COURSE GUIDE

EMT 417

SCIENTIFIC WRITING AND PRESENTATION IN ENVIRONMENTAL SCIENCE

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UNIT 1: ORIGIN OF RESEARCH

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1.0 Introduction

The word "research" originated from the old French word "recerchier" meaning to search and search again; it literally implies repeating a search for something and implicitly assumes that the earlier search was not exhaustive and complete in the sense that there is still scope for improvement (Kabir, 2016). Research is the systematic investigation into and study of materials and sources in order to establish facts and reach new conclusion.

2.0 Objectives

By the end of this unit, student should be able to:

- define research
- explain how the scientific method is used to develop new knowledge.

3.0 Main Content

3.1 Definitions of Research

Research is the diligent systematic enquiry into nature and society to validate and refine existing knowledge and to generate new knowledge (Naidoo, 2011). Research is a

scientific approach of answering a research question, solving a problem or generating new knowledge through a systematic and orderly collection, organization, and analysis of information with an ultimate goal of making the research useful in decision-making (Kabir, 2016). Research is a process to discover new knowledge. Code of Federal Regulations (45 CFR 46.102(d)) defined research as: "A systematic investigation (i.e., the gathering and analysis of information) designed to develop or contribute to generalizable knowledge." The National Academy of Sciences states that the object of research is to "extend human knowledge of the physical, biological, or social world beyond what is already known." Research is different from other forms of discovering knowledge (like reading a book) because it uses a systematic process called the scientific method (Figure 1).

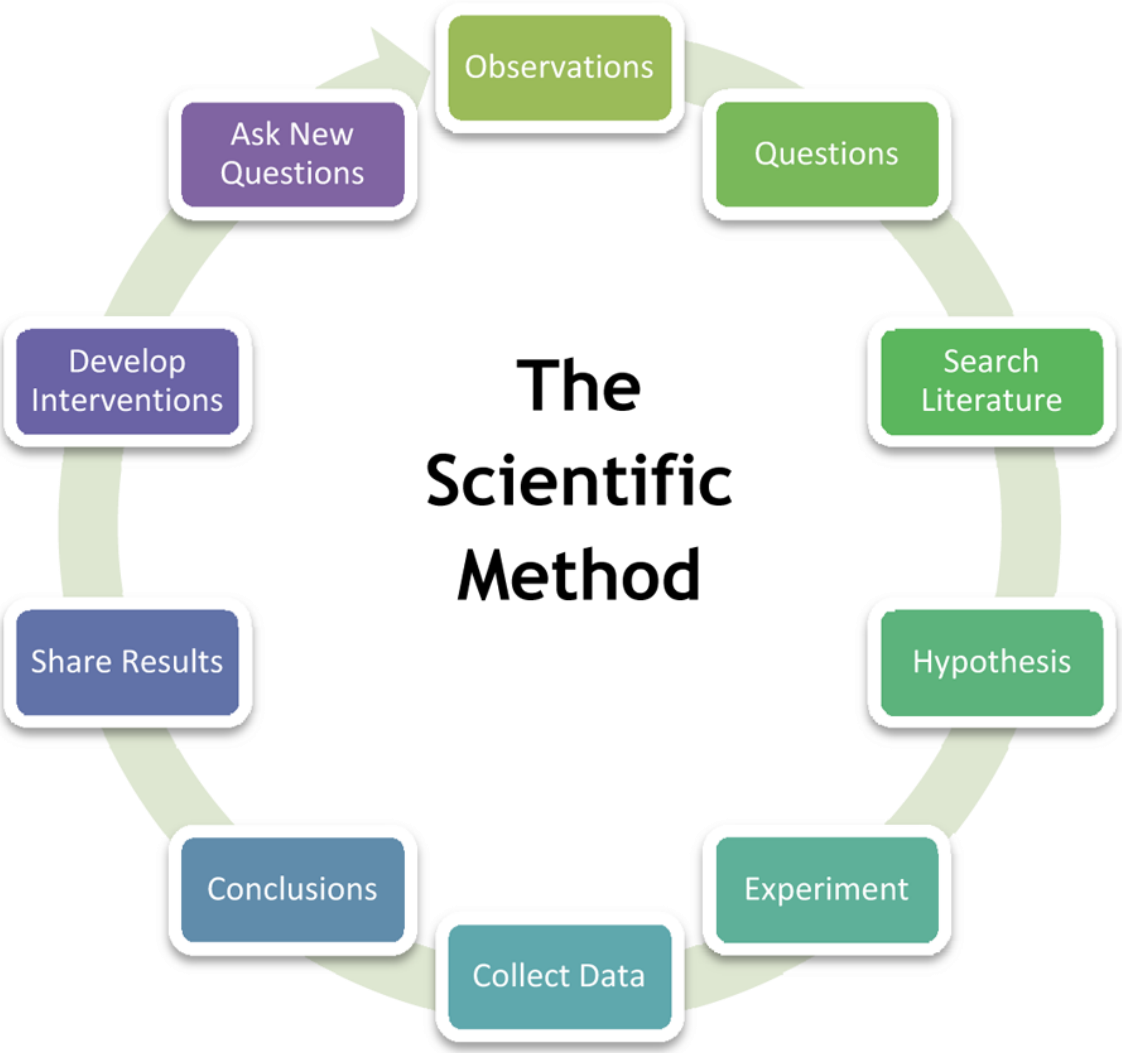


Figure 1: The scientific method

Source: https://ori.hhs.gov/module-1-introduction-what-research

The scientific method consists of observing the world around you and creating a hypothesis about relationships in the world. A hypothesis is an informed and educated prediction or explanation about something. Part of the research process involves testing the hypothesis, and then examining the results of these tests as they relate to both the hypothesis and the world around you. When a researcher forms a hypothesis, this acts like a map through the research study. It tells the researcher which factors are important

to study and how they might be related to each other or caused by a manipulation that the researcher introduces (e.g. a program, treatment or change in the environment). With this map, the researcher can interpret the information he/she collects and can make sound conclusions about the results. Research can be done with human beings, animals, plants, other organisms and inorganic matter.

3.2 Research Process

1. It starts with a question.
2. Collection and analysis of data.
3. Drawing conclusions: what's it all about?

In education, as in all other topic areas, the key thing to remember is: It all starts with a question! (need to know, curiosity, etc.)

If it is in a question form, we call it a research question: e.g., "What is the relationship between motivation to teach and satisfaction level as a first-year teacher?"

If it is in a declarative sentence form, we call it a problem statement: e.g., "This study is to determine the relationship between motivation to teach and satisfaction level as a first-year teacher."

The above two forms are considered to be equivalent and the decision as to which way one prefers to state his "curiosity" depends on such individual. But some professors (and particularly, your dissertation chair) may have a preference as to one form or the other. Guess the moral is: "Know thy audience (and act accordingly)!"

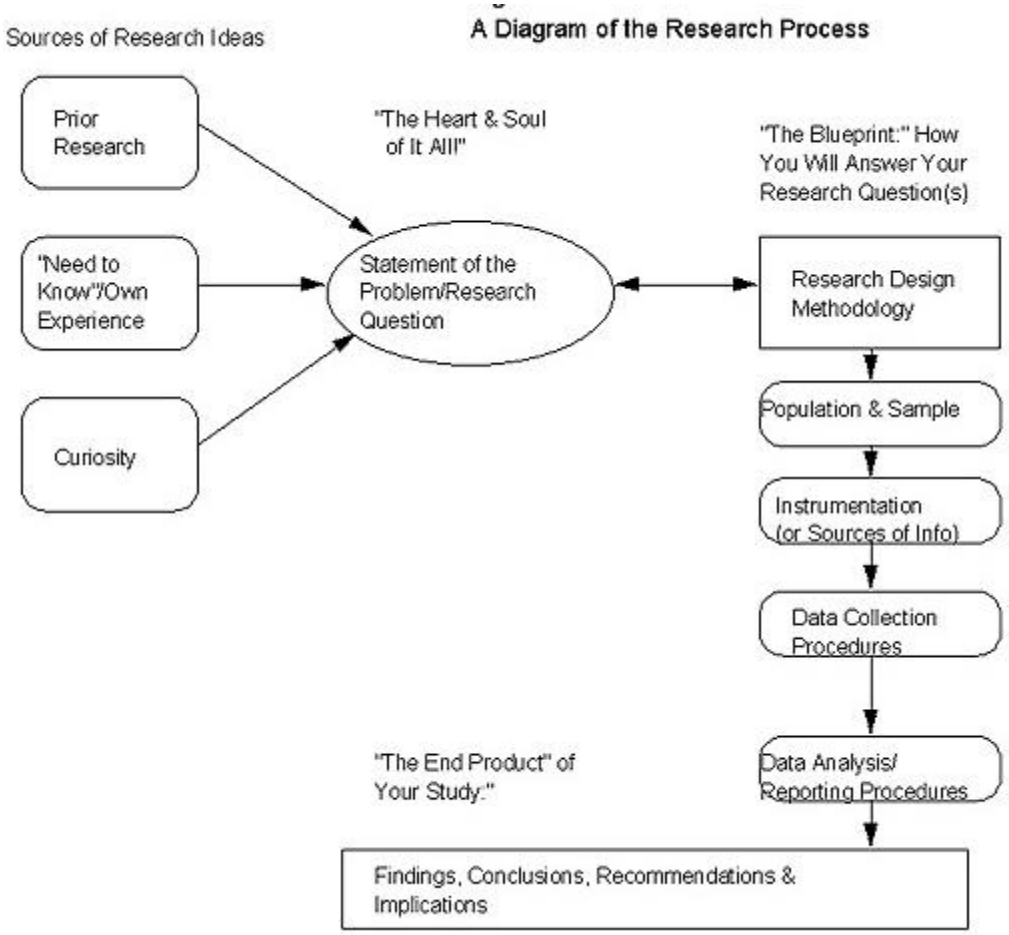


Figure 2: Diagram of the research process

These, then, would be the key steps in the research process:

1. Identify your research question or problem statement.

This can come from:

a. Something in prior research that piques your interest;

b. A need to know based on practice (e.g., you observe a problem at work and wish to understand its causes better; and/or need to develop a solution to the problem)

c. "Just being curious about something!

We'll learn that these research designs come in "families," some of which "cleanly link" to give research questions or problem statements.

Population and sample: The who of your study (the population being "to whom do you wish to project or generalize your findings?" and the sample being "the subjects you actually observe, interview, send surveys to, etc., etc., or otherwise 'study' to get an answer to your question"). For practical purposes, it might not be too feasible, time- and/or cost-wise to personally study everyone to whom one wishes to project or generalize! the task, then, will be to select or "draw" a smaller subset of subjects to actually "use" in our study. "Who" when it comes to population and sample don't have to be persons (although they usually are: e.g., "all 4th-grade special education students

enrolled in national open university for the 2019-2020 academic year"); they can be things (e.g., "all related special education curricula being used for/with these students"). in this case, one can say "what" instead of "who." but since in the majority of "real-life" cases we are dealing with persons instead of things, "who" and "subjects" will be used for population and sample references. and it'll be understood that these can be things too!

The "Instrumentation" or "Sources of Information" -- e.g., your "hands-on tools" for obtaining information needed for and about the population and sample in order to answer your research question(s)! "Instrumentation" is any such tool involving "live and in-person" collection of information. Some examples are as follows:

- Mass-mailed rating scale surveys:
- Surveys with open-ended, fill-in-the-blank items;
- Questions about background and purchasing habits asked of subjects in a telephone interview;
- Open-ended questions about people's attitudes, feelings, likes and dislikes asked of 6-12 subjects in a relaxed setting for about one hour (this is called a "focus group interview");
- The same types of open-ended attitudinal questions asked of subjects one by one, either in person or by telephone (this is called an "individual interview");
- Your log book of notes of your observations taken of discipline methods used by a teacher in a primary grade classroom.

There are many other examples. Do you see how, in each of the above cases, it involves "live and in person" collection of data -- even if, as in the case of the mass-mailed surveys, you may never actually meet the subjects? But it's still a "live" person giving you the answers (hopefully, anyway...!!!).

"Sources of Information," in contrast, involve getting data from existing sources -- e.g., what is called "archival information." The data already exist and one is locating, identifying and 'pulling from' these sources to fit the research needs. Just a few examples of such sources of information are as follows:

a. Pulling off the 400 level ESM students' scores in English and Mathematics for the last 5 years from existing computerized databases in the university records office;

b. Obtaining diaries written and kept by an individual who may be deceased but who is the focus of your area of interest -- and reading and selectively making notes and pulling quotations from these diaries;

c. Obtaining policies on hiring and firing of school district classified staff from three preselected district offices -- and again, selectively 'reading and pulling' from these the information that you need to answer your particular research question(s).

You can see, in the above examples, the data/information/records, etc., already existed (e.g., YOU weren't the 'original compiler') and may in fact have been created for totally different purposes at the time? But now you need to locate and use these sources to address your own particular, unique problem statement or needs to know.

4.0 Conclusion

Research is an investigation that is conducted in order to discover new facts, knowledge or get additional but useful information etc. It is a system of enquiry aimed at providing dependable or reliable solutions to problems through systematic collection, analysis, interpretation and reaching or drawing relevant conclusion from data collected. Research is needed for development and that is one of the reasons why some organizations have R & D (research and development) department so that they can be one step ahead of their competitors.

5.0 Summary

i. Research is a process to discover new knowledge.
ii. Research process deals with the collection and analysis of data.
iii. Research can be done with human beings, animals, plants, other organisms and inorganic matter.

6.0 Tutor-Marked Assignments

1. What is research?
2. Describe instrumentation in research citing relevant examples.

7.0 References and other Resources

Kabir, S.M.S. (2016). Introduction to Research.

Naidoo, N. (2011). What is research? A conceptual understanding. *African Journal of Emergency Medicine*, 1: 47-48.

What is research? https://ori.hhs.gov/module-1-introduction-what-research. Accessed 04.11.2020.

UNIT 2: RESEARCH DESIGN

CONTENTS

1.0. Introduction

A research design is the 'procedures for collecting, analyzing, interpreting and reporting data in research studies' (Creswell & Plano Clark, 2007). The research design is intended to provide an appropriate framework for a study (Sileyew, 2019).

2.0. Objectives

By the end of this unit, you will be able to:

- discuss the research design;
- state the need for research design.

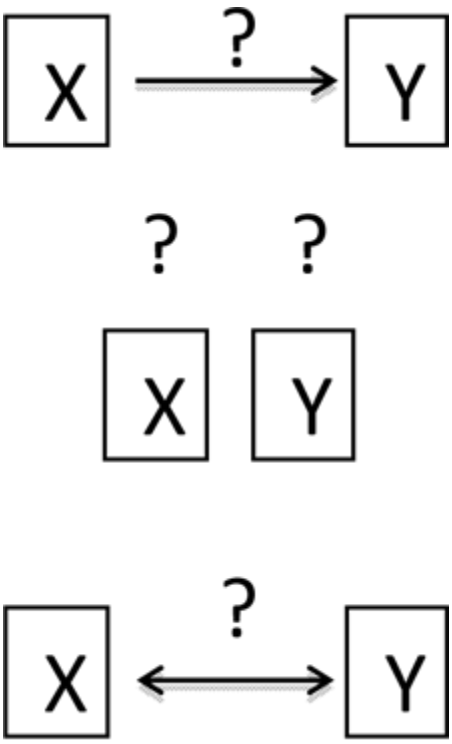
3.0. Main Content

3.1. Research Design

A very significant decision in research design process is the choice to be made regarding research approach since it determines how relevant information for a study will be obtained; however, the research design process involves many interrelated decisions (Aakar *et al*., 2000). Research design can be considered as the structure of research, it is the "Glue" that holds all of the elements in a research project together, in short, it is a plan of the proposed research work (Akhtar, 2016). A design is used to structure the research, to show how all of the major parts of the research project work together to try to address the central research questions." The research design is like a recipe. Just as a recipe provides a list of ingredients and the instructions for preparing a dish, the research design provides the components and the plan for successfully carrying out the study. The research design is the "backbone" of the research protocol.

Research studies are designed in a particular way to increase the chances of collecting the information needed to answer a particular question. The information collected during research is only useful if the research design is sound and follows the research protocol. Carefully following the procedures and techniques outlined in the research protocol will increase the chance that the results of the research will be accurate and meaningful to others. Following the research protocol and thus the design of the study is also important because the results can then be reproduced by other researchers. The more often results are reproduced, the more likely it is that researchers and the public will accept these

findings as true. Additionally, the research design must make clear the procedures used to ensure the protection of research subjects, whether human or animal, and to maintain the integrity of the information collected in the study.



There are many ways to design a study to test a hypothesis. The research design that is chosen depends on the type of hypothesis (e.g. Does X *cause* Y? or How can I *describe* X and Y? or What is the *relationship* between X and Y?), how much time and money the study will cost, and whether or not it is possible to find participants. Each of these points must be considered when designing the study and writing the research protocol.

There are many kinds of research, however, most of them fall into two categories: descriptive and experimental.

3.2 Need for Research Design

Research design is necessary because it makes possible the smooth sailing of the various research procedures, thereby making research as professional as possible, yielding maximum information with a minimum expenditure of effort, time and money (Akhtar, 2016). For better economic and attractive construction of a house, we need a blueprint (the map of the house) prepared by an expert architect. Similarly, we need a research design or a plan in advance of data collection and analysis for research projects. Research design stands for advance planning of the methods to be adopted for collecting the relevant data and the techniques to be used in the analysis, keeping in view the objective of the research and the availability of staff, time and money (McNabb, 2010). It is, therefore, imperative that an efficient and appropriate design must be prepared before starting research processes. Research design helps the investigator to organize his ideas in a way whereby it will be possible for him to look for errors and deficiencies (Michael, 1998).

4.0 Summary

i. Research studies are designed in a particular way to increase the chances of collecting the information needed to answer a particular question.
ii. Research design is the "Glue" that holds all of the elements in a research project together.
iii. Research design is intended to provide an appropriate framework for a study.

5.0 Conclusion

Research design is needed in advance of data collection and analysis. A good research design will take into consideration time and money. Research design must outline the procedures used to ensure the protection of research subjects, whether human or animal, and to maintain the integrity of the information collected in the study for proper analysis and interpretation so that end users are not misled.

6.0 Tutor-Marked Assignments

1. What is research design?
2. Of what significance is research design?

7.0 References and other Resources

Aaker, A., Kumar, V.D., George, S. (2000). Marketing Research. New York: John Wiley & Sons Inc.

Akhtar, I. (2016). Research Design.

Creswell, J., & Plano Clark, V. (2007). Designing and Conducting Mixed Methods Research. Thousand Oaks, CA: Sage

McNabb, D.E. (2010). Case Research in Public Management, New York: Routledge Publication

Michael, C. (1998). The Foundations of Social Research: Meaning and Perspective in the Research Process, New Delhi: SAGE Publications

Research Design. https://ori.hhs.gov/module-2-research-design. Accessed 05.11.2020.

Sileyew, K.J. (2019). Research Design and Methodology.

UNIT 3: TYPES OF RESEARCH STUDY

CONTENTS

1.0 Introduction

Research study can be descriptive or experimental. Data for research purpose can be obtained or gathered from naturally occurring phenomenon. Descriptive studies are carried out sometimes in order to relationship between things. In experimental study, a treatment is introduced and the result is observed.

2.0 Objectives

By the end of this unit, you will be able to:

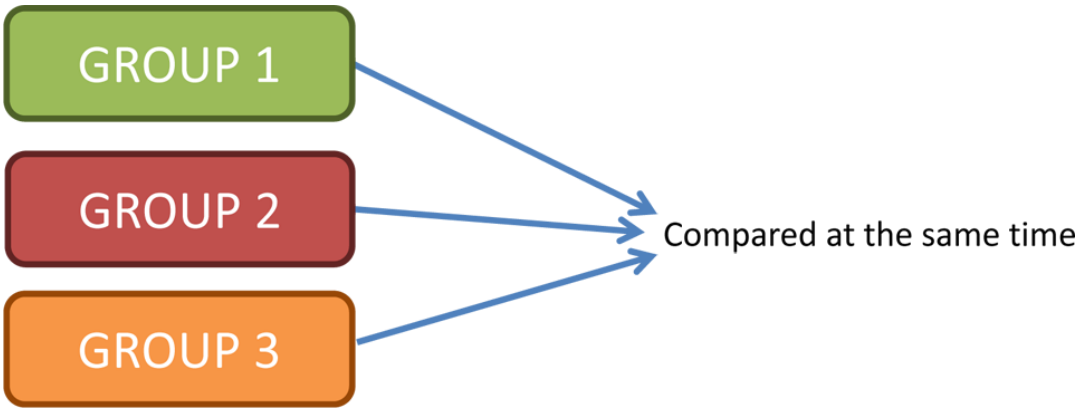
- explain descriptive and experimental researches;
- differentiate between descriptive and experimental design.

3.0 Main Content

3.1 Descriptive Study

A descriptive study is one in which information is collected without changing the environment (i.e., nothing is manipulated). Sometimes these are referred to as “correlational “or” observational " studies. The Office of Human Research Protections (OHRP) defines a descriptive study as "Any study that is not truly experimental." In human research, a descriptive study can provide information about the naturally occurring health status, behavior, attitudes or other characteristics of a particular group. Descriptive studies are also conducted to demonstrate associations or relationships between things in the world around you.

Descriptive studies can involve a one-time interaction with groups of people (cross-sectional study),



or a study might follow individuals over time (longitudinal study) as shown below

Descriptive studies, in which the researcher interacts with the participant, may involve surveys or interviews to collect the necessary information. Descriptive studies in which the researcher does not interact with the participant include observational studies of people in an environment (e.g., "fly on the wall") and studies involving data collection using existing records (e.g., medical record review).

Case Example for a Descriptive Study

A researcher wants to know why individuals in community A have a higher rate of a rare form of cancer when compared to those living in community B. To find out the reasons for the differences in cancer rates in these two communities, the investigator surveyed residents about their lifestyle, noted the types of businesses that were present in the community and searched medical records. The researcher found that the headquarters for the Toxico Chemical Plant is located in Community A, there is a higher rate of cigarette smoking in this community and residents tended to delay or skip going to the doctor for an annual checkup. In Community B, the largest employer was a department store and on average, residents did not smoke as much as residents from Community A. However, like individuals from Community A, Community B residents tended to delay or skip their annual checkup with their doctor.

3.2 Experimental Study

Unlike a descriptive study, an experiment is a study in which a treatment, procedure, or program is intentionally introduced and a result or outcome is observed. The American Heritage Dictionary of the English Language defines an experiment as "A test under controlled conditions that is made to demonstrate a known truth, to examine the validity of a hypothesis, or to determine the efficacy of something previously untried."

True experiments have four elements: manipulation, control , random assignment, and random selection as illustrated above. The most important of these elements are manipulation and control. Manipulation means that something is purposefully changed by the researcher in the environment. Control is used to prevent outside factors from influencing the study outcome. When something is manipulated and controlled and then the outcome happens, it makes us more confident that the manipulation "caused" the outcome. In addition, experiments involve highly controlled and systematic procedures in an effort to minimize error and bias, which also increases our confidence that the manipulation "caused" the outcome.

Another key element of a true experiment is random assignment. Random assignment means that if there are groups or treatments in the experiment, participants are assigned to these groups or treatments, or randomly (like the flip of a coin).

This means that no matter who the participant is, he/she has an equal chance of getting into all of the groups or treatments in an experiment. This process helps to ensure that the groups or treatments are similar at the beginning of the study so that there is more confidence that the manipulation (group or treatment) "caused" the outcome.

Definition: An experiment is a study in which a treatment, procedure, or program is intentionally introduced and a result or outcome is observed.

Case Example for Experimental Study

Experimental Studies — Example 1

An investigator wants to evaluate whether a new technique to teach math to elementary school students is more effective than the standard teaching method. Using an experimental design, the investigator divides the class randomly (by chance) into two groups and calls them "Group A" and "Group B." The students cannot choose their own group. The random assignment process results in two groups that should share equal characteristics at the beginning of the experiment.

In Group A, the teacher uses a new teaching method to teach the math lesson. In Group B, the teacher uses a standard teaching method to teach the math lesson. The investigator compares test scores at the end of the semester to evaluate the success of the new teaching method compared to the standard teaching method. At the end of the study, the results indicated that the students in the new teaching method group scored significantly higher on their final exam than the students in the standard teaching group.

Experimental Studies — Example 2

A fitness instructor wants to test the effectiveness of a performance-enhancing herbal supplement on students in her exercise class. To create experimental groups that are similar at the beginning of the study, the students are assigned into two groups at random (they cannot choose which group they are in). Students in both groups are given a pill to take every day, but they do not know whether the pill is a placebo (sugar pill) or the herbal supplement. The instructor gives Group A the herbal supplement and Group B receives the placebo (sugar pill). The students' fitness level is compared before and after six weeks of consuming the supplement or the sugar pill. No differences in performance ability were found between the two groups suggesting that the herbal supplement was not effective.

4.0 Conclusion

Descriptive studies are usually the best methods for collecting information that will demonstrate relationships and describe the world as it exists. These types of studies are often done before an experiment to know what specific things to manipulate and include in an experiment. Bickman and Rog (1998) suggested that descriptive studies can answer questions such as "what is" or "what was." Experiments can typically answer "why" or "how."

5.0 Summary

In this unit we have leant that:

i. Descriptive study usually asks questions such as what was and what is?
ii. Experimental study is always about why and how of something

True experiments have four elements: manipulation, control , random assignment, and random selection

6.0 Tutor-Marked Assignments

1. Differentiate between descriptive study and experimental study?
2. In detail, describe experimental study.

7.0 Reference/Further Reading

Module 2: Research Design – Section. https://ori.hhs.gov/module-2-research-design-section- Accessed 06.11.2020

UNIT 4: BASIC ELEMENTS OF RESEARCH

CONTENTS

1.0 Introduction

Research is the systematic investigation into and study of materials and sources in order to establish facts and reach new conclusion. Research aims at providing dependable solutions to problems.

