

RESEARCH METHODS

ENGG 6202

MODULE AIM & DESCRIPTION

Keeping abreast of knowledge of new technological developments and future trends in the broad area of engineering is essential for all engineers.

The main aim of this course is to provide the students with an opportunity to comprehend a broad area of engineering topics.

It also provides students with a range of research skills.

The course comprises a series of lectures and formal seminars conducted by academic staff of the School and by invited senior researchers in various disciplines.

MODULE OUTLINE

- Classic and contemporary research strategies
- Research designs and writing a research proposal
- Research ethics, plagiarism and information sources
- Qualitative research methodology
- Interviews and participant observations
- Organising and analysing qualitative data
- Quantitative research methodology
- Using SPSS for quantitative analysis
- Bivariate analysis with SPSS
- Multivariate regression with SPSS

CLASSIC AND CONTEMPORARY RESEARCH STRATEGIES

RESEARCH

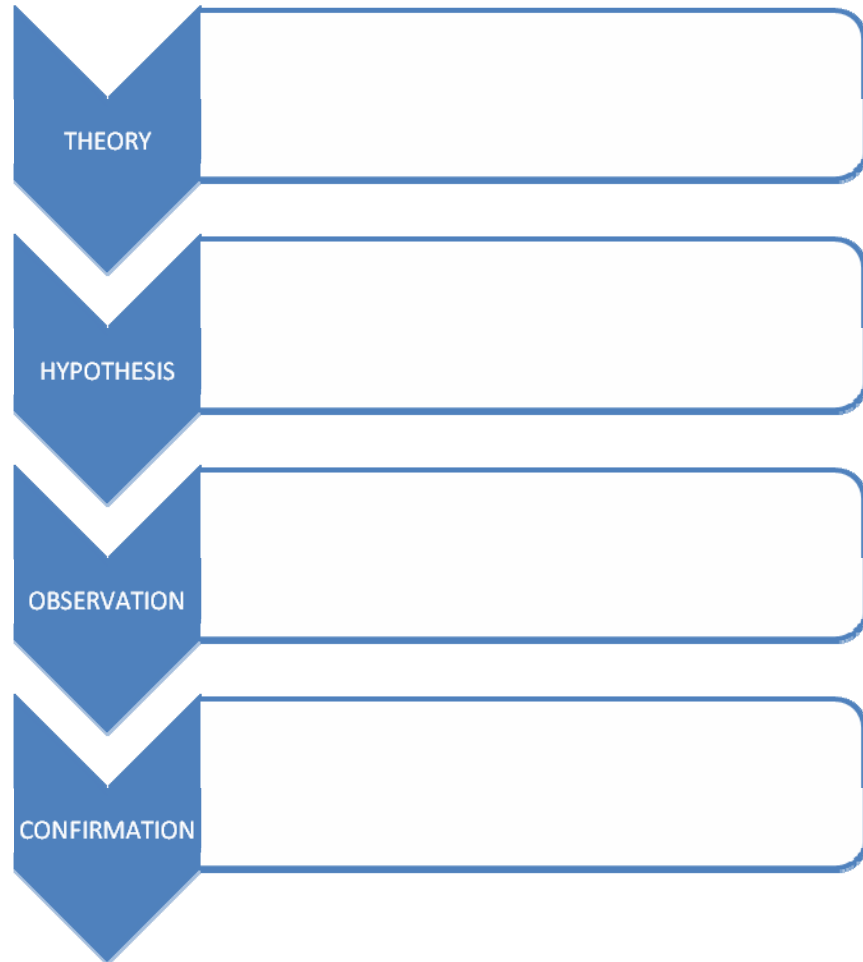
- Definition of Research / The nature of Research
- Theory and Research
- Research Process
- Why do research?
- Why is it important to study research methods?

