

E-contents on Research Methodology

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1. TERMINOLOGY

RESEARCH

Research is defined as the creation of new knowledge and/or the use of existing knowledge in a new and creative way so as to generate new concepts, methodologies and understandings.

OBJECTIVE

Expressing or dealing with facts or conditions as perceived without distortion by personal feelings, prejudices, or interpretations

CONTROL GROUP

The control group is defined as the group in an experiment or study that does not receive treatment by the researchers and is then used as a benchmark to measure how the other tested subjects do.

EXPERIMENTAL GROUP

An experimental group (sometimes called a treatment group) is a group that receives a treatment in an experiment. The “group” is made up of test subjects (people, animals, plants, cells etc.) and the “treatment” is the variable you are studying.

BIAS

Bias is disproportionate weight in favour of or against an idea or thing, usually in a way that is closed-minded, prejudicial, or unfair.

JOURNAL

A journal is a scholarly publication containing articles written by researchers, professors and other experts. Journals focus on a specific discipline or field of study. Unlike newspapers and magazines, journals are intended for an academic or technical audience, not general readers.

VARIABLE

A **variable** is defined as anything that has a quantity or quality that varies. The dependent **variable** is the **variable** a researcher is interested in. An independent **variable** is a **variable** believed to affect the dependent **variable**. Confounding **variables** are defined as interference caused by another **variable**.

CONCEPT

Concepts are defined as abstract ideas or general notions that occur in the mind, in speech, or in thought. They are understood to be the fundamental building blocks of thoughts and beliefs. They play an important role in all aspects of cognition

GENERALIZATION

A generalization is a form of abstraction whereby common properties of specific instances are formulated as general concepts or claims. Generalizations posit the existence of a domain or set of elements, as well as one or more common characteristics shared by those elements.

SPECIFICATION

A specification often refers to a set of documented requirements to be satisfied by a material, design, product, or service. A specification is often a type of technical standard. There are different types of technical or engineering specifications, and the term is used differently in different technical contexts.

CAUSE AND EFFECT

Cause and **effect** is a relationship between events or things, where one is the result of the other or others. This is a combination of action and reaction.

CORRELATION

Correlation is a statistical technique that can show whether and how strongly pairs of variables are related. For example, height and weight are related; taller people tend to be heavier than shorter people.

VALIDITY

VALIDITY is an indication of how sound your **research** is. More specifically, **validity** applies to both the design and the methods of your **research**. **Validity** in data collection means that your findings truly represent the phenomenon you are claiming to measure.

RELIABILITY

In simple terms, **research reliability** is the degree to which **research** method produces stable and consistent results. A specific measure is considered to be **reliable** if its application on the same object of measurement number of times produces the same results.

EPISTEMOLOGY

Epistemology is the branch of philosophy concerned with knowledge. Epistemologists study the nature of knowledge, epistemic justification, the rationality of belief, and various related issues. Epistemology is considered one of the four main branches of philosophy, along with ethics, logic, and metaphysics.

CONCEPT

Concepts are defined as abstract ideas or general notions that occur in the mind, in speech, or in thought. They are understood to be the fundamental building blocks of thoughts and beliefs. They play an important role in all aspects of cognition.

THEORY

Theories are formulated to explain, predict, and understand phenomena and, in many cases, to challenge and extend existing knowledge within the limits of critical bounding assumptions

AUTHENTICITY

Authenticity involves shifting away from concerns about the reliability and validity of research to concerns about research that is worthwhile and thinking about its impact on members of the culture or community being researched.

DATA

Data is measured, collected and reported, and analyzed, whereupon it can be visualized using graphs, images or other analysis tools. **Data** as a general concept refers to the fact that some existing information or knowledge is represented or coded in some form suitable for better usage or processing.

INFORMATION

Knowledge communicated or received concerning a particular fact or circumstance; news: **information** concerning a crime. Knowledge gained through study, communication, research, instruction, etc.; factual data: His wealth of general **information** is amazing. the act or fact of informing.

SAMPLE

A **sample** refers to a smaller, manageable version of a larger group. It is a subset containing the characteristics of a larger population. **Samples** are used in statistical testing when population sizes are too large for the test to include all possible members or observations.

POPULATION

A population is all the organisms of the same group or species who live in a particular geographical area and are capable of interbreeding. The area of a sexual population is the area where inter-breeding is possible between any pair within the area and more probable than cross-breeding with individuals from other areas.

SAMPLING

Sampling is a process used in statistical analysis in which a predetermined number of observations are taken from a larger population. The methodology used to **sample** from a larger population depends on the type of analysis being performed, but it may include simple random **sampling** or systematic **sampling**.

CLUSTER

Cluster sampling refers to a type of sampling method. With **cluster** sampling, the researcher divides the population into separate groups, called **clusters**. Then, a simple random sample of **clusters** is selected from the population. The researcher conducts his analysis on data from the sampled **clusters**.

SCHEDULE

A **schedule** is a structure of a set of questions on a given topic which are asked by the interviewer or investigator personally. ... It contains direct questions as well as questions in tabular form. **Schedule** include open-ended questions and close-ended questions.

DEDUCTIVE

Deductive Approach (Deductive Reasoning) A **deductive approach** is concerned with “developing a hypothesis (or hypotheses) based on existing theory, and then designing a **research** strategy to test the hypothesis”[1]. It has been stated that “**deductive** means reasoning from the particular to the general.

INDUCTIVE

Inductive approach, also known in **inductive** reasoning, starts with the observations and theories are proposed towards the end of the **research** process as a result of observations [1]. ... Patterns, resemblances and regularities in experience (premises) are observed in order to reach conclusions (or to generate theory).

HYPOTHESIS

A **research hypothesis** is a specific, clear, and testable proposition or predictive statement about the possible outcome of a scientific **research study** based on a particular property of a population, such as presumed differences between groups on a particular variable or relationships between variables.

OBSERVATION

Observation, as the name implies, is a way of collecting data through **observing**. **Observation** data collection method is classified as a participatory **study**, because the researcher has to immerse herself in the setting where her respondents are, while taking notes and/or recording.

CERTAINTY

A simple **definition of certainty** for IS **research** is, therefore, doing the right thing to secure desired objectives, while believing in the correctness of one's actions.

BLIND RESEARCH

A **study** done in such a way that the patients or subjects do not know (is **blinded** as to) what treatment they are receiving to ensure that the results are not affected by a placebo effect (the power of suggestion).

CASE STUDY

Case studies aim to analyze specific issues within the boundaries of a specific environment, situation or organization. ... This type of **case studies** focus on phenomena within the contexts of real-life situations.

FOCUS GROUPS

Focus groups are a form of qualitative **research** that is commonly used in product marketing and marketing **research**, but it is a popular method within sociology as well. During a **focus group**, a **group** of individuals—usually 6-12 people—is brought together in a room to engage in a guided discussion of a topic.

EMPIRICAL

Empirical research is research using empirical evidence. It is also a way of gaining knowledge by means of direct and indirect observation or experience. Empiricism values such research more than other kinds. Empirical evidence can be analyzed quantitatively or qualitatively

LOGIC

In **logic**, we often refer to the two broad methods of reasoning as the deductive and inductive approaches. Deductive reasoning works from the more general to the more specific. Sometimes this is informally called a “top-down” approach. We might begin with thinking up a theory about our topic of interest.

2. RESEARCH

2.1 Meaning of Research: Research is the systemic process of collecting and analysing information to increase our understanding of the world. Research is defined as systematic_approach towards purposeful investigation. It always begins with a question or a problem. Its purpose is to find answers to questions through the application of systematic and scientific methods.

Research is basically scientific in nature to provide an objective, which is an unbiased evaluation of data. There is nothing like unscientific research approach even in case of social sciences. We can define research as an activity of systematic enquiry that seeks answers to a problem. We all encounter research in our daily lives. The results of research on many topics are presented to us in the form of newspaper articles, books, reports, and television programmes (1).

2.2 Nature of Research: Nature of research can be classified into three types:

Exploratory

Description

Explanatory

1. Exploratory Explore

In this research the initial research is based on theoretical idea. This research usually goes two ways.

- a. Taking well defined theories and applying them in that particular area
- b. Developing our own theories.

2. Descriptive Describe

This kind of research attempts to explore and explain while providing additional information about the topic. This research usually goes two ways.

- a. Builds on exploratory research
- b. Usually requires lot of data

3. Explanatory Explain

This kind of research tries to explain relations ships between variables.

- a. Builds on both exploratory and description research.
- b. Finally explain why things happen.

comparative analysis:

	Exploratory Research	Descriptive Research	Explanatory Research
Research approach used	Unstructured	Structured	Highly structured
Research conducted through	Asking research questions	Asking research questions	By using research hypotheses.
When is it conducted?	Early stages of decision making	Later stages of decision making	Later stages of decision making

2.3 Objective of Research: A research objective is a clear, concise, declarative statement which provides direction to investigate the variables under the study without a clear objective researcher is aimless and directionless in conducting the study.

Types of objectives-

General objectives

Specific objective

General objectives- These are broad goals to be achieved and states what the researcher expects to achieve by the study in general terms.

Specific objective- These are short term and narrow in focus. General objectives can be broken into small logically connected parts to form specific objectives.

Typical Objective of Research –

Gain familiarity with a new phenomenon.

Investigate some existing situation or problem.

Offer solutions to a problem.

Explore and analyse more general issues.

Construct or create a new procedure or system.

Generate new knowledge.

2.4 Motivating Factors of Research: Some factors, single or combined, for undertaking any research are as follows-

Curiosity about unknown- Curiosity is an intrinsic trait of human mind and a compelling drive in the exploration of man's surroundings.

Desire to understand the cause and effect relationship of social problems-The research of cause and effect relationship has been more persistent than almost any other scientist effort upon which human energies have been spent.

Appearance of new and unexpected situations-In a modern complex and dynamic world a man is often faced with many critical and difficult problems.

Desire to discover New and Test old scientific procedures- It concerns with the technique or methods used in social research .in order to make research results more definite and precise (3).

2.5 Characteristics of Research: There are certain common characteristics of research, some of those are as follows-

Controlled -A good research must be able to control all the variables. In research various factor may affects the outcome; some are taken as controlled factors, whereas the others are tested for possible outcome.

Reliability – Reliability in the context of research is consistency. It refers to the extent to which an investigation produces consistent results. It can also termed as verifiability.

Validity – Here, validity in research mainly stands for accuracy of procedures, research instruments, tests etc. Validity means that research must be unbiased and free from any systematic error as these may impact the applicability of research. Without validity research goes in wrong direction.

Generalizability- It refers to the degree to which research findings can be applied to a larger population.

Rigorous-Research must be reliable in ensuring that the procedures followed to find answers to questions are relevant, appropriate or justified.

Systematic -A good research study must have various well-planned steps, that is all steps must be interrelated, and one step should lead to another step.

valid & verifiable-This concept implies that whatever we conclude on the basis of findings is correct & can be verified by we and others.

Empirical-In research any conclusion drawn should be based upon evidences gathered and information collected from real life experiences and observations.

Logical – It implies that research is guided by the rules of logical reasoning .

Replicable – This characteristic allows the results of the research to be verified by replicating the study and thereby building a sound basis for decisions.

Objectivity-A good research is objective in the sense that it must answer the research questions. It means research is without any bias (3) (6).

3. PROCESS OF RESEARCH (STEPS OF RESEARCH)

Research usually begins with the identification of a problem followed by formulation of research questions or objectives Proceeding from this the researcher determines how best to answer these questions and so decides what information to collect, how it will be collected, and how it will be analysed in order to answer the research question. The chart shown below Figure well illustrates a research process.

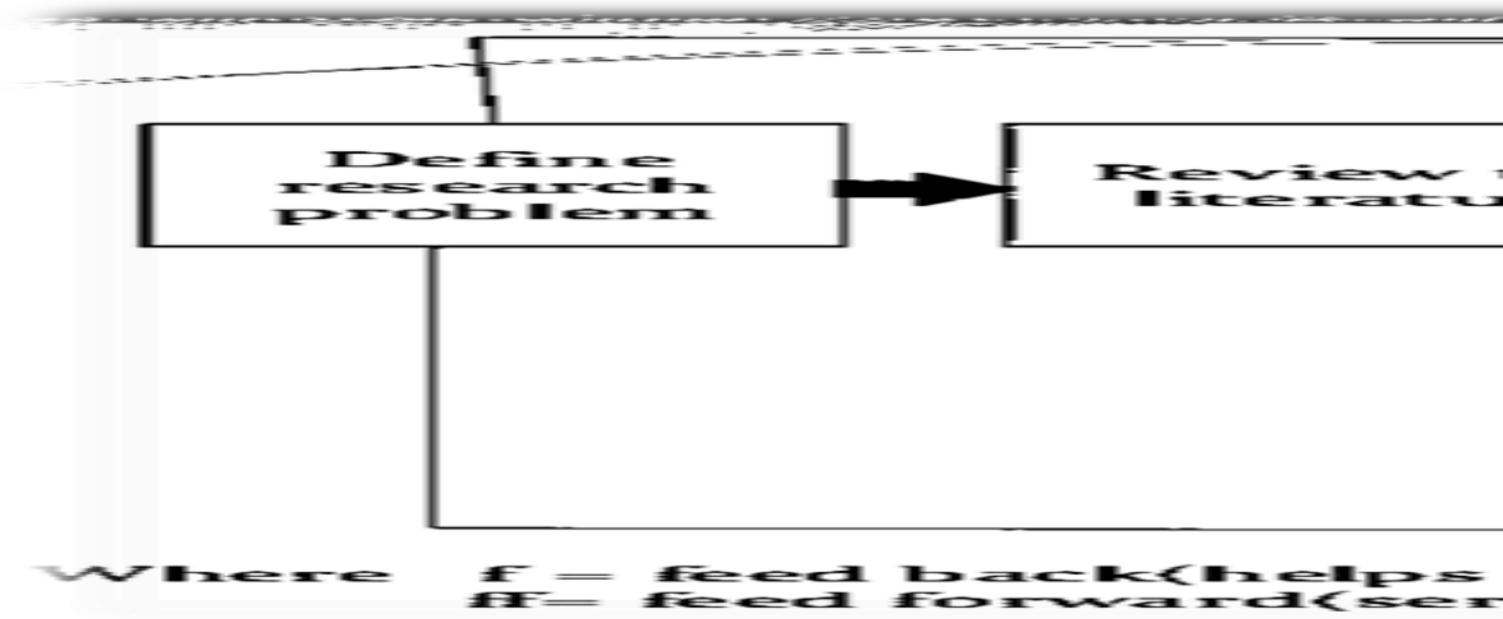


Figure 1 Research process (2)

- **Formulating the Research Problem**- The first step in research is formulating a research problem, at this step, our goal should be clear that what we intend to achieve out of research. It is the most crucial step in the research process. The main function of this is to decide what we want to find out about. The selection of topic for research is a difficult job. When we select a title or research statement, then other activities would be easy to perform. The research topic or problem should be practical, relatively important, feasible, ethically and politically acceptable.

A reasonable level of knowledge in the broad subject area is required to work through these steps. Usually, the following steps are undertaken to formulate a research problem:

Step 1: Identifying a broad area of interest: What really interests me as a professional? As a teacher, I might be interested in the area of teaching methodology or increasing acts of violence among students, psychology, or existence of common conditions of the students in an area.

Step 2: Dividing broad areas into subareas: Suppose I want to study acts of violence among students. It can have various subareas (1) profile of families these students come from, (2) profile of perpetrators, (3) causes for violence (4) role of politicization of education, (5) impact on society, and so on.

Step 3: Focusing on and selecting an area of interest: The researcher may choose one or two areas for current research because it is not possible to pick many areas simultaneously. Delete the subareas in which you as a researcher do not have any interest and subsequently focus on the area you are passionate about.

Step 4: Identifying the gaps and raising research questions: Within an area, list all the questions the researcher wants to find answers to.

Step 5: Formulation of broad objectives: Objectives grow out of the questions.

Step 6: Assessing and reviewing objectives: As a researcher narrows the research problem, the specific identification of study population is crucial in order to select the appropriate

- **Extensive Literature Survey-**The review of literature also educates the researcher about what studies have been conducted in the past, how these studies were conducted, and the conclusions in the problem area. Read around the subject to help clarify our research topic, questions, and methods. Literature review is usually the longest stage in the research process. Actually, the literature review starts even before the formulation of research aims and objective; because we have to check if exactly the same research problem has been addressed before. Nevertheless, the main part of the literature review is conducted after the formulation of research aim and objectives. For this purpose, academic journals, conference and govt. reports and library must be studied.

