Department of Management Studies

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24MBT206 - BUSINESS RESEARCH METHODS

OBJECTIVES:

To understand the complexities of the business research process.

To know the different alternatives of research design and to use the appropriate research design.

To understand the measurement scales in research studies.

To learn various data collection and acquire knowledge in applying appropriate analysis tools.

To know the content and rules pertaining to report preparation in research.

UNIT I INTRODUCTION 8

Research – Introduction - Research Process - Characteristics of Good Research - Types of Research -. Research Problem – Research Objectives - Research Hypothesis – Research Proposal Development - Ethical Issues in Research.

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Research Design – Components, Types – Variables – Types - Validity – Internal Validity and External Validity – Threats - Measurement – Measurement Errors - Scaling Techniques - Different Scales, Validity and Reliability of an Instrument - Methods – Case Study.

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UNIT IV DATA ANALYSIS 13

Data Preparation – Editing and Coding – Tabulation of Data - Data Entry – Data Processing - Data Transformation, Qualitative vs Quantitative Data Analysis - Descriptive vs Inferential Analysis,- Univariate Analysis - Bivariate Analysis – Parametric and Non-Parametric test, Selection of Statistical test. Multivariate Analysis – Multiple Regression, Discriminant Analysis, Factor Analysis, Cluster Analysis and Multi-Dimensional Scaling – Case Study.

UNIT V REPORT WRITING 7

Report Writing – Criteria for Good Research report – Types of Report - Format and of Report - Findings, Suggestions and Recommendations, Conclusion — Referencing Formats – Index - Footnote, Appendices – Layout of a Research Paper - Journals in Business and Management - Impact factor of Journals - Ethical issues related to publishing, Plagiarism.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Sundarapandian P, Muthulakshmi S, Vijayakumar T, Research Methodology and Applications of SPSS in Social Science Research, Sultan Chand and Sons, 1st Edition, 2022
2. Pamela S Schindler, Business Research Methods, Tata McGraw Hill, 13th Edition, 2021
3. Deepak Chawla, Neena Sondhi, Research Methodology: Concepts and Cases, Vikas Publication, 2nd Edition,2018
4. Naval Bajpai, Business Research Methods, Pearson Education, 2017

REFERENCE BOOKS:

1. Kothari C R. Gaurav Garg, Research Methodology Methods and Techniques, New Age International Publishers, 5th Revised Edition, 2023.
2. Roger Bougie, Uma Sekaran, Mala Srivatsava, Research Methods of

Business, Wiley, 8th Edition, 2021.
3. Bill Harley Emma Bell and Alan Bryman, Business Research Methods, International Edition, Oxford University Press, 2020.
4. William G Zikmund, Barry J Babin, Jon C Carr, Mitch Griffin, Business Research Methods, Cengage Learning, 8th Edition,2013.

WEB REFERENCES:

1. www.socialresearchmethods.net

MOOC REFERENCES:

1. https://www.edx.org/course/scientific-methods-and-research
2. https://www.edx.org/course/social-work-research
3. https://www.udemy.com/course/research-methods/
4. https://www.udemy.com/course/research-methods-for-business- students/
5. https://www.coursera.org/learn/research-methods
6. https://swayam.gov.in/nd2_ntr20_ed30/preview

OUTCOMES:

1. Remember fundamentals terms of research.
2. Understand framework of research and validation of instruments.
3. Apply knowledge about the research process.
4. Analyze simple and complex tools available in research.
5. Evaluate skills pertaining to scientific research.

CO-PO MAPPING:

	PO 1	PO 2	PO3	PO 4	PO5	PO 6
CO 1	1	1	1	1	1	1
CO 2	2	2	2	2	2	2
CO 3	3	2	-	3	2	2
CO 4	2	2	-	3	3	3
CO 5	2	2	-	3	3	3

UNIT- I

INTRODUCTION

Research – Introduction - Research Process - Characteristics of Good Research - Types of Research -. Research Problem – Research Objectives - Research Hypothesis – Research Proposal Development - Ethical Issues in Research.

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MEANING OF RESEARCH

Research refers to a search for knowledge. Research is an art of scientific investigation.

The Advanced Learner's Dictionary of Current English lays down the meaning of research as,"a careful investigation or inquiry specially through search for new facts in any branch of knowledge".

DEFINITION of RESEARCH

Redman and Mory, Define research as a," Systematized effort to gain new knowledge". Some people consider research as a movement, a movement from the known to the unknown.

According to Clifford woody, Research comprises defining and redefining problems, formulating hypothesis or suggested solutions collecting, organising and evaluating data, making deductions and reaching conclusions; to determine whether they fit the formulating hypothesis.

BUSINESS RESEARCH

Business research is a process of acquiring detailed information of all the areas of business and using such information in maximizing the sales and profit of the business. Such a study helps companies determine which product/service is most profitable or in demand. In simple words, it can be stated as the acquisition of information or knowledge for professional or commercial purpose to determine opportunities and goals for a business.

Business research can be done for anything and everything. In general, when people speak about business research it means asking research questions to know where the money can be spent to increase sales, profits or market share. Such research is critical to make wise and informed decisions.

"The application of the scientific method in searching for the truth about business phenomena. These activities include defining business opportunities and

problems, generating and evaluating ideas, monitoring performance, and understanding the business process."

For example: A mobile company wants to launch a new model in the market. But they are not aware of what are the dimensions of a mobile that are in most demand. Hence, the company conducts a business research using various methods to gather information and the same is then evaluated and conclusions are drawn, as to what dimensions are most in-demand, This will enable the researcher to make wise decisions to position his phone at the right price in the market and hence acquire a larger market share.

Advantages of Business research

- Business research helps to identify opportunities and threats.
- It helps identify problems and using this information, wise decisions can be made to tackle the issue appropriately.
- It helps to understand customers better and hence can be useful to communicate better with the customers or stakeholders.

- Risks and uncertainties can be minimized by conducting business research in advance.
- Financial outcomes and investments that will be needed can be planned effectively using business research.
- Such research can help track competition in the business sector.
- Business research can enable a company to make wise decisions as to where to spend and how much.
- Business research can enable a company to stay up-to-date with the market and its trends and appropriate innovations can be made to stay ahead in the game.
- Business research helps to measure reputation

Disadvantages of Business research

- Business research can be a high-cost affair
- Most of the time, business research is based on assumptions
- Business research can be time-consuming
- Business research can sometimes give you inaccurate information, because of a biased population or a small focus group.
- Business research results can quickly become obsolete because of the fast-changing markets

Significance of Business research

Business research is one of the most effective ways to understand customers, the market and competitors. Such research helps companies to understand the demand and supply of the market. Using such research will help businesses reduce costs, and create solutions or products that are targeted to the demand in the market and the correct audience.

In-house business research can enable senior management to build an effective team or train or mentor when needed. Business research enables the company to track its competitors and hence can give you the upper hand to stay ahead of them. Failures can be avoided by conducting such research as it can give the researcher an idea if the time is right to launch its product/solution and also if the audience is right. It will help understand the brand value and measure customer satisfaction which is essential to continuously innovate and meet customer demands. This will help the company grow its revenue and market share. Business research also helps recruit ideal candidates for various roles in the company. By conducting such research a company can carry out a SWOT analysis, i.e. understand the strengths, weaknesses, opportunities, and threats. With the help of this information, wise decisions can be made to ensure business success.

Business research is the first step that any business owner needs to set up his business, to survive or to excel in the market. The main reason why such research is of utmost importance is that it helps businesses to grow in terms of revenue, market share and brand value.

Significance of the Research in the Business

Business research programs are the popular way for companies to educate their managers and other employees in a huge collection of different areas. Business research learning can concern to economics, business strategy and ethics and modern business and trade. In a corporate world, company executives must study whether their staff members can really satisfy their jobs effectively without professional education. Having a knowledgeable and informed staff means that operations will run that smoothly. For instance, some business research programmes investigate into the theories behind people. This can be seen as one of

the educational tools for companies. If senior managers are all formally educated and certified in the field of management they will be capable to drive a workforce by using operative motivational techniques. Management is not the only area covered by business research programmes. It is likely for a company to form its knowledge base in the area, streamlining process and improving the efficiency of operations. Reasonably, by enlightening the efficiency of a company, profitability is improved. Another area covered by business research is international business. For companies on the edge of increasing their operations outside their national boundaries sending employee on courses relating to this field is highly worthwhile. International trade has diverse theories and strategies concerning to it and hence by building a set of knowledge on the subject means that it is likely for companies to find that advantage over the global competition.

As information technology (IT) becomes progressively big part of business, education modules in this area have also grown. IT can relate to spending software in management, accounting but as the use of the internet and online, educating employees in the ways to take advantage of this new media is an advisable. Another area in business research is sales and sales techniques. This is particularly vital for many companies as sales are the way of getting new income. Obviously sales techniques will vary subject to the services or products being sold but there are certain common rules that should be followed. By ensuring a well-trained sales team, they will be capable to bring more sales, and hence increase the portfolio and profits of the firm. As an addition to sales is marketing education, this is particularly important in several industries as having a fine presented product or service can gain many benefits. Appreciatively education will effect in employees ensuring the knowledge to produce a brand image that is wanted, lively and above all smart to customers. In a current world where business research is a key portion

of any development plan there are a huge number of training institutions rising to meet these demands. For any company, making a well-trained and talented workforce is an asset. Once this understanding has been complete it will be likely to train staff members and get an employee base with developments in the business world.

Business research is the methodical process of gathering and analysing information to increase our understanding under study. It is the job of the researcher to contribute to the understanding and to communicate that to others. Business research can be defined as the systematic investigation to establish facts. The main purpose for applied research is determining, understanding, and the development of methods and systems for the advancement of human knowledge. Scientific research trusts on the application of the scientific method. This business research provides information and theories for the clarification of the nature and the properties of the world around us.

Business research has its special significance in solving numerous operational and planning problems in the business. The Industrial Network Theory aims to define and explain the business relationships and networks. Business research is essential in the marketing. There is solid need for research in the marketing. Several companies use the research in marketing to determine the changing trends in the market, to identify the changing consumer behaviour. So business research has become the need for the business owing to the threatening competition in the market. So many companies are doing diverse research for their product development, for growing their sales volume. Market research is for learning what people want, need. It can also discover how they act. Once that research is finished, you can determine how to market your product. So there are various types of research carried by the marketing companies. For instance; companies are doing

research for determining number of visitors see to the bill boards during travel. So by this way they can find how they get influence from that advertisement on the bill boards. Likewise several companies are doing their research on the consumer eating habits to find how the consumer likes to eat in a particular environment.

It is understood, research is important in any business to help decision making. The marketer wants to do environmental scanning for that research is conducted. Then the marketer wants to segment, again research is necessary. Choosing the target market is based on the outcomes of the research. The marketer wants to know whether the target market likes it or not. We can say that, the term research is much needed in everyday life. The results are a way of gradually discovering truths and finding the processes that drive the universe. Only by ensuring a stiff structure to experimentation, can results be verified as acceptable contributions. Some other fields, such as economics and history, also do true research, but tend to have their own structures for generating results. They also contribute to knowledge but with different processes.

STEPS INVOLVED IN RESEARCH PROCESS:

The research process consists of a series of actions or steps necessary to effectively carry out research and the desired sequencing of these steps. The research process consists of a number of closely related activities but such activities overlap continuously rather than following a strictly prescribed sequence. One should remember that the various steps involved in a research process are not mutually exclusive, nor they are separate and distinct. They do not necessarily follow each other in any specific order and the researcher has to be constantly anticipating at each step in the research process the requirements of the subsequent steps. However, the following order concerning various steps involved in the research process:

i. Formulating the Research Problem: There are two types of research problems, viz., those which relate to states of nature and those which relate to relationships between variables. The best way of understanding the problem is to discuss it with one's own colleagues or with those having some expertise in the matter. In an academic institution, the researcher can seek help from a guide who is usually an experienced man and has several research problems in mind. Often, the guide puts forth the problem in general terms and it is up to the researcher to narrow it down and phrase the problem in operational terms. In private business units or in governmental organizations', the problem is usually earmarked by the administrative agencies with whom the researcher can discuss as to how the problem originally came about and what considerations are involved in its possible solutions.

ii. Extensive Literature Survey: Once the problem is formulated, a brief summary of it should be written down. It is compulsory for a research worker to write a thesis for a Ph.D. degree to write a synopsis of the topic and submit it to the necessary Committee or the Research Board for approval. At this stage, the researcher should undertake an extensive literature survey connected with the problem. For this purpose, the abstracting and indexing journals and published or unpublished bibliographies are the first place to go. Academic journals, conference proceedings, government reports, books, etc., must be tapped depending on the nature of the problem. In this process, it should be remembered that one source will lead to another. A good library will be a great help to the researcher at this stage.

iii. Development of Working Hypotheses: Working hypothesis is a tentative statement made in order to draw out and test its logical or empirical consequences. As such the manner in which research hypotheses are developed is particularly important since they provide the focal point for research. They also affect the manner in which tests must be conducted in the analysis of data and indirectly the

quality of data that is required for the analysis. The development of the working hypothesis plays an important role in maximum research. Hypothesis should be very specific and limited to the piece of research in hand because it has to be tested. The role of the hypothesis is to guide the researcher by delimiting the area of research and to keep him on the right track. It sharpens his thinking and focuses attention on the more important facets of the problem. It also indicates the type of data required and the type of methods of data analysis to be used.

iv. Preparing the Research Design: The research problem having been formulated in clear cut terms, the researcher will be required to prepare a research design. The preparation of the research design, appropriate for a particular research problem, involves usually the consideration of the following:

- the means of obtaining the information;
- the availability and skills of the researcher and his staff (if any);
- explanation of the way in which selected means of obtaining information will be organized and the reasoning leading to the selection;
- the time available for research; and
- the cost factor relating to research, i.e., the finance available for the purpose.

v. Determining Sample Design: The researcher must decide the way of selecting a sample of what is popularly known as the sample design. In other words, a sample design is a definite plan determined before any data are actually collected for obtaining a sample from a given population.

vi. Collecting the Data: collecting the appropriate data which differs considerably in the context of money costs, time, and other resources at the disposal of the researcher. Primary data can be collected either through experiments or through a survey. If the researcher conducts an experiment, he observes some quantitative

measurements, or the data, with the help of which he examines the truth contained in his hypothesis. It includes – observation, personal interview, telephone interviews, mailing of questionnaires, schedules, etc. The researcher should select one of these methods of collecting the data taking into consideration the nature of the investigation, objective and scope of the inquiry, financial resources, available time, and the desired degree of accuracy.

vii. Execution of the Project: The researcher should see that the project is executed in a systematic manner and in time. If the survey is to be conducted by means of structured questionnaires, data can be readily machine-processed. The survey is under statistical control so that the collected information is in accordance with the pre-defined standard of accuracy. If some of the respondents do not cooperate, some suitable methods should be designed to tackle this problem.

viii. Analysis of data: After the data have been collected, the researcher turns to the task of analyzing them. The analysis of data requires a number of closely related operations such as the establishment of categories, the application of these categories to raw data through coding, tabulation, and then drawing statistical inferences to use computers. Computers not only save time but also make it possible to study a large number of variables affecting a problem simultaneously. The researcher can analyze the collected data with the help of various statistical measures.

ix. Hypothesis-testing: The hypotheses may be tested through the use of one or more of such tests, depending upon the nature and object of the research inquiry. Hypothesis-testing will result in either accepting the hypothesis or in rejecting it.

x. Generalizations and Interpretation: If a hypothesis is tested and upheld several times, it may be possible for the researcher to arrive at generalization, the real value of research lies in its ability to arrive at certain generalizations. If the researcher had no hypothesis to start with, he might seek to explain his findings on

the basis of some theory. It is known as interpretation. The process of interpretation may quite often trigger off new questions which in turn may lead to further researches.

xi. Preparation of the Report: Finally, the researcher has to prepare the report of what has been done by him. Writing of report must be done with great care keeping in view the following:

The layout of the report should be as follows:

(i) Preliminary pages the report should carry title and date followed by acknowledgments and foreword. Then there should be a table of contents followed by a list of tables and list of graphs and charts, if any, given in the report.

(ii) The main text of the report should have the following parts:

(a) Introduction: It should contain a clear statement of the objective of the research and an explanation of the methodology adopted in accomplishing the research. The scope of the study along with various limitations should as well be stated in this part.

(b) Summary of findings: After the introduction, there would appear a statement of findings and recommendations in non-technical language. If the findings are extensive, they should be summarized.

(c) Main report: The main body of the report should be presented in a logical sequence and broken-down into readily identifiable sections.

(d) Conclusion: Towards the end of the main text, the researcher should again put down the results of his research clearly and precisely. In fact, it is the final summing up.

(iii) At the end of the report, appendices should be enlisted in respect of all technical data. Bibliography, i.e., list of books, journals, reports, etc., consulted, should also be given in the end. Index should also be given specially in a published research report.

- Report should be written in a concise and objective style in simple language avoiding vague expressions such as 'it seems,' 'there may be', and the like.
- Charts and illustrations in the main report should be used only if they present the information more clearly and forcibly.
- Calculated 'confidence limits' must be mentioned and the various constraints experienced in conducting research operations may as well be stated.

Types of Business Research

Business research is considered an aspect of the business intelligence process. It is usually conducted to determine the success factors of an organization in your area or to understand the suitable marketing approach the organization should use to promote the products. For this purpose, primarily, there are two types of business research:

A) Qualitative Research Methods

Of both the types', qualitative research is one of the important types of business research. This is the type of business research, which involves getting data through the means of communication by employing open-ended questions or such

resources. These researches help the researchers to understand not only what audience thinks but also why the audiences think the way they think.

There are various types of qualitative research methods. The five types which are main are focus groups, content analysis, ethnographic research, interviews etc. These methods are very important in business research since they help the researchers to know the customer in depth. It is necessary to understand not only what motivates the customer to buy but also why does the customer not buy a certain product and what makes them choose one product over the other.

1) Interviews :

Interviews are similar in their nature to service in the way that they have similar questions. The only difference between both is that the respondent can answer open-ended questions and begin the conversation in interviews while that is not possible in surveys. Interviews help the researchers to understand a detailed perspective and opinions from the subjects of research.

These types of business research also help to understand the experts and can give some critical insights related to businesses while conducting the interviews. Example of research was conducted by a mobile phone company to understand why a certain color of mobile is favored by male customers over female customers.

After an interview in them, the researcher understands that while Blue is related to masculinity, all the shades of blue fall under similar category and pink, on the other hand, relates to feminity, which is why male customers do not prefer a phone color related to Pink. On the other hand, people are shown with neutral colors like black or white or shades of black and white they are widely accepted by both the genders equally. This helps the researcher to understand that it is better to go ahead with

manufacturing Black or White phones and have an open market rather than colored phones and reduce their target audience.

Another example would be if a cosmetic company wants to increase their market share by launching a new fairness product for men. The interview yields a result that almost equal numbers of men are using the already available female fairness cream secretly. The company was deciding to launch a new line of fairness cream with a masculine name so that it appeals their target audience and a feminine name would not work in the market. But because of the interview, they found that launching only a gender variant by keeping the name same would work equally well. Thus interviews help to understand the audience better.

2) Focus Groups :

Focus groups are the types of business research which involves a small set of selected individuals to understand their opinion and behavior towards a product or service. The difference between Focus Group and interviews that Focus Group has a very small number of people but it is ensured that they represent a variety of target market. Although the sample size is quantitatively less, it is qualitatively diverse. Focus groups can also be conducted by online surveys.

The primary intention of the focus group has to launch the new product to a very small targeted audience before launching date in the entire market. Their reactions are studied, suggestions are taken and improvements are made in the product before a full-fledged launch. It ensures that all the screening is done with the audience not knowing about it.

3) Ethnographic Research :

Amongst all the types of business research Ethnographic research is considered to be one of the most challenging research but the one which gives extremely precise results. Ethnographic researches are considered to be one of the most expensive and time-consuming research. These researches involve the researcher to adapt to the natural environment of the target audience and observe them naturally and collect the data. Such a method is considered when there is a need to understand the challenges or cultures are other crucial things that can occur only in a particular setting.

For example, a reality TV show named Big Brother, which is famous all over, follows a similar method. The participants are observed with cameras head and everywhere understand their natural behavior and points are given accordingly to the participants. Ethnographic research also has wide applications in understanding buyer intentions. It has to understand the questions like why would a buyer not prefer a brand over the other, what are the factors that lead a customer to change one brand to other on the spot etc.

4) Case Study Research :

Case study research is considered one of the most crucial types of business research. Case study research is also used as marketing collateral in my many businesses. If research is conducted with intention of assessing the customer satisfaction, the challenges that the customers faced and the solutions that the firm can give them after case studies.

These conclusions are used to point out certain benefits that the customer can avail after choosing their specific firm. Such researches are used in many fields including but not limited to education, Social sciences, marketing, and even

government researches. Businesses provide case studies to new customers to showcase their capabilities and that is the reason why case study research is and related types of business research play a very important role in the business sector.

For example, a gaming app is used as a test with one of its customer. The aim of the study is to find out what were the challenges that were faced by the user during the game, what was the scope of complexity of the game and what suggestions very given to overcome the challenges faced by the customer. The study and with the benefits that this game provides over other game apps, like more number of characters, multiple levels, cost-effective in-app purchases, etc.

5) Website Visitor Research :

Website surveys are relatively new that has come into the market but in fact is proving to be very helpful as most businesses have website nowadays. It is one of the best methods to collect feedback from the visitor visiting your website. You website can use a survey which is considered useful and helps in direct collection of feedback.

Most Businesses have moved online and hence it is important for them to understand the visitors on the website since the website visitors can be your potential target customer. Feedback collection is very useful for any business science without understanding the customer the business cannot proceed ahead. The company has to keep their customers happy and try to convert them to all customers in order to generate regular business revenue and increase market share to stay on top.

Website survey allows the companies to understand their target audience, their intention and collect that feedback to evaluate the online experience of the

customers. Behavior paths, the intention of the visitor, overall satisfaction from the website, are few of the things that can be collected by website visitor profiling.

Depending on the nature of research and information that the company is targeting to acquire multiple forms of website intercept surveys are used to collect responses from customers. An example of the same would be Pop-ups. This technology has also been incorporated into apps. For example, after purchasing on amazon.com, the user will be asked to write about the experience of purchasing it which will be a quick feedback form.

B) Quantitative Research Methods

As the name suggests these types of business research deals with numbers. These types of business research use a systematic investigation by the use of mathematical techniques or statistical tools which usually begin with data collection and then move to statistical analysis by the use of multiple methods.

Following are the five types of business research in quantitative methods

6) Survey Research :

This method is one of the most widely used methods for collection of data for a product or service. This is specially used in business research. This method involves asking questions to set of audience by using various methods like online surveys, questionnaires, online polls, and others. Many companies have been using this method to collect data to understand the nature of the market and make appropriate business decisions like target selection for advertising.

There are various types of service available like longitudinal surveys which are used to collect responses from an audience across various time durations in order to understand the changes in the audience behavior, cross-sectional surveys, etc.

Unlike earlier methods when a person uses to collect surveys from respondents by going and meeting them, online surveys and social media have helped to conduct the same very effectively and with very little cost. By the use of tools such as Google Survey sheets, tones of n audience can be reached in a very short time.

7) Correlational Research :

These types of business research are conducted to know the relationship between two different entities and how the impact over each other. As the name suggests correlational research suggests the correlation between the two entities. These types of business research help to understand patterns trends relationships etc.

Correlational research is generally combined with other tools to draw a stable and substantial conclusion since relying only on the data generated by Correlational research cannot be used to draw a firm conclusion. For example, if one were to understand the relation between the types of social media apps used by generations correlational research can be used. This research will help to establish which generation uses which category of social media apps more.

8) Causal-Comparative research :

Causal-comparative research is a type of business research which is based on comparison as the name suggests, and is used to conclude cause and effect relationship between different variables. This research is also known as quasi-experimental research. Part of the research involves establishing a variable which is independent and studying the effects of that independent variable on the dependent variable.

These researchers do not involve manipulation of any kind however changes are observed on groups due to the influence of similar changes. Inferring conclusions

and this type of business research are slightly tricky since both the dependent and independent variables will co-exist in a group. For example to understand excellent educational facilities in a rural setting this kind of research may be used. The research would analyze and concludes the changes in people when they are exposed two excellent educational facilities.

9) Experimental research :

As the name suggests, this type of business research is purely based on proving a theory. These resources are very useful since they help to understand the behavioral traits of customers which in turn lead to more revenue generation. A set of the audience is observed and then analyzed in their behavior when they are exposed to certain parameters. This is the basis of experimental research.

For example, a food company would conduct to understand the effect of particular colors and their effect on customers and their hunger. When the customers are exposed to particular colors while hungry they observe whether the hunger is stimulated or suppressed. In reality, it was seen that others like Red or yellow tends to increase hunger and that is the reason why many food chains like KFC McDonald's are using red color in their interior and brands.

10) Online Research :

Also known as literature research address considered as one of the oldest types of business research. Owing to its economy and the amount of information that can be gathered in a short amount of time, online research is very popular with a lot of people. This research involves the gathering of information from documents which are already existing and studies which are already been done like annual reports, libraries and old documents.