2.0 Objectives

By the end of this unit, you will be able to:

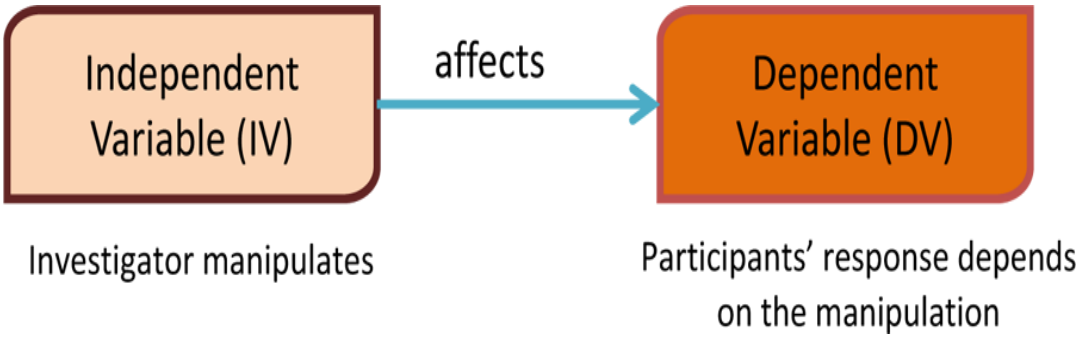
- identify types of variables relevant in a particular research;
- explain associations, cause and relationships between variables.

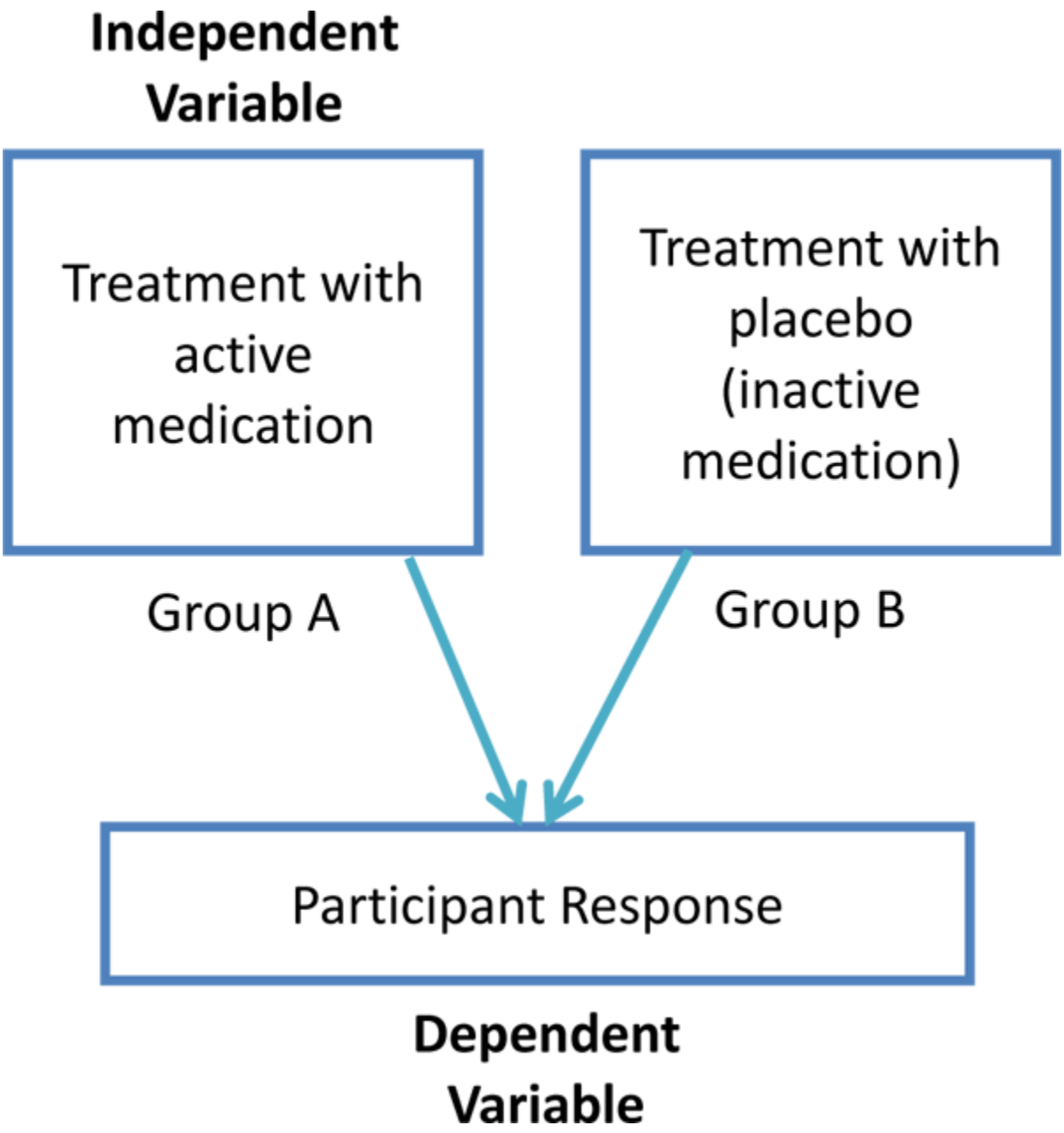
3.0 Main Content

3.1 Variables

The purpose of all research is to describe and explain variance in the world. Variance is simply the difference; that is, variation that occurs naturally in the world or change that we create as a result of a manipulation. Variables are names that are given to the variance we wish to explain.

A variable is either a result of some force or is itself the force that causes a change in another variable. In experiments, these are called dependent and independent variables respectively.





When a researcher gives an active medication to one group of people and a placebo, or inactive medication, to another group of people, the independent variable is the medication treatment. Each person's response to the active medication or placebo is called the dependent variable.

This could be many things depending upon what the medication is for, such as high blood pressure or muscle pain. Therefore, in experiments, a researcher manipulates an independent variable to determine if it causes a change in the dependent variable.

As we learned earlier in a descriptive study, variables are not manipulated. They are observed as they naturally occur and then associations between variables are studied. In a way, all the variables in descriptive studies are dependent variables because they are studied in relation to all the other variables that exist in the setting where the research is taking place. However, in descriptive studies, variables are not discussed using the terms "independent" or "dependent." Instead, the names of the variables are used when discussing the study. For example, there is more diabetes in people of Native American

heritage than people who come from Eastern Europe. In a descriptive study, the researcher would examine how diabetes (a variable) is related to a person's genetic heritage (another variable).

Definition: A variable is either a result of some force or it is the force that causes a change in another variable. In experiments, these are called dependent and independent variables respectively.

Case Examples for Independent and Dependent Variables

Example 1:

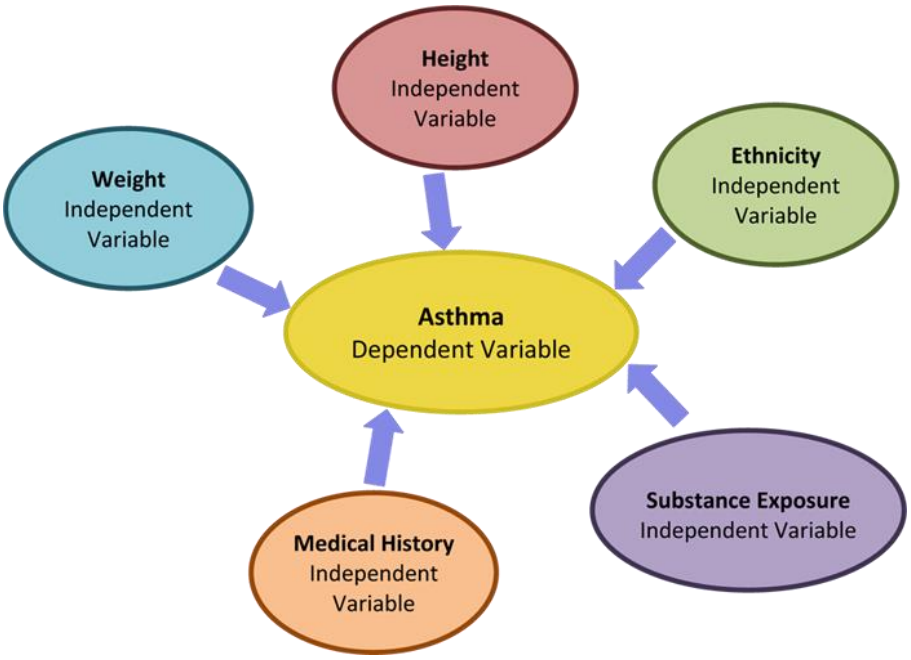
In an experimental study looking at classical music exposure and reading ability in children, the researcher divided the children into two groups (Groups A and B). In Group A, the children listened to Mozart for one hour every day for one month. In Group B, parents were instructed to refrain from playing classical music around the child for one month. At the end of the month, all children were given a reading comprehension test. Those who listened to Mozart daily (Group A) scored significantly higher on the reading test. In this case, the reading comprehension test score is the dependent variable and exposure to Mozart's music is the independent variable. This is because the test score is *dependent* on whether or not the child listens to Mozart's music. The independent variable, exposure to Mozart's music, is *independent* because it is something that can be manipulated or changed by the researcher.

Example 2:

In a study with a similar design as the previous example, researchers looked at the effects of nutrition on reading ability. In Group A, children ate at least three ounces of dark green vegetables every day for one month. In Group B, children were fed their regular diet. At the end of the month, the children took a reading comprehension test. Those who ate the green vegetables every day for one month (Group A) did not vary in their test scores when compared to Group B.

Variables are important to understand because they are the basic units of the information studied and interpreted in research studies. Researchers carefully analyze and interpret the value(s) of each variable to make sense of how things relate to each other in a descriptive study or what has happened in an experiment.

Definition: Variables are characteristics studied in research that can take on different values (e.g., weight, height, exposure to a substance, demographics (i.e., where you live, your ethnicity, how much income you have, medical background).



Case Example for Descriptive Study Variables

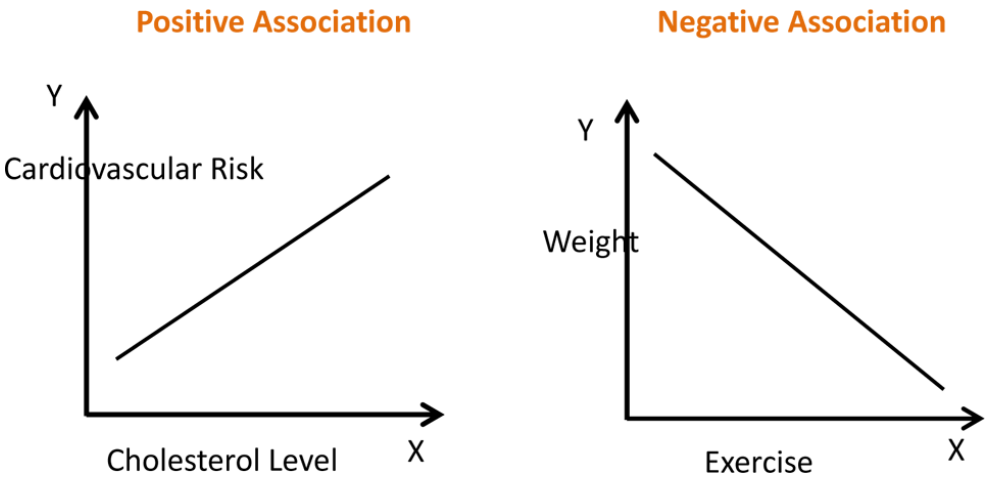
See if you can identify the variables that are under investigation in the following descriptive study:

Many children who live in the Bronx, a borough of New York City, are developing asthma. In a descriptive study investigating this problem, parents whose children have asthma are asked about whether they smoke around their child, whether they live near a freeway, whether their child regularly sees a healthcare provider, their family income level and also if there is a history in their family of asthma. Prior research has shown that these factors may have an influence on the development of asthma in children.

3.2 Association and Cause and Effect

Definition: The term association means that two or more things are related or connected to one another.

The term *association* means that two or more things are related or connected to one another like height and weight, cholesterol level and heart failure or exercise and weight loss. Associations can be positive or negative (the positive and negative associations do not necessarily mean that the association is 'good' or 'bad'). Positive associations suggest that when one variable is increased, the value of another variable increases (e.g., as height increases, so does weight; as cholesterol level increases, so does the risk of heart failure). Negative associations mean that when a variable is increased, the value of another variable decreases (e.g., exercise is introduced (or increased) and weight decreases). Associations can be found in experimental or descriptive studies. Finding significant associations, either during descriptive or experimental studies, may lead to the development of programs or treatments to remedy a particular problem.



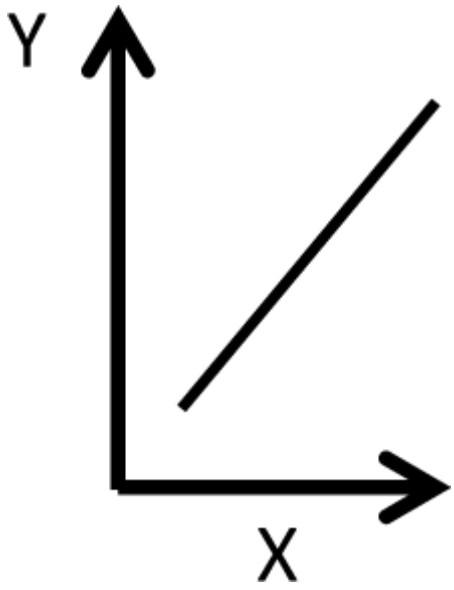
The variable X is the independent variable.

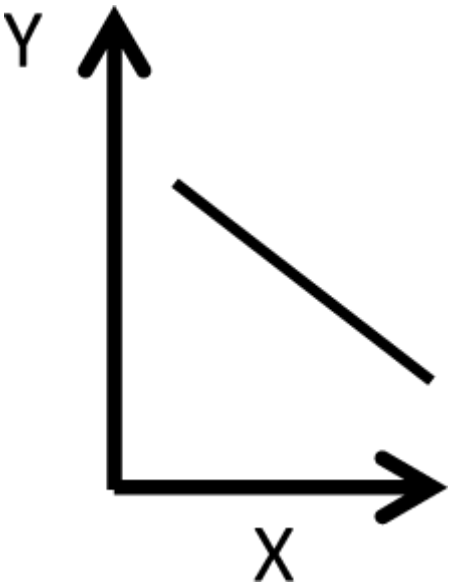
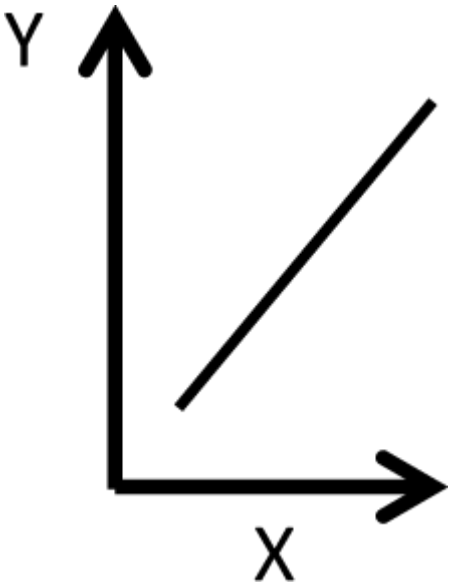
The variable Y is the dependent variable.

Case example for Associations and Cause and Effect

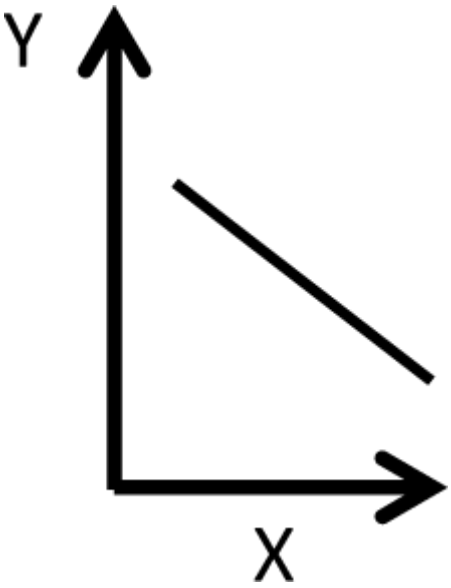
One example of an association is seen with aspirin use and prevention of heart attacks. The more aspirin that a former heart-attack patient takes, the less likely it is that he/she will have another heart attack (American Heart Association, "Aspirin and Heart Disease," , Accessed September 9, 2015).

Examples of Positive and Negative Associations:

Variable 1	**Variable 2**	**Direction of Association**	**Explanation**
Education level	Income level	Positive 	As education level increases, so does income level.
Exercise	Weight	Negative	As exercise increases, weight decreases

Variable 1	Variable 2	Direction of Association	Explanation
			
		Positive	
Study time	Test score		As study time increases, test score increases
Sick days	Work productivity	Negative	As number of sick days increases, work productivity decreases

Variable 1 **Variable 2** **Direction of Association** **Explanation**



4.0 Conclusion

Variables are relevant to research because they are the main units of the information studied, analyzed and interpreted in research studies. Researchers study them in order to know how they influence each other in a descriptive study or an experimental study. In experimental or descriptive studies, there can be some degree of association. Association means that two or more variables are related or connected to one another.

5.0 Summary

In this unit we have leant that:

i. The term *association* means that two or more things are related or connected to one another like height and weight.
ii. Variables are characteristics studied in research that can take on different values.
iii. The purpose of all research is to describe and explain variance in the world.

6.0 Tutor-Marked Assignments

1. Mention two types of variable and describe them
2. Cite and explain one example of association, cause and effect.

7.0 Reference/Further Reading

Elements of Research. https://ori.hhs.gov/module-3-elements-research-section-1. Accessed 06.11.2020.

UNIT 5: DRAWING CONCLUSION

CONTENTS

1.0 Introduction

For any research project and any scientific discipline, drawing conclusions is the final, and most important, part of the process (Shuttleworth and Wilson, 2008). Whichever reasoning processes and research methods were used, the final conclusion is critical, determining success or failure. Success or failure is not a measure of whether a hypothesis is accepted or refuted, because both results still advance scientific knowledge (Shuttleworth and Wilson, 2008). If an otherwise excellent experiment is summarized by a weak conclusion, the results will not be taken seriously.

2.0 Objectives

By the end of this unit, you will be able to:

- draw relevant conclusion from a conducted study;
- make useful recommendations.

3.0 Main Content

3.1 Drawing Conclusions: What's It All About?

You've collected and analyzed your data. Now it's time to answer your research question(s) -- remember, they are at the heart of the research process -- what it's all about!!!

Report your Findings -- e.g., the answer(s) to your research question(s)! Remind us of the question and tell us the answer that you've arrived at for your sample subjects!

But remember -- if you didn't study the whole population to whom you wish to 'project' or 'generalize' your findings and results ... now's the time to take the "leap of faith" and guess what may or may not be true for the population at large!

A discussion about drawing conclusions in research

State your Conclusions -- these are the projections beyond your sample. They could be sentences that sound like (whether you use this phrase or not), "Therefore, it can be concluded that ... "

Example:
Finding: "There was an average difference in science aptitude of 10.7 points between 6th-grade boys and girls for the 100 sample subjects who took the X test. Based on a t-test value of [value] [and other stats jargon we'll learn shortly, so stay tuned!], this difference is statistically significant."

Related Conclusion: "Therefore, it can be concluded that sixth grade boys and girls will differ, on average, in science aptitude."

Do you see, above, how one is very 'factual' and 'tied to YOUR SPECIFIC SAMPLE (finding)?' and how the related conclusion is 'what you assume to hold true in the population at large (from which your sample was drawn) based on these findings?'

Conclusions are the stuff of practitioners! For while you carefully select a sample and do your study, usually you -- and others who read and wish to apply -- your research are interested in going beyond your particular, individual sample and generalizing to the population at large. So -- the "leap of faith" is necessary to make your study widely applicable (beyond your specific sample!)!

We'll be talking in this course, as well as the related Intro to Statistics, about some specific ways that you can "tighten up the credibility" of your conclusions, so as to make them less "guesstimates" and "more certain!"

We've already briefly talked about one way: to use multiple sources of evidence or data -- e.g., to do a multimethod research study and collect data in several forms (numbers AND words) and then see if they "converge," or lead to the same direction of conclusions!

State Your Recommendations:

Based on these broad generalizations, or conclusions, what should the world do with your study findings?

List these as specifically as possible!

Recommendations for Practice (what will/should practitioners -- whoever is of interest in your study -- e.g., teachers of the gifted & talented; corporate chief financial officers; school superintendents in urban districts -- do with your findings?)

Recommendations for Future Research (as we'll see in this course, no single research design is flawless, all-inclusive and complete! You couldn't possibly have studied everything and everybody affected by the topic of your problem statement! How could you, or someone else, redo the study a bit differently to include some things/places/people that you left out? Redo in an urban district? Include a measure of satisfaction as well as motivation? Include individual as well as group interviews and compare the results? etc., etc.!)

State Your Implications:

Implications are your "detailed best guesses" as to "who will be better off and how" as a result of your doing this research study!

These can be listed and should be as thoroughly brainstormed as possible!

Examples:

1. Teachers will [understand, know, do ....];
2. Administrators will [understand, know, do ...];
3. Parents will [understand, know, do ...].

This way, you are truly ending your research report on a 'positive bang!' You are standing, looking out at the horizon, and closing the report by indicating "how the world will be a better place" as a result of your study!

Let's close for now by debunking one myth as to what research is NOT:

*Research is not simply a "massive term paper!"

A major literature review, where you state in detail everything that everyone else has ever found, or studied, about your subject, would NOT be considered "research" according to our definition and the preceding steps of the research process!

This is because of Step # 2 -- a massive lit review has no 'actual data collection' intended to address a defined research question or problem statement.

Now -- it IS OK to use such a massive lit review to help you in identifying a question or problem statement of interest! (Please look back at the diagram & beginning of notes to see that this is one common source of researchable questions.) BUT -- to make this "real research," you THEN have to DO SOMETHING -- e.g, collect and analyze some data of your own, be those data quant, qual, or both -- be they live and in person, or archival -- to answer your question!

This quality (of collecting and analyzing some data, in whatever form(s) to address/answer your problem statement/question -- is known as "empiricism." This quality of empiricism is the hallmark of "real research."

And -- the research process you have applied via the above steps is also known as the "scientific method." That is -- you are objectively collecting and analyzing evidence, information or data and letting THAT objective evidence 'drive' the answer to your research question -- as opposed to "hunches," "because someone else said so," and so forth!!!

4.0 Summary

In this unit we have leant that:

i. After data collection and analysis, the next thing is to report one’s findings.
ii. Stating recommendations is fundamental to research.
iii. Research is not simply a "massive term paper.

5.0 Conclusion

After data collection and analysis, the researcher should be able to report his findings without ambiguities and draw relevant conclusion and make useful recommendations.

All the research questions must be answered clearly and the research method should be such that, it is reproducible. Conclusion provides an opportunity to explain to anyone who is interested in the study what it is all about. Drawing conclusion from the research must be based on the findings of the study and not what the researcher thinks it is appropriate to put in the study. The conclusion must not be based on the findings of another study.

6.0 Tutor-Marked Assignments

1. What is the significance of recommendation to research?
2. Is it compulsory to answer all the research questions in a particular study? Justify the reasons for your answer.

7.0 Reference/Further Reading

Martyn Shuttleworth, Lyndsay T Wilson (2008). Drawing Conclusions. Retrieved Nov 06, 2020 from Explorable.com: https://explorable.com/drawing-conclusions

MODULE 2: HYPOTHESIS FORMULATION AND TESTING

UNIT 1: MEANING OF HYPOTHESIS
UNIT 2: NATURE OF HYPOTHESIS AND ROLES OF HYPOTHESIS
UNIT 3: CHARACTERISTICS, SOURCES, TYPES AND USES OF HYPOTHESES
UNIT 4: FORMULATING AND TESTING HYPOTHESIS
UNIT 5: STATISTICAL ERRORS, STATISTICAL POWER OF RESEARCH, LIMITATIONS AND CRITERIA FOR EVALUATING HYPOTHESIS

UNIT 1: MEANING OF HYPOTHESIS

CONTENTS

1.0 Introduction

A research hypothesis is a prediction of the outcome of a study. The prediction may be based on an educated guess or a formal theory.

2.0 Objectives

By the end of this unit, you will be able to:

- define hypothesis and the components of hypothesis;
- explain assumption, postulate and their importance in hypothesis.

3.0 Main Content

3.1 Definition of Hypothesis

The word hypothesis consists of two words: Hypo + thesis = Hypothesis (Kabir, 2016) 'Hypo' means tentative or subject to verification and 'Thesis' means statement about the solution of a problem. The meaning of the term hypothesis is a tentative statement about the solution of a problem. Hypothesis offers a solution to the problem that is to be verified empirically and based on some rationale. Another meaning of the word hypothesis, which is composed of two words, – 'Hypo' means composition of two or more variables which is to be verified. 'Thesis' means position of these variables in the specific frame of reference. This is the operational meaning of the term hypothesis. Hypothesis is the composition of some variables which have some specific position or role of the variables i.e. to be verified

empirically. It is a proposition about the factual and conceptual elements. Hypothesis is called a leap into the dark. It is a brilliant guess about the solution of a problem.

A hypothesis is a tentative statement about the relationship between two or more variables. A hypothesis is a specific, testable prediction about what you expect to happen in your study. To be complete, the hypothesis must include three components –

- The variables;
- The population; and
- The relationship between the variables. Remember, a hypothesis does not have to be correct. While the hypothesis predicts what the researchers expect to see, the goal of research is to determine whether this guess is right or wrong. When conducting an experiment, researchers might explore a number of different factors to determine which one might contribute to the ultimate outcome. In many cases, researchers may find that the results of an experiment do not support the original hypothesis. When writing up these results, the researchers might suggest other options that should be explored in future studies.

Example 1 is a hypothesis for a non-experimental study.

Example 1: It is hypothesized that first grade girls will show better reading comprehension than first grade boys.

In Example 1, the author is predicting that s/he will find higher comprehension among girls than boys. To test it, a non-experimental study would be appropriate because nothing in the hypothesis suggests that treatments will be given.

A simple research hypothesis predicts a relationship between two variables. From your study of variables, it should be clear that the two variables in Example 1 are (1) gender and (2) reading comprehension. The hypothesis states that reading comprehension is related to gender.

Example 2 is a hypothesis for an experimental study.

Example 2: It is hypothesized that children who are shown a video with mild violence will be more aggressive on the playground than those who are shown a similar video without the violence.

In Example 2, the *independent variable* is violence (mild vs. none), and the *dependent variable* is aggressiveness on the playground.

The hypotheses in Examples 1 and 2 are examples of directional hypotheses. In a directional hypothesis, we predict which group will be higher or have more of something.

Sometimes we have a non-directional hypothesis. Consider Example 3.

Example 3: It is hypothesized that the child-rearing practices of Tribe A are different from those of Tribe B.

The author of Example 3 is saying that there will be a difference but does not predict the direction of the difference. This is perfectly acceptable when there is no basis for making an educated guess.

Instead of a non-directional hypothesis, we might state a research purpose. Example 4 shows a research purpose that corresponds to the non-directional hypothesis in Example 3.