Literature review is an integral part of entire research process. It makes significant contribution to each and every operational step at a later stage. After passing through this stage, a researcher is able to acquaint oneself with the available body of knowledge in the area of interest. The main objectives of literature review are as follows:

1. It broadens the knowledge of researcher about the research problem.
2. It brings better clarity and focus to there search problem and it also helps to improve the authenticity of research.
3. It helps to improve the research methodology.
4. It helps to contextualize the findings. It means how value addition has been done by the researcher to the existing stock of knowledge.

The procedure for reviewing literature covers searching the existing literature, reviewing it, and developing a theoretical and conceptual framework. The main sources of literature review are books and journals. In both cases, specifically in journals, there can be a gap of two to three years between the completion of a research project and the publication in a journal. As with books, the researcher needs to prepare a list of journals for identifying the literatures relevant to his research. Nowadays, researchers make extensive use of the Internet sources for literature survey and review, and at the same time, the researcher should be careful about the authenticity of the contents.

Bibliography given at the end of a project gives a clear and complete description of the sources that were used while preparing the report.

- **Formulate Hypothesis**-The development of hypothesis is a technical work depends on the researcher experience. The hypothesis is to draw the positive & negative cause and effect aspects of a problem. Hypothesis narrows down the area of a research and keep a researcher on the right path. Define clear questions and hypotheses.

Objectives are the goals you set out to attain in your study. They inform the reader what the researcher wants to accomplish through the research work. The wording of the objective should be very precise and specific.

Objectives can be written under two headings:

1. Main objectives or aims
 2. Sub-objectives
- The main objective is an overall statement of the thrust of study. It is also a statement of the main associations and relationships that you seek to discover or establish. The sub-objectives are the specific aspects of the topic that you want to investigate within the main framework of your study.
 1. They should be listed numerically.
 2. The wording should be clear, complete, and specific.

3. Each objective should contain only one aspect of the study.
4. Use action-oriented words or verbs when writing objectives.

The objectives should start with words such as ‘to determine’, ‘to find out’, ‘to ascertain’, ‘to measure’, ‘to explore’, etc. The wording of objectives determines the type of research (descriptive, correlational, and experimental) and the type of research design you need to adopt to achieve them. For example, in case of descriptive studies, the objective can be stated as, ‘To describe the types of incentives provided by the organizations in Chandigarh to their employees in IT industry’. In correlational studies, it may state, ‘To ascertain the impact of coaching classes on students’ performance’.

- **Design Research**-Select a research approach and design that will make it possible to answer research questions and plan the overall research strategy. After the formulation of the problem and creating hypothesis for it, research Design is to prepare by the researcher. It may draw the conceptual structure of the problem. Any type of research design may be made, depend on the nature and purpose of the study.

Research design is an activity and time-based plan keeping in view of the research objectives. It guides about the types of information to be collected and their sources. It is a framework for specifying the relationship among the variables under study. It outlines the procedures. It also answers questions such as, is an intensive study of a small sample more effective than a less intensive study of a large sample? and, should the analysis be primarily qualitative or quantitative?

Research design is also defined as plan, structure, and strategy of investigation conceived so as to obtain answers to research questions and to control variance. It is a master plan specifying the methods and procedures for collecting and analysing the needed information.

Therefore, research design involves consideration of the following:

1. Objectives of research study
2. Selection of method of data collection
3. Source of information—sample design
4. Tools for data collection
5. Data analysis—qualitative and quantitative

Research design achieves the following purposes:

1. It makes research efficient
2. Optimum utilization of resources—maximum information with minimal expenditure, time, and money
3. Flexibility
4. Minimization of bias
5. Reliability and objectivity

- **Determining Sample Design-** The researcher must design a sample. It is a plan for taking its respondents from a specific areas or universe.

Researchers usually draw conclusions about large groups by taking a sample. A sample is a subset of the population selected to represent the population as a whole. The main benefits of sampling are as follows:

1. Reduction in overall cost of research
2. Less time-consuming, and in certain cases, this is desirable as well.
3. In case, the population is consistent, this becomes even more desirable.

Ideally, a representative sample should be an unbiased indication of what the population is like. Some of the factors that researchers consider when selecting a representative sample include sex, age, educational level, socioeconomic status, and marital status. For example, if roughly half of the total population of interest is female, then a sample should be made up of approximately 50 per cent women in order to be representative. In research, the population does not mean only human population all the times; it can be factories, schools, etc. Population is denoted by N and sample as n. The factors affecting inferences drawn from a sample are dependent upon the following:

1. Sample size: The larger the sample, the more is the accuracy.
2. Variation in population: The greater the variation in population, the greater will be the uncertainty of outcome. The higher the consistency in population, the more confident we are about the quality of outcome. The higher the variations in population, the larger should be the sample size.

Types of Sampling Techniques

The sample may be of two types:

Probability Sampling

Non-probability Sampling

1. Probability or Random Samples: Each person in the population has equal, independent, and known chances of being selected. In case, there are 100 elements in a population, every element has 1/100 chance of being selected in a sampling exercise. Here, independence means that selection of one element is neither being affected by the selection of other elements nor it will affect the other elements.

(a) Simple random sample: Every element or member of the population has a known and equal chance of being selected.

(b) Stratified random sample: In case, the population is heterogeneous, the population can be divided into different strata. The population within a stratum is homogeneous with respect to the characteristic under study. Population is divided into mutually exclusive groups such as age groups, and random samples are

drawn from each group. The population in a particular stratum may be in proportion to its population. Suppose there are 1,000 students in a college, 600 study humanities and 400 study commerce. In a sample of 100, 60 students will be from humanities and 40 from commerce, that is, in the same ratio as in the overall population.

(c) Cluster sample: The simple and stratified sampling is adopted in situations when population size is small and units are identifiable. But if the population is larger, the researcher can go for cluster sampling. The population is divided into mutually exclusive groups, and the researcher draws a sample of the group to interview. For example, in a national level survey, at the first few levels, a few states may be selected. Within the states, a few districts may be selected; then, within each district, blocks may be selected and then villages. It is termed as 'multistage cluster sampling'.

2. Non-probability Sampling: It is a sampling technique where the samples are gathered in a process that does not give all the individuals in the population equal chances of being selected. Here, only some elements of the population have a greater chances or unknown chances of being selected.

(a) Convenience sampling: The researcher selects the easiest population members from which to obtain information.

(b) Judgement or purposive sampling: The researcher uses his/her judgement to select population members who are likely to provide accurate information. This can be used for historical research or descriptive research.

(c) Quota sampling: The researcher finds and interviews a prescribed number of people in each of several categories. Here, the main criterion used by the researcher is the ease to access sample population. The sample is selected from a location convenient to him or her; here, there are some possibilities to include people with some visible characteristics. However, the results may not be generalized to larger populations.

(d) Accidental sampling: It is akin to quota sampling, but used in market research (in market places) where a researcher can come across any person and they may not have any information.

(e) Snowball sampling: In this kind of sampling, the information may be selected from few individuals, and they may identify other people for the purpose of gathering information. They may also become a part of the sample. It creates a network of sample elements.

- **Data Collection** -It need to be selected on the basis of critically analysing advantages and disadvantages associated with several alternative data collection methods. The collection of information must be containing on facts which is from the following two types of researcher.

Primary Data Collection: Primary data may be from the following.

Experiment

Questionnaire
Observation
Interview

Secondary data collection: it has the following categories:

Review of literature
Official and non-official reports
Library approach

There are many alternatives available to collect relevant data. The researcher should select one of these methods of collecting data taking into account the nature of investigation, scope and objective of inquiry, financial cost, availability of time, and the desired accuracy.

Primary data can be collected either through experiment or through survey. If the researcher conducts an experiment, he will take some quantitative measurements (data). The data are analysed further to test the hypothesis. In case of a survey, data can be collected by any one or more of the following ways:

1. By observation: This entails the collection of information by the way of investigator's own observation without interviewing the respondents. The information obtained relates to the current happenings. This method is very expensive and the information gathered in such a manner is limited. This method is not suitable for research where large samples are required as is the case with quantitative research.

2. Personal interviews: The investigator follows structured approach, and the questions are pre-conceived. Here, the output also depends upon the ability of the interviewer to a large extent.

3. Telephonic interviews: This method of collecting information involves contacting the respondents on telephone itself. It is used when the survey has to be accomplished in a very limited time.

4. Mailed questionnaires: Questionnaires are mailed to the respondents with a request to return after completing the same. It is the most commonly used method in economic and business surveys. A pilot study may be conducted for testing the questionnaire to check its appropriateness for the purpose.

5. Schedules: In this method, the enumerators are specially appointed and trained for gathering information. Schedules consist of relevant questions. The enumerators visit respondents with these schedules. Schedules are filled up by the enumerators on the basis of replies given by the respondents. Some random checking by the supervisors may be required to ensure the validity of the research process. Although he should pay attention to all these factors, but much depends upon the ability and experience of the researcher.

- **Analysis of data-**The data collected are prepared in such a way that they describe and highlight what was found in the research. Analytical tools are used to describe the data and measure or explore relationships between the subjects or items of interest. It plays an important role in the achievement of research aim and objectives. When data is collected, it is forwarded for analysis which is the most technical job.

The large data should be condensed into a few manageable groups and tables for further analysis. This is done with the help of classification of data into more relevant, purposeful, and usable categories.

1. Editing: The process of cleaning the data is called editing. The purpose of editing is to identify and minimize errors, miscalculations, misclassification, or any gap in information provided by the respondent. Editing improves the quality of the data for coding.

2. Coding: It depends upon how a variable has been measured in your research instrument. For coding, the first step is to ensure the nature of data, that is, whether it is quantitative or qualitative. The qualitative data may be descriptive, (case history) categorical or discrete (Gender: male or female; Income: below average or above average; Attitude: strongly favourable, favourable or unfavourable).

- **Hypothesis Testing** - Research data is then forwarded to test the hypothesis. Do the hypothesis are related to the facts or not? To find the answer the process of testing hypothesis is undertaken which may result in accepting or rejecting the hypothesis.

After analysing the data as stated above, the researcher is in a position to test the hypothesis. As discussed earlier, the qualitative studies may not have any formal hypothesis. In quantitative studies, we have to see whether the facts support the hypothesis or they happen to be contrary. This is the usual question that should be answered while testing hypothesis. Various tests, such as Chi-square test, t-test, and F-test, have been developed by statisticians for this purpose. The hypothesis may be tested through use of one or more such tests, depending upon the nature and object of research inquiry.

Hypothesis testing will result in either accepting the hypothesis or rejecting it. If the researcher had no hypothesis to start with, generalizations established on the basis of data may be stated as hypothesis to be tested by subsequent researches in times to come.

- **Preparation of Report**-A researcher should prepare a report for which he has done his work. He must keep in his mind the following points:

Report Design in Primary Stages

The report should carry a title, brief introduction of the problem and background followed by acknowledgement. There should be a table of contents, graphs and charts.

Main Text of the Report

It should contain objectives, hypothesis, explanations and methodology of the research. It must be divided into chapters and every chapter explains separate title in which summary of the findings should be enlisted. The last section would be clearly of conclusions to show the main theme of the R-study.

Closing the Report

After the preparation of report, the last step in business research process contains of bibliography, references, appendices, index and maps or charts for illustration. For this purpose, the information should clearer.

4. TYPES OF RESEARCH

Depending upon the subject area there are some types of research-

According to objectives

- Descriptive Research
- Exploratory Research
- Correlational Research
- Explanatory Research

According to application

- Basic research
- Applied research
- Action research

According to Logic

- Deductive Approach
- Inductive Approach

According to Inquiry Mode

- Structured Approach
- Unstructured approach

According to Process

- Qualitative Approach
- Quantitative Approach

According to Concept

- Conceptual Approach
- Empirical Approach

(A) Classification of Research on the Basis of Objectives

From the purpose and objectives point of view, a research can be classified as follows:

1. Descriptive research
2. Correlational research
3. Explanatory research
4. Experimental research

(1) Descriptive Research: Descriptive research can answer questions such as ‘what is’ or ‘what was’. Here, the information is collected without changing the environment (i.e., nothing is manipulated). Sometimes these are referred to as ‘correlational’ or ‘observational’ studies. It is ‘any study that is not truly experimental’.

It includes surveys and fact-finding enquiries with adequate interpretation. For example, in human research, a descriptive research can provide information about the naturally occurring health status, behaviour, attitudes, or other characteristics of a particular group.

Descriptive research can involve a onetime interaction with groups of people (cross-sectional study) or a study might follow individuals over time (longitudinal study). Two specific examples are being given here, (1) Ministry of Agriculture would like to know about the crop patterns across different states in India and (2) School principal may be interested to know about the result of his own school in comparison to other schools in the district.

Descriptive research is closely linked with ex post facto, historical, exploratory, and analytical research, and sometimes, these terms can be used interchangeably.

Ex post facto research. 1. It is used in social sciences and business organizations.
2. It is conducted in context of a phenomenon after it has occurred or at the time of its occurrence.
3. It basically deals with non-manipulated variables of a phenomenon.

Historical research 1. It is another dimension of descriptive research and somewhat similar to ex post facto research.

2. It usually focuses on the historical aspect of an issue of interest or problem.
3. Examples are growth of trade unions in India, evolution of modern education system in India, etc.

Analytical research 1. In this method, the researcher uses facts or information already available.
2. It attempts to make critical evaluation of the material.

(2) Correlational Studies 1. It is undertaken to discover or establish relationship or interdependence between two aspects of a situation. Two or more variables may occur together but that does not mean that one has caused the other to occur.

2. It may identify factors leading to a certain situation. For example, ascertaining the degree of relationship between stress among students to perform in the exam and rote learning. What is the impact of promotional campaign on the sales of a product?

3. It refers to the systematic investigation or statistical study of relationships among two or more variables, without necessarily determining cause and effect. It seeks to establish a relation between two or more variables that do not readily offer themselves to experimental manipulation. In other words, correlational research is a type of non-experimental research method, in which researcher measures two variables.

(3) Explanatory Research Explanatory research attempts to answer how and why between two aspects of a situation or a phenomenon. For example, why examination related stress leads to rote learning? Why and how stress leads to a heart disease?

Its primary goal is to understand or to explain relationships. It uses correlations to study relationships between dimensions or characteristics of individuals, groups, situations, or events. Explanatory research explains (How the parts of a phenomenon are related to each other). Explanatory research asks the “Why” question (4).

(4) Exploratory Research 1. It is generally done in the beginning of a research. It is undertaken to explore an area where little is known or to investigate the possibilities of undertaking a particular research study and is akin to feasibility study or pilot study. A ‘small-scale study’ is undertaken to decide whether it is worth carrying out a detailed investigation.

2. It attempts to clarify why and how there is a relationship between two or more aspects of a situation or phenomenon.

3. The purpose of exploratory research is to gain background information, to define terms, to clarify the problems, to develop hypothesis, to establish research priorities and objectives, and to develop questions to be answered.

4. It makes use of secondary data (mainly literature review), experience surveys, case studies, interviews (mainly focus groups, interviews), projective techniques, and Delphi techniques.

5. An exploratory design is conducted about a research problem when there are few or no earlier studies to refer to. It is a type of research conducted for a problem that has not been clearly defined. The results of exploratory research are not usually for decision making by themselves, but they can provide significant insight into a given situation. It involves generation of new ideas and assumptions, development of tentative theories or hypothesis but conclusions can't be drawn even though it provides direction for future research and techniques. This research helps us to investigate any problem with suitable hypothesis. This is

particularly important for clarification of any concept and throwing new light for further research on principles of developing a hypothesis and its testing with statistical tools (3).

Experimental Research or Causal Studies: 1. It is cause-and-effect finding research; it seeks to uncover cause-and-effect relationships.

2. An action or occurrence can cause other action, for example, smoking causes lung cancer. It brings up a definite cause-and-effect relationship. It identifies the variable that changes the dependent variable. For example, smoking causes weak lungs and not vice versa.

3. If we are able to identify the cause of a problem, then we may be on the way to find a solution to the problem, as is the case in medical science. Reflexivity refers to circular relationships between cause and effect. A reflexive relationship is bidirectional with both the cause and the effect affecting one another in a relationship in which neither can be assigned as causes or effects. For example, poverty is the main cause of unemployment; and unemployment is the main cause of poverty.

