Marketing Research and Analysis-II (Application Oriented)
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Lecture – 14
Research Design - IV

Welcome friends to the lecture to the course of Marketing Research and Analysis. In today's lecture, we will be continuing with the extraneous variables and their effect in the experimental case. So we have understood that during any experimentation, the dependent variable is effected by the independent variable, but to improve the validity of the test, we should be sure that there are no other variables which effect the dependent variable besides the independent variable. So these other variables are called as the extraneous variables and how do we control them.

So we have started in the last lecture and we spoke about history, maturation, and testing effects. Today we will be doing a few more things on controlling the extraneous variable. The one of them is called instrumentation.

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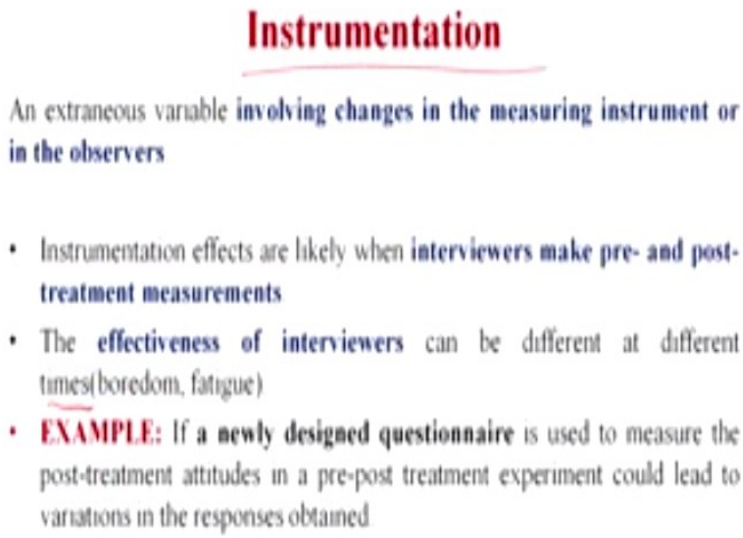

Now as the name suggests instrumentation it says that extraneous variable involving changes in the measuring instrument or in the observers. What does it mean, that means the kind of instrument that you are using during your experiment plays a vital role in the effect on the dependent variable. So it says for example instrumentation effects are likely when interviewers make pre and post treatment measurements. So the type of interviewers you

have selected right during a pre and post treatment can have an effect on the dependent variable.

The effectiveness of the interviewers can be different at different times also because the interviewers could become bored, could become tired, so their level of energy can also have an effect on the final outcome. Let us say this example. If a newly designed questionnaire is used to measure the post treatment, so in pretreatment you have used a different questionnaire and during the post treatment you have changed some of the questions or had a new questionnaire, so in a pre-post treatment experiment it could lead to variations in the response obtained, obviously.

So if you even change the format of the questionnaire that will have an effect on the psyche of the respondents, so this is due to the cause this is effect it happens due to the instrumentation which is responsible which the researcher is using right

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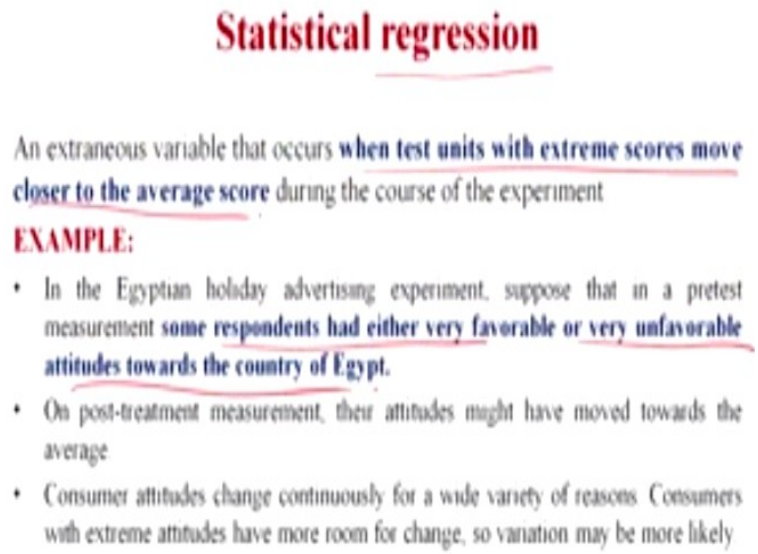

Statistical regression. Now regression means what, moving towards the average, that means an extraneous variable occurs that when test units with extreme scores move closer to the average score during the course of the experiment. Now what does it mean. Let us take our earlier example. In the Egyptian holiday advertising experiment, the people were asked about their opinion to visit Egypt for a holiday. Suppose that in a pretest measurement some respondents had either very favorable or very unfavorable attitude towards the county Egypt.

On the post treatment measurement, their attitudes might have moved towards the average, why because you gave them a treatment, you showed them an advertisement regarding the holiday in Egypt. So after watching this, respondent's opinion might not be the same and from a very unfavorable to a very favorable, they might have moved towards the mean the center. So consumer attitudes change continuously for a wide variety of reasons and consumers with extreme attitudes have more room for change, so variation may be more likely and this has an effect on the again the outcome of the dependent variable.

