IV II & RDD II

PMAP 8521: Program Evaluation for Public Service

November 18, 2019

Fill out your reading report on iCollege!

PLAN FOR TODAY

Instruments

Treatment effects and compliance

Fuzzy RD

Synthetic data with R

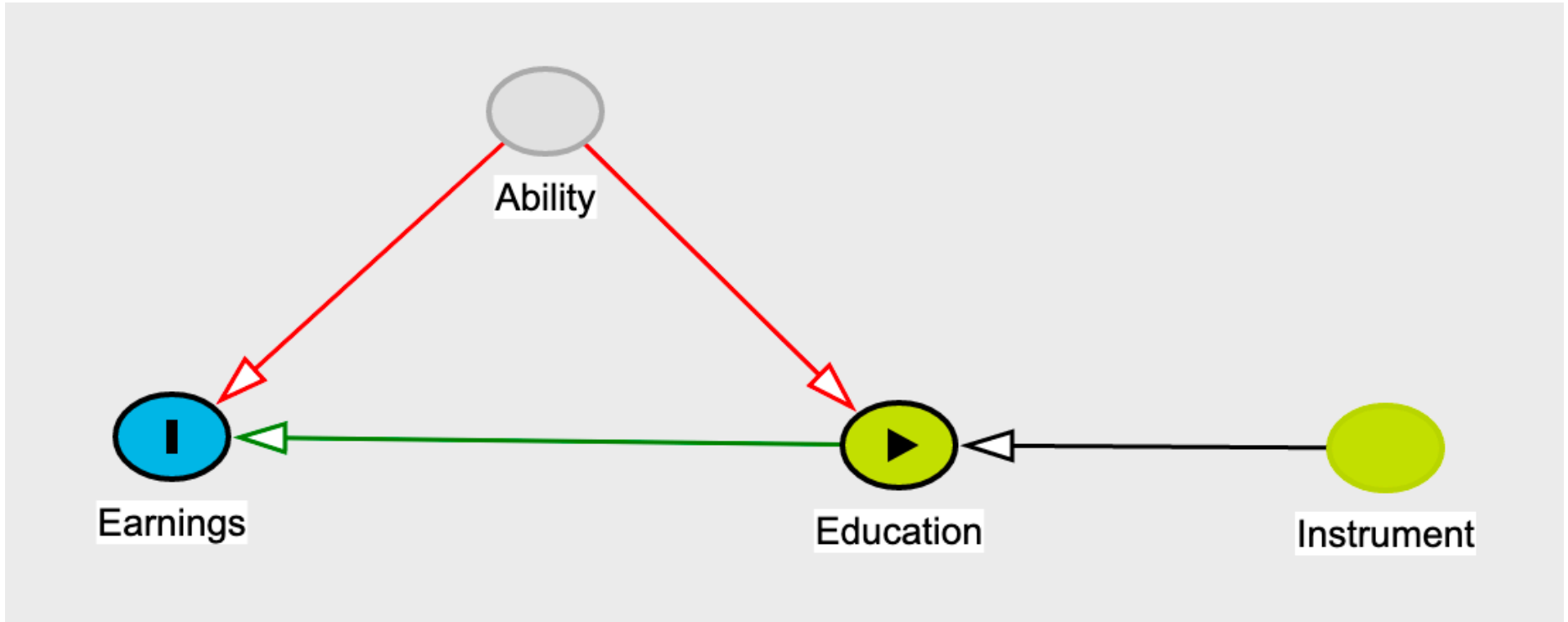
INSTRUMENTS

WHAT IS AN INSTRUMENT?