(B) Classification of Research on the Basis of Application

On the basis of application, research is of two types, namely pure (or basic research) and applied research.

(1) Fundamental (Basic or Pure) Research: This research is concerned with generalization and with the formulation of a theory. It is the research concerning principles or laws or rules, and aims at the achievement of knowledge. In other words, it is the research which is done for knowledge enhancement and for the welfare of human, animals but not for commercial potential.

1. The main purpose of basic research is to add to the existing stock of knowledge and, thus, can be intellectually challenging.

2. The knowledge produced through pure research is sought in order to add to the existing body of research methods.

3. It is not likely to have any practical application at the present time or even in the future.

(2) Applied Research: It aims at finding solutions for immediate problems facing a society or an industrial business organisation. It is more concerned with concrete life. This is designed to solve practical problems of the modern world. It is conducted on large scale but it is expensive.

1. Applied research is done to solve specific, practical questions facing the society.

2. It can be used for policy formulation, administration, and understanding of a phenomenon.

3. It is always done on the basis of basic research and can be carried out by academic or industrial institutions. For example, an academic institution, such as a university, will have a specific applied research program funded by an industrial partner interested in that program.

(3) Action Research

The term 'action research' was coined during 1940s by Kurt Lewin, a German-American social psychologist who is widely considered to be the founder of this field. Action research refers to a wide variety of evaluative, investigative, and analytical research methods designed to diagnose problems or weaknesses whether organizational, academic, or instructional and help researchers to develop practical solutions to address them quickly and efficiently. It may also be applied to programs or educational techniques that are not necessarily experiencing any problems, but that researchers simply want to learn more about the techniques and improve their knowledge. The general goal is to create a simple, practical, repeatable process of iterative learning, evaluation, and improvement that leads to increasingly better results. Action research may also be called a 'cycle of action' or 'cycle of inquiry' because it typically follows a predefined process that is repeated over time.

(C) Classification of Research on the Basis of Logic

In research, conclusions are based on two approaches known as the deduction and the induction.

(1) Deductive Approach: It is also termed as top-down or general-to-specific approach. In deduction, we start from a theory and try to prove it right with the help of available information. The deductive method involves the following three steps:

1. State the hypothesis (based on theory or research literature).
2. Collect data to test the hypothesis.
3. Make decision to accept or reject the hypothesis.

(2) Inductive Approach: It is also termed as bottom-up approach. In inductive research, we move from specific to general. This approach also involves three steps:

1. Observe the different phenomena in the world.
2. Make a search for a pattern in what is observed.
3. Make a generalization about what is occurring.

(D) Classification of Research on the Basis of Inquiry Mode

Basically, the process adopted to find answers to research questions involves two approaches-structured and unstructured.

(1) Structured Approach

1. The structured approach to inquiry is usually classified as quantitative research.
2. Everything that forms the research process, such as objectives, design, sample, and the questions that a researcher plans to ask of respondents, is predetermined.
3. It is more appropriate to determine the extent of a problem, issue, or phenomenon by quantifying the variation. For example, how many people have a particular problem? How many people hold a particular attitude?

(2) Unstructured Approach

1. The unstructured approach to inquiry is usually classified as qualitative research.
2. It allows flexibility in all aspects of their search process.
3. It is more appropriate to explore the nature of a problem, issue, or phenomenon without quantifying it.

(E) Classification of Research on the Basis of Process

(1) Quantitative Research It is similar to deductive research. It is also termed as linear research as it typically follows a linear path:

1. Stating with testable hypothesis
2. Collection of data
3. Analysing the data
4. Accepting or rejecting the hypothesis.

Quantitative research is generally associated with the positivist or post-positivist paradigm. It usually involves collecting and converting data into numerical form so that statistical calculations can be made and conclusions can be drawn.

(2) Qualitative Research

1. This is basically an approach and not just a method to conduct research.

2. Qualitative research is basically inductive or spiral in nature and has a very different structure. The researcher starts with a tentative idea or question; these questions become more specific with progress in research. Then, a pattern may emerge in research. Thus, in qualitative research, one starts with observation and ends with a theoretical position or stance. Thus, it is inductive in nature, that is, the research moves from specific to theory.

Qualitative research is appropriate when:

1. The intended research area is not well studied or understood;
2. A subject needs to be studied in depth;
3. A holistic perspective is needed;
4. Behavioural aspects of people need to be studied;
5. Measurement techniques like questionnaires are not considered suitable;
6. A researcher is more interested in the process (how it works) and not the product (the outcome).

The important methods and approaches used in qualitative research have been discussed below.

1. Focus groups: In this method, a researcher brings together a small number of subjects to discuss the topic of interest. The group size is kept deliberately small so that the members express themselves more openly and also get more time as well.

2. Direct observation: The data are collected by an external observer.

3. In-depth interviews: It is unstructured and has face-to-face interviews.

4. Narrative research: It is an approach to review the literature. Sometimes, it is contrasted with a systematic review. It tends to be less focused than a systematic review and seeks to arrive at a critical interpretation of the literature that it covers.

5. Phenomenology: It is a form of qualitative research in which the researcher attempts to understand how one or more individuals experience a phenomenon. For example, interviewing the wives of 10 prisoners of war and asking them to describe their experiences.

6. Ethnography: It is the process of studying and describing a culture (a culture is the shared attitudes, values, norms, practices, language, and material things of a group of people). It intends to provide an insider's picture of a community under study. A researcher may go and live in that specific community and study the culture and their educational practices.

7. Case study research: It is focused on providing a detailed account of one or more cases. For example, case study of a class that was given a new curriculum of IT.

8. Grounded theory: It is a qualitative approach to generate and develop a theory from data that the researcher collects. Role play, simulation, and diary methods are also used

(F) Classification of Research on the Basis of Concept

(1) Conceptual Research: Conceptual research is generally used by philosophers and thinkers to develop new concepts or to reinterpret the existing concepts. It is related to some abstract idea or theory.

(2) Empirical Research: Empirical research relies on experience or observation alone, which is without due regards for system and theory. It is a data-based research coming up with conclusions that are capable of being verified by observation or experiment. In this research, the researcher must formulate a working hypothesis. He collects data to prove or disprove his hypothesis. The researcher is in control over the facts. Empirical research is appropriate when proof is sought that certain variables affect other variables in one way or another.

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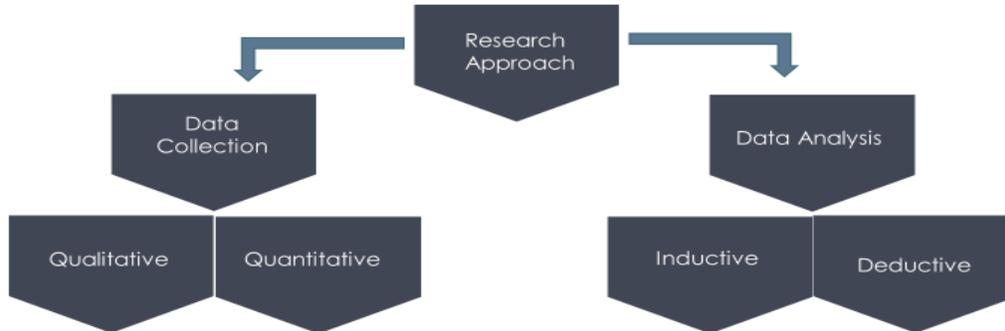
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5. RESEARCH APPROACHES

Research approach is a plan and procedure that consists of the steps of broad assumptions to detailed method of data collection, analysis and interpretation. It is therefore, based on the nature of the research problem being addressed. Research approach is essentially divided into two categories:

1. Approach of data collection and
2. Approach of data analysis or reasoning.

Components of Research Approach



1. Data Collection

Data collection is the process of gathering and measuring information on variables of interest, in an established systematic fashion that enables one to answer stated research questions, test hypotheses, and evaluate outcomes.

The data collection component of research is common to all fields of study including physical and social sciences, humanities, business, etc. While methods vary by discipline, the emphasis on ensuring accurate and honest collection remains the same.

The goal for all data collection is to capture quality evidence that then translates to rich data analysis and allows the building of a convincing and credible answer to questions that have been posed. Regardless of the field of study or preference for defining data (quantitative, qualitative), accurate data collection is essential to maintaining the integrity of research. Both the selection of appropriate data collection instruments (existing, modified, or newly developed) and clearly delineated instructions for their correct use reduce the likelihood of errors occurring.

Data collection is a very demanding job which needs thorough planning, hard work, patience, perseverance and more to be able to complete the task successfully.

Data collection starts with determining what kind of data required followed by the selection of a sample from a certain population. After that, you need to use a certain instrument to collect the data from the selected sample.

Data collection methods can be divided into two categories :

- o Primary methods of data collection.
- o Secondary methods of data collection

<u>Primary Research</u>	<u>Secondary Research</u>
Research is conducted first hand to obtain data. Researcher “owns” the data collected.	Research is based on data collected from previous researches.

<u>Primary research</u> is based on raw data.	Secondary research is based on tried and tested data which is previously analysed and filtered.
The data collected fits the needs of a researcher, it is customized. Data is collected based on the absolute needs of organizations or businesses.	Data may or may not be according to the requirement of a researcher.
Researcher is deeply involved in research to collect data in primary research.	As opposed to primary research, secondary research is fast and easy. It aims at gaining a broader understanding of subject matter.
Primary research is an expensive process and consumes a lot of time to collect and analyse data.	Secondary research is a quick process as data is already available. Researcher should know where to explore to get most appropriate data.

Primary data

- o A primary data source is an original data source, that is, one in which the data are collected firsthand by the researcher for a specific research purpose or project.
 - o Primary data can be collected in a number of ways. However, the most common techniques are self-administered surveys, interviews, field observation, and experiments.
 - o Primary data collection is quite expensive and time consuming compared to secondary data collection.
 - o Notwithstanding, primary data collection may be the only suitable method for some types of research.
 - o Primary data collection methods can be divided into two groups:
 - o Quantitative and
 - o Qualitative
1. **Qualitative Data:** Qualitative data are mostly non-numerical and usually descriptive or nominal in nature. This means the data collected are in the form of words and sentences. Often (not always), such data captures feelings, emotions, or subjective perceptions of something. Qualitative approaches aim to address the ‘how’ and ‘why’ of a program and tend to use unstructured methods of data collection to fully explore the topic. Qualitative questions are open-ended. Qualitative methods include focus groups, group discussions and interviews. Qualitative approaches are good for further exploring the effects and unintended consequences of a program. They are, however, expensive and time consuming to implement. Additionally the findings cannot be generalized to participants outside of the program and are only indicative of the group involved. Furthermore qualitative methods can be used to improve the quality of survey-based quantitative evaluations by helping generate evaluation hypothesis strengthening the design of survey questionnaires and expanding or clarifying quantitative evaluation findings.

Regardless of the kinds of data involved, data collection in a qualitative study takes a great deal of time. The researcher needs to record any potentially useful data thoroughly, accurately, and systematically, using field notes, sketches, audiotapes, photographs and other suitable means.

The qualitative methods most commonly used in evaluation can be classified in three broad categories -

- In-depth interview
- Observation methods
- Document review. [1] [2]

2. Quantitative data : The Quantitative data collection methods, rely on random sampling and structured data collection instruments that fit diverse experiences into predetermined response categories. They produce results that are easy to summarize, compare, and generalize.

Quantitative research is concerned with testing hypotheses derived from theory and/or being able to estimate the size of a phenomenon of interest. Depending on the research question, participants may be randomly assigned to different treatments. If this is not feasible, the researcher may collect data on participant and situational characteristics in order to statistically control for their influence on the dependent, or outcome, variable. If the intent is to generalize from the research participants to a larger population, the researcher will employ probability sampling to select participants.

Typical quantitative data gathering strategies include:

1. Experiments/clinical trials.
2. Observing and recording well-defined events (e.g., counting the number of patients waiting in emergency at specified times of the day).
3. Obtaining relevant data from management information systems.
4. Administering surveys with closed-ended questions (e.g., face-to face and telephone interviews, questionnaires etc).

(a) Interviews

In Quantitative research (survey research), interviews are more structured than in Qualitative research.

Face -to -face interviews have a distinct advantage of enabling the researcher to establish rapport with potential participants and therefore gain their cooperation. These interviews yield highest response rates in survey research. They also allow the researcher to clarify ambiguous answers and when appropriate, seek follow-up information.

Telephone interviews are less time consuming and less expensive and the researcher has ready access to anyone on the planet who has a telephone.

Computer Assisted Personal Interviewing (CAPI): is a form of personal interviewing, but instead of completing a questionnaire, the interviewer brings along a laptop or hand-held computer to enter the information directly into the database. This method saves time involved in processing the data, as well as saving the interviewer from carrying around hundreds of questionnaires. However, this type of data collection method can be expensive to set up and requires that interviewers have computer and typing skills.

(b) Questionnaires

Paper-pencil-questionnaires can be sent to a large number of people and saves the researcher time and money.

People are more truthful while responding to the questionnaires regarding controversial issues in particular due to the fact that their responses are anonymous.

But they also have drawbacks. Majority of the people who receive questionnaires don't return them and those who do might not be representative of the originally selected sample.

(c) Web based questionnaires :

A new and inevitably growing methodology is the use of Internet based research. This would mean receiving an e-mail on which you would click on an address that would take you to a secure web-site to fill in a questionnaire.

This type of research is often quicker and less detailed.

Some disadvantages of this method include the exclusion of people who do not have a computer or are unable to access a computer.

BASIS FOR COMPARISON	QUALITATIVE RESEARCH	QUANTITATIVE RESEARCH
OBJECTIVE	Exploratory research underlying motivation and attitude. Provide insight into problem definition.	Quantify data & generalizing result to target audience. Predict future behaviour.
Sample	Small and narrow Not statistically projectable	Large & broad statistically projectable
Methodology	Focus group, interview , in depth interview.	Survey conducted by phone or mail.
Data collection	Semi structured	Structured Questionnaire
Data analysis	Non numeric Non statistical	Numerical Statistical
Reporting	Directional in nature.	Reports are graphical.
OUTCOME	Not projectable to total target audience.	Projectable to target audience

Secondary data

- o Secondary data is a type of data that has already been published in books, newspapers, magazines, journals, online portals etc.
- o There is an abundance of data available in these sources about your research area in business studies, almost regardless of the nature of the research area.
- o Therefore, application of appropriate set of criteria to select secondary data to be used in the study plays an important role in terms of increasing the levels of research validity and reliability.
- o These criteria include, but not limited to date of publication, credential of the author, reliability of the source, quality of discussions, depth of analyses, the extent of contribution of the text to the development of the research area etc.

Following are popularly used secondary research methods and examples:

1. **Data available on the internet:** One of the most popular ways of collecting secondary data is using the internet. Data is readily available on the internet and can be downloaded at the click of a button. This data is practically free of cost or one may have to pay a negligible amount to download the already existing data.
2. **Government and nongovernment agencies:** Data for secondary research can also be collected from some government and non-government agencies. There is a certain cost applicable to download or use data available with these agencies. Data obtained from these agencies are authentic and trustworthy.
3. **Public libraries:** Public libraries are another good source to search for data for secondary research. Public libraries have copies of important research that were conducted earlier. They are a storehouse of important information and documents from which information can be extracted. The services provided in these public libraries vary from one library to another. More often, libraries have a huge collection of government publications with market statistics, large collection of business directories and newsletters.
4. **Educational Institutions:** Importance of collecting data from educational institutions for secondary research is often overlooked. However, more research is conducted in colleges and universities than any other business sector. The data that is collected by universities is mainly for primary research. However, businesses or organizations can approach educational institutions and request for data from them.
5. **Commercial information sources:** Local newspapers, journals, magazines, radio and TV stations are a great source to obtain data for secondary research. These commercial information sources have first-hand information on economic developments, political agenda, market research, demographic segmentation and similar subjects. [1] [2]

Secondary data collection methods can be divided into two groups:

- a. Deductive and

b. Inductive

Deductive Approach (Deductive Reasoning)

- o A deductive approach is concerned with “developing a hypothesis (or hypotheses) based on existing theory, and then designing a research strategy to test the hypothesis”
- o It has been stated that “deductive means reasoning from general to particular.
- o Deductive approach can be explained by the means of hypotheses, which can be derived from the propositions of the theory. In other words, deductive approach is concerned with deducting conclusions from premises or propositions.
- o Deduction begins with an expected pattern “that is tested against observations, whereas induction begins with observations and seeks to find a pattern within them”.

