SDS 3118: Research Methodology
PUM 4106: Computational Methods

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Purpose of the course

Equip the learner with the skills necessary to carry out research for decision making and for solving practical management problems in a dynamic business world.

Course Objectives

1. Explain basic research concepts
2. Discuss relevant tools and skills in conducting research
3. Explain common types of data applied in business research
4. Write a research proposal
5. Collect and analyze data
6. Write a research report

Logistics

Materials

sam-mutua.github.io/compmethods-resmethods

Exercises

Exercises will be posted under the assignment section and their answers under the solution section

Feel free to interrupt me with questions/comments at any time ✋ .

We are all learning.

About the Lecturer

- Statistics Lecturer, Department of Pure and Applied Sciences at Kirinyaga University
- Author and Maintainer of several R Packages NovelDistns, rKenyaForex and AHSurv
- Active member of **Africa R Consortium**
- Peer Reviewer at Alexandria Engineering Journal and Journal of Probability and Statistics
- Passionate about Data Science and Machine Learning
- Published **over 25** publications in Peer Reviewed Journals

Introductions

- Your Name
- Your Course
- Your Research Interests

Groups

- We have the following groups in this semester:

1. MSc. Statistics
2. MSc. Data Science and Analytics
3. PhD. Pure Mathematics

- For the MSc. Students the unit name is **SDS 3118: Research Methodology** while for the PhD students the unit name is **PUM 3106: Computational Methods**

Introduction to Research

Learning Objectives

After the end of the lesson, students should be able to:

1. Define research in general
2. Enumerate the characteristics of research
3. Identify the different types of research
4. Describe the broad steps involved in research process
5. Explain the roles of research in development

Definition of Research

Definition 1

Research is the scientific and systematic search for pertinent information on a specific topic.

Definition 2

Research is scientific inquiry aimed at learning new facts, testing ideas etc.

Definition 3

Research is the systematic collection, analysis and interpretation of data to generate new knowledge and answer a certain question or solve a problem.

Objectives of Research

Motivation in Research

- The possible motives for doing research may be either one or more of the following:

i. Desire to get a research degree along with its benefits

ii. Desire to face the challenge in solving the unsolved problems.

iii. Desire to get intellectual joy of doing some creative work

iv. Desire to be of service to the society

v. Desire to get respectability

Characteristics of Research

a. It demands a clear statement of the problem

b. It requires a plan

c. It builds on existing data, using both positive and negative findings

d. New data should be collected as required and be organized in such a way that they answer the research questions.

Types of Research

a. Descriptive Research

- This includes surveys and fact-finding inquiries of different kinds.
- The major purpose of descriptive research is description of the state of affairs as it exists in present.

b. Analytical Research

- The researcher has to use facts or information already available and analyze these to make a critical evaluation of the material.

c. Applied Research

- This aims at finding a solution for an immediate problem facing a society or an industry.

d. Fundamental Research

- This is mainly concerned with generalizations and with the formulations of theory.

e. Quantitative Research

- This is based on the measurement of quantity or amount.

f. Qualitative Research

- This is concerned with a qualitative phenomena. e.g Investigating reasons for human behaviour.

Research Process

Introduction

Definition

Research Process consists of series of actions or steps necessary to effectively carry out research and the desired sequencing of these steps.

The steps in the research process are given below:

Qualities of good research

Good research is systematic

Means that research is structured with specified steps to be taken in a specified sequence in accordance with well defined set of rules.

Good research is logical

Research is guided by the rules of logical reasoning and logical process of induction and deduction are of great value in carrying out research.

Good research is empirical

It implies that research is related basically to one or more aspects of a real situation and deals with concrete data that provides a basis for external validity to research results

Good research is replicable

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

Defining the Research Problem

Introduction

- In research process, the first and foremost step happens to be that of selecting and properly defining a research problem

- A researcher must find the problem and formulate it so that it becomes susceptible to research.

- **To define a problem correctly, a researcher must know: What a problem is?**

Problem identification

- Whether a problem requires research problem depends on **three** conditions:

i. There should be a perceived difference or discrepancy between what it is and what should be.

ii. The reasons for this difference should be **unclear**

iii. There should be more than one possible and plausible answer to the question.

