

# **EXPERIMENTAL RESEARCH DESIGN**

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# CHARACTERISTICS

- Experimental research is defined as “OBSERVATIONS UNDER CONTROLLED CONDITIONS”.
- In experimental design the researcher is active agent rather than a passive observer.

- **Experimental designs are concerned with examination of the effect of an independent variable on dependent variable, where the independent variable is manipulated through treatment or intervention(s).**
- **True experimental designs consists of three cardinal feature: RANDOMIZATION, CONTROL & MANIPULATION or TRIAL.**

- According to Riely, experimental design is a powerful design for testing hypotheses of causal relationship among variables.
- Experimental research design is further classified as TRUE EXPERIMENTAL DESIGN, QUASI EXPERIMENTAL DESIGN & PRE EXPERIMENTAL DESIGN

# TRUE EXPERIMENTAL DESIGNS

- In true experimental designs the researchers have complete control over the extraneous variables and can predict confidently that the **observed effect on the dependent variable is only due to the manipulation of independent variable.**

# ESSENTIAL CHARACTERISTICS

A true experimental design consists of three important characteristics. They are as follows:

1. MANIPULATION.

2. CONTROL.

3. RANDOMIZATION.

# MANIPULATION

- Manipulation refers to conscious control of the independent variable by the researcher through treatment or intervention to observe its effect on the dependent variable.

<b>INDEPENDENT VARIABLE</b>	<b>MEDICATION</b>
<b>DEPENDENT VARIABLE</b>	<b>PAIN LEVEL</b>

# CONTROL

- Control refers to the use of control group and controlling the effects of extraneous variables on the dependent variable in which the researcher is interested.
- The subjects in the control and experimental groups are similar in number & characteristics, but the subjects in the control group do not receive experimental treatment or any intervention.



- A comparison of the experimental group is made with the control group to observe the effect of the treatment or intervention.
- The control of effects of extraneous variables on the dependent variable can be ensured by adopting one of the following measures : **Matching**, **counterbalancing**, **Homogeneity by statistical test**.

# MATCHING

- Is a conscious “matching” of the subject characteristics in both the groups.
- It is a weak but a common method of control over the extraneous variables.
- In matching the researcher identifies one or more extraneous variables to be controlled which are supposed to have effect on dependent variable.

- **As the subjects are recruited for one of the treatment groups, the researcher tries to find subjects for the other group (similar to the subjects of the first group based on the specific matching variable).**
- **For example if age and gender are the matching variables of interest in a two group study (if 40 yrs old man is recruited for the first group, the researcher would try to find another man aged 40 yrs for the second group)**

# COUNTER BALANCING

- Counter balancing is another way to exert control over extraneous variables.
- Counter balancing is used in which the researcher is concerned that the orders in which the treatment or interventions are administered influence the study results.

# HOMOGENEITY BY STATISTICAL TEST

- To ensure homogeneity of the demographic characteristics among two groups under study, **a chi-square test may be applied on the frequency distribution of selected characteristics in two groups.**

# RANDOMIZATION

- Means that every subject has an equal chance of being assigned to experimental or control group.
- This is called random assignment of subjects.
- The process involves random assignment to different groups

- **Through random assignment chances of systemic bias is eliminated.**
- **Randomization is used in true experimental designs to minimize the threats of internal validity of the study and eliminates the effects of extraneous variables on the dependent variables.**

# METHODS OF RANDOMIZATION

- Random assignment of study subjects may be done with simple *flip of a coin* for each subject. If coin lands on its “head”, subjects are assigned to first group & with “tail” the subjects are assigned to the second group.



- Another methods is to write the names of the subjects on slips of paper and put the slips into a bowl and then drew lots. **The first designated numbers of subjects are placed in one group and the rest are assigned under another group.**

- **A random table may be used to facilitate the randomization process. In this method blindfolds the subjects to chose a number from a table of numbers horizontally (row) or vertically (column), till a requisite number is reached for both the experimental & control group.**
- **Computer assisted random sequences also may be used for the random assignment of the subjects.**