Advantages of Deductive Approach:

1. Possibility to explain causal relationships between concepts and variables
2. Possibility to measure concepts quantitatively

Application of Deductive Approach

In studies with deductive approach, the researcher formulates a set of hypotheses at the start of the research. Then, relevant research methods are chosen and applied to test the hypotheses to prove them right or wrong.



Generally, studies using deductive approach follow the following stages:

1. Deducing hypothesis from theory.
2. Formulating hypothesis in operational terms and proposing relationships between two specific variables.
3. Testing hypothesis with the application of relevant method(s). These are quantitative methods such as regression and correlation analysis, mean, mode and median and others.
4. Examining the outcome of the test, and thus confirming or rejecting the theory. When analyzing the outcome of tests, it is important to compare research findings with the literature review findings. Modifying theory in instances when hypothesis is not confirmed. [2] [3]

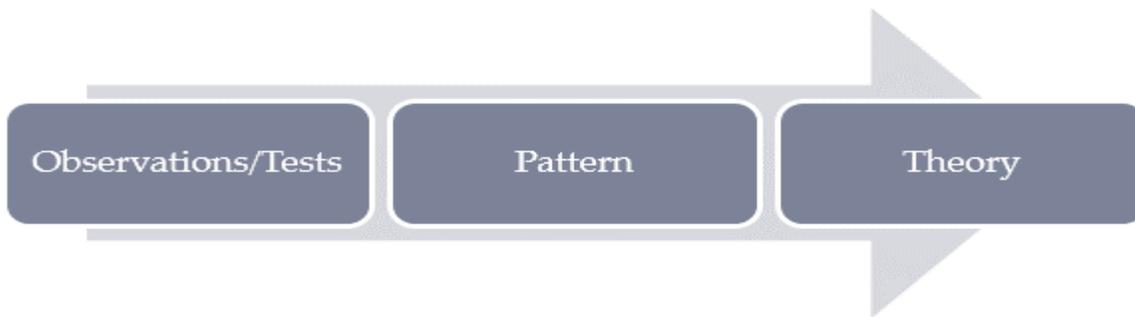
Inductive Approach (Inductive Reasoning)

- o Inductive approach, also known in inductive reasoning, starts with the observations and theories are proposed towards the end of the research process as a result of observations.
- o Inductive research “involves the search for pattern from observation and the development of explanations theories for those patterns through series of hypotheses.
- o No theories or hypotheses would apply in inductive studies at the beginning of the research and the researcher is free in terms of altering the direction for the study after the research process had commenced.
- o This approach aims to generate meanings from the data set collected in order to identify patterns and relationships to build a theory; however, inductive approach does not prevent the researcher from using existing theory to formulate the research question to be explored.
- o Inductive reasoning is based on learning from experience. Patterns, resemblances and regularities in experience (premises) are observed in order to reach conclusions (or to generate theory).
- o An inductive research approach is one that begins with the final stages of scientific research, typically observation, and works backward to form a hypothesis. It is the opposite of deductive research. [3] [2]

Application of Inductive Approach (Inductive Reasoning) in Business Research

Inductive reasoning begins with detailed observations of the world, which moves towards more abstract generalisations and ideas. When following an inductive approach, beginning with a topic, a researcher tends to develop empirical generalisations and identify preliminary relationships as he progresses through his research. No hypotheses can be found at the initial stages of the research and the researcher is not sure about the type and nature of the research findings until the study is completed.

As it is illustrated in figure below, “inductive reasoning is often referred to as a “bottom-up” approach to knowing, in which the researcher uses observations to build an abstraction or to describe a picture of the phenomenon that is being studied”.



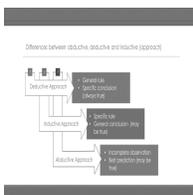
BASIS FOR COMPARISON	INDUCTIVE REASONING	DEDUCTIVE REASONING
Meaning	Inductive Reasoning connotes the argument in which the premises give	Deductive reasoning is the fundamental form of valid

	reasons in support of the probable truth of the conjecture.	reasoning, wherein the premises give guarantee of the truth of conjecture.
Approach	Bottom-up approach	Top-down approach
Starting point	Premises	Conclusion
Based on	Patterns or trend	Facts, truths and rules
Process	Observation > Pattern > Tentative Hypothesis > Theory	Theory > Hypothesis > Observation > Confirmation
Argument	May or may not be strong.	May or may not be valid.
Structure	Goes from specific to general	Goes from general to specific
Draws inferences with	Probability	Certainty

[4]

Abductive reasoning (abductive approach)

- o Abductive reasoning, also referred to as abductive approach is set to address weaknesses associated with deductive and inductive approaches. Specifically, deductive reasoning is criticized for the lack of clarity in terms of how to select theory to be tested via formulating hypotheses. Inductive reasoning, on other hand, criticized because “no amount of empirical data will necessarily enable theory-building”. **Abductive reasoning, as a third alternative, overcomes these weaknesses via adopting a pragmatist perspective.**
- o At the same time, it has to be clarified that abductive reasoning is similar to deductive and inductive approaches in a way that it is applied to make logical inferences and construct theories.
- o When following an abductive approach, researcher seeks to choose the ‘best’ explanation among many alternative in order to explain ‘surprising facts’ or ‘puzzles’ identified at the start of the research process. In the course of explaining ‘surprising facts’ or ‘puzzles’, the researcher can combine both, numerical and cognitive reasoning.[3]



6. SIGNIFICANCE OF RESEARCH

In simple terms, the significance of the study is basically the importance of your research. The significance of a study must be stated in the Introduction section of your research paper.

While stating the significance, you must highlight how your research will be beneficial to the development of science and the society in general.

You can first outline the significance in a broader sense by stating how your research will contribute to the broader problem in your field and gradually narrow it down to demonstrate the specific group that will benefit from your research.

While writing the significance of your study, you must answer questions like:

Why should your research be published?

How will this study contribute to the development of your field? [8] [7]

Hudson Maxim Significance

According to Hudson Maxim significance as “All progress is born of inquiry Doubt is often better than overconfidence, for it leads to inquiry, and inquiry leads to invention”

Research inculcates scientific and inductive thinking and it promotes the development of logical habits of thinking and organization. [7]

The Role of Research

The role of research in several fields of applied economics, whether related to business or to the economy as a whole, has greatly increased in modern times.

The increasingly complex nature of business and government has focused attention on the use of research in solving operational problems. Research, as an aid to economic policy, has gained added importance, both for government and business

Research & Government Policies

Research provides the basis for nearly all government policies in our economic system.

For instance, government’s budgets rest in part on an analysis of the needs and desires of the people and on the availability of revenues to meet these needs.

The cost of needs has to be equated to probable revenues and this is a field where research is most needed. Through research we can devise alternative policies and can as well examine the consequences of each of these alternatives.

Research Special Significance

Research has its special significance in solving various operational and planning problems of business and industry.

Operations research and market research, along with motivational research, are considered crucial and their results assist, in more than one way, in taking business decisions.

Market research is the investigation of the structure and development of a market for the purpose of formulating efficient policies for purchasing, production and sales.

Operations research refers to the application of mathematical, logical and analytical techniques to the solution of business problems of cost minimization or of profit maximization or what can be termed as optimization problems.

Motivational research of determining why people behave as they do is mainly concerned with market characteristics. In other words, it is concerned with the determination of motivations underlying the consumer (market) behaviour. [7] [6]

Research is Equally Important for Social Scientists

Research is equally important for social scientists in studying social relationships and in seeking answers to various social problems.

It provides the intellectual satisfaction of knowing a few things just for the sake of knowledge and also has practical utility for the social scientist to know for the sake of being able to do something better or in a more efficient manner.

To Gather Necessary Information

Research provides you with all necessary information in field of your work, study or operation before you begin working on it. For example, most companies do research before beginning a project in order to get a basic idea about the things they will need to do for the project. Research also helps them get acquainted with the processes and resources involved and reception from the market. This information helps in the successful outcome of the project. [8]

To Make Changes

Sometimes, there are in-built problems in a process or a project that is hard to discover. Research helps us find the root cause and associated elements of a process. The end result of such a research invokes a demand for change and sometimes is successful in producing changes as well. For example, many U.N researches have paved way for changes in environmental policies.[8]

Improving Standard Of Living

Only through research can new inventions and discoveries come into life. It was C.V Raman's research that prompted invention of radio communication. Imagine how you would have communicated had Graham Bell

not come out with the first ever practical telephone! Forget telephones, what would have happened if Martin Cooper did not present the world the concept of mobile phones! Addicted as we are to mobile phones, we need to understand that all the luxuries and the amenities that are now available to us are the result of research done by someone. And with the world facing more and crisis each day, we need researchers to find new solutions to tackle them. [8]

For A Safer Life

Research has made ground breaking discoveries and development in the field of health, nutrition, food technology and medicine. These things have improved the life expectancy and health conditions of human race in all parts of the world and helped eradicate diseases like polio, smallpox completely. Diseases that were untreatable are now history, as new and new inventions and research in the field of medicine have led to the advent of drugs that not only treat the once-incurable diseases, but also prevent them from recurring. [8]

To Know The Truth

It has been proved time and again that many of established facts and known truths are just cover ups or blatant lies or rumours. Research is needed to investigate and expose these and bring out the truth. [8]

Explore Our History

Research about our planets history and human history has enabled us to learn and understand more about our forefathers and helped us learn from their mistakes and absorb good things from their life. Research about the planet's history and existence has told us a lot about how things will shape up in years to come and how we need to respect our planet and work closely together to stop global warming and other scenarios of destruction. [8]

Understanding Arts

This helps us in understanding the work of artists in literature, paintings, sculptures and everything that can be attributed with artistic touch. If no research is conducted into any of these, we will never be able to understand any of these as per the artist's imagination. Also, a lot of great artistic work is hidden in the shadows of history, which needs to be drawn out. [8]

The Significance of Research can also be Understood Keeping in view the Following Points:

1. To those students who are to write a master's or Ph.D. thesis, research may mean a careerism or a way to attain a high position in the social structure.
2. To professionals in research methodology, research may mean a source of livelihood.
3. To philosophers and thinkers, research may mean the outlet for new ideas and insights.
4. To literary men and women, research may mean the development of new styles and creative work

5. To analysts and intellectuals, research may mean the generalizations of new theories. [7]

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7. HYPOTHESIS

7.1 Meaning of Hypothesis:

The term hypothesis has been defined in several ways.

1. A hypothesis is a tentative generalization the validity of which remains to be tested. In its most elementary stage, the hypothesis may be any hunch, guess, imaginative idea which becomes the basis for further investigation.
2. A hypothesis states what we are looking for. A hypothesis looks forward. It is a proposition which can be put to a test to determine its validity. It may prove to be correct or incorrect.
3. A hypothesis is a tentative statement of the relationship between two or more variables. Hypotheses are always in declarative sentence form and they relate, either generally or specifically variable and variables.”
4. A theory when stated as a testable proposition formally and clearly and subjected to empirical or experimental verification is known as a hypothesis.

The word hypothesis consists of two words:

Hypo + thesis = Hypothesis

‘Hypo’ means tentative or subject to the verification and ‘Thesis’ means statement about solution of a problem.

The word meaning of the term hypothesis is a tentative statement about the solution of the problem.

Hypothesis offers a solution of the problem that is to be verified empirically and based on some rationale.

Another meaning of the word hypothesis which is composed of two words:

‘Hypo’ means composition of two or more variables which is to be verified.

‘Thesis’ means position of these variables in the specific frame of reference.

This is the operational meaning of the term hypothesis. Hypothesis is the composition of some variables which have some specific position or role of the variables i.e. to be verified empirically. It is a proposition about the factual and conceptual elements. It is a brilliant guess about the solution of a problem. A tentative generalization or theory formulated about the character of phenomena under observation are called hypothesis. It is a statement temporarily accepted as true in the light of what is known at the time about the phenomena.

Assumption, Postulate and Hypothesis:

The terms assumption, postulate and hypothesis occur most frequently in the research literature, but are often confused by research scholars. Hence these terms need clear explanation.

(a) **Assumption:** Assumption means taking things for granted so that the situation is simplified for logical procedure. Assumption means restrictive conditions before the argument can become valid. Assumptions are made on the basis of logical insight and their truthfulness can be observed on the basis of data or evidences. For example, the formulas of Statistics and measurement are based on number of assumptions.

(b) **Postulate:** The postulates are the basis and form the original point of an argument. Postulates are the working beliefs of most scientific activity. The mathematician begins by postulating a system of numbers which range from 0 to 9 and can permute and combine only thereafter. Postulates are not proven; they are simply accepted at their face value so that their basic work for the discovery of other facts of nature can begin.

(c) **Hypothesis:** A hypothesis is different from both of these. It is the presumptive statement of a proposition which the investigator seeks to prove. The hypothesis is based on some earlier theory and some rationale whereas postulates are taken as granted true. An assumption is the assumed solution of a major problem. It may be partially true. The scientific research process is based on some hypotheses. The nature sciences and mathematics are based on postulates. The statistic is based on some assumptions which are considered approximate science. The assumptions are helpful in conducting a research work in behavioural sciences.

7.2 Nature of Hypothesis:

The following are the main features of a hypothesis:

1. Is conceptual in nature.
2. Is a verbal statement in a declarative form?
3. Has the empirical referent.
4. Indicates the tentative relationship between two or more variables.
5. Is a powerful tool of advancement of knowledge, consistent with existing knowledge and conducive to further enquiry?
6. Can be tested, verifiable or falsifiable.
7. Is not moral or ethical questions.
8. Is neither too specific nor too general.
9. Is considered valuable even if proven false.

7.3 Functions of Hypothesis:

1. It is a temporary solution of a problem concerning with some truth which enables an investigator to start his research work.
2. It offers a basis in establishing the specifics what to study for and may provide possible solutions to the problem.
3. Each hypothesis may lead to formulate another hypothesis.
4. A preliminary hypothesis may take the shape of final hypothesis.
5. Each hypothesis provides the investigator with definite statement which may be objectively tested and accepted or rejected and leads for interpreting results and drawing conclusions that is related to original purpose.

7.4 Importance of a Hypothesis:

1. Hypothesis as the Investigator's "Eyes": By guiding the investigator in further investigation it serves as the investigator's "Eyes" in seeking answers to tentatively adopted generalization.
2. It Focuses Research: Without it, research is unfocussed research and remains like a random empirical wandering. It serves as necessary link between theory and the investigation.
3. It Places Clear and Specific Goals: A well thought out set of hypothesis is that they place clear and specific goals before the research worker and provide him with a basis for selecting sample and research procedure to meet these goals.
4. It Links Together: "It serves the important function of linking together related facts and information and organizing them into wholes."
5. It Prevents Blind Research: "The use of hypothesis prevents a blind search and indiscriminate gathering of masses of data which may later prove irrelevant to the problem under study."

6. **As a Sort of Guiding Light:** A hypothesis serves as a powerful beacon that lights the way for the research work.

7.5 Characteristics of a Good Hypothesis:

A good hypothesis must possess the following main characteristics:

- Should be empirically testable, whether it is right or wrong.
- Should be specific and precise.
- Should not be contradictory.
- Should specify variables between which the relationship is to be established.
- Should describe one issue only. A hypothesis can be formed either in descriptive or relational form.
- Does not conflict with any law of nature which is known to be true.

7.6 Types of Hypothesis:

1. **Directional Hypothesis:** A hypothesis may be directional which connotes an expected direction in the relationship or difference between variables. The hypothesis developer of this type appears more certain of his anticipated evidence than would be the case if he had used either of the previous examples. If seeking a tenable hypothesis is the general interest of the researcher, this kind of hypothesis is less safe than the others because it reveals two possible conditions. These conditions are matter of degree.

