Research Methodology and IPR

Module 2

Module-2

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed.

Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

2.1 Role of Literature Review

Literature reviews play a critical role in scholarship because research remains, first and foremost, a cumulative endeavor (vom Brocke et al., 2009). A rigorous knowledge synthesis is becoming indispensable in assisting practitioners, academics, and graduate students in finding, evaluating, and synthesizing the contents of many empirical and conceptual papers. The literature review is the first step in any research project, and its purpose is to provide a comprehensive overview of the current state of knowledge in a particular field. It involves searching for, reading, and critically evaluating relevant literature on the topic of research. By identifying the main arguments, evidence, and conclusions presented in the literature, the researcher can gain a thorough understanding of the field and identify gaps in the current state of knowledge. This information can then be used to formulate a research question that addresses these gaps and guides the research project.

- It is a systematic…method for identifying, evaluating and interpreting the work produced by researchers, scholars and practitioners."(FINK, A., 1998. Conducting literature research reviews: from paper to the internet. Thousand Oaks, CA: Sage., p.3.)
- Without it you will not acquire an understanding of your topic, of what has already been done on it, how it has been researched, and what the key issues are. (HART, E., 1998. Doing a literature review: releasing the social science research imagination, by E. Hart and M. Bond. London: Sage., p.1).
- A literature review discusses published information in a particular subject area, and sometimes information in a particular subject area within a certain time period.
- A literature review can be just a simple summary of the sources, but it usually has an organizational pattern and combines both summary and synthesis.
- A summary is a recap of the important information of the source, but a synthesis is a re-organization, or a reshuffling, of that information.
- In the context of a research paper or thesis the literature review is a critical synthesis of previous research. The evaluation of the literature leads logically to the research question.

2.2 Benefits of Literature Review

2.2.1. Identify Gap : One of the key functions of the literature review is to identify gaps in the current state of knowledge. By reviewing the literature, the researcher can identify areas where there is a lack of research or where the findings are inconsistent. This information can then be used to guide the research project, helping to ensure that the research question is focused and addresses an important area of study. Additionally, it allows the researcher to evaluate the relevance of their own research question and ensure that their work will contribute to the field in a meaningful way.

2.2.2 Develop Methodology: Another important function of the literature review is to guide the methodology and data analysis of the research project. The literature review provides a foundation for the research design, helping to ensure that the methodology is appropriate and relevant to the research question. It also helps the researcher to identify the best methods for collecting and analyzing data. By reviewing the literature, the researcher can learn from the successes and failures of previous research and apply this knowledge to their own project.

2.2.3 Dissemination of research findings

The literature review also plays a key role in the dissemination of research findings. In order to be published, research must demonstrate that it is original and adds to the current state of knowledge in the field. By conducting a thorough literature review, the researcher can demonstrate that their research is relevant and original and that it addresses a gap in the current state of knowledge. Additionally, the literature review also allows the researcher to situate their own work within the broader context of the field and to provide a clear and concise overview of the research for the audience.

2.2.4 Literature reviews prevent you from duplicating the same information as others in your field, allowing you to find your own, unique approach to your topic.

2.3. How to conduct a Literature Review

2.3.1 Define the research question

- You may need to some exploratory searching of the literature to get a sense of scope, to determine whether you need to narrow or broaden your focus
- Identify databases that provide the most relevant sources, and identify relevant terms (controlled vocabularies) to add to your search strategy
- Finalize your research question

2.3.2 Determine inclusion/exclusion criteria

Think about relevant dates, geographies (and languages), methods, and conflicting points of view

2.3.3 Choose databases and conduct the search

- ✓ Conduct searches in the published literature via the identified databases
- ✓ Check to see if this topic has been covered in other discipline's databases
- ✓ Examine the citations of on-point articles for keywords, authors, and previous research (via references) and cited reference searching.

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2.3.5 Synthesize the information gathered

- ➢ Evaluate the strengths and weaknesses of individual sources and evaluate for bias, methodologies, and thoroughness.
- ➢ Group your results in to an organizational structure that will support why your research needs to be done, or that provides the answer to your research question
- ➢ Develop your conclusions

2.3.6 Analyze the information gathered

- ➢ Are there gaps in the literature?
- ➢ Where has significant research taken place, and who has done it?
- ➢ Is there consensus or debate on this topic?
- ➢ Which methodological approaches work best?

