A Study on the Application of Statistical Tools and Techniques in the Research Analysis

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Abstract

Statistics is a branch of Mathematical science which deals with data collection, its systematic organising and analysis with the random sample of the total population. Statistics tools is very much applicable in the research process to find accurate solution to a long pending problem.

The data related to the problem shall be gathered either from primary or secondary sources and it will be arranged in the prescribed tabular form and it should be analysed with the support of statistical tools and techniques. The results arrived shall be discussed with empirical figures and observations and findings. Statistics in research will support for the data analysis. It helps to researchers to arrive for the accurate results. Therefore, every researcher must have the knowledge of statistics and on the application of statistical tools to the data organised. The results arrived on the data analysis is the base for the interpretation and discussion which is main part of the thesis or dissertation.

In this paper the concepts of statistics, methods of various statistics, its significance in the research data analysis, usage of various statistics tools and techniques, procedure of data collection sources, selection of sample size, its' systematic organisation of data analysis, arriving results, discussion of the results has been explained.

The research format, procedure of research, Review of literature, types of research, framing of objectives, and formulating of Hypothesis, testing of Hypothesis, limitations of research also will briefly be discussed in this paper.

Required information pertaining to this paper has gathered from various research papers, articles, journals, statistical reference books, with regard to procedures, types of various statistical tools and techniques applied, various types diagrams, graphical images, histograms, pictograms also has been discussed for the understanding of the researchers.

Keywords: *Statistical analysis, data collection, research analysis, framing of objectives, formulation of hypothesis, statistical tools and techniques, results discussion.*

Introduction

Research study is the process of gaining a subject knowledge and to find an accurate solution to the long pending problem. Research is an analytical study basing on the data collected pertaining to the problem from field level respondents and through the systematic organisation of data, its processing, analysing with selected tools and techniques and finally discussing the results arrived.

Definitions, Meaning and Concept of Statistics

"The Science of Statistics is essentially a branch of applied mathematics and may be regarded as mathematics applied to observational data".

Sir Ronald Alymer Fisher

"It is a Scientific and systematic research for information on a topic or a problem. It is also known as the art of scientific investigation".

Dr. G. Naveen Kumar, Dr. G. Venkata Reddy

As defined by Redman and Mory in 1923, research is a systematized effort to gain new knowledge. It is an academic activity (Mini projects, Major projects and report writing) and therefore the term should be used in a technical sense (t-test, Z-test, ANOVA, Chi-Square test, Correlation and regression analysis).

As stated by Clifford Woody the research is 'search and research' 'define or redefine' the problem for the solution through the formulation of Hypothesis, collection of data, organising and the evaluation of data and reaching the conclusions. During the testing of the hypothesis, and the relevant data; the role of the tools and techniques are crucial. Therefore, the Research and statistics are closely interrelated. Without the application of statistical tool and techniques, graphs, diagrams no research work is possible. It is trouble shooting process. Research is an analysis of problem and

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finding a solution to the problem through the statistical tools and techniques.

During the process of research, first the collected data must be shown in a tabular form which is termed as 'tabulation' and it should be analysed with the concerned tools and techniques of the statistics. Also, the data related to the problem must also be shown through the graphical images, bar-diagrams, multiple-bar diagram, pie charts, histogram and pictograms, charts and graphical charts for easy understanding and the awareness of the data analysis to the viewers.

Next part of the research is framing the objectives. It is a planning and a road map to our research journey. Our research process shall be decided by the 3 to 5 objectives. Research process and plan of the study and chaptalization depend on the objectives which we have framed.

Further, to process our research, the suitable methodology should be followed. In the part of methodology, source of data collection, either on primary source or on secondary source shall be specified. Selection of source is depending on our researchable topic, availability of data etc. Next sampling techniques play an important role. Sampling with regard to the selection of population, method of study, selection of area, selection of product, institutions. Choosing of suitable sampling should be selected according to the capability, availability of resources, time, availability of the nature of data etc.

Selection of statistical tools and the method of research or findings the, researcher requires, that appropriate statistical tools and techniques shall be applied for the data analysis.

Scope of Research

The scope of the research is not confined to a particular event, to particular time, to a particular product, industry, or an institution. Every topic, field, in the earth is researchable one. Limits or boundaries cannot be fixed, and the research is like "seven oceans" ($3/4^{th}$ of earth is water) and the research has no end just as broad as the sky. Irrespective of it's size, of place, of product, institution, everything is researchable. Research is in general sense, to know about it in depth by thorough searching and how it is useful for the human society.