With the help of technology nowadays such research has become even easier and user-friendly to conduct. Any individual can perform this research online for the information that is required. The intention of online research would be to get in-depth information about a particular topic.

These researchers are used by sales and marketing departments to understand the market and their consumers. It is to be ensured that while conducting such research the sources need to be validated and credible and information is to be collected. This is also termed as secondary research since the primary research has already been done and research is being done on that primary research.

Exploratory and causal Research

Exploratory Research:

Definition

Exploratory research is defined as a research used to investigate a problem which is not clearly defined. It is conducted to have a better understanding of the existing problem, but will not provide conclusive results. For such a research, a researcher starts with a general idea and uses this research as a medium to identify issues, that can be the focus for future research. An important aspect here is that the researcher should be willing to change his/her direction subject to the revelation of new data or insight. Such a research is usually carried out when the problem is at a preliminary stage. It is often referred to as grounded theory approach or interpretive research as it used to answer questions like what, why and how.

For example: Consider a scenario where a juice bar owner feels that increasing the variety of juices will enable increase in customers, however he is not sure and

needs more information. The owner intends to carry out an exploratory research to find out and hence decides to do an exploratory research to find out if expanding their juices selection will enable him to get more customers of if there is a better idea.

Another example of exploratory research is a podcast survey template that can be used to collect feedback about the podcast consumption metrics both from existing listeners as well as other podcast listeners that are currently not subscribed to this channel. This helps the author of the podcast create curated content that will gain a larger audience.

Types and methodologies of Exploratory research

While it may sound a little difficult to research something that has very little information about it, there are several methods which can help a researcher figure out the best research design, data collection methods and choice of subjects. There are two ways in which research can be conducted namely primary and secondary.. Under these two types, there are multiple methods which can used by a researcher. The data gathered from these research can be qualitative or quantitative. Some of the most widely used research designs include the following:

Primary research methods

Primary research is information gathered directly from the subject. It can be through a group of people or even an individual. Such a research can be carried out directly by the researcher himself or can employ a third party to conduct it on their behalf. Primary research is specifically carried out to explore a certain problem which requires an in-depth study.

- **Surveys/polls**: Surveys/polls are used to gather information from a predefined group of respondents. It is one of the most important quantitative method. Various types of surveys or polls can be used to explore opinions, trends, etc. With the advancement in technology, surveys can now be sent online and can be very easy to access. For instance, use of a survey app through tablets, laptops or even mobile phones. This information is also available to the researcher in real time as well. Nowadays, most organizations offer short length surveys and rewards to respondents, in order to achieve higher response rates.

For example: A survey is sent to a given set of audience to understand their opinions about the size of mobile phones when they purchase one. Based on such information organization can dig deeper into the topic and make business related decision.

- **Interviews:** While you may get a lot of information from public sources, but sometimes an in person interview can give in-depth information on the subject being studied. Such a research is a qualitative research method. An interview with a subject matter expert can give you meaningful insights that a generalized public source won't be able to provide. Interviews are carried out in person or on telephone which have open-ended questions to get meaningful information about the topic.

For example: An interview with an employee can give you more insights to find out the degree of job satisfaction, or an interview with a subject matter expert of quantum theory can give you in-depth information on that topic.

- **Focus groups:** Focus group is yet another widely used method in exploratory research. In such a method a group of people is chosen and are allowed to express their insights on the topic that is being studied. Although, it is important

to make sure that while choosing the individuals in a focus group they should have a common background and have comparable experiences.

For example: A focus group helps a research identify the opinions of consumers if they were to buy a phone. Such a research can help the researcher understand what the consumer value while buying a phone. It may be screen size, brand value or even the dimensions. Based on which the organization can understand what are consumer buying attitudes, consumer opinions, etc.

- **Observations:** Observation research can be qualitative observation or quantitative observation. Such a research is done to observe a person and draw the finding from their reaction to certain parameters. In such a research, there is no direct interaction with the subject.

For example: An FMCG company wants to know how it's consumer react to the new shape of their product. The researcher observes the customers first reaction and collects the data, which is then used to draw inferences from the collective information.

Secondary research methods

Secondary research is gathering information from previously published primary research. In such a research you gather information from sources likes case studies, magazines, newspapers, books, etc.

- **Online research:** In today's world, this is one of the fastest way to gather information on any topic. A lot of data is readily available on the internet and the researcher can download it whenever he needs it. An important aspect to be noted for such a research is the genuineness and authenticity of the source websites that the researcher is gathering the information from.

For example: A researcher needs to find out what is the percentage of people that prefer a specific brand phone. The researcher just enters the information he needs in a search engine and gets multiple links with related information and statistics.

- **Literature research**: Literature research is one of the most inexpensive method used for discovering a hypothesis. There is tremendous amount of information available in libraries, online sources, or even commercial databases. Sources can include newspapers, magazines, books from library, documents from government agencies, specific topic related articles, literature, Annual reports, published statistics from research organizations and so on.

However, a few things have to be kept in mind while researching from these sources. Government agencies have authentic information but sometimes may come with a nominal cost. Also, research from educational institutions is generally overlooked, but in fact educational institutions carry out more number of research than any other entities.

Furthermore, commercial sources provide information on major topics like political agendas, demographics, financial information, market trends and information, etc.

For example: A company has low sales. It can be easily explored from available statistics and market literature if the problem is market related or organization related or if the topic being studied is regarding financial situation of the country, then research data can be accessed through government documents or commercial sources.

- **Case study research:** Case study research can help a researcher with finding more information through carefully analyzing existing cases which have gone

through a similar problem. Such analysis are very important and critical especially in today's business world. The researcher just needs to make sure he analyses the case carefully in regards to all the variables present in the previous case against his own case. It is very commonly used by business organizations or social sciences sector or even in the health sector.

For example: A particular orthopedic surgeon has the highest success rate for performing knee surgeries. A lot of other hospitals or doctors have taken up this case to understand and benchmark the method in which this surgeon does the procedure to increase their success rate.

Exploratory research: Steps to conduct a research

- **Identify the problem**: A researcher identifies the subject of research and the problem is addressed by carrying out multiple methods to answer the questions.
- **Create the hypothesis**: When the researcher has found out that there are no prior studies and the problem is not precisely resolved, the researcher will create a hypothesis based on the questions obtained while identifying the problem.
- **Further research**: Once the data has been obtained, the researcher will continue his study through descriptive investigation. Qualitative methods are used to further study the subject in detail and find out if the information is true or not.

Characteristics of Exploratory research

- They are not structured studies
- It is usually low cost, interactive and open ended.
- It will enable a researcher answer questions like what is the problem? What is the purpose of the study? And what topics could be studied?

- To carry out exploratory research, generally there is no prior research done or the existing ones do not answer the problem precisely enough.
- It is a time consuming research and it needs patience and has risks associated with it.
- The researcher will have to go through all the information available for the particular study he is doing.
- There are no set of rules to carry out the research per se, as they are flexible, broad and scattered.
- The research needs to have importance or value. If the problem is not important in the industry the research carried out is ineffective.
- The research should also have a few theories which can support its findings as that will make it easier for the researcher to assess it and move ahead in his study
- Such a research usually produces qualitative data, however in certain cases quantitative data can be generalized for a larger sample through use of surveys and experiments.

Advantages of Exploratory research

- The researcher has a lot of flexibility and can adapt to changes as the research progresses.
- It is usually low cost.
- It helps lay the foundation of a research, which can lead to further research.
- It enables the researcher understand at an early stage, if the topic is worth investing the time and resources and if it is worth pursuing.
- It can assist other researchers to find out possible causes for the problem, which can be further studied in detail to find out, which of them is the most likely cause for the problem.

Disadvantages of Exploratory research

- Even though it can point you in the right direction towards what is the answer, it is usually inconclusive.
- The main disadvantage of exploratory research is that they provide qualitative data. Interpretation of such information can be judgmental and biased.
- Most of the times, exploratory research involves a smaller sample, hence the results cannot be accurately interpreted for a generalized population.
- Many a times, if the data is being collected through secondary research, then there is a chance of that data being old and is not updated.

Importance of Exploratory research

Exploratory research is carried out when a topic needs to be understood in depth, especially if it hasn't been done before. The goal of such a research is to explore the problem and around it and not actually derive a conclusion from it. Such kind of research will enable a researcher to set a strong foundation for exploring his ideas, choosing the right research design and finding variables that actually are important for the analysis. Most importantly, such a research can help organizations or researchers save up a lot of time and resources, as it will enable the researcher to know if it worth pursuing.

Causal Research

The meaning of causal research is to determine the relationship between a cause and effect. It is also known as explanatory research. A variation in an independent variable is observed, which is assumed to be causing changes in the dependent variable. The changes in the independent variable are measured due to the variation taking place in the dependent variable.

To get the accurate output, other confounding variables that might influence the results are kept constant while creating the data or are controlled using statistical methods. The nature of causal research is very complicated as a researcher can never be sure that no other hidden variables are influencing the causal relationship between two variables. For example, when a company wants to study the behavior of their consumers towards the changing price of their goods, they use causal research.

They might test the behavior of customers depending on different variables. Still, they can never be sure as there can be some hidden variables that might affect the decisions of customers. For instance, no matter how much caution you to take to get the accurate results but there can always be a few psychological considerations that a consumer might be influencing the concerns of the customer even when he is not aware.

The cause and effect relationship between two variables can only be confirmed if causal evidence exists that support the relationship.

The following are the three components for causal evidence

1. Non-Spurious association

The correlated variation between two variables can only be valid if there is no other variable related to both cause and effect.

2. Temporal sequence

A cause and effect can exclusively be connected if the cause has taken place before the occurrence of the effect. For example, it is not right to assume the cause of a

dip in sales was the new entrants in the market when sales were already decreasing before the entrance of new entrants.

3. Concomitant variation

Concomitant variation is referred to as the quantitative change occurred in effect is only because of the quantitative change happened in the cause. That means the variation taking place between two variables must be systematic.

For example, if a company does not put effort into increasing sales by hiring skilled employees or by providing training to the employees, then the credit of an increase in sales can't be given to the recruitment of experienced employees. There will be other causes which caused an increase in sales.

Advantages of causal researches

Causal research helps identify the causes behind processes taking place in the system. Having this knowledge helps the researcher to take necessary actions to fix the problems or to optimize the outcomes.

Causal research provides the benefits of replication if there is a need for it.

Causal research helps identify the impacts of changing the processes and existing methods.

In causal research, the subjects are selected systematically. Because of this, causal research is helpful for higher levels of internal validity.

Disadvantages of causal research

The causal research is difficult to administer because sometimes it is not possible to control the effects of all extraneous variables.

Causal research is one of the most expensive research to conduct. The management requires a great deal of money and time to conduct research. Sometimes it costs more than 1 or 2 million dollars to test real-life two advertising campaigns.

One disadvantage of causal research is that it provides information about your plans to your competitors. For example, they might use the outcomes of your research to identify what you are up to and enter the market before you.

The findings of causal research are always inaccurate because there will always be a few previous causes or hidden causes that will be affecting the outcome of your research. For example, if you are planning to study the performance of a new advertising campaign in an already established market. Then it is difficult for you to do this as you don't know the advertising campaign solely influences the performance of your business understudy or it is affected by the previous advertising campaigns.

The results of your research can be contaminated as there will always be a few people outside your market that might affect the results of your study.

Another disadvantage of using causal research is that it takes a long time to conduct this research. The accuracy of the causal research is directly proportional to the time you spend on the research as you are required to spend more time to study the long-term effects of a marketing program.

Coincidence in causal research is the biggest flaw of the research. Sometimes, the coincidence between a cause and an effect can be assumed as a cause and effect relationship.

You can't conclude merely depending on the outcomes of the causal research. You are required to conduct other types of research alongside the causal research to confirm its output.

Sometimes, it is easy for a researcher to identify that two variables are connected, but to determine which variable is the cause and which variable is the effect is challenging for a researcher.

Examples of Causal Research

To test the market for a new product by collecting data about its sales potential.

To check the performance or effectiveness of a new advertising campaign to decide whether to continue it or not.

To measure the improvement in the performance of employees after providing them training on a new skill.

To examine the effects of re-branding initiatives based on the level of loyalty of customers.

Theoretical Research

Theoretical research is a logical exploration of a system of beliefs and assumptions. This type of research includes theorizing or defining how a cyber system and its environment behave and then exploring or playing out the implications of how it is defined. This research is very valuable in understanding

the bounds, edge cases, and emergent behaviors of a system. Often theoretical research is decried as out of touch with reality, so-called “ivory tower” research. Frankly, any research type or approach can run the risk of being irrelevant or out of touch if done incorrectly. In some scientific fields, theoretical research is so far ahead of engineering and technological progress that experiments to validate or refute them are hundreds of years away. In cyber security research, theoretical work often overlaps with mathematics, logic, or theory of computation; cryptography, of course, is a great example of this.

In theoretical research, a scientist might postulate rules, conditions, and the state of a cyber system. This is the creation of a theoretical cyber model. This sort of approach is useful for cyber systems that are rare, expensive, or technologically infeasible today. These models can be used to help develop and inform questions for other types of cyber science. For example, while not the only way, theoretical models are a good way to develop hypotheses. A theoretical model will enable you to investigate how a cyber system would react under certain stimuli. Those theoretical reactions to the stimuli become strong candidates for hypotheses, which could subsequently lead to hypothetico-deductive experiments. Those tests could be used to generate a theoretical model on human usage of passwords of various sizes and then leverage an output from that model as a hypothesis to test against real-world cyber systems with controlled human subjects.

Formal Theory: Formal theory and mathematical exploration are the basis for most of theoretical research. This is primarily due to the fact that theoretical work is in logical space where theories must be modeled and represented in some language. Mathematics is the perfect language suited to defining and exploring possibilities. As such, a lot of work involves formal proofs and internal validity. For example, most of the access control models that exist today are rooted in and

derived from theoretical models that were formally proven. Formal methods is another example of formal theory. The field of Multiple Levels of Security (MLS) Operating Systems often uses formal methods to design, develop, and verify system performance and security.

Formal theoretical research involves the definition of a formal theoretical space where formally tractable propositions, for example, lemmata and theorems and their proofs are described and developed. Generally, all cryptography and formal methods papers will fall into this class of research. But, of course, not all theoretical papers are cryptography and formal methods.

Simulation: As cyber security research often explores very complex systems that are difficult to formally model, the rest of this category of research is covered by simulation. **Simulation** provides the ability to produce automated sampling of a large variable space to test and understand a theoretical model with enough confidence to move forward, while also reducing the test space enough to be computationally possible. New communication protocols and paradigms are often simulated to test their behavior in a broad range of cases before it becomes worth the cost to manufacture and test new communication devices.

Empirical Research

Definition

Empirical research is defined as any study whose conclusions are exclusively derived from concrete, verifiable evidence. The term empirical basically means that it is guided by scientific experimentation and/or evidence. Likewise, a study is empirical when it uses real-world evidence in investigating its assertions.

This research type is founded on the view that direct observation of phenomena is a proper way to measure reality and generate truth about the world (Bhattacharya, 2008). And by its name, it is a research approach that observes the rules of empiricism and uses quantitative and qualitative methods for gathering evidence.

For instance, a study is being conducted to determine if working from home helps in reducing stress from highly-demanding jobs. An experiment is conducted using two groups of employees, one working at their homes, the other working at the office. Each group was observed. The outcomes derived from this research will provide empirical evidence if working from home does help reduce stress or not.

Types and Methodologies of Empirical Research

Empirical research is done using either qualitative or quantitative methods.

Qualitative research – Qualitative research methods are utilized for gathering non-numerical data. It is used to determine the underlying reasons, views, or meanings from study participants or subjects. Under the qualitative research design, empirical studies had evolved to test the conventional concepts of evidence and truth while still observing the fundamental principles of recognizing the subjects beings studied as empirical (Powner, 2015).

This method can be semi-structured or unstructured. Results from this research type are more descriptive than predictive. It allows the researcher to draw a conclusion to support the hypothesis or theory being examined.

Due to realities like time and resources, the sample size of qualitative research is typically small. It is designed to offer in-depth information or more insight

regarding the problem. Some of the most popular forms of methods are interviews, experiments, and focus groups.

Quantitative Research – Quantitative research methods are used for gathering information via numerical data. This type is used to measure behavior, personal views, preferences, and other variables. Quantitative studies are in a more structured format, while the variables used are predetermined.
Data gathered from quantitative studies is analyzed to address the empirical questions. Some of the commonly used quantitative methods are polls, surveys, and longitudinal or cohort studies.

There are situations when using a single research method is not enough to adequately answer the questions being studied. In such cases, a combination of both qualitative and quantitative methods is necessary.

Advantages and Disadvantages of Empirical Research:

Advantages of Empirical Research

There is a reason why empirical research is one of the most widely used method. There are a few advantages associated with it. Following are a few of them.

- It is used to authenticate traditional research through various experiments and observations.
- This research methodology makes the research being conducted more competent and authentic.
- It enables a researcher understand the dynamic changes that can happen and change his strategy accordingly.
- The level of control in such a research is high so the researcher can control multiple variables.

- It plays a vital role in increasing internal validity.

Disadvantages of Empirical research

Even though empirical research makes the research more competent and authentic, it does have a few disadvantages. Following are a few of them.

- Such a research needs patience as it can be very time consuming. The researcher has to collect data from multiple sources and the parameters involved are quite a few, which will lead to a time consuming research.
- Most of the time, a researcher will need to conduct research at different locations or in different environments, this can lead to an expensive affair.
- There are a few rules in which experiments can be performed and hence permissions are needed. Many a times, it is very difficult to get certain permissions to carry out different methods of this research.
- Collection of data can be a problem sometimes, as it has to be collected from a variety of sources through different methods.

Cross –Sectional and Time -Series Research

Definition: A cross-sectional study is defined as a type of observational research that analyzes data of variables collected at one given point in time across a sample population or a pre-defined subset.This study type is also known as cross-sectional analysis, transverse study, or prevalence study. Although cross-sectional research does not involve conducting experiments, researchers often use it to understand outcomes in the physical and social sciences and many business industries.

Defining characteristics of cross-sectional studies

Some of the critical characteristics of a cross-sectional study are:

- Researchers can conduct a cross-sectional study with the same set of variables over a set period.
- Similar research may look at the same variable of interest, but each study observes a new set of subjects.
- The cross-sectional analysis assesses topics during a single instance with a defined start and stopping point, unlike longitudinal studies, where variables can change during extensive research.
- Cross-sectional studies allow the researcher to look at one independent variable as the focus of the cross-sectional study and one or more dependent variables.

Cross-sectional study examples

The data collected in a cross-sectional study involves subjects or participants who are similar in all variables – except the one which is under review. This variable remains constant throughout the cross-sectional study.

- **Retail:** In retail, cross-sectional research can be conducted on men and women in a specific age range to reveal similarities and differences in spending trends related to gender.
- **Business:** In business, researchers can conduct a cross-sectional study to understand how people of different socio-economic status from one geographic segment respond to one change in an offering.
- **Healthcare:** Scientists in healthcare may use cross-sectional research to understand how children ages 2-12 across the United States are prone to calcium deficiency.

- **Education:** A cross-sectional study in school is particularly helpful in understanding how students who scored within a particular grade range in the same preliminary courses perform with a new curriculum.
- **Psychology:** The cross-sectional study definition in psychology is research that involves different groups of people who do not share the same variable of interest (like the variable you're focusing on), but who do share other relevant variables. These could include age range, gender identity, socio-economic status, and so on.

`Cross-sectional research allows scholars and strategists to quickly collect actionable data that helps in decision–making and offering products or services.

Types of cross-sectional studies

When you conduct a cross-sectional research study, you will engage in one or both types of research: descriptive or analytical. Read their descriptions to see how they might apply to your work.

- **Descriptive research:** A cross-sectional study may be entirely descriptive. A cross-sectional descriptive survey assesses how frequently, widely, or severely the variable of interest occurs throughout a specific demographic. Please think of the retail example we mentioned above. In that cross-sectional study example, researchers make focused observations to identify spending trends. They might use those findings for developing products and services and marketing existing offerings. They aren't necessarily looking at why these gendered trends occur in the first place.
- **Analytical research:** Analytical cross-sectional research investigates the association between two related or unrelated parameters. This methodology isn't entirely foolproof, though, because outside variables and outcomes are

simultaneous, and their studies are, too. For example, to validate whether coal miners could develop bronchitis looks only at the variables in a mine. What it doesn't account for is that a predisposition to bronchitis could be hereditary, or this health condition could be present in the coal workers before their employment in the mine. Other medical research has shown that coal mining is detrimental to lungs, but you don't want those assumptions to bias your current study.

In a real-life cross-sectional study, researchers usually use both descriptive and analytical research methods.

Benefits of cross-sectional studies :

- Relatively quick to conduct.
- Researchers can collect all variables at one time.
- Multiple outcomes can be researched at once.
- Prevalence for all factors can be measured.
- Suitable for descriptive analysis.
- Researchers can use it as a springboard for further research.

Time Series Analysis

Time series analysis is a statistical technique that deals with time series data, or trend analysis. Time series data means that data is in a series of particular time periods or intervals.

The data is considered in three types:

- **Time series data:** A set of observations on the values that a variable takes at different times.
- **Cross-sectional data:** Data of one or more variables, collected at the same point in time.
- **Pooled data:** A combination of time series data and cross-sectional data.

A **Time series** is a serially sequenced set of values representing a variable's value or state at different points in **time**. ... **Time series** data also allow examination of trends over **time** and prediction of future values of a variable from past values of that or other variables.

Time series data is a collection of observations obtained through repeated measurements over time. Plot the points on a graph, and one of your axes would always be time.

Time series data is everywhere, since time is a constituent of everything that is observable. As our world gets increasingly instrumented, sensors and systems are constantly emitting a relentless stream of time series data. Such data has numerous applications across various industries. Let’s put this in context through some examples.

Time series data can be useful for:

- Tracking daily, hourly, or weekly weather data
- Tracking changes in application performance
- Medical devices to visualize vitals in real time
- Tracking network logs

Time series examples

- Weather Records, Economic Indicators and Patient Health Evolution Metrics — all are time series data. Time series data could also be server metrics,

application performance monitoring, network data, sensor data, events, clicks and many other types of analytics data.

Research Question

Research questions lie at the core of systematic investigation and this is because recording accurate research outcomes is tied to asking the right questions. Asking the right questions when conducting research can help you collect relevant and insightful information that ultimately influences your work, positively.

The right research questions are typically easy to understand, straight to the point, and engaging. In this article, we will share tips on how to create the right research questions and also show you how to create and administer an online questionnaire with Formplus.

What is a Research Question?

A research question is a specific inquiry which the research seeks to provide a response to. It resides at the core of systematic investigation and it helps you to clearly define a path for the research process.

A research question is usually the first step in any research project. Basically, it is the primary interrogation point of your research and it sets the pace for your work.

Typically, a research question focuses on the research, determines the methodology and hypothesis, and guides all stages of inquiry, analysis, and reporting. With the right research questions, you will be able to gather useful information for your investigation.

A research question is a question that a study or research project aims to answer. This question often addresses an issue or a problem, which, through analysis and interpretation of data, is answered in the study's conclusion. In most studies, the research question is written so that it outlines various aspects of the study, including the population and variables to be studied and the problem the study addresses.

As their name implies, research questions are often grounded on research. As a result, these questions are dynamic; this means researchers can change or refine the research question as they review related literature and develop a framework for the study. While many research projects will focus on a single research question, larger studies often use more than one research question.

Importance of the research question

The primary importance of framing the research question is that it narrows down a broad topic of interest into a specific area of study (Creswell, 2014). Research questions, along with hypotheses, also serve as a guiding framework for research. These questions also specifically reveal the boundaries of the study, setting its limits, and ensuring cohesion.

Moreover, the research question has a domino effect on the rest of the study. These questions influence factors, such as the research methodology, sample size, data collection, and data analysis (Lipowski, 2008).

Types of Research Questions

Research questions can be classified into different categories, depending on the type of research to be done. Knowing what type of research one wants to

do—quantitative, qualitative, or mixed-methods studies—can help in determining the best type of research question to use.

Quantitative research questions

Quantitative research questions are precise. These questions typically include the population to be studied, dependent and independent variables, and the research design to be used. They are usually framed and finalized at the start of the study (Berger, 2015).

Quantitative research questions also establish a link between the research question and the research design. Moreover, these questions are not answerable with "yes" or "no" responses. As a result, quantitative research questions don't use words such as "is," "are," "do," or "does."

Quantitative research questions usually seek to understand particular social, familial, or educational experiences or processes that occur in a particular context and/or location (Marshall & Rossman, 2011). They can be further categorized into three types: descriptive, comparative, and relationship.

- Descriptive research questions aim to measure the responses of a study's population to one or more variables or describe variables that the research will measure. These questions typically begin with "what."
- Comparative research questions aim to discover the differences between two or more groups for an outcome variable. These questions can be causal, as well. For instance, the researcher may compare a group where a certain variable is involved and another group where that variable is not present.
- Relationship research questions seek to explore and define trends and interactions between two or more variables. These questions often include

both dependent and independent variables and use words such as "association" or "trends."

