

Statistics 256: Causality

In-class Activity 8: Instrumental Variables

Name(s): _____

Question 1: The four principal strata. Consider an instrument (Z) and treatment (D) and “potential treatment” values (D_z) of D_0 and D_1 . For each group named below, answer the question about which potential treatments correspond to that group. Then write what we know about the ITT (effect of Z on outcome, Y) for that group.

Group	(i) Who are they?	(ii) What we know about ITT ?
Compliers	$D_0 =$ $D_1 =$	
Always-takers	$D_0 =$ $D_1 =$	
Never-takers	$D_0 =$ $D_1 =$	
Defiers	$D_0 =$ $D_1 =$	

Question 2: Exclusion vs. exogeneity (observational). Card (1993) uses *growing up near a 4-year college* (Z) as an instrument for *years of education* (D) on *log earnings* (Y).

- (a) One plausible reason *exogeneity* could fail:
- (b) One plausible reason *exclusion* could fail (a path from Z to Y *not* through the person’s own education):

Question 3: Randomized encouragement — plug in the numbers. A 12-week fitness program is offered via vouchers. Of $N = 1,000$ adults, half are randomly assigned a voucher ($Z = 1$). Enrollment (D) is observed; the outcome Y is the change in systolic blood pressure (mmHg) at 6 months (negative = improvement). Assume monotonicity (no defiers).

	$Z = 0$ (no voucher)	$Z = 1$ (voucher)
$\mathbb{E}[Y Z]$ (BP change, mmHg)	-1	-3
$\mathbb{E}[D Z]$ (enrollment rate)	0.10	0.60

(a) ITT = _____ $\Pr(\text{complier}) =$ _____ IV (LATE) = _____

(b) Interpret the IV estimate in one sentence: *whose* effect is it, *of what*?

(c) Why is the IV estimate larger in magnitude than the ITT?

Question 4: Same study — do the IV assumptions hold?

(a) Does randomization of Z deliver *exogeneity*? Does it also deliver *exclusion*? (One sentence.)

(b) Describe one concrete way *exclusion* could fail here — a channel by which getting the *voucher* affects BP *other than* through enrollment.

(c) If exclusion fails in the direction you described, will the IV estimate *over-* or *under-*state the program's effect on compliers? Brief reasoning.