

Research Methodology

Paper I- Types and Methods of Research

Pre PhD Course Work

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Syllabus

- Foundations of Research: What is Research? Objectives of Research, Scientific Research, Research and Theory, Conceptual and Theoretical Models, Importance of research methodology in scientific research, **Types and Methods of Research**, Literature Survey and Problem
- Planning of Research: Selection of a Problem for Research, Formulation of the Selected Problems, Hypothesis formation, Measurements, Research Design/Plan.

Types of Research

- There are various types of research that are classified according to their *objective, depth of study, analysed data, time required to study the phenomenon and other factors.*
- A research project may use several types of research

Research Method falls into 3 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
 - 2 and 3 are analytical methods

Research Methods/Techniques used to conduct research- based on collection of Data

<i>Type</i>	<i>Methods</i>	<i>Techniques</i>
1. Library Research	(i) Analysis of historical records (ii) Analysis of documents	Recording of notes, Content analysis, Tape and Film listening and analysis. Statistical compilations and manipulations, reference and abstract guides, contents analysis.
2. Field Research	(i) Non-participant direct observation (ii) Participant observation (iii) Mass observation (iv) Mail questionnaire (v) Opinionnaire (vi) Personal interview (vii) Focused interview (viii) Group interview (ix) Telephone survey (x) Case study and life history	Observational behavioural scales, use of score cards, etc. Interactional recording, possible use of tape recorders, photo graphic techniques. Recording mass behaviour, interview using independent observers in public places. Identification of social and economic background of respondents. Use of attitude scales, projective techniques, use of sociometric scales. Interviewer uses a detailed schedule with open and closed questions. Interviewer focuses attention upon a given experience and its effects. Small groups of respondents are interviewed simultaneously. Used as a survey technique for information and for discerning opinion; may also be used as a follow up of questionnaire. Cross sectional collection of data for intensive analysis, longitudinal collection of data of intensive character.
3. Laboratory Research	Small group study of random behaviour, play and role analysis	Use of audio-visual recording devices, use of observers, etc.

Types of Research

There are various types of research that are classified according to their objective, depth of study, analysed data, time required to study the phenomenon and other factors.

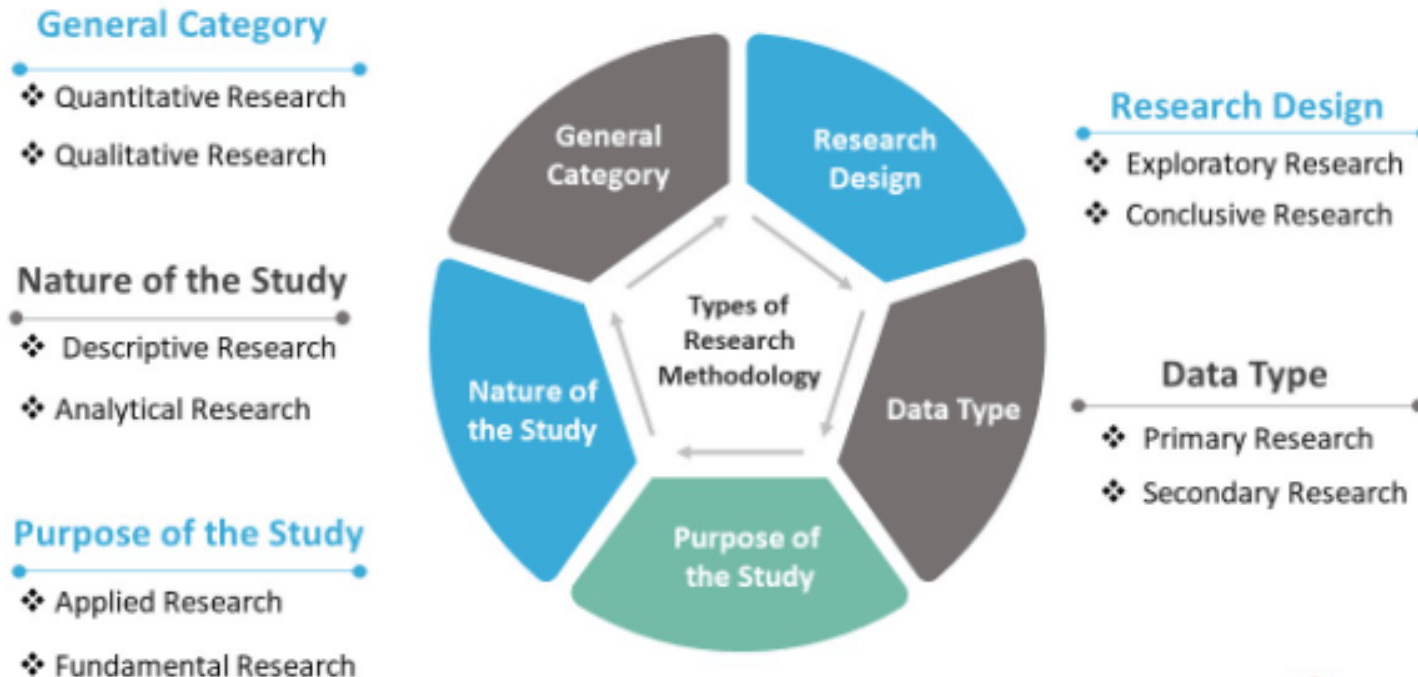
A research project may use several types of research