Example 4: The purpose is to explore the differences in child rearing practices between Tribe A and Tribe B.

A research question may also be substituted for a non-directional hypothesis. Example 5 shows a research question that corresponds to the non-directional hypothesis in Example 3.

Example 5: The research question is 'How do the childrearing practices in Tribe A and Tribe B differ?'

When using a research question as the basis for research, we should be careful not to state it as a question that can be answered with a simple 'yes' or 'no', as it is done in Example 6.

Example 6: The question is, 'Do the child-rearing practices in Tribe A and Tribe B differ?'

Example 6 merely asks 'do they differ?' This is not a very interesting research question. Example 5 is superior because it asks *'how* do they differ?'

The choice between a non-directional hypothesis, a research purpose, and a research question, is purely a matter of personal taste - all are acceptable in the scientific community. Of course, when we are willing to predict the outcome of a study, we should state a directional hypothesis.

3.2 Assumption, Postulate and Hypothesis

The terms assumption, postulate and hypothesis occur most frequently in the research literature, but are often confused by research scholars (Kabir, 2016). Hence these terms need clear explanation.

Assumption: Assumption means taking things for granted so that the situation is simplified for logical procedure. Assumptions are not the very ground of our activity as the postulates are. They merely facilitate the progress of an agreement a partial simplification by introducing restrictive conditions. For example, the formulas of statistics and measurement are based on number of assumptions. Assumption means restrictive conditions before the argument can become valid. Assumptions are made on the basis of logical insight and their truthfulness can be observed on the basis of data or evidences. The postulates are the basis and form the original point of an argument whereas assumptions are a matter of choice and less use, we make them more-free will and our argument is a general proposition or convention.

Postulate: Postulates are the working beliefs of most scientific activity. A postulate is a statement assumed to be true without the need of proof of any kind. A postulate states an assumption that we make about some relationship between objects. For example, we may postulate that $a+b = b+a$. This simply says that if we combine two objects, a and b, the order in which the combination occurs makes no difference in the result. By logical deductions, other statements, called theorems, are derived. From postulates to theorems we are entirely within the realm of ideas. There is no point in asking for experimental proof of deductions. Such a request would be meaningless. The only appeal for proof that is appropriate is entirely within the realm of logic.

Campbell proposed nine postulates. The first three postulates have to do with identities. The next row postulates have to do with the establishment of order. The last four have to do with additivity.

1. Either $a = b$ or $a \neq b$
   The first postulate establishes the identity of a number. Numbers are identical or they are different.
2. If $a = b$, then $b = a$
   The second postulate states that the relation of equality is symmetrical.

3. If a = b and b = c, then a = c
   The third postulate expresses in equation form the familiar dictum; things equal to the same thing are equal to one another.
4. If a > b, then b < a
   Postulate four points out that the relation is asymmetrical.
5. If a > b and b > c, then a > c

   Postulate five is a transitive statement.
6. If a = p and b > 0, then a+b > p
   Postulate six indicates the possibility of summation. It also implies the fact that the addition of zero leaves a number invariant.
7. a+b = b+a
   Postulate seven means that the order in which things are added makes no difference in the result.
8. If a = p and b = q, then a+b = p+q
   Postulate eight means that identical objects may be substituted for one another in addition.
9. (a+b) + c = a + (b+c)
   Finally, postulate nine means that the order of combinations or associations makes no difference in addition.

4.0 Conclusion

A hypothesis is different from a postulate and an assumption. It is the presumptive statement of a proposition which the investigator seeks to prove. It is a condensed generalization. This generalization requires knowledge of principles of things or essential characteristics which pertain to entire class of phenomena. The theory when stated as a testable proposition formally and clearly and subjected to empirical or experimental verification is known as hypothesis. The hypothesis furnishes the basis of the whole investigation and remains to test it out by facts. The hypothesis is based on some earlier theory and some rationale whereas postulates are taken as granted true. An assumption is the assumed solution of a major problem. It may be partially true. The scientific research process is based on some hypotheses. The nature of sciences and mathematics are based on postulates. The statistic is based on some assumptions which are considered approximate science. The assumptions are helpful in conducting a research work in behavioral sciences.

5.0 Summary

In this unit we have leant that:

i. A hypothesis is a tentative statement about the relationship between two or more variables.
ii. Assumption means taking things for granted so that the situation is simplified for logical procedure.
iii. A postulate is a statement assumed to be true without need of proof of any kind.

6.0 Tutor-Marked Assignments

1. Differentiate between a hypothesis and a postulate?
2. Identify three components of a hypothesis and describe them.

7.0 Reference/Further Reading

Kabir, S.M.S. (2016). Basic Guidelines for Research: An Introductory Approach for All Disciplines. Book Zone Publication, ISBN: 978-984-33-9565-8, Chittagong-4203, Bangladesh.

UNIT 2: NATURE OF HYPOTHESIS AND ROLES OF HYPOTHESIS

CONTENTS

1.0 Introduction

We cannot take a single step forward in any inquiry unless we begin with a suggested explanation or solution of the difficulty which originated it (Kabir, 2016). Such tentative explanations are suggested to us by something in the subject-matter and by our previous knowledge. When they are formulated as propositions, they are called hypotheses. The hypothesis (plural hypotheses) is a tentative solution of a problem. Hypothesis is a conjectural statement of relationship between two or more variables (Kerlinger, 1986). Research activities are planned to verify the hypothesis and not to find out the solution of the problem or to seek an answer of a question. It is very essential to a research worker to understand the meaning and nature of hypothesis. The researcher always plans or formulate a hypothesis in the beginning of the problem.

2.0 Objectives

By the end of this unit, you will be able to:

- explain the nature of hypothesis;
- discuss the roles of hypothesis and
- explain the importance of hypothesis.

3.0 Main Content

3.1 Nature of Hypothesis

The hypothesis is a clear statement of what is intended to be investigated. It should be specified before research is conducted and openly stated in reporting the results. This allows to – Identify…

- the research objectives;
- the key abstract concepts involved in the research; and
- its relationship to both the problem statement and the literature review.

The following are the main features of a hypothesis – It…

- Is conceptual in nature.
- Is a verbal statement in a declarative form.

- Has the empirical referent.
- Indicates the tentative relationship between two or more variables.
- Is a powerful tool of advancement of knowledge, consistent with existing knowledge and conducive to further enquiry.
- Can be tested, verified.
- Is not moral or ethical questions.
- Is neither too specific nor to general.
- Is a prediction of consequences.
- Is considered valuable even if proven false.

3.2 Roles of Hypothesis

A hypothesis, which is a provisional formulation, plays significant role in empirical or socio-legal research. It not only navigates research in a proper direction but also contributes in testing or suggesting theories and describing a social or legal phenomenon.

Role of hypothesis in navigating research: A hypothesis, regardless of its source, states what a researcher is looking for. It also suggests some plausible explanations about the probable relationships between the concepts or variables indicated therein. In fact, it navigates the research. Without it, no further step is possible in empirical research or non-doctrinal legal research. A hypothesis helps the researcher in drawing 'meaningful conclusions' supported by 'relevant' empirical data. A hypothesis serves as a sound guide to: (i) the kind of data that must be collected in order to answer the research problem; (ii) the way in which the data should be organized most efficiently and meaningfully, and (iii) the type of methods that can be used for making analysis of the data.

Role of 'tested' hypothesis: A hypothesis needs to be empirically tested to draw some inferences about the initially posited relationship between the variables indicated in the hypothesis. Therefore, when it is empirically tested (or not), the initially assumed relationship between the concepts or variables, as the case may be, becomes a proved fact. Once a hypothesis is established, it ceases to be a hypothesis.

A hypothesis also performs the following significant functions –

Test theories: A hypothesis, when empirically proved, helps us in testing an existing theory. A theory is not a mere speculation, but it is built upon facts. It is a set of inter-related propositions or statements organized into a deductive system that offers an explanation of some phenomenon. Facts constitute a theory when they are assembled, ordered and seen in a relationship. Therefore, when a hypothesis is 'tested', it not only supports the existing theory that accounts for description of some social phenomenon but also in a way 'tests' it.

Suggest new theories: A hypothesis, even though related to some existing theory, may, after tested, reveal certain 'facts' that are not related to the existing theory or disclose relationships other than those stated in the theory. It does not support the existing theory but suggests a new theory.

Describe social phenomenon: A hypothesis also performs a descriptive function. Each time a hypothesis is tested empirically, it tells us something about the phenomenon it is associated with. If the hypothesis is empirically supported, then our information about the phenomenon increases. Even if the hypothesis is refuted, the test tells us something about the phenomenon we did not know before.

Suggest social policy: A hypothesis, after its testing, may highlight such 'ills' of the existing social or legislative policy. In such a situation, the tested hypothesis helps us

in formulating (or reformulating) a social policy. It may also suggest or hint at probable solutions to the existing social problem(s) and their implementation.

The hypotheses play significant role in the scientific studies. According to Kabir (2016), the following are some of the important roles and functions of hypothesis -

- Helps in testing of theories.
- Serves as a great platform in research activities.
- Provides guidance to the research work or study.
- Hypothesis sometimes suggests theories.
- Helps in knowing the needs of data.
- Explains social phenomena.
- Develops theory.
- Also acts as a bridge between the theory and the investigation.
- Provides a relationship between phenomena in such a way that it leads to the empirical testing of the relationship.
- Helps in knowing the most suitable technique of analysis.
- Helps in the determination of the most suitable type of research.
- Provides knowledge about the required sources of data.
- Research becomes focused under the direction of the hypothesis.
- It is very helpful in carrying out an enquiry of a certain activity.
- Helps in reaching conclusions, if it is correctly drawn.

3.3 Importance of Hypothesis

Hypothesis as the Investigator's 'Eyes': By guiding the investigator in further investigation it serves as the investigator's 'Eyes' in seeking answers to tentatively adopted generalization.

It Focuses Research: Without it, research is unfocussed research and remains like a random empirical wandering. It serves as necessary link between theory and the investigation.

It Places Clear and Specific Goals: A well thought out set of hypotheses is that they place clear and specific goals before the research worker and provide researcher with a basis for selecting sample and research procedure to meet these goals.

It Links Together: It serves the important function of linking together related facts and information and organizing them into wholes.

It Prevents Blind Research: The use of hypothesis prevents a blind search and indiscriminate gathering of masses of data which may later prove irrelevant to the problem under study.

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

4.0 Summary

In this unit we have leant that:

i. A hypothesis provides the map that guides and expedites the exploration of the phenomena under consideration.
ii. A hypothesis needs to be empirically tested to draw some inferences.
iii. Each hypothesis may lead to formulate another hypothesis.

5.0 Conclusion

Even though, a hypothesis is a tentative statement, it serves many useful purposes. It links together related facts and information and organize them into a whole unit. It is a vital research instrument.

6.0 Tutor-Marked Assignments

1. List five importance of hypothesis.
2. Highlight five features of a hypothesis.

7.0 References/Further Reading

Kabir, S.M.S. (2016). Basic Guidelines for Research: An Introductory Approach for All Disciplines. Book Zone Publication, ISBN: 978-984-33-9565-8, Chittagong-4203, Bangladesh.

Kerlinger, F.N. (1986). Foundations of Behavioural Research, 3rd edition, New York: Holt, Rinehart and Winston.

UNIT 3: CHARACTERISTICS, SOURCES, TYPES AND USES OF HYPOTHESES

CONTENTS

1.0 Introduction

A hypothesis should be clear in terms of context and should be verifiable. It should not be at variance with existing knowledge.

2.0 Objectives

By the end of this unit, you will be able to:

- mention the characteristics of a good hypothesis;
- mention the sources, types and uses of hypothesis.

3.0 Main Content

3.1 Characteristics of a good Hypothesis

A good hypothesis must possess the following characteristics –
It…

- is never formulated in the form of a question.
- should be empirically testable, whether it is right or wrong.
- should be specific and precise.
- should not be contradictory.
- should specify variables between which the relationship is to be established.
- should describe one issue only. A hypothesis can be formed either in descriptive or relational form.
- does not conflict with any law of nature which is known to be true.
- guarantees that available tools and techniques will be effectively used for the purpose of verification.
- should be stated as far as possible in most simple terms so that the same is easily understandable by all concerned.
- must explain the facts that give rise to the need for explanation.
- should be amenable to testing within a reasonable time.

A ‘workable’ or ‘usable’ hypothesis would be the one that satisfies many of the following criteria.

Hypothesis should be conceptually clear: The concepts used in the hypothesis should be clearly defined, not only formally but also, if possibly, operationally. Formal definition of the concepts will clarify what a particular concept stands for, while the operational definition will leave no ambiguity about what would constitute the empirical evidence or indicator of the concept on the plane of reality. Obviously, an undefined or ill-defined concept makes it difficult or rather impossible for the researcher to test hypothesis as there will not be any standard basis for researcher to know the observable facts. However, a researcher, while defining concepts, should use, as far as possible, the terms that are communicable or definitions that are commonly accepted. It should be stated as far as possible in most simple terms so that it can be easily understood by all. Researcher should not create "a private world of words."

Hypothesis should be specific: No vague or value-judgmental terms should be used in formulation of a hypothesis. It should specifically state the posited relationship between the variables. It should include a clear statement of all the predictions and operations indicated therein and they should be precisely spelt out. Specific formulation of a hypothesis assures that research is practicable and significant. It helps to increase the validity of results because the more specific the statement or prediction, the smaller the probability that it will actually be borne out as a result of mere accident or chance. A researcher, therefore, must remember that narrower hypothesis is generally more testable and s/he should develop such a hypothesis.

Hypothesis should be empirically testable: It should have empirical referents so that it will be possible to deduce certain logical deductions and inferences about it. Therefore, a researcher should take utmost care that his/her hypothesis embodies concepts or variables that have clear empirical correspondence and not concepts or variables that are loaded with moral judgments or values. Such statements as 'criminals are no worse than businessmen', 'capitalists exploit their workers', 'bad parents beget bad children', 'bad homes breed criminality', or 'pigs are well named because they are so dirty' can hardly be usable hypotheses as they do not have any empirical referents for testing their validity. In other words, a researcher should avoid using terms loaded with values or beliefs or words having moral or attitudinal connotations in his hypothesis.

Hypothesis should be related to available techniques: Ignorance of the available techniques, makes a researcher weak in formulating a workable hypothesis. A hypothesis, therefore, needs to be formulated only after due thought has been given to the methods and techniques that can be used for measuring the concepts or variables incorporated in the hypothesis.

Hypothesis should be related to a body of theory or some theoretical orientation: A hypothesis, if tested, helps to qualify, support, correct or refute an existing theory, only if it is related to some theory or has some theoretical orientation. A hypothesis imaginatively formulated does not only elaborate and improve existing theory but may also suggest important links between it and some other theories. Thus, exercise of deriving hypothesis from a body of theory may also be an occasion for scientific leap into newer areas of knowledge.

A hypothesis derived from a theory invests its creator with the power of prediction of its future. The potency of hypothesis in regard to predictive purpose constitutes a great advancement in scientific knowledge. A genuine contribution to knowledge is more likely to result from such a hypothesis. A hypothesis, it is said, to be preferred is one which can predict what will happen, and from which we can infer what has already happened, even if we did not know (it had happened) when the hypothesis was formulated.

3.2 Sources of Hypothesis

Hypotheses are originated from essentially the same background that serves to reveal problem. These sources are namely theoretical background, knowledge, insight and imagination that come from instructional program and wide reading experiences, familiarity with existing practices. The major sources of hypotheses are given below-

- Specialization of an educational field.
- Published studies, abstracts research journals, hand books, seminars on the issue, current trends on the research area.
- Instructional programs.
- Analysis of the area studied.
- Existing practices and needs.
- Extension of investigation.
- Offshoots of research studies in the field.

Researcher employs these sources for formulating hypotheses of his/her investigation. S/he has to use two logical processes to draw upon in developing a hypothesis. The processes are known as - (a) Deductive thinking, and (b) Inductive thinking.

Deduction is a process which goes from the general to the specific. In deduction, general expectations about problems or events based on presumed relationships between variables are used to arrive at more specific expectations.

Induction is a process which goes from the specific to the general. In the induction process, researcher starts with specific observations and combines them to produce a more general statement of relationship namely a hypothesis.

Many researchers begin by searching the literature for relevant specific findings in order to induce a hypothesis, and other often run a series of exploratory studies before attempting to induce a hypothesis. Induction begins with data and observations or empirical events and proceeds toward hypothesis and theories, while deduction begins with theories and general hypothesis and proceeds towards specific hypothesis.

A hypothesis or a set of hypotheses may originate from a variety of sources. The source of hypothesis, however, has an important bearing on the nature of contribution in the existing body of knowledge. A few prominent sources of hypothesis are discussed here below.

Hunch or intuition: A hypothesis may be based simply on hunch or intuition of a person. It is a sort of virgin idea. Such a hypothesis, if tested, may ultimately make an important contribution to the existing science or body of knowledge. However, when a hypothesis is tested in only one study, it suffers from two limitations. First, there is no assurance that the relationship established between the two variables incorporated in the hypothesis will be found in other studies. Secondly, the findings of such a hypothesis are likely to be unrelated to, or unconnected with other theories or body of science. They are likely to remain isolated bits of information. Nevertheless, these findings may raise interesting questions worth pursuing. They may stimulate further research, and if substantiated, may integrate into an explanatory theory.

Findings of other: A hypothesis may originate from findings of other study or studies. A hypothesis that rests on the findings of other studies is obviously free from the first limitation, i.e. there is no assurance that it may relate with other studies. If such a hypothesis is proved, it confirms findings of the earlier studies though it replicates earlier study conducted in different concrete conditions.

A theory or a body of theory: A hypothesis may stem from existing theory or a body of theory. A theory represents logical deductions of relationship between inter-related proved facts. A researcher may formulate a hypothesis, predicting or proposing certain relationship between the facts or propositions interwoven in a theory, for verifying or reconfirming the relationship. A theory gives direction to research by stating what is known. Logical deductions from these known facts may trigger off new hypotheses.

General social culture: General social culture furnishes many of its basic hypotheses. Particular value-orientation in the culture, if it catches attention of social scientists for their careful observation, generates a number of empirically testable propositions in the form of hypotheses.

Analogy: Analogies may be one of the fertile sources of hypothesis. Analogies stimulate new valuable hypotheses. They are often a fountain-head of valuable hypotheses. Even casual observation in the nature or in the framework of another science may be a fertile source of hypotheses. A proved particular pattern of human behavior, in a set of circumstances or social settings, may be a source of hypothesis. A researcher may be tempted to test these established co-relations with similar attributes in different social settings. Researcher may be interested to test these analogies in a sort of different settings and circumstances. Researcher seeks inspiration for formulating the hypothesis from analogies of others. However, a researcher, when s/he uses analogy as a source of his/her hypothesis, needs to carefully appreciate the theoretical framework in which the analogy was drawn and its relevance in the new frame of reference.

Personal experience: Not only do culture, science and analogy, among others, affect the formulation of hypotheses. The way in which an individual reacts to each of these is also a factor in the statement of hypotheses. Therefore, individual experience of an individual contributes to the type and the form of the questions researcher asks, as also to the kinds of tentative answers to these questions (hypotheses) that s/he might provide. Some scientists may perceive an interesting pattern from merely seem a 'jumble of facts' to a common man. The history of science is full of instances of discoveries made because the 'right' individual happened to make the 'right' observation because of researcher's particular life history, personal experience or exposure to a unique mosaic of events. Researcher's personal experience or life history may influence his/her perception and conception and in turn direct quite readily to formulate certain hypothesis.

Thus, a hypothesis may originate from a variety of sources, in isolation or in combination with another. However, in spite of these fertile sources of hypotheses, it is not easy to formulate a usable or workable hypothesis. It is often more difficult to find and formulate a problem than to solve it. If a researcher succeeds in formulating a hypothesis, s/he can assure that it is half-solved. While formulating a hypothesis, researcher has to keep reminding that s/he has to formulate tentative proposition in such a way that it becomes usable in systematic study.

3.3 Types of Research Hypothesis

Before researchers can begin working on a question that interests them, they need to formulate a research hypothesis. This is an important step in the scientific method

because this determines the direction of the study. Scientists need to scrutinize previous work in the area and select an experimental design to use that helps them find data that either supports or rejects their hypothesis. Research hypotheses are of different types: simple, complex, directional, non-directional, associative, causal, inductive & deductive, null, and alternative or research.

Simple Hypothesis: This predicts the relationship between a single independent variable (IV) and a single dependent variable (DV). For example: Lower levels of exercise postpartum (IV) will be associated with greater weight retention (DV).

Complex Hypothesis: This predicts the relationship between two or more independent variables and two or more dependent variables. Example of a complex multiple independent variable hypothesis - low risk pregnant women (IV) who

- value health highly;
- believe that engaging in health promoting behaviour will result in positive outcomes;
- perceive fewer barriers to health promoting activities; are more likely than other women to attend pregnancy-related education programs (DV). Another example of a complex multiple dependent variable hypothesis - the implementation of an evidence-based protocol for urinary incontinence (IV) will result in (DV)
- decreased frequency of urinary incontinence episodes;
- decreased urine loss per episode;
- decreased avoidance of activities among women in ambulatory care settings.

Directional Hypothesis: This may imply that the researcher is intellectually committed to a particular outcome. They specify the expected direction of the relationship between variables i.e. the researcher predicts not only the existence of a relationship but also its nature. Scientific journal articles generally use this form of hypothesis. The investigator bases this hypothesis on the trends apparent from previous research on this topic. Considering the example, a researcher may state the hypothesis as, 'High school students who participate in extracurricular activities have a lower GPA than those who do not participate in such activities.' Such hypotheses provide a definite direction to the prediction.

Non-directional Hypothesis: This form of hypothesis is used in studies where there is no sufficient past research on which to base a prediction. Do not stipulate the direction of the relationship. Continuing with the same example, a non-directional hypothesis would read, 'The academic performance of high school students is related to their participation in extracurricular activities.'

Associative Hypothesis: Associative hypotheses propose relationships between variables, when one variable changes, the other changes. Do not indicate cause and effect.

Causal Hypothesis: Causal hypotheses propose a cause and effect interaction between two or more variables. The independent variable is manipulated to cause effect on the dependent variable. The dependent variable is measured to examine the effect created by the independent variable. For the example mentioned, the causal hypothesis will state, 'High school students who participate in extracurricular activities spend less time studying which leads to a low GPA.' When verifying such hypotheses, the researcher needs to use statistical techniques to demonstrate the presence of a relationship between

the cause and effect. Such hypotheses also need the researcher to rule out the possibility that the effect is a result of a cause other than what the study has examined.

Inductive and Deductive Hypotheses: Inductive hypotheses are formed through inductively reasoning from many specific observations to tentative explanations. Deductive hypotheses are formed through deductively reasoning implications of theory.

Table 1: States of Nature and Decisions on Null Hypothesis

Decision on Null Hypothesis	States of Nature	
	Null Hypothesis True	Null Hypothesis False
Accept	Correct Decision Probability = 1- α	Type II error Probability = β
Reject	Type I error Probability = α (α is called significance level)	Correct Decision Probability = 1- β (1- β is called power of a test)

The rejection of the null hypothesis indicates that the differences have statistical significance and the acceptance of the null hypothesis indicates that the differences are due to chance.

Alternative or Research Hypothesis: This hypothesis proposes a relationship between two or more variables, symbolized as H_1. For example, if a researcher is interested in examining the relationship between music and emotion, s/he may believe that there is a relationship between music and emotion.
H_1 (the research/alternative hypothesis): Music at a fast tempo is rated by participants as being happier than music at a slow tempo.
H_0 (the null hypothesis): Music at a fast tempo and at a slow tempo is rated the same in happiness by participants.
The two hypotheses we propose to test must be *mutually exclusive;* i.e., when one is true the other must be false. And we see that they must be *exhaustive*; they must include all possible occurrences.

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

3.4 Uses of Hypotheses in Educational Research

Educational researches may be classified into four types: experimental research; normative survey research; historical research; and complex casual research.

- Hypotheses are indispensable for experimental researches. The experiments are conducted to collect empirical data to verify hypotheses. The experimental method or experimental designs are based on hypotheses. Hypotheses are the crucial aspects of such researches.
- In normative survey research, the investigator may or may not employ hypothetical type thinking, depending upon the purpose of the research study. Hypotheses are essential for analytical studies and there is little scope in descriptive type studies.
- In historical research, the purpose may be either to produce a faithful record of the past events irrespective of present-day problem or to extend the experience with phenomena in the present to past in order to make the view of the phenomena. There is a little scope of hypotheses in historical research because hypothesis has the future reference and its verification on empirical data. Case study method has no scope for constructing hypotheses because it is developmental type study.
- In complex casual research, the hypotheses have important role in such investigations. These types of studies are conceptual in nature whereas historical

are more factual in nature. Therefore, formulation of hypothesis is a crucial step of this type of studies.

4.0 Conclusion

Hypothesis is of different types, each having its own peculiarity and it is indispensable in research. A hypothesis may originate from a variety of sources, in isolation or in combination with another. Different types of hypothesis are simple, complex, directional, non-directional, associative, casual, inductive & deductive, null, and alternative or research.

5.0 Summary

In this unit we have leant that:

i. Alternative or Research Hypothesis proposes a relationship between two or more variables, symbolized as H_1.
ii. A hypothesis may stem from existing theory or a body of theory.
iii. Causal hypotheses propose a cause and effect interaction between two or more variables.

6.0 Tutor-Marked Assignments

1. Differentiate between alternative and null hypothesis.
2. What is type I error?

7.0 Reference/Further Reading

Kabir, S.M.S. (2016). Basic Guidelines for Research: An Introductory Approach for All Disciplines. Book Zone Publication, ISBN: 978-984-33-9565-8, Chittagong-4203, Bangladesh.

UNIT 4: FORMULATING AND TESTING HYPOTHESIS

CONTENTS

1.0 Introduction

Hypothesis needs to be properly formulated so that appropriate analytical tool can be deployed to test them. According to Kabir (2016), parameters such as level of significance, critical region, confidence interval, etc. have to be taken into consideration.

2.0 Objectives

By the end of this unit, you will be able to:

- Formulate hypothesis;
- Know the meaning of directional and non-directional tests

3.0 Main Content

3.1 Formulating Hypothesis

3.1.1 Level of Significance

The level of significance is the probability of rejecting a true null hypothesis that is the probability of "Type I error" and is denoted by α (Kabir, 2016). The frequently used values of α are 0.05; 0.01; 0.1 etc.

When, $\alpha = 0.05$ it means that level of significance is 5%.

$\alpha = 0.01$ it means 1% level of significance.

$\alpha = 0.1$ it means 10% level of significance.