Objectives of Research

Research is useful to find a solution to a long pending problem basing on the data collected from various sources and through the data processing and data analysis applying various statistical tools. Every type of research has its own specific objective.

a) To examine the association or effect between two variables (by hypothesis testing).
b) To analyse the frequency of occurrence of an event or condition (diagnosis research).
c) To identify specific features or characteristics of a particular individual, group or situation (Descriptive Research)
d) To gain familiarity with new findings or observations related to a problem (formulative research)

Types and Methods of Research

a) Fundamental Research
b) Applied Research
c) Qualitative Research
   D. Quantitative Research.
d) Mixed Research.
e) Exploratory Research.
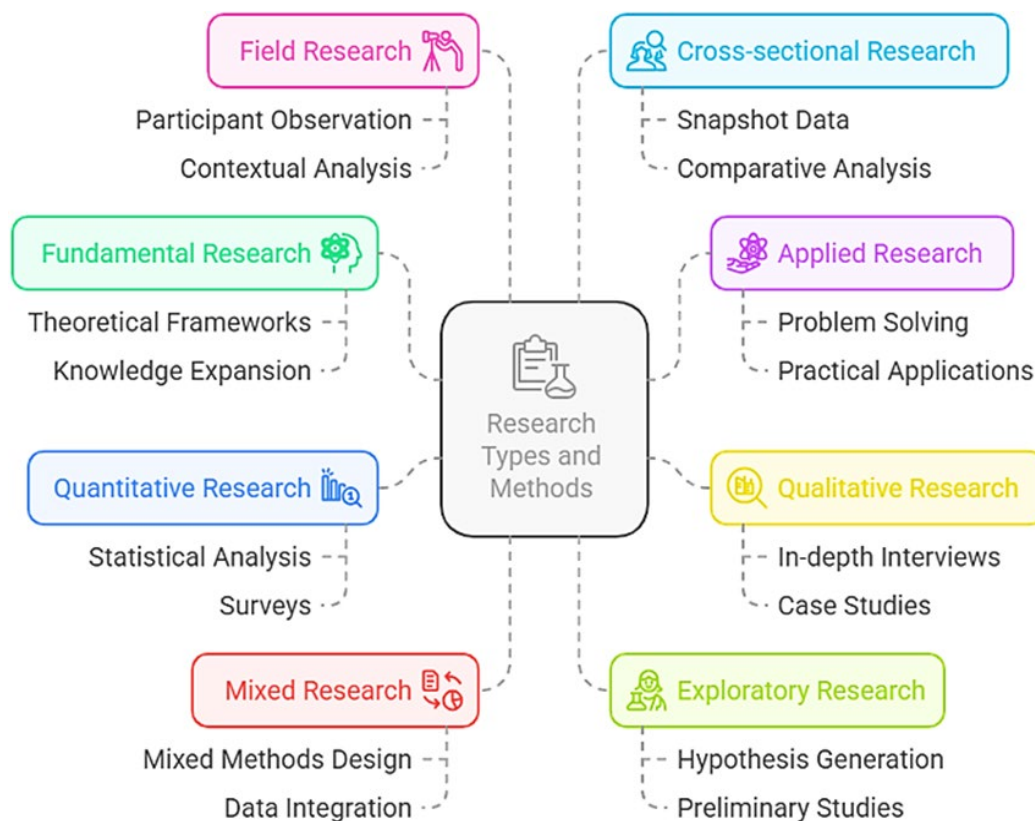f) Field Research.
g) Cross sectional Research.

Fig 1: Research Types and Methods

Research Process

The process of research in the following steps or in stages or in phases. Through which the journey of research will continue up to reaching of research objectives and goals. It is like a flow chart of Research journey.

i). Identifying a research problem

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ii).   Review of Literature
iii). Developing hypothesis
iv). Preparing Research Design
v).   Selection of sampling
vi). Collection of data either primary or secondary sources.
vii). Execution of the project

viii). Analysis of data
ix). Testing of Hypothesis
x).   Interpretation of data
xi). Preparation of report
xii). Conclusions, summary and findings, suggestions

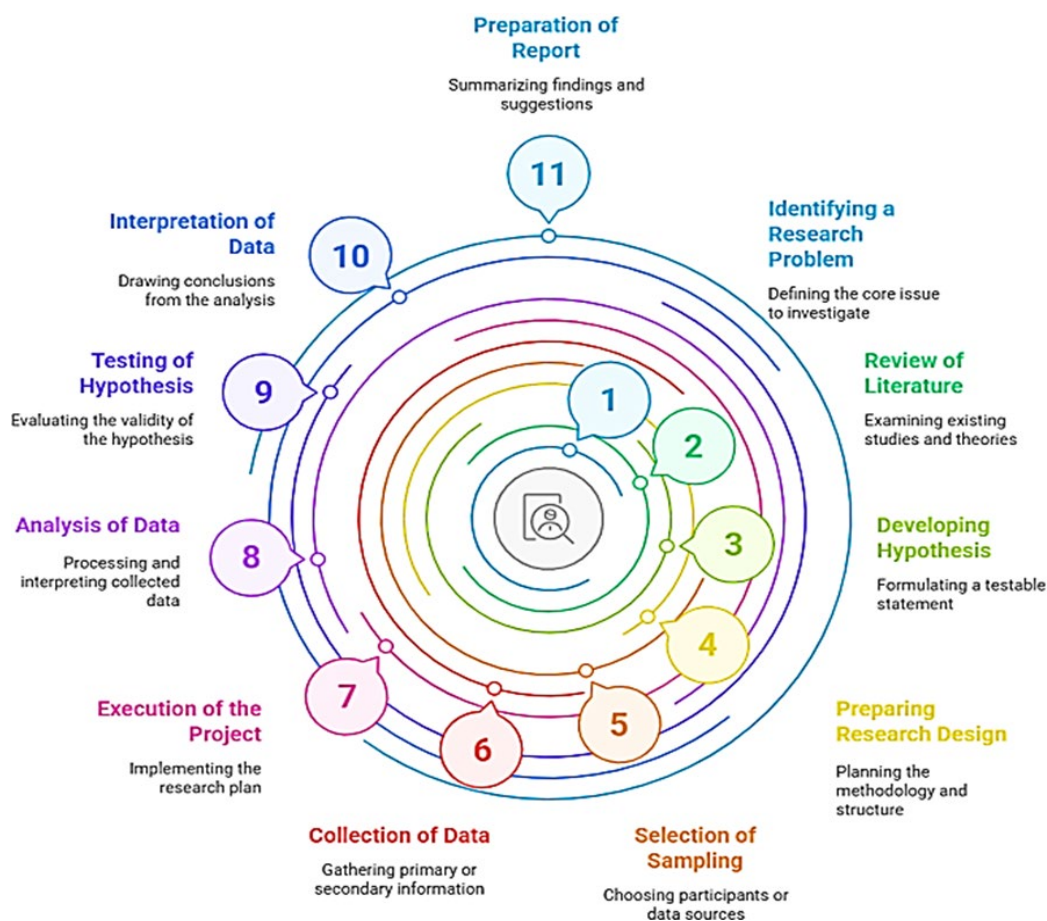**Fig 2:** Comprehensive Research Process Overview

