

Instrumental Variables

Discussion 9

Reminders and Announcements

- Problem Set 4 due Friday at 11:59pm
- Problem Set 3 peer review due Thurs at 11:59pm
- Office Hours tomorrow 11-12am in Comstock 1181 (different location!)

Ice-Breaker

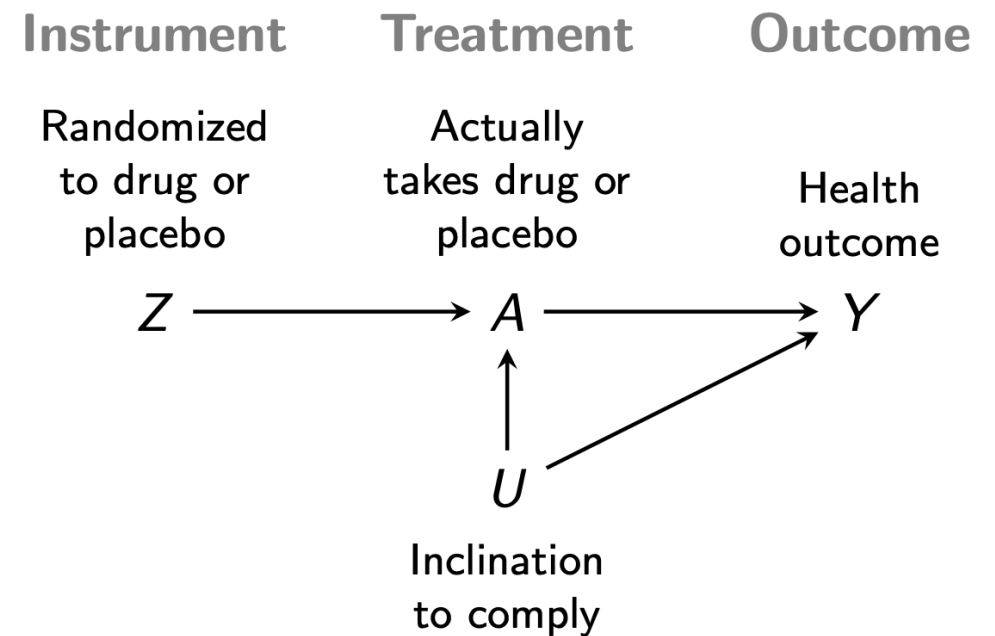
- Greet/meet 3-4 people next to you!

In your groups discuss (using the example from class):

- What is the key assumption of IV?
- What is the intent to treat effect?
- The average causal effect on the compliers is

$$E(Y^1 - Y^0 \mid \text{Complier}).$$

This quantity is also sometimes called the Local Average Treatment Effect (LATE)
Why might this quantity be useful?



Proportion of compliers

$$\begin{aligned} E(A \mid Z = 1) - E(A \mid Z = 0) &= E(A^{Z=1} - A^{Z=0}) \\ &= \sum_s E(A^{Z=1} - A^{Z=0} \mid S = s) \underbrace{P(S = s)}_{\substack{\text{Denote} \\ \pi_s}} \\ &= E(A^{Z=1} - A^{Z=0} \mid S = \text{Complier})\pi_{\text{Complier}} \\ &\quad + E(A^{Z=1} - A^{Z=0} \mid S = \text{Always-Taker})\pi_{\text{Always-Taker}} \quad (= 0) \\ &\quad + E(A^{Z=1} - A^{Z=0} \mid S = \text{Never-Taker})\pi_{\text{Never-Taker}} \quad (= 0) \\ &\quad + E(A^{Z=1} - A^{Z=0} \mid S = \text{Defier})\pi_{\text{Defier}} \quad (= 0) \\ &= \pi_{\text{Complier}} \end{aligned}$$

ACE for Compliers

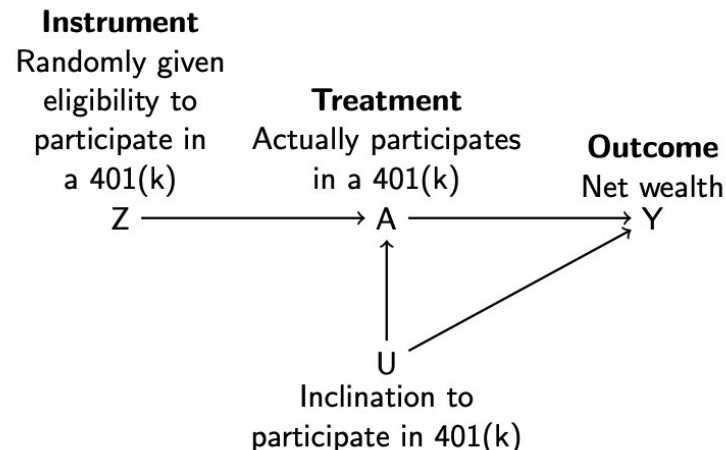
Deriving the general case:

$$\begin{aligned} E(Y \mid Z = 1) - E(Y \mid Z = 0) &= E(Y^{Z=1} - Y^{Z=0}) \\ &= \sum_s E(Y^{Z=1} - Y^{Z=0} \mid S = s) \underbrace{P(S = s)}_{\substack{\text{Denote} \\ \pi_s}} \\ &= E(Y^{Z=1} - Y^{Z=0} \mid S = \text{Complier})\pi_{\text{Complier}} \\ &\quad + E(Y^{Z=1} - Y^{Z=0} \mid S = \text{Always-Taker})\pi_{\text{Always-Taker}} \quad (= 0) \\ &\quad + E(Y^{Z=1} - Y^{Z=0} \mid S = \text{Never-Taker})\pi_{\text{Never-Taker}} \quad (= 0) \\ &\quad + E(Y^{Z=1} - Y^{Z=0} \mid S = \text{Defier})\pi_{\text{Defier}} \quad (= 0) \end{aligned}$$

$$\begin{aligned} E(Y^{A=1} - Y^{A=0} \mid S = \text{Complier}) &= \frac{E(Y^{Z=1} - Y^{Z=0})}{\pi_{\text{Complier}}} \\ &= \frac{E(Y \mid Z = 1) - E(Y \mid Z = 0)}{E(A \mid Z = 1) - E(A \mid Z = 0)} \end{aligned}$$

401(k) Example

- Does participating in a 401(k) increase an individual's wealth?
- Participating in a 401(k) is not a random thing!
- However, being eligible for a 401(k) is arguably random.
- 401(k) eligibility affects net wealth *only* through participation.



401(k) Example

In your groups discuss:

- Describe what the intent to treat effect is?
- Describe who are the always-takers? Never-takers? Compliers?
- What would it look like in this context if someone was a defier?
- Why does it matter that our instrument (Z) is assigned randomly?
(In other words, what assumption becomes credible because (Z) is random?)

Let's do it ourselves!

- There is a short coding exercise on the website...