In fact, α specifies the critical region. A computed value of the test statistic that falls in the critical region (CR) is said to be significant. So, α is called the level of significance.

3.1.2 Critical/Rejection Region

The critical region (CR) or rejection region (RR) is the area under the curve beyond certain limits in which the population value is unlikely to fall by chance only when the null hypothesis is assumed to be true. If an observed value falls in this region H_0 is rejected and the observed value is said to be significant. In a word, the region for which H_0 is rejected is called critical region or rejection region.

3.1.3 Confidence Interval

Confidence interval is the interval marked by limits within which the population value lies by chance and the hypothesis is consider to be tenable. If an observed value falls in confidence interval, H_0 is accepted

3.1.4 Critical Values

The values of the test statistic which separates critical region from confidence region (acceptance region) are called critical values.

3.1.5 Standard Deviation

The standard deviation is the most frequently calculated measure of variability or dispersion in a set of data points. The standard deviation value represents the average distance of a set of scores from the mean or average score. A smaller standard deviation represents a data set where scores are very close to the mean score (a smaller range). A data set with a larger standard deviation has scores with more variance (a larger range). For example, if the average score on a test was 80 and the standard deviation was 2, the scores would be more clustered around the mean than if the standard deviation was 10.

3.1.6 Standard Error

The standard error is an estimate of the standard deviation . The standard error is important because it is used to compute other measures, like confidence intervals and margins of error. The standard error is computed from known sample statistic, and it provides an unbiased estimate of the standard deviation of the statistic.

3.1.7 Degree of Freedom

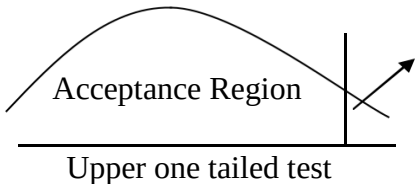
Degree of freedom refers to the number of values which are free to vary after we have given the number of restrictions imposed upon the data. It is commonly abbreviated by *df*. In statistics, it is the number of values in a study that are free to vary. For example, if you have to take ten different courses to graduate, and only ten different courses are offered, then you have nine degrees of freedom. Nine semesters you will be able to choose which class to take; the tenth semester, there will only be one class left to take - there is no choice, if you want to graduate. Degrees of freedom are commonly discussed in relation to chi-square (χ^2) and other forms of hypotheses testing statistics. It is important to calculate the degree(s) of freedom when determining the significance of a chi-square statistic and the validity of the null hypothesis. In chi-square (χ^2) the number of degrees of freedom is described as the number of observations that are free to vary after certain restrictions have been imposed on the data. In a contingency table, the cell frequencies of all columns but one *(c-1)* and of all rows but one *(r-1)* can be assigned arbitrarily and so the number of degrees of freedom for all cell frequencies is *(c-1) (r-1),* where *'c'* refers columns and *'r'* refers rows. Thus, in a 2x2 table, the degrees of freedom would be (2-1) (2-1) = 1 and in a 3x3 table, the *df* would be (3-1) (3-1) = 4.

3.1.8 One-tailed and Two-tailed Tests

One-tailed Test: A test in which the critical region is located in one tail of the distribution of test of statistic is called one-tailed test. There are two types of one-tailed test in test of hypothesis – (a) Right tailed test and (b) Left tailed test.

A test in which critical region is located in right tail of the distribution of test statistic is called a right tailed test or upper one tailed test.

Critical Region



Upper one tailed test

A test in which critical region is located in left tail of the distribution of test statistic is called left tailed test or lower one tailed test.

Critical Region

Lower one tailed test

One tailed alternative hypothesis leads to one tailed test. Hypotheses of one tailed tests are –

a. $H_0: \Theta \leq \Theta_0$ $H_1: \Theta > \Theta_0$

b. $H_0: \Theta \geq \Theta_0$ $H_1: \Theta < \Theta_0$

Two-tailed Test: A test in which the critical region is located in two tails of the distribution of test of statistic is called two tailed test.

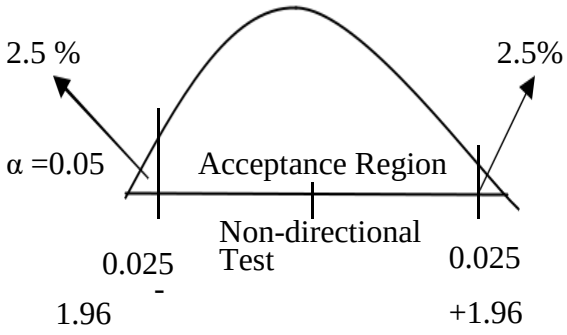
Two-tailed Test

Two-sided alternative hypothesis leads to two-tailed test. The hypotheses are represented as – $H_0: \Theta = \Theta_0$; $H_1: \Theta \neq \Theta_0$

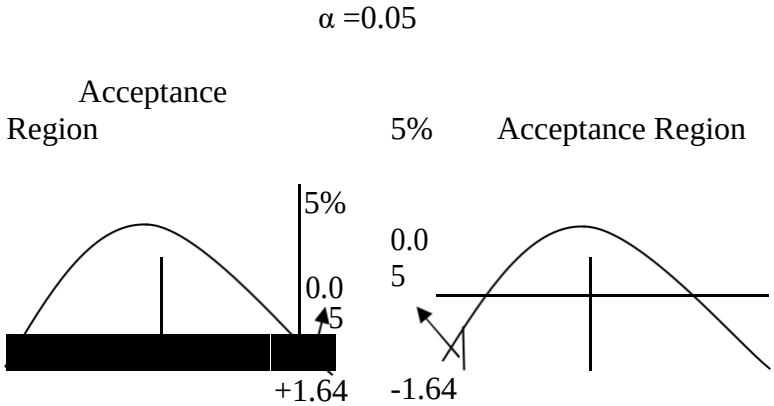
3.1.9 Directional and Non-directional Tests

Non-directional Test: We may wish to test the null hypothesis $H_0: \mu_1 - \mu_2 = 0$ against the alternative $H_1: \mu_1 - \mu_2 \neq 0$. This means that if H_0 is rejected, the decision is that a difference exists between the two means. No assertion is made about the direction of the difference. Such a test is a non-directional test. A test of this kind is sometimes called a two-tailed or two-sided test, because if the normal distribution or the distribution of *t* is used, the two tails of the distribution are employed in the estimation of probabilities.

Consider a 5% significance level. If the sampling distribution is normal, 2.5% of the area of the curve falls to the right of 1.96 standard deviation units below the mean.



Directional Test: Under certain circumstances we may wish to make a decision about the direction of the difference. If concerned with the direction of the difference, we may test the hypothesis $H_0: \mu_1 - \mu_2 \leq 0$



Directional Test

against the alternative H_1: $\mu_1 - \mu_2 > 0$ or the hypothesis H_0: $\mu_1 - \mu_2 \geq 0$ against the alternative H_1: $\mu_1 - \mu_2 < 0$. The symbol H_0 has been used to denote three different hypotheses – (a) a hypothesis of no difference, (b) a hypothesis of equal to or less than, and (c) a hypothesis of equal to or greater than. Such tests are directional one-sided test. If the normal or *t* distribution is used, one side or one tail only is employed to estimate the required probabilities.

To reject H_0: $\mu_1 - \mu_2 \leq 0$ and accept H_1: $\mu_1 - \mu_2 > 0$, using the normal distribution, a normal deviate greater than +1.64 is required for significance at the 0.05 level. Likewise, to reject H_0: $\mu_1 - \mu_2 \geq 0$ and accept H_1: $\mu_1 - \mu_2 < 0$, the corresponding normal curve is less than -1.64. The fact that for a normal distribution 5 percent of the area of the curve falls beyond +1.64 standard deviation units above the mean, and 5% beyond -1.64 standard deviation units below the mean.

The choice between a non-directional or directional alternative hypothesis should be determined by the rationale that gives rise to the study and should be made before the data are gathered. The major advantage of a directional alternative hypothesis is that it takes less of a deviation from expectation to reject the null hypothesis.

3.2 Testing the Hypothesis

Approaches of Hypothesis Testing: There are three approaches of hypothesis testing (Table 1). Each approach requires different subjective criteria and objective statistics but ends up with the same conclusion.

Test Statistic Approach: The classical test statistic approach computes a test statistic from empirical data and then compares it with a critical value. If the test statistic is larger than the critical value or if the test statistic falls into the rejection region, the null hypothesis is rejected.

P-Value Approach: In the *p*-value approach, researchers compute the *p*-value on the basis of a test statistic and then compare it with the significance level (test size). If the *p*-value is smaller than the significance level, researches reject the null hypothesis. A *p*-value is considered as amount of risk that researchers have to take when rejecting the null hypothesis.

Confidence Interval Approach: Finally, the confidence interval approach constructs the confidence interval and examines if a hypothesized value falls into the interval. The null hypothesis is rejected if the hypothesized value does not exist within the confidence interval.

Table 1: Three Approaches of Hypothesis Testing

Step	Test Statistic Approach	P- value Approach	Confidence Interval Approach
1	State H_0 and H_1	State H_0 and H_1	State H_0 and H_1
2	Determine test size α and find the critical value	Determine test size α or 1- α	Determine test size α or 1- α, and a hypothesized value
3	Compute a test statistic	Compute a test statistic and its p-value	Constructthe (1- α) 100% confidence interval
4	Reject H_0 if Test Statistic > Critical Value	Reject H_0 if *p*-value < α	Reject H_0 if a hypothesized value does not exist in Confidence Interval
5	Substantive interpretation	Substantive interpretation	Substantive interpretation

Procedure for/ Steps of Hypothesis Testing: All hypothesis tests are conducted the same way. The researcher states a hypothesis to be tested, formulates an analysis plan, analyzes sample data according to the plan, and accepts or rejects the null hypothesis, based on results of the analysis. The general logic and procedure followed in testing hypothesis comprised the following steps –

1. Assumption: If there is any assumption about the normality of the population distribution, equality of variance, independence of samples, etc. they should be stated.
2. State the Hypotheses: Every hypothesis test requires the analyst to state a null hypothesis (H_0) and an alternative hypothesis (H_1). A hypothesis which states that there is no difference between assumed and actual value of the parameter is the null hypothesis and the hypothesis that is different from the null hypothesis is the alternative hypothesis. The hypotheses are stated in such a way that they are mutually exclusive. That is, if one is true, the other must be false; and vice versa.
3. Set up a Statistical Significance Level: Set the significance level (α) if not already given. α specifies the critical region. Often, researchers choose significance levels equal to 0.01, 0.05, or 0.10; but any value between 0 and 1 can be used.
4. Determination of a Suitable Test Statistic: Test statistic is a formula or function on sample data. When the null hypothesis involves a mean or proportion, use either of the following equations to compute the test statistic.

Test statistic = (Statistic - Parameter) / (Standard deviation of statistic)
Test statistic = (Statistic - Parameter) / (Standard error of statistic)
Where, parameter is the value appearing in the null hypothesis, and statistic is the point estimate of parameter.

5. Determine the Critical Region: It is important to specify the acceptance (confidence interval) and rejection (critical) region before the sample is taken, which values of the test statistic will lead to a rejection or acceptance of H_0.
6. Doing Computations: Compute the appropriate test statistic based on sample information.
7. Interpret the Results: Examine whether the calculated test statistic falls in the acceptance or rejection region. If it falls in the rejection region (critical region), the null hypothesis is rejected. If it falls in the accepted region, the null hypothesis is accepted.
8. Making Decision: Make the suitable conclusion for the problem under study.

4.0 Conclusion

All hypothesis tests are carried out in the same way. The researcher states a hypothesis to be tested, formulates a plan of analysis, analyzes sample data according to the plan, and accepts or rejects the null hypothesis based on the results of the analysis.

5.0 Summary

In this unit we have leant that:

i. A test in which the critical region is located in two tails of the distribution of test of statistic is called two tailed-test.
ii. Degree of freedom refers to the number of values which are free to vary after we have given the number of restrictions imposed upon the data.
iii. The standard error is an estimate of the standard deviation of a statistic.

6.0 Tutor-Marked Assignments

1. Define level of significance.
2. What is critical value?

7.0 Reference/Further Reading

Kabir, S.M.S. (2016). Basic Guidelines for Research: An Introductory Approach for All Disciplines. Book Zone Publication, ISBN: 978-984-33-9565-8, Chittagong-4203, Bangladesh.

UNIT 5: STATISTICAL ERRORS, STATISTICAL POWER OF RESEARCH, LIMITATIONS AND CRITERIA FOR EVALUATING HYPOTHESIS

CONTENTS

1.0 Introduction

This section deals with statistical errors in in hypothesis, statistical power of research, limitations of hypothesis and criteria for evaluating hypothesis.

2.0 Objectives

By the end of this unit, you should be able to:

- identify statistical errors in hypothesis;
- discuss the criteria for evaluating hypothesis.

3.0. Main Content

3.1 Statistical Errors in Hypothesis

In statistical test theory the notion of statistical error is an integral part of hypothesis testing. In an ideal world we would always reject the null hypothesis when it is false, and we would not reject the null hypothesis when it is indeed true. But there are two other scenarios that are possible, each of which will result in an error (Kabir, 2016).

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

Type II Error: A type II error, also known as an error of the second kind, occurs when the null hypothesis is false, but erroneously fails to be rejected. It is failing to

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

Example: As it is conjectured that adding fluoride to toothpaste protects against cavities, the null hypothesis of no effect is tested. When the null hypothesis is true (i.e., there is indeed no effect), but the data give rise to rejection of this hypothesis, falsely suggesting that adding fluoride is effective against cavities, a type I error has occurred. A type II error occurs when the null hypothesis is false (i.e., adding fluoride is actually effective against cavities), but the data are such that the null hypothesis cannot be rejected, failing to prove the existing effect. Table 1 shows the relationship between truth or falseness of the null hypothesis.

Table 1: Tabularized relations between truth/falseness of the null hypothesis and outcomes of the test

	Null hypothesis (H_0) is true	*Alternative hypothesis (H_1) is true*
Accept H_1	Type I error (False Alarm)	Correct Decision
Accept H_0	Correct Decision	Type II error (Miss)

Source: Kabir (2016)

Hence, when a statistical hypothesis is tested, there are four possible results –

(a) When we accept H_1 and H_1 is true, this is a correct decision about nature.
(b) When we accept H_0 and H_0 is true, this is also a correct decision about nature.
(c) The acceptance of H_1 when H_0 is true, is called a 'Type I' error. It's incorrect decision about nature.
(d) The acceptance of H_0 when H_1 is true, is called a 'Type II' error. It's also incorrect decision about nature.

In 1948, Frederick Mosteller (1916–2006) argued that a 'third kind of error' was required to describe circumstances he had observed, namely-

Type I error: Rejecting the null hypothesis when it is true.
Type II error: Accepting the null hypothesis when it is false.
Type III error: Correctly rejecting the null hypothesis for the wrong reason.

Type I and type II errors are part of the process of hypothesis testing. Although, errors cannot be completely eliminated, we can minimize one type of error. Typically, when we try to decrease the probability one type of error, the probability for the other type increases. We could decrease the value of alpha from 0.05 to 0.01, corresponding to a 99% level of confidence. However, if everything else remains the same, then the probability of a type II error will nearly always increase. Many times, the real-world application of our hypothesis test will determine if we are more accepting of type I or type II error. This will then be used when we design our statistical experiment.

3.2 Statistical Power of Research

The power of a statistical test (Table 2) is the probability that it correctly rejects the null hypothesis when the null hypothesis is false (Kabir, 2016). It can be equivalently thought of as the probability of correctly accepting the alternative hypothesis when the alternative hypothesis is true - that is, the ability of a test to detect an effect, if the effect actually exists. If the power increases, the chances of a Type II error occurring decrease. The probability of a Type II error occurring is referred to as the false negative rate (β) and the power is equal to $1-\beta$. The power is also known as the sensitivity.

Table 2: Power

Decision on Null Hypothesis	State of Nat	
	Null Hypothesis T	
Accept	Correct Decision Probability = 1- α (Confidence Leve	
Reject	Type I error Prob α and α is called significance level	

Source: Kabir (201

We have found six factors that affect the power of a test, the probability of rejecting H_0 when it is false. They are:

Discrepancy Between the True Population Mean (μ_{true}) and the Hypothesized Mean (μ_{hyp}): The larger the discrepancy, the greater the power.

Sample Size: Other things being equal, the larger the size of the sample, the smaller the standard error of the mean and the greater the power of the test.

Standard Deviation of the Variable: The smaller the standard deviation, the greater the power. The standard deviation can be reduced by improving the reliability of the measuring instrument.

Relation Between Samples (More Than One Mean): Dependent samples can increase power. In general, the higher the correlation induced by pairing, the stronger the effect on power.

Level of Significance: The larger the value of α, the lower the value of β and the greater the power.

Choice of H_1: Power is greater for a one-tailed test than for a two-tailed test (when the direction specified by H_1 is correct).

3.3 Limitation of the Tests of Hypothesis

We have some important tests (both parametric and non-parametric) often used for testing hypotheses on the basis of which important decisions may be based. But there are several limitations of the said tests which should always be borne in mind by a researcher (Kabir, 2016). Important limitations are as follows-

- The tests should not be used in a mechanical fashion. It should be kept in view that testing is not decision-making itself; the tests are only useful aids for decision-making. Hence, proper interpretation of statistical evidence is important to intelligent decisions.
- Tests do not explain the reasons as to why does the difference exist, say between the means of the two samples. They simply indicate whether the difference is due to fluctuations of sampling or because of other reasons but the tests do not tell us as to which is/are the other reason(s) causing the difference.
- Results of significance tests are based on probabilities and as such cannot be expressed with full certainty. When a test shows that a difference is statistically significant, then it simply suggests that the difference is probably not due to chance.
- Statistical inferences based on the significance tests cannot be said to be entirely correct evidences concerning the truth of the hypotheses. This is specially so in case of small samples where the probability of drawing erring inferences happens to be generally higher. For greater reliability, the size of samples should be sufficiently enlarged.

All these limitations suggest that in problems of statistical significance, the inference techniques (or the tests) must be combined with adequate knowledge of the subject-matter along with the ability of good judgement.

3.4 Criteria for Evaluating Hypothesis

Some hypotheses are considered more satisfactory than others. The following are the serious considerations of a satisfactory hypothesis and these criteria may be helpful to make this judgement (Kabir, 2016).

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

Testability of Explanation: The variables should be defined operationally and the predicted relations among them can be tested empirically. The variables of the hypothesis should be measurable or quantifiable. The suitable measuring instrument is available or it can be considered easily.

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

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

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

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

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

Levels of Explanation: The value of hypothesis can best be comprehended by tracing their relationship to facts theories and laws. The scientists build gradually a hierarchy of knowledge consisting of (a) hypotheses (b) theories and (c) laws.

 Hypotheses and Facts: A hypothesis is the first step in the direction of scientific truth. In the hierarchy of scientific knowledge, it is the lowest on the scale. If empirical evidence can be found to verify the hypothesis, it gains the status of a fact. Thus, a fact is the verified hypothesis.

 Hypotheses and Theories: A theory may contain several logically interrelated hypotheses and postulates may be used as a synonym for hypotheses. Hypotheses and theories are both conceptual in nature. A theory usually provides a higher-level explanation than a hypothesis. A theory presents a comprehensive conceptual scheme that may involve several related hypotheses and explain diverse phenomena, considerable empirical evidences are needed to support it.

 Hypotheses and Laws: Some hypotheses receive sufficient confirmation to lead to the formulation of theories; some lead to the establishment of laws. Laws utilize highly abstract concepts, for they provide the most comprehensive type of explanations. Laws may explain phenomena that have been explained previously by two or three theories. A law retains its lofty scientific status which it claims to explain.

Hence, the basic criteria for evaluating research hypotheses are – (a) stated in declarative form; (b) consistent with known facts, prior research, or theory; (c) logical extension of the research problem; (d) states an expected relationship between two or more variables; (e) can be tested; and (f) is clear and concise.

4.0 Summary

In this unit we have leant that:

i. The probability of a Type II error occurring is referred to as the false negative rate (β) and the power is equal to $1-\beta$.
ii. Results of significance tests are based on probabilities and as such cannot be expressed with full certainty.
iii. A theory presents a comprehensive conceptual scheme that may involve several related hypotheses and explain diverse phenomena, considerable empirical evidences are needed to support it.

5.0 Conclusion

In as much hypotheses are useful instruments in research, they have their limitations and criteria for evaluating them. Criteria for evaluating hypothesis must be consistent with known facts or previous studies. Care must be taken to avoid either making type I or type II error.

6.0 Tutor-Marked Assignments

1. Differentiate between Type I error and Type II error.
2. Differentiate between hypothesis and theory.

7.0 Reference/Further Reading

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MODULE 3: SAMPLING TECHNIQUES AND DATA SOURCES

UNIT 1: SAMPLING METHODS
UNIT 2: DATA SOURCES
UNIT 3: TYPES OF DATA

UNIT 1: SAMPLING METHODS

CONTENTS

1.0 Introduction

A sampling method is typically used when an entire target population is too large or it is not feasible to collect data from the group due to geographic distance, funding, etc. It consists of selecting individuals from a target population and enables evaluators to generalize results about the population being studied. If you choose to use a sampling procedure, the selection should be based on the purpose of your evaluation. Depending on the goals of your evaluation, unbiased sampling (such as systematic sampling) or less rigorous techniques (such as snowball sampling) might be most appropriate.

2.0 Objectives

By the end of this unit, you will be able to:

- discuss the sampling method;
- mention the various types of sampling techniques.

3.0 Main Content

3.1 Sampling

In order to answer the research questions, it is doubtful that researcher should be able to collect data from all cases (Taherdoost, 2016). Thus, there is a need to select a sample. The entire set of cases from which researcher sample is drawn in called the population. Since, researchers neither have time nor the resources to analysis the entire population so they apply sampling technique to reduce the number of cases. Figure 1 illustrates the stages that are likely to go through when conducting sampling.

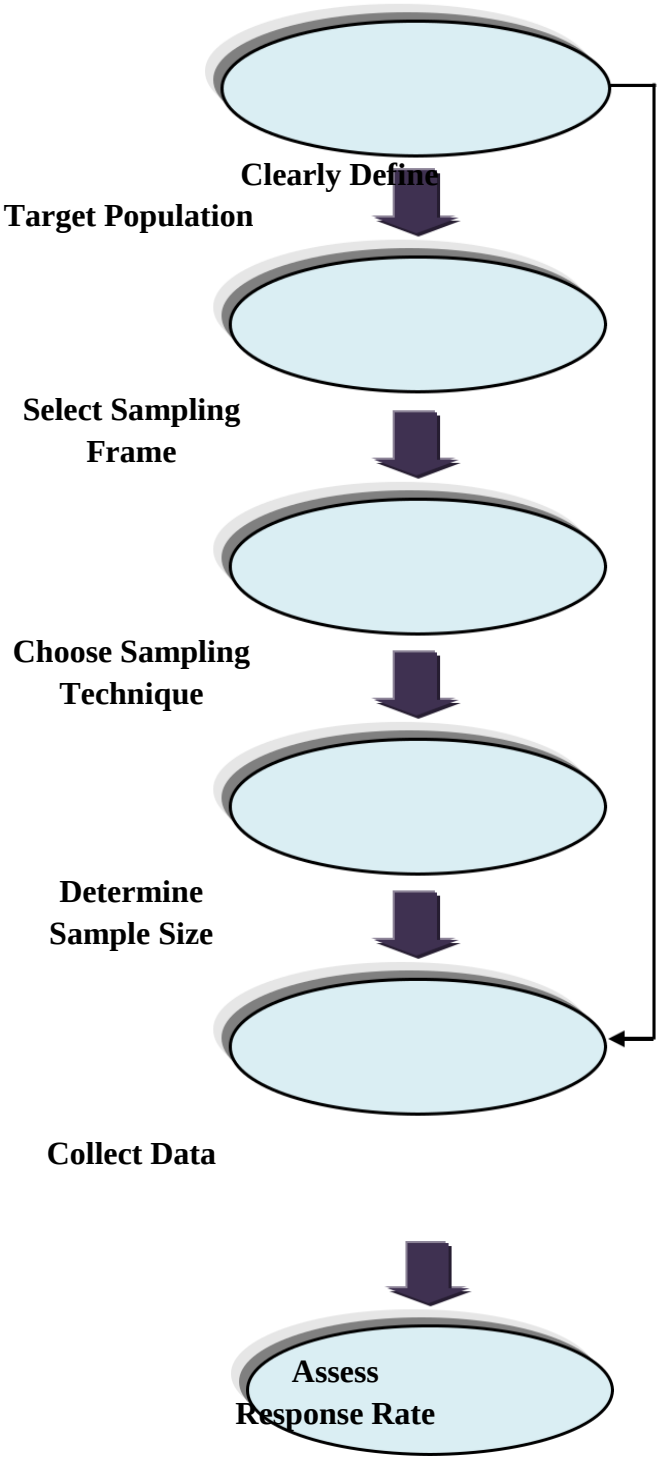


Figure 1: Sampling Process Steps

Source: Taherdoost, 2016.

A. Stage 1: Clearly Define Target Population

The first stage in the sampling process is to clearly define target population. Population is commonly related to the number of people living in a particular country.

B. Stage 2: Select Sampling Frame

A sampling frame is a list of the actual cases from which sample will be drawn. The sampling frame must be representative of the population.

C. Stage 3: Choose Sampling Technique

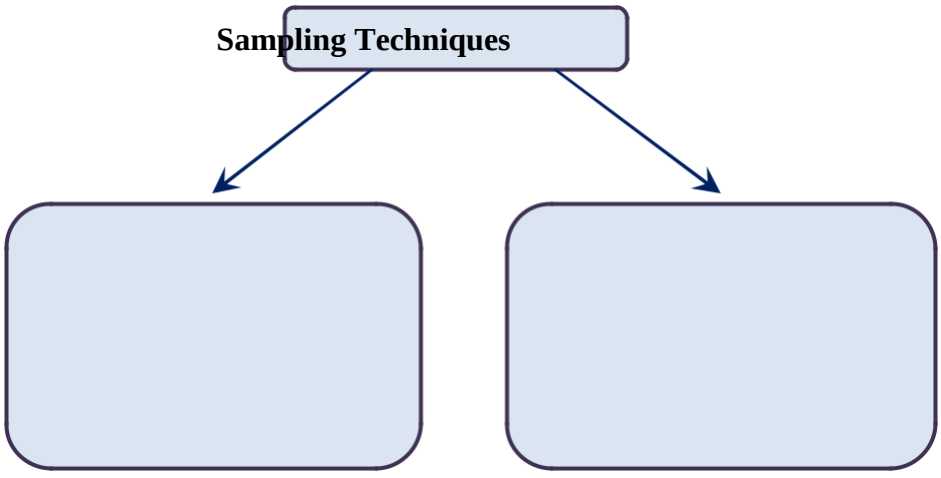
Prior to examining the various types of sampling method, it is worth noting what is meant by sampling, along with reasons why researchers are likely to select a sample. Taking a subset from chosen sampling frame or entire population is called sampling. Sampling can be used to make inference about a population or to make generalization in relation to existing theory. In essence, this depends on choice of sampling technique.

