Double/Debiased Machine Learning

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Basics

Consider the following partially linear model:

$$Y = \alpha D + g(X) + \epsilon$$

$$D = m(X) + v$$

where

Y **:** Outcome of interest

D **:** Treatment or policy variable of interest

X **:** High-dimensional vector of control variables

α **:** Parameter targeted for estimation (treatment effect)

ϵ, v **:** Error terms

m, g **:** Unknown "nuisance" functions

Naive Approach

To estimate the causal parameter α, the given sample of data can be split into two smaller samples, which we can call the **main sample** and the **auxiliary sample**. We then use the auxiliary sample to train a simple ML algorithm to estimate the nuisance function $g(X)$. Given the estimated function $\hat{g}(X)$, we can use the main sample to estimate the parameter α such that

$$\hat{\alpha} = \left(\frac{1}{n} \sum_{i \in I_{main}} D_i^2 \right)^{-1} \frac{1}{n} \sum_{i \in I_{main}} D_i (Y_i - \hat{g}(X_i))$$

Normalization Bias

Bias Arises..