Classification can be made according to the data collection techniques based on causality, relationship with time and the medium through which they are applied.

- According to data collection techniques:
 - Observational
 - Experimental
- According to causality relationships:
 - Descriptive
 - Analytical
- According to relationships with time:
 - Retrospective
 - Prospective
 - Cross-sectional
- According to the medium through which they are applied:
 - Clinical
 - Laboratory
 - Social descriptive research

List of Types of Research Methodology

Types of Research Methodology



Based of Purpose

➤ Theoretical/ Basic/ Pure/ Fundamental and Conceptual/ Applied Research

- Theoretical research, also referred to as pure or basic research, **focuses on generating knowledge, regardless of its practical application.**
- Data collection is used to generate new general concepts for a better understanding of a particular field or to answer a theoretical research question.
- **Fundamental research is driven by a scientist's curiosity or interest in a scientific question.**
- The main motivation is to expand man's knowledge, not to create or invent something.
- **There is no obvious commercial value to the discoveries that result from basic research.**
- For example, basic science investigations probe for answers to questions such as:
 - ✓ How did the universe begin?
 - ✓ What are protons, neutrons, and electrons composed of?
 - ✓ How do slime molds reproduce?
 - ✓ What is the specific genetic code of the fruit fly?

Conceptual/ Applied Research

- Focusses on strategies that can be used to address a specific research problem.
- Applied research draws on theory to generate practical scientific knowledge, and its use is very common in STEM fields such as engineering, computer science and medicine.
- For example, applied researchers may investigate ways to:
 - Improve agricultural crop production
 - Treat or cure a specific disease
 - Improve the energy efficiency of homes, offices, or modes of transportation
- Applied research is usually based on knowledge or results obtained through theoretical research.
- In fact, it is common for research projects to first establish the theoretical framework both to define the field of study and to identify possible theories that could be tested or applied to solve the specific problem posed in the project.

TYPES OF RESEARCH According to your **Depth of Scope** of research

- **Scope of Research:** The scope of a study explains the extent to which the research area will be explored in the work and specifies the parameters within the study will be operating.
 - Define scope in terms of subjects, objectives, facilities, area, time frame, and the issues to which the research is focused
 - Keeps research practical and feasible
- **Delimitation in scope of Research: Limits set in determining the variables under investigation**
 - *Factors and variables that will not be included in the investigation*

Scope and delimitations are two essential elements of a research paper or thesis

Eg Study market behavior for new prototype of smart switches

Scope: Target certain sector of the market: Corporate houses in the months of summer in the city of Mumbai

Delimitation: delimitations are the characteristics that limit the scope and describe the boundaries of the study. Researchers needs to identify why the variables set above were chosen.