Something that is correlated with the policy variable

Something that does not directly cause the outcome

Something that is not correlated with the omitted variables


Ability
Earnings
Education
Instrument

TREATMENT EFFECTS & COMPLIANCE

POTENTIAL OUTCOMES

$$\delta = (Y|P = 1) - (Y|P = 0)$$

δ = Causal impact of program

P = Program

Y = Outcome

$$\delta = Y_1 - Y_0$$

Fundamental problem of causal inference

$$\delta_i = Y_i^1 - Y_i^0$$

Individual-level effects are impossible to observe

AVERAGE TREATMENT EFFECT

Difference between expected value when program is on vs. expected value when program is off

$$ATE = E(Y_1 - Y_0) = E(Y_1) - E(Y_0)$$

Can be found for a whole population, on average

$$\delta = (\bar{Y}|P = 1) - (\bar{Y}|P = 0)$$

Every individual has a treatment/causal effect

ATE = average of all unit-level causal effects

ATE = average effect for the whole population

VERSIONS OF CAUSAL EFFECTS

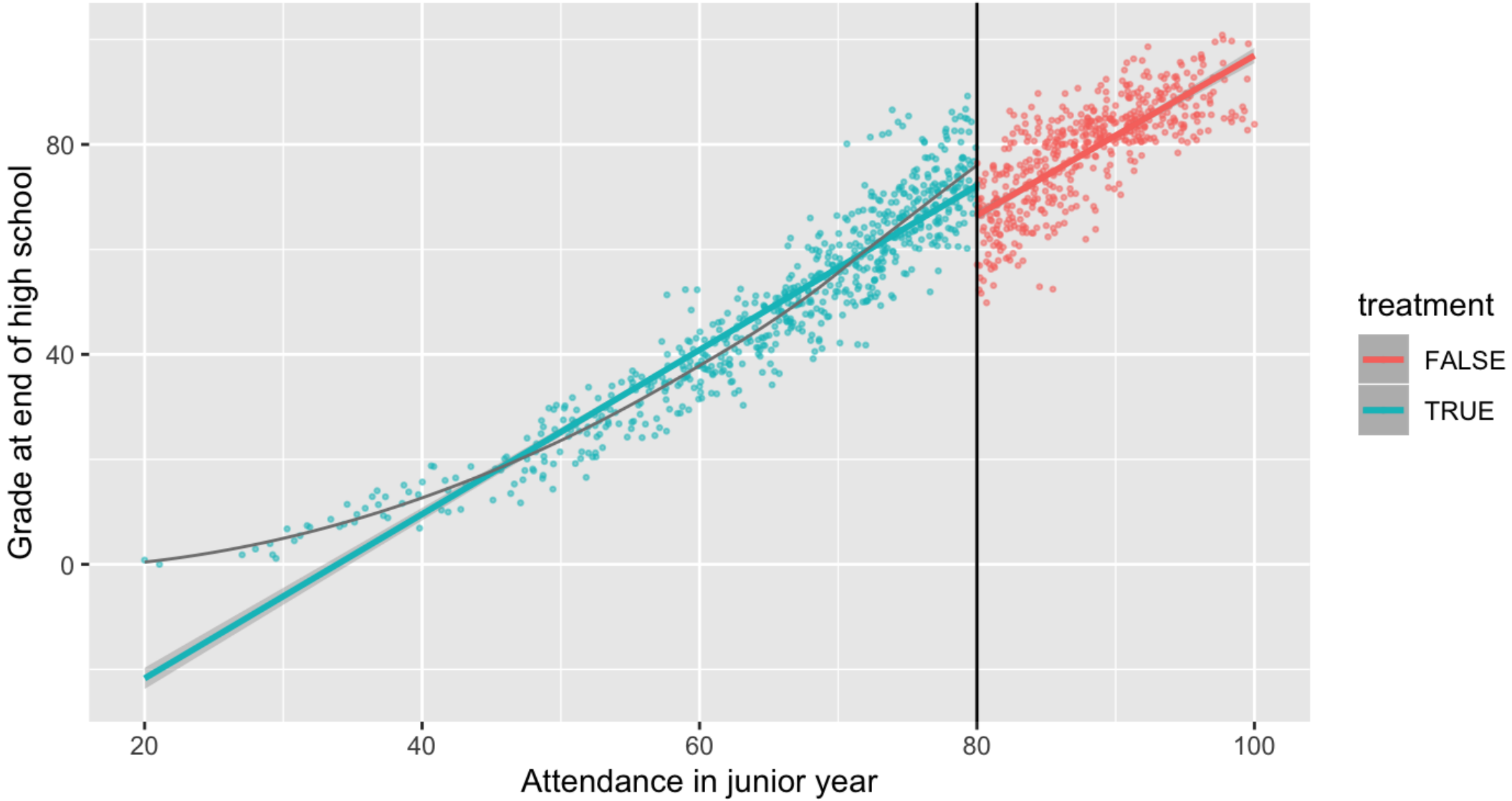
Average treatment on the treated

ATT / TOT

Conditional average treatment effect

CATE

LOCAL EFFECTS



LATE

Local average treatment effect (LATE) = weighted ATE

Narrower effect; only includes some of the population

Can’t make population-level claims with LATE

(But that can be okay)