Importance Objectives, and Hypothesis in Research:
In a research paper of a field or topic for a solution to the problem, various components are to study to have a base for the research like
i).   Introduction of the field or topic to study.
ii). Its significance,
iii). History of previous studies,
iv). Sum up the literature,
v).   Research gap,
vi). Statement of the problem etc.,

All these must be linked up with one another and closely related, with regard to the present research on a problem.

Objectives
The present research should be routed through the "objectives" as road map. Generally, 4 or 5 Objectives will be fixed to guide the researcher to plan the complete the research. For each objective one chapter may be allotted. Without the framing the objective, research may not be in a systematic manner.
Objectives will show a clear-cut direction for a smooth going of research. Objectives will decide the plan study of our PhD thesis or M. Phil Dissertation.
Plan of study is nothing but the total chapters of thesis. In how many chapters the research will be completed the objectives (Scope of the study) will decide. Therefore, the

framing of objectives should be very careful keeping in view of scope study, nature of research problem. If these objectives fixed, major part of research will be fulfilled.

Objectives of the Study
i).   To introduce and create awareness on the Research analysis process
ii). To introduce statistical method of application for the data analysis and its significance.

Hypothesis
Another important component of Research is 'Hypothesis' with regard to the research problem. "Hypothesis is reasonable guess based on the probability. It specifies the relationship between at least two variables and are to be testable".
Hypothesis is a tentative predictive statement which shall be tested with the statistical tool 'Chi-square test' Hypothesis classified into 7 forms, but mainly used in two types 1. Null Hypothesis (H_0)2. Alternative Hypothesis (H_1) used in the research works.
In the testing of Hypothesis, it may be proved the statement or may not be proved but the testing of Hypothesis is mandatory, this part of component is very important part in any research work. Findings and observations of the research shall be arrived with the hypothesis testing. It is one way a solution to the research problem.

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Forms of Hypothesis, Features & Functions

Table 1: Types of Hypotheses: Forms, Features, and Functions.

S. No.	Forms	Features	Functions
1.	Simple Hypothesis	Power of prediction	Directs the Research
2.	Complex Hypothesis	Close to observe	Acts as Guide
3.	Empirical Hypothesis	Simplicity	Save time, money
4.	Null Hypothesis (H_0)	Clarity	Answer the question
5.	Alternative (H_1)	Testability	Avoids blind research
6.	Logical Hypothesis	Relates to problem	Selects required facts
7.	Statistical Hypothesis	Tentative	Link theory & research

Research Design Concept, Meaning, Definition

- "Research Design is a conceptual structure within which the research shall be conducted".
- According to Green and Tull, "Research is the specification of methods and procedures for acquiring the information needed".
- "It is overall an operational framework of the project which stipulates the method from which needed information be collected".
- "Research design is an important as it guides and directs the researcher to identify the correct method of data collection".
- "A Good research design is characterised by its flexible and effectiveness and suitability".

Significance of Research Design

Table 2: Importance of Research Design in Research Process.

S. No	Significance of Research Design
1	It minimises inconsistency.
2	Helps to get maximum efficiency.
3	It minimises the wastage of time.
4	It is helpful in collecting research materials.
5	It is helpful for testing hypothesis.
6	It guides the researcher in the right direction.
7	It gives the idea of resources like money, manpower, time, and efforts.
8	It facilitates the smooth sailing of the various research operations.
9	It provides an overview to other experts.
10	It stands for advance planning for data collection keeping in view of the research objectives.

Methodology

In this part, the data collection methods and sources will be explained whether on primary or secondary source.