Descriptive versus Analytical Research

- **Omar (2015)** describes it as a question of what vs. why.

Descriptive research asks “what?” It describes something.

Analytical research asks “why?” We try to find out how something came to be.

Descriptive research classifies, describes, compares, and measures data.

Analytical research focuses on cause and effect.

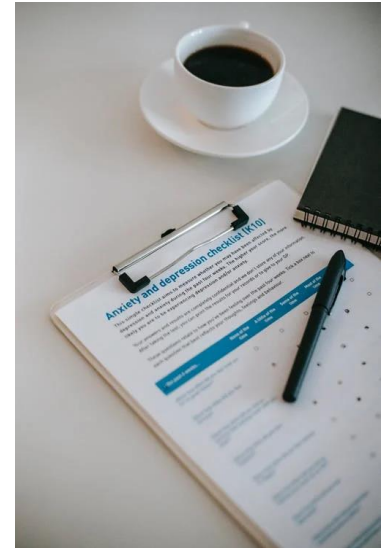


Descriptive Research:

- **Descriptive research** includes surveys and fact-finding enquiries of different kinds. The major purpose of descriptive research is *description of the state of affairs as it exists at present*.
- It does not answer questions about how/when/why the characteristics occurred. Rather it addresses the "**what**" question
- In social science and business research, the term *Ex post facto research* for descriptive research studies. A **category of research design in which the investigation starts after the fact has occurred without interference from the researcher.**
- The main characteristic of this method is that the researcher has no control over the variables; he can only report what has happened or what is happening.
- *Ex post facto* studies also include attempts by researchers to discover causes even when they cannot control the variables.

Descriptive Research

- The methods of research utilized in descriptive research are survey methods including comparative and correlational methods
1. **SURVEY:** Methods of scientific or systematic collection of data, compiling, presenting in useful manner, analysing and evaluating them.
 - Focus on objective of study: measuring what is to be measured
 - Designing method of data collection
 - Questionnaire
 - Examination of records/ observations
 - Selecting the sample



Closed-ended questions and open-ended survey questions.

Closed-Ended Questions

- The respondents are given a list of predetermined responses from which to choose their answer.
- The list of responses should include every possible response and the meaning of the responses should not overlap.
- An example of a close-ended survey question would be, "Please rate how strongly you agree or disagree with the following statement: 'I feel good about my work on the job.' Do you strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, or strongly disagree?"
- A Likert scale, which is used in the example above, is a commonly used set of responses for closed-ended questions.
- Closed-ended questions are usually preferred in survey research because of the ease of counting the frequency of each response.

Open-Ended Questions

- Survey respondents are asked to answer each question in their own words. An example would be, "In the last 12 months, what was the total income of all members of your household from all sources before taxes and other deductions?" Another would be, "Please tell me why you chose that child care provider?"

It is worth noting that a question can be either open-ended or close-ended depending on how it is asked. In the previous example, if the question on household income asked respondents to choose from a given set of income ranges instead, it would be considered close-ended.

Types of survey

- Descriptive survey: gather data about different subjects
- Descriptive normative survey: Survey results are compared with the norm
- Descriptive status: Based on understanding real time data- growth time and production of certain by-products
- Descriptive comparative: Survey divided between 2 groups of subjects
- Descriptive classification: Biological classification of genus

Advantages and Disadvantages of Survey Research

Advantages

- Surveys are a cost-effective and efficient means of gathering information about a population.
- Data can be collected from a large number of respondents. In general, the larger the number of respondents (i.e., the larger the sample size), the more accurate will be the information that is derived from the survey.
- Sampling using probability methods to select potential survey respondents makes it possible to estimate the characteristics (e.g., socio-demographics, attitudes, behaviors, opinions, skills, preferences and values) of a population without collecting data from all members of the population.
- Depending on the population and type of information sought, survey questionnaires can be administered in-person or remotely via telephone, mail, online and mobile devices.

