STATISTICS 536B, Lecture #10

March 31, 2015

Instrumental Variables?

Search well-respected medical journal (e.g. JAMA, NEJM, BMJ, Lancet):

'propensity score'

'instrumental variable'

Intuition (and 'magic calculus') of IV approach

Want effect of X on Y, adjusted for U

Can't get U data

Can get Z data, where Z:

- is associated with X
- is independent of U
- won't have any **direct** impact on outcome Y
    - $Z \perp Y | X, U$

Can (Y,X,Z) data suffice in place of (Y,X,U) data which can't be collected?

$$\frac{\partial Y}{\partial X} \;=\; \frac{\partial Y / \partial Z}{\partial X / \partial Z}$$

Example from Greenland (2000, Int. J. Epi.)

Vitamin A supplementation in childhood

Z = randomized to treatment
X = received/took treatment
Y = one-year mortality

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Z   X      Y
1   0      34/2419
1   1      12/9675
0   0      74/11588
0   1      ---
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Vitamin A ex.: Intention-to-treat estimate

Vitamin A ex.: As-treated estimate

Vitamin A ex.: Instrumental variable estimate

Outcome Y, exposure X, observed confounders C, unobserved confounders U, instrument Z.

IV assumptions:

- X and Z are associated given C
- Z and U are conditionally independent given C
- Z and Y are conditionally independent given (X, U, C)

So the 'with C' version of the calculation you did:

Say
$$E(X|Z, C) = \alpha_0 + \alpha_1 Z + \alpha_2 C$$
$$E(Y|X, C, U) = \beta_0 + \beta_1 X + \beta_2 U + \beta_3 C$$

Hence we can estimate β_1 by fitting both the $(X|Z, C)$ and $(Y|Z, C)$ regressions.

Xian et. al., 2011, JAMA

Patients who suffer acute ischemic stroke

700 of 5000 acute-care hospitals are *certified stroke centers* (CSC)

$X =$ treated at a CSC?

$Y =$ 30-day mortality

$C =$ demographics, comorbidities, hospital characteristics

$U =$ unmeasured aspects of stroke severity

$Z =$ **differential** distance

$$Z = \text{dist(patient's home , nearest CSC hospital)} - \text{dist(patient's home , nearest hospital)}$$

Found a benefit of CSC
(estimated risk difference 0.025, statistically significant).

Also looked at effect of CSC on 30-day mortality for:

- patients who suffer acute myocardial infarction
- patients who suffer gastrointestinal hemorrhage