The first condition is that the problem of seeking relationship between variables is so obvious that additional evidence is scarcely needed. The second condition derives because researcher has examined the variables very thoroughly and the available evidence supports the statement of a particular anticipated outcome.
2. **Non-Directional Hypothesis:** A hypothesis may be stated in the null form which is an assertion that no relationship or no difference exists between or among the variables. This form null hypothesis is a statistical hypothesis which is testable within the framework of probability theory.
3. **Null Hypothesis:** This is a hypothesis that proposes no relationship or difference between two variables. This is the conventional approach to making a prediction. It involves a statement that says there is no relationship between two groups that the researcher compares on a certain variable. The hypothesis may also state that there is no significant difference when different groups are compared with respect to a particular variable. For example, 'There is no difference in the academic performance of high school students who participate in extracurricular activities and those who do not participate in such activities' is a null hypothesis. It asserts that there is no true difference in the sample statistic and population parameter under consideration (hence the word 'null' which means invalid, void, or amounting to nothing) and that

the difference found is accidental arising out of fluctuations of sampling. It is denoted as H_0

The null hypothesis is stated as,

$H_0: \mu_1 = \mu_2$ where

H_0 = the null hypothesis,

μ_1 = the mean of population 1, and

μ_2 = the mean of population 2.

4. **Alternate or Research Hypothesis:** This hypothesis proposes a relationship between two or more variables, symbolized as H_1 . For example, if a researcher was interested in examining the relationship between music and emotion, s/he may believe that there is a relationship between music and emotion. H_1 (the research/alternate hypothesis): Music at a fast tempo is rated by participants as being happier than music at a slow tempo.

H_0 (the null hypothesis): Music at a fast tempo a data slow tempo is rated the same in happiness by participants.

The two hypotheses we propose to test must be *mutually exclusive*; i.e., when one is true the other must be false. And we see that they must be *exhaustive*; they must include all possible occurrences.

The alternative hypothesis is stated as,

$H_1: \mu_1 \neq \mu_2$

where

H_1 = the alternative hypothesis,

μ_1 = the mean of population 1, and

μ_2 = the mean of population 2

5. **Statistical Hypothesis:** Statistical hypothesis is an assumption about statistical populations that one seeks to support or refute. The null hypothesis and alternative hypothesis together are called statistical hypothesis.

7.7 Application of Hypothesis:

Mostly find out in Educational Researches that may be classified into four types:

1. Experimental research,
2. Normative survey research,
3. Historical research, and
4. Complex casual research

Hypotheses are indispensable for experimental researches. The experiments are conducted to collect empirical data to verify hypotheses. The experimental method or experimental designs are based on hypotheses. Hypotheses are the crucial aspects of such researches.

In normative survey research the investigator may or may not employ hypothetical type thinking, depending upon the purpose of the research study. Hypotheses are essential for analytical studies and there is little scope in descriptive type studies.

In historical research the purpose may be either to produce a faithful record of the past events irrespective of present-day problem or to extend the experience with phenomena in the present to past in order to make the view of the phenomena. There is a little scope of hypotheses in historical research because hypothesis has the future reference and its verification on empirical data. Case study method has no scope for constructing hypotheses because it is developmental type study.

In complex casual research the hypotheses have important role in such investigations. These types of studies are conceptual in nature whereas historical are more factual in nature. Therefore, formulation of hypothesis is a crucial step of this type of studies.

7.8 Sources of Hypothesis:

Hypothesis are originated from essentially the same background that serves to reveal problem. These sources are namely theoretical background, knowledge, insight and imagination that comes from instructional programmed and wide reading experiences, familiarity with existing practices. The major sources of hypothesis are given below:

Specialization of an educational field.

Program of reading: Published studies, abstracts research journals. Hand books, seminar, current trends on the research area.

Instructional programmers persuaded.

Analyse of the area studied.

Considering existing practices and needs.

Extension of the investigation.

Offshoots of research studies in the field.

8. FORMULATING A HYPOTHESIS:

The basic steps in the formulation of a hypothesis is

1. Define Variables

At first, with a view to formulating a hypothesis, you must define your variables. What do you want to test? Will you test that rewards increase reading achievement? Or rewards decrease reading achievement? Whatever your goals are, they need to be clearly defined, quantifiable, and measurable. This will provide you with a clear idea of what to follow to achieve results.

2. Study In-Depth the Variables

If we do think that your variables are Rewards & Achievements, then you need to intense study how rewards increase reading achievements? An in-depth study, rigorous questions, and data of rewards increase reading achievements will make you able to confirm your hypothesis. Specify dependent and independent variables.

3. Specify the Nature of Relationship

Then, identify what relationship there exist between the variables. What variable influences the other? That is what the dependent variable is and what is the independent variable? How Rewards impact achievements? If reward plays a key role in reading achievements, then reward is the independent variable.

4. Identify Study Population

The population in research we mean the entire group of individuals is going to study. If you want to test how rewards increase reading achievements in the United Kingdom, you need not study the whole population of the United Kingdom. Because the total population does not involve in reading achievements. Therefore, the researcher must identify the study population.

5. Make Sure Variables are Testable

Variables in your hypothesis must be testable. Otherwise, the hypothesis would be worthless. Because your research study must accept or reject a variable. So, variables you must need to test. Testable variables can only be accepted or rejected. Moreover, the sole aim of a research hypothesis is to test variables in the long run.

9. CRITERIA FOR EVALUATING HYPOTHESIS

Some hypothesis are considered more satisfactory than others. The following are the serious considerations of a satisfactory hypothesis and these criteria may be helpful to make this judgment.

Plausibility of Explanation: Several criteria are involved in establishing the plausibility of explanations. A satisfactory hypothesis should have relevant and logical possibility about the relationship of variables included in them.

Testability of Explanation: The variables should be defined operationally and the predicted

relations among them can be tested empirically. The variables of the hypothesis should be measurable or quantifiable. The suitable measuring instrument is available or it can be considered easily.

Adequacy of Scope: The most useful hypotheses explain all the facts that are relevant to the phenomena being explained and contradict none of them. The broader the scope of a theory, the more valuable it is. The more consequences that a hypothesis yields, the greater is its fruitfulness. A hypothesis is of greater value if it establishes a generalization that can be applied in many areas of education or in many fields. The most satisfactory hypotheses not only explain all the known facts that gave rise to the original problems but also enable scientists to make predictions about as yet unobserved events and relationships.

Usefulness of False Hypotheses: Hypotheses need not be the correct answers to problems to be useful. In almost every inquiry a scholar formulates several hypotheses and hopes that one will provide a satisfactory solution to the problem. By eliminating the false hypotheses one by one the investigator keeps narrowing the field in which the answer must lie. The testing of false hypotheses is also of value if it directs the attention of scientists to unsuspected facts or relations, they eventually help in solving.

Roots in Existing Theories: A useful educational hypothesis, therefore, adds something to previously established knowledge by supporting, qualifying, refuting or enlarging upon existing theories. A hypothesis that is compatible with well-attested theories is in a favourable position to advance knowledge. If progress is to be made new hypotheses must fit into the framework of existing theories and transform them into more perfect explanatory schemes. Thus, even the more revolutionary theories are not completely different from the existing edifice of knowledge.

Suitability for Intended Purpose: Each hypothesis that offers a satisfactory explanation of what it intends to explain is useful for that purpose. Every hypothesis serves a specific purpose and must be adequate for the purpose it claims to serve. Thus, suitability is also the important criterion for an effective hypothesis.

Simplicity of Explanation: If two hypotheses are capable to explain the same facts, the simpler one is the better hypothesis. Simplicity means that the hypothesis explains the phenomena with the least complex theoretical structure. The hypothesis that accounts for all facts with the fewest independent or special assumptions and complexities is always preferable.

10. STATISTICAL ERRORS IN HYPOTHESIS

In statistical test theory the notion of statistical error is an integral part of hypothesis testing. In an ideal world we would always reject the null hypothesis when it is false, and we would not reject the null hypothesis when it is indeed true. But there are two other scenarios that are possible, each of which will result in an error.

Type I Error:

A type I error, also known as an error of the first kind, occurs when the null hypothesis (H_0) is true, but is rejected. It is asserting something that is absent, a false hit. A type I error may be compared with a so-called false positive (a result that indicates that a given condition is present when it actually is not present) in tests where a single condition is tested for. A false positive error, or in short false positive, commonly called a 'false alarm', is a result that indicates a given condition has been fulfilled, when it actually has not been fulfilled. A false positive error is a Type I error where the test is checking a single condition, and results in an affirmative or negative decision usually designated as 'true or false'. The rate of the type I error is called the size of the test and denoted by the Greek letter α (alpha). It usually equals the significance level of a test. In the case of a simple null hypothesis α is the probability of a type I error.

Type II Error:

A type II error, also known as an error of the second kind, occurs when the null hypothesis is false, but erroneously fails to be rejected. It is failing to assert what is present, a miss. A type II error may be compared with a so-called false negative (where an actual 'hit' was disregarded by the test and seen as a 'miss') in a test checking for a single condition with a definitive result of true or false. A false negative error, or in short false negative, is where a test result indicates that a condition failed, while it actually was successful. A false negative error is a type II error occurring in test steps where a single condition is checked for and the result can either be positive or negative. The rate of the type error is denoted by the Greek letter β (beta) and related to the power of a test (which equals $1-\beta$).

Tabularized relations between truth/falseness of the null hypothesis and outcomes of the test-

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Null hypothesis (H_0) is true