<https://www.researchconnections.org/research-tools/data-collection/survey-research-and-questionnaires>

Disadvantages

- Questions asked in surveys tend to be broad in scope.
- Surveys often do not allow researchers to develop an in-depth understanding of individual circumstances or the local culture that may be the root cause of respondent behaviour.
- Respondents may be reluctant to share sensitive information about themselves and others.
- Respondents may provide socially desirable responses to the questions asked. That is, they may give answers that they believe the researcher wants to hear or answers that shed the best light on them and others. For example, they may over-report positive behaviours and under-report negative behaviours.
- A growing problem in survey research is the widespread decline in response rates, or percentage of those selected to participate who chose to do so.

<https://www.researchconnections.org/research-tools/data-collection/survey-research-and-questionnaires>

Descriptive Research contd..

- **2. Case Studies:** A case study is a sample group (an individual, a group of people, organizations, events, etc.) whose characteristics are used to describe the characteristics of a larger group in which the case study is a subgroup. The information gathered from investigating a case study may be generalized to serve the larger group.
- **3. Correlational Studies:** Correlative studies are used to determine whether the relationship between 2 variables is positive, negative, or neutral. That is, if 2 variables, say X and Y are directly proportional, inversely proportional or are not related to each other.

Descriptive Research

- **2. Case Studies**

A case study is a **research approach** that gives understanding of group/person, event, process or subject

It is used to generate an in-depth, multi-faceted understanding of a complex issue in its real-life context. It is an established research design that is used extensively in a wide variety of disciplines

The case study approach is particularly useful to employ when there is a need to obtain an in-depth appreciation of an issue, event or phenomenon of interest, in its natural real-life context.

'Case report' and 'case series' have a long tradition in clinical practice and research. Presenting detailed critiques, typically of one or more patients, aims to provide insights into aspects of the clinical case

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Case Studies in Infectious Disease



Infectious diseases have plagued man throughout history. In the era of modern medicine antibiotics and vaccines brought the hope of liberation from the great scourges of smallpox, polio, and tuberculosis. Yet, in the ensuing decades as we hoped to close the book on infectious diseases, we have instead been confronted by wave upon wave of new assailants.

This content collection explores a variety of case studies on infectious diseases. From meningitis to zoonotic disease, it gives an overview of causation and discusses the best methods of treatment.

Chapters free until April 30th 2020

3. Correlational Studies

- A **correlational study** is a type of research design where a researcher seeks to understand what kind of relationships naturally occurring variables have with one another.
- Examples
 - Someone may want to find out if drinking while pregnant is associated with an increased risk of depression for the teenage child.
 - Is smoking associated with Alzheimer's disease?

Analytical Research

- Analytical research is a **specific type of research that involves critical thinking skills and the evaluation of facts and information relative to the research being conducted.**
- Why does it happen?



Analytical Research

- Measure and Evaluate Causal Relationship between variables
- Two types of Analytical Research
 - Observational Research: we measure or survey members of a sample without trying to affect them
 - Cohort Base: Group
 - Case Study: Individual
 - Longitudinal Study: Research conducted over extended period of time
 - Retrospective study uses already existing data, collected during previously conducted research with similar methodology and variables.
 - Cross Sectional Study: observes a single instance with all variables remaining the same throughout the study.
 - Experimental Research: have some sort of treatment condition applied to at least some participants by random assignment

Types

- **Observational Analytical Research:**

- The participants/test are grouped and evaluated according to a research plan or protocol.
- **Cohort Studies (Prospective, Retrospective and Ambidirectional):** A cohort is a group formed by patients having common characteristics. A cohort study is the one in which a group of patients is followed-up in time
 - *Prospective cohort study:* The results are obtained **after the research starts**.
 - *Retrospective cohort study:* The researcher's following-up of cohort subjects from a **certain point towards the past**
 - Cohort studies that **begin after exposure and before disease development** are called *ambidirectional studies*.
- **Case-Control Studies:** these studies are retrospective cohort studies. They examine the cause and effect relationship from the effect to the cause. The detection or determination of data depends on the information recorded in the past.
- **Cross-Sectional Studies:** in cross- sectional studies, the patients or events are examined at a particular point in time.
 - Prevalence studies (the percentage of a population having a disease at a certain time) are the ones in which the diagnosis and disease mechanism are detected and the cause and effect relationship is examined at the same level.