RESEARCH APPROACH

- In research, we often refer to the two broad methods of reasoning as the deductive and inductive approaches

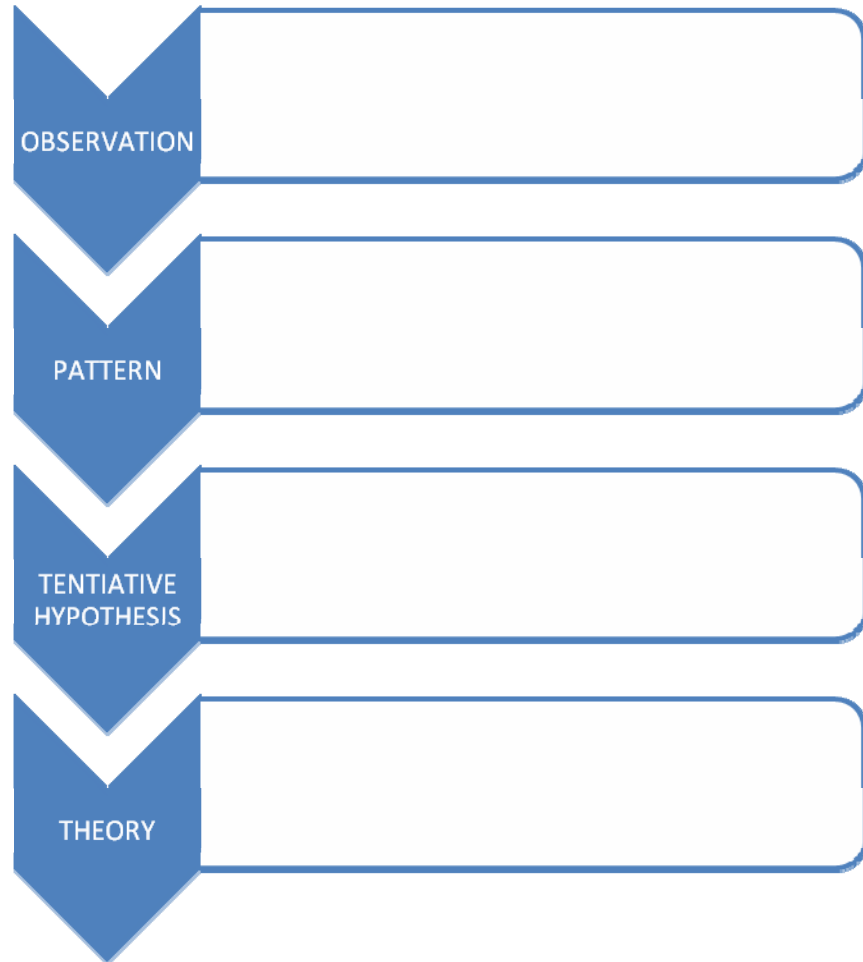
DEDUCTIVE APPROACH

- Deductive reasoning works from the more general to the more specific
- Sometimes this is informally called a “top-down” approach
- Conclusion follows logically from premises (available facts)



INDUCTIVE APPROACH

- Inductive reasoning works from the other way, moving from specific observations to broader generalisations and theories
- Informally, we sometimes call this a “bottom up” approach
- Conclusion is likely based on premises
- Involves a degree of uncertainty



EPISTEMOLOGICAL CONSIDERATIONS

- Positivism
- Interpretivism
- Realism

POSITIVISM

- Positivism is an epistemological position that advocates the application of the methods of the natural sciences to the study of social reality and beyond.
- But the term stretches beyond this principle, though the constituent elements vary between authors.

POSITIVISM

Positivism is also taken to entail the following principles:

1. Only phenomena and hence knowledge confirmed by the senses can genuinely be warranted as knowledge
2. The purpose of theory is to generate hypotheses that can be tested and that will thereby allow explanations of laws to be assessed
3. Knowledge is arrived at through the gathering of facts that provide the basis for laws
4. Science must be conducted in a way that is value free
5. There is a clear distinction between scientific statements and normative statements and a belief that the former are the true domain of the scientist

INTERPRETIVISM

Interpretivism is taken to denote an alternative to the positivist orthodoxy that has held sway for decades. It is predicated upon the view that a strategy is required that respects the differences between people and the objects of the natural sciences and therefore requires the social scientist to grasp the subjective meaning of social action.

