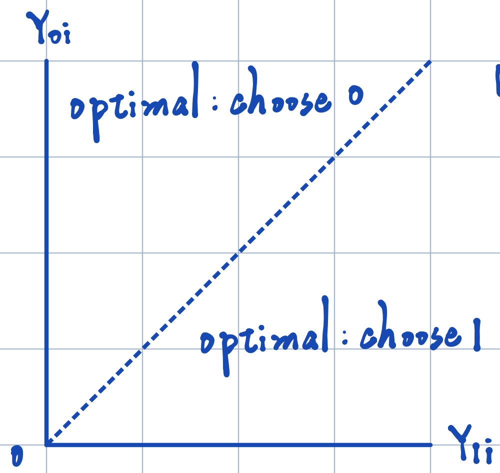
1.

(1) $\begin{cases} Y_{0i} = \mu_0 + \varepsilon_{0i} \\ Y_{1i} = \mu_1 + \varepsilon_{1i} \end{cases}, \begin{pmatrix} \varepsilon_{0i} \\ \varepsilon_{1i} \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_0^2 & \rho\sigma_0\sigma_1 \\ \rho\sigma_0\sigma_1 & \sigma_1^2 \end{pmatrix} \right)$

(2)



(3) $\left[\begin{array}{l} \text{choose 1 : take labor economics} \\ \text{choose 0 : take public finance} \end{array}\right.$

$\left[\begin{array}{l} Y_{1i} \\ Y_{0i} \end{array}\right.$ income for individual i who $\begin{array}{l} \text{take labor economics} \\ \text{take public finance} \end{array}$

$\left[\begin{array}{l} \mu_1 \\ \mu_0 \end{array}\right.$ average income for people who $\begin{array}{l} \text{take labor economics} \\ \text{take public finance} \end{array}$

2.

(1) choose 1 : be an economist

$\Rightarrow$ Y_{1i} is the income for individual i who choose to be an economist,

μ_1 is the average income for people who choose to be an economist

choose 2 : be an accountant

$\Rightarrow$ Y_{2i} is the income for individual i who choose to be an accountant,

μ_2 is the average income for people who choose to be an accountant

choose 3 : be a trader

$\Rightarrow$ Y_{3i} is the income for individual i who choose to be a trader,

μ_3 is the average income for people who choose to be a trader

(2)

$$P(D=1) = P(\mu_1 + \varepsilon_{i1} > \mu_2 + \varepsilon_{i2} \wedge \mu_1 + \varepsilon_{i1} > \mu_3 + \varepsilon_{i3}) = \frac{e^{\mu_1}}{e^{\mu_1} + e^{\mu_2} + e^{\mu_3}} \quad \square$$

(3) $$L(\mu_1, \mu_2, \mu_3) = \prod_{i=1}^{10} \frac{e^{\mu_{D_i}}}{e^{\mu_1} + e^{\mu_2} + e^{\mu_3}} \quad \square$$

(4) $$\hat{\mu}_1, \hat{\mu}_2, \hat{\mu}_3 = \underset{\{\mu_1, \mu_2, \mu_3\}}{\arg\max} \prod_{i=1}^{10} \frac{e^{\mu_{D_i}}}{e^{\mu_1} + e^{\mu_2} + e^{\mu_3}} \quad \square$$

3.

(1) From the definition of A_i, we know it's a dummy that takes value of 1 for those who attend the labor class and 0 for those who do not.

$\Rightarrow W_i = A_i W_{A_i=1} + (1-A_i) W_{A_i=0}$ $\square$

(2) $\text{propensity}(S_i=1) = Pr(A_i=1 \mid S_i=1) = \dfrac{Pr(A_i=1 \wedge S_i=1)}{Pr(S_i=1)} = \dfrac{Pr(A_i=1 \wedge S_i=1)}{0.4}$

$\text{propensity}(S_i=0) = Pr(A_i=1 \mid S_i=0) = \dfrac{Pr(A_i=1 \wedge S_i=0)}{Pr(S_i=0)} = \dfrac{Pr(A_i=1 \wedge S_i=1)}{0.6}$ $\square$

(3) IV assumptions: (let Z be an IV)

a. Z is independent with error term in the second stage regression

b. $Cov(Z, A) \neq 0$

c. Z affects W "only" through A

d. Z affects W in the same direction $\forall i$ (monotonicity)

according to the above assumptions, E_i can be an IV.

(4) Take E_i as an IV, we can identify

$$LATE = E[W_{A_i=1} - W_{A_i=0} \mid A_i(E_i=1) - A_i(E_i=0) = 1]$$

$$= \frac{E(W_i \mid E_i=1) - E(W_i \mid E_i=0)}{E(A_i \mid E_i=1) - E(A_i \mid E_i=0)},$$ which is the effect on compliers. $\square$

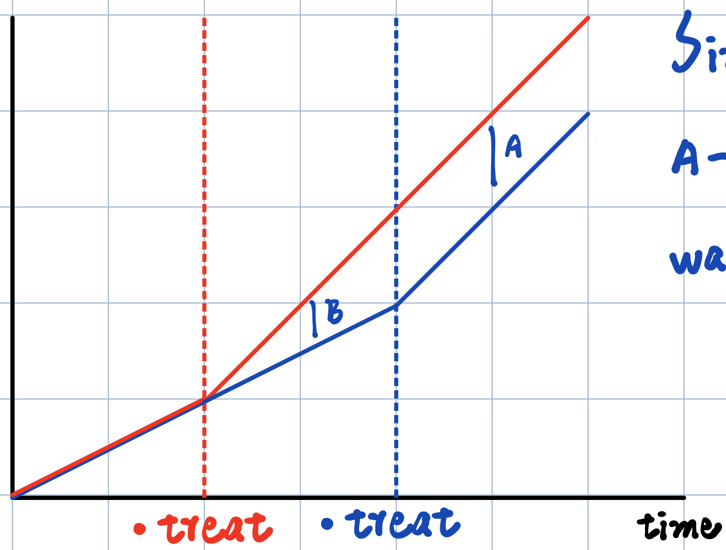
4.

(1) Define $post_{it} = \begin{cases} 1 & \text{if } t=2 \\ 0 & \text{if } t=1 \end{cases}$ and $sick_{it} = \begin{cases} 1 & \text{if individual } i \text{ is hit by a health shock at time } t \\ 0 & \text{if not} \end{cases}$

$$\Rightarrow Y_{it} = \beta_0 + \beta_1 post_{it} + \beta_3 sick_{it} + \underbrace{\beta_4}_{\text{DID effect (ATT)}} post_{it} \times sick_{it} \ \square$$

(2) Assumption needed: we need to have a group of "never treated"

(3)



Since regressions (OLS) give A−B, which is not the ATT we want, TWFE does not work.

(4) Use published packages in statistical softwares.

5. Monday