LATE

In RDD, LATE = people in the bandwidth

In RCTs, IVs, etc., LATE = compliers

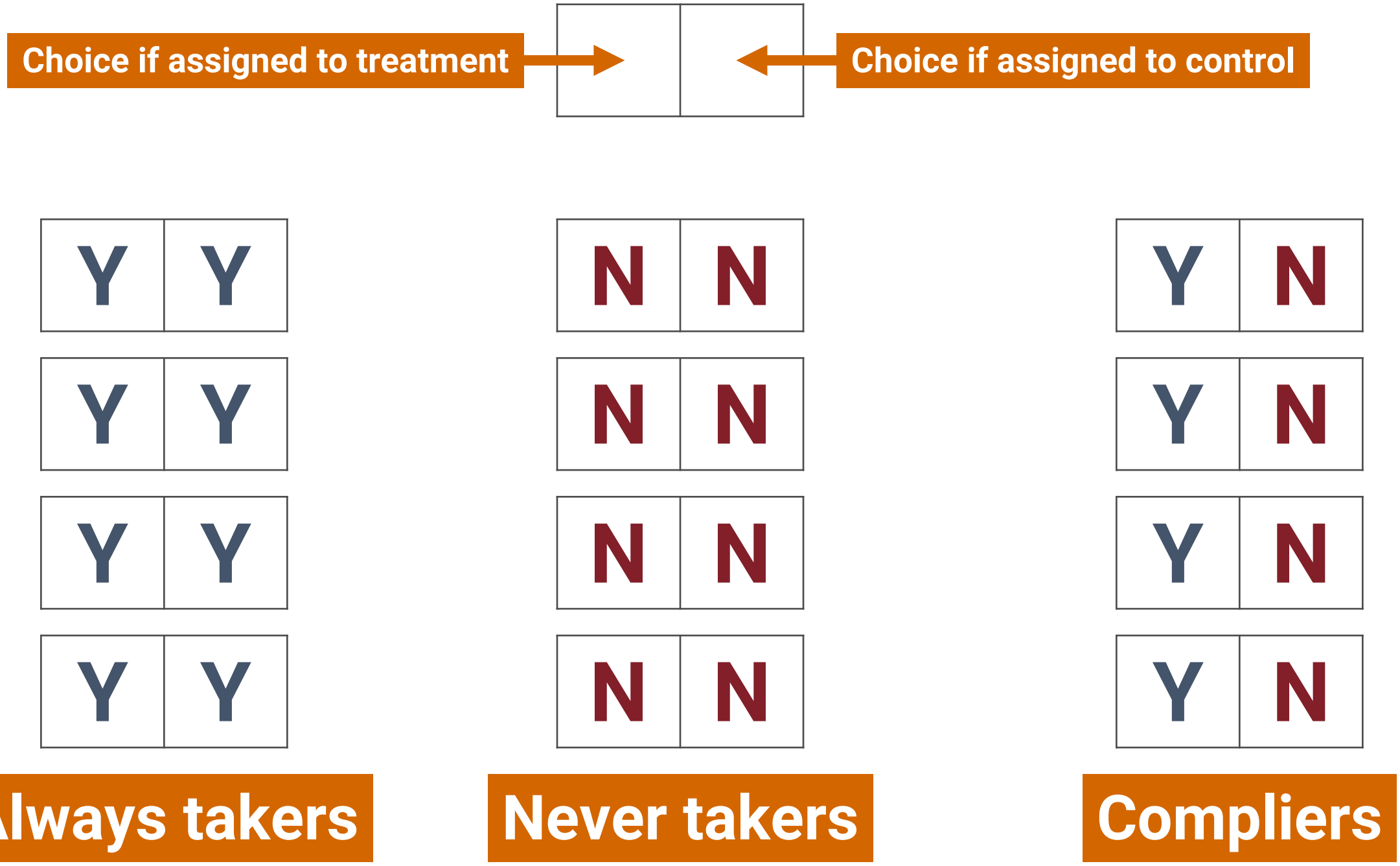
COMPLIANCE

Compliers Treatment follows assignment

Always takers Gets treatment regardless of assignment

Never takers Rejects treatment regardless of assignment

Defiers Does opposite treatment from assignment


Choice if assigned to treatment
Choice if assigned to control
Y Y
Y Y
Y Y