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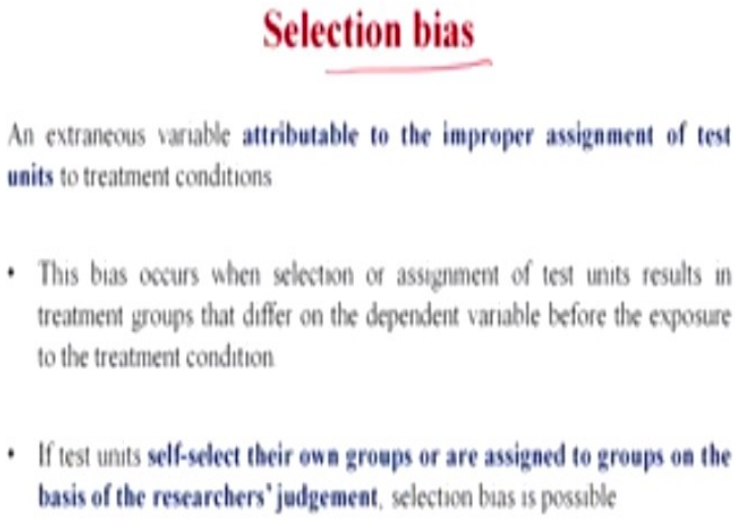

Another important extraneous factor is the selection bias. Now what is selection bias, it means that an extraneous variable attributable to the improper assignment of a test units to treatment conditions, that means you have wrongly selected, so there is a bias in the selection process. This bias occurs when selection of test units results in treatment groups that differ on the dependent variable before the exposure to the treatment condition. If test units self-select their own groups or are assigned to two groups on the basis of the researcher's judgment, selection bias is possible.

You have to understand this. What does this mean. Suppose you are selecting the respondents, the sample groups, and you are using your own logic so when you are using your own logic or judgment, there is a possibility that you are creating a selection bias, so that in that condition the effect could be a different kind of effect, what would have happened had you selected them on a random basis on a randomly manner. So this is what we considered as a selection bias. So a selection bias can also have a large impact on the final outcome of the experiment. Now take this example

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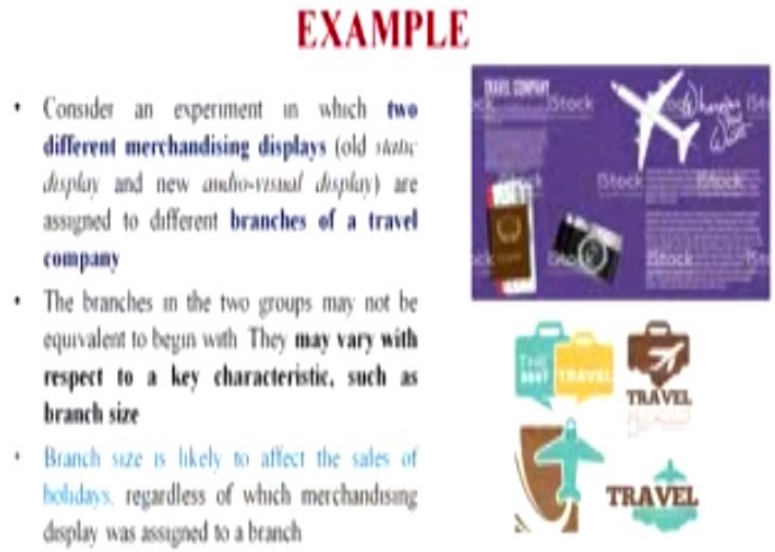

Consider an experiment in which two different merchandising displays are assigned to different branches of a travel company. The branches in the two groups may not be equivalent to begin with, they may vary with respect to characteristics such as branch size. Branch size is likely to affect the sales of holidays regardless of which merchandising display was assigned to a branch. So here in this case when you do a selection on basis of the size or something, then you may lead to a problem that may create an error.

Similarly another important factor is the mortality. Mortality means loss of test units when the experiment is being conducted. This happens for many reasons such as test units refusing to be a part of the study or it is difficult to determine whether the lost test units would respond in the same manner. So mortality confounds results, what happens when mortality effects the results because it is difficult to determine whether the test units that you have lost, the samples that you have lost, would have responded in the same manner to the ones that you have may be brought in new.

Suppose some test units have been lost and you have refilled with new test units or brought some new sample groups, this sample groups might be behaving differently to the earlier ones. So this is how mortality explains the effect on the outcome variable.

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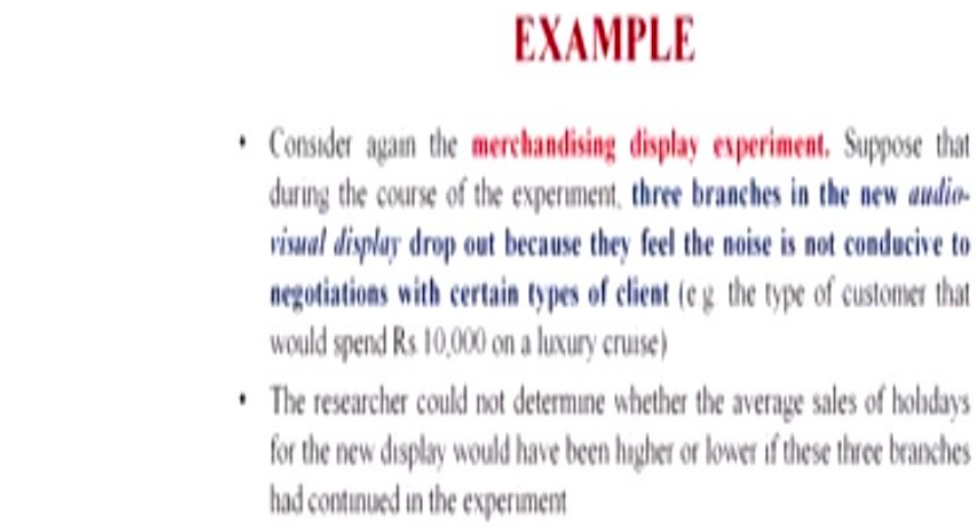

Let us take this earlier example three branches in the new audio-visual display dropout because they feel the noise is not conducive to negotiations with certain types of client type. So there are three branches who want to drop out because the amount of noise generated is not going well with their clients, the clients are not happy. Example the type of customer that would spend Rs.10,000 on a luxury cruise would not be happy if there is too much of noise.