# SYMBOLIC PRESENTATION OF RANDOM NUMBERS

52 35 89 71 43  
15 25 00 20

85 76 92 46 35  
81 67 32 65

06 42 48 47 43  
65 95 10 56

82 64 12 42 27  
59 32 09 37

32 65 75 62 73  
96 58 34

69 34 80 76 71  
92 75 38 88

05 95 66 79 46  
01 17 74 62

06 53 57 26 08  
72 39 41

87 83 84 64 72  
62 19 38 45

45 19 75 72 05  
65 39 21 56

31 08 43 49 29  
35 45 43 07

03 97 92 46 53  
27 08 54 82

# EXAMPLE OF RANDOMIZATION PROCEDURE

NAME	NUMBER	GROUP
RAMU	1	I
BABU	2	II
SOMU	3	II
SIMBU	4	II
ACHU	5	I
BUJJU	6	II
KICHU	7	I
SACHU	8	I

# TYPES OF TRUE EXPERIMENTAL DESIGNS

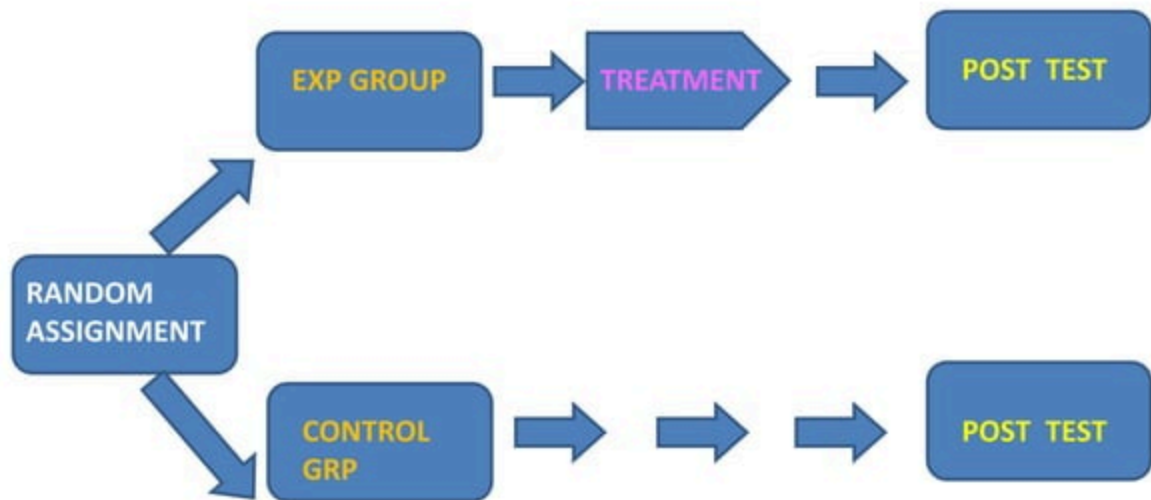
1. POST TEST ONLY DESIGN.
2. PRETEST-POST-TEST-ONLY DESIGN.
3. SOLOMOM FOUR GROUP DESIGN.
4. FACTORIAL DESIGN.
5. RANDOMIZED BLOCK DESIGN.
6. CROSS OVER DESIGN.

## POST TEST ONLY CONTROL DESIGN

- Is composed of two randomly assigned group - experimental & control groups.
- Both the groups are not tested previous to the introduction of an intervention.
- While treatment is implemented on the experimental group only, post test observations are made on both the groups.

- **This design is helpful in situations where it is not possible to pre test the subjects.**
- **E.g., A study on educational intervention related to contraception among couples.**

