Causal Inference Final Paper

Post-Treatment Bias

“Conditioning on post-treatment variables eliminates the advantages of randomization because we are now comparing dissimilar groups.” (5)

“concerns about post-treatment bias are not really (or only) about the post-treatment variable itself. The problem is that by conditioning on a post-treatment variable we have unbalanced the treatment and control groups with respect to every other possible confounder.” (6)

“In short, when we include a post-treatment variable in the set of conditioning variables either directly or indirectly, Assumption (1) is violated. As a result, ⌧ 6= for the reasons discussed above. Standard estimates such as the di↵erence in conditional means (ˆ ) will therefore be biased regardless of sample size, measurement precision, or estimation method.9 Further, the bias of standard estimates such as ˆ can be in any direction and of any magnitude depending on the value of unknown (and unknowable) parameters (e.g., Y , the e↵ect of the unmeasured confounder on the outcome). Once we have conditioned on a post-treatment variable, we have eliminated the assurance of unconfoundedness provided by randomization.” (11)

“the post-treatment covariate (x) and the outcome (y) share an unmeasured cause (u)”

“In our example, we might wish to estimate the e↵ect of the civics education class only among low-interest students to show that the e↵ect is not isolated to previously engaged students. Dropping respondents based on manipulation checks is often done to show that the estimated treatment e↵ect is larger among compliers, which might appear to suggest that the treatment is working through the researchers’ proposed mechanism. This reasoning is wrong. Selecting a portion of the data based on post-treatment criteria will not allow us to generate an unbiased estimate of the treatment e↵ect within an interesting subset of respondents. Instead, we will obtain a biased estimate among an endogenously selected group.” (13)

“By selecting based on a criterion that is partially a function of unobserved covariates and the treatment, we have inadvertently created imbalance in the treatment and control conditions with respect to u.” (14)

“Including control variables is therefore potentially appropriate, but only covariates that are unrelated to the treatment and preferably measured in advance” (23)

“Moderators that are vulnerable to treatment spillovers like racial resentment should be measured pre-treatment” (23)

Key Assumptions broken by Conditioning on Post-Treatment Variables

1. Ignorability 🡪

Ways Post-Treatment Bias is introduced

* Condition on a variable that is affected by the treatment
  + i.e., measure interest after participation in a program that may affect interest
  + effort to prevent omitted variable bias
  + account for noncompliance
  + measure a moderator after experimental manipulation
* Dropping or selecting observations based on criteria influenced by the treatment
  + Sometimes unavoidable
  + “The treatment itself may cause some respondents to be more likely to be omitted from the sample, a phenomenon which is usually termed non-random attrition.” (12)
  + “researchers frequently drop subjects who fail a post-treatment manipulation check or other measure of attention or compliance” (13)
    - “can imbalance the sample with respect to observed or unobserved confounders” (13)

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**Motivation**

While it seems obvious that including variables affected by an experimental treatment when analyzing results, the reality is not as straightforward. One of the main motivations for researching the effects of post-treatment variables comes from my experience working as a Research Assistant at the Marron Institute. Oftentimes, our practitioners are interested in what they consider the true effect of the treatment—the effect of the treatment for those who actually completed it, rather than simply looking at an intent to treat analysis of those who were assigned to the treatment condition. In some trials, there may be a valid method to complete this analysis with appropriate statistical rigor. More often, though, unless this possible analysis plan was considered during the trial’s design, intent to treat is the only possible method to make any causal attributions.

Subgroup analysis is the primary culprit when it comes to my personal experience of

**Assumptions**

1. Ignorability
2. Monotonicity
3. Exclusion Restriction—if your treatment wouldn’t be different even if your instrument assignment was different, then your outcome (or, more generally, the distribution of your outcome) also won’t be different