If it is done on primary sources for the data collection, the methods will be explained directly from the respondents through a well-structured questionnaire by online electronic methods or by physical approach, and through personal or phone interview methods., and by observation methods. These are the primary sources of data collection.

Next the data collection from the secondary sources, published sources i.e. research papers, articles, reference books, and annual reports of the various organisations, like banks, corporate business organisations and through the website's storage information are the best example. This source of the data is not collected either from the field or from the respondents. It has already been collected, processed and preserved as annual reports, periodical returns of the organisation.

And also available in the research papers, articles already published in Journals and magazines and published as analysis in the Business magazines. Newspapers and also from the survey reports. Ex: Population Census survey, Covid treatment survey report, Polio vaccine and results survey reports.

How the required data collected and from what source collected, should be mentioned in this part for the sake of information to the readers to assess the goodness, genuine of the data. According to the sources of the data collection, its statistical analysis method also depends for the primary and secondary separately.

Method of sampling also be selected according nature research for Ex: case study, empirical study, review method study or conceptual study, incident or accident, crime investigation, on specific problem etc., for finding cause for ill-health issue.

The population, the organisation, the product, and the service, institution, crime incident, accident, blood sample, etc., like that sample should selected for the investigation or research.

Sampling – Methods of Sampling-Techniques

Sample is a subset of the population. It represents the whole or particular group or class of population which contains the characteristics, features or qualities selected group or class of population for a testing. Ex: to diagnosis of a medical complaint or a disease a drop of blood, urine shall be examined and not required to take heavy quantity of blood or urine.

Methods of Sampling Techniques
Random and Non-random Sample

A research population usually, it's a large collection of individuals or objects that is the main focus of a scientific problem. A research population is also known as a well-defined collection of individuals or things known to have similar features. The following are the some of the important methods of sampling.

i). **Simple Random-Sampling:** It is a type of probability sampling in which the researcher selects a particular object as subset of group or class. Every individual in the population has an equal chance of being selected.

ii). **Systematic Sampling**: It is a type of probability sample method in which sample members from a large population selected according to random starting point but with a fixed or periodical interval.

iii). **Stratified Sampling:** It is a method which involves dividing the entire population into homogeneous group called strata.

iv). **Cluster Sampling:** It is a probability sampling technique where researcher divide the population into multiple groups. Ex: According to caste, community, profession, occupation, educated or non-educated, gender wise, income wise, higher income, lower income, middle class, lower middle, upper middle like that among total population.

v). **Convenient Sampling:** Convenience sampling (also known as accidental sampling, opportunity sampling is a

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type of non-probability sampling. This type of sampling is most useful for pilot testing.

vi). **Quota Sampling:** Quota sampling is known as non-probability sampling method in which researcher create a sample involving individuals that represents a population. They decide and create quotas so that the market research samples can be useful in collecting the data EX: Among

the population a set of section people., old age, children, Male or female above 40 yrs of age

vii). **Judgement Sampling:** It is also known as Purposive or judgemental or selective or subjective wise is a form non probability sampling. It means particular group Ex: Intellectual; Non-intellectual Skilled or unskilled, software or hardware and teachers' scientists, employees, students like that. Technical and non-technical.
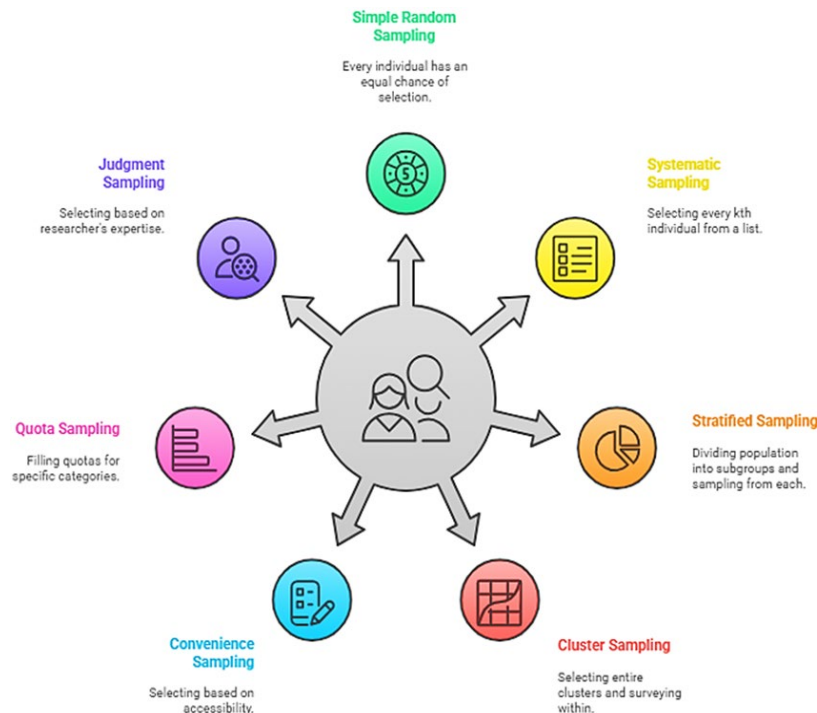

Fig 3: Sampling Techniques

Data Analysis and Data Processing
Once the data collected related to the statement of the problem and broad field of research shall be filtered and unnecessary data should be eliminated and with the purified data shall be arranged in an organised table with necessary rows and columns under a suitable caption to the table.

