by the fact that the number zero is an existing variable. In the ordinal scale, zero means that the data does not exist. In the interval scale, zero has meaning – for example, if you measure degrees, zero has a temperature.
- Data points on the interval scale have the same difference between them. The difference on the scale between 10 and 20 degrees is the same between 20 and 30 degrees. This scale is used to quantify the difference between variables, whereas the other two scales are used to describe qualitative values only. Other examples of interval scales include the year a car was made or the months of the year.

4. Ratio scale of measurement

- Ratio scales of measurement include properties from all four scales of measurement. The data is nominal and defined by an identity, can be classified in order, contains intervals and can be broken down into exact value. Weight, height and distance are all examples of ratio variables. Data in the ratio scale can be added, subtracted, divided and multiplied.

- Ratio scales also differ from interval scales in that the scale has a 'true zero'. The number zero means that the data has no value point. An example of this is height or weight, as someone cannot be zero centimetres tall or weigh zero kilos – or be negative centimetres or negative kilos. Examples of the use of this scale are calculating shares or sales. Of all types of data on the scales of measurement, data scientists can do the most with ratio data points.

Types of Data

Quantitative

Data that can be measured with numbers, such as duration or speed

Discrete

Whole numbers that can't be broken down, such as a number of items

Continuous

Numbers that can be broken down, such as height or weight

Interval

Numbers with known differences between variables, such as time

Ratio

Numbers that have measurable intervals where difference can be determined, such as height or weight

Qualitative

Non-numerical data that is categorical, such as yes/no responses or eye colour

Nominal

Data used for naming variables, such as hair colour

Ordinal

Data used to describe the order of values, such as 1 = happy, 2 = neutral, 3 = unhappy