Y Y
N N
N N
N N
N N
Y N
Y N
Y N
Y N
Always takers
Never takers
Compliers

IGNORING DEFIERS

We can generally assume defiers don't exist

In drug trials this makes sense; can't get access to medicine without being in treatment

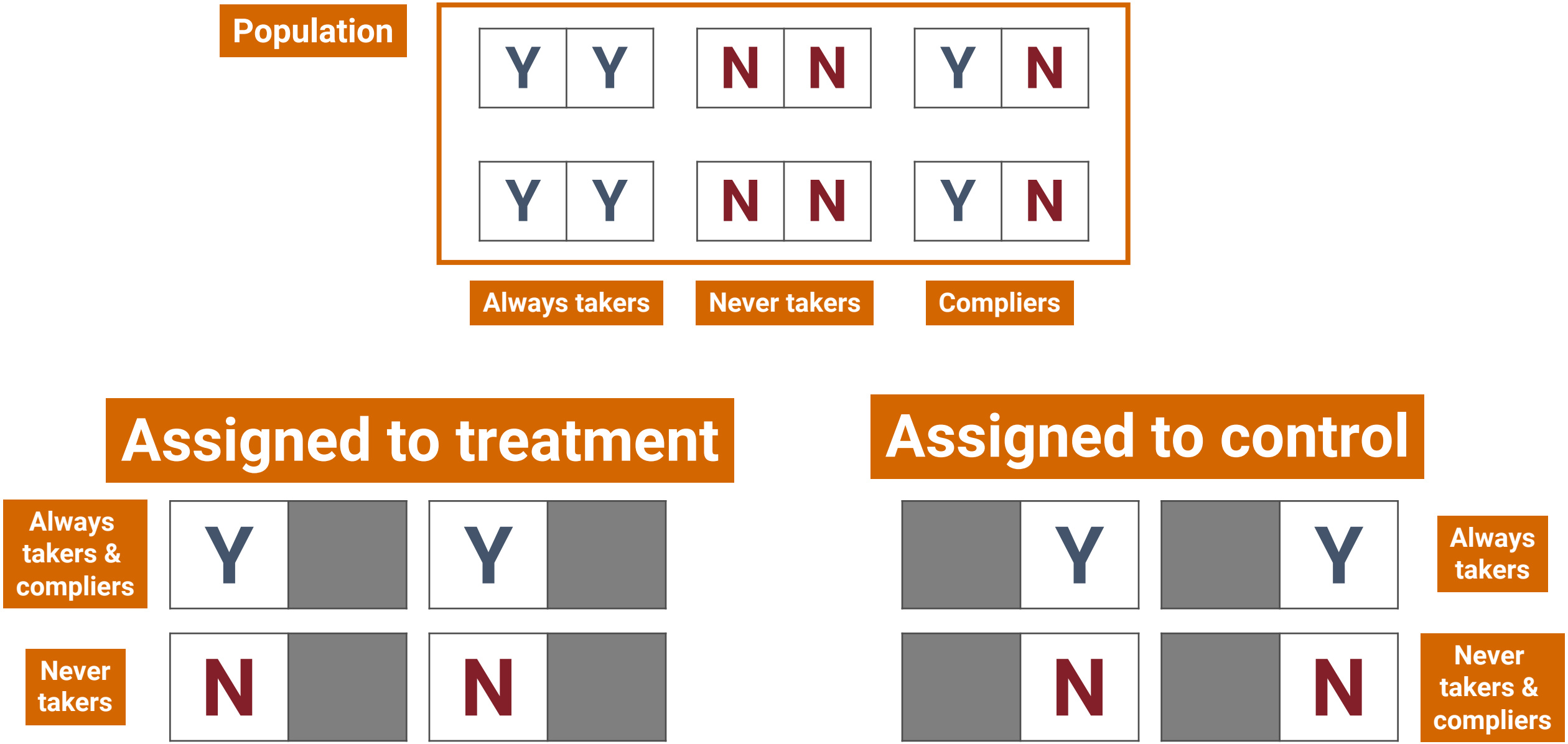
In development, it can make sense; in a bed net RCT, a defier assigned to treatment would have to tear down all existing bed nets out of spite