3.2 Sampling Techniques

According to Taherdoost (2016), sampling techniques can be divided into two types:

i. Probability or random sampling
ii. Non- probability or non- random sampling

Before choosing specific type of sampling technique, it is needed to decide broad sampling technique. Figure 2 shows the various types of sampling techniques.



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Probability Samp
- Simple rando
- Stratified ran
- Cluster sampl
- Systematic sa
  - Multistage

Probability Sampling

Probability sampling means that every item in the population has an equal chance of being included in sample. One way to undertake random sampling would be if researcher was to construct a sampling frame first and then used a random number generation computer program to pick a sample from the sampling frame (Zikmund, 2002). Probability or random sampling has the greatest freedom from bias but may represent the most costly sample in terms of time an energy for a given level of sampling error (Brown, 1947).

Simple random sampling

The simple random sample means that every case probability of inclusion in sample. of the population has an e
Disadvantages sampling include (Ghauri and Gronhaug, 2005): associated with simple ra

i. A complete frame (a list of all units in the whole population) is needed;
ii. In some studies, such as surveys by personal interviews, the costs of obtaining the sample can be high if the units are geographically widely scattered;
iii. The standard errors of estimators can be high.

Systematic sampling

Systematic sampling is where every nth case after a random start is selected. For example, if surveying a sample of consumers, every fifth consumer may be selected from your sample. The advantage of this sampling technique is its simplicity.

Stratified random sampling

Stratified sampling is where the population is divided into strata (or subgroups) and a random sample is taken from each subgroup. A subgroup is a natural set of items. Subgroups might be based on company size, gender or occupation (to name but a few). Stratified sampling is often used where there is a great deal of variation within a population. Its purpose is to ensure that every stratum is adequately represented (Ackoff, 1953).

Cluster sampling

Cluster sampling is where the whole population is divided into clusters or groups. Subsequently, a random sample is taken from these clusters, all of which are used in the final sample (Wilson, 2010). Cluster sampling is advantageous for those researchers whose subjects are fragmented over large geographical areas as it saves time and money (Davis, 2005). The stages to cluster sampling can be summarized as follows:

i. Choose cluster grouping for sampling frame, such as type of company or geographical region
ii. Number each of the clusters
iii. Select sample using random sampling

Multi-stage sampling

Multi-stage sampling is a process of moving from a broad to a narrow sample, using a step by step process (Ackoff, 1953). If, for example, a Malaysian publisher of an automobile magazine were to conduct a survey, it could simply take a random sample of automobile owners within the entire Malaysian population. Obviously, this is both expensive and time consuming. A cheaper alternative would be to use multi-stage sampling. In essence, this would involve dividing Malaysia into a number of geographical regions. Subsequently, some of these regions are chosen at random, and then subdivisions are made, perhaps based on local authority areas. Next, some of these are again chosen at random and then divided into smaller areas, such as towns or cities. The main purpose of multi-stage sampling is to select samples which are concentrated in a few geographical regions. Once again, this saves time and money.

Non probability Sampling

Non probability sampling is often associated with case study research design and qualitative research. With regards to the latter, case studies tend to focus on small samples and are intended to examine a real-life phenomenon, not to make statistical inferences in relation to the wider population (Yin, 2003). A sample of participants or cases does not need to be representative, or random, but a clear rationale is needed for the inclusion of some cases or individuals rather than others.

Quota sampling

Quota sampling is a non-random sampling technique in which participants are chosen on the basis of predetermined characteristics so that the total sample will have the same distribution of characteristics as the wider population (Davis, 2005).

Snowball sampling

Snowball sampling is a non-random sampling method that uses a few cases to help encourage other cases to take part in the study, thereby increasing sample size. This approach is most applicable in small populations that are difficult to access due to their closed nature, e.g. secret societies and inaccessible professions (Breweton and Millward, 2001).

Convenience sampling

Convenience sampling is selecting participants because they are often readily and easily available. Typically, convenience sampling tends to be a favored sampling technique among students as it is inexpensive and an easy option compared to other sampling techniques (Ackoff, 1953). Convenience sampling often helps to overcome many of the limitations associated with research. For example, using friends or family as part of sample is easier than targeting unknown individuals.

Purposive or judgmental sampling

Purposive or judgmental sampling is a strategy in which particular certain persons or events are selected deliberately in order to provide important information that cannot be obtained from other choices (Maxwell, 1996). It is where the researcher includes cases or participants in the sample because they believe that they warrant inclusion.

Table 1 illustrates strengths and weaknesses associated with each respective sampling technique.

TABLE 1: STRENGTHS AND WEAKNESSES OF SAMPLING TECHNIQUES

Technique	Strengths	Weaknesses
Convenience sampling	Least expensive, least time-consuming, most convenient	Selection bias, sample not representative, not recommended by descriptive or casual research
Judgment sampling	Low-cost, convenient, not time-consuming, ideal for exploratory research design	Does not allow generalization, Subjective
Quota sampling	Sample can be controlled for certain characteristics	Selection bias, no assurance
Snowball sampling	Can estimate rare characteristics	Time-consuming
Simple Random sampling	Easily understood, results Projectable	Difficult to construct sampling frame, expensive, lower precision, no assurance of representativeness
Systematic sampling	Can increase representativeness, easier to implement than simple random sampling, sampling frame not always necessary	Can decrease representativeness
Stratified sampling	Includes all important sub-population, precision	Difficult to select relevant stratification variables, not feasible to stratify on many variables, Expensive
Cluster sampling	Easy to implement, cost-effective	Imprecise, difficult to compute an interpret results

Source: Malhotra And Birks, 2006.

Types of Sampling

	Definition	Uses	Example
Random Sampling	All members of a population have an equal probability of being selected for the sample	When looking for an unbiased sample that is representative of the population	Drawing, at random, the first 100 names out of a hat from your total population
Systematic Sampling	Type of random sampling where every *n*th member from a population is selected into the sample	When looking for a fairly representative population	In a sample of underserved youth, selecting every 7th person of your target population
Convenience Sampling	Selection is nonrandom and participants are selected based on ease of access	When collecting general information about the population you intend to sample while keeping costs at a minimum	Interviewing the first 6 people you see in the morning or the first 4 people you talk to tomorrow
Snowball Sampling	Having participants refer or recommend other potential participants	When the population being sampled is not readily available or difficult to find	An evaluator trying to gather information about homeless individuals asks participants to refer them to someone else they might know in the same situation
Intensity Sampling	Involves measuring	When trying to understand a	Selecting a population of

	extreme populations	phenomenon	geniuses or a population of college students with extremely low grade point averages

Source: https://cyfar.org/sampling

Stage D: Determining Sample Size

In order to generalize from a random sample and avoid sampling errors or biases, a random sample needs to be of adequate size. What is adequate depends on several issues which often confuse people doing surveys for the first time. This is because what is important here is not the proportion of the research population that gets sampled, but the absolute size of the sample selected relative to the complexity of the population, the aims of the researcher and the kinds of statistical manipulation that will be used in data analysis. While the larger the sample the lesser the likelihood that findings will be biased does hold, diminishing returns can quickly set in when samples get over a specific size which need to be balanced against the researcher's resources (Gill et al., 2010). To put it bluntly, larger sample sizes reduce sampling error but at a decreasing rate. Several statistical formulas are available for determining sample size.

There are numerous approaches, incorporating a number of different formulas, for calculating the sample size for categorical data.

$n= p\ (100-p)z^2/E^2$
n is the required sample size;
P is the percentage occurrence of a state or condition E is the percentage maximum error required;
Z is the value corresponding to level of confidence required

There are two key factors to this formula (Bartlett et al., 2001). First, there are considerations relating to the estimation of the levels of precision and risk that the researcher is willing to accept:

E is the margin of error (the level of precision) or the risk the researcher is willing to accept (for example, the plus or minus figure reported in newspaper poll results). In the social research a 5% margin of error is acceptable. So, for example, if in a survey on job satisfaction 40% of respondents indicated they were dissatisfied would lie between 35% and 45%. The smaller the value of E the greater the sample size required as technically speaking sample error is inversely proportional to the square root of n, however, a large sample cannot guarantee precision (Bryman and Bell, 2003).

Z is concerned about the level of confidence that the results revealed by the survey findings are accurate. What this means is the degree to which we can be sure the characteristics of the population have been accurately estimated by the sample survey. Z is the statistical value corresponding to level of confidence required. The key idea behind this is that if a population were to be sampled repeatedly the average value of a variable or question obtained would be equal to the true population value. In management research the typical levels of confidence used are 95 percent (0.05: a Z value equal to 1.96) or 99 percent (0.01: Z=2.57). A 95 percent level of confidence implies that 95 out of 100 samples will have the true population value within the margin of error (E) specified.

The second key component of a sample size formula concerns the estimation of the variance or heterogeneity of the population (P). Management researchers are commonly concerned with determining sample size for issues involving the estimation of population percentages or proportions (Zikmund, 2002). In the formula the variance of a proportion or the percentage occurrence of how a particular question, for example, will be answered is P(100-P). Where, P= the percentage of a sample having a characteristic, for example, the 40 % of the respondents who were dissatisfied with pay, and (100-P) is the percentage (60%) who lack the characteristic or belief. The key issue is how to estimate the value of P before conducting the survey? Bartlett et al. (2001) suggest that researchers should use 50% as an estimate of P, as this will result in the maximization of variance and produce the maximum sample size (Bartlett et al., 2001).

The formula for determining sample size, of the population has virtually no effect on how well the sample is likely to describe the population and as Fowler (2002) argues, it is most unusual for it (the population fraction) to be an important consideration when deciding on sample size (Fowler, 2002).

The sample sizes reflect the number of obtained responses, and not necessarily the number of questionnaires distributed (this number is often increased to compensate for non-response). However, in most social and management surveys, the response rates for postal and e-mailed surveys are very rarely 100%. Probably the most common and time effective way to ensure minimum samples are met is to increase the sample size by up to 50% in the first distribution of the survey (Bartlett et al., 2001).

Stage E: Collection of Data

Once target population, sampling frame, sampling technique and sample size have been established, the next step is to collect data.

Stage F: Assess Response Rate

Response rate is the number of cases agreeing to take part in the study. These cases are taken from original sample. In reality, most researchers never achieve a 100 percent response rate. Reasons for this might include refusal to respond, ineligibility to respond, inability to respond, or the respondent has been located but researchers are unable to

make contact. In sum, response rate is important because each non response is liable to bias the final sample. Clearly defining sample, employing the right sampling technique and generating a large sample, in some respects can help to reduce the likelihood of sample bias.

4.0 Summary

In this unit we have leant that:

i. Probability sampling means that every item in the population has an equal chance of being included in sample.
ii. A sampling frame is a list of the actual cases from which sample will be drawn. The sampling frame must be representative of the population.
iii. A Sampling method is typically used when an entire target population is too large or it is not feasible to collect data from the group due to geographic distance, funding, etc.

5.0 Conclusion

Sampling techniques are divided into probability and non-probability type with each having its own advantages and disadvantages. The researcher determines which one is good for the sample he/she wants to select.

6.0 Tutor-Marked Assignments

1. What is stratified sampling technique.
2. List two non-probability sampling techniques and explain them.

7.0 References and other Resources

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UNIT 2: DATA SOURCES

CONTENTS

1.0 Introduction

Data either primary or secondary are important parts of the entire research process. Data are gathered to be analyzed in order to generate results that will lead to a conclusive research from which recommendations will be made.

2.0 Objectives

By the end of this unit, you will be able to:

- state the different data sources;
- differentiate the different data sources;
- mention the different data collection techniques.

3.0. Main Content

3.1 Data Sources

In program evaluation, methods of data collection beyond first-hand research exist. Data retrieved first-hand are known as primary data, but data retrieved from preexisting sources are known as secondary data.

3.1.1 Primary Data Collection

Primary data sources include information collected and processed directly by the researcher, such as observations, surveys, interviews, and focus groups.

3.1.2 Secondary Data Collection

Secondary data sources include information retrieved through preexisting sources: research articles, Internet or library searches, etc. Preexisting data may also include records and data already within the program: publications and training materials, financial records, student/client data, performance reviews of staff, etc.

3.1.3 Differences between primary data sources and secondary data sources

Primary Data Source Facts	Secondary Data Source Facts
• Data collected by the evaluator using methods such as observations, surveys, or interviews	• Provides information if existing data on a topic or project is not current or directly applicable to the chosen evaluation questions
• Can be more expensive and time-consuming, but it allows for more targeted data collection	• Information that has already been collected, processed, and reported by another researcher or entity
• Offers an opportunity to review any and all secondary data available before collecting primary data (saving time)	• Will reveal which questions still need to be addressed and what data has yet to be collected

3.1.4 Overview of Different Data Collection Techniques

Technique	Key Facts	Example
Interviews	• Can be conducted in person or over the telephone • Can be done formally (structured), semi-structured, or informally • Questions should be focused, clear, and encourage open-ended responses • Are mainly qualitative in nature	A one-on-one conversation with the parent of an at-risk youth who can help you understand the issue.
Questionnaires and Surveys	• Responses can be analyzed with	The results of a satisfaction

	quantitative methods by assigning numerical values to Likert-type scales • Results are generally easier to analyze (compared to qualitative techniques) • Pretests and posttests can be compared and analyzed	or opinion survey.
Observations	• Allow for the study of the dynamics of a situation and frequency counts of target behaviors or other behaviors as indicated by the needs of the evaluation • Good source for providing additional information about a particular group; can use video to provide documentation • Can produce qualitative (e.g., narrative data) and quantitative data (e.g.,	Site visits to an after-school program to document the interaction between youth and staff within the program

	frequency counts, mean length of interactions, and instructional time)	
Focus Groups	• A facilitated group interview with individuals that have something in common • Gathers information about combined perspectives and opinions • Responses are often coded into categories and analyzed thematically	A group of parents of teenagers in an after-school program are invited to informally discuss programs that might benefit and help their children succeed
Ethnographies, Oral History, and Case Studies	• Involves studying a single phenomenon • Examines people in their natural settings • Uses a combination of techniques such as observation, interviews, and surveys • A more holistic approach to evaluation • Researcher	Shadowing a family while recording extensive field notes to study the experience and issues associated with youth who have a parent or guardian who has been deployed.

	can become a confounding variable	
Documents and Records	• Consists of examining existing data: databases, meeting minutes, reports, attendance logs, financial records, newsletters, etc. • This can be an inexpensive way to gather information but may be an incomplete data source	To understand the primary reasons students miss school, records on student absences are collected and analyzed.

3.1.5 Technology and Data Collection

While using paper and pencil surveys is the tried and true method of collecting data, technology is rapidly becoming a popular and oftentimes more efficient way to collect data, especially quantitative data. This section provides an overview of the benefits and challenges of using technology to collect data. Technology useful for data collection include:

- Online or web-based surveys
- Smartphones, cell phones, and other mobile-sensing devices
- Social media sites
- Online labor markets

Online Surveys

Online and web-based surveys enable users to design a survey that can then be administered via an internet link. Some online tools include Survey Monkey and Qualtrics.

Advantages	Disadvantages
• Simpler and quicker way of collecting both quantitative and qualitative data	• Limited to respondents who have access to the Internet • Some populations may be less likely

• Easy to access a large group of respondents in geographically diverse locations • More cost-effective than manually administering surveys • Data can typically be exported, eliminating manual data entry • Improves accuracy of data entry (e.g., reduces omissions, duplicate entries, etc.)	to have internet access and to respond to online questionnaires • Some may find online interface off-putting • There is no way to collect a probability sample from the general population using the internet • Potential lack of security

Smartphone, Cell Phones, and Other Mobile-Sensing Devices

In 2018, the PEW Research Center found that 77% of Americans own a smartphone and 95% of Americans own a cell phone (http://www.pewinternet.org/fact-sheet/mobile/). These devices put data collection tools in the hands of participants and can be used for data collection in the field. The robust processing capacity coupled with new sensing applications make smartphones an attractive tool for researchers. Accelerometer, Bluetooth, GPS, light sensors, microphones, proximity sensors, and WiFi offer options for researchers who would like to gather data about participant's behavior, sociability, lifestyle, etc. Other mobile-sensing devices such as smart watches offer some of the same data points for researchers.

In addition to the range of data options smartphone technology offers researchers, the ability to text make them useful as a portable, real time data collection tool. Text messaging is a way to capture information from a large group at one time. Each participant would need to have a smart-device or cell phone with texting ability. To store/collate data, the use of a message relay system or interface technology (software program, for example) may also be needed.

Smartphones with internet capability can be used as hand-held mobile computers to complete surveys in a 'clicker' type fashion. Participants input responses to questions, quizzes, or games, etc. on their device and data is transferred to another computer for analysis.

Advantages	Disadvantages
• Participants supply the smartphone device • Streamlines the data collection process • Reduces errors and missing data • Greatly reduces or eliminates data entry • Enables collection of more data in a shorter time frame • Increase internal program evaluation capacity • Can collect data from large groups of respondents at once	• Some segments of the population may not have a smartphone • Data loss due to malfunctioning device

Social Media

Social networking sites often include profiles of individuals including information such as the user's age (or birthdate), gender, ethnicity, location (address or city), sexual orientation, political affiliation, education, and contact information (email, phone number, website, etc.). These sites may also include forums where users can interact with one another. Examples of networking sites include Facebook, Instagram, and Twitter, all of which have gained popularity as social forums and modes of communication. Data could be collected through sampling random sites for trends, soliciting information from specific users, and creating a profile for data collection that attracts certain users for discussions (such as online focus groups).

Advantages	Disadvantages
• Able to reach a young demographic • Option to create a profile to target specific communities • Ability to engage participants in remote locations in real time • Can be a rich source of quantitative and qualitative data, some of which is publicly available	• No verification of information available on public profiles • Privacy settings on profiles may impede data collection • Social networking caters to a very specific demographic of users, with an average age range of 14 to 35 years • Consent issues involved in working with underage youth (if soliciting information not publicly available on profile)

Online Labor Markets

Online labor markets represent a virtual workforce that can be used for data collection. The largest and most commonly used for academic research is Amazon Mechanical Turk (MTurk). Launched by Amazon in 2005, MTurk allows individuals to post short online tasks, such as surveys, that workers fill out for a small payment. Initial research suggests MTurk is a low-cost method for recruiting a large, diverse sample of participants.

Advantages	Disadvantages
• Affordable (example in the research literature includes $1.00 for a 20 minute survey) • Can be conducted in a short time frame (less than a week for hundreds of responses) • Ability to select only "high-reputation workers" who have been vetted and found to submit high-quality data • Ability to include "attention checks" to ensure participants are reading all the questions	• No ability to conduct longitudinal studies • Smaller participant pool (~100,000 MTurk workers participate in academic studies each year) • MTurk population is significantly less politically diverse, higher educated, younger, and less religious than the general US population

4.0 Summary

In this unit we have leant that:

i. Primary data sources include information collected and processed directly by the researcher.
ii. Secondary data sources include information retrieved through preexisting sources.
iii. Online and web-based surveys enable users to design a survey that can then be administered via an internet link.

5.0 Conclusion

Data collected first hand from the original sources are called primary data while data retrieved from preexisting sources are called secondary data. Technology useful for data collection include online or web-based surveys, smartphones, cell phones, and other mobile-sensing devices etc.

6.0 Tutor-Marked Assignments

1. List five sources of primary data.
2. Explain the role of technology in sourcing for data.

7.0 References and other Resources

Data Sources. https://cyfar.org/data-sources. Accessed 10.11.2020
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UNIT 3: TYPES OF DATA

CONTENTS

1.0 Introduction

Data used for research purposes are of different types, they can be primary or secondary. Data are collections of words, numbers, pictures etc. in raw or unprocessed form used by researchers and provide an evidential record of their research or the study they have undertaken. Data is the plural of datum. In practice, some people use data both in singular and plural form.

2.0 Objectives

By the end of this unit, you will be able to:

- discuss the meaning of primary and secondary data;
- state the differences between primary and secondary data.

3.0. Main Content

3.1 Data Type

3.1.1 Primary Data

Primary data are the kind of data that are collected directly from the data source without going through any existing sources. It is mostly collected specially for a research project and may be shared publicly to be used for another research

Primary data are often reliable, authentic, and objective in as much as they were collected with the purpose of addressing a particular research problem. It is noteworthy that primary data is not commonly collected because of the high cost of implementation.

A common example of primary data is the data collected by organizations during market research, product research, and competitive analysis. This data is collected directly from its original source which in most cases are the existing and potential customers.

Most of the people who collect primary data are government authorized agencies, investigators, research-based private institutions, etc.

One of the major elements and basis of statistical research is data collection, where the most basic data that can be collected in this process is primary data. In other words, we can say that data is the basis of all statistical operations and primary data is the simplest of all data.

Primary data is one of the 2 main types of data, with the second one being the secondary data. These 2 data types have important uses in research, but in this article, we will be considering the primary data type.

We will introduce you to what primary data is, examples, and the various techniques of collecting primary data.

What is Primary Data?

Primary data is a type of data that is collected by researchers directly from main sources through interviews, surveys, experiments, etc. Primary data are usually collected from the source, where the data originally originates from and are regarded as the best kind of data in research.

The sources of primary data are usually chosen and tailored specifically to meet the demands or requirements of a particular research. Also, before choosing a data collection source, things like the aim of the research and target population need to be identified.

For example, when doing a market survey, the goal of the survey and the sample population need to be identified first. This is what will determine what data collection source will be most suitable, an offline survey will be more suitable for a population living in remote areas without internet connection compared to online surveys.

Examples of Primary Data

- **Market Research**

This is an important aspect of business strategy that involves the process of gathering information about the target market and customers. The data gathered during market research is primary as it is tailored specifically to meet the business needs.

An organization doing market research about a new product (say phone) they are about to release will need to collect data like purchasing power, feature preferences, daily phone usage, etc. from the target market. The data from past surveys are not used because the product differs.

- **Student Thesis**

When conducting academic research or a thesis experiment, students collect data from the primary source. The kind of data collected during this process may vary according to the kind of research being performed—lab experiments, statistical data gathering, etc.

For example, a student carrying out a research project with the aim of finding out the effect of daily intake of fruit juice on an individual's weight will need to take a sample population of 2 or more people, feed them with fruit juice daily and record the changes in their weight. The data gathered throughout this process is primary.

- **Trauma Survivors**

Although people react differently to trauma, there is usually a trait common to people who have gone through the same kind of trauma. The research aimed at finding out how victims of sexual abuse overcame the traumatic experience will include interviewing the survivors, sending them surveys, or any other primary source of data collection. Experiences differ and every situation is unique. Therefore, using secondary data may not be the best option in this case.

Primary Data Collection Methods

Primary data collection methods are different ways in which primary data can be collected. It explains the tools used in collecting primary data, some of which are highlighted below:

- **Interviews**:

Interview is a method of data collection that involves two groups of people, where the first group is the interviewer (the researcher(s) asking questions and collecting data) and the interviewee (the subject or respondent that is being asked questions). The questions and responses during an interview may be oral or verbal as the case may be.

Interviews can be carried out in 2 ways, namely; in-person interviews and telephonic interviews. An in-person interview requires an interviewer or a group of interviewers to ask questions from the interviewee in a face to face fashion.

It can be direct or indirect, structured or unstructured, focused or unfocused, etc. Some of the tools used in carrying out in-person interviews include a notepad or recording device to take note of the conversation—very important due to human forgetful nature.

Telephonic interviews, on the other hand, are carried out over the phone through ordinary voice call or video calls. The 2 parties involved may decide to use video calls like Skype to carry out interviews.

A mobile phone, Laptop, Tablet or desktop computer with an internet connection is required for this.

Pros

- In-depth information can be collected.
- Non-response and response bias can be detected.
- The samples can be controlled.

Cons

- It is more time-consuming.
- It is expensive.
- The interviewer may be biased.

Surveys & Questionnaires

Surveys and questionnaires are 2 similar tools used in collecting primary data. They are a group of questions typed or written down and sent to the sample of study to give responses.

After giving the required responses, the survey is given back to the researcher to record. It is advisable to conduct a pilot study where the questionnaires are filled by experts and meant to assess the weakness of the questions or techniques used.

There are 2 main types of surveys used for data collection, namely; online and offline surveys. Online surveys are carried out using internet-enabled devices like mobile phones, PCs, Tablets, etc.

They can be shared with respondents through email, websites, or social media. Offline surveys, on the other hand, do not require an internet connection for it to be carried out.

The most common type of offline survey is paper-based surveys. However, there are also offline surveys like Formplus that can be filled with a mobile device without access to an internet connection.

This kind of survey is called online-offline surveys because they can be filled offline but require an internet connection to be submitted.

Pros

- Respondents have adequate time to give responses.
- It is free from the bias of the interviewer.
- They are cheaper compared to interviews.

Cons

- A high rate of non-response bias.
- It is inflexible and can't be changed once sent.
- It is a slow process.

Observation

Observation method is mostly used in studies related to behavioral science. The researcher uses observation as a scientific tool and method of data collection. Observation as a data collection tool is usually systematically planned and subjected to checks and controls.

There are different approaches to the observation method, structured or unstructured, controlled or uncontrolled, and participant, non-participant, or disguised approach.

The structured and unstructured approach is characterized by careful definition of subjects of observation, style of observer, conditions, and selection of data. An observation process that satisfies this is said to be structured and vice versa.

A controlled and uncontrolled approach signifies whether the research took place in a natural setting or according to some pre-arranged plans. If an observation is done in a natural setting, it is uncontrolled but becomes controlled if done in a laboratory.

Before employing a new teacher, academic institutions sometimes ask for a sample teaching class to test the teacher's ability. The evaluator joins the class and observes the teaching, making him or her a participant.

The evaluation may also decide to observe from outside the class, becoming a non-participant. An evaluator may also be asked to stay in class and disguise as a student, in order to carry out a disguised observation.

Pros

- The data is usually objective.
- Data is not affected by past or future events.

Cons

- The information is limited.
- It is expensive

Focus Groups

Focus Groups are gathering of 2 or more people with similar characteristics or who possess common traits. They seek open-ended thoughts and contributions from participants.

A focus group is a primary source of data collection because the data is collected directly from the participant. It is commonly used for market research, where a group of market consumers engage in a discussion with a research moderator.

