# 6) Instrumental Variables (IV) and Local Average Treatment Effect (LATE)

Vitor Kamada

June 2018

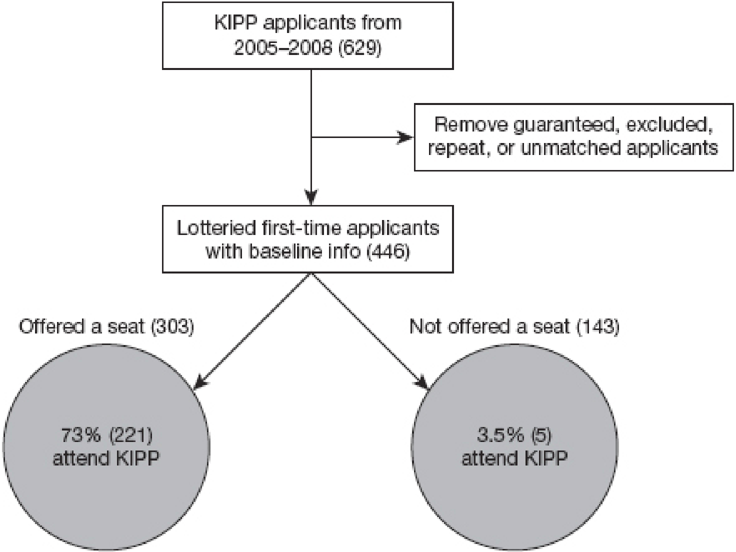
# Reference

Tables, Graphics, and Figures from

**Mastering 'Metrics: The Path from Cause to Effect**

Angrist & Pischke (2014): Chapter 3.1 and 3.2

# Knowledge Is Power Program (KIPP)



# Analysis of KIPP Lotteries (A)

| | | KIPP applicants | | | |
|---|---|---|---|---|---|
| | Lynn public fifth graders | KIPP Lynn lottery winners | Winners vs. losers | Attended KIPP | Attended KIPP vs. others |
| | (1) | (2) | (3) | (4) | (5) |
| | | Panel A. Baseline characteristics | | | |
| Hispanic | .418 | .510 | −.058 | .539 | .012 |
| | | | (.058) | | (.054) |
| Black | .173 | .257 | .026 | .240 | −.001 |
| | | | (.047) | | (.043) |
| Female | .480 | .494 | −.008 | .495 | −.009 |
| | | | (.059) | | (.055) |
| Free/Reduced price lunch | .770 | .814 | −.032 | .828 | .011 |
| | | | (.046) | | (.042) |
| Baseline math score | −.307 | −.290 | .102 | −.289 | .069 |
| | | | (.120) | | (.109) |
| Baseline verbal score | −.356 | −.386 | .063 | −.368 | .088 |
| | | | (.125) | | (.114) |

# Analysis of KIPP Lotteries (B)

| | Lynn public fifth graders (1) | KIPP applicants: KIPP Lynn lottery winners (2) | Winners vs. losers (3) | Attended KIPP (4) | Attended KIPP vs. others (5) |
|---|---|---|---|---|---|
| Panel B. Outcomes | | | | | |
| Attended KIPP | .000 | .787 | .741 | 1.000 | 1.000 |
| | | | (.037) | | — |
| Math score | −.363 | −.003 | .355 | .095 | .467 |
| | | | (.115) | | (.103) |
| Verbal score | −.417 | −.262 | .113 | −.211 | .211 |
| | | | (.122) | | (.109) |
| Sample size | 3,964 | 253 | 371 | 204 | 371 |

