Escola de Economia de São Paulo - Fundação Getulio Vargas

Course: Microeconometria 1

Instructor: Bruno Ferman and Vitor Possebom

Problem Set: Lecture 2

Total = 310 points

Question 1 (ATU as a weighted average of the MTE function - 80 points)

Show that

$$ATU := \mathbb{E}\left[Y(1) - Y(0) \middle| D = 0\right] = \int_0^1 \mathbb{E}\left[Y(1) - Y(0) \middle| V = v\right] \cdot \omega(v)\, dv,$$

where $\omega(v) = \dfrac{\int_0^v f_P(p)\, dp}{\mathbb{E}\left[1 - P(Z)\right]}$.

Question 2 (Estimating the MTE function - 180 points)

(After you debug your code, running it may take a while. In my laptop, it ran in 4 hours. In my desktop at FGV, it ran in 8 hours.)

Our goal is to use a Monte Carlo Simulation to evaluate the finite sample performance of two MTE estimators. Your data generating process is given by:

$$\begin{aligned}
V &\sim Uniform\left(a_V, b_V\right) \\
Z &\sim Uniform\left(a_Z, b_Z\right) \\
P(Z) &= \gamma \cdot Z \\
D &= \mathbf{1}\left\{P(Z) \geq V\right\} \\
Y(0) &\sim N\left(0, \sigma_0^2\right) \\
Y(1) &= Y(0) + U + \beta_0 + \beta_1 \cdot V + \beta_2 \cdot V^2 \\
U &\sim N\left(0, \sigma_U^2\right)
\end{aligned}$$

where $a_V = 0$, $b_V = 1$, $a_Z = 0$, $b_Z = 1/2$, $\gamma = 1/b_Z$, $\sigma_0^2 = 1$, $\sigma_U^2 = 1$, $\beta_0 = 1$, $\beta_1 = 2$, $\beta_2 = 3$.

Your sample size is $N = 10.000$ *(ten thousand). The number of MC iterations is* 1.000 *(one thousand).*

Your evaluation grid is $\mathcal{V} \coloneqq \{0.1, 0.2, \ldots, 0.9\}$.

For any $v \in \mathcal{V}$*, let* $\hat{MTE}(v)$ *be an estimator of* $MTE(v) \coloneqq \mathbb{E}\left[Y(1) - Y(0) \middle| V = v\right]$. *Using our Monte Carlo simulation, we will compute the relative bias of our estimator:*

$$RB(v) = \frac{\hat{MTE}(v) - MTE(v)}{MTE(v)}.$$

We will do so for two estimators:

1. *(90 points) Parametric Estimator — Derive the correct expression for the MTE function and for the reduced form* $\mathbb{E}\left[Y \middle| P(Z) = p\right]$*, and use them to propose a parametric estimator for the MTE function.*

2. *(90 points) Nonarametric Estimator — Use a Local Quadratic Regression to estimate the MTE function.*

Question 3 (Interpreting the MTE function - 50 points)

Interpret Figure IV(B) by Agan, Doleac and Harvey (2023, *https://doi.org/10.1093/qje/qjad005**).*