REALISM

Realism shares two features with positivism: a belief that the natural and social sciences can and should apply the same kinds of approach to the collection of data and to explanation, and a commitment to the view that there is an external reality to which scientists direct their attention (in other words, there is a reality that is separate from our descriptions of it).

ONTOLOGICAL CONSIDERATIONS

- Objectivism
- Constructionism

OBJECTIVISM

Objectivism is an ontological position that asserts that social phenomena and their meanings have an existence that is independent of social actors. It implies that social phenomena and the categories that we use in everyday discourse have an existence that is independent or separate from actors.

CONSTRUCTIONISM

Objectivism is an ontological position (also often referred to as constructivism) which asserts that social phenomena and their meanings are continually being accomplished by social actors.

It implies that social phenomena and categories are not only produced through social interaction but that they are in a constant state of revision.

RESEARCH STRATEGY

- Quantitative and Qualitative

QUANTITATIVE RESEARCH

Quantitative research can be construed as a research strategy that emphasizes quantification in the collection and analysis of data and that:

- Entails a deductive approach to the relationship between theory and research, in which the accent is placed on the generation of theories;
- Has incorporated the practices and norms of the natural scientific model and of positivism in particular; and
- Embodies a view of social reality as an external, objective reality.

QUALITATIVE RESEARCH

Qualitative research can be construed as a research strategy that usually emphasizes words rather than quantification in the collection and analysis of data and that:

- Predominantly emphasizes an inductive approach to the relationship between theory and research, in which the emphasis is placed on the generation of theories;
- Has rejected the practices and norms of the natural scientific model and of positivism in particular in preference for an emphasis on the ways in which individuals interpret their social world; and
- Embodies a view of social reality as a constantly shifting emergent property of individual's creation.

QUANTITATIVE AND QUALITATIVE RESEARCH STRATEGIES

| | QUANTITATIVE | QUALITATIVE |
|--|---|---------------------------------|
| Physical orientation to the role of theory in relation to research | Deductive: testing of theory | Inductive: generation of theory |
| Epistemological orientation | Natural science model, in particular positivism | Interpretivism |
| Ontological orientation | Objectivism | Constructionism |
| | | |

**RESEARCH DESIGNS AND WRITING
A RESEARCH PROPOSAL**

RESEARCH DESIGNS

RESEARCH DESIGN

A research design provides a framework for the collection and analysis of data. A choice of research design reflects decisions about the priority being given to a **range of dimensions** of the research process. These include the importance attached to:

- Expressing causal connections between variables;
- Generalising to a larger groups of individuals than those actually forming part of the investigation;
- Understanding behaviour and the meaning of that behaviour in its specific social context;
- Having a temporal (i.e., over time) appreciation of social phenomena and their interconnections

RESEARCH METHOD

A research method is simply a technique for collecting data. It can involve a specific instrument, such as a self-completion questionnaire or a structured interview schedule, or participant observation whereby the researcher listens to and watches others.

RESEARCH DESIGNS

- Experimental Design;
- Cross-sectional or Social Survey Design;
- Longitudinal Design;
- Case Study Design; and
- Comparative Design

EXPERIMENTAL DESIGN

Experimental research is frequently held up as a touchstone because it engenders considerable confidence in the robustness and trustworthiness of causal findings. In other words, true experiments tend to be very strong in terms of internal validity.

- Classic Experimental Design
- The laboratory experiment
- Quasi-experiments

CROSS-SECTIONAL DESIGN

- Cross-sectional design entails the collection of data on more than one case (usually quite a lot more than one) and at a single point in time in order to collect a body of quantitative or quantifiable data in connection with two or more variables (usually many more than two), which are then examined to detect patterns of association.
- Research Methods associated with cross-sectional research:
 - Questionnaires
 - Structured Interviewing
 - Structured Observation
 - Content Analysis
 - Official Statistics, and
 - Diaries

LONGITUDINAL DESIGN

- A longitudinal study is one that involves the repeated observation or examination of a set of subjects over time with respect to one or more study variables.