2.3.7 Write the literature review

- ✓ Pick an organizational structure, i.e., themes, approaches, concepts, methodologies. For example: Background, Current Practices, Critics and Proponents, Where/How this study will fit in.
- ✓ Organize your citations and focus on your research question and pertinent studies
- ✓ Compile your bibliography

2.4 : How to write a Review Paper

A review Paper must have the following:

i) Introduction: Gives a quick idea of the topic of the literature review, such as the central theme or organizational pattern. The introduction should provide the reader with the scale and structure of your review. It serves as a kind of map.

ii) Body: Contains your discussion of sources and is organized either chronologically, thematically, or methodologically (see below for more information on each). Literature reviews should be evaluative and not merely descriptive. For example possible reasons for similarities or differences between studies are considered rather than a mere identification of them.

iii) Conclusions/Recommendations: Discuss what you have drawn from reviewing literature so far. The findings can be related to the aims of the study you are proposing to do.

2.4.1 Six typical ways of organizing the sources into a review:

- ❖ Chronological
- ❖ By publication

- By trend
- Thematic
- Methodological

2.5 Research Design

2.5.1 What is meaning of Research Design?

The research design is the conceptual structure within which research is conducted; it constitutes the blueprint for the collection, measurement and analysis of data. We can split the design into

1. Sampling Design: How to select the samples for study?
2. Observational Design: Conditions under which the observations are to be made;
3. Statistical design: How many items are to be observed and how the information and data gathered are to be analyzed; and
4. Operational design: Techniques by which the procedures specified in the sampling, statistical and observational designs can be carried out.

2.5.2 Why do we need Research Design?

- ✓ Facilitates the smooth sailing of the various research operations,
- ✓ Improves efficiency
- ✓ Maximum output with minimized time, money and manpower
- ✓ Minimize errors
- ✓ Clarity on operation
- ✓ Expect hurdles and challenges

2.5.3 Features of a good Research Design

- Focused: The research question and goals are specific and clear. Narrow the scope to what can be studied .
- Logical: The steps of the design follow each other in a reasonable order. Each step prepares for or builds on the next in an orderly manner. For example, surveys are given after interviews to clarify and quantify initial findings.
- Thorough: Enough depth and detail are included to answer the research question,
- Pragmatic: The design is realistic, given constraints. For example, limiting the number of interviews to what can be transcribed and analyzed within the study timeframe.
- Ethical: Protocols ensure participants are treated ethically.
- Transparent: The design is described in sufficient detail so others can critique and reproduce the research.
- Valid: Measures what it intends to measure. There are no systematic errors that distort the results.
- Replicable: Methods and procedures are described in enough detail so others can reproduce the study.
- Feasible: Can be implemented within available resources and constraints.

- ❖ Objective: Methods are chosen to minimize researcher subjectivity and bias

2.5.4 Terminology

1. **Variables:** A quantity that can take different values is a variable. We have continuous (age, height) and discrete variables (number of cars) . A variable that is does not depend on any other variable and is controllable by the researcher is called an Independent variable. If a variable depends upon or is a consequence of another variable it is called a dependent variable. Independent variables that are not related to the purpose of the study, but may affect the dependent variable are termed as extraneous variables . Whatever effect is noticed on dependent variable as a result of extraneous variable(s) is technically described as an 'experimental error'. A study must always be so designed that the effect upon the dependent variable is attributed entirely to the independent variable(s), and not to some extraneous variable or variables.

2. **Control:** The technical term 'control' is used when we design the study minimizing the effects of extraneous independent variables. In experimental researches, the term 'control' is used to refer to restrain experimental conditions.

3. **Confounded relationship:** Confounding variables are a type of extraneous variable that are related to a study's independent and dependent variables. It is coorelated with the independent variable. It is causally related to the dependent variable. When the dependent variable is not free from the influence of confounding variable(s), the relationship between the dependent and independent variables is said to be confounded by an extraneous variable(s).

4. **Research hypothesis:** When a prediction or a hypothesized relationship is to be tested by scientific methods, it is termed as research hypothesis. The research hypothesis is a predictive statement that relates an independent variable to a dependent variable. It should be testable and verifiable.