Alternative hypothesis (H_1) is true

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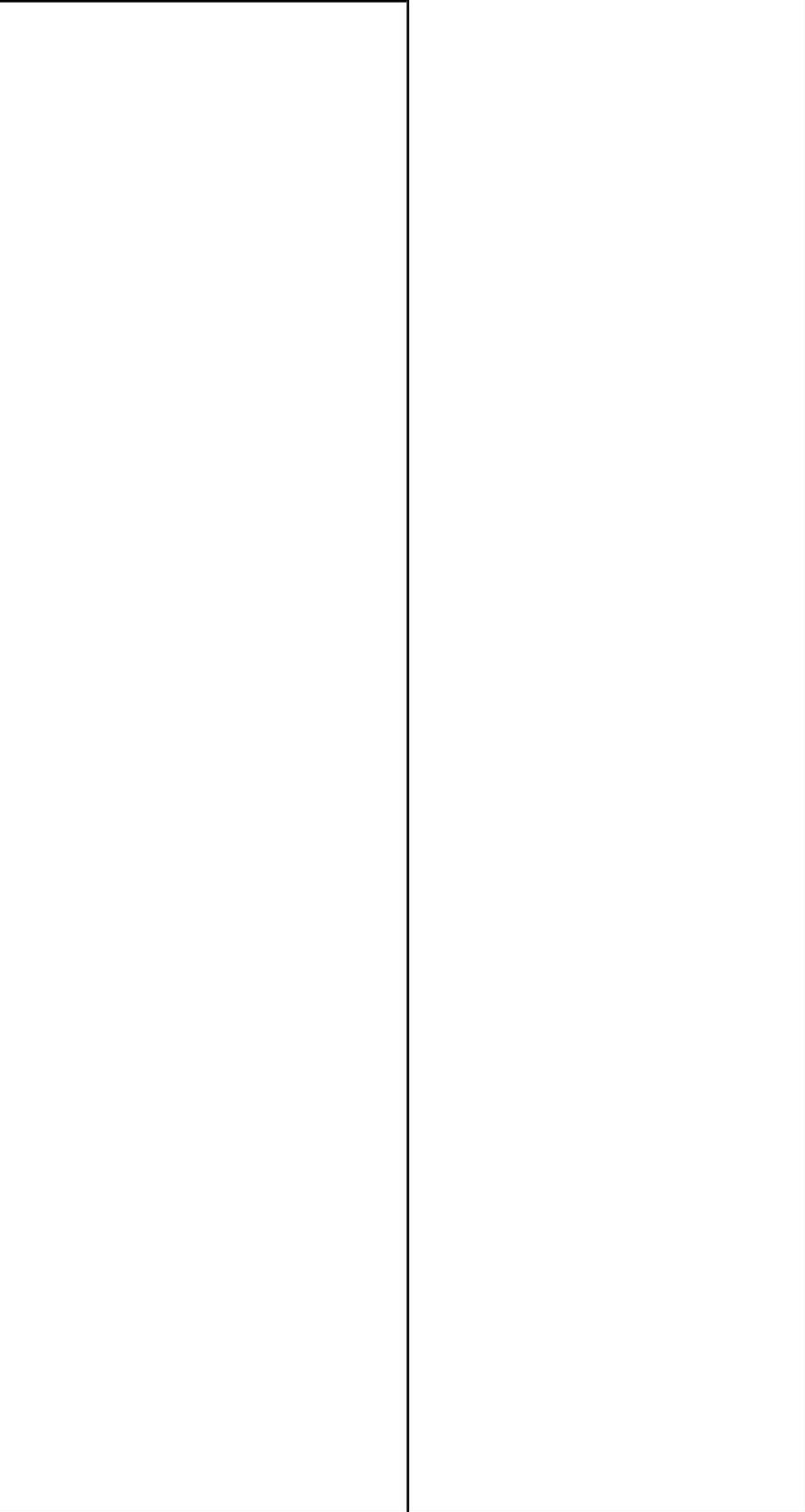
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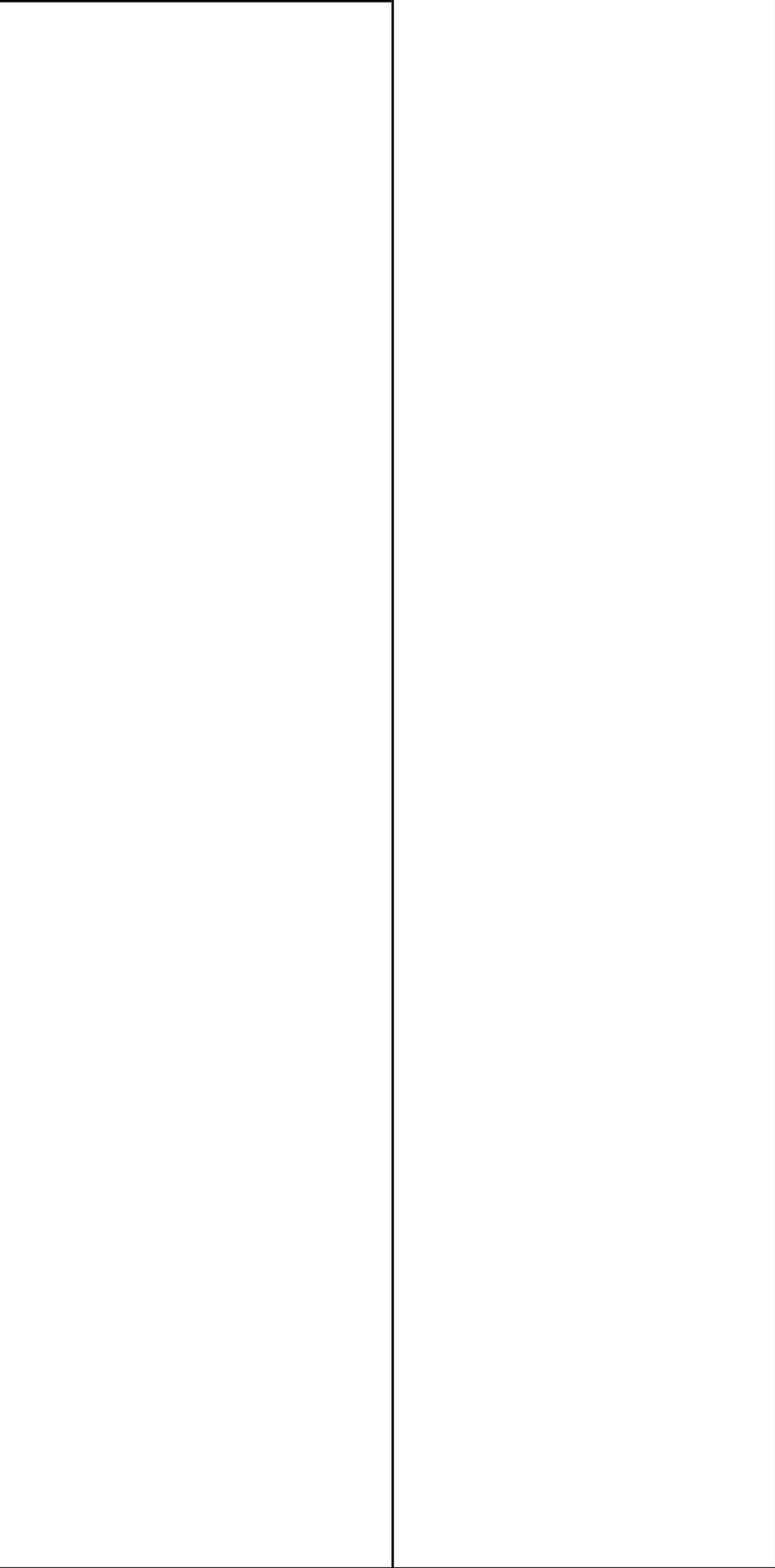
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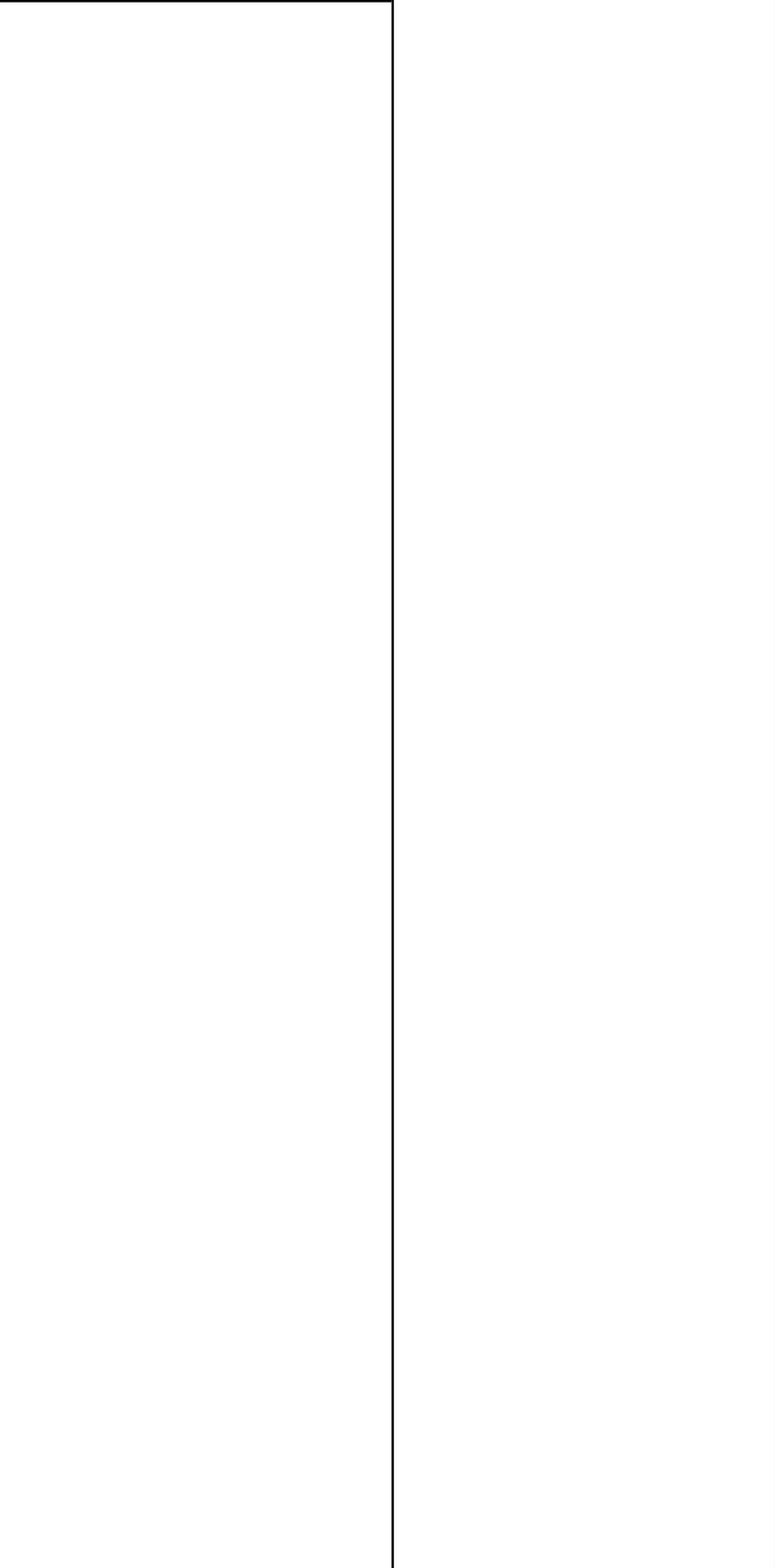
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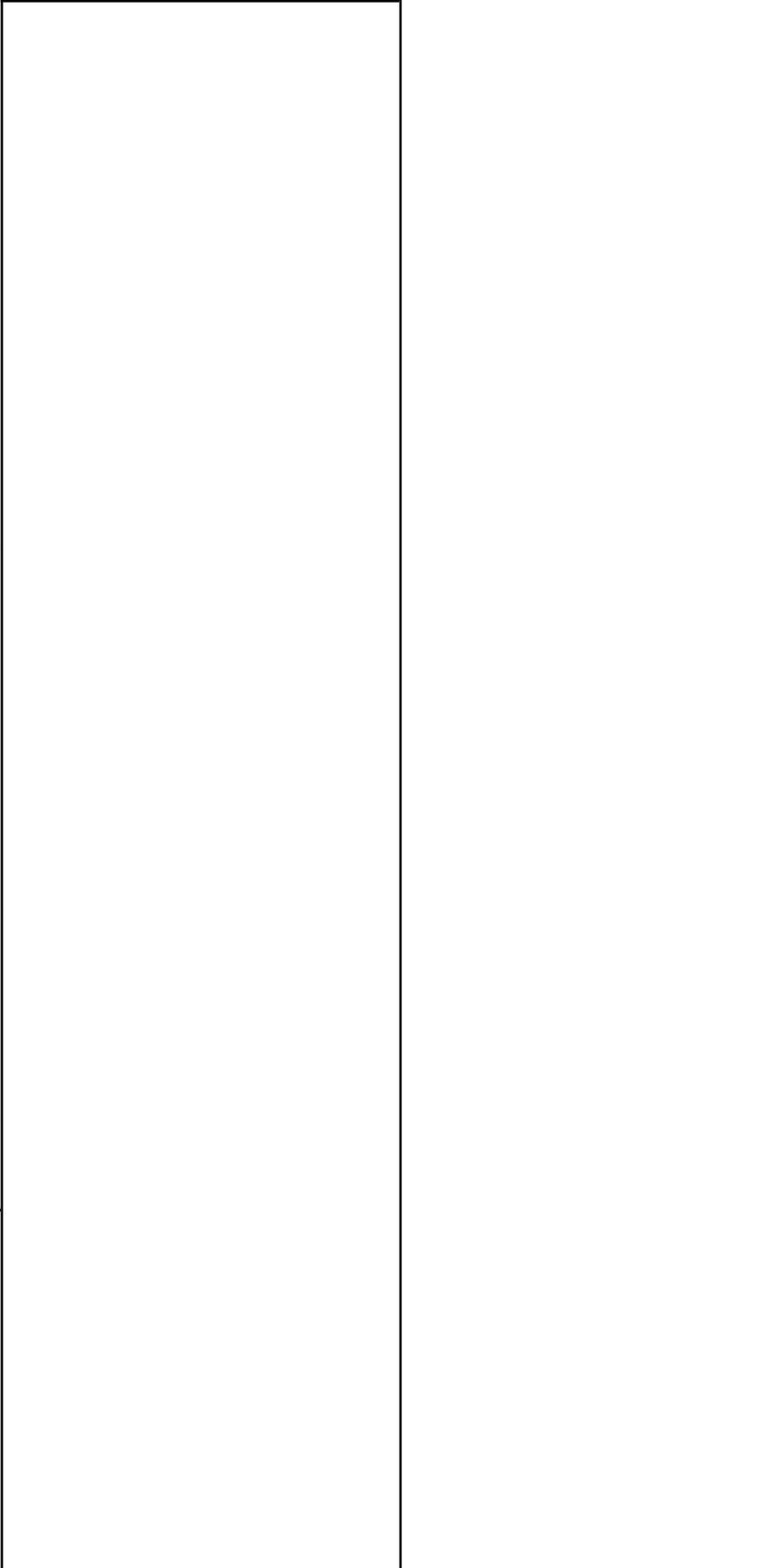
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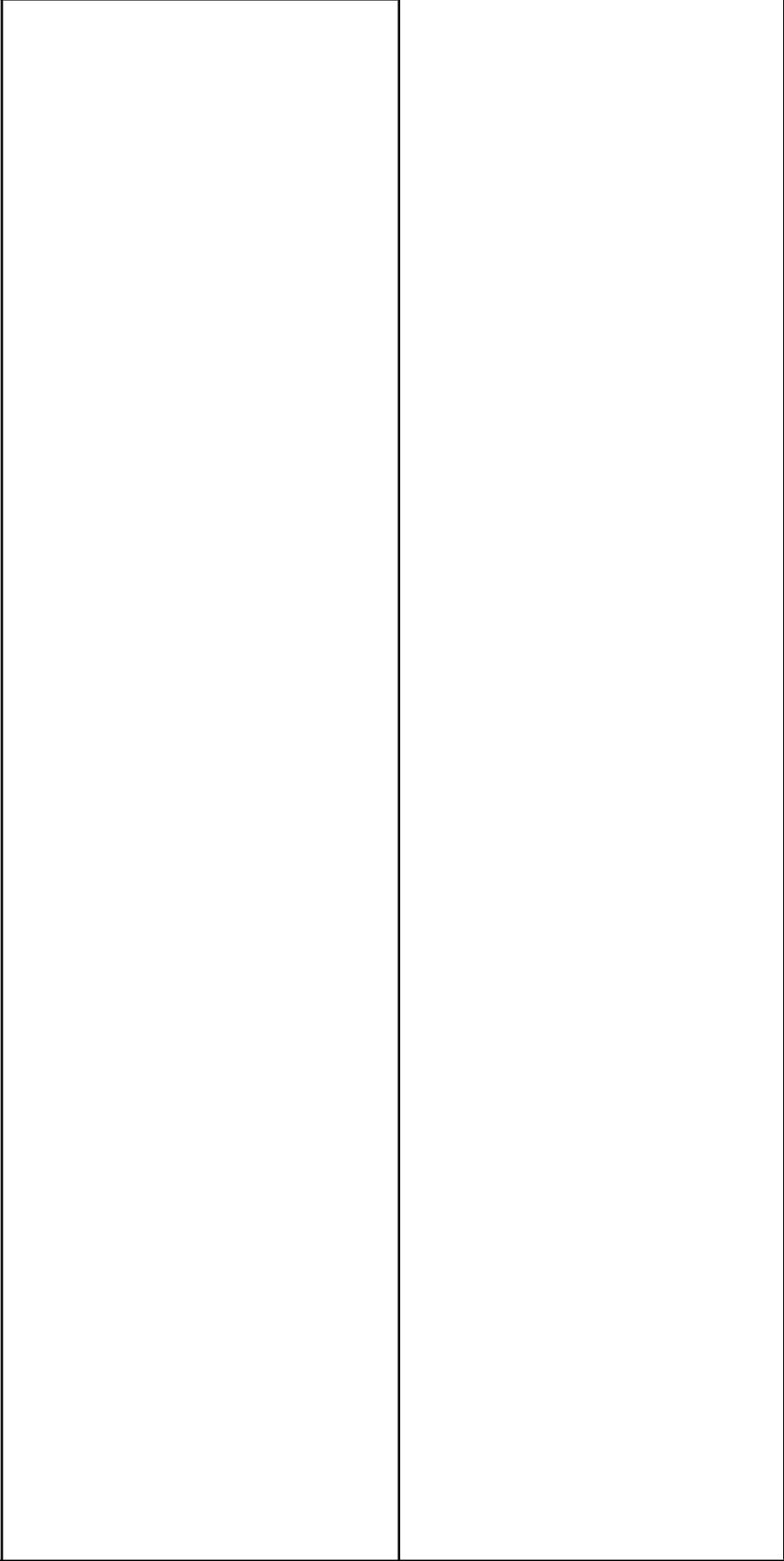
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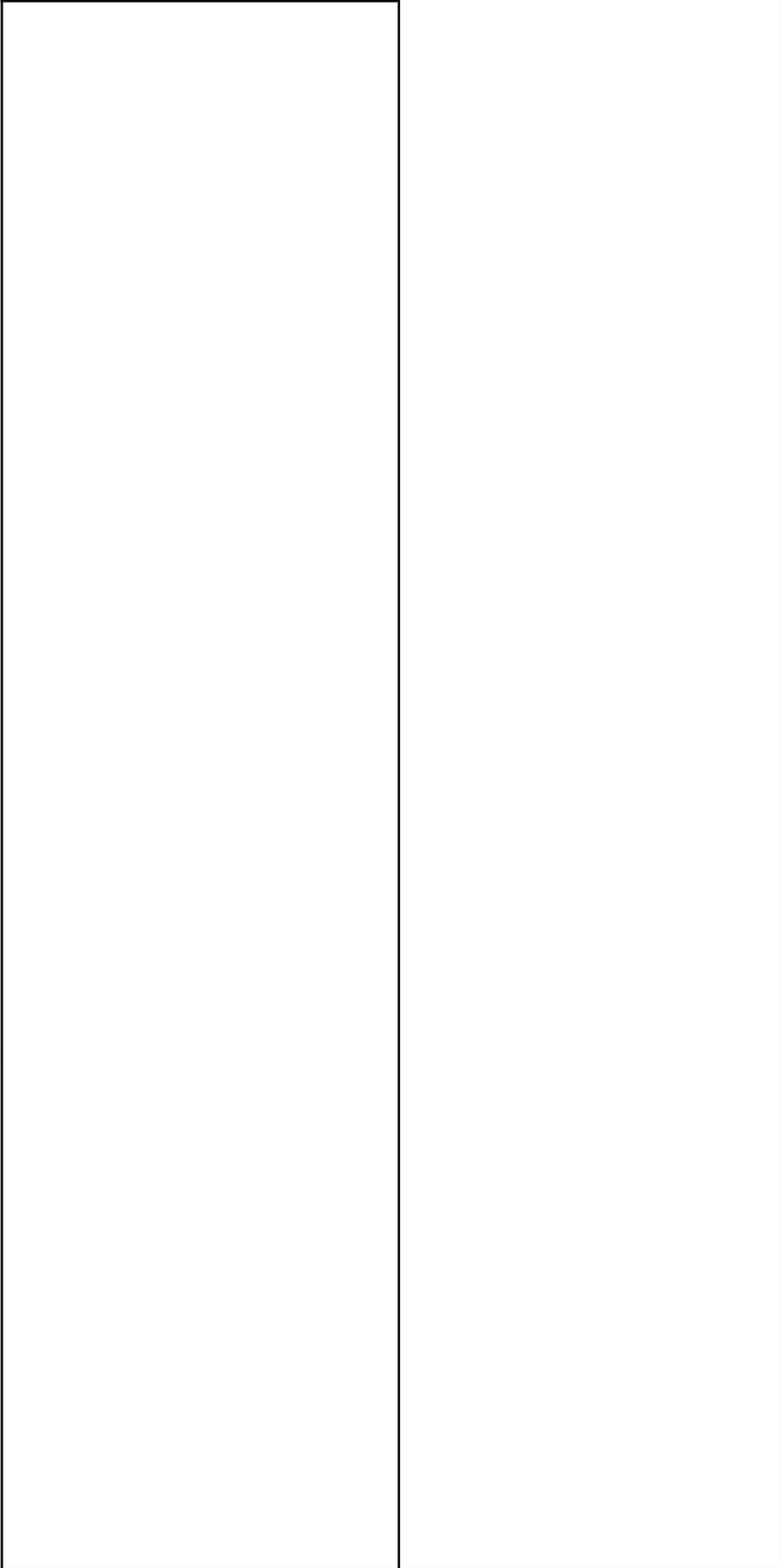
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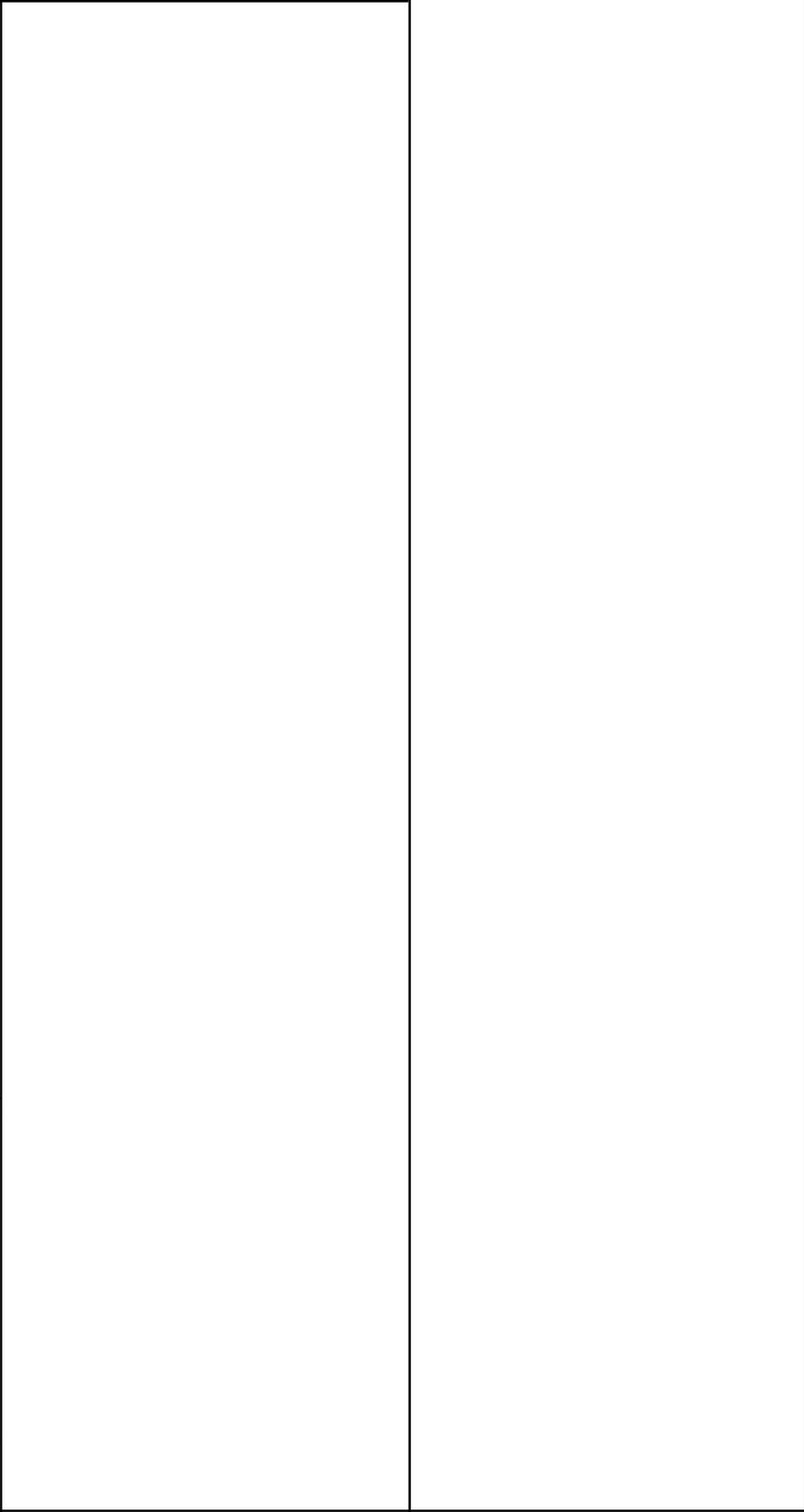
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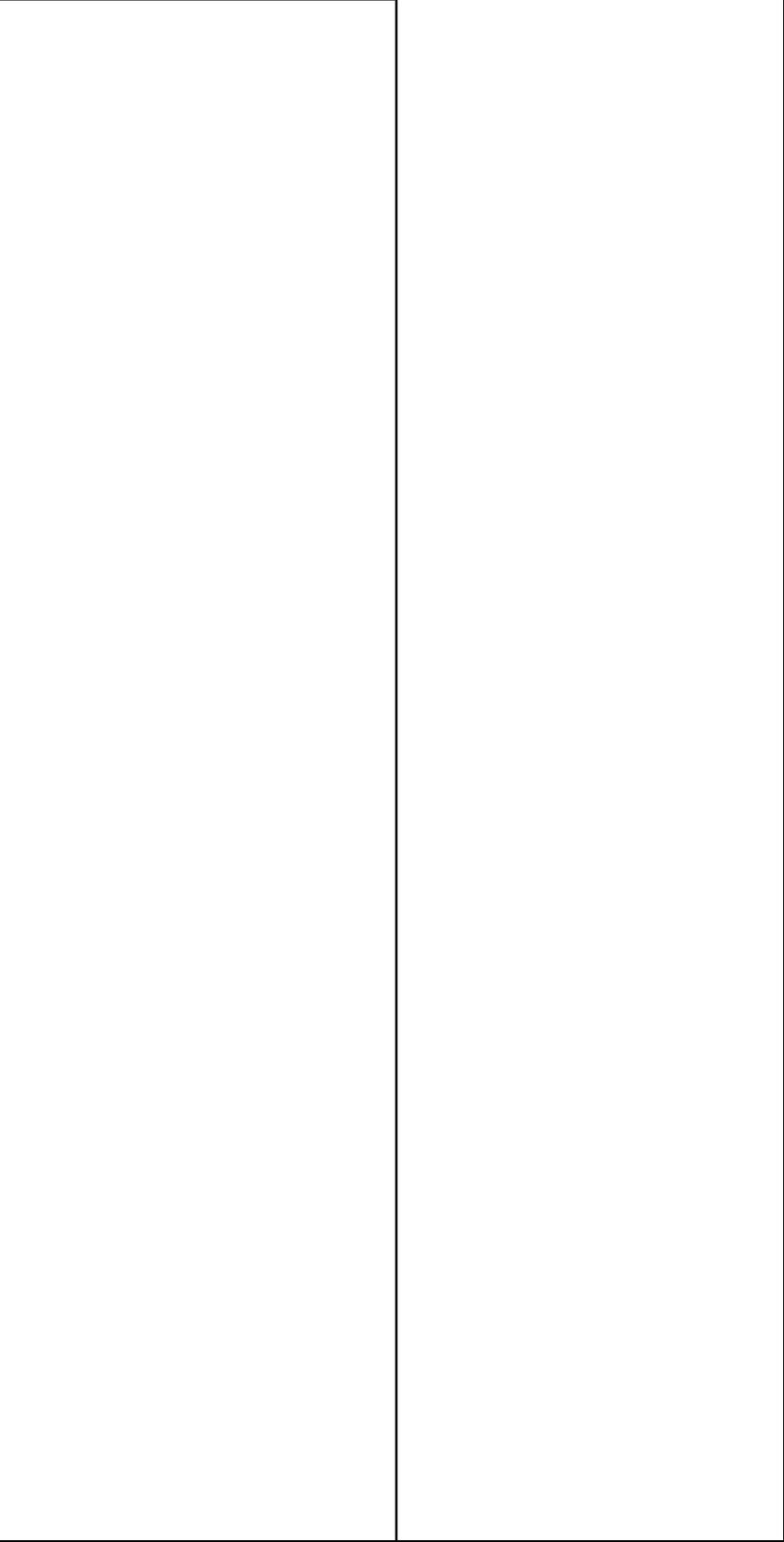
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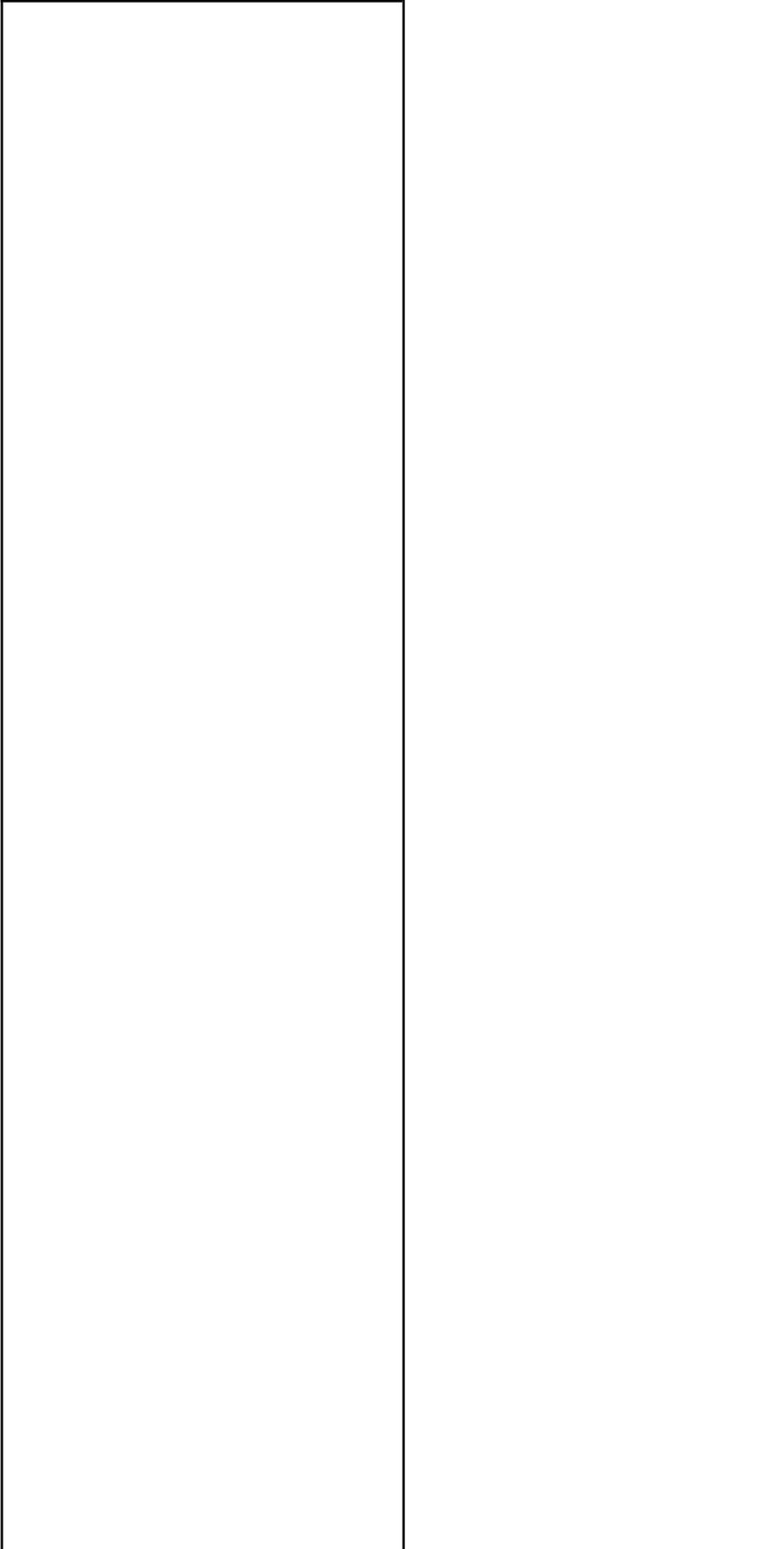
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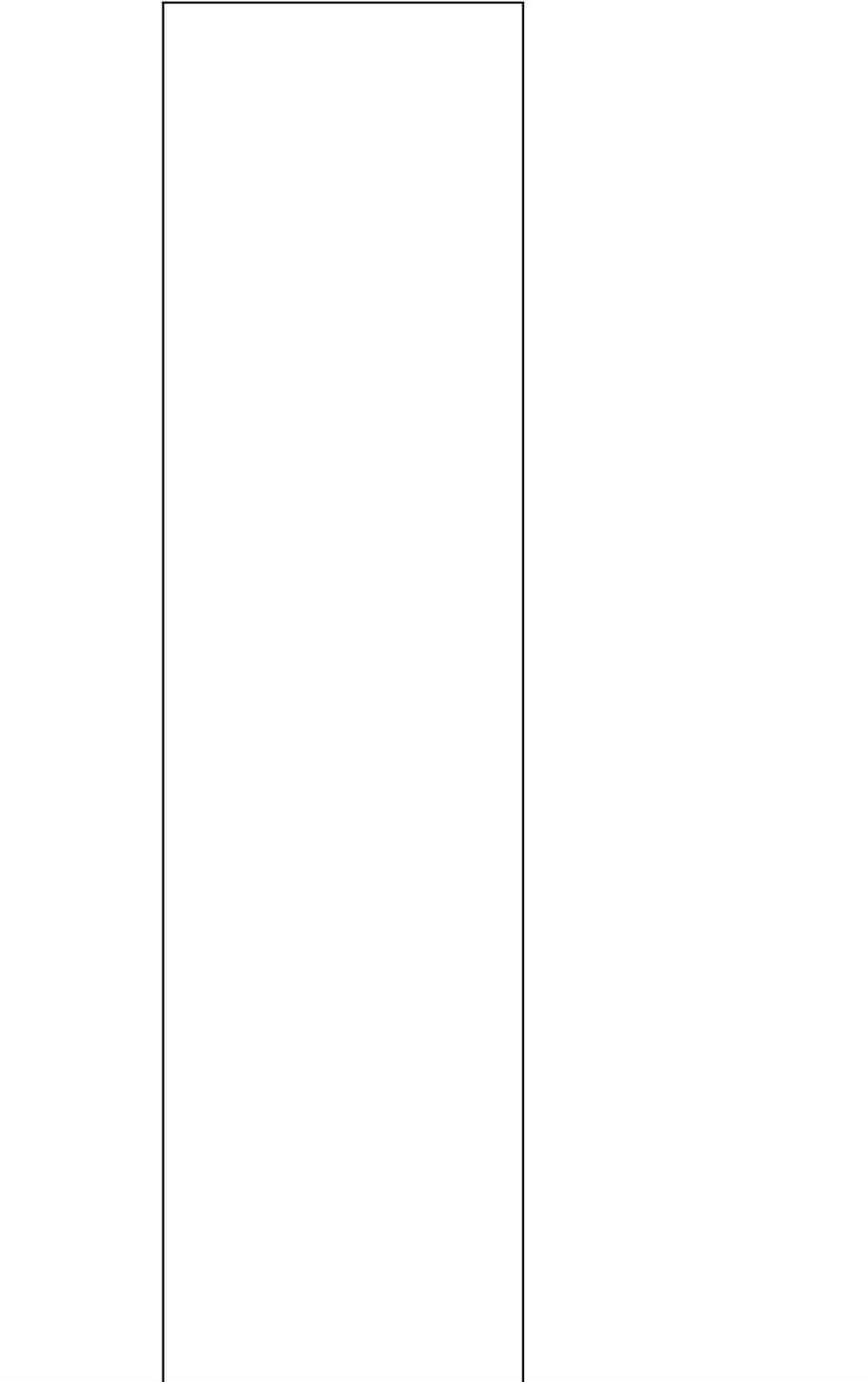