The researcher could not determine whether the average sales of holidays for the new display would have been higher or lower if these three branches had continued in the experiment. So when you have removed some of the test units, now during the course of the experiment, then it can create, it will or it may very likely chance to create a problem because you do not know how the new test units that you will bring in, how they will react, and how they will behave to the same experiment.

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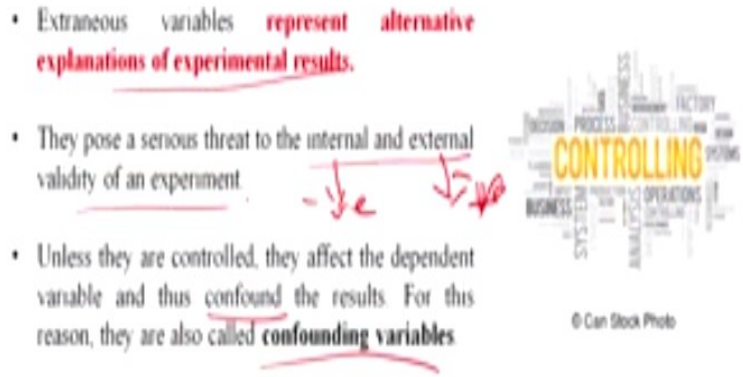
Controlling extraneous variables



How do you control the extraneous variables? Extraneous variables represent alternative explanations of experimental results, so they tell alternate results. So they tell you that independent variable was not the only thing, there was something else beyond it. They pose a serious threat to the internal external validity of an experiment, that means neither you can say the independent variable is responsible, so the internal validity is lost, and you cannot explain and take the study further to the population at large, so external validity goes down, so negative both are negative.

Unless these are controlled, they affect the dependent variable and thus confound the results or disturb the results. For these reasons, they are called confounding variables because they disturb the results and the affect the results in a different manner, they are called confounding, confusing, the confound the results.

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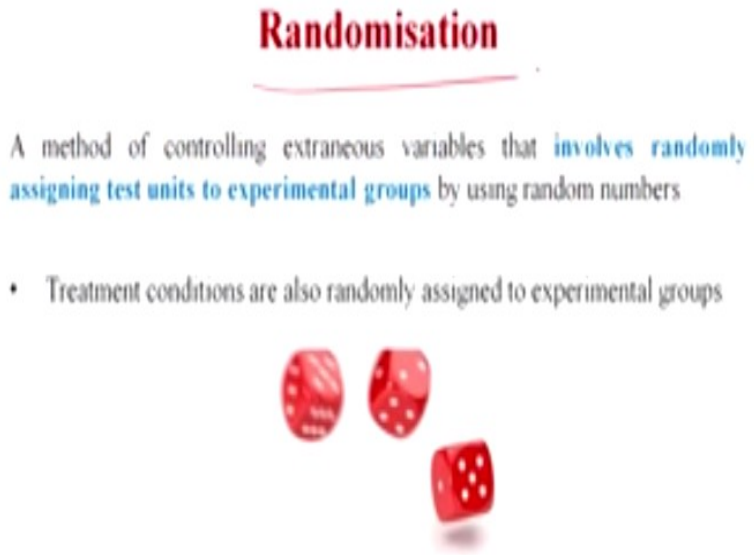

What is randomisation now, a method of controlling extraneous variables that involves randomly assigning test units to experimental groups, so instead of using a selection bias if I use a randomization method, then what happens is my bias element is lost, is gone, and my study becomes more effective and robust. Treatment conditions also randomly assigned to experimental groups. So then we cannot say anything is left anything is biased, it is completely at chance, so whatever has come has true now.

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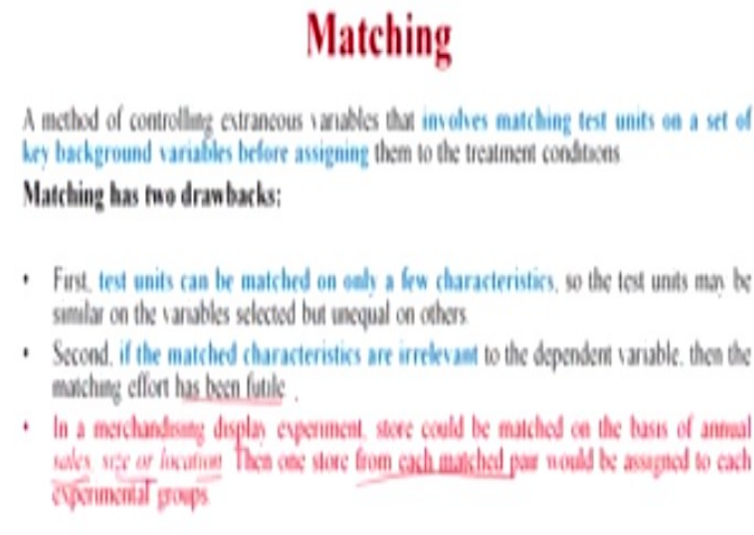

Matching. Method of controlling extraneous variables that involves matching test units on a set of key background variables before assigning them to the treatment conditions. Now what does it mean? It means that you select two test units on basis of certain characteristics, for example the two test units could be on the basis of sales or the size of the branch or the number of people working in the branch.

So you could be selecting several test units on basis of certain criteria, but the question is this criteria, if you take on the basis of certain criteria, this is good, you can control the extraneous variables but also there are some drawbacks. First what is it, test units can be matched on only a few characteristics. So the test units may be similar on the variables selected but unequal on the others. Just imagine the case, you are comparing two different you know branches on basis let us say the number of people.