Qualitative research questions

Qualitative research questions may concern broad areas of research or more specific areas of study. Similar to quantitative research questions, qualitative research questions are linked to research design. Unlike their quantitative counterparts, though, qualitative research questions are usually adaptable, non-directional, and more flexible (Creswell, 2013). As a result, studies using these questions generally aim to "discover," "explain," or "explore."

Ritchie et al. (2014) and Marshall and Rossman (2011) have also further categorized qualitative research questions into a number of types, as listed below:

- Contextual research questions seek to describe the nature of what already exists.
- Descriptive research questions attempt to describe a phenomenon.
- Emancipatory research questions aim to produce knowledge that allows for engagement in social action, especially for the benefit of disadvantaged people.
- Evaluative research questions assess the effectiveness of existing methods or paradigms.
- Explanatory research questions seek to expound on a phenomenon or examine reasons for and associations between what exists.
- Exploratory research questions investigate little-known areas of a particular topic.

- Generative research questions aim to provide new ideas for the development of theories and actions.
- Ideological research questions are used in research that aims to advance specific ideologies of a position.

The following table illustrates the differences between quantitative and qualitative research questions.

Topic	**Quantitative Research Questions**	**Qualitative Research Questions**
Mental health diagnoses	How does race affect rates of mental health diagnosis among teens in foster care?	What is the experience of African-American teens seeking help for mental health concerns?
Career choice	What is the relationship between household income and career choice among American university students?	How do American university students from low-income households experience making a career choice?
Social media use	What proportion of Australians aged 55 to 75 use popular social media sites?	How do Australians aged 55 to 75 use social media?
Early-stage dementia	What are the differences in the perceptions towards people	How do people with early-stage dementia experience other people's

	with early-dementia before and after diagnosis?	reactions to their changed condition?

Mixed-methods studies

Mixed-methods studies typically require a set of both quantitative and qualitative research questions. Separate questions are appropriate when the mixed-methods study focuses on the significance and differences in quantitative and qualitative methods and not on the study's integrative component (Tashakkori & Teddlie, 2010).

Researchers also have the option to develop a single mixed-methods research question. According to Tashakkori and Teddlie (2010), this suggests an integrative process or component between the study's quantitative and qualitative research methods.

Steps to Developing a Good Research Question

Broadly, a good research question should be relevant, decided, and meaningful (Stone, 2002). Creating a research question can be a tricky process, but there is a specific method you can follow to ease the process. The steps to this method are outlined below:

1. Start with a broad topic.

A broad topic provides writers with plenty of avenues to explore in their search for a viable research question. Techniques to help you develop a topic into subtopics and potential research questions include brainstorming and concept mapping. These techniques can organize your thoughts so you can identify connections and relevant themes within a broad topic.

When searching for a topic, it's wise to choose an area of study that you are genuinely interested in, since your interest in a topic will affect your motivation levels throughout your research. It's also wise to consider the interests being addressed recently by the research community, as this may affect your paper's chances of getting published.

2. Do preliminary research to learn about topical issues.

Once you have picked a topic, you can start doing preliminary research. This initial stage of research accomplishes two goals. First, a preliminary review of related literature allows you to discover issues that are currently being discussed by scholars and fellow researchers. This way, you get up-to-date, relevant knowledge on your topic.

Second, a preliminary review of related literature allows you to spot existing gaps or limitations in existing knowledge of your topic. With a certain amount of fine-tuning, you can later use these gaps as the focus of your research question.

Moreover, according to Farrugia et al. (2010), certain institutions that provide grants encourage applicants to conduct a systematic review of available studies and evidence to see if a similar, recent study doesn't already exist, before applying for a grant.

3. Narrow down your topic and determine potential research questions.

Once you have gathered enough knowledge on the topic you want to pursue, you can start focusing on a more specific area of study. One option is to focus on gaps in existing knowledge or recent literature. Referred to by Sandberg and Alvesson (2011) as "gap-spotting," this method involves constructing research questions out of identified limitations in literature and overlooked areas of study. Similarly,

researchers can choose research questions that extend or complement the findings of existing literature.

Another way of identifying and constructing research questions: problematization (Sandberg & Alvesson, 2011). As a methodology for constructing research questions, problematization aims to challenge and scrutinize assumptions that support others' and the researcher's theoretical position. This means constructing research questions that challenge your views or knowledge of the area of study.

Lipowski (2008), on the other hand, emphasizes the importance of taking into consideration the researcher's personal experiences in the process of developing a research question. Researchers who are also practitioners, for instance, can reflect on problematic areas of their practice. Patterns and trends in practice may also provide new insights and potential ideas for research questions.

4. Evaluate the soundness of your research question.

Your initial research and review of related literature will have produced some interesting questions that seem like they're worth pursuing. However, not all interesting questions make for sound research questions. Keep in mind that a research question draws its answer or conclusion through an analysis of evidence.

Hulley et al. (2007) suggest using a set of criteria- known as the "FINER" criteria-to find out if you have a good research question. The FINER criteria are outlined below:

F – Feasible

A good research question is feasible, which means that the question is well within the researcher's ability to investigate. Researchers should be realistic about the scale of their research as well as their ability to collect data and complete the

research with their skills and the resources available to them. It's also wise to have a contingency plan in place in case problems arise.

I – Interesting

The ideal research question is interesting not only to the researcher but also to their peers and community. This interest boosts the researcher's motivation to see the question answered.

N – Novel

Your research question should be developed to bring new insights to the field of study you are investigating. The question may confirm or extend previous findings on the topic you are researching, for instance.

E – Ethical

This is one of the more important considerations of making a research question. Your research question and your subsequent study must be something that review boards and the appropriate authorities will approve.

R – Relevant

Aside from being interesting and novel, the research question should be relevant to the scientific community and people involved in your area of study. If possible, your research question should also be relevant to the public's interest.

5. Construct your research question properly.

Research questions should be structured properly to ensure clarity. There are a number of frameworks that you can use for properly constructing a research question. The two most commonly used frameworks are explained below.

PICOT Framework

The PICOT framework was first introduced in 1995 by Richardson et al. Using the PICOT framework; research questions can be constructed to address important elements of the study, including the population to be studied, the expected outcomes, and the time it takes to achieve the outcome. With these elements, the framework is more commonly used in clinical research and evidence-based studies.

- P – population, patients, or problem
- I – intervention or indicator being studied
- C – comparison group
- – outcome of interest
- T – timeframe of the study

The sample research question below illustrates the PICOT framework and its elements:

Between the ages of five and 18, are children of parents with diagnosed mental health issues at increased risk of depression or anxiety compared with children of parents with no diagnosed mental health issues?	
P (population being studied)	children
I (indicator or intervention)	parents with diagnosed mental health issues
C (comparison group)	children of parents with no diagnosed mental health issues

O (outcome of interest)	increased risk of depression or anxiety
T (timeframe of interest)	between the ages of five and 18

PEO Framework

Like the PICOT framework, the PEO framework is commonly used in clinical studies as well. However, this framework is more useful for qualitative research questions. This framework includes these elements:

P – population being studied

E – exposure to preexisting conditions

O – outcome of interest

Below is a sample research question in the PEO framework:

In infants and children aged below 8, how does exposure to classical music affect the development of emotional expression?	
P (population being studied)	infants and children aged below 8
E (exposure to preexisting conditions)	exposure to classical music
O (outcome of interest)	effects on development of emotional expression

Other commonly used frameworks for research questions include the SPIDER (Sample, Phenomenon of Interest, Design, Evaluation, Research type) and CLIP (Client group, Location of provided service, Improvement/Information/Innovation, Professionals) frameworks. Aside from helping researchers properly structure research questions, these frameworks also help refine research results and improve the focus of data analysis.

Examples of Good and Bad Research Questions

The following examples of good and bad research questions can further guide researchers on properly constructing a research question.

Example no. 1

Bad: How does social media affect people's behavior?
Good: What effect does the daily use of YouTube have on the attention span of children aged under 16?

The first research question is considered bad because of the vagueness of "social media" as a concept and the question's lack of specificity. A good research question should be specific and focused, and its answer should be discovered through data collection and analysis.

Example no. 2

Bad: Has there been an increase in childhood obesity in the US in the past 10 years?
Good: How have school intervention programs and parental education levels affected the rate of childhood obesity among 1st to 6th-grade students?

In the second example, the first research question is not ideal because it's too simple, and it's easily answerable by a "yes" or "no." The second research question is more complicated; to answer it, the researcher must collect data, perform in-depth data analysis, and form an argument that leads to further discussion.

Important Points to Keep in Mind in Creating a Research Question

Developing the right research question is a critical first step in the research process. The key points outlined below should help researchers in the pursuit:

The development of a research question is an iterative process that involves continuously updating one's knowledge on the topic and refining ideas at all stages (Maxwell, 2013).

Remain updated on current trends, state-of-the-art research studies, and technological advances in the field of study you are pursuing.

Make the research question as specific and concise as possible to ensure clarity. Avoid using words or terms that don't add to the meaning of the research question.

Aside from doing a literature review, seek the input of experts in the field, mentors, and colleagues. Such inputs can prove beneficial not only for the research question but also for creating the rest of the study.

Finally, refrain from committing the two most common mistakes in framing research questions: posing a question as an anticipated contribution and framing a question as a method (Mayo et al., 2013).

RESEARCH PROBLEM

One of the most fundamental components of a study is the research problem. In fact, the research problem drives the entire study; if you do not have a research

problem, you do not have a study. Yet, beginning researchers sometimes do not understand the importance of the research problem or understand exactly what a research problem is. This blog is intended to shed light on the nature and purpose of the research problem.

A research problem is exactly what it sounds like: a problem or issue in or with the research.

Although the research problem stems from a social or organizational issue, the actual research problem itself is developed by looking into the literature. I cannot emphasize this point enough: the research problem is developed by diving into the research on the topic to see what is there and what research is needed. It does not come from what we think is important, from our opinion about what needs to be studied, or from our desire to study something. The research problem exists in and is developed from the literature.

For example, let's say there is a problem with special education teachers leaving the profession. The first thing to do is to go to the research to see what is already known about the topic. So, the research says they are leaving because they are not satisfied in their jobs, jobs demands are high, and pay is commensurately low. They also leave because they do not feel adequately prepared and feel they are not supported by administration. So now, where do we go from here? You can review the "Recommendations for Further Research" sections of recent studies. These are recommendations for future research suggested by researchers based on their findings. These recommendations may be developed into research problems.

To develop a research problem, you should delve into the issue further. Look at *how* we know what we know about teachers leaving special education. Maybe the research is primarily quantitative, necessitating qualitative inquiry to gain in-depth information on teachers' perceptions and experiences. Or, maybe it is the reverse. Maybe we have lots of information on teachers' experiences but little quantitative research confirming the relationships between factors and constructs. Or, maybe we do not have comprehensive information about the topic, necessitating the views of other stakeholders such as administrators, or more comprehensive study designs such as case studies with multiple data sources. These shortcomings in the research represent gaps in what we know or problems with the research that, if addressed, can enhance understanding of the topic and uniquely contribute to the research.

Research Objectives

In general, research objectives describe what we **expect to achieve** by a project.

Research objectives are usually expressed in **lay terms** and are directed as much to the client as to the researcher. Research objectives may be linked with a hypothesis or used as a statement of purpose in a study that does not have a hypothesis.

Even if the nature of the research has not been clear to the layperson from the hypotheses, s/he should be able to understand the research from the objectives.

A statement of research objectives can serve to guide the activities of research. Consider the following examples.

- **Objective:** To describe what factors farmers take into account in making such decisions as whether to adopt a new technology or what crops to grow.
- **Objective:** To develop a budget for reducing pollution by a particular enterprise.
- **Objective:** To describe the habitat of the giant panda in China.

In the above examples the intent of the research is largely descriptive.

- In the case of the first example, the research will end the study by being able to specify factors which emerged in household decisions.
- In the second, the result will be the specification of a pollution reduction budget.
- In the third, creating a picture of the habitat of the giant panda in China.

These observations might prompt researchers to formulate hypotheses which could be tested in another piece of research. So long as the aim of the research is exploratory, ie to describe what is, rather than to test an explanation for what is, a research objective will provide an adequate guide to the research.

Objective of Research in Research Methodology

The purpose of research is to discover answers to questions through the application of scientific procedures. The main aim of research is to find out the truth which is hidden and which has not been discovered as yet. Though each research study has its own specific purpose, we may think of research objectives as falling into a number of following broad groupings:

Aims and Objectives of Research Methodology

1. To gain familiarity with a phenomenon or to achieve new insights into it (studies with this object in view are termed as exploratory or formulative research studies);
2. To portray accurately the characteristics of a particular individual, situation or a group(studies with this object in view are known as descriptive research studies);
3. To determine the frequency with which something occurs or with which it is associated with something else (studies with this object in view are known as diagnostic research studies);
4. To test a hypothesis of a causal relationship between variables (such studies are known as hypothesis-testing research studies).

Research Hypothesis

Hypothesis is an assumption that is made on the basis of some evidence. This is the initial point of any investigation that translates the research questions into a prediction. It includes components like variables, population and the relation between the variables. A research hypothesis is a hypothesis that is used to test the relationship between two or more variables.

Characteristics of Hypothesis

Following are the characteristics of hypothesis:

- The hypothesis should be clear and precise to consider it to be reliable.
- If the hypothesis is a relational hypothesis, then it should be stating the relationship between variables.
- The hypothesis must be specific and should have scope for conducting more tests.

- The way of explanation of the hypothesis must be very simple and it should also be understood that the simplicity of the hypothesis is not related to its significance.

Sources of Hypothesis

Following are the sources of hypothesis:

- The resemblance between the phenomenon.
- Observations from past studies, present-day experiences and from the competitors.
- Scientific theories.
- General patterns that influence the thinking process of people.

Types of Hypothesis

There are six forms of hypothesis and they are:

- Simple hypothesis
- Complex hypothesis
- Directional hypothesis
- Non-directional hypothesis
- Null hypothesis
- Associative and casual hypothesis

Simple Hypothesis

It shows a relationship between one dependent variable and a single independent variable. For example – If you eat more vegetables, you will lose weight faster. Here, eating more vegetables is an independent variable, while losing weight is the dependent variable.

Complex Hypothesis

It shows the relationship between two or more dependent variables and two or more independent variables. Eating more vegetables and fruits leads to weight loss, glowing skin, reduces the risk of many diseases such as heart disease, high blood pressure and some cancers.

Directional Hypothesis

It shows how a researcher is intellectual and committed to a particular outcome. The relationship between the variables can also predict its nature. For example- children aged four years eating proper food over a five-year period are having higher IQ levels than children not having a proper meal. This shows the effect and direction of effect.

Non-directional Hypothesis

It is used when there is no theory involved. It is a statement that a relationship exists between two variables, without predicting the exact nature (direction) of the relationship.

Null Hypothesis

It provides the statement which is contrary to the hypothesis. It's a negative statement, and there is no relationship between independent and dependent variables. The symbol is denoted by "HO".

Associative and Causal Hypothesis

Associative hypothesis occurs when there is a change in one variable resulting in a change in the other variable. Whereas, causal hypothesis proposes a cause and effect interaction between two or more variables.

Examples of Hypothesis

Following are the examples of hypothesis based on their types:

- Consumption of sugary drinks every day leads to obesity is an example of a simple hypothesis.
- All lilies have the same number of petals is an example of a null hypothesis.
- If a person gets 7 hours of sleep, then he will feel less fatigue than if he sleeps less.

Functions of Hypothesis

Following are the functions performed by the hypothesis:

- Hypothesis helps in making an observation and experiments possible.
- It becomes the start point for the investigation.
- Hypothesis helps in verifying the observations.
- It helps in directing the inquiries in the right directions.

How will Hypothesis help in Scientific Method?

Researchers use hypothesis to put down their thoughts directing how the experiment would take place. Following are the steps that are involved in the scientific method:

- Formation of question
- Doing background research
- Creation of hypothesis
- Designing an experiment
- Collection of data

- Result analysis
- Summarizing the experiment
- Communicating the results

Research in an evolutionary perspective

An evolutionary perspective of personality and individual differences proposes that our personalities and individual differences have evolved, in part, to provide us with some form of adaptive advantage in the context of survival and reproduction. This perspective is an evolutionary psychology perspective, which in itself is based on biological evolutionary theory. Evolutionary psychology integrates psychological theory with evolutionary biology, in an effort to understand traits, cognition, and behaviors, and how individuals may differ across these in light of achieving their evolutionary goals.

The role of Theory in Research.

Theory provides significant guidelines and trails for the conduct of research by pointing to areas that are most likely to be fruitful, that is, areas in which meaningful relationships among variables are likely to be found. If the variables come to be selected such that no relationships between them obtain, the research will be sterile no matter how meticulous the subsequent observations and inferences.

A theoretic system narrows down the range of facts to be studied. Theory provides the researcher with a definite view point a direction which goes a long way toward

helping him enquire into relationships between certain variables selected from among an almost infinite array of variables.

Another contribution of theory for research is in terms of increasing the meaningfulness of the findings of a particular study by helping us to perceive them as special cases of the operation of a set of more general or abstract statements of relationships rather than as isolated bits of empirical information.

A theory typically enhances the meaningfulness of research, since seemingly unrelated findings of isolated studies assume new meaning and significance when they are put into proper theoretical perspective. Let us take the example of observation by Durkheim that Catholics have a lower suicide rate as compared to the Protestants.

As an isolated empirical uniformity, the finding would not add greatly to our understanding of suicidal behaviour unless it conceptualized, that is, conceived of as an illustration of a linkage amongst abstractions of a higher order (e.g., Catholicism-Social Cohesion unrelieved anxieties-suicide rate).

The linkage of the specific empirical findings to a more general concept has another major advantage. It affords a more secure ground for prediction than do these empirical findings by themselves. The theory by providing a rationale behind the empirical findings introduces a ground for prediction which is more secure" than mere extrapolation from previously observed trends.

Whereas an empirical finding as a proposition referring to certain concrete contextual manifestation of a phenomenon does not afford a basis for drawing diverse inferences about what will follow, its reformulation or revamping in theoretic terms affords a secure basis for arriving at the inferences about the varied

positive consequences in areas quite remote from the central area to which the given finding relates.

Theory thus mediates between specific empirical generalization or uniformities and broad theoretical orientations anchored in the intellectual tradition.

In affording broader meanings to empirical findings the theory also attests to their truth. A hypothesis is as much confirmed by fitting it into a theory as by fitting it into facts, because it then enjoys the support provided by evidence for all the other hypotheses of the given theory.

Theory helps us to identify gaps in our knowledge and seek to bridge them up with intuitive, impressionistic or extensional generalizations. As Karl Jaspers said, **"It is only when using methodologically classified sciences that we know what we know and what we do not know."** This way, theory constitutes a crucially important guide to designing of fruitful research.

UNIT II

RESEARCH DESIGN AND MEASUREMENT

Research Design – Components, Types – Variables – Types - Validity – Internal Validity and External Validity – Threats - Measurement – Measurement Errors - Scaling Techniques - Different Scales, Validity and Reliability of an Instrument - Methods – Case Study.

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Introduction to Research design

Research design is the framework of research methods and techniques chosen by a researcher. The design allows researchers to hone in on research methods that are suitable for the subject matter and set up their studies up for success.

The design of a research topic explains the type of research (experimental, survey, correlational, semi-experimental, review) and also its sub-type (experimental design, research problem, descriptive case-study).

There are three main types of research design: Data collection, measurement, and analysis.

The type of research problem an organization is facing will determine the research design and not vice-versa. The design phase of a study determines which tools to use and how they are used.

An impactful research design usually creates a minimum bias in data and increases trust in the accuracy of collected data. A design that produces the least margin of error in experimental research is generally considered the desired outcome.

The essential elements of the research design are:

1. Accurate purpose statement
2. Techniques to be implemented for collecting and analyzing research
3. The method applied for analyzing collected details
4. Type of research methodology
5. Probable objections for research
6. Settings for the research study
7. Timeline
8. Measurement of analysis

Proper research design sets your study up for success. Successful research studies provide insights that are accurate and unbiased. You'll need to create a survey that meets all of the main characteristics of a design. There are four key characteristics of research design:

Neutrality: When you set up your study, you may have to make assumptions about the data you expect to collect. The results projected in the research design should be free from bias and neutral. Understand opinions about the final evaluated scores and conclusion from multiple individuals and consider those who agree with the derived results.

Reliability: With regularly conducted research, the researcher involved expects similar results every time. Your design should indicate how to form research questions to ensure the standard of results. You'll only be able to reach the expected results if your design is reliable.

Validity: There are multiple measuring tools available. However, the only correct measuring tools are those which help a researcher in gauging results according to

the objective of the research. The questionnaire developed from this design will then be valid.

Generalization: The outcome of your design should apply to a population and not just a restricted sample. A generalized design implies that your survey can be conducted on any part of a population with similar accuracy.

The above factors affect the way respondents answer the research questions and so all the above characteristics should be balanced in a good design.

A researcher must have a clear understanding of the various types of research design to select which model to implement for a study. Like research itself, the design of your study can be broadly classified into quantitative and qualitative.

Qualitative research design: Qualitative research determines relationships between collected data and observations based on mathematical calculations. Theories related to a naturally existing phenomenon can be proved or disproved using statistical methods. Researchers rely on qualitative research design methods that conclude "why" a particular theory exists along with "what" respondents have to say about it.

Quantitative research design: Quantitative research is for cases where statistical conclusions to collect actionable insights are essential. Numbers provide a better perspective to make critical business decisions. Quantitative research design methods are necessary for the growth of any organization. Insights drawn from hard numerical data and analysis prove to be highly effective when making decisions related to the future of the business.

Types of research design into five categories:

1. Descriptive research design: In a descriptive design, a researcher is solely interested in describing the situation or case under their research study. It is a theory-based design method which is created by gathering, analyzing, and presenting collected data. This allows a researcher to provide insights into the why and how of research. Descriptive design helps others better understand the need for the research. If the problem statement is not clear, you can conduct exploratory research.

2. Experimental research design: Experimental research design establishes a relationship between the cause and effect of a situation. It is a causal design where one observes the impact caused by the independent variable on the dependent variable. For example, one monitors the influence of an independent variable such as a price on a dependent variable such as customer satisfaction or brand loyalty. It is a highly practical research design method as it contributes to solving a problem at hand. The independent variables are manipulated to monitor the change it has on the dependent variable. It is often used in social sciences to observe human behavior by analyzing two groups. Researchers can have participants change their actions and study how the people around them react to gain a better understanding of social psychology.

3. Correlational research design: Correlational research is a non-experimental research design technique that helps researchers establish a relationship between two closely connected variables. This type of research requires two different groups. There is no assumption while evaluating a relationship between two

different variable tools, and statistical analysis techniques calculate the relationship between them.

A correlation coefficient determines the correlation between two variables, whose value ranges between -1 and +1. If the correlation coefficient is towards +1, it indicates a positive relationship between the variables and -1 means a negative relationship between the two variables.

4. Diagnostic research design: In diagnostic design, the researcher is looking to evaluate the underlying cause of a specific topic or phenomenon. This method helps one learn more about the factors that create troublesome situations.

This design has three parts of the research:

- Inception of the issue
- Diagnosis of the issue
- Solution for the issue

5. Explanatory research design: Explanatory design uses a researcher's ideas and thoughts on a subject to further explore their theories. The research explains unexplored aspects of a subject and details about what, how, and why of research questions.

Exploratory, Descriptive, and Causal Research Designs

Research design is a tool that is used in carrying out marketing researches. The design is supposed to give in detail the procedures that are supposed to be

followed to solve problems that marketing researches present. The major approaches used in researches include exploratory, causal, and exploratory research designs. Information requirements, measures, and scales have to be spelt out clearly. Sampling process, sample size, and data analysis plans also feature prominently as components of the three research designs,

Descriptive Research design

Descriptive research design is mainly used to describe a behavior or type of subject. It not intended to look for specific relationships between variables neither does it correlate variables. Its major set back is that it cannot identify cause because its setting is completely natural.

Moreover, it has all the variables present. Descriptive research design is an asset to a researcher because a lot of information can be acquired through description. For purposes of identification of variables and hypothetical constructs which can be subjected to further investigations using other means, descriptive research design come in handy. Some of its advantages include the ability of its descriptions to be used to indirectly test theory or model behaviors that cannot be studied using any other means (Creswell 1998).

Categories of descriptive design include surveys and observational studies. Field surveys feature prominently under surveys. Under this, the participants are expected to fill in the questionnaires or be subjected to interviews in natural settings.

Much attention should be devoted to construction and content validity of the questionnaires; the scores must be reliable; the questions should be clear and

precise hence mutually exclusive answers; the interviewer must be consistent and controlled in his or her behavior; and the order of questions as they appear in the questionnaire have to be counterbalanced. This helps in identifying and controlling one sided responses. Finally, field surveyors have to pay attention to concrete behaviors that naïve respondents describe accurately.

Surveys are quite often mailed or facilitated through phone calls. Surveys conducted through mails involve questionnaires that are relatively long. It takes some time before these mails are returned. However, not all of them can be returned but 50% return rate is normally okay for the survey.