# POST TEST ONLY CONTROL DESIGN



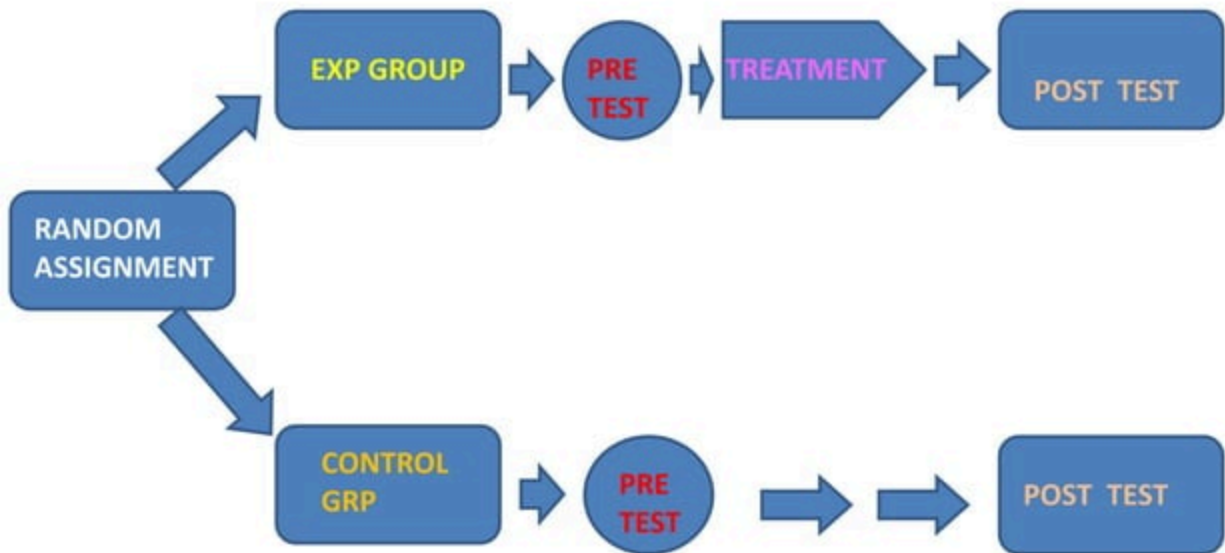


## PRETEST-POST-TEST-ONLY DESIGN

- In this design, subjects are randomly assigned to either the experimental or control group.
- The effect of the dependent variable on both the groups is seen before the treatment (pre test).

- **Following this the treatment is carried out on experimental group only.**
- **After treatment observation of dependent variable is made on both the groups to examine the effect of the manipulation of independent variable on dependent variable.**

# PRETEST –POST TEST ONLY DESIGN



## SOLOMON FOUR GROUP DESIGN

- There are two experimental and two control group.(control group - I & II) (Exp group- I &II).
- Initially the researcher randomly assigns subjects to the four groups.

- **Out of four groups, only exp grp I & control grp I receives the pre test followed by the treatment to the experimental grp I & II.**
- **Finally all the four groups receive post test, where the effects of the dependent variables of the study are observed and comparison is made of the four groups to assess the effect of independent variable (experimental variable) on the dependent variable.**

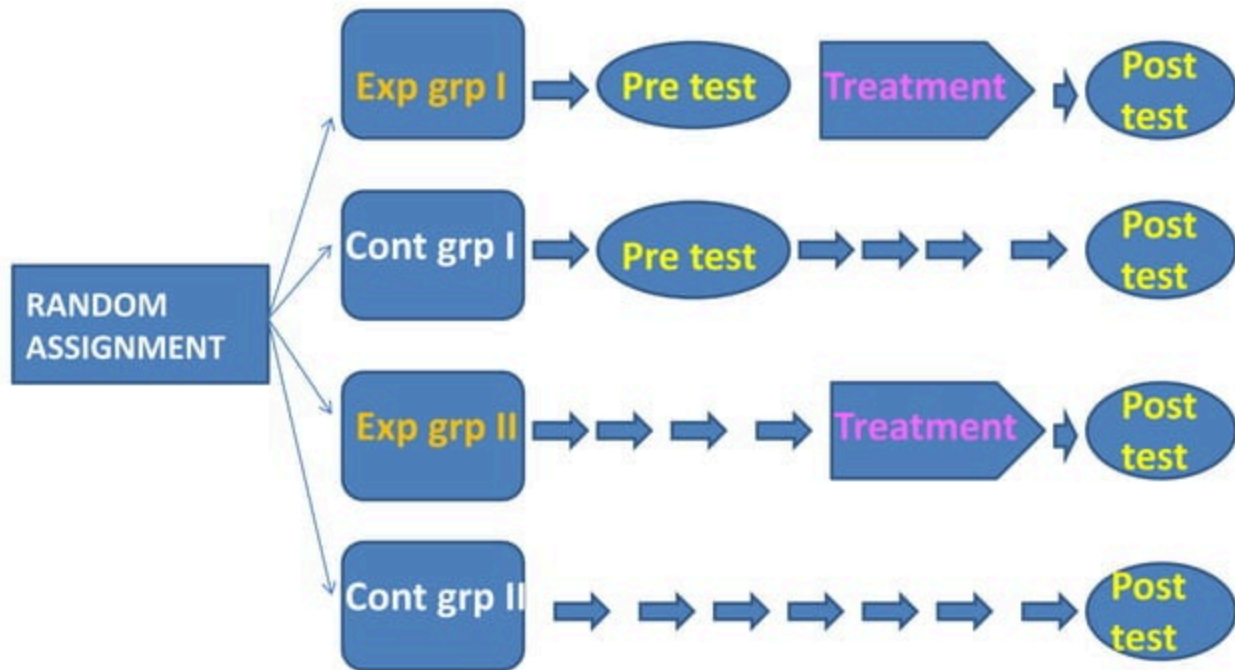
- **The experimental group II is observed at one occasion.**
- **To estimate the amount of change in experimental & control group II the average test scores of experimental & control groups I are used as baseline.**

- The solomon four group design is considered to be most prestigious experimental research design, because it minimizes the threat to internal and external validity.
- The test effectively presents the reactive effects of the pre test.
- Any difference between the experimental and control group can be more confidently attributed to the experimental treatment.