Now if you take into account a highly automated company and a company which is using lot of manpower let us say. So if we select on the basis of number of only people, then a company with the sales of 1 million, like two company we select on the basis of 1 million each, but in one there is only 50 people and the other there 5000 people. So this difference although sales is same but look at the number of people working, so this there is no matching in fact, so this a drawback that can happen.

Second if the matched characters are irrelevant, suppose they are not relevant, so you are comparing something which might not be very relevant to the dependent variable, then the matching effort, that means you need to use those variables which have an influence or which may affect the dependent variable. Take this example, in a merchandizing display experiment store could be matched on the basis of annual sales, size or location.

Then one store from each matched pair would be assigned to the experimental group, that means on the basis of some certain characteristics like the sales, size, or location you have taken some matched units test units and randomly then you have picked one of them and assigned to the treatment to see how that would react, but then you have to be careful as I said the about the drawbacks you have to be careful right.

For example you cannot compare the sales of two different kind of industries, for example FMCG industry versus an oil Industry, although sales they are same but the potential business that is possible for FMCG unit could be much lesser than an oil industry.

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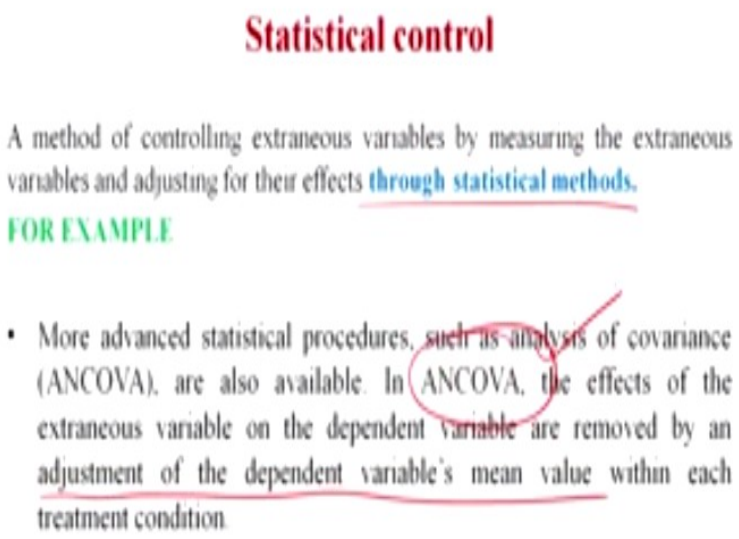

Statistical control. A method of controlling extraneous variables by measuring the extraneous variables and adjusting for their effects through statistical methods. For example statistical processes such as analysis of covariance in which the effects of the extraneous variables on the dependent variable are removed by an adjustment of the dependent variables mean value within each treatment condition. So well at the moment you may just understand that there are several statistical methods also through which you can control the extraneous variables, in fact we will be doing in detail when we will be going further in experimental statistical techniques.

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Design control. So design control is controlling the extraneous variables that involves using specific types of experimental designs. So what are they? We will be just looking in the next few slides, but understand there were extraneous variables that could impact the dependent

variable, but then we understood how you can control this extraneous variables and one of them being also the design control. So now coming to the design control part, a classification of experimental designs or the design control part, we will see what are the different kinds of designs.

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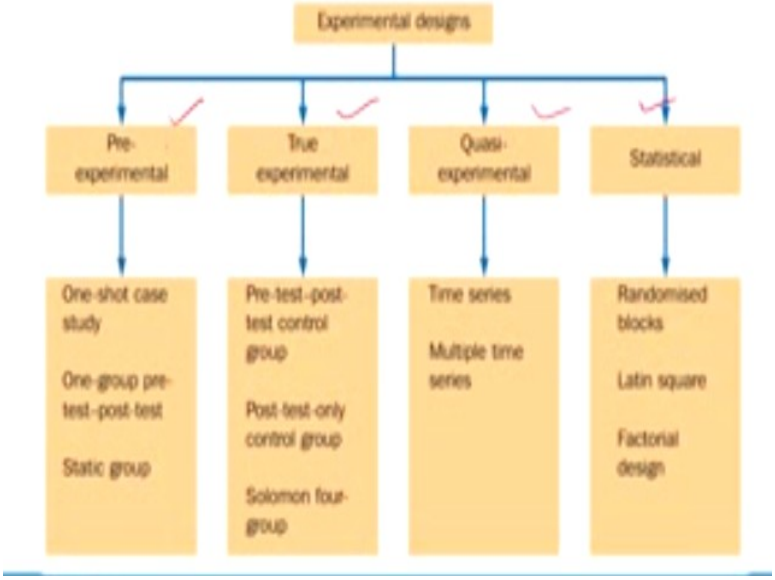

So experimental designs is basically broken into 4 parts. So pre-experimental, true experimental, quasi experimental, and statistical experimental. So let us see each one of them let us go to each one of them

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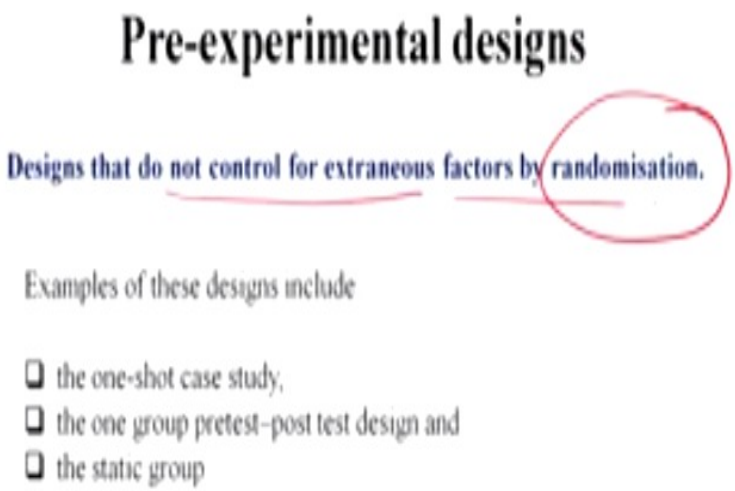

So what is this pre-experimental design first. Pre-experimental design is a design in which it does not control for extraneous factors by randomisation. So this point, this facility of

randomisation is not available in the pre-experimental designs. Example of some of them are the one-shot case study. Let us see what are they, let us take one by one.

