Stat 209 [redacted]

JASA 91 (1996)

# Identification of Causal Effects Using Instrumental Variables

Joshua D. ANGRIST, Guido W. IMBENS, and Donald B. RUBIN

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$Y_i$ obs health outcome $D_i$ veteran status (treatment)
effect: veteran status on health outcome (Vietnam era) p445
$Z_i$ "assignment" draft status, lottery: $Z=1$ low lottery number
imperfect compliance: not all $Z=1$ became $D=1$
not all $Z=0$ became $D=0$, volunteers
$Z, D$ positive association

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Y on D regression (t-test) $Y_i = \beta_0 + \beta_1 D_i + \varepsilon$
indicate effect of service on health (self-selection etc)
$\beta_1$ biased? eqs p. 445
use Z as instrument uncorr $\varepsilon, v$

$$\hat{\beta}_1^{IV} = s_{yz}/s_{Dz} = \frac{\bar{Y}_{z=1} - \bar{Y}_{z=0}}{\bar{D}_{z=1} - \bar{D}_{z=0}}$$ p.447

Results p. 453
Born 1950

service $D=1$: If $Z=1$ then .353 $D=1$
$Z=0$ then .193 $D=1$
Draft status (random) produced .159 increment

mortality $y=1$: If $Z=1$ .0204 died
$Z=0$ .0195 died
diff .0009
ACE draft on mortality

IV estimator $.0009/.159 = .0056$
causal effect of military service on mortality (population induced by draft)

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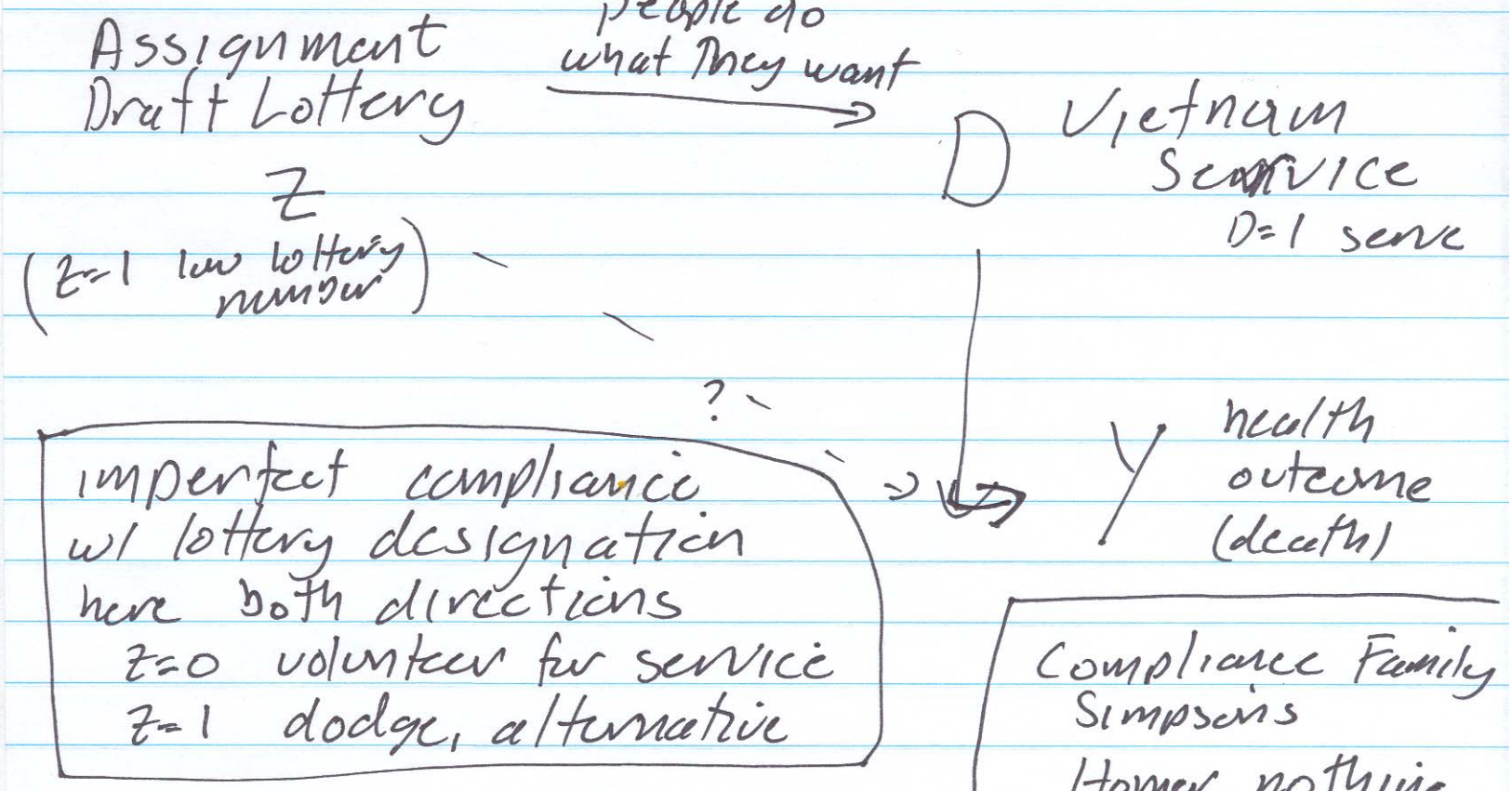
week 7

# Compliance Formulation for AIR




imperfect compliance w/ lottery designation here both directions
Z=0 volunteer for service
Z=1 dodge, alternative

Compliance Family
Simpsons
Homer nothing
Bart opposite
Marge comply
Lisa protocol, regardless

1950 results

effect of lottery on Viet service

$\hat{\beta}_{DZ} = .353 - .193 = .159$ (Marge − Lisa/Bart)

effect lottery on death

$\hat{\beta}_{YZ} = .0204 - .0195 = .0009$

proportion compliers

ITT
draft status = served

consider Z as an instrument for Y on D regression (effect of Viet on health)

IV est $\frac{S_{YZ}}{S_{DZ}} = \hat{\beta}_{YZ}/\hat{\beta}_{DZ} = .0057$ CACE (AIR)
effect of service on death.

$.0009/.157$

IV est is adjusted for compliance

AIR eqs
Vietnam era

$Y$ = health outcome

$D$ "treatment" — serving in military draft status (at random birthday)

$Z$ "assignment" lottery

compliance imperfect
low lottery # $\Rightarrow Z=1$ "drafted"
not all $D=1$ served

high lottery number $Z=0$ exempt from draft.
not all $D=0$ sat out. "volunteers"

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Because of self-selection in part to $D$, an $D$ regression (t-test) can't indicate effect of service on health.

$Y_i = \beta_0 + \beta_1 D + \varepsilon$ — $\beta_1$ biased?

cut-off of control endogenous

$D_i^* = \alpha_0 + \alpha_1 Z_i + \nu_i$ $\quad D_i = \begin{cases} 1 \text{ if } D_i^* > 0 \\ 0 \text{ if } D_i^* \leq 0 \end{cases}$

$Z$ uncorr w/ $\nu$, $\varepsilon$

$\hat{\beta}_1^{IV} = S_{YZ}/S_{DZ}$

p. 445