The entire process is called tabulation. After the tabulation of the data completed, the data shall be analysed, applied the principle of the concerned statistical tool. The results obtained from the data should be thoroughly interpreted and discussed to derive meaningful insights and conclusions.

This is the data analysis and processing of the raw data when the raw data processed, it will give the useful and meaningful information. This process is very important in the research analysis.

Objective
Statistical Tools and Techniques to be used in Data Analysis
After the tabulation process is over of the entire data related to demographic, and related to the main research problem, broad field of subject with the suitable titles and with the specific columns and rows, the data tabulated shall be analysed tested with the relevant statistical tool according to the nature of research, nature of data collected and nature of the problem of research.

Averages and percentages of the data shall be the initial analysis under the Measures of central tendency and Dispersion.
i). Arithmetic Mean
ii). Median

iii). Mode
iv). Dispersion
v). Skewness and
vi). Kurtosis

Central Tendency Calculations
Measures of central tendency, Arithmetic Mean, Median and Mode indicates the central position of series. They indicate general tendency of the data but fail to reveal all the peculiar, special characteristics of the series and the degrees of spread out or the extent of variability.

Objects of Central Tendency
i). The first object of central tendency is to calculate an average or measuring central tendency is to determine a single figure which will represent the entire data.
ii). The second object is that an average represents the entire data which facilitates the comparison of within a group or between groups of the data.
iii). And the third object is that an average helps in computing various other statistical measures such as dispersion, skewness and kurtosis.

Classification of Data
The data collected either from the Primary or secondary sources is known as raw data or unorganised data and same should be organised in a systematic manner or in a meaningful manner attractively in order to facilitate to analyse statistically. Therefore, the investigator who collected the raw data from respondents in a field must show it in a condensed

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manner into a classified method into different segments, classes or groups. Then it is called as classification.

Tabulation is concerned with a systematic arrangement of collected and classified data in an organised table with a title under specific columns and rows. Those tables must be given the serial number like Table1 or table 2 at a top with the description of table content. At the bottom of the table source of the data as field or secondary source should be mentioned
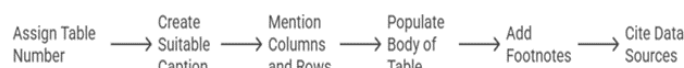
Objects Advantages of Classification
Main Objects of Classification of Table
i). It condenses the mass data showing it meaningfully.
ii). It eliminates unnecessary waste data.
iii). It facilitates comparison and highlights the significant aspect of data.
iv). It enables one to get clear picture of the information to draw the inferences.
v). It helps in the statistical treatment of the information collected.

Types of Classification
a) **Chronological:** In Chronological classification the collected data are arranged according to the order of time expressed in years.
b) **Geographical:** In this geographical classification, the data collected shall be arranged according to the geographical location, or area or place.
c) **Qualitative:** In this Qualitative classification data shall be shown on the basis of certain attributes or quality like sex, literacy, income, qualification, employment.
d) **Quantitative:** In Quantitative classification, data is organized based on measurable characteristics or attributes of human beings, such as height, weight, chest size, and abdominal measurements.
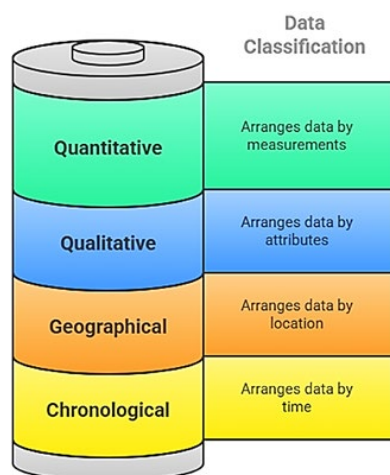

Fig 4: Types of Classification

Tabulation of Data
Tabulation is the process of systematic summarised, classified or grouped data. The data arranged in a table with some certain columns and rows. Every table shall be assigned a serial number. And title of the table reflecting the nature of data shall be fixed at the centre of the top od table and the left side of bottom of the table the Source of the data shall be mentioned.

Features of the Table
a) Table Number should be assigned
b) Suitable Caption of the Table
c) Mentioning the cols. and rows. With captions
d) Body of the table.
e) Footnotes
f) Sources of the data.

Fig 5: Features of the table

Advantage of the Tables
a) The data shall be arranged attractively and meaningfully
b) It facilitates the comparison of the data
c) Tabulated data are good for references and they made it easy
d) Basing on the data shown statistical calculations can easily be made like averages, percentages, correlation, and dispersion etc.,
e) It has simplified the complex data.