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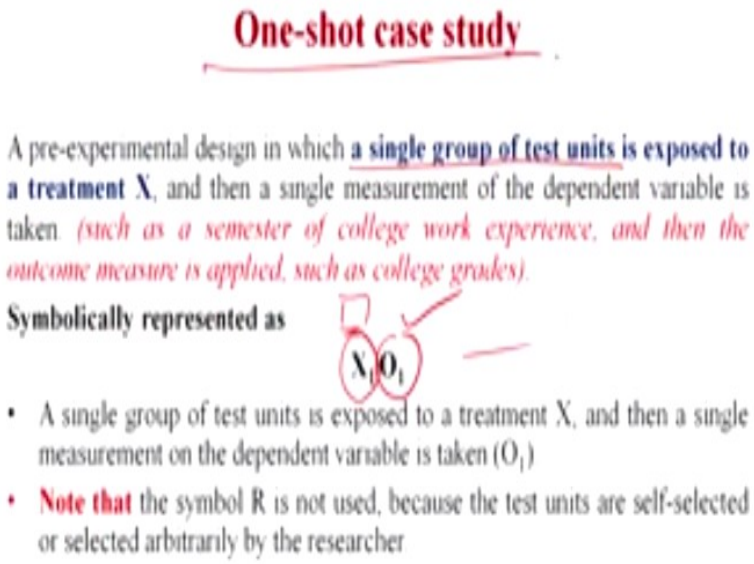

The one-shot case study is a first kind of a pre-experimental study design in which a single group of test units is exposed to a treatment X and then a single measurement of the dependent variable is taken, such as a semester of college work experience and then the outcome measure is applied such as college grades. So how much time you have spent in your college or in a class room and then your grade for example. A single group of test units is exposed to a treatment X and then a measurement of the dependent variable is taken as O_1.

So you expose them to some kind of a method and after exposing them you observed what is the impact. Now you see the symbol R is not used obviously because the test units are self-selected or selected arbitrarily by the researcher. So these test units have not been selected may be randomly, so there is no case of randomisation here.

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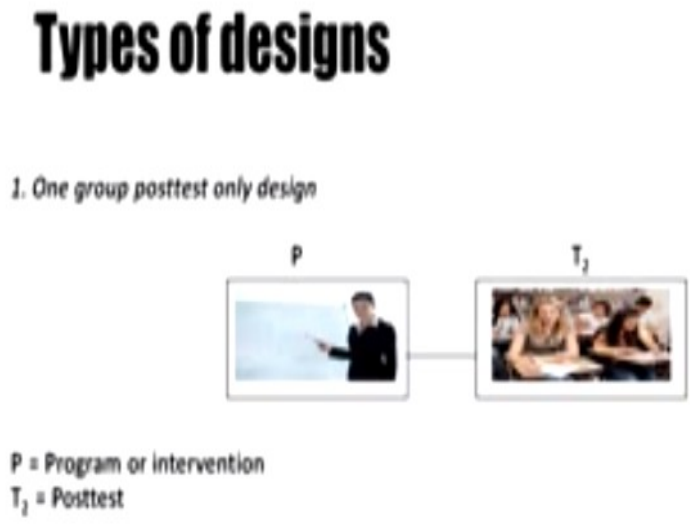

Now look at this. Here a tutor is teaching something and after teaching the treatment, how this group was selected, we do not know, had it been randomly selected we do not know, so it could be a bias selection also. May be this group already is a good group that means they are already good in studies. So if we say that the score that they get is good and we say that it is because of the tutor's teaching method, then it might not be correct. Had it been selected on a random basis, we could have claimed yes the teacher's teaching method has worked.

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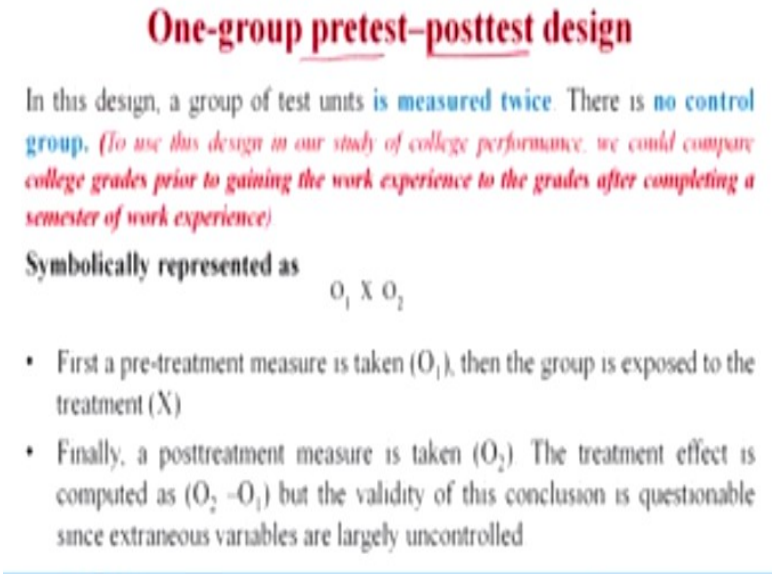

Then one group pretest posttest, pre post, in this design the test unit is measured twice. There is no control group. What is the control group, a control group is that group where no other effects are there, that means everything is more or less similar or in a condition state or there is no effect of any other variable. To use this design in our study of college performance, we

could compare college grades prior to gaining the work experience to the grades after completing a semester.