Exploratory research design

Exploratory research design is normally used in research whose purpose involves inquiry into new products that should be developed, how the product appeal will enhance its advertising, and how the existing services can be improved.

Research questions in exploratory research design border on the alternative ways that exist that can be used for example to provide lunch for school children, the kind of benefits people stand to get from the product, and the nature of dissatisfaction the customer may be getting from the product in the case of marketing research. The hypothesis here has unknown constructs. The hypothesis also suspects that the major problem in the study could be impersonalization.

Causal research design

The purpose of this research design in marketing research perspective is to ascertain whether an increase in the service staff ca be profitable, which advertising program for public transit is suitable, and whether new budget should be

contemplated. The research questions here touch on the correlation between size of staff offering services and the revenue that is accrued. What do people stand to get from cars and the public transport.

Comparison of the three research designs

The major objective of exploratory research design is to discover ideas and insights where as in descriptive research design involves describing market aspects and functions. Nevertheless, causal research design tries to determine the cause-effect relationships in the research one is conducting.

A major feature of exploratory design is its flexibility, its adaptability, and the front end of total research design. However, descriptive research design is marked by past formulation of specific hypotheses from observations and studies. This design is pre-planned and structured. Causal research approach can proceed through one or more independent variables. Other mediating variables that fall under this design can also be controlled.

An exploratory research approach entails the use of surveys, case studies, information from other studies, and qualitative analyses. In contrast, a descriptive research approach uses information from other studies, panels, analyses, and observation. Causal research design strictly uses experiments.

Descriptive Research

Descriptive research is a type of research that describes a population, situation, or phenomenon that is being studied. It focuses on answering the *how, what, when, and where* questions If a research problem, rather than the *why.*

This is mainly because it is important to have a proper understanding of what a research problem is about before investigating why it exists in the first place.

For example, an investor considering an investment in the ever-changing Amsterdam housing market needs to understand what the current state of the market is, how it changes (increasing or decreasing), and when it changes (time of the year) before asking for the why. This is where descriptive research comes in.

What Are The Types of Descriptive Research?

Descriptive research is classified into different types according to the kind of approach that is used in conducting descriptive research. The different types of descriptive research are highlighted below:

- **Descriptive-survey**

Descriptive-survey research uses surveys to gather data about varying subjects. This data aims to know the extent to which different conditions can be obtained among these subjects.

For example, a researcher wants to determine the qualification of employed professionals in Maryland. He uses a survey as his research instrument, and each item on the survey related to qualifications is subjected to a Yes/No answer.

This way, the researcher can describe the qualifications possessed by the employed demographics of this community.

- **Descriptive-normative survey**

This is an extension of the descriptive-survey, with the addition being the normative element. In the descriptive-normative survey, the results of the study should be compared with the norm.

For example, an organization that wishes to test the skills of its employees by a team may have them take a skills test. The skills tests are the evaluation tool in this case, and the result of this test is compared with the norm of each role.

If the score of the team is one standard deviation above the mean, it is very satisfactory, if within the mean, satisfactory, and one standard deviation below the mean is unsatisfactory.

- **Descriptive-status**

This is a quantitative description technique that seeks to answer questions about real-life situations. For example, a researcher researching the income of the employees in a company, and the relationship with their performance.

A survey will be carried out to gather enough data about the income of the employees, then their performance will be evaluated and compared to their income. This will help determine whether a higher income means better performance and low income means lower performance or vice versa.

- **Descriptive-analysis**

Descriptive-analysis method of research describes a subject by further analyzing it, which in this case involves dividing it into 2 parts. For example, the HR personnel of a company that wishes to analyze the job role of each employee of the company may divide the employees into the people that work at the Headquarters in the US and those that work from Oslo, Norway office.

A questionnaire is devised to analyze the job role of employees with similar salaries and work in similar positions.

- **Descriptive classification**

This method is employed in biological sciences for the classification of plants and animals. A researcher who wishes to classify the sea animals into different species will collect samples from various search stations, then classify them accordingly.

- **Descriptive-comparative**

In descriptive-comparative research, the researcher considers 2 variables which are not manipulated, and establish a formal procedure to conclude that one is better than the other. For example, an examination body wants to determine the better method of conducting tests between paper-based and computer-based tests.

A random sample of potential participants of the test may be asked to use the 2 different methods, and factors like failure rates, time factors, and others will be evaluated to arrive at the best method.

- **Correlative Survey**

Correlative used to determine whether the relationship between 2 variables is positive, negative, or neutral. That is, if 2 variables, say X and Y are directly proportional, inversely proportional or are not related to each other.

Experimental Research design

Definition:

Experimental research is research conducted with a scientific approach using two sets of variables. The first set acts as a constant, which you use to measure the differences of the second set. Quantitative research methods, for example, are experimental.

If you don't have enough data to support your decisions, you must first determine the facts. Experimental research gathers the data necessary to help you make better decisions.

Any research conducted under scientifically acceptable conditions uses experimental methods. The success of experimental studies hinges on researchers confirming the change of a variable is based solely on the manipulation of the constant variable. The research should establish a notable cause and effect.

You can conduct experimental research in the following situations:

- Time is a vital factor in establishing a relationship between cause and effect.
- Invariable behavior between cause and effect.
- You wish to understand the importance of the cause and effect.

Types of experimental research design

The classic experimental design definition is, "The methods used to collect data in experimental studies."

There are three primary types of experimental design:

- Pre-experimental research design

- True experimental research design
- Quasi-experimental research design

The way you classify research subjects, based on conditions or groups, determines the type of design.

1. Pre-experimental research design: A group, or various groups, are kept under observation after implementing factors of cause and effect. You'll conduct this research to understand whether further investigation is necessary for these particular groups.

You can break down pre-experimental research further in three types:

- One-shot Case Study Research Design
- One-group Pretest-posttest Research Design
- Static-group Comparison

2. True experimental research design: True experimental research relies on statistical analysis to prove or disprove a hypothesis, making it the most accurate form of research. Of the types of experimental design, only true design can establish a cause-effect relationship within a group. In a true experiment, three factors need to be satisfied:

- There is a Control Group, which won't be subject to changes, and an Experimental Group, which will experience the changed variables.
- A variable which can be manipulated by the researcher
- Random distribution

This experimental research method commonly occurs in the physical sciences.

3. Quasi-experimental research design: The word "Quasi" indicates similarity. A quasi-experimental design is similar to experimental, but it is not the same. The difference between the two is the assignment of a control group. In this research, an independent variable is manipulated, but the participants of a group are not randomly assigned. Quasi-research is used in field settings where random assignment is either irrelevant or not required.

Advantages of experimental research

It's vital to test new ideas or theories. Why put time, effort, and funding into something that may not work?

Experimental research allows you to test your idea in a controlled environment before taking it to market. It also provides the best method to test your theory, thanks to the following advantages:

- Researchers have a stronger hold over variables to obtain desired results.
- The subject or industry does not impact the effectiveness of experimental research. Any industry can implement it for research purposes.
- The results are specific.
- After analyzing the results, you can apply your findings to similar ideas or situations.
- You can identify the cause and effect of a hypothesis. Researchers can further analyze this relationship to determine more in-depth ideas.
- Experimental research makes an ideal starting point. The data you collect is a foundation on which to build more ideas and conduct more research.

VALIDITY OF FINDINGS

Validity refers to how accurately a method measures what it is intended to measure. If research has high validity, that means it produces results that correspond to real properties, characteristics, and variations in the physical or social world.

High reliability is one indicator that a measurement is valid. If a method is not reliable, it probably isn't valid.

If the thermometer shows different temperatures each time, even though you have carefully controlled conditions to ensure the sample's temperature stays the same, the thermometer is probably malfunctioning, and therefore its measurements are not valid.

If a symptom questionnaire results in a reliable diagnosis when answered at different times and with different doctors, this indicates that it has high validity as a measurement of the medical condition.

However, reliability on its own is not enough to ensure validity. Even if a test is reliable, it may not accurately reflect the real situation.

The thermometer that you used to test the sample gives reliable results. However, the thermometer has not been calibrated properly, so the result is 2 degrees lower than the true value. Therefore, the measurement is not valid.

A group of participants take a test designed to measure working memory. The results are reliable, but participants' scores correlate strongly with their level of reading comprehension. This indicates that the method might have low validity: the test may be measuring participants' reading comprehension instead of their working memory.

Validity is harder to assess than reliability, but it is even more important. To obtain useful results, the methods you use to collect your data must be valid: the research must be measuring what it claims to measure. This ensures that your discussion of the data and the conclusions you draw are also valid.

TYPES OF VALIDITY

Internal validity refers to the degree of confidence that the causal relationship being tested is trustworthy and not influenced by other factors or variables.

External validity refers to the extent to which results from a study can be applied (generalized) to other situations, groups or events.

The external validity of a study is the extent to which you can generalize your findings to different groups of people, situations, and measures. External validity is the extent to which your results can be generalized to other contexts. The validity of your experiment depends on your experimental design.

Variables in Research

A variable in research simply refers to a person, place, thing, or phenomenon that you are trying to measure in some way. The best way to understand the difference between a dependent and independent variable is that the meaning of each is implied by what the words tell us about the variable you are using.

A variable is any property, a characteristic, a number, or a quantity that increases or decreases over time or can take on different values (as opposed to constants, such as n, that do not vary) in different situations.

When conducting research, experiments often manipulate variables. For example, an experimenter might compare the effectiveness of four types of fertilizers.

Types of Variable

1. Qualitative Variables.
2. Quantitative Variables.
3. Discrete Variable.
4. Continuous Variable.
5. Dependent Variables.
6. Independent Variables.
7. Background Variable.
8. Moderating Variable.
9. Extraneous Variable.
10. Intervening Variable.
11. Suppressor Variable.

Qualitative Variables

An important distinction between variables is between the qualitative variable and the quantitative variable.

Qualitative variables are those that express a qualitative attribute such as hair color, religion, race, gender, social status, method of payment, and so on. The values of a qualitative variable do not imply a meaningful numerical ordering.

The value of the variable ‘religion’ (Muslim, Hindu, ..,etc.) differs qualitatively; no ordering of religion is implied. Qualitative variables are sometimes referred to as **categorical variables.**

For example, the variable sex has two distinct categories: ‘male’ and ‘female.’ Since the values of this variable are expressed in categories, we refer to this as a categorical variable.

Quantitative Variables

Quantitative variables, also called **numeric variables,** are those variables that are measured in terms of numbers. A simple example of a quantitative variable is a person’s age.

The age can take on different values because a person can be 20 years old, 35 years old, and so on. Likewise, family size is a quantitative variable, because a family might be comprised of one, two, three members, and so on.

That is, each of these properties or characteristics referred to above varies or differs from one individual to another. Note that these variables are expressed in numbers, for which we call them quantitative or sometimes numeric variables.

Dependent and Independent Variables

In many research settings, there are two specific classes of variables that need to be distinguished from one another, **independent variable** and **dependent variable.**

Many research studies are aimed at unrevealing and understanding the causes of underlying phenomena or problems with the ultimate goal of establishing a causal relationship between them.

Look at the following statements:

- Low intake of food causes underweight.
- Smoking enhances the risk of lung cancer.
- Level of education influences job satisfaction.
- Advertisement helps in sales promotion.
- The drug causes the improvement of a health problem.
- Nursing intervention causes more rapid recovery.
- Previous job experiences determine the initial salary.
- Blueberries slow down aging.
- The dividend per share determines share prices.

In each of the above queries, we have two variables: one independent and one dependent. In the first example, 'low intake of food' is believed to have caused the 'problem of underweight.'

Independent Variable

The variable that is used to describe or measure the factor that is assumed to cause or at least to influence the problem or outcome is called an **independent variable.**

The definition implies that the experimenter uses the independent variable to describe or explain the influence or effect of it on the dependent variable.

Variability in the dependent variable is presumed to depend on variability in the independent variable.

Depending on the context, an independent variable is sometimes called a predictor variable, regressor, controlled variable, manipulated variable, explanatory variable, exposure variable (as used in reliability theory), risk factor (as used in medical statistics), feature (as used in machine learning and pattern recognition) or input variable.

Dependent Variable

The variable that is used to describe or measure the problem or outcome under study is called a **dependent variable.**

In a causal relationship, the cause is the independent variable, and the effect is the dependent variable. If we hypothesize that smoking causes lung cancer, ‘smoking’ is the independent variable and cancer the dependent variable.

A business researcher may find it useful to include the dividend in determining the share prices. Here dividend is the independent variable, while the share price is the dependent variable.

Measurement and scaling

Measurement in Research

- In our day to day life, we are said to measure when we use some yardstick to determine the weight, height or some other feature of a physical object.

- We also measure when we judge how well we like a song, a painting or the personalities of our friends and whom we admire/heroes.

- We, thus, measure physical objects as well as abstract concepts.

- Measurement is a relatively complex and demanding task, specially so when it concerns qualitative or abstract phenomena.

- Thus, by measurement, we mean the process of assigning numbers to objects or observations, the level of measurement being a function of the rules under which the numbers are assigned.

- It is easy to measure in respect of objects or concepts that are quantifiable, because measurement tools are standardized. The measurement obtained is highly accurate.

- However, if the concept of abstract are qualitative form, the measurement becomes quite difficult because the measurement tools are not standardized and the results are relatively less accurate.

- Technically speaking, measurement could be called to be a process of mapping aspects of domain onto other aspects of a range according to some rule of correspondence.

- In measuring we devise some form of scale and then transform or map the properties or features of objects from the domain on to this scale.

- For example, in case we want to find out the male to female attendance ratio while conducting a study of persons who attend some show, then we may tabulate those who come to the show according to their sex.

- In terms of set theory, this process is one of mapping the observed physical properties of those coming to the show (the domain) on to a sex classification (the range).

- The rule of correspondence is if the object in the domain appears to be male, assign to “0” and if female assign to” 1".

- Likewise, we may also record a person's marital status as 1,2,3 or 4 depending on whether the person is single, married, widowed or divorced.

- We can also record "Yes" or "No" answers to a question as "0" and "1". In this artificial or nominal way, categorical data (qualitative or descriptive) can be made into numerical data and if we thus code the various categories, we refer to the numbers we record as nominal data.

- 'Nominal data' are numerical in name only, because they do not share any of the properties of the numbers we deal in ordinary mathematics.
- or instance, if we record the marital status as 1,2,3 and 4, we cannot write 4>2 or 3<4 and we cannot write 3-1 = 4-2, 1+3=4 or 4-2 =2.

- In some situations when the cannot also anything except set up

inequalities, we refer to the data as "ordinal data".

- For instance if one mineral can scratch another, it receives a higher hardness number and on Mohs' scale the numbers from 1 to 10 are assigned respectively to talc, gypsum, calcite, fluorite, apatite, …, topaz, sapphire and diamond.

- With these numbers we can write 5>2 or 6<9 as appetite is harder than gypsum, but we cannot write 10-92 5-4 because the difference in hardness between diamond and sapphire is actually much greater than between appetite and fluorite.

- Similarly, in addition to setting up inequalities if we can also form difference, we refer this data 'as interval data'. For instances we observe the following temperature readings(in degree farenheit) : 58^o. 63^o, 70^o, 90^o, 110^o etc.

- In this case we can write $100^o > 70^o$ or $90^o < 110^o$. We can also write 95^o-70^o = 35^o-110^o since equal temperature difference are equal.

- Likewise in addition to setting up inequalities and forming differences, if we can also form quotients, we refer such data as 'ratio-data'.

Measurement Scales

- The most widely used classification of measurement scales are

(a) Nominal Scale,

(b) Ordinal Scale,

(c) Interval Scale, And

(d) Ratio Scale

(a) Nominal Scale:

- Nominal scale is simply a system of assigning number symbols to event in order to label them.

- Such number cannot be considered to be associated with an ordered scale, for their order is of no consequence.

- The numbers are just convenient labels for the particular class of events and as such have no quantitative value.

- Nominal scales provide convenient ways keeping track of people, objects and events.

- One cannot do much with the numbers involved.

- Example, one cannot usefully average the numbers on the back of a group of football players and come up with a meaningful value.

- Neither can one usefully compare the numbers assigned to one group with the numbers assigned to another.
- Accordingly, we are restricted to use mode as the measure of central tendency.
- Likewise, Chi-square test is the most common test of statistical significance that can be utilized.

- Nominal scale is the least powerful level of measurement. It indicates no order or distance relationship and has no arithmetic origin.

- A nominal scale simply describes differences between things by assigning them to categories.

- Nominal data are, thus counted data.

(b) Ordinal Scale:

- The ordinal scale places event in order, but there is no attempt to make the intervals of scale equal in terms of some rule.

- Rank orders represent ordinal scales and are frequently used in

research relating to qualitative phenomena.

- A students rank in has graduation class involves the use of ordinal scale.

- One has to be very careful in making statement about scores based on ordinal scales.

- For example, if Ram's position in his class is 10^{th} and Mohan's position 40^{th}, it cannot be said that Ram's position is four times as good as that of Mohan.

- The statement would make no sense at all ordinal scales only permit the ranking of items from highest to lowest.

- Ordinal measures have no absolute values and the real differences between adjacent ranks may not be equal.

- All that can be said one person is higher or lower on the scale than another, but more precise comparisons cannot be made.

- Since the numbers of this scale have only a rank meaning, the appropriate measure of central tendency is Median.

1. A percentile or quartile measure is used for measuring dispersion.

(c) Interval Scale:

- In case of interval scale, the intervals are adjusted in terms of some rule that has been established as a basis of a making the units equal.

- The unit are equal only in so far as one accepts the assumptions on which the rule is based.
- Interval scales can have an arbitrary zero, but it is not possible to determine for them what may be called an absolute zero or the unique origin.

- The primary limitation of the interval scale is the lack of a true zeros, it does not have the capacity to measure the complete absence of a trait or characteristics.

- The Fahrenheit scale is an example of an interval scale and shows similarities in what one can and cannot do write it.
- One can say that an increase in temperature from 30^o to 40^o involves the same in temperature as an increase from 60^o to 70^o; but one cannot say that the temperature of 60^o is twice as warm as the temperature of 30^o because both numbers are dependent on the fact that the zero on the scale is set arbitrarily at the temperature of freezing point of water.

- The ratio of the two temperatures, 30^o and 60^o, means nothing because zero is an arbitrary point.

- Interval scale provides a more powerful measurement than ordinal scale for interval scale also incorporates the concept of equality of interval.

- As such more powerful statistical measures can be used with Interval scales.

- Mean is the appropriate measure of central tendency, while standard deviation in the mode widely used measure of dispersion.

(d) Ratio Scale:

- Ratio scales have an absolute or true zero of measurement.

- The term 'absolute zero' is not as precise as it was once believed to be.

- We can conceive of an absolute zero of length and similarly we can conceive of an absolute zero of time.

- With ratio scale involved one can make statements like "X's" typing performance was twice as good as that of Y's.

- The ratio involved does have significance and facilities a kind of comparison which is not possible in case of interval scale.

- Ratio scale represents the actual amounts of variables.

- Generally, all statistically techniques are usable with ratio scales and all manipulations that one can carry out with real numbers can also be carried out with ratio scale values.

- Geometric and harmonic means can be used as measures of central tendency and coefficient of variation may also be calculated.

- Thus, proceeding from the nominal scale (the least pre use type of scale) to ratio scale (the most precise); the relevant information is obtained increasingly.

- If the nature of the variables permits, the researcher should use the scale that provides the most precise description.

- Researchers in physical sciences have the advantage to describe variables in ratio scale form but the behavioural sciences are generally limited to describe variables in interval scale form, a less precise type of measurement.

Sources of Error in Measurement

- Measurement should be precise and unambiguous in an ideal research study.

- Thus objective is often not met with in entirety.

- The researcher must be aware about the sources of error in measurement.
- The following are the possible sources of error in measurement.

(a) Respondent:

- At times the respondent may be reluctant to express strong negative feelings or it may just be possible that he may have very little knowledge but may not admit has ignorance.

- All this reluctance is likely to result in an interview of "guesses". Similarly, transient factors like fatigue, boredom, anxiety etc. may also limit the ability of respondent to respond accurately and fully.

(b) Situation:

- Situational factors may also come in the way of correct measurement.

- Any condition which places a strain on interview can have serious effects on the interview respondent rapport.

- For instance, if some one else is present, he can distort responses

by joining in or merely by being present.

- If the respondent feels that anonymity is not assured, he may be reluctant to express certain feelings.

(c) Measurer:

- The interviewer can distort responses by "rewording" or "re-ordering" questions.

- His behaviour, style and looks may encourage or discourage certain replies from respondent.

- Careless mechanical processing may district the findings.

- Errors may also creep in because of incorrect coding, faculty tabulation and or statistical calculations, particularly in the data analysis stage.

(d) Instruments:

- Error may arise because of the defective measuring instrument.

- The use of complex words, beyond the comprehension of the respondent, ambiguous meanings, poor printing, inadequate space for replies, etc. are a few things that make the measuring instrument defective and many result in measurement errors.

Scaling

- In research use quite often face the problem of measurement, specially when the concepts to be measured are complex and abstract, and we do not possess the standardized measurement tools.

- In other words, we can say that while measuring attitudes and opinions, we face the problem of their valid measurement.

- As such we should study some procedures which enable us to measure abstract concepts more accurately.
- This brings us to the study of scaling technique.

Meaning of Scaling:

- Scaling describes the procedures of assigning numbers to various degrees of opinion, attitude and other concepts.

- This is done by in two ways:

- Making a judgement about some charecteristic of an indisvidual and this placing him directly on a scale that has been defined in terms of that characteristics, and

- Constructing questionnaires in such away that the scores of individual's responses assign him a place on a scale.

- It may be stated that a scale is a continuum, consisting of the highest point (in terms of some characteristics e.g. preference, favourableness etc.) and the lowest point along with several intermediate points between these two extremes points.

- These scale points positions are so related to each other that when the first point happens to be the highest point, the second point indicate a higher degree in terms of a given characteristic as compared to the third point and so on.

- Thus, the term 'scaling' is applied to the procedures for attempting to determine quantitative measures of subjective abstract concepts.

- Scaling has been defined as a "procedure for the assignment of numbers to a property of objects in order to impart some of the characteristics of numbers to the properties in question.

Scale Classification Bases:

- The number assigning procedures or the scaling procedures may be broadly classified on the following basis:

(i) Subject orientation,

(ii) response form,

(iii) degree of subjectivity,

(iv) scale properties,

(v) number of dimensions, and

(vi) scale construction technique.

(i) Subject orientation:

- Under it a scale may be designed to measure characteristics of the respondent who completes it or to judge the stimulus object which is presented to the respondent.

- In respect of the farmer, we presume that the stimuli-presented are sufficiently homogeneous so that the between stimuli variation small compared to the variation among respondents.

- In the latter approach, we ask the respondent to judge some specific object in terms of one or more dimensions and we presume that the between respondent variation well be small as compared to the variation among the different stimuli presented to the respondents for judging.

(ii) Response form:

- Under this we may classify the scales as categorical and comparative.

- Categorical scales are also known as rating scales.

- These scales are used when respondent scores some object without direct reference to other objects.

- Under the comparative scales, which are also known as ranking scales, the respondent is asked to compare two or more objects.

- In this sense the respondent may state that one object is superior to the other. The essence of ranking is infact, a relative comparison of a certain property of two or more objects.

(iii) Degree of subjectivity:

- With this basis the scale data may be based on whether we measure subjective personal preferences or simply make non-preference judgements.

- In the former case, the respondent is asked to choose which person he favours or which solution he would like to see employed, whereas in the latter case he is simply asked to judge which person is more effective in some aspect or which solution will taken fewer resources without reflecting any personal preference.

(iv) Scale properties:

- Considering scale properties, one may classify the scales as nominal, ordinal, interval and ratio scales.

- Nominal scales merely classify without indicating order, distance or unique origin, ordinal scales indicate magnitude relationship of 'more than' or 'less than', but indicate no distance or unique origin. Interval scales have both order and distance values, no unique origin. Ratio scales posses all these features.

(v) Number of dimensions:

- In respect of this basis, scales can be classified as 'uni-dimensional' and 'multi- dimensional' scales under the former we measure only one attribute of the respondent or object; whereas multi dimensional scaling recognises the can object might be described better by using the concept of an attribute space of 'n' dimensions.

(vi) Scale of construction techniques:

- The scale of construction techniques can be developed by following methods:

(i) Arbitrary Approach:

- It is an approach where scale is developed on 'ad-hoc' basis.

- It is the most widely used approach.

- It is presumed that such scales measure the concepts for which they have been designed, although there is little evidence to support such an assumption.

(ii) Consensus Approach:

- Here a panel of judges evaluates the items chosen for inclusion in the instrument in terms of whether they are relevant to the topic area and unambiguous in approach.

(iii) Item Analysis Approach:

- Under it a number of individual items are developed into a test which is given to a group of respondent.

- After administering the test, the total scores are calculated for every one.

- Individual items are then analysed to determine which items discriminates between persons or objects with high total scores and those with low scores.

(iv) Cumulative Scales:

- Cumulative scales are chosen on the basis of their conforming to some ranking of items with ascending and descending discriminating power.

(v) Factor Scales:

- Factor scales may be constructed on the basis of items which indicate that a common factor accounts for the relationship between items.