IGNORING DEFIERS

Monotonicity assumption

Assignment to treatment only has an effect in one direction

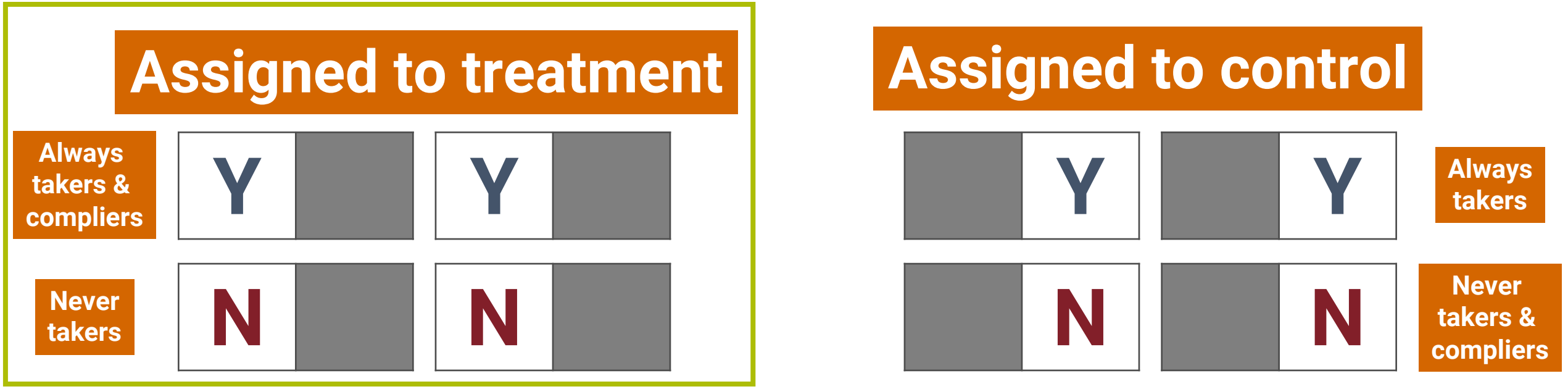
Assignment to treatment can only increase—not decrease—your actual chance of treatment


Population
Y Y
N N
Y N
Y Y
N N
Y N
Always takers
Never takers
Compliers
Assigned to treatment
Always takers & compliers
Y
Y
Never takers
N
N
Assigned to control
Y
Y
Always takers
N
N
Never takers & compliers