Now first you took a score, then you gave a treatment, then you again took a score. So now you look at this the treatment effect is computed as how much O_2-O_1, but the validity of this conclusion is questionable since extraneous variables are largely uncontrolled. When you are saying the extraneous variable are largely uncontrolled, what does it mean, only the teaching or the treatment that you have exposed to might not be reason why the students score is good or bad because there could be other extraneous variables like where the exam was taken, when the exam was conducted. who were the students, what is the background of the students, all matters okay.

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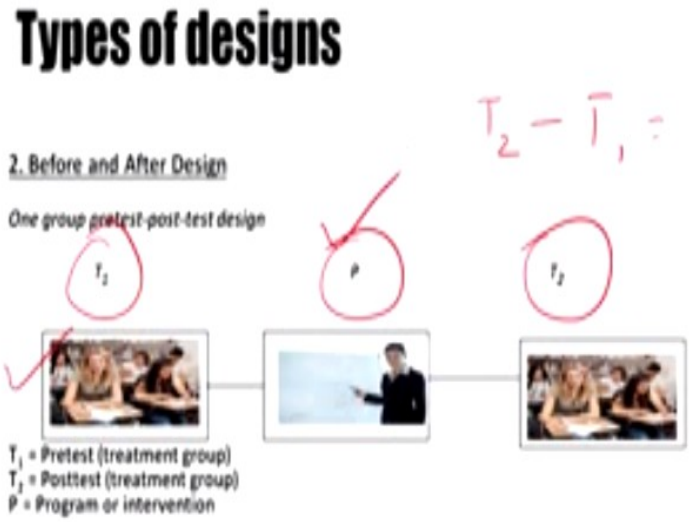

Now take this example. So you took a T_1 test before, then you gave a treatment, then observed again by taking a test 2, so this test score T_2 minus the test score T_1 is the effect of this study or this treatment effect.

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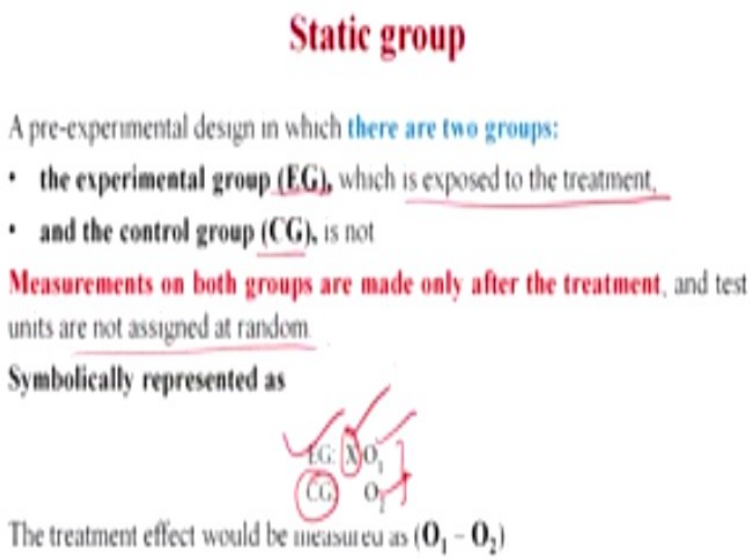

Then the third is the static group. So what is it saying. A pre-experimental design in which there are two groups now, one the experimental group, the other is a control group. So what is the experimental group which is exposed to the treatment. So treatment could be for example in this case this, so there is one group like this and there is another group which is may be there but no tuition or no coaching is given to them, so this is a control group. Measurements on both the groups are made only after the treatment and test units are not assigned at random.

Now this is again a problem, so this is why it is a pre-experimental. So measurements on both the groups are made only after the treatment, symbolically represented as experimental group so you give a treatment and observe the score; control group, so there is no treatment just observe the score, give the test and observe the score. So the treatment effect is now found out as O_1-O_2, so whatever the difference between these two scores right is due to the cause of the treatment, it is understood that way.

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EXAMPLE

- A static group comparison to measure the effectiveness of a test advertisement for the Renault Laguna would be conducted as follows
- Two groups of respondents would be recruited on the basis of convenience. Only the experimental group would be exposed to the TV program containing the advertisement
- Then, attitudes towards the Renault Laguna of both the experimental and control group respondents would be measured
- The effectiveness of the test advertisement would be measured as $(O_1 - O_2)$

Example. A static group comparison to measure the effectiveness of a test advertisement for Renault is done. Two groups of respondents would be recruited on the basis of convenience. So what is the sampling method, convenience sampling. Only the experimental group would be exposed to the TV program containing the advertisement. So there is an advertisement for this and one group is exposed to the treatment, the advertisement.

The attitude towards the Renault Laguna of both the experimental and the control group, so the experimental group was shown, the control group was not shown, but their opinion was taken. So the difference in the opinion of one to whom the TV ad was shown and the other one whom TV ad was not shown, this scores the difference is because of the TV advertisement. So this is what it says.

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True experimental designs

Experimental designs distinguished by the fact that:

- the researcher can **randomly assign test units to experimental groups** and
- also **randomly assign treatments to experimental groups**

Included in this category are:

- the pretest-posttest control group design,
- the posttest-only control group design and
- the Solomon four-group design

Coming to the next is true experimental. So as the name suggest true experimental means which allows you for randomisation. So that means the researcher allows for randomisation, so you can randomly select the subunits or the test units. Experimental designs distinguished by the fact that the researcher can randomly assign test units to experimental groups and also randomly assign treatments to experimental groups. So what is saying, randomly assign test units to experimental groups and randomly assign treatments.

So one is assign test units, the other is treatments, so both are randomly done. So what are this designs in this category, the pretest posttest, control group design, posttest only, Solomon four group design. Let us see what are they.