5. **Experimental and non-experimental hypothesis-testing research:** When the purpose of research is to test a research hypothesis, it is termed as hypothesis-testing research. It can be of the experimental design or of the non-experimental design. Research in which the independent variable is manipulated is termed 'experimental hypothesis-testing research' and a research in which an independent variable is not manipulated is called 'non-experimental hypothesis-testing research.

   Example: Does intelligence affect reading ability ? – Non-experimental

   Example: Does training in memory affect reading ability? – experimental

6. Experiment: A way of getting an answer to a question which the experimenter wants to know.

7. Experimental Unit : For conducting an experiment, the experimental material is divided into smaller parts and each part is referred to as experimental unit.

8. Treatment: Is an intervention that a researcher applies to change the conditions of an experiment. The goal of a treatment is to answer a research question or test a hypothesis. The independent variable is manipulated by the experimenters, and its exact form depends on the type of research being performed.

- In a medical trial, it might be a new drug or therapy. (To cure a disease)

- Application of fertilizer (to increase yield)

9. Factor: A controlled independent variable. The experimenter wants to study its effect on the outcome. Factors can be quantitative or qualitative, and can be fixed or random. Factors are used to compare the effects of different treatments on a response variable. . The level of the factor is set by the experimenter. Level is the factor setting.

10. Outcome / Output /Response: The variable that is being observed.

Example: Consider the following problem. A researcher wants to study if training improves the running time of a runner. He selects three groups of runners and subjects each one to a different training program.

Hypothesis: Training improves the running time

Experimental units: Groups of runners.

Treatment: Training

Factor: Training type; Level : the three types of training

2.6 Research design for exploratory research

It is discovery of ideas and insights. As such the research design appropriate for such studies must be flexible enough to provide opportunity for considering different aspects of a problem under study.

Primary design methods: Information gathered directly from the subject.

- **Surveys:** Surveys/polls are used to gather information from a predefined group of respondents. Survey could be online, through post, Example a mobile manufacturing company conducts a survey on a given set of audience to understand their opinions about the size of mobile phones when they purchase one.
- **Interviews:** A person can give in-depth information on the subject being studied. Interviews are carried out in person or on telephone which have open-ended questions to get meaningful information about the topic.
- **Observations**

Secondary design method is gathering information from previously published primary research. In such a research you gather information from sources likes case studies, magazines, newspapers, books, etc. Online research, Literature research , case study . They are called insight-stimulating examples.

2.7 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 research design must make enough provision for protection against bias and must maximize reliability, with due concern for the economical completion of the research study. The design in such studies must be rigid and not flexible.

2.8 Experimental Design

2.8.1. Principle of Replication: According to the Principle of Replication, the experiment should be repeated more than once. Thus, each

treatment is applied in many experimental units instead of one.

Example :

- High jump: To measure how good students are at high jump, you can ask them to repeat the same activity multiple times and record their maximum heights.
- Seed productivity
- To test the productivity of a crop with different types of seeds, you can assign each seed to a unit of land in a random manner. You can then repeat the process so that each unit of land gets each variety of seed at least once.

  Replication helps improve the accuracy of the experiment.

✓ It helps measure variability between different groups.

✓ It helps identify the reasons for variations in the data.

✓ It helps estimate experimental error.

✓ It helps estimate the parameters of the model.

2.8.2 Principle of Randomization

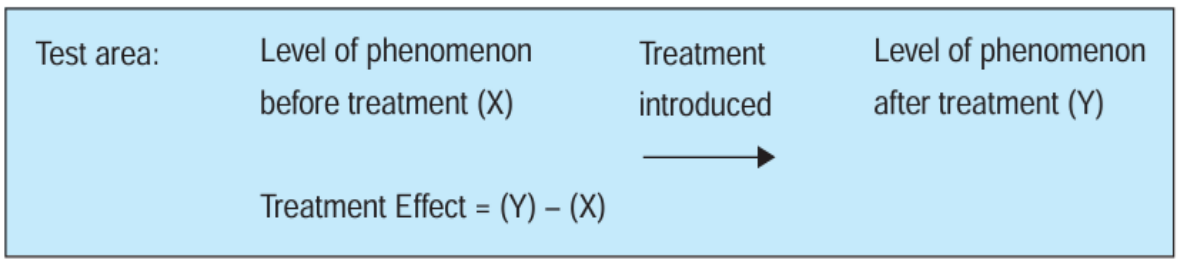
The principle of randomization in experimental design is the process of randomly assigning treatments to experimental units. This process is used to avoid bias and ensure that the only difference between groups is the treatment condition. Through the application of the principle of randomization, we can have a better estimate of the experimental error.