MORE EFFECTS

Intent to treat (ITT)

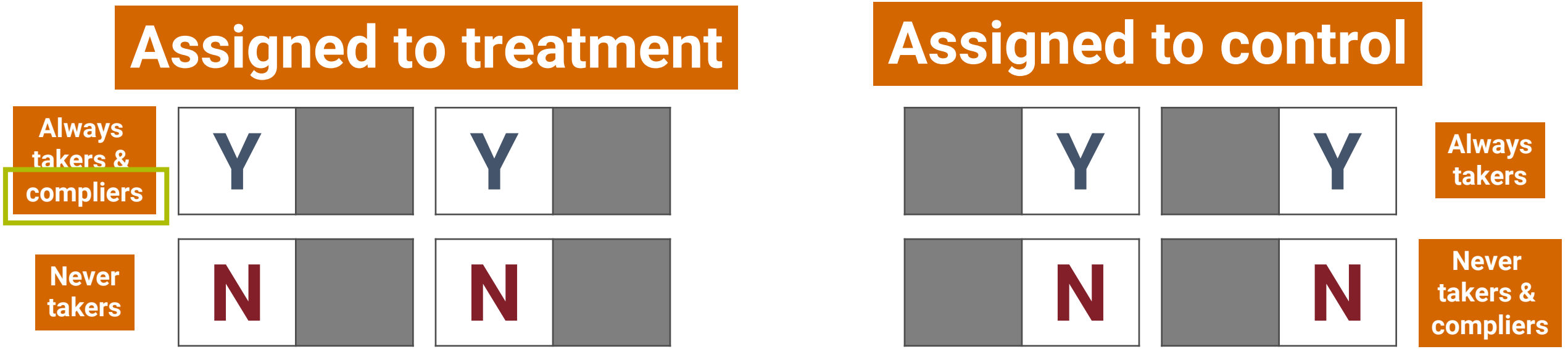
Effect of assignment (not actual treatment!

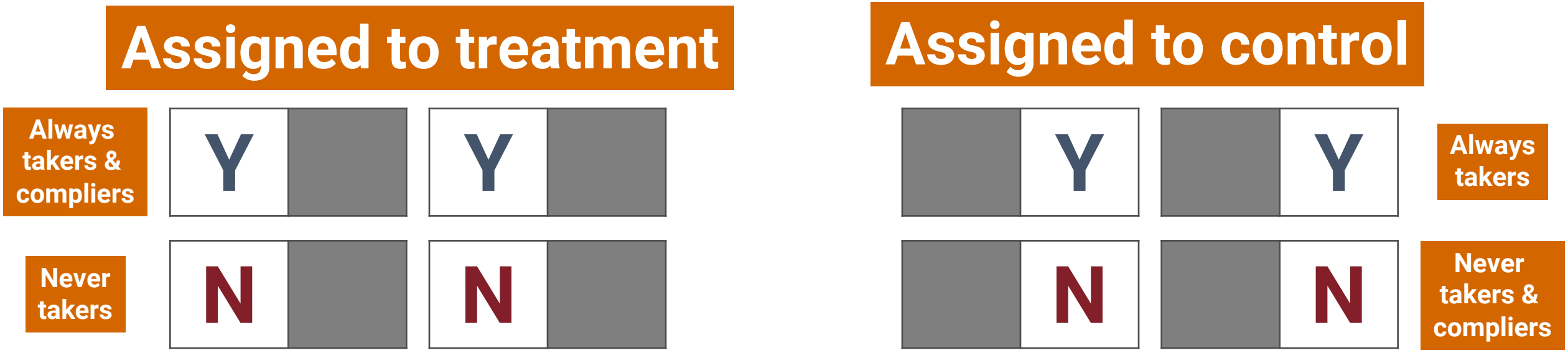


MORE EFFECTS

Complier Average Causal Effect (CACE)