Selecting the research problem

- The following points should be observed by a researcher in selecting a research problem:

i. Subject which is overdone should not be normally chosen.

ii. Controversial subject should not become the choice of an average researcher.

iii. Too narrow or too vague problems should be avoided

iv. The subject selected for research should be familiar and feasible

Criteria for selecting a research problem

Relevance

- The topic you choose should be a priority problem.
- Questions to be asked include:
  - How large or widespread is the problem?
  - Who is affected?
  - How severe is the problem.

Avoidance of duplication

- Investigate whether the topic has been researcher.

Cont'd

Feasibility

- Consider the complexity of the problem and the resources you will require to carry out the study.

Applicability of possible results and recommendations

- Is it likely that the recommendations from the study will be applied?

Research Designs

Introduction

Definition

A research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure.

One may split the overall research design into the following parts:

1. *The sampling design:* which deals with the method of selecting items to be observed for the given study

2. *The observational design* which relates to the conditions under which the observations are to be made

3. *The statistical design* which concerns with the question of how many items are to observed and how the information and data gathered are to be analysed

4. *The operational design* which deals with the techniques by which the procedures specified in the sampling, statistical and observational designs can be carried out.

Need for Research Design

- Research design is needed because it facilitates the smooth sailing of the various research operations, thereby making research as efficient as possible yielding maximal information with minimal expenditure of effort and time.

- The design helps the researcher to organize his ideas in a form whereby it will be possible for him to look for flaws and inadequacies.

Features of a Good Research Design

- A good design is often characterized by adjectives like *flexible,appropriate,efficient, economical etc*

- Generally the design which **minimizes bias and maximizes the reliability** of the data collected and analyzed is considered a good design.

- The design which gives the **smallest experimental error** is supposed to be the best design in many investigations.

- A design which yields **maximal information and provides an opportunity for considering many different aspects** of a problem is considered most appropriate and efficient design in respect of many research problems

Cont'd

- A research design appropriate for a particular research problem, usually involves the following considerations:
  - The means of obtaining the information
  - The availability and skills of the researcher and his/her staff
  - The objective of the problem to be studied
  - The availability of time and money for the research work

Concepts Relating to Research Design

a. **Dependent and independent variables**

- If one variable depends upon or is a consequence of the other variable it is termed as **dependent variable** and the variable that is antecedent to the dependent variable is called **independent variable**

b. **Extraneous Variable**

- Independent variables that are not related to the purpose of the study but may affect the dependent variable are termed as *extraneous variable*

Cont'd

c. **Control**

- The term *control* is used when we design the study minimizing the effects of extraneous independent variables.

d. **Confounded Relationship**

- When the dependent variable is not free from the influence of extraneous variable(s), the relationship between the dependent and independent variables is said to be confounded by an extraneous variable(s).

Cont'd

e. **Research Hypothesis**

- The research hypothesis is a predictive statement that relates an independent variable to a dependent variable.

Cont'd

g. **Experimental and Control Group**

- In an experimental hypothesis-testing research when a group is exposed to usual conditions, it is termed a 'control group', but when the group is exposed to some novel or special condition, it is termed an 'experimental group'.

h. **Treatment**

- The different conditions under which experimental and control groups are put are usually referred to as 'treatments'.

Cont'd

i. **Experiment**

- The process of examining the truth of a statistical hypothesis, relating to some research problem, is known as an experiment

j. **Experimental Units**

- The pre-determined plots or the blocks, where different treatments are used, are known as experimental units.

Different Research Designs

Introduction

- Different research designs can be conveniently described if we categorize them as:

  i. Research design in case of *exploratory research studies*

  ii. Research design in case of *descriptive and diagnostic research studies*

  iii. Research design in case of *hypothesis-testing research studies*

Research Design in case of Exploratory Research Studies

- Exploratory research studies are also termed as formulative research studies.
- The main purpose of such studies is that of formulating a problem for more precise investigation or of developing the working hypothesis from an operational point of view.
- The major emphasis in such studies is on the discovery of ideas and insights.
- Generally the following three methods in the context of research design for such design are talked about:

  i. The survey of concerning literature

  ii. The experience survey

  iii. The analysis of insight-stimulating examples

Research design in case of descriptive and diagnostic research studies

- Descriptive research studies are those studies which are concerned with describing the characteristics of a particular individual, or of a group, whereas diagnostic research studies determine the frequency with which something occurs or its association with something else.