It is slightly similar to interviews, but this involves discussions and interactions rather than questions and answers. Focus groups are less formal and the participants are the ones who do most of the talking, with moderators there to oversee the process.

Pros

- It incurs a low cost compared to interviews. This is because the interviewer does not have to discuss with each participant individually.
- It takes lesser time too.

Cons

- Response bias is a problem in this case because a participant might be subjective to what people will think about sharing a sincere opinion.
- Group thinking does not clearly mirror individual opinions.

Experiments

An experiment is a structured study where the researchers attempt to understand the causes, effects, and processes involved in a particular process. This data collection method is usually controlled by the researcher, who determines which subject is used, how they are grouped and the treatment they receive.

During the first stage of the experiment, the researcher selects the subject which will be considered. Some actions are therefore carried out on these subjects, while the primary data consisting of the actions and reactions are recorded by the researcher.

After which they will be analyzed and a conclusion will be drawn from the result of the analysis. Although experiments can be used to collect different types of primary data, it is mostly used for data collection in the laboratory.

Pros

- It is usually objective since the data recorded are results of a process.
- Non-response bias is eliminated.

Cons

- Incorrect data may be recorded due to human error.
- It is expensive.

Advantages of Primary Data Over Secondary Data

When discussing the advantages of primary data over secondary data, a lot of examples can be sighted. This is because primary data has vast uses in research, statistics, and even business.

- **Specific**

Collecting your own data allows you the freedom to address issues specific to your business, or research aim. In this case, the data collected is exactly what the researcher wants and needs.

The researcher reports it in a way that benefits the current situation of the organization or research. For example, when doing market research for a product, the data collected will be specifically for the product in question.

- **Accurate:**

Primary data is much more accurate compared to secondary data. For example, when collecting statistical data from online sources, you are at risk of coming across false data.

This is because the data available online is not regulated, unlike the data you collect yourself. This is very common in journalism, where blogs share unverified and exaggerated information just to gain cheap traffic.

- **Ownership**

The data collected through a primary source is usually owned by the researcher, who may choose to either share or not share with others. In the market research example stated earlier, researchers may keep the results to themselves and not give access to their competitors who may want to use the information. Also, a researcher can choose to sell the data to make a huge amount of money because they own it.

- **Up to date information**

The data collected from primary sources are up-to-date, unlike that of the secondary sources. It collects data in real-time and does not take information from stale and outdated sources.

For example, when the population of a community is something that continues to fluctuate as people die and children are born. Going by the National Census, one may not get accurate results of the population, and can only settle for estimates.

- **Control:**

A researcher can easily control the research design and methods to be used. As a researcher, you can choose which subject to consider, and also control how the information is gathered. There are no limitations to the kind and amount of data that can be generated by the researcher.

Disadvantages of Primary Data

- **Expensive:**

Compared to secondary data, the data collection process for primary data is very expensive. No matter how little the research is, at least one professional researcher will need to be employed to carry out the research. Also, the research process itself may cost some amount of money. How expensive it is, will be determined by which method is used in carrying out the research.

- **Time-consuming**

Going from the starting point of making the decision to perform the research, to the point of generating data, the time is much longer compared to the time it takes to acquire secondary data. Each stage of the primary data collection process requires much time for execution.

- **Feasibility**

It is not always feasible to carry out primary research because of the volume and unrealistic demands that may be required. For example, it will be unrealistic for a company to do a census of the people living in a community, just to measure the size of their target market.

A more sensible thing to do in this case will be to use the data of the recorded census to know the demography of people in that community.

Pros and Cons of Secondary Data

The study of primary data is not something that can be neglected in research and statistics. It entails the use of immediate data from its original source for research and drawing conclusions.

The different sources of primary data collection are designed in a way that the data collected are tailored to the specific research needs. Although it can be a long process it provides first-hand information that is preferable in many cases.

For a research process to be successful, it is absolutely important to have access to reliable data. This is one of the situations where primary data becomes a better choice.

Pros

- Primary data is specific to the needs of the researcher at the moment of data collection. The researcher is able to control the kind of data that is being collected.
- It is accurate compared to secondary data. The data is not subjected to personal bias and as such the authenticity can be trusted.
- The researcher exhibit ownership of the data collected through primary research. He or she may choose to make it available publicly, patent it, or even sell it.
- Primary data is usually up to date because it collects data in real-time and does not collect data from old sources.
- The researcher has full control over the data collected through primary research. He can decide which design, method, and data analysis techniques to be used.

Cons

- Primary data is very expensive compared to secondary data. Therefore, it might be difficult to collect primary data.
- It is time-consuming.
- It may not be feasible to collect primary data in some cases due to its complexity and required commitment.

3.1.2 Secondary Data

Secondary data is the data that has been collected in the past by someone else but made available for others to use. They are usually once primary data but become secondary when used by a third party. Secondary data are usually easily accessible to researchers and individuals because they are mostly shared publicly. This, however, means that the data are usually general and not tailored specifically to meet the researcher's needs as primary data does.

For example, when conducting a research thesis, researchers need to consult past works done in this field and add findings to the literature review. Some other things like definitions and theorems are secondary data that are added to the thesis to be properly referenced and cited accordingly. Some common sources of secondary data include trade publications, government statistics, journals, etc. In most cases, these sources cannot be trusted as authentic.

What is Secondary Data?

Secondary data is the data that has already been collected through primary sources and made readily available for researchers to use for their own research. It is a type of data that has already been collected in the past.

A researcher may have collected the data for a particular project, then made it available to be used by another researcher. The data may also have been collected for general use with no specific research purpose like in the case of the national census.

A data classified as secondary for a particular research may be said to be primary for another research. This is the case when a data is being reused, making it a primary data for the first research and secondary data for the second research it is being used for.

Sources of Secondary Data

Sources of secondary data includes books, personal sources, journal, newspaper, website, government record etc. Secondary data are known to be readily available compared to that of primary data. It requires very little research and need for manpower to use these sources.

With the advent of electronic media and the internet, secondary data sources have become more easily accessible. Some of these sources are highlighted below.

- **Books**

Books are one of the most traditional ways of collecting data. Today, there are books available for all topics you can think of. When carrying out research, all you have to do is look for a book on the topic being researched on, then select from the available repository of books in that area. Books, when carefully chosen are an authentic source of authentic data and can be useful in preparing a literature review.

- **Published Sources**

There are a variety of published sources available for different research topics. The authenticity of the data generated from these sources depends majorly on the writer and publishing company. Published sources may be printed or electronic as the case may be. They may be paid or free depending on the writer and publishing company's decision.

- **Unpublished Personal Sources**

This may not be readily available and easily accessible compared to the published sources. They only become accessible if the researcher shares with another researcher who is not allowed to share it with a third party. For example, the product management team of an organization may need data on customer feedback to assess what customers think about their product and improvement suggestions. They will need to collect the data from the customer service department, which primarily collected the data to improve customer service.

- **Journal**

Journals are gradually becoming more important than books these days when data collection is concerned. This is because journals are updated regularly with new publications on a periodic basis, therefore giving up to date information. Also, journals are usually more specific when it comes to research. For example, we can have a journal on, "Secondary data collection for quantitative data" while a book will simply be titled, "Secondary data collection".

- **Newspapers**

In most cases, the information passed through a newspaper is usually very reliable. Hence, making it one of the most authentic sources of collecting secondary data. The kind of data commonly shared in newspapers is usually more political, economic, and educational than scientific. Therefore, newspapers may not be the best source for scientific data collection.

- **Websites**

The information shared on websites are mostly not regulated and as such may not be trusted compared to other sources. However, there are some regulated websites that only share authentic data and can be trusted by researchers. Most of these websites are usually government websites or private organizations that are paid, data collectors.

- **Blogs**

Blogs are one of the most common online sources for data and may even be less authentic than websites. These days, practically everyone owns a blog and a lot of people use these blogs to drive traffic to their website or make money through paid ads. Therefore, they cannot always be trusted. For example, a blogger may write good things about a product because he or she was paid to do so by the manufacturer even though these things are not true.

- **Diaries**

They are personal records and as such rarely used for data collection by researchers. Also, diaries are usually personal, except for these days when people now share public diaries containing specific events in their life. A common example of this is Anne Frank's diary which contained an accurate record of the Nazi wars.

- **Government Records**

Government records are a very important and authentic source of secondary data. They contain information useful in marketing, management, humanities, and social science research. Some of these records include; census data, health records, education institute records, etc. They are usually collected to aid proper planning, allocation of funds, and prioritizing of projects.

- **Podcasts**

Podcasts are gradually becoming very common these days, and a lot of people listen to them as an alternative to radio. They are more or less like online radio stations and are generating increasing popularity. Information is usually shared during podcasts, and listeners can use it as a source of data collection.

Some other sources of data collection include:

- Letters
- Radio stations
- Public sector records.

What are the Secondary Data Collection Tools?

Popular tools used to collect secondary data include; bots, devices, library, etc. In order to ease the data collection process from the sources of secondary data highlighted above, researchers use these important tools which are explained below.

- **Bots**

There are lots of data online and it may be difficult for researchers to browse through all these data and find what they are actually looking for. In order to ease this process of data collection, programmers have created bots to do an automatic web scraping for relevant data. These bots are "*software robots*" programmed to perform some task for the researcher. It is common for businesses to use bots to pull data from forums and social media for sentiment and competitive analysis.

- **Internet-Enabled Devices**

This could be a mobile phone, PC, or tablet that has access to an internet connection. They are used to access journals, books, blogs, etc. to collect secondary data.

- **Library**

This is a traditional secondary data collection tool for researchers. The library contains relevant materials for virtually all the research areas you can think of, and it is accessible to everyone. A researcher might decide to sit in the library for some time to collect secondary data or borrow the materials for some time and return when done collecting the required data.

- **Radio**

Radio stations are one of the secondary sources of data collection, and one needs a radio to access it. The advent of technology has even made it possible to listen to radio on mobile phones, deeming it unnecessary to get a radio.

Secondary Data Analysis

Secondary data analysis is the process of analyzing data collected from another researcher who primarily collected this data for another purpose. Researchers leverage secondary data to save time and resources that would have been spent on primary data collection.

Secondary data analysis process can be carried out quantitatively or qualitatively depending on the kind of data the researcher is dealing with. The quantitative method of

secondary data analysis is used on numerical data and is analyzed mathematically, while the qualitative method uses words to provide in-depth information about data.

How to Analyze Secondary Data

There are different stages of secondary data analysis, which involve events before, during and after data collection. These stages include:

- **Statement of Purpose**

Before collecting secondary data for analysis, you need to know your statement of purpose. That is, a clear understanding of why you are collecting the data, the ultimate aim of the research work and how this data will help achieve it. This will help direct your path towards collecting the right data, and choosing the best data source and method of analysis.

- **Research Design**

This is a written-down plan on how the research activities will be carried out. It describes the kind of data to be collected, the sources of data collection, method of data collection, tools, and even method of analysis. A research design may also contain a timestamp of when each of these activities will be carried out. Therefore, serving as a guide for the secondary data analysis. After identifying the purpose of research, the researcher should design a research process which will guide the data analysis process.

- **Developing the Research Questions**

It is not enough to just know the research purpose, you need to develop research questions that will help in better identifying Secondary data. This is because they are usually a pool of data to choose from, and asking the right questions will assist in collecting authentic data.

For example, a researcher trying to collect data about the best fish feeds to enable fast growth in fishes will have to ask questions like, what kind of fish is considered? Is the data meant to be quantitative or qualitative? What is the content of the fish feed? Growth rate in fishes after feeding on it, and so on.

- **Identifying Secondary Data**

After developing the research questions, researchers use them as a guide to identify relevant data from the data repository. For example, if the kind of data to be collected is qualitative, a researcher can filter out qualitative data.

The suitable secondary data will be the one that correctly answers the questions highlighted above. When looking for the solutions to a linear programming problem for instance, the solutions will be numbers that satisfies both the objective and the constraints.

Any answer that doesn't satisfy both, is not a solution.

- **Evaluating Secondary Data**

This stage is what many classify as the real data analysis stage because it is the point where analysis is actually performed. However, the stages highlighted above are a part of the data analysis process, because they influence how the analysis is performed.

Once a dataset that appears viable in addressing initial requirements discussed

above is located, the next step in the process is evaluation of the dataset to

ensure the appropriateness for the research topic. The data is evaluated to ensure that it really addresses the statement of the problem and answers the research questions.

After which it will now be analyzed either using the quantitative method or the qualitative method depending on the type of data it is.

Advantages of Secondary Data

- **Ease of Access**

Most of the sources of secondary data are easily accessible to researchers. Most of these sources can be accessed online through a mobile device. People who do not have access to the internet can also access them through print.

They are usually available in libraries, book stores, and can even be borrowed from other people.

- Inexpensive

Secondary data mostly require little to no cost for people to acquire them. Many books, journals, and magazines can be downloaded for free online. Books can also be borrowed for free from public libraries by people who do not have access to the internet.

Researchers do not have to spend money on investigations, and very little is spent on acquiring books if any.

- **Time-Saving**

The time spent on collecting secondary data is usually very little compared to that of primary data. The only investigation necessary for secondary data collection is the process of sourcing for necessary data sources.

Therefore, cutting the time that would normally be spent on the investigation. This will save a significant amount of time for the researcher

- **Longitudinal and Comparative Studies**

Secondary data makes it easy to carry out longitudinal studies without having to wait for a couple of years to draw conclusions. For example, you may want to compare the country's population according to census 5 years ago, and now.

Rather than waiting for 5 years, the comparison can easily be made by collecting the census 5 years ago and now.

- **Generating new insights**

When re-evaluating data, especially through another person's lens or point of view, new things are uncovered. There might be a thing that wasn't discovered in the past by the primary data collector, that secondary data collection may reveal.

For example, when customers complain about difficulty using an app to the customer service team, they may decide to create a user guide teaching customers how to use it. However, when a product developer has access to this data, it may be uncovered that the issue came from and UI/UX design which needs to be worked on.

Disadvantages of Secondary Data

- **Data Quality:**

The data collected through secondary sources may not be as authentic as when collected directly from the source. This is a very common disadvantage with online sources due to a lack of regulatory bodies to monitor the kind of content that is being shared.

Therefore, working with this kind of data may have negative effects on the research being carried out.

- **Irrelevant Data:**

Researchers spend so much time surfing through a pool of irrelevant data before finally getting the one they need. This is because the data was not collected mainly for the researcher.

In some cases, a researcher may not even find the exact data he or she needs, but have to settle for the next best alternative.

- **Exaggerated Data**

Some data sources are known to exaggerate the information that is being shared. This bias may be some to maintain a good public image or due to a paid advert.

This is very common with many online blogs that even go a bead to share false information just to gain web traffic. For example, a FinTech startup may exaggerate the amount of money it has processed just to attract more customers.

A researcher gathering this data to investigate the total amount of money processed by FinTech startups in the US for the quarter may have to use this exaggerated data.

- **Outdated Information**

Some of the data sources are outdated and there are no new available data to replace the old ones. For example, the national census is not usually updated yearly.

Therefore, there have been changes in the country's population since the last census. However, someone working with the country's population will have to settle for the previously recorded figure even though it is outdated.

Pros and Cons of Secondary Data

Secondary data has various uses in research, business, and statistics. Researchers choose secondary data for different reasons, with some of it being due to price, availability, or even needs of the research.

Although old, secondary data may be the only source of data in some cases. This may be due to the huge cost of performing research or due to its delegation to a particular body (e.g. national census).

In short, secondary data has its shortcomings, which may affect the outcome of the research negatively and also some advantages over primary data. It all depends on the situation, the researcher in question and the kind of research being carried out.

Pros

- Secondary data is easily accessible compared to primary data. Secondary data is available on different platforms that can be accessed by the researcher.
- Secondary data is very affordable. It requires little to no cost to acquire them because they are sometimes given out for free.
- The time spent on collecting secondary data is usually very little compared to that of primary data.
- Secondary data makes it possible to carry out longitudinal studies without having to wait for a long time to draw conclusions.
- It helps to generate new insights into existing primary data.

Cons

- Secondary data may not be authentic and reliable. A researcher may need to further verify the data collected from the available sources.
- Researchers may have to deal with irrelevant data before finally finding the required data.
- Some of the data is exaggerated due to the personal bias of the data source.
- Secondary data sources are sometimes outdated with no new data to replace the old ones.

3.1.3 Differences between primary and secondary data

- **Definition**

Primary data is the type of data that is collected by researchers directly from main sources while secondary data is the data that has already been collected through primary sources and made readily available for researchers to use for their own research.

The main difference between these 2 definitions is the fact that primary data is collected from the main source of data, while secondary data is not.

The secondary data made available to researchers from existing sources are formerly primary data which was collected for research in the past. The availability of secondary data is highly dependent on the primary researcher's decision to share their data publicly or not. According to Boslaugh (2007), the distinction between primary and secondary data depends on the relationship between the person or research team who collected a data set and the person who is analyzing it. This is an important concept because the same data set could be primary data in one analysis and secondary data in another. If the data set in question was collected by the researcher (or a team of which the researcher is a part) for the specific purpose or analysis under consideration, it is primary data. If it was collected by someone else for some other purpose, it is secondary data.

- **Examples:**

An example of primary data is the national census data collected by the government while an example of secondary data is the data collected from online sources. The secondary data collected from an online source could be the primary data collected by another researcher.

For example, the government, after successfully conducted the national census, they share the results in newspapers, online magazines, press releases, etc. Another government agency that is trying to allocate the state budget for healthcare, education, etc. may need to access the census results.

With access to this information, the number of children who need education can be analyzed and hard to determine the amount that should be allocated to the education sector. Similarly, knowing the number of old people will help in allocating funds for them in the health sector.

- **Data Types**

The type of data provided by primary data is real-time, while the data provided by secondary data is stale. Researchers are able to have access to the most recent data when conducting primary research, which may not be the case for secondary data.

Secondary data have to depend on primary data that has been collected in the past to perform research. In some cases, the researcher may be lucky that the data is collected close to the time that he or she is conducting research. Thereby, reducing the amount of difference between the secondary data being used and the recent data.

- **Process**

Researchers are usually very involved in the primary data collection process, while secondary data is quick and easy to collect. This is due to the fact that primary research is mostly longitudinal. Therefore, researchers have to spend a long- time performing research, recording information, and analyzing the data. This data can be collected and analyzed within a few hours when conducting secondary research.

For example, an organization may spend a long time analyzing the market size for transport companies looking to talk into the ride-hailing sector. A potential investor will take this data and use it to inform his decision of investing in the sector or not.

- **Availability**

Primary data is available in crude form while secondary data is available in a refined form. That is, secondary data is usually made available to the public in a simple form for a layman to understand while primary data are usually raw and will have to be simplified by the researcher.

Secondary data are this way because they have previously been broken down by researchers who collected the primary data afresh. A good example is the Thomson Reuters annual market reports that are made available to the public.

When Thomson Reuters collect this data afresh, they are usually raw and may be difficult to understand. They simplify the results of this data by visualizing it with graphs, charts, and explanations in words.

- **Data Collection Tools**

Primary data can be collected using surveys and questionnaires while secondary data are collected using the library, bots, etc. The different ones between these data collection tools are glaring and can it be interchangeably used.

When collecting primary data, researcher’s lookout for a tool that can be easily used and can collect reliable data. One of the best primary data collection tools that satisfy this condition is Formplus. Formplus is a web-based primary data collection tool that helps researchers collect reliable data while simultaneously increasing the response rate from respondents.

- **Sources**

Primary data sources include: surveys, observations, experiments, questionnaires, focus groups, interviews, etc., while secondary data sources include; books, journals, articles, web pages, blogs, etc. These sources vary explicitly and there is no intersection between the primary and secondary data sources. Primary data sources are sources that require a deep commitment from researchers and require interaction with the subject of study. Secondary data, on the other hand, do not require interaction with the subject of study before it can be collected.

In most cases, secondary researchers do not have any interaction with the subject of research.

- **Specific**

Primary data is always specific to the researcher's needs, while secondary data may or may not be specific to the researcher's need. It depends solely on the kind of data the researcher was able to lay hands on.

Secondary researchers may be lucky to have access to data tailored specifically to meet their needs, which mag is not the case in some cases. For example, a market researcher researching the purchasing power of people from a particular community may not have access to the data of the subject community.

Alternatively, there may be another community with a similar standard of living to the subject community whose data is available. The researcher mag uses to settle for this data and use it to inform his conclusion on the subject community.

- **Advantage**

Some common advantages of primary data are its authenticity, specific nature, and up to date information while secondary data is very cheap and not time-consuming.

Primary data is very reliable because it is usually objective and collected directly from the original source. It also gives up to date information about a research topic compared to secondary data.

Secondary day, on the other hand, is not expensive making it easy for people to conduct secondary research. It doesn't take so much time and most of the secondary data sources can be accessed for free.

- **Disadvantage**

The disadvantage of primary data is the cost and time spent on data collection while secondary data may be outdated or irrelevant. Primary data incur so much cost and takes time because of the processes involved in carrying out primary research.

For example, when physically interviewing research subjects, one may need one or more professionals, including the interviewees, videographers who will make a record of the interview in some cases and the people involved in preparing for the interview. Apart from the time required, the cost of doing this may be relatively high.

Secondary data may be outdated and irrelevant. In fact, researchers have to surf through irrelevant data before finally having access to the data relevant to the research purpose.

- **Accuracy and Reliability**

Primary data is more accurate and reliable while secondary data is relatively less reliable and accurate. This is mainly because the secondary data sources are not regulated and are subject to personal bias.

A good example of this is business owners who lay bloggers to write good reviews about their product just to gain more customers. This is not the case with primary data which is collected by being a researcher himself.

One of the researcher's aim when gathering primary data for research will be gathering accurate data so as to arrive at correct conclusions. Therefore, biases will be avoided at all costs (e.g. same businesses when collecting feedback from customers).

- **Cost-effectiveness**

Primary data is very expensive while secondary data is economical. When working on a low budget, it is better for researchers to work with secondary data, then analyze it to uncover new trends.

In fact, a researcher might work with both primary data and secondary data for one research. This is usually very advisable in cases whereby the available secondary data does not fully meet the research needs.

Therefore, a little extension on the available data will be done and cost will also be saved. For example, a researcher may require a market report from 2010 to 2019 while the available reports stop at 2018.

- **Collection Time**

The time required to collect primary data is usually long while that required to collect secondary data is usually short. The primary data collection process is sometimes longitudinal in nature.

Therefore, researchers may need to observe the research subject for some time while taking down important data. For example, when observing the behavior of a group of people or particular species, researchers have to observe them for a while.

Secondary data can, however, be collected in a matter of minutes and analyzed to dead conclusions—taking a shorter time when compared to primary data. In some rare cases, especially when collecting little data, secondary data may take a longer time because of difficulty consulting different data sources to find the right data.

3.1.4 Similarities Between Primary & Secondary Data

- **Contains Same Content:**

Secondary data was once primary data when it was newly collected by the first researcher. The content of the data collected does not change and therefore has the same content with primary data.

It doesn't matter if it was further visualized in the secondary form, the content does not change. A common example of these are definitions, theorems, and postulates that were made years ago but still remain the same.

- **Uses**

Primary data and secondary data are both used in research and statistics. They can be used to carry out the same kind of research in these fields depending on data availability. This is because secondary data and primary data have the same content. The only difference is the method by which they are collected.

Since the method of collection does not directly affect the uses of data, they can be used to perform similar research. For example, whether collected directly or from an existing database, the demography of a particular target market can be used to inform similar business decisions.

4.0 Summary

In this unit we have leant that:

i. Primary data are the kind of data that are collected directly from the data source without going through any existing sources.
ii. Secondary data is the data that has already been collected through primary sources and made readily available for researchers to use for their own research.
iii. Primary data is very expensive while secondary data is economical.

5.0. Conclusion

When performing research, it is important to consider the available data options so as to ensure that the right type of data is used to arrive at a feasibility conclusion. A good understanding of the different data types, similarities, and differences are however required to do this. Primary data and secondary data both have applications in business and research. They may, however, differ from each other in the way in which they are collected, used, and analyzed. The most common setback with primary data is that it is very expensive, which is not the case for secondary data. Secondary data, on the other hand, has authenticity issues.

6.0 Tutor-Marked Assignments

1. As a final year student, will you prefer secondary data to primary data in writing your thesis? Justify the reasons for your answer.
2. What are the advantages of primary data over secondary data?

7.0 References/Further Reading

Primary vs Secondary Data: 15 Key Differences & Similarities.
https://www.formpl.us/blog/primary-secondary-data. Accessed 10.11.2020.

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MODULE 4: RESEARCH PROPOSAL AND WRITING A COMPLETE THESIS

UNIT 1: GUIDE TO PROPOSAL WRITING

CONTENTS

1.0 Introduction

A research proposal is intended to convince others that you have a worthwhile research project and that you have the competence and the work-plan to complete it (Sidik, 2005). Generally, a research proposal should contain all the key elements involved in the research process and include sufficient information for the readers to evaluate the proposed study.

2.0 Objectives

By the end of this unit, you will be able to:

- choose a research topic
- identify gaps during literature review.

3.0. Main Content

3.1 Proposal writing

This hub discusses some of the common elements in a research proposal. Whether you are doing quantitative or qualitative research, it is important that you outline the reasons why you propose doing the study and what process or procedures you will follow to complete the proposed study.

Some of the important parts of a good quantitative or qualitative research proposal include:

1. Determining the general topic;
2. Performing a Literature review on the topic;
3. Identifying a gap in the literature;

4. Identifying a problem highlighted by the gap in the literature and framing a purpose for the study;
5. Writing an Introduction to the study;
6. Framing research hypotheses and or research questions to investigate or guide the study;
7. Determine the method of investigation
8. Outline the research design
9. Define the Sample size and the characteristics of the proposed sample;
10. Describe the procedures to follow for data collection and data analyses.

Determine a General Topic

The first step in writing an academic research proposal is to identify a general topic or subject area to investigate. Usually this first point is the easiest because the research proposal will be tied to the overall theme of a course. In such a case, the general subject for investigation is normally determined by a professor who is leading the class, the school's department chair, or academic advisory committee.

Perform a Literature Review

The next step is to read as much literature on the general subject matter as time will allow. While you read the literature, it is advised to take copious notes and then summarize the purpose and findings of each study relevant to the general subject matter of the eventual research proposal.

Identify a Gap in the Literature

The general purpose of the literature review is not to have notes on a whole bunch of different journal articles and books on a particular subject. The purpose is to understand what studies have already been done on the subject and then to identify any glaring gaps in the literature. Identifying gaps in the literature will open up opportunities to add to the body of knowledge within the general subject area.

