Randomized trials w/ non-compliance

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Setup: Randomize trial (RT)

Z ... randomization to treatment (eg. 1 if we randomize to treatment, 0 if we randomize to placebo/no treatment)

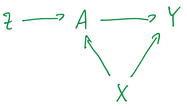
A ... treatment received (1 if receive treatment, 0 otherwise)

Y ... outcome

NOTE: Not everyone assigned to treatment ($A=1$) will actually receive the treatment (non-compliance) b/c we could have ($Z=0$).

DAG:

- non-compliance makes the RT like an observational study (i.e. we might have confounding).
- there could be confounding based on treatment received.
- reasonable to assume that treatment assignment does not directly affect outcome Y.



Step 1: use X to determine treatment.
Step 2: draw random Z to choose whether or not to apply advised treatment from step 1.

Potential treatment:

- observed data: (Z, A, Y)
- for a given subject: they were assigned treatment Z and received treatment A

A ... observed treatment
Z ... assigned treatment

- each subject has 2 potential values of treatment:
  1. $A^{Z=1}$: value of treatment if randomized to $Z=1$.
  2. $A^{Z=0}$: value of treatment if randomized to $Z=0$.

⇒ every subject has 2 potential treatments: (A^0, A^1) & the value of Z determines the actual received treatment

Average Causal Effect of treatment assignment on treatment received:

pop. causal effect b/c we don't condition on any variables

- $E(A^1 - A^0)$ (equals to 1 under perfect compliance)

↳ estimable from observed data b/c:

$E(A^1) = E(A \mid Z=1)$ & $E(A^0) = E(A \mid Z=0)$

b/c of randomization of Z

Perfect compliance iff $A^1 = 1$ ∀ patients and $A^0 = 0$ ∀ patients.

- Causal Effect: Contrast in potential outcomes on a common population.
- Consistency needed to estimate $E(A^1 - A^0)$ from observed data:
  ↳ $A^1 = A$ if $Z=1$ & $A^0 = \bar{A}$ if $Z=0$

Average causal effect of treatment assignment on the outcome:

- $E(Y^{Z=1} - Y^{Z=0})$: "intention-to-treat" effect

+ $Z=1$ means subject is assigned to receive treatment.
+ $Z=0$ means ——— " ——— not receive treatment.

- if perfect compliance, then $E(Y^{Z=1} - Y^{Z=0}) \equiv$ causal effect of the treatment
- $E(Y^{Z=1} - Y^{Z=0})$ is identifiable/estimable from observed data, as, by randomization and consistency:

$E(Y^{Z=1}) = E(Y \mid Z=1)$, $E(Y^{Z=0}) = E(Y \mid Z=0)$

$E(Y^{Z=1})$: avg. value of the outcome, had everyone in the population be assigned $Z=1$.

both are observed data

What about causal effect of treatment received on the outcome?

- the instrumental variable Z can be thought of as strong encouragement to receive treatment (i.e. $Z=1 \rightarrow A=1$, $Z=0 \rightarrow A=0$)
- Z determines treatment assignment. As such, it affects treatment received.
- but Z does not affect the outcome directly.