2.8.3. Principle of Local Control: Under it the extraneous factor, the known source of variability, is made to vary deliberately over as wide a range as necessary and this needs to be done in such a way that the variability it causes can be measured and hence eliminated from the experimental error.

2.9 Informal Experimental design

2.9.1 Before and after without control design: In such a design a single test group or area is selected and the dependent variable is measured before the introduction of the treatment. The treatment is then introduced and the dependent variable is measured again after the treatment has been introduced.

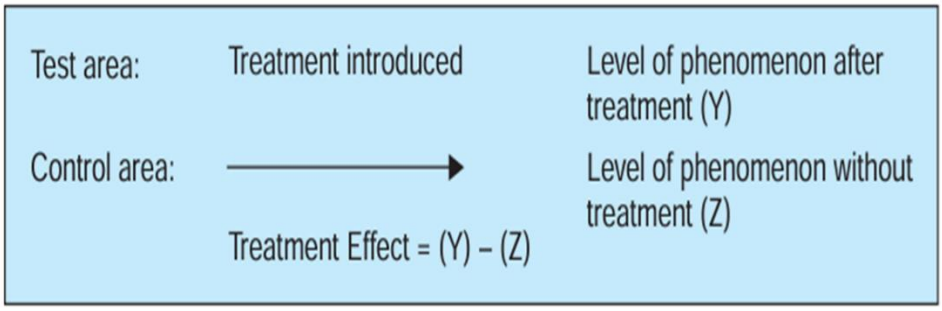
Apply fertilizer and find yield of crop(Y). Compare what was before (X)



2.9.2 After only with control design

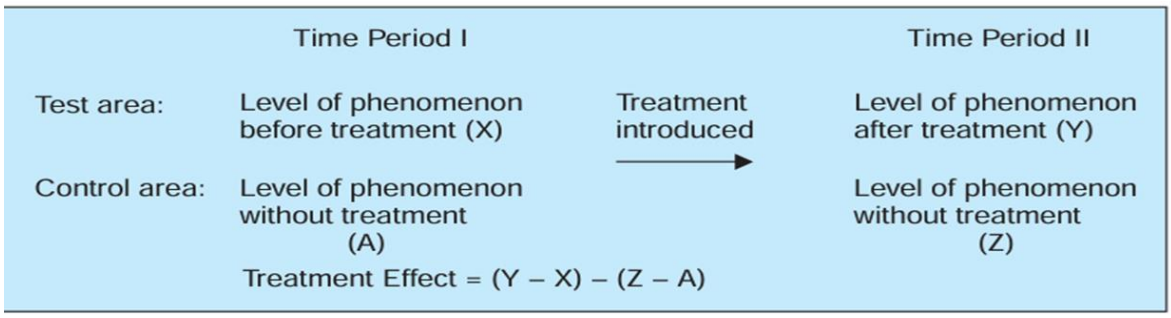
In this design two groups or areas (test area and control area) are selected and the treatment is introduced into the test area only. The dependent variable is then measured in both the areas at the same time.

Divide land into two. Apply fertilizer to one. Find yield (Y). Find yield on the other area , without fertilizer. (Z). Both at same time.



The basic assumption in such a design is that the two areas are identical with respect to their behavior towards the phenomenon considered. If this assumption is not true, there is the possibility of extraneous variation (soil) entering into the treatment effect.

2.9.3 Before and after with control design : In this design two areas are selected and the dependent variable is measured in both the areas for an identical time-period before the treatment. The treatment is then introduced into the test area only, and the dependent variable is measured in both for an identical time-period after the introduction of the treatment. It avoids extraneous variation resulting both from the passage of time and from non-comparability of the test and control areas.