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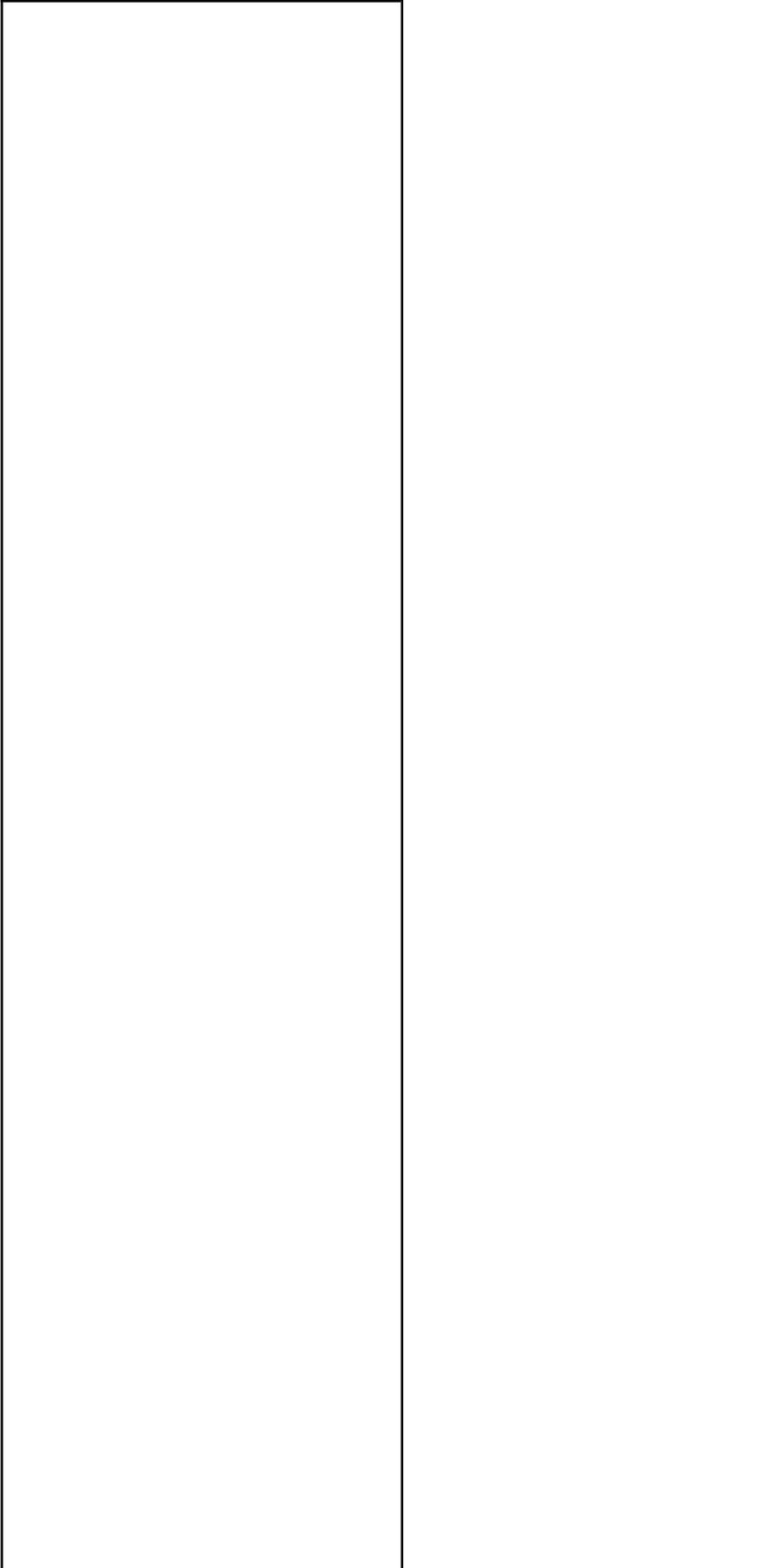
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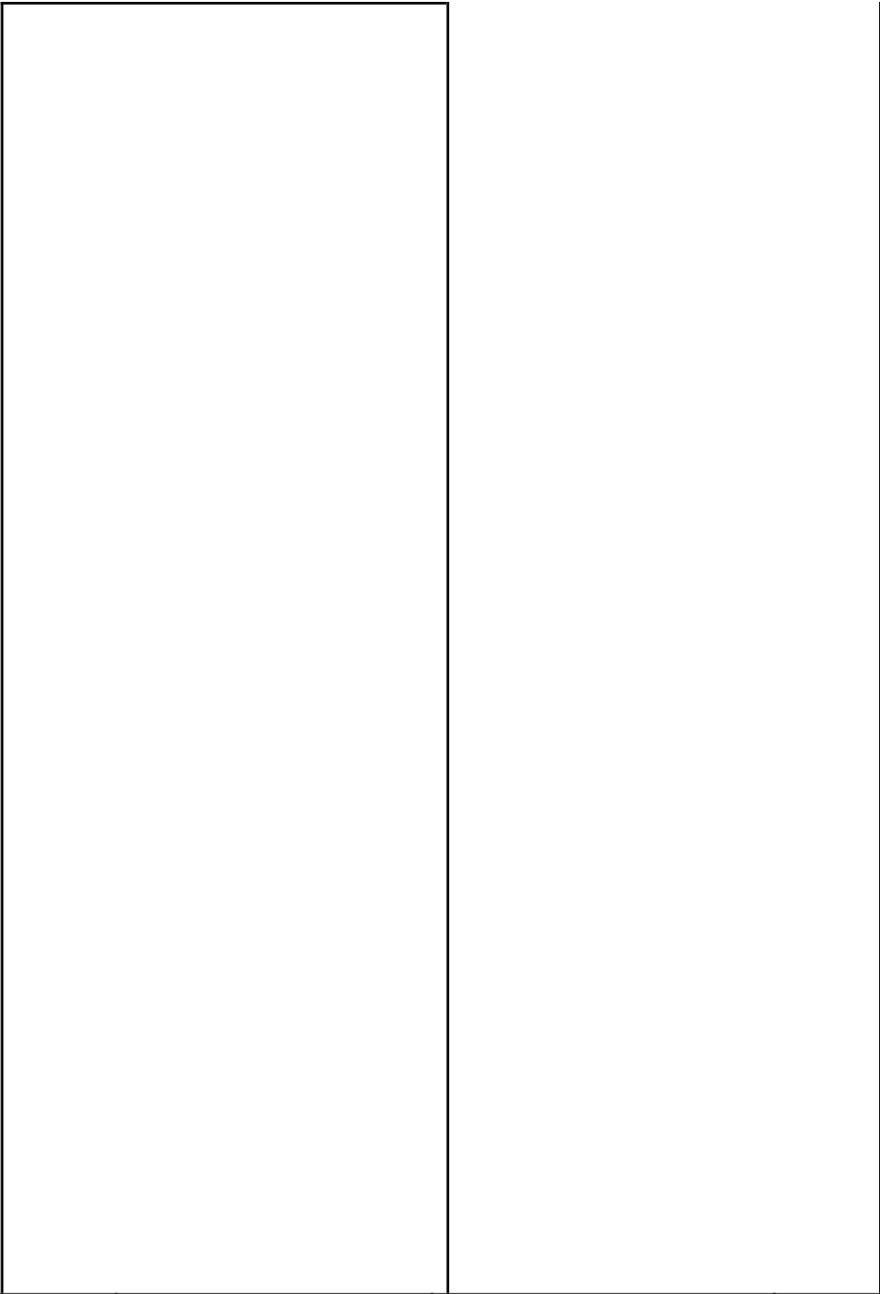
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Mark (50% of value)

