Applied Causality Reading Assignment 6

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This reading response summarizes Chapter 12 of [1]. As a continuous reading on the same topic of last week, this chapter uses a different language to introduce the same assumptions and methods. The extension is the discussion about variance bounds of the causal estimands, and a few more ways to use propensity score besides matching. In this reading response, I will thus summarize (1). The link between Chapter 12 of [1] and Chapter 8 of [2]; (2). Extension of variance bounds of the estimands.

1 Link between the two languages

In [2], the author explained estimating causal effects using graphs, back-door criteria, and focused more on computational advantages of propensity score (i.e., dimension reduction). [1], on the other hand, focused on probabilistic and econometric perspectives of estimating causal effects when one assumes unconfoundedness assumptions of some pre-treatment variables. Although the languages used in the two chapters sound different, the goals and the methods are basically the same. The following table gives the comparison of them. The goal is to find independence of treatment assignment X and potential outcomes $Y(0), Y(1)$ given some set of variable(s) S, or certain functions of S, $R = f(S)$, such as the propensity score.

Aspects	Shalizi	Imbens and Rubin
Assumption	Back-Door criteria	Unconfoundedness
(Possible) drawback of using S	High dimensionality	Unbalancedness
Advantage of using R	Dimension reduction	Balancedness

2 Extension of variance bounds of the estimands

One extension made by [1] is the calculation of variance bounds of the estimands. From there, one sees the importance of the so-called $balancedness$ in [1]'s language, i.e., when the distribution of the variable to condition on are very different between the two assignment groups, that is, the propensity score is close to 0 or 1, the variance of the estimands, both super-population and finite-sample will be large. This is a very intuitive insight thats addresses the need to select good variables to form propensity score and condition on to avoid unbalanced situations, even though other variables or their functions may also satisfy the back-door criteria.

References

[1] Imbens, Rubin *Causal Inference for Statistics, Social, and Biomedical Sciences*. Cambridge (2012).

[2] Shalizi *Advanced Data Analysis from an Elementary Point of View*. In preparation (2017).