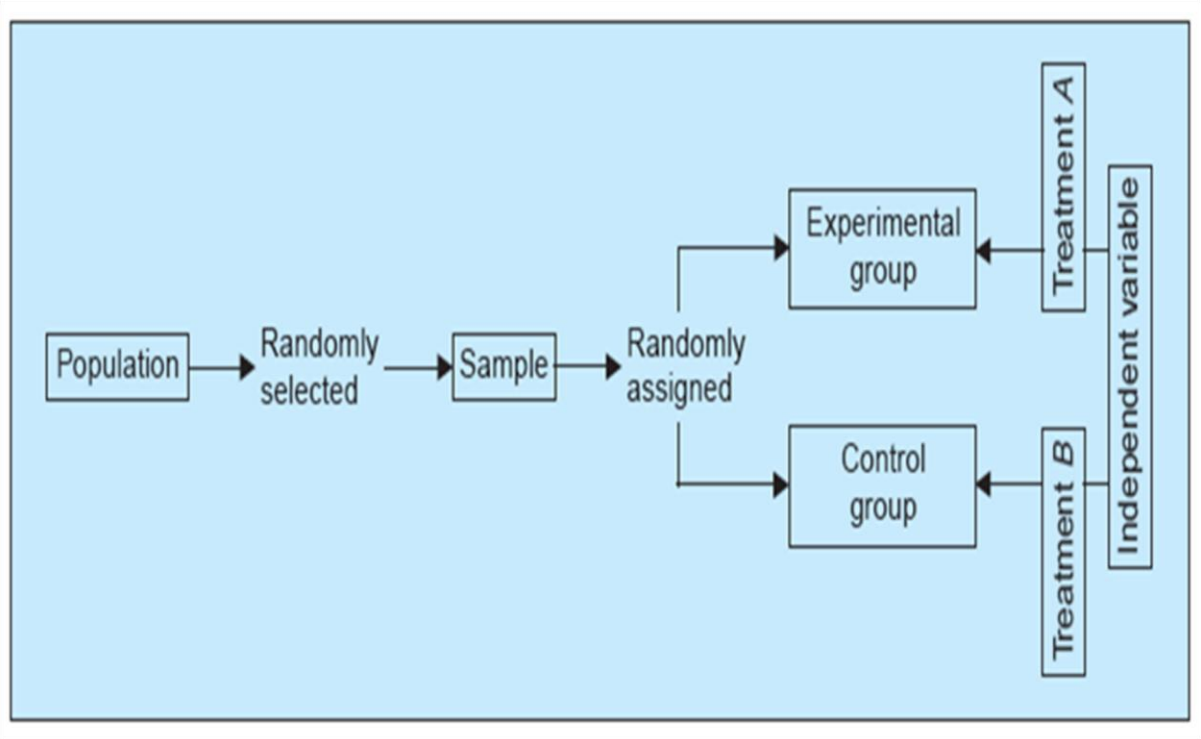


2.10 Formal Experimental Design

2.10.1 Completely Randomized Design(C.R Design)

Uses Principles of replication and principles of randomization. Subjects are randomly assigned to treatments. Such a design is generally used when experimental areas happen to be homogeneous. Technically, when all the variations due to uncontrolled extraneous factors are included under the heading of chance variation, we refer to the design as C- R Design

A. Two group Simple Randomized Design: A **two-group design** the population is selected, subjects are selected randomly , and the researcher divides subjects into **two groups** randomly and then compares the results. The **two groups** usually consist of a control **group**, who does not get the treatment, and a treatment or experimental **group**, who does get the treatment.



Since in the sample randomized design the elements constituting the sample are randomly drawn from the same population and randomly assigned to the experimental and control groups, it becomes possible to draw conclusions on the basis of samples applicable for the population. It is simple and randomizes the differences among the sample items. It does not control the extraneous variable and as such the result of the experiment may not depict a correct picture.