- **The disadvantage of this design is that it requires a large sample and statistical analysis, and therefore not commonly used in health care researches.**



# SOLOMON FOUR GROUP DESIGN



# FACTORIAL DESIGN

- Here the researcher manipulates two or more independent variables simultaneously to observe their effects on the dependent variables.
- This design is particularly useful when there are more than two independent variables to be tested.

- E.g., researcher wants to test the efficacy of two different medication.
- The design facilitates the testing of several hypotheses at a single time.
- Typically factorial design incorporates 2x2 or 2x3 factorial. (it can be any combination)

- The first number (alpha - A) refers to the independent variables or the types of experimental treatments and the second number (beta -B) refers to the level or frequency of the treatment.

# FACTORIAL DESIGN

FREQUENCY OF TREATMENT	PROTOCOLS OF TREATMENT	PROTOCOLS OF TREATMENT
	ALPHA (I) (DRUG I)	BETA (II) (DRUG II)
4 hourly (B1)	A1 B1	A2 B1
6 hourly (B2)	A1 B2	A2 B2
8 hourly (B3)	A1 B3	A2 B3

# RANDOMIZED BLOCK DESIGN

- **Randomized block design is used when the researcher desires to bring homogeneity among selected groups.**
- **This is a simple method to reduce the variability among the treatment groups by a more homogenous combination of the subjects through randomized block design.**

- For example if the researcher wants to test the efficacy of three different medications in reducing hypertension, to ensure homogeneity among subjects under treatment, researcher randomly places the subjects in homogenous groups (blocks).
- like patients with hypertension, diabetic patients with hypertension and hypertensive patients with heart diseases.

The design looks similar to that of factorial design in structure, but **out of two factors one factor is not experimentally manipulated.**



# RANDOMIZED BLOCK DESIGN

TYPE OF HYPERTENSIVE DRUG	BLOCKS	BLOCKS	BLOCKS
	PATIENT WITH HYPERTENSION (I)	DIABETIC PATIENT WITH HYPERTENSION (II)	PATIENT WITH HEART DISEASE AND HYPERTENSION (III)
A	A,1	A, I	A, III
B	B,1	B, I	B, II
C	C,1	C, I	C, III

# CROSS OVER DESIGN

- In cross over design the study subjects are exposed to more than one treatment.
- It is also known as “repeat measure design”.

- **This design is more efficient in establishing the highest possible similarity among subjects exposed to different conditions where groups compared obviously have equal distribution of characteristics.**
- **Some times this design is not effective because, when subjects are exposed to two different conditions, their responses of the second condition may be influenced by their experience in the first condition.**

# CROSS OVER DESIGN

<b>GROUPS</b>	<b>TREATMENT PROTOCOL</b>	<b>TREATMENT PROTOCOL</b>
<b>GROUP I</b>	<b>TREATMENT I</b>	<b>TREATMENT II</b>
<b>GROUP II</b>	<b>TREATMENT II</b>	<b>TREATMENT I</b>

# ADVANTAGES OF TRUE EXPERIMENTAL DESIGN

- **Most powerful design to establish the causal relationship between independent and dependent variable.**
- **Since the study is conducted under controlled environment, it can yield a greater degree of purity in observation.**

- **Conditions that are not found in natural setting can be created in experimental setting in a short period of time that may take years to naturally occur (therefore very useful in genetic studies).**
- **Because the experiment is carried out in experimental setting the problems of real life situations and the personal problems of the researcher is eliminated.**

# DISADVANTAGES OF TRUE EXPERIMENTAL DESIGN

- Most often the results of experimental designs cannot be replicated in studies conducted on humans due to ethical problems.
- Many of the human variables neither have valid measurable criteria nor instruments to measure them.

- In experimental studies conducted in natural settings like a hospital or community, it is not possible to impose control over extraneous variables.
- Experiments are often more impractical when the effect of independent variable may require a lengthy period of time before it can emerge as a response on the criterion measures.



- **It is very difficult to obtain permission from the participants.**
- **Because the size of the sample is kept small especially studies involving humans, the representativeness of the findings of such study is questionable.**
- **Though theoretically experimental designs can yields a greater insights , yet practically many a times they are not possible in human studies as humans & their parameters are complex.**

**THANK YOU**