LATE for the compliers





$$\text{ITT} = \pi_{\text{compliers}} \times (\text{T} - \text{C})_{\text{compliers}} + \pi_{\text{always takers}} \times (\text{T} - \text{C})_{\text{always takers}} + \pi_{\text{never takers}} \times (\text{T} - \text{C})_{\text{never takers}}$$

$$\text{ITT} = \pi_{\text{C}}\text{CACE} + \pi_{\text{A}}\text{ATACE} + \pi_{\text{N}}\text{NTACE}$$

$$\text{ITT} = \pi_{\text{C}}\text{CACE} + \pi_{\text{A}}\text{ATACE} + \pi_{\text{N}}\text{NTACE}$$

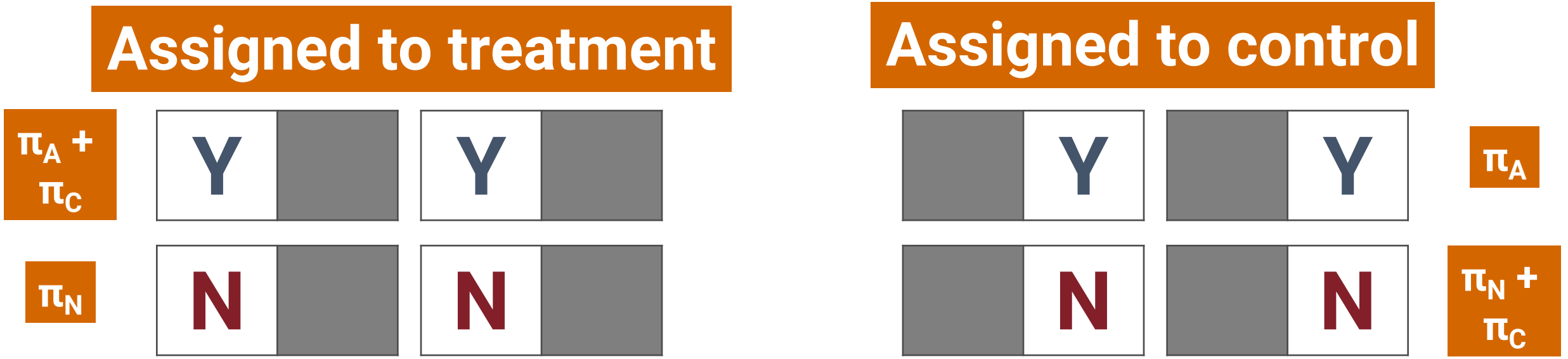
$$\text{ITT} = \pi_{\text{C}}\text{CACE} + \pi_{\text{A}}0 + \pi_{\text{N}}0$$

Exclusion restriction; treatment received is same regardless of assignment

$$\text{ITT} = \pi_{\text{C}}\text{CACE}$$

$$\text{CACE} = \frac{\text{ITT}}{\pi_C}$$

$$\text{CACE} = \frac{\text{ITT}}{\pi_C} \qquad \text{ITT} = (\bar{y}|\text{Treatment}) - (\bar{y}|\text{Control})$$



