Econ 312 Part A, Spring 2023

**Problem Set 3**

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**Due April 9th, 2023 at Midnight**

This draft: April 3, 2023

1. [**15 pts**] Answer all of the questions embedded in the "Alternative Methods for Evaluating the Impact of Interventions" handout.

2. [**40 pts**] Using the posted data set ps3q23_dt.csv, consider the model

$$Y_i = \alpha_i + \beta_i D_i \quad (*)$$

where $D_i = 1$ if a person goes to training (say); $D_i = 0$ otherwise, and where

$$\begin{aligned} D_i =& 1(\alpha_i + \beta_i - C(Z_i) > \alpha_i) \quad (**) \\ C(Z_i) =& \gamma Z_i + \omega_i \end{aligned}$$

where $Z$ is the cost of schooling (the $\alpha_i$ on both sides of the indicator function for treatment choice is not a typo–what's the intuition? Hint: relate to potential outcomes). Assume observations are iid across $i$. $\alpha_i \perp\!\!\!\perp \omega_i$. $\beta_i$ may be positively or negatively correlated with $\omega_i$. $E(\omega_i) = 0$. *NOTE: for question 2, the relevant outcome and treatment you should use from the dataset are called $Y$ and $D$, which have been defined to follow this model. The variables $Y_{alt}$ and $D_{alt}$ will be used in question 3.*

   (i) Characterize ability bias (define).

(ii) Characterize sorting bias (define).

(iii) What is the marginal treatment effect?

(iv) What does OLS applied to (*) identify?

(v) Suppose $Z_i \perp\!\!\!\perp \varepsilon_i$, what does IV estimate?

(vi) Suppose $Z_i \perp\!\!\!\perp (\varepsilon_i, \beta_i, \alpha_i)$, what is the "propensity score" for this model?

(vii) How would you determine whether $\beta_i$ is correlated with $D_i$ only using cross section data?

(viii) Give OLS, IV estimates for the posted sample and determine the answer to above.

(ix) Characterize selection-bias.

(x) Under what conditions is training meritocratic?

3. **[10 pts]** Suppose next, that agents don't know $\beta_i$ before they enter that program but they know $\alpha_i$. They anticipate $E(\beta_i)$, and use this value instead of $\beta_i$ in determining treatment in (**). How does this affect your answers to question (2)? Which of the available samples has agents without individual knowledge of $\beta_i$? Answer all of the questions in (2), again using the posted data set ps3q23_dt.csv. *NOTE: for question 3, the relevant outcome and treatment you should use from the dataset are called* $Y_{alt}$ *and* $D_{alt}$*, which have been defined to follow the new treatment choice rule that is based on* $E(\beta_i)$ *rather than* $\beta_i$.

4. **[25 pts]** Suppose you have panel data on earnings. Using the posted

data set ps3q4_dt.csv, consider:

$$Y_{it}(0) = \alpha + U_{it}$$

$$Y_{it}(1) = \alpha + \beta_i + U_{it}$$

where

$$U_{it} = \delta V_i + \varepsilon_{i,t}$$

$$\beta_i = \phi V_i + \omega_i$$

Observed outcome $Y_{it}$ is

$$Y_{it} = \alpha + \beta_i D_i + U_{it}$$

The choice model at time period $k$ is:

$$D_{i,k} = 1\left[\sum_{t=k+1}^{\infty} \frac{Y_{i,t}(1)}{(1+r)^{t-k}} - \sum_{t=k}^{\infty} \frac{Y_{i,t}(0)}{(1+r)^{t-k}} - C(Z_i) > 0\right]$$

where $C(Z_i) = \gamma Z_i + \tau_i$.

Assume that $V_i, \epsilon_{it}, \omega_i, \tau_i$ are all mutually independent and all have mean zero, and are also all jointly independent of $Z_i$.

(i) Answer questions to (2) and (3) for this model.

(ii) How does access to panel data aid identification?

(iii) Suppose you only have aggregate time data on income by schooling before and after $k$? What can you identify? Use the posted data set to illustrate your analysis.

5. **[10 pts]** Consider the discrete choice model, utility for $j \in \mathcal{J}$, $U(j)$ is

$$U_i(j) = X(j)\beta_i + \varepsilon_{ij}$$

The choice set is $\mathcal{J} \leftarrow (\mathcal{J})$ $X(j)$ are attributes of good j.

$$\beta_i = Q_i V_j + e_i$$

where $e_i \perp\!\!\!\perp \varepsilon_{i,j}$. The $Q_i$ are personal attributes of $i$.

Suppose $\bar{\mathcal{J}}$ has three elements. What is the probability that $j$ is selected? (Give explicit calculations.) Consider several cases:

(i) $\beta_i$ is the same for all $i$. $\varepsilon_{i,j}$ is iid, $\forall_{i,j}$ is extreme value distributed.

(ii) $\beta_i$ varies,

$$\beta_i \sim N(\bar{\beta}, \Sigma\beta)$$

$$\beta_i \perp\!\!\!\perp \varepsilon_{i,j} \text{ all } i, j$$

(iii) Show how you can use a model fit under cases (i) and (ii) above in a cross section to predict the demand for a new good with attributes $X(J+1)$, where $J+1$ is a new good never observed, but attributes known.