$$= L1+L2$$

$$2dx=X-Afdx \quad \dot{x} = A + \sum f dx N$$

1043 + 4 = 7533 No. of Students (f) $CF_M = \frac{N+1}{2} = \frac{140-501452020351030}{2}$

$$\frac{28+1}{2} = \frac{29}{2} = 14.5$$

Merits of Arithmetic Mean

- Simple and easy to understand
- Considers each and every item of the series
- Similarity in the answer after application of the formula of average
- Rigidly defined
- Does not depend on the position of the series
- Does not fluctuate with sampling

Demerits of Arithmetic Mean

- Not suitable in case of qualitative data
- In case of normal distribution, mean is not a good measure of central tendency

Median (M)

It refers to the middle value in a distribution. It is a positional average. It is the exact mid point in a ranked series. In a skewed distribution, it is the exact average, it is the half way point. There are always 50% of all observations above median and 50% below.

Individual Series

Discrete

Continuous

1. Arrange the given order ascending/descending order

1 Arrange the given order

1 Arrange the given data in ascending/descending order

2. $M = \frac{N+1}{2}$

2

2 Calculate Cumulative Frequency

2 Calculate CF

Where,

3 $M = \frac{N+1}{2}$

2

3 Calculate $m = \frac{N}{2}$

?

N = Number of items

Where, $N = \sum f$

4 $M = l + \frac{i}{2} \left(\frac{m-c}{i} \right)$

f

Where,

m = Median group l = Lower limit

i = class interval difference

c= CF of just preceding median group

Example of Individual series in odd case

Find the median of 4,10,12,15,5,3,9

Step 1: Arrange

3,4,5,9,10,12,15

Step 2: $M = \frac{N+1}{2}$

$M = \frac{8}{2} = 4^{\text{th}}$ item, so Median is 9

Example of Individual series in even case

Find the median of 4, 10,12,15,5,3,9,17

Step 1: Arrange

3, 4, 5,9,10,12,15,17

Step 2: $M = \text{size of } (\frac{N}{2})^{\text{th}} \text{ item} + (\frac{N}{2} + 1)^{\text{th}} \text{ item}$

$M = \frac{8}{2} = 4.5$

$\frac{2}{2} + \frac{2}{2}$

So, we will take 4^{th} item + 5^{th} item i.e $\frac{9 + 10}{2} = 9.5$

Example of Discrete series

Marks

514 + 5 = 19153	7	7 + 7 =14
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0-103310-2071020-3051530-40621M = l + $\frac{t}{2}$ (m-c)No. of studentsCFm = $\frac{N}{2} + 6 = 2735127 + 1 = 28$ Total N = 28Now cl to it in Marks column we get 20
f

l = 20
i = 10
f = 5
c = 10
m = 12

M = 24 **2**

24 = 12

2

So our answer is 20

Example of Continuous series

Marks
306

No. of Students Find out highest frequency 26 Total N= 24

Highest Frequency is 20 So Mode is 10

Merits of Median

Easy to calculate in case of unequal intervals of class
It is not strongly affected by extreme observations
Can be determined graphically

Demerits of Median

Data arrangement is very much necessary
Affected by fluctuation in sampling
Does not take into account each and every item of the series

Mode (Z)

It is that value of the variate which occurs with maximum frequency. Mode can also be defined as that value which is most concentrated.

Individual Series

Value which occurs more in series.

Discrete Series

Inspection Method

If frequency is regular

Continuous Series

- 1 Obtain the grouped data
- 2 Locate the class having maximum frequency. This class is called Modal Class
- 3 Mode of a grouped data is given by :
- 4 $\text{Mode} = l + h \left(\frac{f_m - f_1}{f_m - f_1 - f_2} \right)$
- 5 $\frac{f_m - f_1 - f_2}{f_m - f_1 - f_2}$
- 6 Where, l = lower limit of the modal class h = width of the class interval
- 7 f_m = frequency of the modal class
- 8 f_1 = frequency of the class preceding the modal class
- 9 f_2 = frequency of the class succeeding the modal class

10

11

Example of Individual Series

Suppose we need to find out the value of the mode from the following scores of the students:

25, 29, 24, 27, 28, 25, 29, 25

Mode is 25

Example of Discrete Inspection Method

Marks

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~~XXXXXXXXXXXXXXXXXXXX~~ Frequency 25102321123

~~42~~
~~1500~~
10-20

46
3000 Deviation (X-
20-30

~~300~~
30-40

~~45005~~
40-5012

10
9
30-604

10
42

~~4144~~
~~15800~~

210
~~4990~~
414

~~980~~
35

~~504288~~
700
35

1500-4000
35

-5000
45-20
0000

~~380~~
49004500

05

5620

105240

Marks

$M = \frac{\sum fX}{\sum f} = \frac{45678910111213}{2589121414151113}$ (Ans
Mode: 10)
0-77-1414-2121-2828-3535-4242-49 No. of students
347110169 (Ans Median: 28) No. of students
1535608496127198250 (Ans Mean: 50.4)
20304050607080

Uses of Mean:

There are certain general rules for using mean.

Some of these uses are as following:

1. Mean is the center of gravity in the distribution and each score contributes to the determination of it when the spread of the scores are symmetrically around a central point.
2. Mean is more stable than the median and mode. So that when the measure of central tendency having the greatest stability is wanted mean is used.
3. Mean is used to calculate other statistics like S.D., coefficient of correlation etc.

. Uses of Median:

1. Median is used when the exact midpoint of the distribution is needed or the 50% point is wanted.
2. When extreme scores affect the mean at that time median is the best measure of central tendency.
3. Median is used when it is required that certain scores should affect the central tendency, but all that is known about them is that they are

above or below the median.

4. Median is used when the classes are open ended or it is of an equal cell size.

. Uses of Mode:

The mode is used:

(i) When we want a quick and approximate measure of central tendency.

(ii) When we want a measure of central tendency which should be typical value. For example when we want to know the typical dress style of Indian women i.e. the most popular dress style. Like this the average marks of a class is called modal marks.

(iii)

7)References:

- 1) [.https://corporatefinanceinstitute.com/resources/knowledge/other/central-tendency/](https://corporatefinanceinstitute.com/resources/knowledge/other/central-tendency/)
- 2) <http://www.yourarticlelibrary.com/education/statistics/central-tendency-meaning-uses-and-measures/64944>
- 3)
- 4) Research methodology C.R Kothari.
- 5)
- 6) Research methodology Mukul Gupta, Deepa Gupta
- 7)
- 8) <https://byjus.com/maths/assumed-mean-method/>
- 9)
- 10) <https://livedu.in/arithmetric-mean-formula-with-example/>
- 11)
- 12) Elements of computer oriented statistical method (Jeevansons publications)

13) 3. DISPERSION

3.1 Meaning : Dispersion is the state of getting dispersed or spread. Statistical dispersion means the extent to which a numerical data is likely to vary about an average value. In other words, dispersion helps to understand the distribution of the data.

Measures of Dispersion

The measures of dispersion are descriptive statistics that describe how similar a set of scores are to each other. It help to interpret the variability of data i.e. to know how much homogenous or heterogeneous the data is.

The more similar the scores are to each other, the lower the measure of dispersion will be

The less similar the scores are to each other, the higher the measure of dispersion will be

In general, the more spread out a distribution is, the larger the measure of dispersion will be.

Characteristics of Measures of Dispersion.

A measure of dispersion should be rigidly defined.

It must be easy to calculate and understand.

Not affected much by the fluctuations of observations.

Based on all observations

3.2 Types of Measures of Dispersion:

There are two main types of dispersion methods in statistics which are:

- i) Absolute Measure of Dispersion**
- ii) Relative Measure of Dispersion**
- iii)**

Absolute Measure of Dispersion

An absolute measure of dispersion contains the same unit as the original data set. Absolute dispersion method expresses the variations in terms of the average of deviations of observations like standard or means deviations.

Absolute dispersion methods include:

- i) Range (R)
- ii) Average Deviation (AD) or Mean Deviation (MD)
- iii) Standard Deviation (SD)
- iv)

Relative Measure of Dispersion:

The relative measures of dispersion are used to compare the distribution of two or more data sets. This measure compares values without units.

Common relative dispersion methods include:

- i) Coefficient of Range
- ii) Coefficient of Mean Deviation
- iii) Coefficient of Standard Deviation
- iv)

Coefficient of Dispersion: The coefficients of dispersion are calculated along with the measure of dispersion when two series are compared which differ widely in their averages. The dispersion coefficient is also used when two series with different measurement unit are compared.

vi)

) 4. RANGE (R)

- i) Range is the simplest measure of variability or dispersion. It is calculated by subtracting the lowest scores in the series from the highest.

ix)

x)

- xi) Where,

xii) $X_{\max} = \text{Max Value in a given series.}$

xiii) $X_{\min} = \text{Min Value in a given series.}$

xiv)

When To Use The Range

The range is used when

You have ordinal data or

You are presenting your results to people with little or no knowledge of statistics.

The range is rarely used in scientific work as it is fairly insensitive.

It depends on only two scores in the set of data, X_{\max} and X_{\min} .

Merits of Range

- i) **It is the simplest of the measure of dispersion.**
- ii) **Easy to calculate.**
- iii) **Easy to understand.**
- iv) **Independent of change of origin.**
- v)

Demerits of Range

- i) **It is based on two extreme observations. Hence, get affected by fluctuations.**
- ii) **A range is not a reliable measure of dispersion.**
- iii) **Dependent on change of scale.**

Example: The monthly expenditure of 8 students is given below:

Rs. 40, 42, 45, 47, 50, 52, 55, 60

Solution: The range within which the items are distributed is 40 to 60 and the dispersion of series is 20.

vii)

5. AVERAGE DEVIATION (AD) or MEAN DEVIATION (MD):

Average deviation (AD) or Mean deviation (MD) is the average of difference of all the values of items from some average of the series. In calculating the mean deviation we ignore the minus sign of deviation while taking their total for obtaining the mean deviation. Mean deviation is:

Where,

M
=
M
e
a
n
,
M
d
=
M
e
a
d
i
a

n
,
M
o
=
M
o
d
e
X
i
=
M
e
a
n
o
f
t
h
e
g
i
v

e
n
s
a
m
p
l
e

N = Number of item in the given sample

Example : Find out the average deviation of the scores 15, 10, 6, 8, 11 of series.

Solution : Mean of the given data = $(15 + 10 + 6 + 8 + 11)/5 = 10$

Score s

Que:10 Find the Mode for the following distribution:

Size(x)

Q9. Find the median for the following distribution:

Marks

510

15

06-448-225

10

110	1	1
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F|D|FFx|X-8|6810121416Frequency22453211

|D|

Solution:

X

24				
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