For instance, both Kimura and Coggins found that servant leadership is actively admired and taught in the Cambodian Christian community which makes up only a small percentage of the Cambodian population. However, no one has yet investigated attitudes towards servant leadership in the non-Christian Cambodian community which makes up over 90% of the population. This is an obvious gap in the literature.

Identify a Problem and Frame a Purpose Statement

After you have performed the literature review and hopefully identified an obvious gap in the literature, next you need to identify a problem related to the gap and frame a purpose statement as to why you are investigating what you propose and why other should care about the study. If your readers cannot answer the question so what? Or your answer the question why should I care? Then it may be interesting to you, but not relevant to anyone else.

Write an Introduction

After you have identified a pertinent problem and framed a purpose statement, then you need to craft an introduction. Among other things, the introduction to the proposal will include

- The statement of research problem
- A brief summary of the literature
- A brief description of the gap in the literature
- A Purpose statement as to why you are proposing the study and why others should care about the subject matter tied to your research proposal.

Determine Research Hypotheses and or Research Questions

Next, you need to identify and craft carefully defined research hypotheses and or research questions. Research hypotheses identify what you are actually going to investigate and what you expect to find from your research study. Research hypotheses are normally found in quantitative research proposals which compare differences and/or relationships between independent variables (or causes of phenomena) and dependent variables (or the effects that result from causes). Research questions are normally found in qualitative research studies. Most importantly, in good academic writing, research hypotheses and questions must be informed or flow from the literature review.

Determine the Method of Investigation

The method section is the second of the two main parts of the research proposal. In good academic writing it is important to include a method section that outlines the procedures you will follow to complete your proposed study. The method section generally includes sections on the following:

- Research design;
- Sample size and characteristics of the proposed sample;
- Data collection and data analysis procedures

Determine the Research Design

The next step in good academic writing is to outline the research design of the research proposal. For each part of the design, it is highly advised that you describe two or three possible alternatives and then tell why you propose the particular design you chose. For instance, you might describe the differences between experimental, quasi-experimental, and non-experimental designs before you elaborate on why you propose a non-experimental design.

Determine the Sample Size and the Characteristics of the Sample

In this section of your research proposal, you will describe the sample size and the characteristics of the participants in the sample size. Describe how you determined how many people to include in the study and what attributes they have which make them uniquely suitable for the study.

Determine the Data Collection and Data Analysis Procedures

The last section highlighted in this hub is the data collection and analysis procedures. In this section you will describe how you propose to collect your data e.g. through a questionnaire survey if you are performing a quantitative analysis or through one-on-one interviews if you are performing a qualitative or mixed methods study.

After you collect the data, you also need to follow a scheme as how to analyze the data and report the results. In a quantitative study you might run the data through Excel or better yet SPSS and if you are proposing a qualitative study you might use a certain computer program like ATLAi to perform a narrative study or grounded theory study that exposes the main themes from the proposed interviews.

4.0 Summary

In this unit we have leant that:

i. The first step in writing an academic research proposal is to identify a general topic or subject area to investigate.
ii. The next step is to read as much literature on the general subject matter as time will allow.
iii. The purpose of literature review is to understand what studies have already been done on the subject and then to identify any glaring gaps in the literature.

5.0. Conclusion

Irrespective of your research area and the methodology you choose, all research proposals must be based on what you plan to achieve, and how you are going to achieve it.

6.0 Tutor-Marked Assignments

1. Explain how to identify gaps during literature review.
2. List five important components of a good research proposal.

7.0 References/Further Reading

Sidik, S.M. (2005). How to write a research proposal. *The Family Physician*, 13(3): 1-4

10 Steps to Writing an Academic Research Proposal.
http://ecoggins.hubpages.com/hub/10-Steps-to-Writing-a-Research-Proposal. Accessed 10.11.2020

UNIT 2: RESEARCH TOPICS

CONTENTS

1.0 Introduction

Ideas for research problems or topics can arise from a range of sources such as personal or professional experience, a theory, the media, or other research studies.

2.0 Objectives

By the end of this unit, you should be able to understand how to:

- Get researchable topics;
- Formulate research problem.

3.0 Main Content

3.1 Where do research ideas come from?

Personal or professional experience

Everyday personal or professional experience may lead us to identify a problem for which we would like a solution. Alternatively, we may encounter a question or questions that we would like to try and answer. For example, on a personal level, you may prefer the taste of organically produced vegetables and thus wonder if people in general prefer the taste of organically produced vegetables to those produced non-organically. The research topic is a study into taste preferences and the question 'do people in general prefer the taste of organically produced vegetables to those produced non-organically?' Alternatively, for example, as a professional nature reserve warden you may want to encourage the establishment and spread of a particular plant species because you know it is a food source for a rare butterfly. The research problem may be, 'how do I encourage the spread of the plant species of interest?'

Theory

Theories are ideas about how things relate to each other. Theories may be general, commonly held beliefs (such as, domestic cats are the cause of a decline in bird numbers in UK gardens) or more technical ideas (for example, that global warming is causing a change to the timing of the seasonal responses of the flowering cherry tree in

the UK). There are many ways of expressing theories, some are very formal, others are informal. Here are some examples:

- Keynes' statement that ... 'men are disposed as a rule and on average, to increase their consumption as their income increases, but not as much as the increase in their income ...' is a theory.
- The idea that distance learners have different needs than on-campus students is a theory.
- A hunch that crossing two particular strains of maize will produce a more drought-tolerant variety is a theory.
- The assumption that every species has a fundamental niche, is a theory. Theories may be useful in suggesting interesting questions and generally guiding fieldwork, but should not restrict us from exploring alternative explanations. The end result of the research process is knowledge.

Literature and the media

There are many sources of literature, such as books, journal articles, and newspapers. When searching and reading literature it is possible to encounter gaps in information and knowledge, and problems for which there is currently no solution. These may provide a good basis for research. We are also flooded with information presented by the media, such as television, which again might give rise to research ideas.

3.2 Formulating the Research Problem

Once the general topic or problem has been identified, this should then be stated as a clear research problem, that is, taken from just a statement about a problematic situation to a clearly defined researchable problem that identifies the issues you are trying to address. It is not always easy to formulate the research problem simply and clearly. In some areas of scientific research the investigator might spend years exploring, thinking, and researching before they are clear about what research questions they are seeking to answer. Many topics may prove too wide-ranging to provide a researchable problem. Choosing to study, for instance a social issue such as child poverty, does not in itself provide a researchable problem. The problem is too wideranging for one researcher to address. Time and resources would make this unfeasible and the results from such a study would consequently lack depth and focus.

Statement of research problem

An adequate statement of the research problem is one of the most important parts of the research. Different researchers are likely to generate a variety of researchable problems from the same situation since there are many research issues that can arise out of a general problem situation. Your research will be able to pursue only one in depth. For a problem statement to be effective in the planning of applied research it should have the following characteristics (Andrew and Hildebrand 1982). (1) The problem reflects felt needs (2) The problem is non-hypothetical, i.e. it must be based on factual evidence (3) It should suggest meaningful and testable hypotheses – to avoid answers that are of little or no use to the alleviation of the problem (4) The problems should be relevant and manageable

Formulating the research problem allows you to make clear, both to yourself and the reader, what the purpose of your research is. Subsequent elaboration of method should

be oriented to providing information to address that problem. The problem statement is therefore a very important device for keeping you on track with your research. It is also one means by which your research will be evaluated – does the research address the problem as stated.

3.3 From research problem to researchable questions?

Arriving at specific research objectives, questions or hypotheses from an idea or problem is a highly personalised activity – there are different ways of doing it and we all do it differently. Below is one suggestion based around the idea of 'brainstorming'. The results of this process can be displayed in the form of a 'spider diagram' or mental map of ideas and themes related to your research idea. The resulting conceptual map can serve both as a starting point and as a conceptual framework for your investigation.

Conceptual frameworks

A common tactic here is to 'unpack' your idea or problem thus generating a range of possibilities before narrowing down on one or two themes. Following the suggestions of Punch (1998) steps could be:
(1) write down the all the concepts involved, and all the sub-questions you can think of pertaining to the issue. Reading around your research idea will help to generate questions and information and to identify themes and potential information sources
(2) subdivide your questions where possible; split wide general questions into smaller ones
(3) begin to order questions and develop focus: group questions together under common themes, separate general and specific questions
(4) start to trim by selecting those questions that you wish to deal with, consider the resources that will be available to you
(5) collate these thoughts within a loose conceptual framework – this shows how questions and themes are related and may help guide your thinking at a later stage.

This process of thinking wide and then focusing and delimiting your questions, should result in a handful of research questions that you wish to investigate. These may still need further modification to render them answerable; they may need to be operationalised.

Note: there are no right or wrong answers in such an exercise; the purpose is to get you thinking about as many facets of your research idea as possible. It should also cause you to question some of the concepts you might previously have accepted as given.

4.0 Summary

In this unit we have leant that:

i. Everyday personal or professional experience may lead us to identify a problem for which we would like a solution.
ii. When searching and reading literature it is possible to encounter gaps in information and knowledge, and problems for which there is currently no solution.
iii. Formulating the research problem allows you to make clear, both to yourself and the reader, what the purpose of your research is.

5.0. Conclusion

Regardless of your interest, any topic that you choose must be researchable, there should be enough information for your literature review, appropriate instruments for data collection etc. Whatsoever topic that you choose must not be too narrow or broad.

6.0 Tutor-Marked Assignments

1. Explain how to identify research topic.
2. Explain the significance of statement of research problem in writing a research proposal.

7.0 References and other Resources

Andrew CO, Hildebrand PE. (1982). Planning and Conducting Applied Agricultural Research. Westview Press Inc.

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UNIT 3: FORMULATING RESEARCH QUESTIONS, HYPOTHESES, AND OBJECTIVES

CONTENTS

1.0 Introduction

In this section we continue to explore the issue of turning ideas into questions by taking a look at how to refine questions and generate research objectives and hypotheses.

2.0 Objectives

By the end of this unit, you will be able to:

- develop and write research questions;
- formulate and write research hypotheses and objectives.

3.0 Main Content

3.1 Research Questions

It is usually best to pose only few questions. Do not pose more than necessary questions as this generally leads to a much larger research project. Start questions with terms like, how, who, what, why, and when. Questions should be specific, not vague.

Example of research questions

- When is the best time of year to translocate a meadow grassland from its original site to a new site?
- How does applying fertilizer affect the yield of a wheat crop grown in north eastern part of Nigeria?
- What are the implications of de-regulating a hitherto controlled market for a staple food commodity on producers and consumers in a named region of a country?
- Why do residents of a named village object to the siting of wind turbines 2 km from their homes?

The questions above represent wide differences in scope and complexity and hence will make very different demands on research resources. Some of these questions might later need to be modified to fit resources (abilities, time, finance, equipment) while still addressing research problem.

3.2 Research Hypotheses

It is appropriate to use a hypothesis when you are testing a theory. Your immediate answer to this may be 'I'm not testing a theory'; however, remember that our definition of theory is very broad – 'an idea about how things relate to each other'. If you have an expectation of how your research question will be answered (the outcome) then it is fair to say you have a theory in mind. If you ask of your research question 'What is the expected outcome?' and have an answer, you can ask why? What is my thinking behind this prediction? This is essentially the theory that you will be testing. If you are not able to predict the answer to your question then your approach is not one of theory testing and you should not proceed with developing hypotheses to test. Your research questions remain as such. This will be the case if your research is descriptive or exploratory in nature.

Developing a hypothesis from a research question

Our definition of a hypothesis stresses that it can be tested. To meet this criterion, the hypothesis must be operationalised – that is the concepts employed in the hypothesis must be measurable.

Developing hypotheses requires that you identify one character, variable or descriptor of a sampling unit that causes, affects, or has an influence on, another character, variable or descriptor of the same or other sampling units. The character, variable or descriptor that affects other variables or sampling units is called the independent variable. The character, variable or descriptor which is affected by the independent variable is called the dependent variable or response variable. Note that although for the purposes of research methodology some variables may be called 'dependent' when investigating their relationship with other 'independent' variables, this does not imply the existence of a causal (as compared with associative) relationship unless strict rules of research design are followed.

Research without hypotheses

In exploratory research our base knowledge of a subject may be so low that we cannot formulate meaningful hypotheses. Nonetheless, exploratory research should be guided by a clear sense of purpose. Instead of hypotheses, the design for the exploratory study should state its purpose, or research objectives as well as criteria by which the exploration will be judged successful. For example, if we are trying to encourage farmers to make use of compost, we may first need to know the social structure or social norms of the farming community before we can begin making meaningful hypotheses about which individuals will influence the decision and the factors they consider when making their decision. We can state that our exploratory study would have the purpose of generating hypotheses about personal characteristics which correlate with the adoption/rejection of composting, the composition of the decision-making unit, and the factors which influence the decision either to adopt or reject. Success would be measured in terms of generating testable hypotheses. Interpretative research, which seeks to develop knowledge through understanding meaning, does not usually proceed with hypotheses.

3.3 Research Objective(s)

What are 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, i.e. to describe what is, rather than to test an explanation for what is, a research objective will provide an adequate guide to the research.

Examples of research statements

From research problem to hypothesis, a natural science example

Problem

Will the time of year affect establishment when translocating a grassland community to a new site?

Question

When is the best time of year to translocate a meadow grassland from its original site in southeast England, to a new site?

Research hypothesis

Translocation of meadow grassland in south-east England is more successful if carried out in the autumn, rather than the spring.

Objective

To determine whether spring or autumn is the best time for translocation of meadow grassland in southeast England

4.0 Summary

In this unit we have leant that:

i. Developing hypotheses requires that you identify one character, variable or descriptor of a sampling unit that causes, affects, or has an influence on, another character, variable or descriptor of the same or other sampling units.

ii. Research objectives may be linked with a hypothesis or used as a statement of purpose in a study that does not have a hypothesis.

iii. It is appropriate to use a hypothesis when you are testing a theory.

5.0. Conclusion

Research questions, objectives and hypotheses are important parts of research proposal that are indispensable. They are the fuel that drive the research engine to a successful destination. From research questions, objectives are derived and from objectives, hypotheses are formed.

6.0 Tutor-Marked Assignments

1. Explain how to identify research topic.
2. Explain the significance of statement of research problem in writing a research proposal.

7.0 References/Further Reading

Andrew CO, Hildebrand PE. (1982). Planning and Conducting Applied Agricultural Research. Westview Press Inc.

Bryman A. (2008). Social Research Methods, 3rd edn. Oxford University Press, Oxford.

Dixon BR, Bouma GD, Atkinson GBJ. (1987). A Handbook of Social Science Research. Oxford University Press, Oxford.

Dorward AR, Chirwa E, Boughton D, Kelly V. (2007). Evaluation of the 2006/7 Agricultural Input Supply Programme, Malawi: Interim Report. Imperial College London.

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Punch KF. (1998). Introduction to Social Research: Qualitative and Quantitative Approaches. Sage Publications, London.

UNIT 4: LITERATURE REVIEW

CONTENTS

1.0 Introduction

Why do you need to review the existing literature? The most obvious reason is that you want to know what is already known about your area of interest so that you do not simply 'reinvent the wheel' (Bryman, 2012). Your literature review is where you demonstrate that you are able to engage in scholarly review based on your reading and understanding of the work of others in the same field. Beyond this, using the existing literature on a topic is a means of developing an argument about the significance of your research and where it leads.

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2.0 Objectives

By the end of this unit, you should be able to understand how to:

- Review literature and
- Identify gaps through literature review.

3.0 Main Content

3.1 Reviewing the Existing Literature

A competent review of the literature is at least in part a means of affirming your credibility as someone who is knowledgeable in your chosen area (Bryman, 2012). This is not simply a matter of reproducing the theories and opinions of other scholars, but also being able to interpret what they have written, possibly by using their ideas to support a particular viewpoint or argument. According to Bryman (2012), the purpose of exploring the existing literature should be to identify the following issues.

• What is already known about this area?
• What concepts and theories are relevant to this area?
• What research methods and research strategies have been employed in studying this area?
• Are there any significant controversies?
• Are there any inconsistencies in findings relating to this area?
• Are there any unanswered research questions in this area?

This last issue points to the possibility that you will be able to revise and refine your research questions in the process of reviewing the literature.

Important points to note during literature review

According to Bryman (2012), when you are reading the existing literature try to do the following.

• Take good notes, including the details of the material you read.

• Develop critical reading skills. In reviewing the literature, you should do more than simply summarize what you have read. You should, whenever appropriate, be critical in your approach.

• Bear in mind that reading the literature is not something that you should stop doing once you begin designing your research. You should continue your search for and reading of relevant literature more or less throughout your research.

• Your search for literature should be guided by your research questions, but as well you should use your review of the literature as a means of showing why your research questions are important. For example, if one of your arguments in arriving at your research questions is that, although a lot of research has been done on X (a general topic or area, such as the secularization process, female entrepreneurship, or employee absenteeism), little or no research has been done on X1 (an aspect of X), the literature review is the point where you can justify this assertion.

• Bear in mind that you will want to return to much of the literature that you examine in the discussion of your findings and conclusion.

3.2 Systematic Review

This is an approach to reviewing literature that adopts explicit procedures (Bryman, 2012). It has emerged as a focus of interest for two main reasons. One is that it is sometimes suggest that many reviews of the literature tend to 'lack thoroughness' and reflect the biases of the researcher. Proponents of systematic review suggest that adopting explicit procedures makes such biases less likely to surface. Second, in fields like medicine, there has been a growing movement towards evidence-based solutions to illnesses and treatments. Systematic reviews of the literature are often seen as an accompaniment to evidence-based approaches, as their goal is to provide advice for clinicians and practitioners based on all available evidence. Such reviews are deemed to be valuable for decision-makers, particularly in areas where there is conflicting evidence concerning treatments (as often occurs in the case of medicine).

The systematic review approach is beginning to diffuse into other areas, like social policy, so that policy-makers and others can draw on reviews that summarize the balance of the evidence in certain areas of practice.

Systematic review has been defined as 'a replicable, scientific and transparent process . . . that aims to minimize bias through exhaustive literature searches of published and unpublished studies and by providing an audit trail of the reviewer's decisions, procedures and conclusions' (Tranfield *et al*., 2003: 209).

A systematic review that includes only quantitative studies is a meta-analysis. In recent times, the development of systematic review procedures for qualitative studies has attracted a great deal of attention, especially in the social sciences. Meta-ethnography is one such approach to the synthesis of qualitative findings, but currently there are several different methods, none of which is in widespread use (Mays *et al*., 2005).

According to Bryman (2012), accounts of the systematic review process vary slightly, but they tend to comprise the following steps in roughly the following order.

1. Define the purpose and scope of the review. The review needs an explicit statement of the purpose of the review (often in the form of a research question) so that decisions about key issues such as what kinds of research need to be searched for and what kinds of samples the research should relate to can be made in a consistent way.
2. Seek out studies relevant to the scope and purpose of the review. The reviewer should seek out studies relevant to the research question(s). The search will be based on keywords and terms relevant to the purpose defined in Step 1.
3. Appraise the studies from Step 2. The reviewer might want to restrict the review to studies published only in a particular time period or to studies that derive from one region or nation rather than another.
4. Analyse each study and synthesize the results. A formal protocol should be used to record features like: date when the research was conducted; location; sample size; data-collection methods; and the main findings.

3.3 Narrative Review

Rather than reviewing the literature to find out what their research project can add to existing knowledge about a subject, interpretative researchers can have quite different reasons for reviewing the literature on a particular subject, since their purpose is to enrich human discourse (Geertz, 1973a) by generating understanding rather than by accumulating knowledge. The literature review is for them a means of gaining an initial impression of the topic area that they intend to understand through their research. The process of reviewing the literature is thus a more uncertain process of discovery, in that you might not always know in advance where it will take you! Narrative reviews therefore tend to be less focused and more wide-ranging in scope than systematic reviews. They are also invariably less explicit about the criteria for exclusion or inclusion of studies.

Reasons for writing a literature review

According to Bryman (2012), the following is a list of reasons for writing a literature review.
• You need to know what is already known in connection with your research area, because you do not want to be accused of reinventing the wheel.
• You can learn from other researchers' mistakes and avoid making the same ones.
• You can learn about different theoretical and methodological approaches to your research area.
• It may help you to develop an analytic framework.
• It may lead you to consider the inclusion of variables in your research that you might not otherwise have thought about.
• It may suggest further research questions for you.
• It will help with the interpretation of your findings.
• It gives you some pegs on which to hang your findings.
• It is expected!

4.0 Summary

In this unit we have leant that:

i. A competent review of the literature is at least in part a means of affirming your credibility as someone who is knowledgeable in your chosen area.

ii. Systematic review is an approach to reviewing literature that adopts explicit procedures.
iii. A systematic review that includes only quantitative studies is a meta-analysis.

5.0. Conclusion

Literature review in research proposal is essential because it is a process of identifying relevant information through the investigation of past and present studies writing. It is also an avenue of learning that helps to increase the knowledge of the researcher and helps to shape the course of his/her research.

6.0 Tutor-Marked Assignments

1. State five reasons for writing literature review.
2. Describe systematic review.

7.0 References and other Resources

Bryman, A. (2012). Social Research Methods. 4th Edition. Oxford University Press Inc., New York, USA.

Mays, N., Pope, C., and Popay, J. (2005). 'Systematically Reviewing Qualitative and Quantitative Evidence to Inform Management and Policy-Making in the Health Field', *Journal of Health Services Research and Policy*, 10 (Supplement 1): S6 – S20.

Tranfield, D., Denyer, D., and Smart, P. (2003). 'Towards a Methodology for Developing Evidence-Informed Management Knowledge by Means of Systematic Review', *British Journal of Management*, 14: 207– 22.

UNIT 5: METHODOLOGY

CONTENTS

1.0 Introduction

This section describes and justifies the data gathering method used. It also outlines how you analyzed your data. Begin by describing the method you chose and why this method is the most appropriate and in doing so, you should cite reference literature about the method (Hon, no date).
Next, detail every step of the data gathering and analysis process. Although this section varies depending on method and analysis technique chosen, many of the following areas typically are addressed:
--description of research design
internal validity
external validity
--description of population and description of and justification for type of sample used or method for selecting units of observation
--development of instrument or method for making observations (e.g., question guide, categories for content analysis)
pre-test
reliability and validity of instrument or method
--administration of instrument or method for making observations (e.g., interviews, observation, content analysis)
--coding of data
--description of data analysis
statistical analysis and tests performed
identification of themes/categories (qualitative or historical research)

2.0 Objectives

By the end of this unit, you should be able to:

- research methodology and
- research method.

3.0 Main Content

3.1 Research Method and Research Methodology

Research method and research methodology are two terms that are often confused as one and the same (Goundar, 2012). Strictly speaking they are not so and they show differences between them. One of the primary differences between them is that research methods are the methods by which you conduct research into a subject or a topic. On the other hand, research methodology explains the methods by which you may proceed with your research. Research methods involve conduct of experiments, tests, surveys and the like. On the other hand, research methodology involves the learning of the various techniques that can be used in the conduct of research and in the conduct of tests, experiments, surveys and critical studies. This is the technical difference between the two terms, namely, research methods and research methodology.

Research methodology is a systematic way to solve a problem. It is a science of studying how research is to be carried out (Groundar, 2012). Essentially, the procedures by which researchers go about their work of describing, explaining and predicting phenomena are called research methodology. It is also defined as the study of methods by which knowledge is gained. Its aim is to give the work plan of research.

Research methods are the various procedures, schemes, algorithms, etc. used in research (Groundar, 2012). All the methods used by a researcher during a research study are termed as research methods. They are essentially planned, scientific and value-neutral. They include theoretical procedures, experimental studies, numerical schemes, statistical approaches, etc. Research methods help us collect samples, data and find a solution to a problem. Particularly, scientific research methods call for explanations based on collected facts, measurements and observations and not on reasoning alone. They accept only those explanations which can be verified by experiments.

In short it can be said that research methods aim at finding solutions to research problems. On the other hand, research methodology aims at the employment of the correct procedures to find out solutions. It is thus interesting to note that research methodology paves the way for research methods to be conducted properly. Research methodology is the beginning whereas research methods are the end of any scientific or non-scientific research.

Let us take for example a subject or a topic, namely, ‘employment of figures of speech in English literature’. In this topic if we are to conduct research, then the research methods that are involved are study of various works of the different poets and the understanding of the employment of figures of speech in their works. On the other hand, research methodology pertaining to the topic mentioned above involves the study about the tools of research, collation of various manuscripts related to the topic, techniques involved in the critical edition of these manuscripts and the like.

If the subject into which you conduct a research is a scientific subject or topic then the research methods include experiments, tests, study of various other results of different experiments performed earlier in relation to the topic or the subject and the like. On the other hand, research methodology pertaining to the scientific topic involves the techniques regarding how to go about conducting the research, the tools of research,

advanced techniques that can be used in the conduct of the experiments and the like. Any student or research candidate is supposed to be good at both research methods and research methodology if he or she is to succeed in his or her attempt at conducting research into a subject.

Research methods may be understood as all those methods/techniques that are used for conduction of research (Groundar, 2012). Research methods or techniques, thus, refer to the methods the researchers use in performing research operations. In other words, all those methods which are used by the researcher during the course of studying his research problem are termed as research methods (Groundar, 2012). Since the object of research, particularly the applied research, is to arrive at a solution for a given problem, the available data and the unknown aspects of the problem have to be related to each other to make a solution possible. Keeping this in view, research methods can be put into the following three groups:

1. In the first group we include those methods which are concerned with the collection of data. These methods will be used where the data already available are not sufficient to arrive at the required solution;
2. The second group consists of those statistical techniques which are used for establishing relationships between the data and the unknowns;
3. The third group consists of those methods which are used to evaluate the accuracy of the results obtained.

Research methods falling in the above stated last two groups are generally taken as the analytical tools of research.

Research methodology seeks to inform: why a research study has been undertaken, how the research problem has been defined, in what way and why the hypothesis has been formulated, what data have been collected and what particular method has been adopted, why particular technique of analysing data has been used and a host of similar other questions are usually answered when we talk of research methodology concerning a research problem or study.

4.0 Conclusion

Research methods or techniques refer to the methods the researcher use in carrying out research operations. Research methodology, on the other hand, has to do with how a research will be carried out. The two are indispensable ingredients of research, they add value to the entire research process.

5.0 Summary

In this unit we have leant that:

i. Research methodology is a science of studying how research is to be carried out.
ii. All the methods used by a researcher during a research study are termed as research methods.
iii. Essentially, the procedures by which researchers go about their work of describing, explaining and predicting phenomena are called research methodology.