Types of Tables
Tables can be classified as follows:
a) Simple or One way table
b) Two Way table
c) Manifold table

Graphical Representation of Data
The collected data one tabulated and statically analysed with tools and techniques shall be represented to show with a graphical image as shown below for easy understanding of the viewers.
i). Bar diagram (one dimensional, two dimensional, Three dimensional or multi-dimension)
ii). Pie charts
iii). Frequency Polygon
iv). Histogram
v). Pictograms
vi). Line Graph
vii). Scatter plot
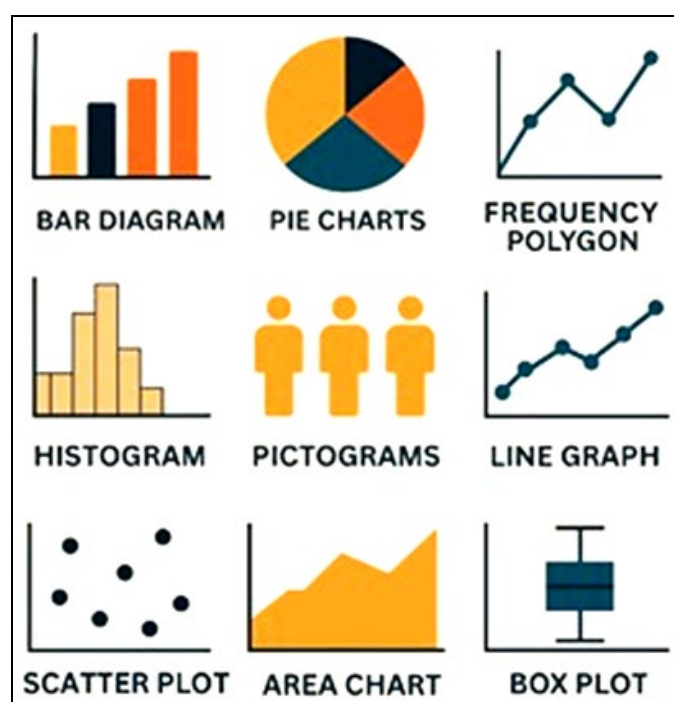viii). Area Chart
ix). Box Plot

Fig 6: Types of Graphical Data

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Correlation

The concept is widely used, often without recognizing that it's known as Correlation. Ex: when comparing two variables Income & expenditure, Hard Work & good result, Target & Actuals., Age & weight of individuals., Age & Height of individuals, Jobs & Qualifications, jobs & salaries.

The study related to the features and qualities of wages, age, height, weight is known as univariate analysis of variables. The statistical analysis related to the study of the relationship between two variables is also known as 'Bivariate Analysis"

Correlation is a statistical method used to measures and analyses the degree to which two variables move in relation to each other. It helps in identifying the strength and direction of a linear relationship between variables but does not establish a cause-and -effect relationship. For example, the price of a product may impact its supply. Similarly, manufacturing targets are often determined based on product demand.

Definition

According to Croxton Cowden,

"When the relationship of a quantitative nature the appropriate statistical tool for discovering and measuring the relationship and expressing it in a brief formula is known as Correlation"

As defined by A. M. Tuttle.,

"Correlation is an analysis of the co-variation two or more variable".

Types of Correlation

Correlation shall be classified as follows:
i). Positive and Negative,
ii). Simple and Multiple,
iii). Partial and Total,
iv). Linear and Non-Linear.

Advantages of Correlation

The following are the uses of Correlation
a) It can be applied across various disciplines, including Physical sciences, social sciences, economics, biology, psychology and more.
b) It enables researchers, statisticians and economists to identify and measure the strength and direction of the relationship between two or more variables.
c) Correlation facilitates the estimation of sampling error, which is essential in assessing the reliability of data and results.
d) It helps quantify the degree of association between variables such as income and expenditure, price and demand, or supply and demand.
e) Correlation serves as the foundation for regression analysis, which goes a step further to predict the values of one variable based on another.

Time Series Analysis

Statistical data that is collected and recorded along with the time of its occurrence is known as Time Series Data. When data such as industrial output or agricultural yield is recorded periodically-say, every year over the last five years-it is referred to as a yearly time series.

"Time series is defined as a sequence of data points measurement at a consistent time intervals over a period of time".

Data Collected on ad-hoc or irregular basis does not fall under time series.

Time series analysis is widely used in statistics for evaluating trends, patterns, and fluctuations in variables over time. For instance, it can be effectively applied to analyse.
- Industrial output over the years
- Agricultural production trends
- Sales returns of a company in periodic intervals (e.g., monthly, quarterly, or yearly)

Such analysis helps in forecasting future values and making informed decisions based on historical trends.

The Elements & Components Time Series:

The factors that cause changes in a time series over time are known as the components of time series. These components help in understanding and analysing the underlying patterns and behaviours in data collected over regular intervals. The four main components are:
a) Secular Trends (Or General trends)
b) Seasonal Movements
c) Cyclical Movements
d) Irregular or erratic trends

Benefits of Applying the Time Series

Time series analysis serves various purposes in statistical, economic, and business contexts. It helps organizations track performance, identify trends, and forecasts. The major applications of time series analysis include:
a) **Descriptive Analysis:** Used to visualize trends and patterns over time with the help of line graphs, bar charts, or other graphical tools.
b) **Spectral Analysis:** Also known as frequency domain analysis, it separates cyclical or periodic components within a time series. This is especially useful in fields like signal processing or economics.
c) **Forecasting:** A crucial tool in business decision-making, forecasting uses historical data to predict future values-such as production levels, turnover and profit targets.
d) **Intervention Analysis:** Used to assess the impact of an event or intervention over time. *Example: Evaluating employees' performance before and after a training program.*
e) **Explanative Analysis:** This examines the relationship between two or more time series to understand how one influences the other. *Example: Analysis the relationship between employee training session and employee turnover rates.*

Regression Analysis

It is a statistical tool used to determine the significant and probable change in one variable based on the known change in another. In simple terms, it allows us to predict the value of an unknown variable from the value of a known variable. This prediction is based on the regression line, a single line that best fits the data-meaning it minimizes the overall distance (errors) between the data points and the line.