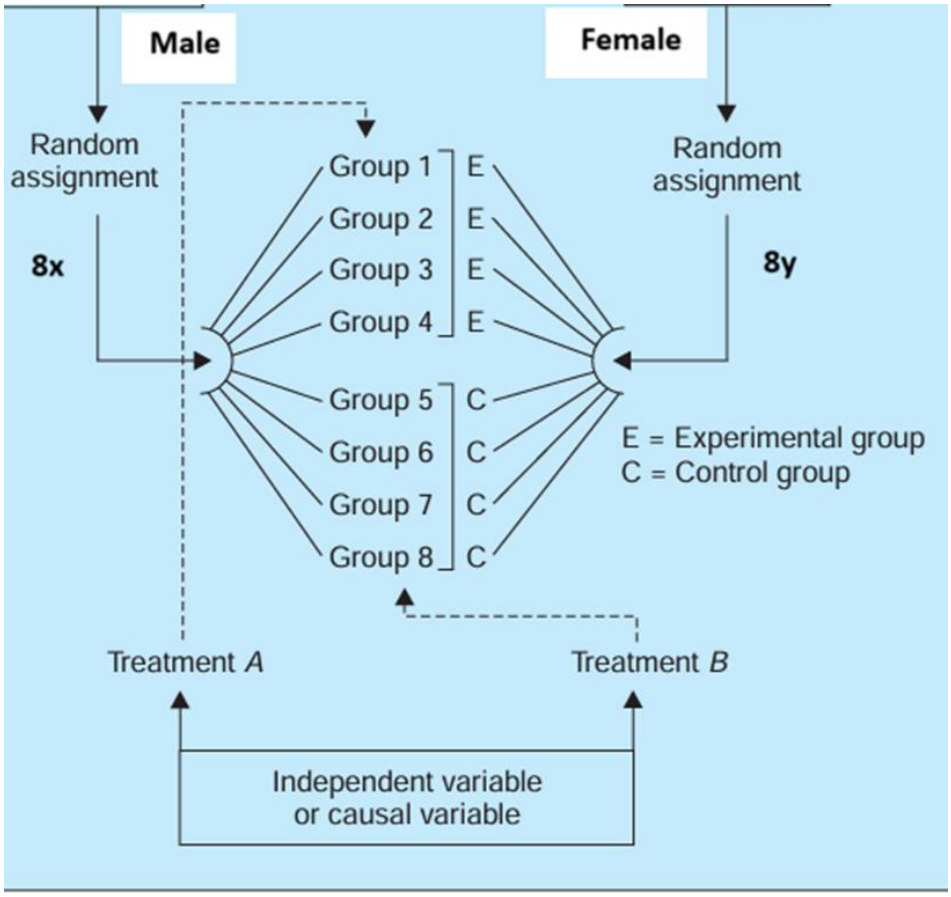
Example : Consider a population of 1000 people. We need to study effect of caffeine on improving alertness.

- ✓ Sample 100 People randomly.
- ✓ Then group people randomly into Group A (Control group) who are given treatment caffeine (50) and Group B (test group) who are not given treatment(50)
- ✓ Study alertness of both

B. Random replication design: Removes the error due to extraneous variable. For example consider a group of 100 students, made of boys and girls. We need to test the effect of a training program on their math ability.

One method is we decide on a sample size of 30 . We randomly select 30 students. We again randomly select 15 students for control group and 15 students for test group (they receive training). We then evaluate. Here the extraneous factor is gender. To eliminate this , we do the following.

We create 3 control and 3 test groups. Lets name them G1,G2,G3….G6. We assign 6 students (3boys and 3 girls) to each group . We thus need total of 6(3+3) = 36 students. We now randomly select 18 girls and 18 boys from the population. We then randomly divide the 18 girls into 6 groups, of 3 . We assign the same with the boys. Thus each of the groups G1,G2… is assigned 3 girls and 3 boys. Three of the test groups receive the training (Replication). Then the students are evaluated.



C Randomized Block Design : Principle of randomization, replication and local control is applied. A randomized block design is a restricted randomized design, in which experimental units are first organized into homogeneous blocks and then the treatments are assigned at random to these units within these blocks. The main advantage of this design is, if done properly, it provides more precise results. Suppose four different forms of a standardized test in statistics were given to each of five students (selected one from each of the five I.Q. blocks) and following are the scores which they obtained. If each student separately randomized the order in which he or she took the four tests (by using random numbers or some similar device), we refer to the design of this experiment as a R.B. design.

D. Latin Square Design: Very common in agriculture and drug testing.

When there are two exogenous variables (factors) .

Consider study of fertilizers (5 types) on crop yields. The factors are the fertility of the soil (say 5) and the type of crop (or seed). The treatment is application of the fertilizer.

There are several research designs and the researcher must decide in advance of collection and analysis of data as to which design would prove to be more appropriate for his research project. Researcher must give due weight to various points such as the type of universe and its nature, the objective of his study, the resource list or the sampling frame, desired standard of accuracy and the like when taking a decision in respect of the design for the research project.

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