Experimental/ Interventional/Causal Research Design

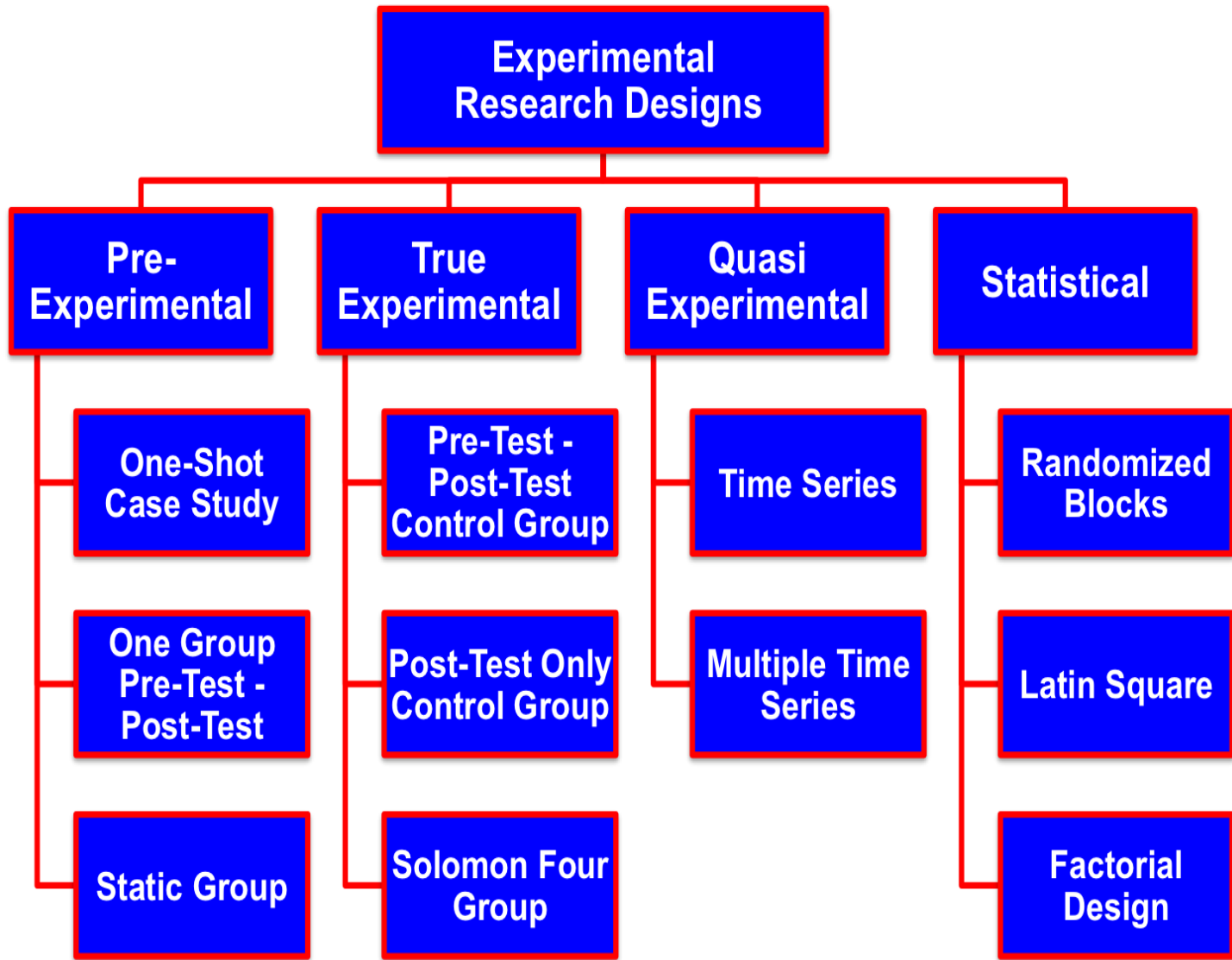
- The researcher decides upon which effect the participant will be exposed to in this study. A control group is included in the study.
- Post-intervention, the researcher waits for the result, observes and obtains the data.