The regression line reflects the strength and direction of the relationship between variables. It is especially useful when we want to understand how one variable influence another.

While both correlation and regression analyse the relationship between variables, they differ in the following key ways:
i). **Purpose:**
- Correlation measures the degree of relationship (how strongly X and Y move together).

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- Regression explores the nature of the relationship, often with the goal of prediction.

ii). Cause-and-effect:
- Correlation does not imply causation-it cannot confirm whether one variable causes change in the other.
- Regression, however, is more directional and can suggest a cause-and-effect relationship, identifying which variable is dependent and which is independent.

Regression analysis is widely used across all scientific disciplines for analysing and modelling relationships between variables. In economics, it plays a crucial role in estimating and measuring the strength and direction of such relationships.

For example, regression can be used to study the relationship between:
- Rainfall and agricultural crop yield
- Price of an input and the overall cost of a product
- Consumer expenditure and disposable income

These relationships help researchers, policymakers and businesses make data-driven decisions and predictions.

Types of Regression:
a) Simple and Multiple.
b) Linear and Non-linear
c) Total and Partial

Differences between Correlation and Regression

Table 3: Comparison between Correlation and Regression

Correlation	Regression
It is the relationship between two or more variables.	It means going back and is a mathematical measure showing the average of two variables.
Both the variables X and Y are random variables.	Here X is random and Y is a fixed variable.
It finds out the degree of relationship between two variables.	It mentions cause and effect of relationship between variables.
The coefficient of correlation is a relative measure.	It is an absolute figure. If the independent variable is known, the dependent variable can be predicted.
It is not useful for further mathematical treatment.	It is widely used for further mathematical treatment.
It has a limited application as it is confined only to linear relation between two variables.	It has wider application as it studies both linear and non-linear relationships.

Standard Deviation
"The Standard Deviation, denoted by the Greek Letter 'σ' (Sigma), is a fundamental statistical measure used to assess how individual data points deviate from the mean (average) of a dataset. It helps in judging the representativeness of the mean and the dispersion or variability of data.

The concept was introduced by Karl Pearson and is considered practically significant because it overcomes several limitations associated with other measures of dispersion like Range, Quartile Deviation and Mean Deviation.
"Standard Deviation is defined as the square root of the average of the squared deviations from the mean. It is also referred to as the Root Mean Square Deviation. The square of the standard deviation is called variance, denoted as σ^2".
Standard Deviation can be calculated in 'four ways' as in the case of raw data.
a) When the actual values are used directly.
b) When the deviations are taken from actual mean $(\bar{x})$.
c) When the deviations are taken from a conveniently chosen assumed mean to simplify calculations.
d) When the deviations are taken from an assumed mean and further simplified using a common factor (Step value) to reduce computational effort.

Standard Deviation (S.D):

Table 4: Advantages and Disadvantages of Standard Deviation.

Advantages	Disadvantages
It is the best measure of dispersion because it takes all items of future algebraic treatment and statistical analysis.	It is very difficult to compute.
It is possible to calculate S.D for two or more series.	It assigns more weights to extreme items and less weight to items nearer to the mean.
This measure is very suitable for making comparisons.	---

Findings and Observations & Conclusion:
i). Research is a continuous and creative process used to discover new knowledge and solve problems by exploring alternative methods and analysing data.
ii). **Data Presentation:** Once collected, data is shown using tables, charts, diagrams, histograms, pictograms and polygons.
iii). **Statistical Tools:** Key techniques include:
- Averages, Standard Deviation, Correlation, Regression
- **Hypothesis Tests:** Chi-Square, t-test, Z-test, F-test, ANOVA, ANCOVA

4. **Time Series:** Used to study data over time to identify trends and patterns.

5. **Sources of Data:**
- **Primary Data:** Collected directly via questionnaires, surveys, interviews or observations
- **Secondary Data:** Taken from research papers, books, reports, financial statements and census data.

This table summarizes key statistical techniques, their definitions, and applications. It includes basic measures, inferential tests, graphical tools, and advanced methods used in data analysis across various fields like research, economics, healthcare, and social sciences.

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Table 5: Statistical Techniques in Research.