CASE STUDY

The basic case study entails the detailed and intensive analysis of a single case. Case study is concerned with the complexity and particular nature of the case in question. A case can be:

- A single organisation
- A single location
- A person
- A single event

COMPARATIVE DESIGN

Comparative design entails the study using more or less identical methods of two or more contrasting cases. It embodies the logic of comparison in that it implies that we can understand social phenomenon better when they are compared in relation to two or more meaningfully contrasting cases or situation.

The comparative design may be realised in the context of quantitative or qualitative research.

NATURE OF RESEARCH

- Descriptive Research
- Exploratory Research
- Explanatory (Causal) Research

EXPLORATORY RESEARCH

- Exploratory research involves gathering information and developing ideas about a relatively under-researched problem or context
- The value of exploratory research could be that it clears the ground for other kinds of research, or that it throws up interesting differences and comparisons between more well-studied topics, and those that are less well-studied.
- The prime purpose is to develop understanding in an area that is little understood.

EXPLORATORY RESEARCH

- Since 'exploratory research' implies there is less of a basis from which to conduct research, and that a given area is not well understood, it is more appropriate to carry out this kind of research using qualitative methods.
- Though one might develop hypotheses, this kind of research would not involve testing particular hypotheses.

DESCRIPTIVE RESEARCH

- Descriptive research involves describing a problem, context or a situation. This is a feature of exploratory research as well of course, however descriptive type questions are generally more structure, and more reliant on prior ideas and methods.
- This type of study could be suited to either qualitative or quantitative methods;

EXPLANATORY RESEARCH

- Explanatory research can be thought as being concerned with causes.
- The focus here is on seeking and providing or evaluating an explanation between two or more phenomena.
- Explanatory research typically seeks to identify and explain a causal relationship that is substantively important or meaningful.

EXPLANATORY RESEARCH

- In this kind of research, people typically develop hypotheses to be tested (in light of the existing literature) and then see whether the data they have collected can be called on to support or refute those hypotheses.
- This type of approach is more likely to employ quantitative methods, typically a survey, but one could also seek explanatory type research using case study or observational data

WRITING A RESEARCH PROPOSAL

WHAT IS A RESEARCH PROPOSAL?

A Research Proposal is a plan showing the step-by-step description of how a proposed research will be undertaken. It reflects the researcher's understanding of the problem and ability to conduct the research.

WHY A RESEARCH PROPOSAL?

It gives an opportunity to think through your project carefully, and clarify and define what you want to research

Provides you with an outline and to guide you through the research process

Lets your supervisor and department/faculty know what you would like to research and how you plan to go about it

Helps the department to choose an appropriate supervisor

AIM OF RESEARCH PROPOSAL – I

- Your Research Proposal needs to persuade the members of the “Dissertation Committee” that your research will be most valuable and fascinating
- You should have a clear idea in your mind that your research is really going to be effective
- You should develop the exact strategies for writing your research proposal.

AIM OF RESEARCH PROPOSAL – II

- In the research proposal, you need to mention the expected outcomes of your work, possible difficulties and time limits.
- This will persuade the “Dissertation committee” that you have thought over the whole research thoroughly.
- You need to be aware:
 - What you want to achieve?
 - What can bother you?
 - How you can overcome it?

A GOOD RESEARCH PROPOSAL

- Your RP should be detailed
- You need to mention the methods you are going to use for achieving the results
- You need to say why these methods are suitable for that aim
- You need to give reasonable arguments that will support your every point of view

THE RESEARCH PROPOSAL PROCESS

- Choosing a Topic
- Narrowing and focusing your Topic (title)
- Formulating your Research Objectives or Questions
- Outlining the key literature in the topic area / study
- Describing the research methodology including the research designs and methods
- Proposing an approach to Data Analysis
- Developing a Project Schedule (Time Plan) and a Budget / Resources you will need
- Developing a bibliography

FORMAT OF YOUR RESEARCH PROPOSAL

- Title
- Introduction / Background
- Significance of Study
- Literature Review
- Research Methodology
- Ethical Considerations
- Limitations and Constraints
- References
- Planning (Gantt Chart)

TITLE

This normally includes the following:

1. Title: Proposal for Research and Research title
2. Department and Supervisor(s) if applicable
3. Your name, Course

INTRODUCTION / BACKGROUND

- Context of your Study
- State why you chose your topic / area
- What prompted your interest in the topic / area
- Problem Statement
- Research Objectives
- Research Questions (if applicable)
- Hypotheses (if applicable)

SIGNIFICANCE OF STUDY

- Why is your research work important?
- What are the implications of doing it?
- How does it link to other knowledge (or research)? This should show how this project is significant to our body of knowledge
- Why is it important to our understanding of the world?