Interventional studies are divided into two: quasi-experimental and clinical research.

- **Quasi-Experimental Research:** they are conducted in cases in which a quick result is requested and the participants or research areas cannot be randomised, e.g. giving hand-wash training and comparing the frequency of nosocomial infections before and after hand wash.
- **Clinical Research:** they are prospective studies carried out with a control group for the purpose of comparing the effect and value of an intervention in a clinical case (s).

Criteria for Experimental Design:

1. The people/subject/product who participate in the experiment.
2. The independent variable or variables, which are also called the treatment variables. These are the variables the researchers manipulate during the experiment.
3. The dependent variable, or the effect that the researchers measure.
4. The plan for controlling extraneous variables.



Experimental Design Symbols

Symbol	Meaning
O	A formal observation or measurement
X	Exposure to the Experimental Treatment
EG	Experimental Group: Test units exposed to a treatment
CG	Control Group: Test units not exposed to a treatment
R	Random assignment of test units to the EG and CG
M	Assignment to a EG or CG are balanced to assure that the EG and CG are roughly equal.

Pre Experimental Research Design

- **One-Shot Case Studies:** With a one-shot case study, test units—are exposed to a treatment. The standard notion for a treatment is the symbol "X." A single measurement of the dependent variable is taken (O_1). There is no random assignment of test subjects as there is only one treatment, and there is no control. Here is the standard notation for a One-Shot Case Study: **X O₁**

This research design has two significant flaws: 1) there is no pre-test and 2) there is no control group. A control group would, in this case, be a group that did not receive the treatment. Without these restraints, this research design cannot establish internal or external validity.

- **One Group Pre-Test - Post-Test:** With this research design the test unit is measured twice, one before the test and once after the test. There is still no control group; which is to say, a group not receiving the treatment.
- Here is the standard notation for a one-group pre-test - post-test study: **O₁XO₂**

Effect can be measured by subtracting post test from pre test data. However, given the lack of a control, the validity of the conclusions are questionable

- **Static Group Design:** With the Static Group design there is a Control Group (CG) in addition to the Experimental Group (EG). The experimental group is exposed to the treatment while the control group is not. Test units, however, are not randomly assigned to the control or experimental groups. Here is the standard notation for a Static Group study: **EG: X O₁ CG:**

Weaknesses of this research design stem from the fact that test units are not randomly assigned to the experimental or control groups and there are no pre-test measurements taken

True Experimental Designs

Experimental Design Symbols	
Symbol	Meaning
O	A formal observation or measurement
X	Exposure to the Experimental Treatment
EG	Experimental Group: Test units exposed to a treatment
CG	Control Group: Test units not exposed to a treatment
R	Random assignment of test units to the EG and CG
M	Assignment to a EG or CG are balanced to assure that the EG and CG are roughly equal.

- **Post-Test Only Control Group Design:**

With this research design, test units are **randomly assigned** to the experimental and control groups. The experimental group is exposed to the treatment and then both the experimental and control groups are measured. But, there is only one measurement is taken

**Post-Test Only
Control Group Design**
EG: R X O₁
CG: R O₂
R = Random Assignment

- **Pre-Test - Post-Test Control Group Design:**

With this research design, test units are **randomly assigned** to experimental and control groups. A pre-test measure is taken from both groups. Selection bias is controlled by the randomized assignments of test units.

**Pre-Test - Post-Test
Control Group Design**
EG: R O₁ X O₂
CG: R O₃ O₄
R = Random Assignment

- **The Solomon Four Group Design** is a research design that assesses the impact of pretesting on subsequent measures. It is used when the researcher suspects that earlier tests influence the results of later tests.