- Thus relationship is typically measured through factor analysis method.

Construction of instrument

Instrumentation is the process of constructing research instruments that could be used appropriately in gathering data on the study. The questionnaire, interview and observation are the most commonly used tools in gathering data.

A research instrument is a tool used to obtain, measure, and analyze data from subjects around the research topic. You need to decide the instrument to use based on the type of study you are conducting: quantitative, qualitative, or mixed-method. For instance, for a quantitative study, you may decide to use a questionnaire, and for a qualitative study, you may choose to use a scale. While it helps to use an established instrument, as its efficacy is already established,

Validity and Reliability of instrument:

Validity and reliability are two important factors to consider when developing and testing any instrument (e.g., content assessment test, questionnaire) for use in a study. Attention to these considerations helps to insure the quality of your measurement and of the data collected for your study.

Understanding and Testing Validity

Validity refers to the degree to which an instrument accurately measures what it intends to measure. Three common types of validity for researchers and evaluators to consider are content, construct, and criterion validities.

- *Content validity* indicates the extent to which items adequately measure or represent the content of the property or trait that the researcher wishes to measure. Subject matter expert review is often a good first step in instrument development to assess content validity, in relation to the area or field you are studying.
- *Construct validity* indicates the extent to which a measurement method accurately represents a construct (e.g., a latent variable or phenomena that can't be measured directly, such as a person's attitude or belief) and produces an observation, distinct from that which is produced by a measure of another construct. Common methods to assess construct validity include, but are not limited to, *factor analysis, correlation tests, and item response theory models* (including Rasch model).
- *Criterion-related validity* indicates the extent to which the instrument's scores correlate with an external criterion (i.e., usually another measurement from a different instrument) either at present (*concurrent validity*) or in the future (*predictive validity*). A common measurement of this type of validity is the correlation coefficient between two measures.

Often times, when developing, modifying, and interpreting the validity of a given instrument, rather than view or test each type of validity individually, researchers and evaluators test for evidence of several different forms of validity, collectively.

Understanding and Testing Reliability

- Reliability refers to the degree to which an instrument yields consistent results. Common measures of reliability include internal consistency, test-retest, and inter-rater reliabilities.
- Internal consistency reliability looks at the consistency of the score of individual items on an instrument, with the scores of a set of items, or subscale, which typically consists of several items to measure a single construct. Cronbach's alpha is one of the most common methods for checking internal consistency reliability. Group variability, score reliability, number of items, sample sizes, and difficulty level of the instrument also can impact the Cronbach's alpha value.
- Test-retest measures the correlation between scores from one administration of an instrument to another, usually within an interval of 2 to 3 weeks. Unlike pre-post tests, no treatment occurs between the first and second administrations of the instrument, in order to test-retest reliability. A similar type of reliability called alternate forms, involves using slightly different forms or versions of an instrument to see if different versions yield consistent results.
- Inter-rater reliability checks the degree of agreement among raters (i.e., those completing items on an instrument). Common situations where more than one rater is involved may occur when more than one person conducts classroom observations, uses an observation protocol or scores an open-ended test, using a

rubric or other standard protocol. Kappa statistics, correlation coefficients, and intra-class correlation (ICC) coefficient are some of the commonly reported measures of inter-rater reliability.

UNIT III

DATA COLLECTION AND SAMPLING

Data – Primary and Secondary data – Sources - Data collection Methods – Observations, Survey, Interview, Projective Techniques and Questionnaire - Sampling – Probability and Non probability Sampling Techniques, Errors in sampling - Case Study.

Research Data

Introduction

Research data is, any information that has been collected, observed, generated or created to validate original research findings.

Although usually digital, research data also includes non-digital formats such as laboratory notebooks and diaries.

- Data is a set of values of subjects with respect to qualitative or quantitative variables.
- Data is raw, unorganized facts that need to be processed. Data can be something simple and seemingly random and useless until it is organized.

- When data is processed, organized, structured or presented in a given context so as to make it useful, it is called information.
- Information, necessary for research activities are achieved in different forms.

The main forms of the information available are:

1. Primary data
2. Secondary data
3. Cross-sectional data
4. Categorical data
5. Time Series Data

Primary Data

- Primary data is an original and unique data, which is directly collected by the researcher from a source according to his requirements.
- It is the data collected by the investigator himself or herself for a specific purpose.
- Data gathered by finding out first-hand the attitudes of a community towards health services, ascertaining the health needs of a community, evaluating a social program, determining the job satisfaction of the employees of an organization, and ascertaining the quality of service provided by a worker are the examples of primary data.

Secondary Data

- Secondary data refers to the data which has already been collected for a certain purpose and documented somewhere else.
- Data collected by someone else for some other purpose (but being utilized by the investigator for another purpose) is secondary data.

- Gathering information with the use of census data to obtain information on the age-sex structure of a population, the use of hospital records to find out the morbidity and mortality patterns of a community, the use of an organization's records to ascertain its activities, and the collection of data from sources such as articles, journals, magazines, books and periodicals to obtain historical and other types of information, are examples of secondary data.

Cross-Sectional Data

- Cross-sectional data is a type of data collected by observing many subjects (such as individuals, firms, countries, or regions) at the same point of time, or without regard to differences in time.
- It is the data for a single time point or single space point.
- This type of data is limited in that it cannot describe changes over time or cause and effect relationships in which one variable affects the other.

Categorical Data

- Categorical variables represent types of data which may be divided into groups. Examples of categorical variables are race, sex, age group, and educational level.
- The data, which cannot be measured numerically, is called as the categorical data. Categorical data is qualitative in nature.
- The categorical data is also known as attributes.
- A data set consisting of observation on a single characteristic is a univariate data set. A univariate data set is categorical if the individual observations are categorical responses.

Example of categorical data: Intelligence, Beauty, Literacy, Unemployment

Time-Series Data

- Time series data occurs wherever the same measurements are recorded on a regular basis.
- Quantities that represent or trace the values taken by a variable over a period such as a month, quarter, or year.
- The values of different phenomenon such as temperature, weight, population, etc. can be recorded over a different period of time.
- The values of the variable remain increasing or decreasing or constant.
- The data according to time periods is called time-series data. e.g. population in a different time period.

Spatial Data

- Also known as geospatial data or geographic information it is the data or information that identifies the geographic location of features and boundaries on Earth, such as natural or constructed features, oceans, and more.
- Spatial data is usually stored as coordinates and topology and is data that can be mapped.
- Spatial data is used in geographical information systems (GIS) and other geo location or positioning services.
- Spatial data consists of points, lines, polygons and other geographic and geometric data primitives, which can be mapped by location, stored with an object as metadata or used by a communication system to locate end-user devices.
- Spatial data may be classified as scalar or vector data. Each provides distinct information pertaining to geographical or spatial locations.

Ordered Data

- Data according to ordered categories is called as ordered data.

- Ordered data is similar to a categorical variable except that there is a clear ordering of the variables.
- For example for category economic status ordered data may be, low, medium and high.

Primary Data Vs. Secondary Data

In statistic analysis, collection of data plays a significant part. The method of collecting information is divided into two different sections, namely, primary data and secondary data. In this process, primary data is assembling of data or information for the first time, whereas, secondary data is the data that has been already gathered or collected by others.

The most important characteristics of primary data is it is original and first-hand, whereas, secondary data is the interpretation and analysis of the primary data.

What is primary data?

Primary data is the data collected for the first time through personal experiences or evidence, particularly for research. It is also described as raw data or first-hand information. The mode of assembling info is costly, as the analysis is done by an agency or an external organisation and needs human resources and investment. The investigator supervises and controls the data collection process directly.

Mostly the data is collected through observations, physical testing, mailed questionnaires, surveys, personal interviews, telephonic interviews, case studies and focus groups, etc.

What is secondary data?

Secondary data are second-hand data that is already collected and recorded by some researchers for their purpose and not for the current research problem. It is accessible in the form of data collected from different sources such as government publications, censuses, internal records of the organisation, books, journal articles, websites and reports, etc.

This method of gathering data is affordable, readily available, saves cost and time. However, the one disadvantage is that the information assembled is for some other purpose and may not meet the present research purpose or may not be accurate.

The Differences between primary data and secondary data are represented in a comparison format are as follows:

Primary Data	**Secondary Data**
Definition	
Primary data are those which are collected for the first time.	Secondary data refers to those data which have already been collected by some other person.
Originality	
Primary data is original because these are collected by the Investigator for the first time.	Secondary data are not original because someone else has collected these for his own purpose.
Nature of data	

Primary data are in the form of raw materials.	Secondary data are in the finished form.
Reliability and Suitability	
Primary data are more reliable and suitable for the enquiry because it is collected for a particular purpose.	It is less reliable and less suitable as someone else has collected the data which may not perfectly match our purpose.
Time and Money	
Collecting primary data is quite expensive both in time and money terms.	Secondary data requires less time and money so it is economical.
Precaution and Editing	
No particular precaution or editing is required while using primary data as these have been collected with a definite purpose.	Both precaution and editing are essential as secondary data were collected by someone else for his own purpose.

Data Collection Methods

DATA Collection Methods

To analyze and make decisions about a certain business, sales, etc., data will be collected. This collected data will help in making some conclusions about the performance of a particular business. Thus, data collection is essential to analyze the performance of a business unit, solving a problem and making assumptions

about specific things when required. Before going into the methods of data collection, let us understand what data collection is and how it helps in various fields.

What is Data Collection?

In Statistics, data collection is a process of gathering information from all the relevant sources to find a solution to the research problem. It helps to evaluate the outcome of the problem. The data collection methods allow a person to conclude an answer to the relevant question. Most of the organizations use data collection methods to make assumptions about future probabilities and trends. Once the data is collected, it is necessary to undergo the data organization process.

The main sources of the data collections methods are “Data”. Data can be classified into two types, namely primary data and secondary data. The primary importance of data collection in any research or business process is that it helps to determine many important things about the company, particularly the performance. So, the data collection process plays an important role in all the streams. Depending on the type of data, the data collection method is divided into two categories namely,

- Primary Data Collection methods
- Secondary Data Collection methods

The different types of data collection methods and their advantages and limitations are explained as follows,

Primary Data Collection Methods

Primary data or raw data is a type of information that is obtained directly from the first-hand source through experiments, surveys or observations. The primary data collection method is further classified into two types. They are

- Quantitative Data Collection Methods
- Qualitative Data Collection Methods

Let us discuss the different methods performed to collect the data under these two data collection methods.

Quantitative Data Collection Methods

It is based on mathematical calculations using various formats like close-ended questions, correlation and regression methods, mean, median or mode measures. This method is cheaper than qualitative data collection methods and it can be applied in a short duration of time.

Qualitative Data Collection Methods

It does not involve any mathematical calculations. This method is closely associated with elements that are not quantifiable. This qualitative data collection method includes interviews, questionnaires, observations, case studies, etc. There are several methods to collect this type of data. They are

Observation Method

Observation method is used when the study relates to behavioural science. This method is planned systematically. It is subject to many controls and checks. The different types of observations are:

- Structured and unstructured observation
- Controlled and uncontrolled observation

- Participant, non-participant and disguised observation

Interview Method

The method of collecting data in terms of oral or verbal responses. It is achieved in two ways, such as

Personal Interview – In this method, a person known as an interviewer is required to ask questions face to face to the other person. The personal interview can be structured or unstructured, direct investigation, focused conversation, etc.

- **Telephonic Interview** – In this method, an interviewer obtains information by contacting people on the telephone to ask the questions or views orally.

Questionnaire Method

In this method, the set of questions are mailed to the respondent. They should read, reply and subsequently return the questionnaire. The questions are printed in the definite order on the form. A good survey should have the following features:

- Short and simple
- Should follow a logical sequence
- Provide adequate space for answers
- Avoid technical terms
- Should have good physical appearance such as colour, quality of the paper to attract the attention of the respondent

Schedules

This method is similar to the questionnaire method with a slight difference. The enumerations are specially appointed for the purpose of filling the schedules. It explains the aims and objects of the investigation and may remove

misunderstandings, if any have come up. Enumerators should be trained to perform their job with hard work and patience.

Secondary Data Collection Methods

Secondary data is data collected by someone other than the actual user. It means that the information is already available, and someone analyses it. The secondary data includes magazines, newspapers, books, journals, etc. It may be either published data or unpublished data.

Published data are available in various resources including

- Government publications
- Public records
- Historical and statistical documents
- Business documents
- Technical and trade journals

Unpublished data includes

- Diaries
- Letters
- Unpublished biographies, etc.

<u>Survey Vs Observation</u>

Survey Data: Definition

Survey data is defined as the resultant data that is collected from a sample of respondents that took a survey. This data is comprehensive information gathered

from a target audience about a specific topic to conduct research. There are many methods used for survey data collection and statistical analysis.

Various mediums are used to collect feedback and opinions from the desired sample of individuals. While conducting survey research, researchers prefer multiple sources to gather data such as online surveys, telephonic surveys, face-to-face surveys, etc. The medium of collecting survey data decides the sample of people that are to be reached out to, to reach the requisite number of survey responses.

Factors of collecting survey data such as how the interviewer will contact the respondent (online or offline), how the information is communicated to the respondents etc. decide the effectiveness of gathered data.

Types of survey data based on deployment methods:

There are four main survey data collection methods – Telephonic Surveys, Face-to-face Surveys, and Online Surveys.

- **Online Surveys**

Online surveys are the most cost-effective and can reach the maximum number of people in comparison to the other mediums. The performance of these surveys is much more widespread than the other data collection methods. In situations where there is more than one question to be asked to the target sample, certain researchers prefer conducting online surveys over the traditional face-to-face or telephone surveys.

Online surveys are effective and therefore require computational logic and branching technologies for exponentially more accurate survey data collection vs

any other traditional means of surveying. They are straightforward in their implementation and take a minimum time of the respondents. The investment required for survey data collection using online surveys is also negligible in comparison to the other methods. The results are collected in real-time for researchers to analyze and decide corrective measures.

- **Face-to-face Surveys**

Gaining information from respondents via face-to-face mediums is much more effective than the other mediums because respondents usually tend to trust the surveyors and provide honest and clear feedback about the subject in-hand.

Researchers can easily identify whether their respondents are uncomfortable with the asked questions and can be extremely productive in case there are sensitive topics involved in the discussion. This online data collection method demands more cost-investment than in comparison to the other methods. According to the geographic or psychographic segmentation, researchers must be trained to gain accurate information.

- **Telephone Surveys**

Telephone surveys require much lesser investment than face-to-face surveys. Depending on the required reach, telephone surveys cost as much or a little more than online surveys. Contacting respondents via the telephonic medium requires less effort and manpower than the face-to-face survey medium.

If interviewers are located at the same place, they can cross-check their questions to ensure error-free questions are asked to the target audience. The main drawback of conducting telephone surveys is that establishing a friendly equation with the respondent becomes challenging due to the bridge of the medium. Respondents are

also highly likely to choose to remain anonymous in their feedback over the phone as the reliability associated with the researcher can be questioned.

- **Paper Surveys**

The other commonly used survey method is paper surveys. These surveys can be used where laptops, computers, and tablets cannot go, and hence they use the age-old method of data collection; pen and paper. This method helps collect survey data in field research and helps strengthen the number of responses collected and the validity of these responses.

A popular example or use case of a paper survey is a fast food restaurant survey where the fast-food chain would like to collect feedback on the dining experience of its patrons.

Observation Methods of Data Collection

Definition, Types, Examples, Advantages

The observation method is described as a method to observe and describe the behavior of a subject. As the name suggests, it is a way of collecting relevant information and data by observing. It is also referred to as a participatory study because the researcher has to establish a link with the respondent and for this has to immerse himself in the same setting as theirs. Only then can he use the observation method to record and take notes.

Observation method is used in cases where you want to avoid an error that can be a result of bias during evaluation and interpretation processes. It is a way to obtain objective data by watching a participant and recording it for analysis at a later stage.

A researcher can use the observation method in a Montessori school and record the behavior of the children at a young age. Are the children comfortable sharing their tiffin at such an early age will make a good study for the researcher? In this example, the researcher can observe and record the details objectively. Observation data collection method is associated with a few ethical issues as it needs the full consent of a research participant.

Observation method in data collection can be

- **Structured observation method** – This is a systematic observation method where data is collected as per a pre-defined schedule. The specific variable is used in this method for data collection.
- **Unstructured observation method** – The unstructured observation method is conducted in a free and open manner without using any pre-determined objectives, schedules or variables.

Types of observation method:

1) Controlled observations

The controlled observation is carried out in a closed space. It is the researcher who has the authority to decide the place and the time where and when the observation will take place. He also decides who the participants will be and in what circumstances will he use the standardized process.

The participants are chosen for a variable group randomly. The researcher observes and records a detailed and descriptive data of behavior and divides it into a distinct category. Sometimes the researcher codes the action as per an agreed scale by using a behavior schedule. The coding can include letters or numbers or a range to measure behavior intensity and describe its characteristics.

Advantages of controlled observation method

1. The data and information received from a controlled observation method are structured and analytical. It is thus easy to analyze it quickly and is considered less time-consuming than the other observation methods
2. Other researchers can easily replicate the report that has been created through the controlled observation method. They use a similar observation schedule, and this makes it easy to test for reliability.
3. As the controlled observation method is several quick observations can be conducted within a short time frame. Thus the researcher can collect large samples which makes it easier for him to generalize a large population

Limitations of controlled observation method

1. The controlled observation method lacks validity because when the participants are aware of being observed their behavior will automatically change

2) Naturalistic observations

Social scientists and psychologists generally use the naturalistic observation method. The process involves observing and studying the spontaneous behavior of the participants in open or natural surroundings. The role of the researcher is to find and record whatever he can see and observe in natural habitat.

Advantages of naturalistic observation method

1. When a participant is in a natural habitat, his flow of behavior is natural and not forced.
2. The studies have gained better ecological validity than the controlled observation method

3. The naturalistic observation method is used by the researchers to create new ideas. The researcher has the chance to observe the total situation and can find avenues that other people have not thought about

Limitations of naturalistic observation methods

1. The naturalistic observation method facilitates observations on a micro-scale. It often lacks a representative sample and thus cannot help the researcher in making a generalization that relates to a broader society
2. In this type of observation method, the researcher needs proper training to recognize aspects that are significant and worth attention.
3. The observations through naturalistic observation method are not as reliable as the researcher wants them to be because it is not possible to control some variables. This is why other researchers cannot similarly repeat the study or research.
4. Establishing the cause and effect relationship is not possible because the researcher cannot manipulate the variables

3) Participant observations

The participant observation method is often considered a variant of the naturalistic observation method because it has some similarities with it. The point of difference is that the researcher is not a distant observer anymore because he has joined the participants and become a part of their group. He does this to get a more in-depth and greater insight into their lives.

The researcher interacts with other members of the group freely, participates in their activities, studies their behavior and acquires a different way of life. Participant observation can be overt or covert.

1. **Overt** –When the researcher asks permission from a group to mingle the observation method is known as overt. He does so by revealing his true purpose and real identity to the group with whom he wants to mingle
2. **Covert**– When the researcher does not show either his true identity or real meaning to the group he wants to join then the observation is known as covert. He keeps both concealed and takes on a false role and identity to enter and mingle in the group. He generally acts as if he is a genuine member of that group

Advantages of Participant Observation methods

1. It is easy to study and observe the natural behavior of the participants in the group by becoming a part of that group. The respondents generally do not know that they are being observed and behavior recorded, so they are not restrained or constrained in their activities and behavior
2. The researcher becomes understanding by following the events of the respondents from such a close angle.
3. During the participant observation method, the researcher develops a good and healthy relationship with the respondents. This rapport helps him to participate in all the activities and make observations with a detached mind
4. The participant observation method helps the research to observe the actual behavior of the respondents and create an inclusive and intensive case study of that group
5. Actual participation in the activities provides the researcher with an opportunity to converse freely with other members about various events, their meaning and their importance to them. He gains an in-depth knowledge which would not have been possible only by observation.

Limitations of Participant Observation methods

1. It is challenging to work undercover. For example, the researcher will have only to observe and not record in front of others because he will not want to blow his cover. He relies heavily on his memory which can be faulty at times
2. Sometimes the researcher becomes too involved in the intricacies of that group. There is a higher chance of losing his objectivity because his reporting will be selective and dependent on his memory
3. The emotional participation of the researcher can result in bias interpretation. He will be influenced to some degree and a time might come when he would start supporting them unconditionally because their views and behavior will ultimately become his. This will result in a personal viewpoint of the scenario and not an objective or scientific report
4. In the participant observation method, the researcher's experience becomes intense because of his proximity to the group members but the range becomes limited
5. The researcher misses many vital points because of his familiarity
6. Proximity with the group will involve him in group factionalism, and he will have to take sides. He then loses his objectivity as an impartial observer with whom everyone is ready to cooperate.

Experimental Methods:

Experimentation is the best known way to test the veracity of scientific theories, eliminate alternative explanations, engineer novel solutions to practical problems, and provide clues to causal inference.

An experiment is a data collection method where you as a researcher change some variables and observe their effect on other variables. The variables that you

manipulate are referred to as **independent** while the variables that change as a result of manipulation are **dependent** variables. Imagine a manufacturer is testing the effect of drug strength on number of bacteria in the body. The company decides to test drug strength at 10mg, 20mg and 40mg. In this example, drug strength is the independent variable while number of bacteria is the dependent variable. The drug administered is the treatment, while 10mg, 20mg and 40mg are the levels of the treatment.

The greatest advantage of using an experiment is that you can explore causal relationships that an observational study cannot. Additionally, experimental research can be adapted to different fields like medical research, agriculture, sociology, and psychology. Nevertheless, experiments have the disadvantage of being expensive and requiring a lot of time.

Experimental research is a scientific approach to research, where one or more independent variables are manipulated and applied to one or more dependent variables to measure their effect on the latter. The effect of the independent variables on the dependent variables is usually observed and recorded over some time, to aid researchers in drawing a reasonable conclusion regarding the relationship between these 2 variable types.

The experimental research method is widely used in physical and social sciences, psychology, and education. It is based on the comparison between two or more groups with a straightforward logic, which may, however, be difficult to execute.

Mostly related to a laboratory test procedure, experimental research designs involve collecting quantitative data and performing statistical analysis on them during research. Therefore, making it an example of quantitative research method.

What are The Types of Experimental Research Design?

The types of experimental research design are determined by the way the researcher assigns subjects to different conditions and groups. They are of 3 types, namely; pre-experimental, quasi-experimental, and true experimental research.

Pre-experimental Research Design

In pre-experimental research design, either a group or various dependent groups are observed for the effect of the application of an independent variable which is presumed to cause change. It is the simplest form of experimental research design and is treated with no control group.

Although very practical, experimental research is lacking in several areas of the true-experimental criteria. The pre-experimental research design is further divided into three types

ne-shot Case Study Research Design

In this type of experimental study, only one dependent group or variable is considered. The study is carried out after some treatment which was presumed to cause change, making it a posttest study.

One-group Pretest-posttest Research Design:

This research design combines both posttest and pretest study by carrying out a test on a single group before the treatment is administered and after the treatment is administered. With the former being administered at the beginning of treatment and later at the end.

Static-group Comparison:

In a static-group comparison study, 2 or more groups are placed under observation, where only one of the groups is subjected to some treatment while the other groups are held static. All the groups are post-tested, and the observed differences between the groups are assumed to be a result of the treatment.

Quasi-experimental Research Design

The word "quasi" means partial, half, or pseudo. Therefore, the quasi-experimental research bearing a resemblance to the true experimental research, but not the same. In quasi-experiments, the participants are not randomly assigned, and as such, they are used in settings where randomization is difficult or impossible.

This is very common in educational research, where administrators are unwilling to allow the random selection of students for experimental samples.

Some examples of quasi-experimental research design include; the time series, no equivalent control group design, and the counterbalanced design.

True Experimental Research Design

The true experimental research design relies on statistical analysis to approve or disprove a hypothesis. It is the most accurate type of experimental design and may be carried out with or without a pretest on at least 2 randomly assigned dependent subjects.

The true experimental research design must contain a control group, a variable that can be manipulated by the researcher, and the distribution must be random. The classification of true experimental design include:

The posttest-only Control Group Design: In this design, subjects are randomly selected and assigned to the 2 groups (control and experimental), and only the

experimental group is treated. After close observation, both groups are post-tested, and a conclusion is drawn from the difference between these groups.

The pretest-posttest Control Group Design: For this control group design, subjects are randomly assigned to the 2 groups, both are presented, but only the experimental group is treated. After close observation, both groups are post-tested to measure the degree of change in each group.

Solomon four-group Design: This is the combination of the pretest-only and the pretest-posttest control groups. In this case, the randomly selected subjects are placed into 4 groups.

The first two of these groups are tested using the posttest-only method, while the other two are tested using the pretest-posttest method.

Examples of Experimental Research

Experimental research examples are different, depending on the type of experimental research design that is being considered. The most basic example of experimental research is laboratory experiments, which may differ in nature depending on the subject of research.

Administering Exams After The End of Semester

During the semester, students in a class are lectured on particular courses and an exam is administered at the end of the semester. In this case, the students are the subjects or dependent variables while the lectures are the independent variables treated on the subjects.