# Instrumental Variable

**Effect of offers on scores**

**=(Effect of offers on attendance)x(Effect of attendance on scores)**

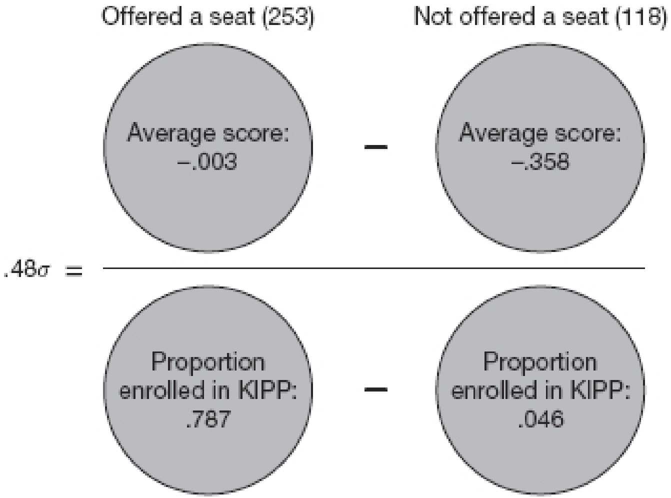
**Effect of attendance on scores**

**= (Effect of offers on scores)/(Effect of offers on attendance)**

# Local Average Treatment Effect (LATE)

$$\lambda = \frac{\rho}{\phi} = \frac{E[Y_i|Z_i{=}1]-E[Y_i|Z_i{=}0]}{E[D_i|Z_i{=}1]-E[D_i|Z_i{=}0]}$$

# IV in School: Effect of KIPP Attendance on Math Scores



# The Four Types of Children

| | | Lottery losers $Z_i = 0$ | |
|---|---|---|---|
| | | Doesn't attend KIPP $D_i = 0$ | Attends KIPP $D_i = 1$ |
| Lottery winners $Z_i = 1$ | Doesn't attend KIPP $D_i = 0$ | Never-takers (*Normando*) | Defiers |
| | Attends KIPP $D_i = 1$ | Compliers (*Camila*) | Always-takers (*Alvaro*) |

$$\lambda = \frac{\rho}{\phi} = E[Y_{1i} - Y_{0i} | C_i = 1]$$

$$TOT = E[Y_{1i} - Y_{0i} | D_i = 1]$$

# The Minneapolis Domestic Violence Experiment (MDVE)

| Assigned treatment | Delivered treatment: Arrest | Coddled: Advise | Coddled: Separate | Total |
|---|---|---|---|---|
| Arrest | 98.9 (91) | 0.0 (0) | 1.1 (1) | 29.3 (92) |
| Advise | 17.6 (19) | 77.8 (84) | 4.6 (5) | 34.4 (108) |
| Separate | 22.8 (26) | 4.4 (5) | 72.8 (83) | 36.3 (114) |
| Total | 43.4 (136) | 28.3 (89) | 28.3 (89) | 100.0 (314) |

$$P(Coddled|Assig.Coddled) = .797(\frac{84+5+5+83}{108+114})$$

$$P(Coddled|Not.Assig.Coddled) = .011(\frac{1}{92})$$

# MDVE Variables

- Police were called for a second domestic violence intervention at 18% of the addresses in the MDVE sample

$Y_i$: at least one post-treatment episode of suspected abuse

$D_i$: incidents where coddling was delivered

$Z_i$: assignment to coddling

# Intention-to-Treat (ITT) Effects

$$E[Y_i|Z_i = 1] - E[Y_i|Z_i = 0] = .211 - .097 = .114$$

- Captures the causal effect of being assigned to treatment
- But, ITT effect does not take the noncompliance into account
- ITT as IV for treatment delivered eliminates the selection bias

# LATE

$$E[Y_i|D_i = 1] - E[Y_i|D_i = 0] = .216 - .129 = .087$$

$$E[Y_i|Z_i = 1] - E[Y_i|Z_i = 0] = .211 - .097 = .114$$

$$E[D_i|Z_i = 1] - E[D_i|Z_i = 0] = .797 - .011 = .786$$

$$\lambda = \frac{.114}{.786} = .145$$

# LATE = TOT

- Almost no always-takers in the MDVE
- Always-takers are suspected batterers who were coddled without regard to treatment assigned

$$E[Y_{1i} - Y_{0i} | C_i = 1] = E[Y_{1i} - Y_{0i} | D_i = 1]$$