- With this research design, test units are randomly allocated to two experimental groups and two control groups. One of the experimental groups and one of the control groups is measured. Both experimental groups are then exposed to a treatment. Afterwards, both experimental and control groups are measured.

- A total of six measurements are taken. The design aims to account for pre-testing bias and pre-test manipulation interaction bias.

**Solomon Four
Group Design**
EG₁ R₁ O₁ X O₃
CG₁ R₂ O₂ O₄
EG₂ R₃ X O₅
CG₂ R₄ O₆

Here is the standard notation for a Solomon Four Group study:

Quasi Experimental Research Design

- Quasi means resembling
- Used to establish effect of independent variable on dependent variable (causality) in situations where researchers are not able to randomly assign the subjects to groups for various reasons
- Differ from experimental in lack of randomized control
- Quasi-experiments are most likely to be conducted in field settings in which random assignment is difficult or impossible. They are often conducted to evaluate the effectiveness of a psychotherapy treatment or educational change/intervention.
- Element of manipulation

- Two types
 - 1. Non random control group design
 - 2. Time Series Design

Non Randomized Control Group/ Non equivalent control group design

- No random assignment of study subjects in experimental and control group
- Similar to pre test- post test group design
- Dependent variable are observed on both experimental and control groups before intervention
- After experimental group receives treatment, post test observation of dependent variable is carried out for both groups to assess effect of intervention or treatment on control group.
- When group assignment is not controlled there is a significant threat to internal validity. Since group assignment is not random, there is a chance that the groups are not similar

Times Series Quasi Experimental Research Design

- A time series is a set of measurements taken at intervals over a period of time, usually between treatments

- **Pretest-Posttest Design**

In a **pretest-posttest design**, the dependent variable is measured once before the treatment is implemented and once after it is implemented.

- **Interrupted Time Series Design**

It includes multiple pretest and posttest measurements

Example

- In one classic example, the treatment was the reduction of the work shifts in a factory from 10 hours to 8 hours (Cook & Campbell, 1979). Because productivity increased rather quickly after the shortening of the work shifts, and because it remained elevated for many months afterward, the researcher concluded that the shortening of the shifts caused the increase in productivity. Notice that the interrupted time-series design is like a pretest-posttest design in that it includes measurements of the dependent variable both before and after the treatment.

Cook, T. D., & Campbell, D. T. (1979). *Quasi-experimentation: Design & analysis issues in field settings*. Boston, MA: Houghton Mifflin.

Controlled Experimental/Statistical Experimental research design

- Objects or individuals are randomly assigned to experimental groups called as blocks
- Most reliable method to create homogenous groups that are without bias
- Two types
 - Randomized Block design (RBD): assigned to known blocks such as placebo or drug treated. Each block contains as well experimental units as number of treatments.
Randomized, Replication and Control
 - Two block Randomized Design
 - Multiple Block Randomized Design
 - Factorial RBD:
 - Completely randomized design (CRD): blocks are also random and experimental treatment also
 - Latin square research design
 - Factorial CRD

Randomized Block Design

- Usually one factor or variable of interest. Rest are considered nuisance and require blocking
- Rule: *Block what you can, randomized what you cannot*
- Example : 100 men get **the placebo**, 100 men get the vaccine, 100 women get the placebo, and 100 women get the vaccine

2x2 Factorial research design

		Independent Variable 2	
		Level 1	Level 2
Independent Variable 1	Level 1	Dependent Variable	Dependent Variable
	Level 2	Dependent Variable	Dependent Variable

Research problem

- Two professors decide to test the effect of giving daily quizzes on student performance in a Refresher Methodology course. They decide that Professor A will give quizzes but Professor B will not.
- They will then compare the performance of students in their two sections on a common final exam.
- List five other variables that might differ between the two sections that could affect the results.

Reading Material

- [Research Methodology : Methods And Techniques \(Multi Colour Edition\)](#) by C.R. Kothari and Gaurav Garg. New Age International Publications
- Wikipedia
- Open Educational Resources (OER commons)
- <http://media.acc.qcc.cuny.edu>