- The studies concerning whether certain variables are associated are examples of diagnostic research studies.

Research design in case of hypothesis-testing research design

- Hypothesis-testing research studies (generally known as experimental studies) are those where the researcher tests the hypotheses of causal relationships between variables.

Methods of Data Collection

Introduction

- The task of data collection begins after a research problem has been defined and research design/plan chalked out.

- While deciding about the method of data collection to be used for the study, the researcher should keep in mind two types of data:

  i. **Primary data** - Are those that are collected afresh and for the first time and thus happen to be original in character.

  ii. **Secondary data** - Are those which have already been collected by someone else and which have already been passed through the statistical process.

Collection of Primary Data

Introduction

- There are several methods of collecting primary data which include:
  i. Observation Method
  ii. Interview Method
  iii. Through questionnaires
  iv. Through schedules

Observation Method

Definition

The observation method is the most commonly used method especially in study relating to behavioural studies.

Advantages

- Subjective bias is eliminated if observation is done accurately.
- The information obtained under this method relates to what is currently happening
- This method is independent of respondents' willingness to respond and as such is relatively less demanding of active cooperation on the part of respondents as happens to be the case in the interview or the questionnaire method.

Cont'd

Disadvantages

- It is an expensive method
- The information provided by this method is very limited
- Unforeseen factors may interfere with the observational task

Interview Method

- The interview method of collecting data involves presentation of oral-verbal stimuli and reply in terms of oral-verbal responses.

- This method can be used through personal interviews and, if possible, through telephone interviews.

Personal Interviews

Definition

Personal interview method requires a person known as the interviewer asking questions generally in a face-to-face contact to the other person or persons.

Advantages of Personal Interviews

- More information and that too in-depth can be obtained.
- There is greater flexibility in this method
- The interviewer can usually control which person(s) will answer the questions.
- The interviewer can collect supplementary information about the respondent's personal characteristics and environment which is often of great value in interpreting results.

Disadvantages of Personal Interviews

- It is a very expensive method, specially when large and widely spread geographical sample is taken.
- There remains the possibility of the bias of interviewer as well as that of the respondent; there also remains the headache of supervision and control of interviewers.
- Interviewing at times may also introduce systematic errors.
- Effective interview presupposes proper rapport with respondents that would facilitate free and frank responses. This is often a very difficult requirement.

Telephone Interviews

Tip

- This method of collecting information consists in contacting respondents on telephone itself.
- It is not a very widely used method, but plays important part in industrial surveys, particularly in developed regions.

Advantages of Telephone Interviews

- It is more flexible in comparison to mailing method.
- It is faster than other methods i.e., a quick way of obtaining information.
- It is cheaper than personal interviewing method; here the cost per response is relatively low.
- Recall is easy; callbacks are simple and economical.
- There is a higher rate of response than what we have in mailing method; the non-response is generally very low.
- Replies can be recorded without causing embarrassment to respondents.

Disadvantages of Telephone Interviews

- Little time is given to respondents for considered answers;
- Surveys are restricted to respondents who have telephone facilities.
- Extensive geographical coverage may get restricted by cost considerations.
- It is not suitable for intensive surveys where comprehensive answers are required to various questions.
- Possibility of the bias of the interviewer is relatively more.
- Questions have to be short and to the point; probes are difficult to handle.

Collecting Data Through Questionnaire

Definition

- This method of data collection is quite popular, particularly in case of big enquiries.
- It is being adopted by private individuals, research workers, private and public organisations and even by governments.

Advantages of Questionnaires

- There is low cost even when the universe is large and is widely spread geographically.
- It is free from the bias of the interviewer; answers are in respondents' own words.
- Respondents have adequate time to give well thought out answers.
- Respondents, who are not easily approachable, can also be reached conveniently.
- Large samples can be made use of and thus the results can be made more dependable and reliable.

Disadvantages of Questionnaires

- Low rate of return of the duly filled in questionnaires; bias due to no-response is often indeterminate.
- It can be used only when respondents are educated and cooperating.
- The control over questionnaire may be lost once it is sent.
- It is difficult to know whether willing respondents are truly representative.
- This method is likely to be the slowest of all.