$$\pi_A + \pi_C = \% \text{ in treatment and yes}$$

$$\pi_C = \% \text{ in treatment and yes} - \pi_A$$

$$\text{CACE} = \frac{\text{ITT}}{\pi_C}$$

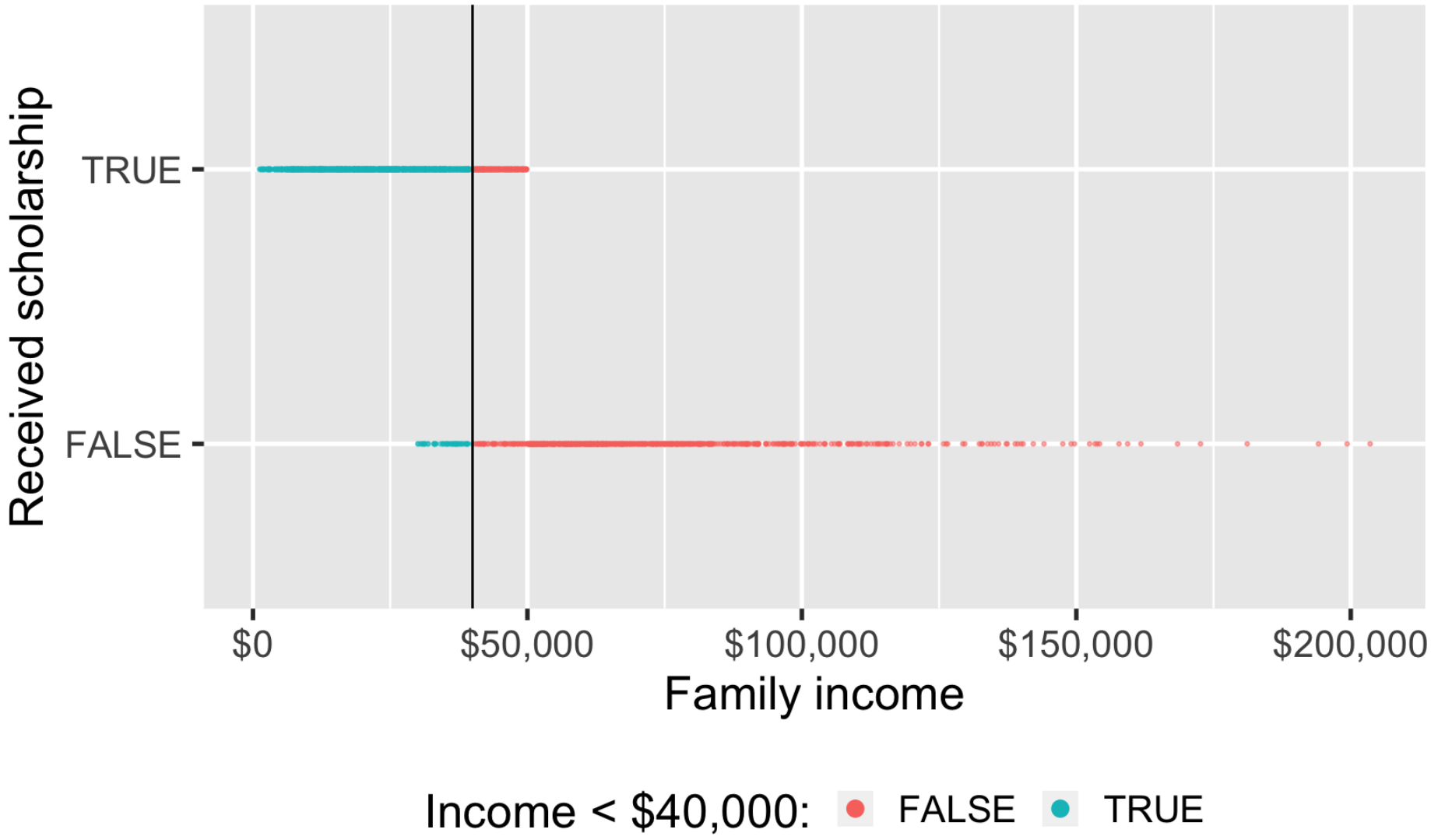
$$\text{ITT} = (\bar{y}|\text{Treatment}) - (\bar{y}|\text{Control})$$

$$\pi_\text{C} = \%\text{ in treatment and yes} - \%\text{ in control and yes}$$

Example in R

FUZZY RD

oh no


Received scholarship
TRUE
FALSE
$0
$50,000
$100,000
$150,000
$200,000
Family income
Income < $40,000:
FALSE
TRUE

Use an instrument to deal with noncompliance

Often actual participation in program works as instrument

SYNTHETIC DATA WITH R