

EXERCISE 6 KEY

Purpose: To learn how to use the website

<https://www.youtube.com/playlist?list=PLEbg1KdW5Se7-R0EuD-j1ELF-ApXcdkDF>

to come to understand how econometric methods can be used to evaluate the efficacy of public policies in the presence of observational data. This website is maintained by the Partnership for Economic Policy (PEP). You can find more information on PEP at www.pep-net.org.

This exercise is based on the YouTube video entitled **Class 2: Randomized Control Trial - RCT**. Use this class to answer the following questions. You are to hand in this exercise on **Tuesday, March 2 at 5:00 pm CT on Canvas**.

(a) Define the following terms: **Internal Validity**, **External Validity**. Give an example of each.

Answer:

Internal Validity: A research finding is internally valid when it is based on a process that is free from systematic error. **A violation example:** A member of the treatment group shares some of his/her treatment information or treatment regime with a control group member.

External Validity: A research finding is externally valid if it is applicable beyond the context in which the analysis was conducted. **A violation example:** The participants in an RCT are all from a certain village in a certain country while the outcome of the same RCT applied to other villages in other countries may not produce the same result because of sociological and custom differences.

(b) What is meant by the term “unobserved counterfactual?”

Answer:

If an individual is in the control group we can only observe the control outcome for the individual (Y_i^c), not the treatment outcome (Y_i^t). On the other hand, if an individual is in the treatment group, we can never observe his/her control outcome.

(c) Explain the meaning of the mathematical expression $Y_i^t - Y_i^c$. Define the terms here.

Answer:

Y_i^t = i-th individual's treatment outcome, Y_i^c = i-th individual's control outcome.

$Y_i^t - Y_i^c$ = hypothetical treatment effect for the i-th individual. This is unobservable.

Getting an estimate of this is one of the fundamental problems in casual inference.

(d) Define the term $ATE = E(Y|D=1) - E(Y|D=0)$. What do each of the conditional expectations mean?

Answer:

This is called the Average Treatment Effect and is the difference in the expected value of the treatment outcomes ($E(Y|D=1)$) versus the expected value of the control outcomes ($E(Y|D=0)$). This is something we desire to estimate, given an RCT.

(e) Describe how you would go about getting an unbiased estimate of ATE in an RCT and solving the problem of the counterfactual.

Answer:

$$\widehat{E}(Y^t - Y^c) = \bar{Y}^t - \bar{Y}^c$$

We just use the difference in the treatment sample mean and control sample mean.

(f) Name the three threats to internal validity discussed in the video. Give an example of each.

Answer:

(i) **Contamination:** **Contamination bias** occurs when the members of one group in a trial receive the treatment or are exposed to the intervention that is meant for the other group. The result is a minimization of any real difference that exists between the groups.

(ii) **Attrition:** **Attrition bias** occurs when people leaving either the control group or the treatment group are systematically different from the people that remain in their group (e.g. a preponderance of women leaving one of the groups giving rise to a difference in gender across the control and treatment groups).

(iii) **Evaluation Effects:** **Evaluation bias** occurs when systematic differences between groups during the study arise for reasons apart from the actual treatment effect itself. For example, if participants know that they are in the treatment group rather than the control group, this could create positive expectations that have an impact on treatment outcomes beyond that of the intervention itself. **Ideally, participants and investigators should remain unaware of which group participants are assigned to.** The same could go for individuals in the control group. They could decide that they are going to perform better than the treatment group people to show up the people in the treatment group by putting in extra effort over and beyond what might be expected in circumstances where individuals do not know which group they belong to.