LITERATURE REVIEW

- The purpose of the LR is to situate your research in the context of what is already known about a topic, it needs to show how your work will benefit the whole. It should provide the theoretical basis for your work, show what has been done in the area by others, and see the stage for your work.
- It is also in this section where you present the gap in the knowledge that need to be plugged and by doing so doing, situate your work.

LITERATURE REVIEW

- It shares with the reader the results of other studies that are closely related to the study being reported
- It provides a framework for establishing the importance of your study, as well as a benchmark for comparing the results of your study with other findings
- Used to demonstrate that you are aware of the debates and issues raised in relevant bodies of literature
- References to key articles and texts should be made to show that you appreciate their relevance to your research area

RESEARCH METHODOLOGY – I

- In this section, identify the methodology that underpins your research and give a rationale for your approach
- Show how you have used your LR to construct your own research methodology
- To state which strategies he/she will follow during the research (i.e., the actions and their sequence)

RESEARCH METHODOLOGY - II

- Determination of Research Design (Exploratory, Descriptive or Causal)
- Qualitative or Quantitative Approach
- Primary or Secondary Data
- Data Collection Methods
- Questionnaire Design
- Questionnaire Administration
- Estimates of Reliability, Validity and the norms of the instruments used

RESEARCH METHODOLOGY – III

- Statistical Techniques including software to be used
- Data Analysis
(Descriptive, Univariate, Bivariate or Multivariate)
- Statistical Tests to be employed
- Methods to prove your hypotheses (if applicable)

EXPECTED RESULTS

- You should have some idea of expected outcomes based on the research conducted in the past
- It should join the data analysis and possible outcomes to the theory and questions that you have raised
- You can also summarise the significance of the work

ETHICAL CONSIDERATIONS

- Discuss the ways in which your study will protect confidentiality, anonymity, and the physical and mental well-being of participants
- Any other codes of conduct (e.g., relevant governmental / other established codes) also need to be mentioned.

LIMITATIONS

- Identifies potential weaknesses of the study

REFERENCES

- You should include a short list of references of key articles and texts included in the document
- You can use the UoM Guide to Harvard System of Referencing

PROJECT PLAN / SCHEDULE

- It is important that you include a project plan or schedule to guide you and keep you on track
- For instance, you will need to estimate the time needed for different tasks for your dissertation and assign tasks for each month / week

FINANCIAL RESOURCES

- Outline the resources you need and propose a budget (Optional)

RESEARCH ETHICS, PLAGIARISM AND INFORMATION SOURCES

RESEARCH ETHICS

- Research ethics involves the application of fundamental ethical principles to a variety of topics involving scientific research
- These include the design and implementation of research involving human experimentation, animal experimentation, various aspects of academic scandal including scientific misconduct (such as fraud, fabrication of data and plagiarism), whistleblowing

ETHICAL ISSUES

- Principle of voluntary participation
- Requirement of informed consent
- Risk of harm
- Confidentiality
- Principle of anonymity
- ...

PLAGIARISM

- Plagiarism is the act of copying materials without acknowledging the source of information and passing it as one's own writing.
- This is a breach of University Regulations which will render students liable to penalisation.
- Students should therefore ensure that ideas which are not their own are properly referenced.

TIPS FOR AVOIDING 'UNINTENTIONAL' PLAGIARISM

- Don't cut and paste from the web
- Don't copy notes from sources word for word – rework at the time you are reading the material
- Fully reference your notes as you go, including page numbers if applicable
- Use several sources in your writing, this minimises the reliance on any one author and reduces the risk of accidentally leaving passages unreferenced

REFERENCING

- Referencing is the practice of letting the reader of any written work know the source of any idea, opinion or information included in the text.
- It is an acknowledgement of a piece of writing by another author which has been referred to or quoted directly in a written piece of work.
- Referencing enables the student to identify whose ideas or arguments they are using.