Only one group of carefully selected subjects are considered in this research, making it a pre-experimental research design example. We will also notice that tests are only carried out at the end of the semester, and not at the beginning.

Further making it easy for us to conclude that it is a one-shot case study research.

Employee Skill Evaluation

Before employing a job seeker, organizations conduct tests that are used to screen out less qualified candidates from the pool of qualified applicants. This way, organizations can determine an employee's skill set at the point of employment.

In the course of employment, organizations also carry out employee training to improve employee productivity and generally grow the organization. Further evaluation is carried out at the end of each training to test the impact of the training on employee skills, and test for improvement.

Here, the subject is the employee, while the treatment is the training conducted. This is a pretest-posttest control group experimental research example.

Evaluation of Teaching Method

Let us consider an academic institution that wants to evaluate the teaching method of 2 teachers to determine which is best. Imagine a case whereby the students assigned to each teacher is carefully selected probably due to personal request by parents or due to stubbornness and smartness.

This is a no equivalent group design example because the samples are not equal. By evaluating the effectiveness of each teacher's teaching method this way, we may conclude after a post-test has been carried out.

However, this may be influenced by factors like the natural sweetness of a student. For example, a very smart student will grab more easily than his or her peers irrespective of the method of teaching.

What are the Characteristics of Experimental Research?

Variables

Experimental research contains dependent, independent and extraneous variables. The dependent variables are the variables being treated or manipulated and are sometimes called the subject of the research.

The independent variables are the experimental treatment being exerted on the dependent variables. Extraneous variables, on the other hand, are other factors affecting the experiment that may also contribute to the change.

Setting

The setting is where the experiment is carried out. Many experiments are carried out in the laboratory, where control can be exerted on the extraneous variables, thereby eliminating them.

Other experiments are carried out in a less controllable setting. The choice of setting used in research depends on the nature of the experiment being carried out.

Multivariable

Experimental research may include multiple independent variables, e.g. time, skills, test scores, etc.

What are the Disadvantages of Experimental Research?

- It is highly prone to human error due to its dependency on variable control which may not be properly implemented. These errors could eliminate the validity of the experiment and the research being conducted.
- Exerting control of extraneous variables may create unrealistic situations. Eliminating real-life variables will result in inaccurate conclusions. This may also result in researchers controlling the variables to suit his or her personal preferences.
- It is a time-consuming process. So much time is spent on testing dependent variables and waiting for the effect of the manipulation of dependent variables to manifest.
- It is expensive.
- It is very risky and may have ethical complications that cannot be ignored. This is common in medical research, where failed trials may lead to a patient's death or a deteriorating health condition.
- Experimental research results are not descriptive.
- Response bias can also be supplied by the subject of the conversation.
- Human responses in experimental research can be difficult to measure.

Differences between Experimental and Non-Experimental Research

- In experimental research, the researcher can control and manipulate the environment of the research, including the predictor variable which can be changed. On the other hand, non-experimental research cannot be controlled or manipulated by the researcher at will.
- This is because it takes place in a real-life setting, where extraneous variables cannot be eliminated. Therefore, it is more difficult to conclude

non-experimental studies, even though they are much more flexible and allow for a greater range of study fields.

- The relationship between cause and effect cannot be established in non-experimental research, while it can be established in experimental research. This may be because many extraneous variables also influence the changes in the research subject, making it difficult to point at a particular variable as the cause of a particular change
- Independent variables are not introduced, withdrawn or manipulated in non-experimental designs, but the same may not be said about experimental research.

Construction of questionnaires and instrument

- A **questionnaire** is defined as a document containing questions and other types of items designed to solicit information appropriate for analysis.
- The questionnaire may be regarded as a form of an interview on paper.
- Procedure for the construction of a questionnaire follows a pattern similar to that of the interview schedule.
- However, because the questionnaire is impersonal it is all the more important to take care of its construction.
- Since there is no interviewer to explain ambiguities or to check misunderstandings, the questionnaire must be especially clear in its working.
- The variety of possible answers to each question must be anticipated more fully than for an interview.

- **The Essentials of the Questionnaire Construction**

- Questionnaire design is a very crucial and important part of the research because an inappropriate questionnaire misleads the research, academics, and policymaking.
- Therefore, a set of adequate and appropriate questions in a sequential order is required in a questionnaire.
- The format of the questionnaire mostly depends on the type of questionnaire used.

- **Types of Questionnaire**

There are roughly two types of questionnaires, structured and unstructured. A mixture of these both is the quasi-structured questionnaire that is used mostly in social science research.

- **Structured questionnaires** include pre-coded questions with well-defined skipping patterns to follow the sequence of questions. Most of the quantitative data collection operations use structured questionnaires. Fewer discrepancies, easy to administer consistency in answers and easy for the data management are advantages of such structured questionnaires.
- **Unstructured questionnaires** include open-ended and vague opinion-type questions. Maybe questions are not in the format of interrogative sentences and the moderator or the enumerator has to elaborate the sense of the question. Focus group discussions use such a questionnaire.
- Not all questions are easily pre-coded with almost possible alternatives to answers. Given answer alternatives of some questions in the standard questionnaires are left as ‘others’ (please specify). A common and pragmatic practice is that most of the questions are structured, however, it is comfortable to have some unstructured questions whose answers are not feasible to

enumerate completely. Such a type of questionnaire is called a **quasi-structured questionnaire**.

- **The Format of Questionnaire**

Size:

- It should be smaller in size than that of the schedule.
- The extent in length and breadth should be appropriate.
- It should not be more than two or three pages as to the nature of the research.

Appearance:

- It should be constructed on a good quality paper and printing.
- It should have an attractive layout.

Clarity:

- The questions should be short, clear in terms, tenure, and expression.

Sequence:

- The question should be arranged according to the importance and preference.

Communicability:

- The questions of the questionnaire should be able to keep the interest of the respondents

Span:

- The length of the questions of the questionnaire should be as short as possible.
- The questionnaire should not be long in length.

Question Types in a Questionnaire

The questions asked can take two forms:

- **Restricted questions**, also called closed-ended, are the ones that ask the respondent to make choices — yes or no, check items on a list, or select from multiple choice answers.

Restricted questions are easy to tabulate and compile.

- **Unrestricted questions** are open-ended and allow respondents to share feelings and opinions that are important to them about the matter at hand.

Unrestricted questions are not easy to tabulate and compile, but they allow respondents to reveal the depth of their emotions.

- If the objective is to compile data from all respondents, then sticking with restricted questions that are easily quantified is better.
- If degrees of emotions or depth of sentiment are to be studied, then develop a scale to quantify those feelings.

Characteristics of Good Questions in a Questionnaire

General rules of question crafting:

- Clear objective
- Simple language
- Clear concepts
- Without bias
- Adequate answer options
- Shorter questions
- The single question at a time
- Affirmative sentences
- Mathematics not imposed
- Short/clear reference periods
- Avoid question reference

Question Types to be avoided in a Questionnaire

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1. **Question without objective**

- Each question should have an objective.

Example:

The proposed research is to assess the knowledge of respondents on sexually transmitted diseases. If the proposed analytical framework has no consideration of the educational (by discipline) background of the respondent it is futile to ask: "Which subject did you study at university before you joined the recent job?"

2. **Complex language**

- The language of the questionnaire should not be complicated to understand. The vocabulary of the respondents should be used in the questionnaire.
- A simple language is preferred. The use of rhetorical and elite language creates problems while the questionnaire is administered.

Example:

Did you realize the complexities of life in a different way by the behavior of your spouse when you were tested positive with HIV/AIDS? Instead, the questions like Do your spouse knows about your HIV positive? (If Yes, Do you find a change in his/her behavior? If Yes, What kind)

3. **Ambiguous concepts**

- Ambiguous concepts should not be incorporated into the questions.

Example: What is your opinion about some medical researches that pledge for the high prevalence of transmission of HIV among the elite group of Nepal after the restoration of a multiparty system? This question has three major elements as medical research, HIV transmission, and restoration of multiparty democracy. Elite group and high prevalence are other minor elements. Respondent would not be able to correctly form his/her opinion.

4. **Reference of previous questions**

It is extremely not suggested to ask the questions like "As I asked in Question number 12 above about ….. ". If reference or cue of previous questions is required to recall the answer of respondents by stating full questions and answers to continue the further interview.

5. **Longer and vague reference periods**

Reference periods should be clear and preferably shorter. Longer reference period causes recall lapse errors. These errors mislead the research.

For example, after the year of a greater earthquake or in these ten years how many times did you visit the health post for antenatal check-ups? Instead ” How many times did you visit health post for a check-up during the period of your last pregnancy (or three months)?

6. **Questions with calculations**

- As far as possible, avoid all calculation seeking questions. Respondents do hesitate to calculate and there is always the possibility of receiving wrong answers.
- Respondents who can not calculate also give wrong answers to hide their ignorance and who can, they also have a tendency of wrong calculation to exhibit their confidence in calculations.

Example: What percent of your income is spent on the treatment? Instead, use “What is your monthly income?” as a preceding question of “How much do you spend in your treatment?” and calculation should be performed in the data processing and analysis phase.

- Do not give strains to the respondents.

7. **Double negative (Double-barrelled)**

- Double negatives must be avoided in the language of the question.
- Double negative gives positive meaning but sounds like negation to the statement. It also creates confusion for the interviewers and respondents.

Example: “Do not you want to move from this place not to expose yourself?” Instead, “Do you want to move from this place to hide?” would be better.

8. **Two in one Questions**

- Merging of two questions into one should be completely avoided.

- Such merging often confuses the respondent and according to the cognitive capacity, some respondents serve answers to the latter and some to the former.
- No, all respondents provide answers to both parts.

Example: When did you visit your spouse and how many nights did you spend there? There are clearly 2 questions and they are to be segregated.

9. **Leading and embarrassing questions (Wording, Leading and threatening)**

- Leading and embarrassing questing should be biased.
- People feel offensive to answer these questions.
- Such questions also lead towards biased answers, therefore these are to be avoided.

Example: Don't you agree that persons with HIV positive have also rights to marry? Or suppose, you are suffering from HIV positive, should not you have the right to marry? Such types of questions insist the respondent provide answers that match the positive or negative tone of the question itself.

Sampling plan – Sample size

Definition:

A sampling plan is a term widely used in research studies that provide an outline on the basis of which research is conducted. It tells which category is to be surveyed, what should be the sample size and how the respondents should be chosen out of the population.

Sampling plan is a base from which the research starts and includes the following three major decisions:

1. What should be the **Sampling unit** i.e. choosing the category of the population to be surveyed is the first and the foremost decision in a sampling plan that initiates the research.

   e.g. In the case of Banking industry, should the sampling unit consist of current account holders, saving account holders, or both? Should it include male or female account holders? These decisions once made the then sampling frame is designed to give everyone in the target population equal chance of being sampled.
2. The second decision in sampling plan is determining the **size of the sample** i.e. how many objects in the sample is to be surveyed. Generally, "*the larger the sample size, the more is the reliability"* and therefore, researchers try to cover as many samples as possible.
3. The final decision that completes the sampling plan is selecting the **sampling procedure** i.e**.** which method can be used such that every object in the population has an equal chance of being selected. Generally, the researchers use the probability sampling to determine the objects to be chosen as these represents the sample more accurately.

- Following are the probability samples:
- **Simple Random Sample**– where every item of the sample has an equal chance of getting selected.

- **Stratified Sample**– In this, the population is divided into mutually exclusive groups viz. age group and then the choice is made randomly from each group.
- **Cluster Sample**– It is also called area sampling, here the population is divided on the basis of location viz. city and then selected randomly.

In case the researcher finds probability samples to be costly and time-consuming then the researcher can make use of non-probability samples **which means by choice**.

Following are the non-probability samples:

- **Convenience Sample**– Here, the researcher selects the easiest and accessible population member.
- **Judgment Sample**-Here, the researcher select those members of the population whom he thinks to contribute the accurate information.
- **Quota sample**-Here, the researcher interviews the fixed number of members of each category.

Thus, a researcher can select any type of sample according to his convenience provided it fulfills the purpose for which the research is conducted.

Sample size

The sample size is a term used in market research for defining the number of subjects included in a sample size. By sample size, we understand a group of subjects that are selected from the general population and is considered a representative of the real population for that specific study.

For example, if we want to predict how the population in a specific age group will react to a new product, we can first test it on a sample size that is representative of the targeted population. The sample size, in this case, will be given by the number of people in that age group that will be surveyed.

Calculation of sample size

The use of statistical formulas for determining the sample size implies, first of all, the choice of a significant benchmark for the measures to be made based on the results provided by the qualitative research to be performed, usually, the researcher has, in this sense, two alternatives:
It can monitor the measurement of variables and determine specific indicators that express their evolution. Thus, the researcher can follow the determination of the frequency of visit of a commercial unit and the appropriate indicator describing this variable to be the weekly average frequency of visiting the group in question, in the specialized literature, the choice of this alternative is designated under the concept of sampling in relation to the variables investigated.

It may be aimed at evaluating specific attributes of the investigated marketing phenomenon. For example, the researcher may pursue the identification of consumers' preferences for the interior arrangement of a commercial unit, this evaluating a set of representative attributes for the interior design, in the specialized literature, the choice of this alternative is designated under the sampling concept with the investigated characteristics.

Sample size formula is:

N = population size • e = Margin of error (percentage in decimal form) • z = z-score

Another sample size formula is:

$n = N*X / (X + N – 1)$,

where,

$X = Z\alpha/22 *p*(1-p) / MOE2$,

and $Z\alpha/2$ is the critical value of the Normal distribution at $\alpha/2$ (for a confidence level of 95%, α is 0.05 and the critical value is 1.96), MOE is the margin of error, p is the sample proportion, and N is the population size. Note that a Finite Population Correction has been applied to the sample size formula.

Sample size process

The sampling size process involves several specific activities, namely:

* defining the population that is the object of the research;

* choosing the sampling size frame;

* choosing the sampling size method;

* establishing the modalities of the selection of the sample size units;

* determining the mother of the sample size;

* choosing the actual units of the sample size;

* conducting field activity.

Defining the target population must be done with great care to avoid either the tendency to choose an unjustified large population or the inclination to select an unjustifiably narrow population. For example, for companies that produce cars, the

total population can be represented by the people of the whole country, including children of different ages.

But, the relevant population, which will be the subject of the research, will be made up only of the population over 18 years old. No unjustifiably restricted population such as, for example, the male population between the ages of 25 and 50 can be admitted. This can cover a large part of the car market but excludes some essential segments.

In practice, in the case of random sampling, the sample will be chosen from a list of the population that often differs, to some extent, from the population that is the subject of the research. This list represents the sampling frame or the sampling base because it contains the elements from which the sample is to be constituted.

The establishment of the sample implies the establishment of the sampling unit. The sampling unit is represented by a distinct element or a group of different elements within the investigated population, which can be selected to form the sample. The sampling unit may be a person, a family, a household, a company or a company, a locality, etc. It is necessary to specify that the sampling unit is not always identical with the unit of analysis. For example, in the study of family expenses, the sampling unit may be the home or the household, and the unit of analysis may be a person or a family.

Determinants optimal sample size

The sample size is a term used in market research for defining the number of subjects included in a sample size. By sample size, we understand a group of subjects that are selected from the general population and is considered a representative of the real population for that specific study.

For example, if we want to predict how the population in a specific age group will react to a new product, we can first test it on a sample size that is representative of the targeted population. The sample size, in this case, will be given by the number of people in that age group that will be surveyed.

Calculation of sample size

The use of statistical formulas for determining the sample size implies, first of all, the choice of a significant benchmark for the measures to be made based on the results provided by the qualitative research to be performed, usually, the researcher has, in this sense, two alternatives:
It can monitor the measurement of variables and determine specific indicators that express their evolution. Thus, the researcher can follow the determination of the frequency of visit of a commercial unit and the appropriate indicator describing this variable to be the weekly average frequency of visiting the group in question, in the specialized literature, the choice of this alternative is designated under the concept of sampling in relation to the variables investigated.

It may be aimed at evaluating specific attributes of the investigated marketing phenomenon. For example, the researcher may pursue the identification of consumers' preferences for the interior arrangement of a commercial unit, this evaluating a set of representative attributes for the interior design, in the specialized literature, the choice of this alternative is designated under the sampling concept with the investigated characteristics.

Sample size formula is:

N = population size • e = Margin of error (percentage in decimal form) • z = z-score

Another sample size formula is:

$n = N*X / (X + N – 1)$,

where,

$X = Z\alpha/22 *p*(1-p) / MOE2$,

and $Z\alpha/2$ is the critical value of the Normal distribution at $\alpha/2$ (for a confidence level of 95%, α is 0.05 and the critical value is 1.96), MOE is the margin of error, p is the sample proportion, and N is the population size. Note that a Finite Population Correction has been applied to the sample size formula.

Sample size process

The sampling size process involves several specific activities, namely:

* defining the population that is the object of the research;

* choosing the sampling size frame;

* choosing the sampling size method;

* establishing the modalities of the selection of the sample size units;

* determining the mother of the sample size;

* choosing the actual units of the sample size;

* conducting field activity.

Defining the target population must be done with great care to avoid either the tendency to choose an unjustified large population or the inclination to select an unjustifiably narrow population. For example, for companies that produce cars, the

total population can be represented by the people of the whole country, including children of different ages.

But, the relevant population, which will be the subject of the research, will be made up only of the population over 18 years old. No unjustifiably restricted population such as, for example, the male population between the ages of 25 and 50 can be admitted. This can cover a large part of the car market but excludes some essential segments.

In practice, in the case of random sampling, the sample will be chosen from a list of the population that often differs, to some extent, from the population that is the subject of the research. This list represents the sampling frame or the sampling base because it contains the elements from which the sample is to be constituted.

The establishment of the sample implies the establishment of the sampling unit. The sampling unit is represented by a distinct element or a group of different elements within the investigated population, which can be selected to form the sample. The sampling unit may be a person, a family, a household, a company or a company, a locality, etc. It is necessary to specify that the sampling unit is not always identical with the unit of analysis. For example, in the study of family expenses, the sampling unit may be the home or the household, and the unit of analysis may be a person or a family.

Why is it important to determine the sample size?

Are you ready to survey your research target? Research surveys help you gain insights from your target audience. The data you collect gives you insights to meet customer needs, leading to increased sales and customer loyalty. Sample size

calculation and determination are imperative to the researcher to determine the right number of respondents, keeping in mind the research study's quality.

So, how should you determine the sample size? How do you know who should get your survey? How do you decide on the number of the target audience?

Sending out too many surveys can be expensive without giving you a definitive advantage over a smaller sample. But if you send out too few, you won't have enough data to draw accurate conclusions. Knowing how to calculate and determine sample size accurately can give you an edge over your competitors. Let's take a look at what a good sample includes. Also, let's look at the sample size calculation formula so you can determine the perfect sample size for your next survey.

What are the terms used around the sample size?

Before we jump into sample size determination, let's take a look at the terms you should know:

1. **Population size:** Population size is how many people fit your demographic. For example, you want to get information on doctors residing in North America. Your population size is the total number of doctors in North America. Don't worry! Your population size doesn't always have to be that big. Smaller population sizes can still give you accurate results as long as you know who you're trying to represent.
2. **Confidence level:** Confidence level tells you how sure you can be that your data is accurate. It is expressed as a percentage and aligned to the confidence interval. For example, if your confidence level is 90%, your results will most likely be 90% accurate.

3. **The margin of error (confidence interval):** When it comes to surveys, there's no way to be 100% accurate. Confidence intervals tell you how far off from the population means you're willing to allow your data to fall. A margin of error describes how close you can reasonably expect a survey result to fall relative to the real population value. Remember, if you need help with this information you can use our margin of error calculator.
4. **Standard deviation:** Standard deviation is the measure of the dispersion of a data set from its mean. It measures the absolute variability of a distribution. The higher the dispersion or variability, the greater the standard deviation and the greater the magnitude of the deviation. For example, you have already sent out your survey. How much variance do you expect in your responses? That variation in response is the standard of deviation.

Sampling Techniques:

An introduction to sampling methods

When you conduct research about a group of people, it's rarely possible to collect data from every person in that group. Instead, you select a sample. The sample is the group of individuals who will actually participate in the research.

To draw valid conclusions from your results, you have to carefully decide how you will select a sample that is representative of the group as a whole. There are two types of sampling methods:

- **Probability sampling** involves random selection, allowing you to make strong statistical inferences about the whole group.

- **Non-probability sampling** involves non-random selection based on convenience or other criteria, allowing you to easily collect data.

You should clearly explain how you selected your sample in the methodology section of your paper or thesis.

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Population vs sample

First, you need to understand the difference between a population and a sample, and identify the target population of your research.

- The **population** is the entire group that you want to draw conclusions about.
- The **sample** is the specific group of individuals that you will collect data from.

The population can be defined in terms of geographical location, age, income, and many other characteristics.

It can be very broad or quite narrow: maybe you want to make inferences about the whole adult population of your country; maybe your research focuses on customers of a certain company, patients with a specific health condition, or students in a single school.

It is important to carefully define your target population according to the purpose and practicalities of your project.

If the population is very large, demographically mixed, and geographically dispersed, it might be difficult to gain access to a representative sample.

Sampling frame

The sampling frame is the actual list of individuals that the sample will be drawn from. Ideally, it should include the entire target population (and nobody who is not part of that population).

Example
You are doing research on working conditions at Company X. Your population is all 1000 employees of the company. Your sampling frame is the company's HR database which lists the names and contact details of every employee.

Sample size

The number of individuals you should include in your sample depends on various factors, including the size and variability of the population and your research design. There are different sample size calculators and formulas depending on what you want to achieve with statistical analysis.

Probability sampling methods

Probability sampling means that every member of the population has a chance of being selected. It is mainly used in quantitative research. If you want to produce results that are representative of the whole population, probability sampling techniques are the most valid choice.

There are four main types of probability sample.

1. Simple random sampling

In a simple random sample, every member of the population has an equal chance of being selected. Your sampling frame should include the whole population.

To conduct this type of sampling, you can use tools like random number generators or other techniques that are based entirely on chance.

Example

You want to select a simple random sample of 100 employees of Company X. You assign a number to every employee in the company database from 1 to 1000, and use a random number generator to select 100 numbers.

2. Systematic sampling

Systematic sampling is similar to simple random sampling, but it is usually slightly easier to conduct. Every member of the population is listed with a number, but instead of randomly generating numbers, individuals are chosen at regular intervals.

Example

All employees of the company are listed in alphabetical order. From the first 10 numbers, you randomly select a starting point: number 6. From number 6 onwards, every 10th person on the list is selected (6, 16, 26, 36, and so on), and you end up with a sample of 100 people.

If you use this technique, it is important to make sure that there is no hidden pattern in the list that might skew the sample. For example, if the HR database groups employees by team, and team members are listed in order of seniority, there

is a risk that your interval might skip over people in junior roles, resulting in a sample that is skewed towards senior employees.

3. Stratified sampling

Stratified sampling involves dividing the population into subpopulations that may differ in important ways. It allows you draw more precise conclusions by ensuring that every subgroup is properly represented in the sample.

To use this sampling method, you divide the population into subgroups (called strata) based on the relevant characteristic (e.g. gender, age range, income bracket, job role).

Based on the overall proportions of the population, you calculate how many people should be sampled from each subgroup. Then you use random or systematic sampling to select a sample from each subgroup.

Example

The company has 800 female employees and 200 male employees. You want to ensure that the sample reflects the gender balance of the company, so you sort the population into two strata based on gender. Then you use random sampling on each group, selecting 80 women and 20 men, which gives you a representative sample of 100 people.

4. Cluster sampling

Cluster sampling also involves dividing the population into subgroups, but each subgroup should have similar characteristics to the whole sample. Instead of sampling individuals from each subgroup, you randomly select entire subgroups.

If it is practically possible, you might include every individual from each sampled cluster. If the clusters themselves are large, you can also sample individuals from within each cluster using one of the techniques above.

This method is good for dealing with large and dispersed populations, but there is more risk of error in the sample, as there could be substantial differences between clusters. It's difficult to guarantee that the sampled clusters are really representative of the whole population.

Example
The company has offices in 10 cities across the country (all with roughly the same number of employees in similar roles). You don't have the capacity to travel to every office to collect your data, so you use random sampling to select 3 offices – these are your clusters.

Non-probability sampling methods

In a non-probability sample, individuals are selected based on non-random criteria, and not every individual has a chance of being included.

This type of sample is easier and cheaper to access, but it has a higher risk of sampling bias. That means the inferences you can make about the population are

weaker than with probability samples, and your conclusions may be more limited. If you use a non-probability sample, you should still aim to make it as representative of the population as possible.

Non-probability sampling techniques are often used in exploratory and qualitative research. In these types of research, the aim is not to test a hypothesis about a broad population, but to develop an initial understanding of a small or under-researched population.

1. Convenience sampling

A convenience sample simply includes the individuals who happen to be most accessible to the researcher.

This is an easy and inexpensive way to gather initial data, but there is no way to tell if the sample is representative of the population, so it can't produce generalizable results.