Sl. No.	Name of Statistical Technique	Description	Applications
1	Central Tendency (Mean, Median, Mode)	Measures the centre of a data set	Summarizing data, descriptive analysis
2	Correlation (Rank/Linear)	Measures the strength and direction of a relationship between variables	Identifying relationships in market studies, psychology, etc.
3	Standard Deviation	Measures the amount of variation in a set of values	Risk assessment, quality control
4	Regression	Predictive modelling technique for dependent and independent variables	Forecasting, economics, health research
5	Spearman Rank Correlation	Non-parametric measure of rank correlation	Social sciences, educational research
6	Coefficient	Measures the strength or level of relationship	Regression analysis, elasticity in economics
7	ANOVA/ANCOVA	Compares means across multiple groups	Experimental design, medical trials
8	T-test, Z-test, F-test	Tests for statistical differences between means or variances	Hypothesis testing, comparing group means
9	Factor Analysis	Reduces data dimensions by identifying underlying variables	Psychology, market research
10	Parametric Tests	Assumes data follows a known distribution	Used when assumptions of normality are met
11	Non-Parametric Tests	No assumptions about data distribution	Ordinal data, small samples
12	Graphical Images	Visual representation of data	Communication of data insights
13	Diagrams (Single, Double, Multiple Bar)	Different types of bar diagrams	Comparison across categories
14	Pictograms	Pictures used to represent data	Infographics, education
15	Histogram	Graphical display of frequency distribution	Distribution analysis, quality control
16	Polygon	Line graph of frequency distribution	Comparing data distributions
17	Scatter Diagram	Plots relationships between two variables	Correlation and regression analysis
18	Time Series	Data points indexed in time order	Trend analysis, stock market, climate data
19	Index Numbers	Measures relative changes over time	Economic indices, price indices
20	Probability Theory	Study of randomness and uncertainty	Risk modelling, statistical inference
21	Chi-Square Test	Compares observed vs. expected frequencies	Goodness-of-fit test, independence test
22	Other Specific Tests (Post hoc, etc.)	Advanced or situation-specific statistical tests	Medical research, post-ANOVA comparisons
23	Skewness	Measures the asymmetry of the data distribution	Determining the direction and magnitude of data skew
24	Kurtosis	Measures the 'tailedness' of the data distribution	Detecting outliers and shape of distribution

Below table summarizes commonly used statistical software tools in research, highlighting their data type, features, license, and research applications. It helps researchers choose the right tool based on their analysis needs—whether for quantitative methods like regression and hypothesis testing, or qualitative approaches like thematic coding. Both open-source (e.g., R, Python) and paid (e.g., SPSS, SAS) options are included.

Table 6: Statistical Software tools for Research

Software Name	Type of Data	Features	License	Research Applications
SPSS	Quantitative	GUI-based, wide range of statistical procedures	Paid	Survey analysis, experimental design, hypothesis testing
SAS	Quantitative	Advanced analytics and predictive modeling	Paid	Clinical trials, epidemiology, big data analysis
R	Quantitative	Extensive packages for data analysis and visualization	Free (Open-source)	Statistical modeling, bioinformatics, simulations
Python	Quantitative	Statistical libraries for data analysis and machine learning	Free (Open-source)	Reproducible research, machine learning, text mining
Stata	Quantitative	Econometric and statistical analysis	Paid	Econometrics, health research, social research
Minitab	Quantitative	Simple stats, control charts, process improvement	Paid	Quality control research, industrial experiments
JMP	Quantitative	Visual stats, modeling, and DOE tools	Paid	Design of experiments (DOE), engineering research
Excel + ToolPak	Quantitative	Basic stats and quick analyses	Freemium	Descriptive stats, preliminary data analysis
MATLAB	Quantitative	High-level math, modeling, and simulation	Paid	Simulation-based research, algorithm development

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EViews	Time-Series, Econometrics	Forecasting and time series modeling	Paid	Financial modeling, economic forecasting
G*Power	Quantitative	Power and sample size calculation	Free	Research design planning, hypothesis testing
Amos	Quantitative	SEM and path analysis	Paid	Structural modeling in social and behavioral research
GraphPad Prism	Quantitative	Biostatistics and graphing	Paid	Biomedical research, dose-response studies
RStudio	Quantitative	IDE for R, supports reproducible reports	Free	Reproducible research, statistical computing
NVivo	Qualitative	Text and audio coding, theme identification	Paid	Qualitative research, interviews, case studies
ATLAS.ti/ MAXQDA	Qualitative	Coding and visualizing textual data	Paid	Thematic analysis, ethnographic and mixed methods

Conclusion

Statistics is a branch of mathematical science that focuses on the collection, organization, analysis, and interpretation of data using various statistical tools and techniques. It plays a crucial role in business environments, particularly in processing and analysing data to support managerial decision-making. This paper explores the commercial scope and objectives of research in business organizations, emphasizing the vital connection between statistics and the research process. By highlighting this relationship, the paper underscores how statistical methods contribute significantly to informed decision-making and effective business strategies.

The data collected for any research problem is systematically processed through tabulation and analysed using tools such as measures of central tendency, correlation, standard deviation, regression analysis, and time series techniques. These methods enable researchers to draw meaningful conclusions and support evidence-based practices. This work aims to serve as a helpful reference for readers and researchers by integrating insights from multiple scholarly sources. We sincerely acknowledge and express our gratitude to the authors and researchers whose contributions have been refined and cited throughout this paper.

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