**Quantitative research: true experimental quasi-experimental**

Lecture objectives:

Students will be acquainted with

1. The basic concepts in experimental design such as treatment, randomisation, control group, and use of controls.
2. The a few examples of experimental designs of varying degrees of validity.

**Lecture content**

**Basic concepts in experimental design.**

* What is an experiment? An experiment is an investigation conducted for the purpose of measuring change resulting from the manipulation of (a) variable(s). Experiments allow identifying causal factors and establishing causal relationships between variables. Meticulous measurement is then necessary to make causal inferences in experimental research.
* An experimental study involves usually two groups of participants, the treatment group and the control group. The treatment group, also called the experimental group, receives a treatment. The control group, also called the comparison group, receives no treatment.
* The use of controls: in experimental research, it is difficult to establish the connection between the independent variable and the dependent one without the control of the other factors (nuisance/confounding) that could explain the observed/measured changes. Through control, the researcher ensures that the comparisons he/she makes are valid and the results he / she obtains are relevant to the factors under investigation and not something else. One can use controls by simply selecting one of the following solutions:
  + Hold the variable constant,
  + Eliminate the factor from the experiment,
  + Introduce the nuisance variable as one of the factors of the experiment
  + Randomisation: this refers to giving equal chance fro every participant in the study to be allocated either to the control group or experimental group. This term should not be confused with random selection of the sample.

Population => random selection => sample => random assignment => experimental group or control group

* + Matching
  + Using analysis of covariance
  + Using the participants as their own control
* Measuring the effect of the treatment: to draw valid conclusions, an investigator needs to test the effects of an experiment and obtain some measurements. They could be an achievement scores, aptitude tests, or some other kind of performance assessment.
* Pre-test post test: are tests administered to the participants in the experiment to measure particular characteristics/ variables before the treatment is given and after is finished.

**Common characteristics of experimental design/ elements of experimental design:**

Every experimental design regardless of its typeshould display all these characteristics.

* Manipulation of one or more variables
* Use of controls
* Careful measurements (or observation) of one or more dependent variables

**True experiment and Quasi-experiment**

True experiment is considered the type having optimal internal validity. The random assignment (allocation) of the of the participants to the groups minimises the risk of confounding variables. The advantage of high control makes true experiments the most accurate and strongest methods to investigate causality relationships between variables.

Some practical or ethical constraints may prevent from assigning participants randomly to equivalent groups, so intact groups are usually selected to conduct the study on. Because of the absence of randomisation, they are sometimes regarded less scientifically rigorous than true experimental design. One solution to cope with this constraint is to ensure that the selected intact groups are as equivalent as possible.

**Types of experimental design**

Different types of experimental designs exist. They share the three common characteristics mentioned above and differ in others. Use, application, and conditions under which the experiments have been conducted are what determine the type of the experimental design.

**Repeated measure design**

Different experimental treatments are given to the participants. After each experimental treatment, a measurement of the outcomes is carried out.

**Factorial design**

The name of this design comes from ‘factor’ a term denoting simply an independent variable. Another term important for understanding this type is level, a subdivision or a value of the factor. In the factorial design, more than one independent variable is manipulated; hence, more than one relationship is simultaneously involved. This allows examining not only the possible effects of separate variables but also how one variable can moderate another one and how interaction can occur between two or more independent variables. It is then possible to study how, for example, a treatment incorporating the use of particular technique can influence learning, in addition to how this treatment interacts with gender. Factorial designs can have a quite large number of combinations of variables and variable levels, which makes things difficult to control. However, a typical and common factorial design, also called ‘two by two’ design’ would include four groups. Two groups get the treatment with independent variable A but would have different levels of the same variable while two other groups get the treatment with the independent variable B at two different levels.

**Time-series design**

This type involves studying a single group by repetitively testing it over a period of time and obtaining measurements both before and after the treatment. Having no control group to compare with, this type ensures stability through pre-treatment testing and effectiveness of the treatment through post-treatment testing. A multiple time series design adds a control group to address validity threats, namely history and …..

**One-shot design**

In this design, the researcher gives a treatment to an intact experimental group without ensuring randomisation or having a control group. Then, the effects are not compared to what happens with the control group; instead, they are compared to what the researcher guesses would happen without the treatment. Obviously, the absence of a control group and a pre test in this design poses problems of validity, the researcher cannot thus be certain that the observed outcomes are logically related to the independent variable.

**Threats of internal validity in different types of experimental designs**

An experimental research is said to have internal validity if the observed outcomes are caused by the experimental treatment and not something else. There are, however, possible factors that influence the relationship and lead to erroneous conclusions. An alternative hypothesis could be behind the obtained results and not the hypothesis set by the researcher. The following are examples of internal validity threats.

* History: during the study duration extending between the pre-test and post-test,some unexpected events may happen. The participants when taking the tests were influenced by the events and they accordingly perform better or worse not because of the treatment, but because of the unexpected event.
* Maturation: the participants may gain more experience over the duration of the treatment, or they may develop due to some unknown reasons exterior to the treatment. This makes it difficult to decide whether any observed changes are the result of the treatment or of the maturation.
* Regression: the scores obtained in tests tend to regress to the mean. Therefore, if a participant obtains in a pre-test an extreme score; that is to say a very good score or a very poor one, he/she is more likely to perform worse or better the subsequent test(s). With the fluctuation between high performance and low performance, over time the participant gets naturally closer to the mean of his/ her performance.
* Selection:
* Mortality: for unexpected reasons, some of the participants in the study may decide to drop out. The loss of the participants can affect the outcomes of the study.
* Interaction with selection