Example

You are researching opinions about student support services in your university, so after each of your classes, you ask your fellow students to complete a survey on the topic. This is a convenient way to gather data, but as you only surveyed students taking the same classes as you at the same level, the sample is not representative of all the students at your university.

2. Voluntary response sampling

Similar to a convenience sample, a voluntary response sample is mainly based on ease of access. Instead of the researcher choosing participants and directly

contacting them, people volunteer themselves (e.g. by responding to a public online survey).

Voluntary response samples are always at least somewhat biased, as some people will inherently be more likely to volunteer than others.

Example
You send out the survey to all students at your university and a lot of students decide to complete it. This can certainly give you some insight into the topic, but the people who responded are more likely to be those who have strong opinions about the student support services, so you can't be sure that their opinions are representative of all students.

3. Purposive sampling

This type of sampling, also known as judgement sampling, involves the researcher using their expertise to select a sample that is most useful to the purposes of the research.

It is often used in qualitative research, where the researcher wants to gain detailed knowledge about a specific phenomenon rather than make statistical inferences, or where the population is very small and specific. An effective purposive sample must have clear criteria and rationale for inclusion.

Example
You want to know more about the opinions and experiences of disabled students at your university, so you purposefully select a number of students with different support needs in order to gather a varied range of data on their experiences with student services.

4. Snowball sampling

If the population is hard to access, snowball sampling can be used to recruit participants via other participants. The number of people you have access to "snowballs" as you get in contact with more people.

Example

You are researching experiences of homelessness in your city. Since there is no list of all homeless people in the city, probability sampling isn't possible. You meet one person who agrees to participate in the research, and she puts you in contact with other homeless people that she knows in the area.

UNIT IV

DATA PREPARATION AND ANALYSIS

Data Preparation – Editing and Coding – Tabulation of Data - Data Entry – Data Processing - Data Transformation, Qualitative vs Quantitative Data Analysis - Descriptive vs Inferential Analysis,- Univariate Analysis - Bivariate Analysis – Parametric and Non-Parametric test, Selection of Statistical test. Multivariate Analysis – Multiple Regression, Discriminant Analysis, Factor Analysis, Cluster Analysis and Multi-Dimensional Scaling – Case Study.

Definition of research in data analysis: According to *LeCompte* and *Schensul*, research data analysis is a process used by researchers for reducing data to a story and interpreting it to derive insights. The data analysis process helps in reducing a large chunk of data into smaller fragments, which makes sense.

Three essential things take place during the data analysis process — the first data organization. Summarization and categorization together contribute to becoming the second known method used for data reduction. It helps in finding patterns and themes in the data for easy identification and linking. Third and the last way is data analysis – researchers do it in both top-down or bottom-up fashion.

Marshall and Rossman, on the other hand, describe data analysis as a messy, ambiguous, and time-consuming, but a creative and fascinating process through which a mass of collected data is being brought to order, structure and meaning.

We can say that "the data analysis and interpretation is a process representing the application of deductive and inductive logic to the research and data analysis."

Why analyze data in research?

Researchers rely heavily on data as they have a story to tell or problems to solve. It starts with a question, and data is nothing but an answer to that question. But, what if there is no question to ask? Well! It is possible to explore data even without a problem – we call it *'Data Mining'* which often reveal some interesting patterns within the data that are worth exploring.

Irrelevant to the type of data, researchers explore, their mission, and audiences' vision guide them to find the patterns to shape the story they want to tell. One of the essential things expected from researchers while analyzing data is to stay open

and remain unbiased towards unexpected patterns, expressions, and results. Remember, sometimes, data analysis tells the most unforeseen yet exciting stories that were not expected at the time of initiating data analysis. Therefore, rely on the data you have at hand and enjoy the journey of exploratory research.

Types of data in research

Every kind of data has a rare quality of describing things after assigning a specific value to it. For analysis, you need to organize these values, processed and presented in a given context, to make it useful. Data can be in different forms; here are the primary data types.

- **Qualitative data:** When the data presented has words and descriptions, then we call it qualitative data. Although you can observe this data, it is subjective and harder to analyze data in research, especially for comparison. **Example:** Quality data represents everything describing taste, experience, texture, or an opinion that is considered quality data. This type of data is usually collected through focus groups, personal interviews, or using open-ended questions in surveys.
- **Quantitative data:** Any data expressed in numbers of numerical figures are called quantitative data. This type of data can be distinguished into categories, grouped, measured, calculated, or ranked. **Example:** questions such as age, rank, cost, length, weight, scores, etc. everything comes under this type of data. You can present such data in graphical format, charts, or apply statistical analysis methods to this data. The (Outcomes Measurement Systems) OMS questionnaires in surveys are a significant source of collecting numeric data.
- **Categorical data:** It is data presented in groups. However, an item included in the categorical data cannot belong to more than one group. **Example:** A person

responding to a survey by telling his living style, marital status, smoking habit, or drinking habit comes under the categorical data. A chi-square test is a standard method used to analyze this data.

Data analysis in qualitative research

Data analysis and qualitative data research work a little differently from the numerical data as the quality data is made up of words, descriptions, images, objects, and sometimes symbols. Getting insight from such complicated information is a complicated process. Hence it is typically used for exploratory research and data analysis.

Finding patterns in the qualitative data

Although there are several ways to find patterns in the textual information, a word-based method is the most relied and widely used global technique for research and data analysis. Notably, the data analysis process in qualitative research is manual. Here the researchers usually read the available data and find repetitive or commonly used words.

For example, while studying data collected from African countries to understand the most pressing issues people face, researchers might find *"food"* and *"hunger"* are the most commonly used words and will highlight them for further analysis.

The keyword context is another widely used word-based technique. In this method, the researcher tries to understand the concept by analyzing the context in which the participants use a particular keyword.

For example, researchers conducting research and data analysis for studying the concept of *'diabetes'* amongst respondents might analyze the context of when and how the respondent has used or referred to the word 'diabetes.'

The scrutiny-based technique is also one of the highly recommended text analysis methods used to identify a quality data pattern. Compare and contrast is the widely used method under this technique to differentiate how a specific text is similar or different from each other.

For example: To find out the "importance of resident doctor in a company," the collected data is divided into people who think it is necessary to hire a resident doctor and those who think it is unnecessary. Compare and contrast is the best method that can be used to analyze the polls having single answer questions types.

Metaphors can be used to reduce the data pile and find patterns in it so that it becomes easier to connect data with theory.

Variable Partitioning is another technique used to split variables so that researchers can find more coherent descriptions and explanations from the enormous data.

Methods used for data analysis in qualitative research

There are several techniques to analyze the data in qualitative research, but here are some commonly used methods,

- **Content Analysis:** It is widely accepted and the most frequently employed technique for data analysis in research methodology. It can be used to analyze the documented information from text, images, and sometimes from the physical

items. It depends on the research questions to predict when and where to use this method.

- **Narrative Analysis:** This method is used to analyze content gathered from various sources such as personal interviews, field observation, and **surveys.** The majority of times, stories, or opinions shared by people are focused on finding answers to the research questions.
- **Discourse Analysis:** Similar to narrative analysis, discourse analysis is used to analyze the interactions with people. Nevertheless, this particular method considers the social context under which or within which the communication between the researcher and respondent takes place. In addition to that, discourse analysis also focuses on the lifestyle and day-to-day environment while deriving any conclusion.
- **Grounded Theory:** When you want to explain why a particular phenomenon happened, then using grounded theory for analyzing quality data is the best resort. Grounded theory is applied to study data about the host of similar cases occurring in different settings. When researchers are using this method, they might alter explanations or produce new ones until they arrive at some conclusion.

Data analysis in quantitative research

Preparing data for analysis

The first stage in research and data analysis is to make it for the analysis so that the nominal data can be converted into something meaningful. Data preparation consists of the below phases.

Phase I: Data Validation

Data validation is done to understand if the collected data sample is per the pre-set standards, or it is a biased data sample again divided into four different stages

- **Fraud:** To ensure an actual human being records each response to the survey or the questionnaire
- **Screening:** To make sure each participant or respondent is selected or chosen in compliance with the research criteria
- **Procedure:** To ensure ethical standards were maintained while collecting the data sample
- **Completeness:** To ensure that the respondent has answered all the questions in an online survey. Else, the interviewer had asked all the questions devised in the questionnaire.

Phase II: Data Editing

More often, an extensive research data sample comes loaded with errors. Respondents sometimes fill in some fields incorrectly or sometimes skip them accidentally. Data editing is a process wherein the researchers have to confirm that the provided data is free of such errors. They need to conduct necessary checks and outlier checks to edit the raw edit and make it ready for analysis.

Phase III: Data Coding

Out of all three, this is the most critical phase of data preparation associated with grouping and assigning values to the survey responses. If a survey is completed with a 1000 sample size, the researcher will create an age bracket to distinguish the respondents based on their age. Thus, it becomes easier to analyze small data buckets rather than deal with the massive data pile.

Methods used for data analysis in quantitative research

After the data is prepared for analysis, researchers are open to using different research and data analysis methods to derive meaningful insights. For sure, statistical techniques are the most favored to analyze numerical data. The method is again classified into two groups. First, *'Descriptive Statistics'* used to describe data. Second, *'Inferential statistics'* that helps in comparing the data.

Descriptive statistics

This method is used to describe the basic features of versatile types of data in research. It presents the data in such a meaningful way that pattern in the data starts making sense. Nevertheless, the descriptive analysis does not go beyond making conclusions. The conclusions are again based on the hypothesis researchers have formulated so far. Here are a few major types of descriptive analysis methods.

Measures of Frequency

- Count, Percent, Frequency
- It is used to denote home often a particular event occurs.
- Researchers use it when they want to showcase how often a response is given.

Measures of Central Tendency

- Mean, Median, Mode
- The method is widely used to demonstrate distribution by various points.
- Researchers use this method when they want to showcase the most commonly or averagely indicated response.

Measures of Dispersion or Variation

- Range, Variance, Standard deviation

- Here the field equals high/low points.
- Variance standard deviation = difference between the observed score and mean
- It is used to identify the spread of scores by stating intervals.
- Researchers use this method to showcase data spread out. It helps them identify the depth until which the data is spread out that it directly affects the mean.

Measures of Position

- Percentile ranks, Quartile ranks
- It relies on standardized scores helping researchers to identify the relationship between different scores.
- It is often used when researchers want to compare scores with the average count.

For quantitative market research use of descriptive analysis often give absolute numbers, but the analysis is never sufficient to demonstrate the rationale behind those numbers. Nevertheless, it is necessary to think of the best method for research and data analysis suiting your survey questionnaire and what story researchers want to tell. For example, the mean is the best way to demonstrate the students' average scores in schools. It is better to rely on the descriptive statistics when the researchers intend to keep the research or outcome limited to the provided sample without generalizing it. For example, when you want to compare average voting done in two different cities, differential statistics are enough.

Descriptive analysis is also called a 'univariate analysis' since it is commonly used to analyze a single variable.

Inferential statistics

Inferential statistics are used to make predictions about a larger population after research and data analysis of the representing population's collected sample. For example, you can ask some odd 100 audiences at a movie theater if they like the

movie they are watching. Researchers then use inferential statistics on the collected sample to reason that about 80-90% of people like the movie.

Here are two significant areas of inferential statistics.

- Estimating parameters: It takes statistics from the sample research data and demonstrates something about the population parameter.
- Hypothesis test: It's about sampling research data to answer the survey research questions. For example, researchers might be interested to understand if the new shade of lipstick recently launched is good or not, or if the multivitamin capsules help children to perform better at games.

These are sophisticated analysis methods used to showcase the relationship between different variables instead of describing a single variable. It is often used when researchers want something beyond absolute numbers to understand the relationship between variables.

Here are some of the commonly used methods for data analysis in research.

- **Correlation:** When researchers are not conducting experimental research wherein the researchers are interested to understand the relationship between two or more variables, they opt for correlational research methods.
- **Cross-tabulation:** Also called contingency tables, cross-tabulation is used to analyze the relationship between multiple variables. Suppose provided data has age and gender categories presented in rows and columns. A two-dimensional cross-tabulation helps for seamless data analysis and research by showing the number of males and females in each age category.
- **Regression analysis:** For understanding the strong relationship between two variables, researchers do not look beyond the primary and commonly

used regression analysis method, which is also a type of predictive analysis used. In this method, you have an essential factor called the dependent variable. You also have multiple independent variables in regression analysis. You undertake efforts to find out the impact of independent variables on the dependent variable. The values of both independent and dependent variables are assumed as being ascertained in an error-free random manner.

- **Frequency tables:** The statistical procedure is used for testing the degree to which two or more vary or differ in an experiment. A considerable degree of variation means research findings were significant. In many contexts, ANOVA testing and variance analysis are similar.
- **Analysis of variance:** The statistical procedure is used for testing the degree to which two or more vary or differ in an experiment. A considerable degree of variation means research findings were significant. In many contexts, ANOVA testing and variance analysis are similar.

Considerations in research data analysis

- Researchers must have the necessary skills to analyze the data, Getting trained to demonstrate a high standard of research practice. Ideally, researchers must possess more than a basic understanding of the rationale of selecting one statistical method over the other to obtain better data insights.
- Usually, research and data analytics methods differ by scientific discipline; therefore, getting statistical advice at the beginning of analysis helps design a survey questionnaire, select data collection methods, and choose samples.
- The primary aim of data research and analysis is to derive ultimate insights that are unbiased. Any mistake in or keeping a biased mind to collect data, selecting an analysis method, or choosing audience sample il to draw a biased inference.
- Irrelevant to the sophistication used in research data and analysis is enough to rectify the poorly defined objective outcome measurements. It does not matter if

the design is at fault or intentions are not clear, but lack of clarity might mislead readers, so avoid the practice.

- The motive behind data analysis in research is to present accurate and reliable data. As far as possible, avoid statistical errors, and find a way to deal with everyday challenges like outliers, missing data, data altering, data mining, or developing graphical representation.

Bivariate analysis

Bivariate analysis is slightly more analytical than Univariate analysis. When the data set contains two variables and researchers aim to undertake comparisons between the two data set then Bivariate analysis is the right type of analysis technique. For example – in a survey of a classroom, the researcher may be looking to analysis the ratio of students who scored above 85% corresponding to their genders. In this case, there are two variables – gender = X (independent variable) and result = Y (dependent variable). A Bivariate analysis is will measure the correlations between the two variables as shown the table below.

Gender = X (Independent variable)	Number = n	Ratio of students who scored above 85% = Y (Dependent variable)
Boys	38	10
Girls	45	7

How Bivariate analysis is conducted

1. Correlation coefficients

Correlations is a statistical association technique where strength of relationship between two variables are observed. It shows the strength as strong or weak correlations and are rated on a scale of –1 to 1, where 1 is a perfect direct correlation, –1 is a perfect inverse correlation, and 0 is no correlation.

2. Regression analysis

Regression analysis is used for estimating the relationships between two different variables. It includes techniques for modelling and analysing several variables, when the focus is on the relationship between a dependent variable and one or more independent variables. It helps to understand how the value of the dependent variable changes when any one of the independent variables is changed. Regression analysis is used for advanced data modelling purposes like prediction and forecasting. There are a range of different regression techniques used depending on the nature of variable and the type of analysis sought by the research. For example –

- Linear regression
- Simple regression
- Polynomial regression
- General linear model
- Discrete choice
- Binomial regression
- Binary regression
- Logistic regression

Multivariate analysis

Multivariate analysis is a more complex form of statistical analysis technique and used when there are more than two variables in the data set. Here is an example –

A doctor has collected data on cholesterol, blood pressure, and weight. She also collected data on the eating habits of the subjects (e.g., how many ounces of red meat, fish, dairy products, and chocolate consumed per week). She wants to investigate the relationship between the three measures of health and eating habits?

In this instance, a multivariate analysis would be required to understand the relationship of each variable with each other.

How Multivariate analysis is conducted

Commonly used multivariate analysis technique include –

- Factor Analysis
- Cluster Analysis
- Variance Analysis
- Discriminant Analysis
- Multidimensional Scaling
- Principal Component Analysis
- Redundancy Analysis

Discriminant Analysis

Discriminant analysis is a technique that is used by the researcher to analyze the research data when the criterion or the dependent variable is categorical and the predictor or the independent variable is interval in nature. The term

categorical variable means that the dependent variable is divided into a number of categories. For example, three brands of computers, Computer A, Computer B and Computer C can be the categorical dependent variable.

The objective of discriminant analysis is to develop discriminant functions that are nothing but the linear combination of independent variables that will discriminate between the categories of the dependent variable in a perfect manner. It enables the researcher to examine whether significant differences exist among the groups, in terms of the predictor variables. It also evaluates the accuracy of the classification.

Discriminant analysis is described by the number of categories that is possessed by the dependent variable.

As in statistics, everything is assumed up until infinity, so in this case, when the dependent variable has two categories, then the type used is two-group discriminant analysis. If the dependent variable has three or more than three categories, then the type used is multiple discriminant analysis. The major distinction to the types of discriminant analysis is that for a two group, it is possible to derive only one discriminant function. On the other hand, in the case of multiple discriminant analysis, more than one discriminant function can be computed.

There are many examples that can explain when discriminant analysis fits. It can be used to know whether heavy, medium and light users of soft drinks are different in terms of their consumption of frozen foods. In the field of psychology, it can be used to differentiate between the price sensitive and non price sensitive buyers of groceries in terms of their psychological attributes or characteristics. In the field of business, it can be used to understand the characteristics or the attributes of a customer possessing store loyalty and a customer who does not have store loyalty.

Cluster analysis

Cluster analysis is a statistical method used to group similar objects into respective categories. It can also be referred to as segmentation analysis, taxonomy analysis, or clustering.

The goal of performing a cluster analysis is to sort different objects or data points into groups in a manner that the degree of association between two objects is high if they belong to the same group, and low if they belong to different groups.

Cluster analysis differs from many other statistical methods due to the fact that it's mostly used when researchers do not have an assumed principle or fact that they are using as the foundation of their research.

This analysis technique is typically performed during the exploratory phase of research, since unlike techniques such as factor analysis, it doesn't make any distinction between dependent and independent variables. Instead, cluster analysis is leveraged mostly to discover structures in data without providing an explanation or interpretation.
Put simply, cluster analysis discovers structures in data without explaining why those structures exist.

For example, when cluster analysis is performed as part of market research, specific groups can be identified within a population. The analysis of these groups can then determine how likely a population cluster is to purchase products or services. If these groups are defined clearly, a marketing team can then target varying cluster with tailored, targeted communication.

Correlation Analysis

Correlation analysis is applied in quantifying the association between two continuous variables, for example, an dependent and independent variable or among two independent variables.

Regression Analysis

Regression analysis refers to assessing the relationship between the outcome variable and one or more variables. The outcome variable is known as the dependent or response variable and the risk elements, and co-founders are known as predictors or independent variables. The dependent variable is shown by “y” and independent variables are shown by “x” in regression analysis.

The sample of a correlation coefficient is estimated in the correlation analysis. It ranges between -1 and +1, denoted by r and quantifies the strength and direction of the linear association among two variables. The correlation among two variables can either be positive, i.e. a higher level of one variable is related to a higher level of another or negative, i.e. a higher level of one variable is related to a lower level of the other.

The sign of the coefficient of correlation shows the direction of the association. The magnitude of the coefficient shows the strength of the association.

For example, a correlation of r = 0.8 indicates a positive and strong association among two variables, while a correlation of r = -0.3 shows a negative and weak association. A correlation near to zero shows the non-existence of linear association among two continuous variables.

Linear Regression

Linear regression is a linear approach to modelling the relationship between the scalar components and one or more independent variables. If the regression has

one independent variable, then it is known as a simple linear regression. If it has more than one independent variable, then it is known as multiple linear regression. Linear regression only focuses on the conditional probability distribution of the given values rather than the joint probability distribution. In general, all the real world regressions models involve multiple predictors. So, the term linear regression often describes multivariate linear regression.

Correlation and Regression Differences

There are some differences between Correlation and regression.

- Correlation shows the quantity of the degree to which two variables are associated. It does not fix a line through the data points. You compute a correlation that shows how much one variable changes when the other remains constant. When r is 0.0, the relationship does not exist. When r is positive, one variable goes high as the other goes up. When r is negative, one variable goes high as the other goes down.

- Linear regression finds the best line that predicts y from x, but Correlation does not fit a line.

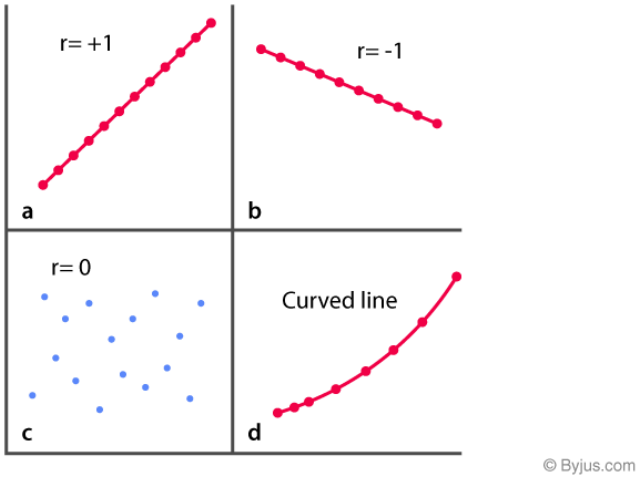
- Correlation is used when you measure both variables, while linear regression is mostly applied when x is a variable that is manipulated.

Comparison Between Correlation and Regression

Basis	**Correlation**	**Regression**
Meaning	A statistical measure that defines co-relationship or association of two variables.	Describes how an independent variable is associated with the dependent variable.
Dependent and Independent variables	No difference	Both variables are different.
Usage	To describe a linear relationship between two variables.	To fit the best line and estimate one variable based on another variable.
Objective	To find a value expressing the relationship between variables.	To estimate values of a random variable based on the values of a fixed variable.

Correlation and Regression Statistics

The degree of association is measured by “r” after its originator and a measure of linear association. Other complicated measures are used if a curved line is needed to represent the relationship.



The above graph represents the correlation.

The coefficient of correlation is measured on a scale that varies from +1 to -1 through 0. The complete correlation among two variables is represented by either +1 or -1. The correlation is positive when one variable increases and so does the other; while it is negative when one decreases as the other increases. The absence of correlation is described by 0.

Correlation Coefficient Formula

Let X and Y be the two random variables.

The population correlation coefficient for X and Y is given by the formula:

$$\rho_{X,Y} = \operatorname{corr}(X,Y) = \frac{\operatorname{cov}(X,Y)}{\sigma_X \sigma_Y} = \frac{\mathrm{E}[(X-\mu_X)(Y-\mu_Y)]}{\sigma_X \sigma_Y}$$

Where,

ρ_{XY} = Population correlation coefficient between X and Y

μ_X = Mean of the variable X

μ_Y = Mean of the variable Y

σ_X = Standard deviation of X

σ_Y = Standard deviation of Y

E = Expected value operator

Cov = Covariance

The above formulas can also be written as:

$$\rho_{X,Y} = \frac{\mathrm{E}(XY) - \mathrm{E}(X)\,\mathrm{E}(Y)}{\sqrt{\mathrm{E}(X^2) - \mathrm{E}(X)^2} \cdot \sqrt{\mathrm{E}(Y^2) - \mathrm{E}(Y)^2}}$$

The sample correlation coefficient formula is:

$$r_{xy} = \frac{n\sum x_i y_i - \sum x_i \sum y_i}{\sqrt{n\sum x_i^2 - (\sum x_i)^2}\,\sqrt{n\sum y_i^2 - (\sum y_i)^2}}$$

The above formulas are used to find the correlation coefficient for the given data. Based on the value obtained through these formulas, we can determine how strong is the association between two variables.

Simple Linear Regression Equation

As we know, linear regression is used to model the relationship between two variables. Thus, a simple linear regression equation can be written as:

$Y = a + bX$

Where,

Y = Dependent variable

X = Independent variable

$a = [(\sum y)(\sum x^2) - (\sum x)(\sum xy)]/ [n(\sum x^2) - (\sum x)^2]$

$b = [n(\sum xy) - (\sum x)(\sum y)]/ [n(\sum x^2) - (\sum x)^2]$

Regression Coefficient

In the linear regression line, the equation is given by:

$Y = b_0 + b_1X$

Here b_0 is a constant and b_1 is the regression coefficient.

The formula for the regression coefficient is given below.

$b_1 = \sum[(x_i - x)(y_i - y)]/ \sum[(x_i - x)^2]$

The observed data sets are given by x_i and y_i. x and y are the mean value of the respective variables.

We know that there are two regression equations and two coefficients of regression.

The regression coefficient of y and x formula is:

$b_{yx} = r(\sigma_y/\sigma_x)$

The regression coefficient of x on y formula is:

$b_{xy} = r(\sigma_x/\sigma_y)$

Where,

σ_x = Standard deviation of x

σ_y = Standard deviation of y

Some of the properties of a regression coefficient are listed below:

- The regression coefficient is denoted by b.

- The regression coefficient of y on x can be represented as b_{yx}. The regression coefficient of x on y can be represented as b_{xy}. If one of these regression coefficients is greater than 1, then the other will be less than 1.
- They are not independent of the change of scale. They will change in the regression coefficient if x and y are multiplied by any constant.
- The arithmetic mean of both regression coefficients is greater than or equal to the coefficient of correlation.
- The geometric mean between the two regression coefficients is equal to the correlation coefficient.