6.0 Tutor-Marked Assignments

1. Highlight the significance of research methodology.
2. Differentiate between research method and research methodology.

7.0 References/Further Reading

Hon, L.D. (no date). Guidelines for Writing a Thesis or Dissertation.

Goundar, S. (2012). Research Methodology and Research Method.

MODULE 5: RESEARCH PROPOSAL AND WRITING A COMPLETE THESIS CONT'D

UNIT 1: THE RESULTS AND DISCUSSION SEGMENT:
REPORTING YOUR FINDINGS
UNIT 2: SUMMARY, CONCLUSION AND RECOMMENDATIONS
UNIT 3: REFERENCING UNIT 4: THESIS STRUCTURING
UNIT 5: TECHNICAL ISSUES IN WRITING

UNIT 1: THE RESULTS AND DISCUSSION SEGMENT: REPORTING YOUR FINDINGS

CONTENTS

1.0 Introduction

This section deals with the presentation of the results as they are, there is no need for exaggeration or embellishment of the truth. Report the findings as they appear and let your research audience understand what you are talking about in simple and concise manner.

.

2.0 Objectives

By the end of this unit, you should be able to understand how to:

- present results of data analysis and
- discuss them thoroughly.

3.0 Main Content

3.1 Presentation of the Results

According to Fox and Jennings (2014), the results section should purely present and describe the output of the analyses "as you found it". No interpretation or extended discussion of the results is needed. The discussion section is specifically designed to interpret the results, and put them into a broader theoretical or applied context. Thus, the results section should contain only data, tables, graphs, and an explanation of each. In other words, a good results section will aim to tell the story of the data as it was laid out earlier in the literature review and methodology sections. A bad results section will simply display a long tedious list of analyses and tables.

Still, it is important that all relevant results are presented, not just those that are statistically significant or supportive of your hypotheses. In fact, the results should be presented in the same order and format as the corresponding hypotheses in the methodology and literature review. Each section of the paper should aim to be a mirror image of the others in an effort to maintain a consistent pattern for the readers. It is therefore important to be thoughtful about the structure and presentation of results, and possibly change the format of earlier sections so the paper is organized and easily interpretable. Also remember that it is not appropriate to bring up findings in the discussion section that were not presented first in the results. Therefore, it is helpful to consider the results section as the climax of the methodology and prelude to the discussion, but none of these sections should be redundant per se.

Writing the results

When writing up the results, it is important to start with the forest, and then move to the trees (Fox and Jennings, 2014). In other words, begin first with the central findings regarding the study's hypotheses and research questions and then move on to more peripheral findings such as unexpected results or variations of the major analysis output. Often, this section begins with descriptive statistics such as the means, medians, standard deviations, frequencies, and proportions for the variables of interest, as well as the results from any analyses on the integrity or internal consistency of the data and measures. These findings help set the stage for the upcoming results and assist readers in evaluating the study's validity.

Next, a brief discussion of the statistical analysis used in the study should follow. If more than one type of analysis is utilized in the study, each should be described in the order the results will be presented. This discussion should cover the more technical aspects of the analysis, such as the statistical underpinnings and formula/s for the analysis, the alpha level (p-value) used for hypothesis testing, the specific variables used in each analysis, any special software needed to conduct the analysis, and how the results of each type of analysis should be interpreted by readers.

At this point researchers may begin presenting the findings from their analyses, though it is beneficial to make use of sub-sections and sub-headings to organize the results for the readers. For instance, if you plan to test multiple hypotheses using several regressions, create a section for each hypothesis tested using a unique analysis and present those results within that section before moving on to the next hypothesis and analysis. Again, the order of these sub-sections should mirror how the hypotheses were discussed in the literature review and methodology to maintain organization throughout the paper. Also, you should title each section to accurately reflect the analysis being conducted. For instance, do not simply label the sub-section "The ANOVA", but instead label it "Effects of opposing expert testimony conditions on verdicts: ANOVA Results". This will help readers quickly navigate and understand what is being presented your paper and what type of analysis is being described. In addition, within each subsection author/s should begin by re-stating the hypothesis to be tested and the results predicted by the hypothesis.

Following this, you should then present the analysis used to test the hypothesis in writing and in a table if needed and neutrally report the findings of the test. Do not attempt to bend or partially report results just to support hypotheses of your research.

Instead, let the results speak for themselves and report them all neutrally without any distortion, or interpretation of context.

For each type of analysis, there are specific ways to describe and discuss results in writing. For instance, when presenting the results of descriptive analyses, the APA (American Psychological Association) suggests reporting the means and standard deviations for each variable, as well as test statistics, degrees of freedom, and probability of the result occurring by chance (p-value). Each of these statistics should be rounded to two decimal places, statistical symbols (e.g., M, SD, t, p, etc.) should be italicized, and all results should be referred to in the past tense, according to APA formatting. For hypothesis tests and inferential statistics, there are more specific methods of presentation that correspond to the specific analyses. But, in general, all output should indicate whether there was a significant difference between the two groups of interest, the direction of the difference (i.e. higher/less than the other group), and the effect size of the findings if it is available. Some of the most common analyses used to test hypotheses in quantitative research are the t-test, chi-square test, correlation, analysis of variance, and regression. According to Fox and Jennings (2014), here are examples of how to present the results of these analyses in the text of the manuscript.

1. Descriptive statistics: Although participants in the study were relatively young ($M = 18.22$, $SD = 3.45$), over half (52%) of the sample was married.
2. t-test: Results from a t-test indicate that undergraduate students taking a research methods course in Criminology had higher IQ scores ($M = 131$, $SD = 15.4$) compared to students taking a research methods course in Theoretical Physics ($M = 122$, $SD = 12.3$), $t(44) = 2.58$, $p = .05$.
3. Chi-square test: A chi-square test a showed significant relationship between marital status and depression, $\chi 2\ (3, N = 126) = 24.7$, $p < .001$. Married couples were less likely to be depressed than were unmarried individuals.
4. Correlations: The Pearson correlation coefficient for income and happiness level shows a statistically significant but moderate negative linear relationship between the two variables, $r(205) = -0.485$, $p = 0.02$, two-tailed.
5. Analysis of variance (ANOVA): A two-way ANOVA showed a significant main effect for the gender of diners, $F(1, 108) = 4.94$, $p < .05$, as the average tip was significantly higher for men ($M = \$5.30$, $SD = 1.44$) than for women ($M = \$3.66$, $SD = 1.18$). The main effect of touch was non-significant, $F(1,108) = 2.24$, $p = .09$. However, the interaction effect of gender and touch was significant, $F\ (1,108) = 5.55$, $p < .01$, with the gender effect on tips stronger in the touch condition than in the non-touch condition.
6. Regression: Results of the OLS regression showed that parental attachment was significantly associated with self-esteem scores, $b = .34$, $t(225) = 6.53$, $p < .01$. Parental attachment also explained a significant proportion of variance in self-esteem scores, $R^2 = .12$, $F(1, 225) = 42.64$, $p < .01$.

As stated, there are many cases where reporting the results in text alone is not the most efficient or effective way of conveying the findings to readers. In many cases, the results must be supported by a full table or graph that numerically displays the analytical output. Nevertheless, it
is essential that every table or graph presented must also be discussed in the text. Or in other words, do not present a graph or table that is not discussed sufficiently, or at all, in the text of the results section.

4.0 Conclusion

Reporting your findings should be documented in a simple and catchy manner. Your results presentation should not confuse your reader and do not report what is not part of your findings as your own results. Write your results the way they are, no need for exaggeration at all.

5.0 Summary

In this unit we have leant that:

i. For each type of analysis, there are specific ways to describe and discuss results in writing.
ii. It is important that all relevant results are presented, not just those that are statistically significant or supportive of your hypotheses.
iii. Remember that it is not appropriate to bring up findings in the discussion section that were not presented first in the results.

6.0 Tutor-Marked Assignments

1. What are the implications of a badly written result?
2. Describe briefly, how to write the result section of a thesis.

7.0 References/Further Reading

Fox, B.H., & Jennings, W. G. (2014): How to write a methodology and results section for empirical research, *Journal of Criminal Justice Education*, 25(2), 137-156. DOI: 10.1080/10511253.2014.888089

UNIT 2: SUMMARY, CONCLUSION AND RECOMMENDATIONS

CONTENTS

1.0 Introduction

This section deals with summarizing the major findings of your research and drawing relevant conclusion. After this you are to make recommendations based on the findings of your study for policy purposes, suggestion for further studies etc.
.

2.0 Objectives

By the end of this unit, you will be able to:

- summarize research findings and
- draw relevant conclusion and make recommendations.

3.0 Main Content

3.1 Research Summary

The summary section of your research puts together your research in brief plus the major findings in simple and concise manner. To start with, summarize what one has attempted to do and the results one has achieved; one may restate the original research questions, or hypotheses, and indicate whether one has supported, or rejected them (Ebrahim, 2018). Briefly summarize everything covered in the first three chapters and in the findings portion of chapter four (results) (Mutai, 2001). The summary reminds and informs the reader about the purpose of the study, the process used to collect, analyze data and the major findings of the study. A summary must reflect as accurately as possible the body of one's report (Mugenda & Mugenda, 2003)

3.2 Conclusion and Recommendations

The Conclusion and recommendations may be combined or, in long reports, presented in separate sections based on the writing style of each institution. If there are no recommendations to be made as a result of the project, just call this section Conclusions. Always endeavor to follow the style of your institution.

The conclusion section sums up the key points of your discussion, the essential features of your design, or the significant outcomes of your investigation. As its function is to round off the story of your project, it should:
be written to relate directly to the aims of the project as stated in the introduction;
indicate the extent to which the aims have been achieved;
summarise the key findings, outcomes or information in your report;
acknowledge limitations and make recommendations for future work (where applicable);
highlight the significance or usefulness of your work.
The conclusions should relate to the aims of the work:

One's summary and conclusions should lead logically to one's recommendations (Ebrahim, 2018). Recommendations must be consistent with the purpose of the study, its objectives, the evidence presented by the data and the interpretations given. Recommendations should be practical and achievable (Mugenda & Mugenda, 2003).

Where recommendations involve policy decisions, state them completely as possible including who should do what, when and why (Mutai, 2001). Common recommendations that researchers often make include:
1. Areas of further research: emphasizing the questions in the study that remain unanswered and therefor ought to be explored further.
2. Methodological issues: that could be addressed and refined to improve future research in the areas of study.
3. Actions that should be taken to address the problem based on the research findings: solving specific problems could involve designing and implementing an intervention of project (Mugenda & Mugenda, 2003, p.152).

4.0 Conclusion

The summary section presents the major findings of your results together with the essential aspects of the overall research. The conclusion rounds off the entire research while recommendations are made based on the findings of your study.

5.0 Summary

In this unit we have leant that:

i. The conclusion section sums up the key points of your discussion, the essential features of your design, or the significant outcomes of your investigation.
ii. The summary reminds and informs the reader about the purpose of the study, the process used to collect, analyze data and the major findings of the study.
iii. One's summary and conclusions should lead logically to one's recommendations.

6.0 Tutor-Marked Assignments

1. What is the essence of recommendation in research?
2. What should constitute the summary of a study?

7.0 References and other Resources

Conclusions and recommendations. https://www.monash.edu/rlo/assignment-samples/engineering/eng-writing-technical-reports/conclusions-and-recommendations. Accessed 12.11.2020.

Ebrahim, Y.H. (2018). Lesson 28 Chapter six (Conclusion and recommendation): Preparation for academic research and theses from undergraduate to postgraduate degree levels: Chapter preview

Mugenda, O. & Mugenda, A. (2003). Research methods: quantitative and qualitative approaches. (1st ed.). Nairobi: African Centre for Technology Studies (ACTS).

Mutai, B.K. (2001). How to write standard dissertation: A systematic and simplified approach. (1st ed.). Edinburgh: Thelley Publications.

UNIT 3: REFERENCING

CONTENTS

1.0 Introduction

Referencing the work of others is an important academic convention because it emphasizes that you are aware of the historical development of your subject, particularly if you use the Harvard (or author–date) method, and shows that you recognize that your own research builds on the work of others (Bryman, 2012).

2.0 Objectives

By the end of this unit, you will be able to:

- state the meaning of referencing
- mention the approaches to referencing.

3.0 Main Content

3.1 Referencing Your Work

Referencing in your literature review is thus a way of emphasizing your understanding and knowledge of the subject. In other parts of your dissertation referencing will serve somewhat different purposes—for example, it will show your understanding of methodological considerations or help to reinforce your argument. A reference is also sometimes described as a citation and the act of referencing as citing (Bryman, 2012).
Your institution will probably have its own guidelines as to which style of referencing you should use in your dissertation and if it does you should definitely follow them. However, the two main methods used are:
• Harvard or author–date. The essence of this system is that, whenever you paraphrase the argument or ideas of an author or authors in your writing, you add in parentheses immediately afterwards the surname of the author(s) and the year of publication. If you are quoting the author(s), you put quotation marks around the quotation and after the year of publication you include the page number where the quotation is from. All books, articles, and other sources that you have cited in the text are then given in a list of references at the end of the dissertation in alphabetical order by author surname. This is by far the most common referencing system in social research and the one that we follow in this book. It is, therefore, the style that we would encourage you to use if your university does not require you to follow its own guidelines.
• Footnote or numeric. This approach involves the use of superscript numbers in the text that refer to a note at the foot of the page or the end of the text, where the reference is

given in full together with the page number if it is a direct quotation. If a source is cited more than once, an abbreviated version of the reference is given in any subsequent citation, which is why this is often called the short-title system. As well as being used to refer to sources, footnotes and endnotes are often used to provide additional detail, including comments from the writer about the source being cited. This is a particular feature of historical writing. One of the advantages of the footnote or numeric method is that it can be less distracting to the reader in terms of the flow of the text than the Harvard method, where sometimes particularly long strings of references can make a sentence or a paragraph difficult for the reader to follow. Furthermore, software packages like Word make the insertion of notes relatively simple, and many students find that this is a convenient way of referencing their work. However, when students use this method, they often use it incorrectly, as it is quite difficult to use it well, and they are sometimes unsure whether or not also to include a separate bibliography. The footnote approach to referencing does not necessarily include a bibliography, but this can be important in the assessment of students' work. As not having a bibliography is a potential disadvantage to this style of referencing, your institution may recommend that you do not use it.

The Harvard and note approaches to referencing

The examples below show some fictitious examples of referencing in published work. Note that in published articles there is usually a list of references at the end; books using the Harvard system usually have a list of references, whereas a bibliography is used with the short-title system of notes. The punctuation of references—such as where to place a comma, or whether to capitalize a title in full or just the first word—varies considerably from source to source. For example, with Harvard referencing, in some books and journals the surname of the author is separated from the date in the text with a comma—for example (Name, 1999)—but in others, there is no comma. However, the main thing is to be consistent. Select a format for punctuating your references, such as the one adopted by a leading journal in your subject area, and then stick to it.

An example of a Harvard reference to a book

In the text:

As Name and Other (1999) argue, motivation is a broad concept that comprises a variety of intrinsic and extrinsic factors . . .

. . . and in the bibliography or list of references:

Name, A., and Other, S. (1999). Title of Book in Italics. Place of Publication: Publisher.

An example of a Harvard reference with a direct quotation from a book

In the text:

However, the importance of intrinsic factors often tends to be overlooked since 'studies of motivation have tended predominantly to focus on the influence of extrinsic factors' (Name and Other 1999: 123).

. . . and in the bibliography or list of references:

Name, A., and Other, S. (1999). *Title of Book in Italics*. Place of Publication: Publisher.

An example of a Harvard reference to a journal article

In the text:

Research by Name (2003) has drawn attention to the importance of intrinsic factors in determining employee

motivation.

. . . and in the bibliography or list of references:

Name, A. (2003). 'Title of Journal Article', Journal Title, 28(4): 109–38, Refers to volume (issue) numbers.

Issue numbers are often not included, as in the case of the References in this book.

An example of a Harvard reference to a chapter in an edited book
In the text:
As Name (2001) suggests, individual motivation to work is affected by a range of intrinsic and extrinsic factors . . .
. . . and in the bibliography or list of references:
Name, A. (2001). 'Title of Book Chapter', in S. Other (ed.) Abbreviation for 'Editor', Title of Book in Italics. Place of Publication: Publisher, pp. 124–56.
An example of a secondary reference using the Harvard method
In the text:
Individual motivation to work is affected by a range of intrinsic and extrinsic factors (Name 1993, cited in Other 2004).
. . . and in the bibliography or list of references:
Name, A. (1993). Title of Book in Italics. Place of Publication: Publisher, cited in S. Other (2004), Title of Textbook in Italics. Place of Publication: Publisher.
An example of a Harvard reference to an Internet site
In the text:
Scopus describes itself as 'the largest abstract and citation database of research literature and quality web sources' (Scopus 2007).
. . . and in the bibliography or list of references:
Scopus (2007). www.scopus.com/scopus/home.url (accessed 5 August 2010).
Note: it is very important to give the date of access, as some websites change frequently (or even disappear!
An example of a note reference to a book
In the text:
On the other hand, research by Name[3] has drawn attention to the influence of intrinsic factors on employee motivation . . .
. . . and in the notes:
[3] A. Name, Title of Book in Italics. Place of Publication, Publisher, 2000, pp. 170–7.
An example of a note reference to an Internet site
In the text:
Scopus describes itself as 'the largest abstract and citation database of research literature and quality web sources'.[39]
. . . and in the notes:
[39] Scopus (2007). www.scopus.com/scopus/home.url (accessed 5 August 2010).
Bear in mind that it is essential when preparing your own referencing in the text and the bibliography or list of references that you follow the conventions and style that are recommended by your institution for preparing an essay, dissertation, or thesis.

Reference to one author

Example 1: Abbas (2019) described three types of research…….

Example 2: According to Abbas (2018), research is a system of enquiry that is aimed at ……

Reference to more than one author

Example 3: Abbas and Jasper (2005) indicated that one of the causes of flooding is ……

Example 4: … there is also a relationship between climate change and reduced agricultural productivity (Abbas & Jasper, 2015).

Example 5: Abbas, Jasper and Olujoba (2009) listed three causes of flooding to include …….

Reference to more than three authors

Example 6: Abbas *et al*. (2013) suggested ways of reducing environmental pollution ……. *et al* means and others.

Example 7: One way of promoting biodiversity is to protect endangered species (Abbas *et al*., 2020).

4.0 Conclusion

Referencing is a standardized way of acknowledging sources of information used in an academic write-up such as theses, dissertations etc. and it helps to prevent plagiarism. Each institution has its unique way of writing it. Please, follow the style adopted by your institution.

5.0 Summary

In this unit we have leant that:

i. A reference is also sometimes described as a citation and the act of referencing as citing.
ii. Footnote involves the use of superscript numbers in the text that refer to a note at the foot of the page or the end of the text, where the reference is given in full together with the page number if it is a direct quotation.
iii. When preparing your own referencing in the text and the bibliography or list of references that you follow the conventions and style that are recommended by your institution for preparing an essay, dissertation, or thesis.

6.0 Tutor-Marked Assignments

1. Explain the concept of referencing in thesis writing.
2. Define footnote.

7.0 References/Further Reading

Bryman, A. (2012). Social Research Methods. 4th Edition. Oxford University Press Inc., New York, USA.

UNIT 4: THESIS STRUCTURING

CONTENTS

1.0 Introduction

Whether it is a project, thesis or dissertation, there are certain ways in which they are organized depending on the writing style of each institution.

2.0 Objectives

By the end of this unit, you will be able to:

- discuss thesis structuring and
- mention what each chapter in a thesis entails.

3.0 Main Content

3.1 Thesis Organization

The purpose of a thesis is to demonstrate your proficiency in academic research and appropriate academic communication, both written and oral. A thesis demonstrates your mastery of a particular subject area and your ability to independently create new scientific knowledge. When writing your thesis, your information retrieval skills are developed and your facility for critical and analytical thinking, problem solving and argumentation is strengthened all of which are skills required for success in your future working life.

A bachelor's thesis is your first academic thesis. Its purpose is to develop the basic skills of academic research. After completion of your bachelor's thesis, you will be familiar with the methods and tools of academic information retrieval and you will be able to critically evaluate the reliability and significance of published information. You will have acquired the necessary skills to choose, define and justify a research topic. Your ability to interpret information will be developed and you know how to draw conclusions from it. The end product is a thesis that adheres to the general principles of academic writing and which you will present orally in a seminar.

Each institution of learning has its own writing style of thesis and each department within a faculty has its own unique style of writing. In some schools, the thesis is structured into five chapters plus the preliminary pages.

Preliminary pages

This section contains information such as the:
Title page
Declaration page
Certification page
Dedication page
Acknowledgement page
Table of contents page
List of Tables page
List of Figures page
Appendix page (The appendices contain all such clarifying information that does not serve any purpose if presented in the actual text. Typical appendices are questionnaires used in the research, outlines for semi-structured interviews)
Abstract page (The abstract presents its reader with a good general idea of the contents and the most important conclusions of the thesis).

This may not be exactly the same as the style of your institution. Always endeavor to follow the style of your institution and your department.

Chapter one

This chapter is basically about the introductory aspect of the research and under the introduction there are sub headings.
INTRODUCTION
-Background to the study
-Statement of research problem
-Research questions
-Objectives of the study
-Test of hypothesis
-Justification of the study
-Scope of the study
-Limitations of the study.
This may not be exactly the same as the style of your institution. Always endeavor to follow the style of your institution and your department.

Chapter two

This section is mainly about literature review; reviewing what other researchers had done that are relevant to your research. Here, you review literature based on your specific objectives and that does not mean you should not review issues that are important to your study.
Here you have sub sections such as:
-Conceptual framework (definition of key terms and concepts)
-Theoretical framework (forms the basis for your own research, its structure and contents are determined by the chosen topic and research orientation)
-Empirical review (different viewpoints, methodological approaches, most important results from other researchers, differences of opinion, contradictions and shortcomings),
-Analytical framework (review of analytical tools to be used)
This may not be exactly the same as the style of your institution. Always endeavor to follow the style of your institution and your department.

Chapter three

This section deals with the methodology adopted by the researcher in performing research operation. The descriptions should be so distinct and transparent that, following them, the research can be repeated.
METHODOLOGY
-Description of the study area
-Sample size and sampling technique
-Method of data collection
-Analytical techniques.
This may not be exactly the same as the style of your institution. Always endeavor to follow the style of your institution and your department.

Chapter four

This chapter deals with the results and discussion part of the research. Here you indicate how you have been able to achieve your research objectives or answer your research questions. This may not be exactly the same as the style of your institution. Always endeavor to follow the style of your institution and your department.

Chapter five

This chapter focuses on summary, conclusion and recommendations of your study. Some schools include contribution to knowledge under this chapter. This may not be exactly the same as the style of your institution. Always endeavor to follow the style of your institution and your department.

After chapter five, there are pages dedicated to references and appendix.

4.0 Summary

In this unit we have leant that:

i. The purpose of a thesis is to demonstrate your proficiency in academic research and appropriate academic communication, both written and oral.
ii. A thesis demonstrates your mastery of a particular subject area and your ability to independently create new scientific knowledge.
iii. Each institution of learning has its own writing style of thesis and each department within a faculty has its own unique style of writing.

5.0 Conclusion

Thesis structuring varies from one school to another. Even within a faculty, it is not the same style that all the departments use. Try as much as possible to learn the style adopted by your department.

6.0 Tutor-Marked Assignments

1. Choose a topic of your own and write a complete thesis following chapter by chapter example explained in this unit.
2. Differentiate between conceptual frame work and theoretical framework.

7.0 References/Further Reading

Guidelines for writing a thesis.
https://www.oulu.fi/sites/default/files/content/Guidelines.pdf. Accessed 13.11.2020.

UNIT 5: TECHNICAL ISSUES IN WRITING

CONTENTS

1.0 Introduction

It is said that you learn to write by writing. Although, that is true about academic writing as well, keeping to agreed formal writing techniques. The writer of a thesis is supposed to know the basics of academic literary conventions. This section describes the typical features of an academic text along with the requirements for the language.

2.0 Objectives

By the end of this unit, you will be able to:

- discuss scientific writing
- discuss logical organization of text.

3.0 Main Content

3.1 Style of Writing

Scientific writing requires a good knowledge of standard language and the command of a formal style of writing. The grammatical and the orthographical rules of the language must be followed. Scientific language is unambiguous and precise and discards vague expressions like “several studies show that…”, with no valid reference to an example. An English text does not use contracted forms like “doesn’t” or “can’t”. All standardized forms of English are accepted but they must not be mixed. A characteristic feature of the scientific style is the use of special concepts and terms, which must be defined when they first occur in the text. Acronyms, like the CBN (Central Bank of Nigeria), can be used if they make the language more fluent and if the reader has previously been familiarized with their meaning. Short expressions like “e.g.” and “cf.” can be used in brackets, but in a consecutive text whole words are written.

In the academic community, the use of the first-person pronouns “I” or “we” is a source of some disagreement. Academic writing tends to be neutral and objectivity is the goal, so, the passive voice or the third person are typically used. The first-person plural is the correct choice if you want to emphasize the choices that you, as a researcher, have made. Notice that academic texts use the pronoun “we” even if the talk is about one person only.

Academic texts are a way of conveying information. To avoid misunderstandings, expression must be exact and precise. This is achieved by logical organization of the text, by writing carefully considered sentences and by the astute division of your text into paragraphs, subchapters and chapters, which then form a solid whole. You can contribute to the clarity of your text by stepping into the shoes of your reader and examining the text from an outsider's point of view. Other important aspects are fluency and coherence of expression. Do individual sentences and paragraphs fit their environment and are the chapters mutually connected? Fluency benefits from letting the reader know, between chapters, what will be dealt with next. This is how the reader will keep pace with your thoughts. This can be done either at the beginning of a new chapter before the first subheading or at the end of the previous chapter. The chosen practice must be followed consistently through the whole work.

5.0 Conclusion

Thesis writing or any other form of academic write up requires an excellent knowledge of a standard and acceptable language. The writer of a thesis is supposed to know the basics of academic literary conventions.

4.0 Summary

In this unit we have leant that:

i. Scientific language is unambiguous and precise and discards vague expressions like "several studies show that…", with no valid reference to an example.
ii. To avoid misunderstandings in academic texts, expression must be exact and precise.
iii. A characteristic feature of the scientific style is the use of special concepts and terms, which must be defined when they first occur in the text.

6.0 Tutor-Marked Assignments

1. Acquaint yourself with the writing style of your department.
2. What is the significance of simple texts in scientific writing?

7.0 Reference/Further Reading

Guidelines for writing a thesis.
https://www.oulu.fi/sites/default/files/content/Guidelines.pdf. Accessed 13.11.2020.