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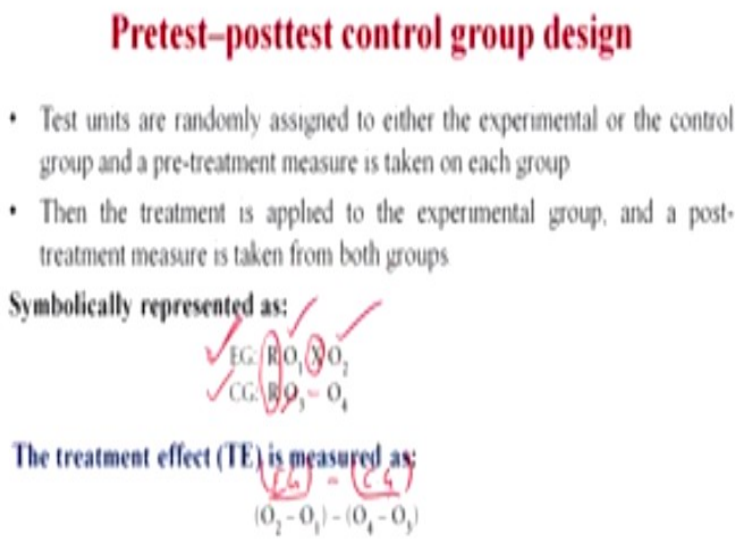

First, the pretest-posttest control group design. In here, the test units are randomly assigned to either the experimental or the control group and a pretreatment measure is taken on each group, pretreatment effect is checked before, then the treatment is applied to the experimental group, and a post-treatment measure is taken. Now for example, first of all the subtest units are randomly assigned to either the experimental or the control group, so this is random right.

Then a pretreatment is taken, first a test is taken, a score is measured and here also a score is measured. So two groups, for first group also this score is measured, here also score is measured, but then the first experimental group they are shown an advertisement or a method of coaching is introduced to them and here no such thing is done, so there is nothing here, and after doing sometime, again a test is taken. So this result, this difference, what is happening is

a treatment effect is measured by now O_2-O_1 so where the treatment was given minus O_4-O_3, so this is the experimental group score this is the control group.

So experimental group minus control group, understand this way, score of the experimental group minus the control group is what is the treatment effect.

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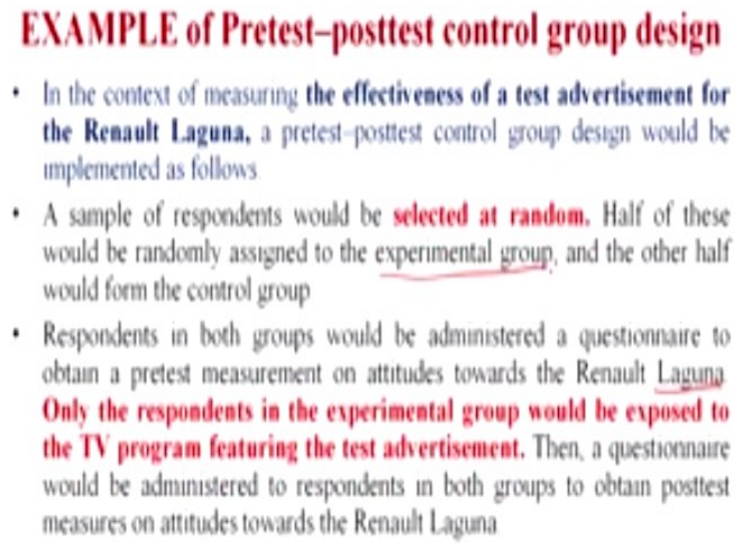

Example, go to the same Laguna case right. A sample of respondents would be selected at random, half of them would be assigned to the experimental group, so which half we do not know and the other half to the control group, so completed randomisation. Respondents in both the groups would be administered a questionnaire to obtain a pretest measurement on attitude towards the car.

The respondents in the experimental group would be exposed to the TV program featuring the advertisement, then again questionnaire would be administered to find out the new scores, and then you would be doing it.

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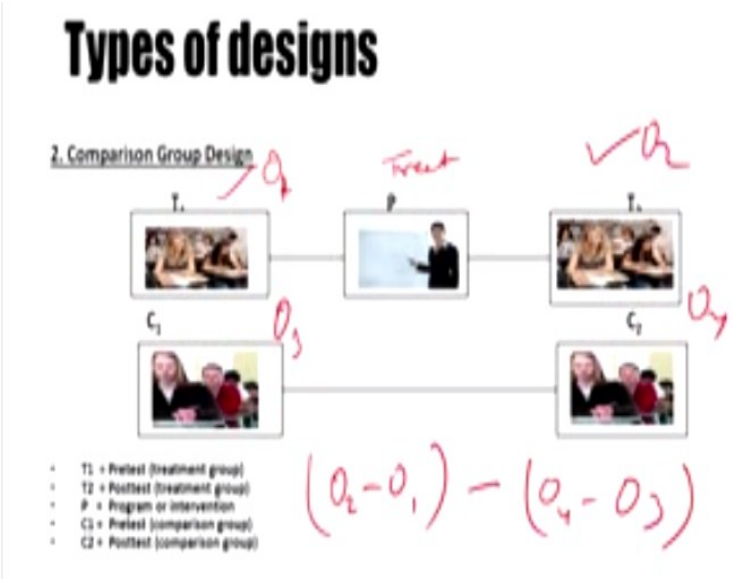

So now look at this case. So first you took a score, then you gave a treatment, then again you took a score. Here there is no treatment, but 2 experiments, pretest and posttest and now you can do it, this is suppose O_1, O_2, O_3, O_4. So O_2-O_1 the experimental group minus the control group which is O_4-O_3 okay, this is what it says.