REASONS FOR REFERENCING

- To let the reader know whose ideas are being used. In academia, ideas are a kind of property of those who develop them. To not acknowledge the source of information, opens the student to accusations of plagiarism.
- To enable the reader to check the information. The reader might want to go back to that author's original work for himself/herself and check the accuracy of the information.
- To provide information for the reader. The current research into a topic might produce an interesting book or journal article which may be new to the reader. If referenced accurately, the reader will be able to find that book or article to get a fuller grasp of the original material.

REFERENCING

- Students need to indicate the sources from which materials have been derived. They should make sure that the reference section consists of ALL and ONLY the sources that have been referred to in the dissertation.
- The Harvard System of Referencing is strongly advised (UoM students can use the UoM Guide to Harvard System of Referencing – available on the University website)

REFERENCING

- Proper referencing for
 - Books
 - Books of collected writing
 - Journal articles
 - Newspaper articles
 - Dissertations
 - World Wide Web
 - ...

QUALITATIVE RESEARCH METHODOLOGY

INTERVIEWS AND PARTICIPANT OBSERVATIONS

ORGANISING AND ANALYSING QUALITATIVE DATA

USING SPSS FOR QUANTITATIVE ANALYSIS

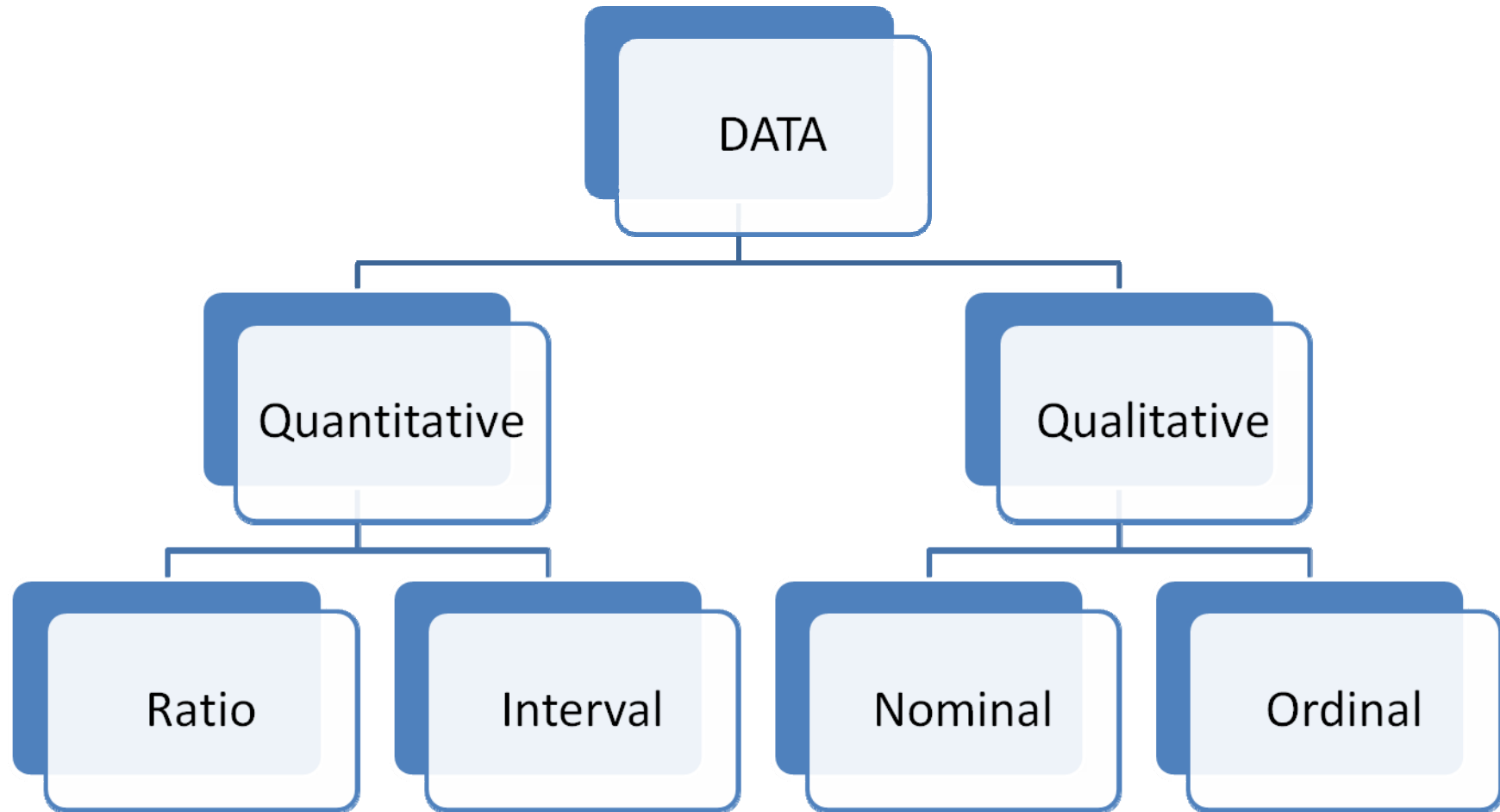
USING SPSS FOR QUANTITATIVE ANALYSIS

- Overview
- Introduction to SPSS
- Data Input
- Simple Frequency Analysis
- Generation of Charts
- Exporting Figures and Charts to MICROSOFT WORD

OVERVIEW: Quantitative Analysis

- Basic Techniques for Analysing Quantitative Data
- Types of Variables
 - Quantitative (Interval and Ratio)
 - Qualitative (Nominal and Ordinal)
- Univariate Analysis
 - Frequency Tables
 - Diagrams
 - Measures of Central Tendency
 - Measures of Dispersion

TYPES OF VARIABLE



UNIVARIATE ANALYSIS

- Frequency Tables
- Diagrams
- Measures of Central Tendency
- Measures of Dispersion
- Measures of Skewness
- Measures of Kurtosis

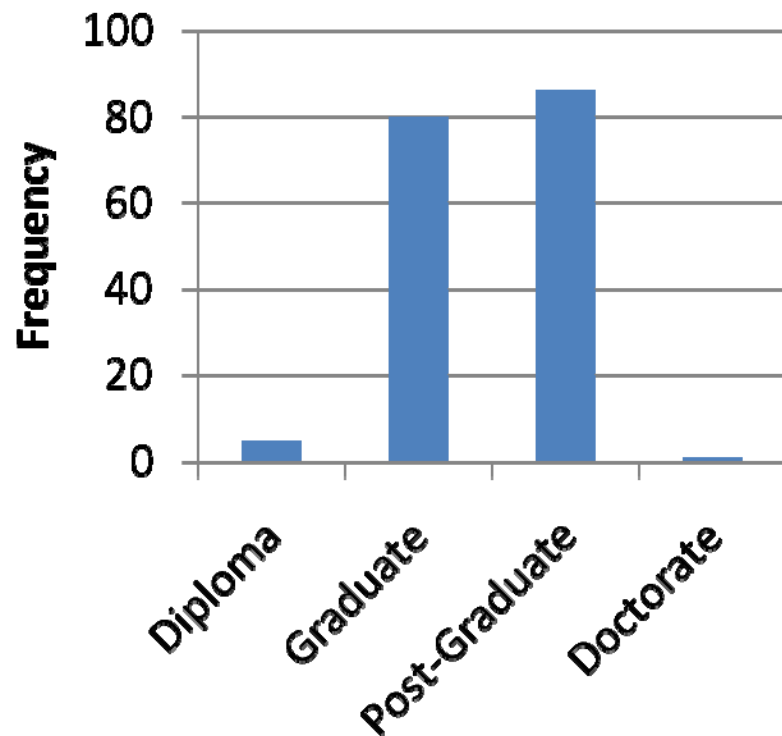
FREQUENCY TABLE

A frequency table provides the number of frequency of people (respondents) and the percentage belonging to each of the categories for the variable in question. It can be used in relation to all of the different types of variable. An example of a frequency table is shown:

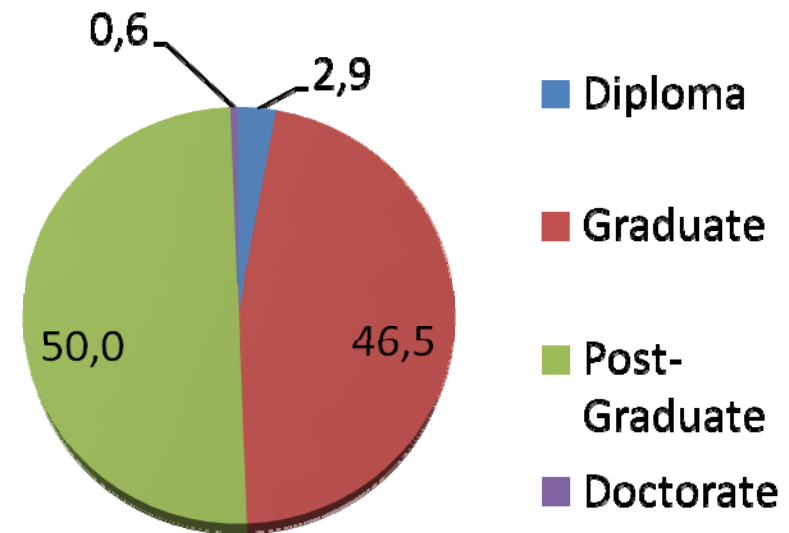
| School | Students | | Staff | |
|--------------|------------|--------------|------------|--------------|
| | N | % | N | % |
| A | 50 | 16.4 | 34 | 19.7 |
| B | 52 | 17.1 | 40 | 23.1 |
| C | 27 | 8.9 | 31 | 17.9 |
| D | 54 | 17.8 | 38 | 22.0 |
| E | 47 | 15.5 | 30 | 17.3 |
| TOTAL | 304 | 100.0 | 173 | 100.0 |

DIAGRAMS

Bar Chart – Highest Education of Respondents



Pie Chart – Highest Education Level of Respondents (%)



MEASURES OF CENTRAL TENDENCY

- **Arithmetic Mean**

This is the average as we understand it in everyday use

- **Mode**

This is the value that occurs most frequently in a distribution

- **Median**

This is the midpoint in a distribution of values

MEASURES OF DISPERSION

- **Range**

This is simply the difference between the maximum and minimum value in a distribution of value associated with an interval/ratio variable

- **Standard Deviation**

This is essentially the average amount of variation around the mean

MEASURES OF SKEWNESS

- Skewness is a measure of asymmetric in a distribution.

MEASURES OF KURTOSIS

- Kurtosis is a measure of “peakedness” of a distribution.

BIVARIATE ANALYSIS WITH SPSS

BIVARIATE ANALYSIS

Bivariate analysis is concerned with the analysis of two variables at a time in order to uncover whether or not the two variables are related.

- Contingency Tables or Cross Tabulations (Tables)
- Chi-Square Tests
- Pearson's r

BIVARIATE ANALYSIS WITH SPSS

SPSS Command:

Cross Tabulations

- Analyse > Descriptive Statistics > Crosstabs...

For Chi-Square Tests

- Select Chi-Square Tests in the option “Statistics”

Correlation Analysis

- Analyse > Correlate > Bivariate

MULTIVARIATE ANALYSIS

- Multivariate analysis entails the simultaneous analysis of 3 or more variables
 - Multiple Linear Regression
 - Multinomial Logistic Regression
 - Factor Analysis
 - ...

MULTIVARIATE REGRESSION WITH SPSS

REFERENCES

- Bryman A. and Bell E., (2007), *Business Research Methods*, Oxford
- Kothari C. R., (2004), *Research Methodology – Methods and Techniques*, New Age International Publishers
- Ramasawmy D. (2011), *Personal MBA Lecture Notes*