  If b_{xy} is positive, then b_{yx} is also positive and vice versa.

Multidimensional Scaling

Multidimensional scaling is a **visual representation of distances or dissimilarities between sets of objects**. "Objects" can be colors, faces, map coordinates, political persuasion, or any kind of real or conceptual stimuli (Kruskal and Wish, 1978). Objects that are more similar (or have shorter distances) are closer together on the graph than objects that are less similar (or have longer distances). As well as interpreting dissimilarities as distances on a graph, MDS can also serve as a dimension reduction technique for high-dimensional data (Buja et. al, 2007).

The term **scaling** comes from psychometrics, where abstract concepts ("objects") are assigned numbers according to a rule (Trochim, 2006). For example, you may want to quantify a person's attitude to global warming. You could assign a "1" to "doesn't believe in global warming", a 10 to "firmly believes in global warming" and a scale of 2 to 9 for attitudes in between. You can also think of "scaling" as the fact that you're essentially *scaling down the data* (i.e. making it simpler by

creating lower-dimensional data). Data that is scaled down in dimension keeps similar properties. For example, two data points that are close together in high-dimensional space will also be close together in low-dimensional space (Martinez, 2005). The "**multidimensional**" part is due to the fact that you aren't limited to two dimensional graphs or data. Three-dimensional, four-dimensional and higher plots are possible.

MDS is now used over a wide variety of disciplines. It's use isn't limited to a specific matrix or set of data; In fact, just about any matrix can be analyzed with the technique as long as the matrix contains some type of relational data (Young, 2013). Examples of relational data include correlations, distances, multiple rating scales or similarities.

As you may be able to tell from the short discussion above, MDS is very difficult to understand unless you have a basic understanding of matrix algebra and dimensionality. If you're new to these concept, you may want to read these articles first:

When to Use MDS

Let's say you were given a list of city locations, and were asked to create a map that included distances between cities. The procedure would be relatively straightforward, involving nothing more complicated than taking a ruler and measuring the distance between each city. However, what if you were given *only* the distances between the cities (i.e. their similarities) — and not their locations? You could still create a map — but it would involve a fair amount of

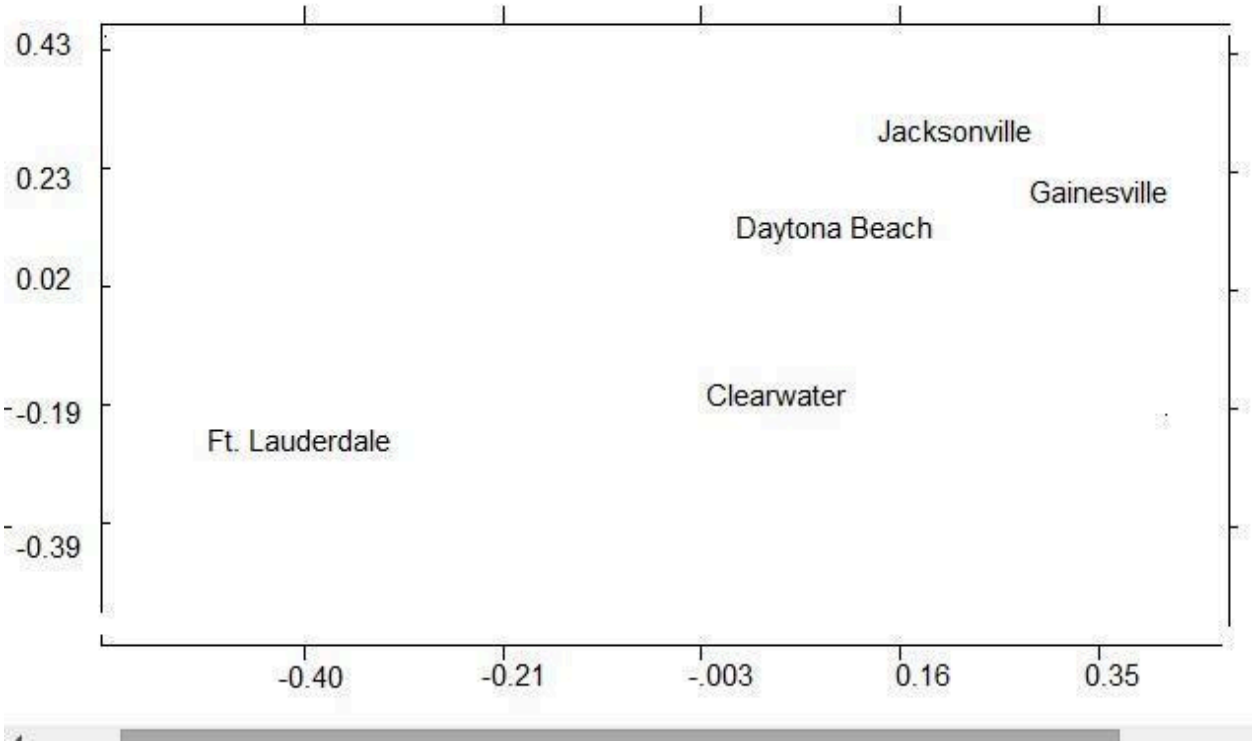
geometry, and some logical deductions. Kruskal & Wish (1978) — the authors of one of the first multidimensional scaling books — state that this type of logic problem is ideal for multidimensional scaling. You're basically given a set of differences, and the goal is to create a map that will also tell you what the original distances where and where they were located.

A Simple Example

Multidimensional scaling uses a square, symmetric matrix for input. The matrix shows relationships between items. For a simple example, let's say you had a set of cities in Florida and their distances:

CITY	Clearwater	Daytona Beach	Ft. Lauderdale	Gainesville	Jacksonville
Clearwater	0	159	247	131	197
Daytona Beach	159	0	230	97	89
Ft. Lauderdale	247	230	0	309	317
Gainesville	131	97	309	0	68
Jacksonville	197	89	317	68	0

The scaling produces a graph like the one below.



The very simple example above shows cities and distances, which are easy to visualize as a map. However, multidimensional scaling can work on "theoretically" mapped data as well. For example, Kruskal and Wish (1978) outlined how the method could be used to uncover the answers to a variety of questions about people's viewpoints on political candidates. This could be achieved by reducing the data and issues (say, partisanship and ideology) to a two-dimensional map.

Basic steps:

1. **Assign a number of points to coordinates in n-dimensional space**. *N*-dimensional space could be 2-dimensional, 3-dimensional, or higher spaces (at least, theoretically, because 4-dimensional spaces and above are

difficult to model). The orientation of the coordinate axes is arbitrary and is mostly the researcher's choice. For maps like the one in the simple example above, axes that represent north/south and east/west make the most sense.

2. **Calculate Euclidean distances for all pairs of points**. The Euclidean distance is the "as the crow flies" straight-line distance between two points x and y in Euclidean space. It's calculated using the Pythagorean theorem ($c^2 = a^2 + b^2$), although it becomes somewhat more complicated for n-dimensional space (see "Euclidean Distance in n-dimensional space"). This results in the similarity matrix.
3. **Compare the similarity matrix with the original input matrix** by evaluating the stress function. *Stress* is a goodness-of-fit measure, based on differences between predicted and actual distances. In his original 1964 MDS paper, Kruskal wrote that fits close to zero are excellent, while anything over .2 should be considered "poor". More recent authors suggest evaluating stress based on the quality of the distance matrix and how many objects are in that matrix.
4. **Adjust coordinates, if necessary, to minimize stress**.

Uses of Multidimensional Scaling

- There are many possible uses of this method of scaling; new applications are being developed steadily. Some of the uses that have already been identified are the following:

- Market segmentation: If brands are located as points in preference space, as in the example and consumers ideal points are similarly located, market segments may then be viewed as subspaces in which consumers have similar ideal positions and perceive the brands similarly.

- Product life cycle: By analyzing respondent perceptions at different times, researchers may be able to relate movement along various dimensions (characteristics) to some measure such as market share, and, thus develop a new concept of product life cycle.

- Vendor Evaluations: Industrial purchasing agents must choose among vendors who differ – for example, in price, delivery, reliability, technical service and credit. How purchasing agents summarize the various characteristics to determine a specific vendor from whom to purchase would be information that would help vendors design sales strategies.

- Advertising Media Selection: Which magazines should be used for an advertising campaign to reach a given audience? Different possible media could be identified aspects in similarity pace (as were cars in the example) and members of their audiences located as ideal points. This would be similar to the market segmentation process. A similar approach might be taken to locate the best media for specific ads.

Limitations of Multidimensional Scaling:

- The above discussion, it has been suggested that many problems exist in the use of multidimensional scaling and must be considered significant limitations in use of the technique. These limitations can be classified in the following three categories:

- Conceptual Problems: Definitions of ‘similarity’ and ‘preference’ that are conceptually clear and that can be communicated accurately to respondents have not been developed and may not be achievable. Criteria in which

similarities are gauged may vary during an interview with respondents; they may vary by the context in which respondents think such as purchase for themselves or as a gift; and small variations in one criterion may be more important than large variations in another. None of these factors is fully understood or amenable to control at present.

- Current studies assume that each stimulus (brand, in the example) is an only choice. If the preferred brand were not available, it is assumed the summer would take the second choice. But what if the consumer purchases two items—for example two cars? After the first choice has been bought, will the order of preference change for the second car?

- How do preferences change over time? Do they change frequently or are they relatively stable? The answers in these questions have much to do with the operational use a firm can make of a multidimensional analysis.

- Empirical Problems: In the discussion of the multidimensional scaling process, it was pointed out that the labeling of the various dimensions (criteria) of importance to respondents is subjective and, hence, open to question.

- The data collection process is as open to bias in multidimensional scaling projects as in any other but the relative impact of such biases is less well known. Procedure for collecting data and the general back ground conditions or ‘scenarios’ in which a project is presented has yet to be standardized.

Conjoint Analysis

Conjoint analysis definition: Conjoint analysis is defined as a survey-based advanced market research analysis method that attempts to understand how people make complex choices. We make choices that require trade-offs every day — so often that we may not even realize it. Even simple decisions like choosing a laundry detergent or deciding to book a flight are mental conjoint studies that contain multiple elements that lead us to our choice.

Conjoint analysis is one of the most effective models in extracting consumer preferences during the purchasing process. This data is then turned into a quantitative measurement using statistical analysis. It evaluates products or services in a way no other method can.

Conjoint analysis is the optimal market research approach for measuring the value that consumers place on features of a product or service. This commonly used approach combines real-life scenarios and statistical techniques with the modeling of actual market decisions.

Introduction to conjoint analysis

Have you ever bought a house? As one of the most complex purchase decisions you can make, you must consider many preferences. Everything from the location and price to interest rate and quality of local schools can play a factor in your home buying decision. Less complicated purchases feature a similar process of choosing a good or service that meets your needs. You just may not be aware you're making those decisions.

Subconsciously, one person might be more price-sensitive while another is more feature-focused. Understanding which elements consumers consider being essential and trivial is the core purpose of a conjoint study.

Why use conjoint analysis in surveys?

Traditional rating surveys can't place a value on the different attributes that make up a product. On the other hand, conjoint analysis can sift through respondents' choices to determine the reasoning for those choices. Analyzing the data gives you the ability to peek into your target audience's minds and see what they value most in goods or services and acts as a market simulator.

Many businesses shy away from the conjoint analysis because of its seemingly sophisticated design and methodology. But the truth is, you can use this method efficiently, thanks to user-friendly survey software like QuestionPro. Here is a breakdown of conjoint in simple terms, along with a conjoint analysis marketing example.

Conjoint analysis example

Let's for example assume a scenario where a product marketer needs to measure individual product features' impact on the estimated market share or sales revenue.

In this conjoint study example, we'll assume the product is a mobile phone. The competitors are Apple, Samsung, and Google. The organization needs to understand how different customers value attributes, such as brand, price, screen size, and screen resolution. Armed with this information, they can create their product range to match consumer preferences.

Conjoint analysis assigns values to these product attributes and levels by creating realistic choices and asking people to evaluate them. It enables businesses to mathematically analyze consumer or client behavior and make decisions based on real insights from customer data. This allows them to develop better business strategies that provide a competitive edge. To fulfill customer wishes, profitably

requires companies to fully understand which aspects of their product and service are most valued.

Why use conjoint analysis?

Researchers consider conjoint analysis as the best survey method for determining customer values. It consists of creating, distributing, and analyzing surveys among customers to model their purchasing decision based on response analysis.

Reliable, accurate data gives your business the best chance to produce a product or service that meets all your customers' needs and wants.

Currently, choice-based conjoint analysis is the most popular form of conjoint. Participants are shown a series of options and asked to select the one they would most likely buy. Other types of conjoint include asking participants to rate or rank products. Choosing a product to buy usually yields more accurate results than ranking systems.

The survey question shows each participant several choices of products or features. The answers they give allow our software to work out the underlying values. For example, the program can work out its preferred size and how much they would pay for their favorite brand. Once we have the choice data, there is a range of analytic options. The critical tools for analysis include What-if modeling, forecasting, segmentation, and applying cost-benefit analysis.

When to use conjoint analysis

Over the past 50 years, Conjoint analysis has evolved into a method that market researchers and statisticians implement to predict the kinds of decisions consumers will make about products by using questions in a survey.

The central idea is that consumers evaluate different characteristics of a product and decide which are more relevant to them for any purchase decision. An online conjoint survey's primary aim is to set distinct values to the alternatives that the buyers may consider when making a purchase decision. Equipped with this knowledge, marketers can target the features of products or services that are highly important and design messages more likely to strike a chord with target buyers.

The discrete choice conjoint analysis presents a set of possible decisions to consumers via a survey and asks them to decide which one they would pick. Each concept is composed of a set of attributes (e.g., color, size, price), detailed by a set of levels.

How to use conjoint analysis

Conjoint models predict respondent preference. For instance, we could have a conjoint study on laptops. The laptop can come in three colors (white, silver, and gold), three screen sizes (11", 13", and 15"), and three prices ($200, $400, and $600). This would give 3 x 3 x 3 possible product combinations. In this example, there are three attributes (color, size, and price) with three levels per attribute.

A set of concepts, or tasks, based on the defined attributes are presented to respondents. Respondents make choices as to which product they would purchase in real life. It is important to note that there are a lot of variations of conjoint

techniques. QuestionPro's conjoint analysis software uses choice-based analysis, which most accurately simulates the purchase process of consumers.

Application of statistical software for data analysis.

SPSS and Its Importance in Research & Data Analysis

SPSS (Statistical package for the social sciences) is the set of software programs that are combined together in a single package. The basic application of this program is to analyze scientific data related with the social science. This data can be used for market research, surveys, data mining, etc.

With the help of the obtained statistical information, researchers can easily understand the demand for a product in the market, and can change their strategy accordingly. Basically, SPSS first store and organize the provided data, then it compiles the data set to produce suitable output. SPSS is designed in such a way that it can handle a large set of variable data formats.

Read How SPSS Helps in Research & Data Analysis Programs:

SPSS is revolutionary software mainly used by research scientists which help them process critical data in simple steps. Working on data is a complex and time consuming process, but this software can easily handle and operate information with the help of some techniques. These techniques are used to analyze, transform, and produce a characteristic pattern between different data variables. In addition to it, the output can be obtained through graphical representation so that a user can easily understand the result. Read below to understand the factors that are responsible in the process of data handling and its execution.

1. Data Transformation: This technique is used to convert the format of the data. After changing the data type, it integrates same type of data in one place and it becomes easy to manage it. You can insert the different kind of data into SPSS and it will change its structure as per the system specification and requirement. It means that even if you change the operating system, SPSS can still work on old data.

2. Regression Analysis: It is used to understand the relation between dependent and interdependent variables that are stored in a data file. It also explains how a change in the value of an interdependent variable can affect the dependent data. The primary need of regression analysis is to understand the type of relationship between different variables.

3. ANOVA(Analysis of variance): It is a statistical approach to compare events, groups or processes, and find out the difference between them. It can help you understand which method is more suitable for executing a task. By looking at the result, you can find the feasibility and effectiveness of the particular method.

4. MANOVA(Multivariate analysis of variance): This method is used to compare data of random variables whose value is unknown. MANOVA technique can also be used to analyze different types of population and what factors can affect their choices.

5. T-tests: It is used to understand the difference between two sample types, and researchers apply this method to find out the difference in the interest of two kinds of groups. This test can also understand if the produced output is meaningless or useful.

This software was developed in 1960, but later in 2009, IBM acquired it. They have made some significant changes in the programming of SPSS and now it can perform many types of research task in various fields. Due to this, the use of this software is extended to many industries and organizations, such as marketing, health care, education, surveys, etc.

UNIT V

REPORT DESIGN, WRITING AND ETHICS IN BUSINESS RESEARCH

Report Writing – Criteria for Good Research report – Types of Report - Format and of Report - Findings, Suggestions and Recommendations, Conclusion — Referencing Formats – Index - Footnote, Appendices – Layout of a Research Paper - Journals in Business and Management - Impact factor of Journals - Ethical issues related to publishing, Plagiarism.

Research report – Different types – Contents of report

A research report is a well-crafted document that outlines the processes, data, and findings of a systematic investigation. It is an important document that serves as a first-hand account of the research process, and it is typically considered as an objective and accurate source of information.

In many ways, a research report can be considered as a summary of the research process that clearly highlights findings, recommendations, and other important

details. Reading a well-written research report should provide you with all the information you need about the core areas of the research process.

Features of a Research Report

So how do you recognize a research report when you see one? Here are some of the basic features that define a research report.

- It is a detailed presentation of research processes and findings, and it usually includes tables and graphs.
- It is written in a formal language.
- A research report is usually written in the third person.
- It is informative and based on first-hand verifiable information.
- It is formally structured with headings, sections, and bullet points.
- It always includes recommendations for future actions.

Types of Research Report

The research report is classified based on 2 things; nature of research and target audience.

- **Qualitative Research Report**

This is the type of report written for qualitative research. It outlines the methods, processes, and findings of a qualitative method of systematic investigation. In educational research, a qualitative research report provides an opportunity for one to apply his or her knowledge and develop skills in planning and executing qualitative research projects.

A qualitative research report is usually descriptive in nature. Hence, in addition to presenting details of the research process, you must also create a descriptive narrative of the information.

- **Quantitative Research Report**

A quantitative research report is a type of research report that is written for quantitative research. Quantitative research is a type of systematic investigation that pays attention to numerical or statistical values in a bid to find answers to research questions.

In this type of research report, the researcher presents quantitative data to support the research process and findings. Unlike a qualitative research report that is mainly descriptive, a quantitative research report works with numbers; that is, it is numerical in nature.

Target Audience

Also, a research report can be said to be technical or popular based on the target audience. If you're dealing with a general audience, you would need to present a popular research report, and if you're dealing with a specialized audience, you would submit a technical report.

- **Technical Research Report**

A technical research report is a detailed document that you present after carrying out industry-based research. This report is highly specialized because it provides information for a technical audience; that is, individuals with above-average knowledge in the field of study.

In a technical research report, the researcher is expected to provide specific information about the research process, including statistical analyses and sampling methods. Also, the use of language is highly specialized and filled with jargon.

Examples of a technical research report include legal and medical research reports.

- **Popular Research Report**

A popular research report is one for a general audience; that is, for individuals who do not necessarily have any knowledge in the field of study. A popular research report aims to make information accessible to everyone.

It is written in very simple language, which makes it easy to understand the findings and recommendations. Examples of popular research reports are the information contained in newspapers and magazines.

Importance of a Research Report

- **Knowledge Transfer**

As already stated above, one of the reasons for carrying out research is to contribute to the existing body of knowledge, and this is made possible with a research report. A research report serves as a means to effectively communicate the findings of a systematic investigation to all and sundry.

- **Identification of Knowledge Gaps**

With a research report, you'd be able to identify knowledge gaps for further inquiry. A research report shows what has been done while hinting at other areas needing systematic investigation.

- In market research, a research report would help you understand the market needs and peculiarities at a glance.
- A research report allows you to present information in a precise and concise manner.
- It is time-efficient and practical because, in a research report, you do not have to spend time detailing the findings of your research work in person. You can easily send out the report via email and have stakeholders look at it.

Structure of a Research Report

- **Title**

This is the title of your systematic investigation. Your title should be concise and point to the aims, objectives, and findings of a research report.

- **Table of Contents**

This is like a compass that makes it easier for readers to navigate the research report.

- **Abstract**

An abstract is an overview that highlights all important aspects of the research including the research method, data collection process, and research findings. Think of an abstract as a summary of your research report that presents pertinent information in a concise manner.

An abstract is always brief; typically 100-150 words and goes straight to the point. The focus of your research abstract should be the 5Ws and 1H format – What, Where, Why, When, Who and How.

- **Introduction**

Here, the researcher highlights the aims and objectives of the systematic investigation as well as the problem which the systematic investigation sets out to solve. When writing the report introduction, it is also essential to indicate whether the purposes of the research were achieved or would require more work.

In the introduction section, the researcher specifies the research problem and also outlines the significance of the systematic investigation. Also, the researcher is expected to outline any jargons and terminologies that are contained in the research.

- **Literature Review**

A literature review is a written survey of existing knowledge in the field of study. In other words, it is the section where you provide an overview and analysis of different research works that are relevant to your systematic investigation.

It highlights existing research knowledge and areas needing further investigation, which your research has sought to fill. At this stage, you can also hint at your research hypothesis and its possible implications for the existing body of knowledge in your field of study.

- **An Account of Investigation**

This is a detailed account of the research process, including the methodology, sample, and research subjects. Here, you are expected to provide in-depth information on the research process including the data collection and analysis procedures.

In a quantitative research report, you'd need to provide information surveys, questionnaires and other quantitative data collection methods used in your research. In a qualitative research report, you are expected to describe the qualitative data collection methods used in your research including interviews and focus groups.

- **Findings**

In this section, you are expected to present the results of the systematic investigation.

- **Discussion**

This section further explains the findings of the research, earlier outlined. Here, you are expected to present a justification for each outcome and show whether the results are in line with your hypotheses or if other research studies have come up with similar results.

- **Conclusions**

This is a summary of all the information in the report. It also outlines the significance of the entire study.

- **References and Appendices**

This section contains a list of all the primary and secondary research sources.

Executive Summary

An executive summary is a short document or section of a larger business report or proposal. It's used to give a reader a quick overview of the larger body of material that follows. In other words, it summarizes a report so that executives don't have to read the whole report to understand its purpose.

It contains a short statement that addresses the problem or proposal detailed in the attached documents, and features background information, a concise analysis and a conclusion. An executive summary is designed to help executives decide whether to go forth with the proposal or not, making it critically important.

What Goes into an Executive Summary?

When writing an executive summary there are guidelines to make sure you hit all the bases. According to the many books that have been written about executive summaries, as well as training courses, seminars and professional speakers, the agreed upon length should be about five to 10 percent of the length of whole report.

Relevant Information

The executive summary should not stray from the material that follows it. It's a summary, not a place to bring up new ideas. To do so would be confusing and would jeopardize your whole proposal.

Establish the need or the problem, and convince the target audience that it must be solved. Once that is set up, then it's important to recommend the solution and show what the value is. Be clear and firm in your recommendation.

Justify your cause. Be sure to note the key reasons why your organization is the perfect fit for the solution you're proposing. This is the point where you differentiate yourself from competitors, be that due to methodology, testimonial from satisfied clients or whatever else you offer that is unique. But don't make this too much about you. Be sure to keep the name of the potential client at the forefront.

Executive Summary Format

So, to put all of that information together, here's the basic format of an executive summary:

- Introduction, be sure to know your audience
- Table of contents in the form of a bulleted list
- Explain the company's role and identify strengths
- Explain the need, or the problem, and its importance
- Recommend a solution and explain its value
- Justify said solution by explaining how it fits the organization
- Strong conclusion that once more wraps up the importance of the project

CHAPTERIZATION

The entire research work will run into five chapters. The first one on Introduction brings out the importance of the study, and states its objectives and hypotheses. It also includes methodology and limitations. Chapter II will contain previous reviews, history of the Problems. A Quick look on subjective well-being will also

be carried out in chapter II. Chapter III will be a methodological part of the study. Analysis and Discussions is to be done in chapter IV. Findings, Conclusions and Suggestions for further Research will be presented in Chapter V followed by Bibliography and References.

EXAMPLE.1.

- **Chapter 1:** Introduction
- **Chapter 2:** Literature review
- **Chapter 3:** Methods
- **Chapter 4:** Paper 1 & general discussion
- **Chapter 5:** Paper 2
- **Chapter 6:** Regular thesis chapter – results
- **Chapter 7**: Regular thesis chapter/general discussion tying in published and unpublished work
- **Chapter 8:** Conclusion
- **Appendices** - May include CD, DVD or other material, also reviews & methods papers

Essential requirements

All theses with publications **must** have the following:

- Title page
- Abstract
- Declaration
- Preface – noting collaborations, and contributions to authorship

- Acknowledgements
- Table of contents
- List of tables, figures & illustrations
- Main text/chapters
- Bibliography or list of references
- Appendices