Compliance classes

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randomized to control condition $A^{Z=0} = A^0$	randomized to treatment condition $A^{Z=1} = A^1$	Label
0 (no treatment)	0 (no treatment)	Never-takers
0	1	Compliers
1 (yes treatment)	0	Defiers (Non-compliers)
1	1 (yes treatment)	Always-takers

↳ if $A=0$: no treatment received; if $A=1$: yes treatment received.

think of these as subpopulations of people

Never takers subpopulation: (no variability in treatment in this group)
- they don't take the treatment, regardless of randomization
  ↳ encouragement doesn't work on these subjects

⇒ we would not learn anything about the effect of treatment in this subpopulation, as there is no variation in treatment received (both, A^0 & A^1 are 1).

Compliers subpopulation:
- take treatment if encouraged to, and don't otherwise.
  ↳ treatment received (A) in this group is always equal to treatment assigned (Z).

⇒ in this group, treatment received is randomized. So we can learn about the causal effect of treatment.

Defiers: - do the opposite of what they are encouraged to do
  ↳ in this group, treatment received is also randomized BUT in the opposite way.

Always-takers: - no variation in treatment received → no way / information to learn about causal effects.

Causal Effect:

- motivation for using IV: general concern about unmeasured confounding
  ↳ when there is unmeasured confounding, we cannot average / marginalize over all confounders (via matching, IPTW, etc)

IV methods do not focus on population average causal effects
  ↳ focus with IV methods is on local average treatment effect

Local average treatment effect:

- the target of inference is: $E(Y^{Z=1} \mid A^0=0, A^1=1) - E(Y^{Z=0} \mid A^0=0, A^1=1)$
  ↳ difference in means of potential outcomes
  ↳ b/c we look at the same subpopulation of subjects (i.e. $A^0=0, A^1=1 \Rightarrow$ compliers), we can compute a valid causal effect of treatment.

note that: $E(Y^{Z=1} \mid A^0=0, A^1=1) - E(Y^{Z=0} \mid A^0=0, A^1=1) =$
$E(Y^{Z=1} - Y^{Z=0} \mid \text{compliers}) =$
$E(Y^{A=1} - Y^{A=0} \mid \text{compliers})$

Why can we claim this?:
B/c for compliers when $Z=1 \Rightarrow A=1$ and o.w. $Z=0 \Rightarrow A=0$

↳ this a local average treatment effect b/c we look at a subpopulation being compliers

- this is valid causal effect b/c it contrasts counterfactuals in a common population.

⇒ a.k.a. complier average causal effect (CACE)
  ↳ this is a causal effect in a subpopulation ⇒ thus "local".
  ↳ no inference about: defiers, always-takers, never-takers.

Observed data:

- for each person, we observe an A and a Z, not (A^0, A^1)

treatment assigned; treatment received; potential treatment if assigned to treatment

Z	A	A^0	A^1	Class (compliance)
0	0	0	?	Complier OR never-taker.
0	1	1	?	Defier OR always-taker.
1	0	?	0	Defier OR never-taker.
1	1	?	1	Complier OR always-taker.

we don't know for sure what they are; we can only narrow down the label to 2 options.

Identifiability:

- compliance classes a.k.a. principal strata, and they are latent (i.e. not directly observable)

→ so how can we then estimate they complier average causal effect (CACE)?

→ next lectures / videos provides necessary assumptions.