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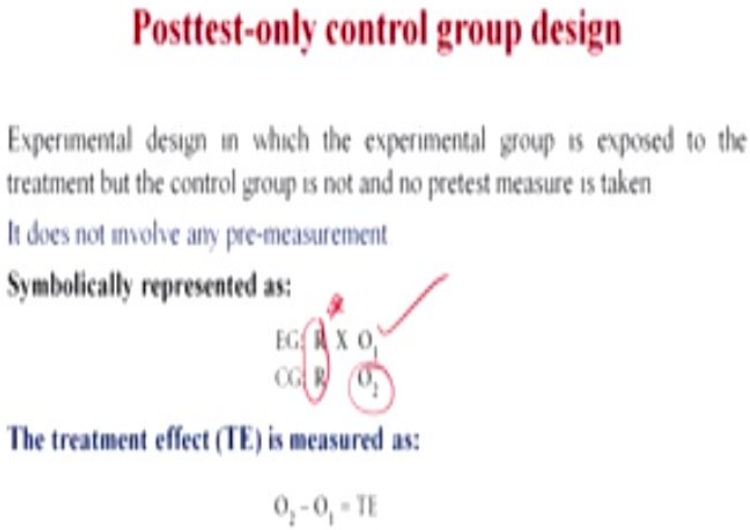

There is a posttest only control group. Experimental design in which the experimental group is exposed to the treatment, but the control group is not and no pretest measure is taken. So here we are not doing any pretest. Now how it looks, so this is random again selection, but here there is no pretest, only a treatment is given and the treatment after giving the score is measured. Here no treatment is given only and directly the score is measured. So the difference of the treatment effect is measured as O_2-O_1.

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- Because there is no pre-measurement, the testing effects are eliminated, but this design is sensitive to selection bias and mortality
- It is assumed that the two groups are similar in terms of pre-treatment measures on the dependent variable because of the random assignment of test units to groups
- Because there is no pre-treatment measurement, this assumption cannot be checked

Because there is no pre-measurement, the testing effects are eliminated, so what does this mean testing effects. That means what when you do a pretreatment, the subject or the test unit might get sensitized because they start getting aware that they are being questioned on a certain brand or a certain product or certain service or something. So that is why this is eliminated, but this design is sensitive to selection bias and mortality.

So selection bias how you have selected the random samples and whether the samples are continuing till the end of the experiment from the beginning to the end or not that will have an effect. If they have changed, then that will drastically change the result of the experiment. It is assumed that two groups are similar in terms of pretreatment measures on the dependent variable because of the random assignment of test units to groups.

Because there is no pretreatment measurement, this assumption cannot be checked. So well understand this much, that means what we are saying, the posttest only control group design takes care of eliminates the problem of sensitivity which can happen due to the pretreatment and it measures the treatment effect.

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EXAMPLE of Posttest-only control group design

- In the context of measuring the effectiveness of a test advertisement for the Renault Laguna, **a posttest-only control group design** would be implemented as follows
- A sample of respondents would be **selected at random**. The sample would be **randomly split**, with half the subjects forming the experimental group and the other half constituting the control group
- **Only the respondents in the experimental group would be exposed to the TV program containing the test Renault Laguna advertisement**. Then, a questionnaire would be administered to both groups to obtain posttest measures on attitudes towards the Renault Laguna
- The differences in the attitudes of the experimental group and the control group would be used as a measure of the effectiveness of the test commercial

Now example, same problem. The sample of respondents would be selected at random and they would be randomly split, half the subjects forming the experimental group and the other half control group. The respondents in the experimental group would be exposed to the TV program continuing the test advertisement. Then a questionnaire would be administered to both the groups and their attitude would be measured. The difference in the attitudes of the experimental group and the control group would be used as measure of effectiveness of the test commercial. I hope this is clear now

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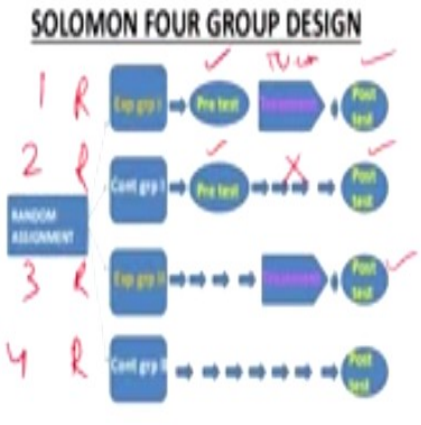
Solomon four-group design

An experimental design that **explicitly controls for interactive testing effects**, in addition to controlling for all the other extraneous variables



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This is the last. This is the Solomon four group design which is an experimental design that explicitly controls for interactive testing effects in addition to controlling for all other extraneous variables. Now what it does is basically. You see it is like again a pretest-posttest measure. What it has done. There are four groups of study, four tests. First one there is an

experimental group, first of all you see this is random assignment, so this is a random assignment.

So four groups are made and the groups are randomly assigned, the population is split into four groups and they are randomly assigned. So the experimental group 1, control group 1; experimental group 2, control group 2. In the first case, a pretest is done, then a TV commercial is shown, then a posttest is done. The results are measured. In the control group, the pretest is done, but no treatment is given, only posttest is done. The second case coming to the new experimental group, a treatment is given, but no pretest is done, and the posttest is done.

Similarly for the control group, only a posttest is done. Now if you look at the let us say 1, 2, 3, 4. If you look at 1-2 and 3-4, then what it gives you is the treatment effect basically. So this is Solomon four group design. So I will wind up here today. We will stop the lecture here. So this Solomon four group design is a very interesting design because it helps you to study the pre and posttest treatment effects. So this is what we have done. In the next lecture, we will continue with the experimental design and we will try to cover it up. Thank you so much for the day.