COUNTERFACTUALS AND DAGS I

PMAP 8521: Program Evaluation for Public Service

September 23, 2019

Fill out your reading report on iCollege!

PLAN FOR TODAY

Indicators

R tips

Causal models

Backdoors and adjustment

INDICATORS

INDICATORS

Inputs, activities, & outputs

Generally directly measurable

# of citations mailed,
% increase in grades, etc.

Outcomes

Harder to directly measure

Commitment to school, reduced risk factors

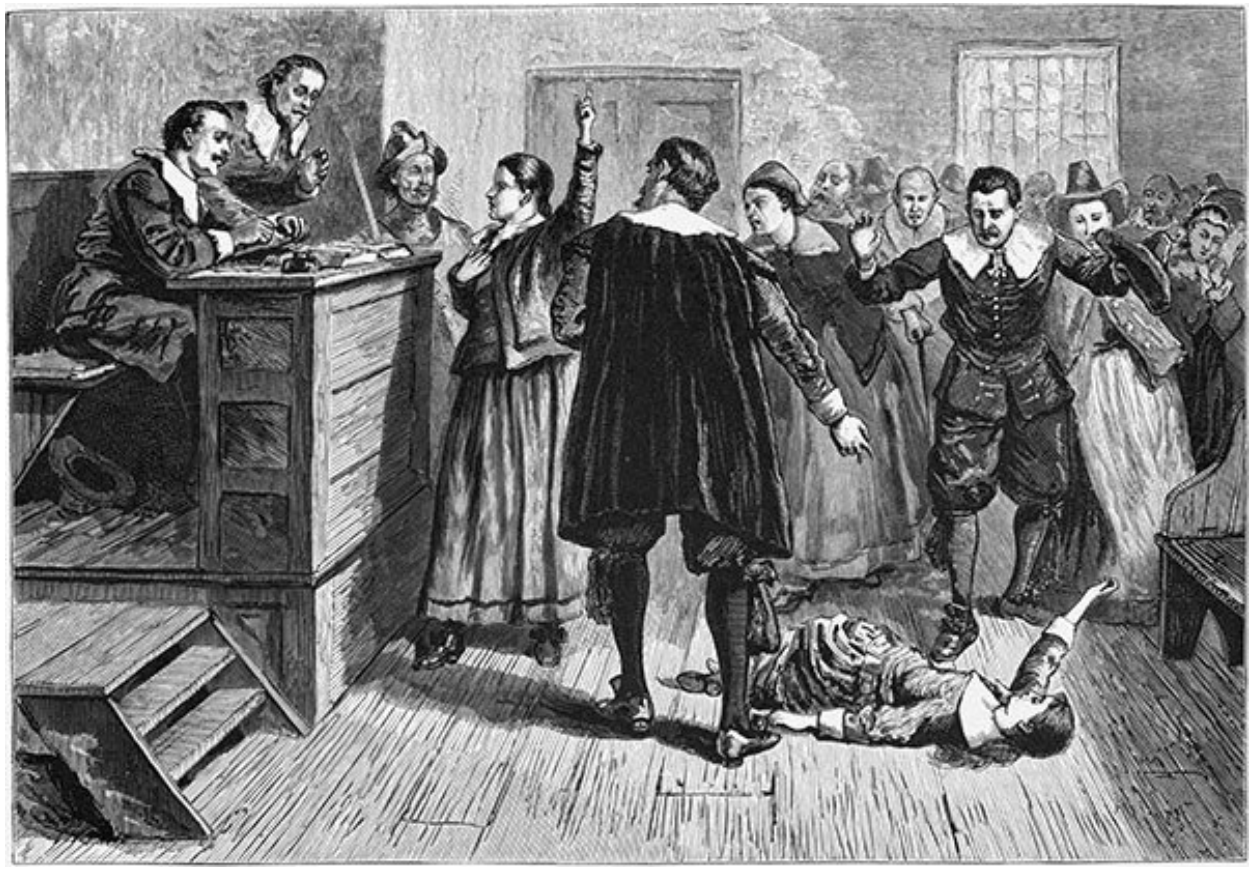
MEASUREMENT

Ladders of abstraction

Conceptual stretching

Connection to theory

Construct validity



GOOD INDICATORS

Specific

Measurable

Attributable

Realistic

Targeted

MEASURMENT

Juvenile delinquency

School performance

Poverty

R TIPS

CAUSAL MODELS

JUDEA PEARL

WINNER OF THE TURING AWARD

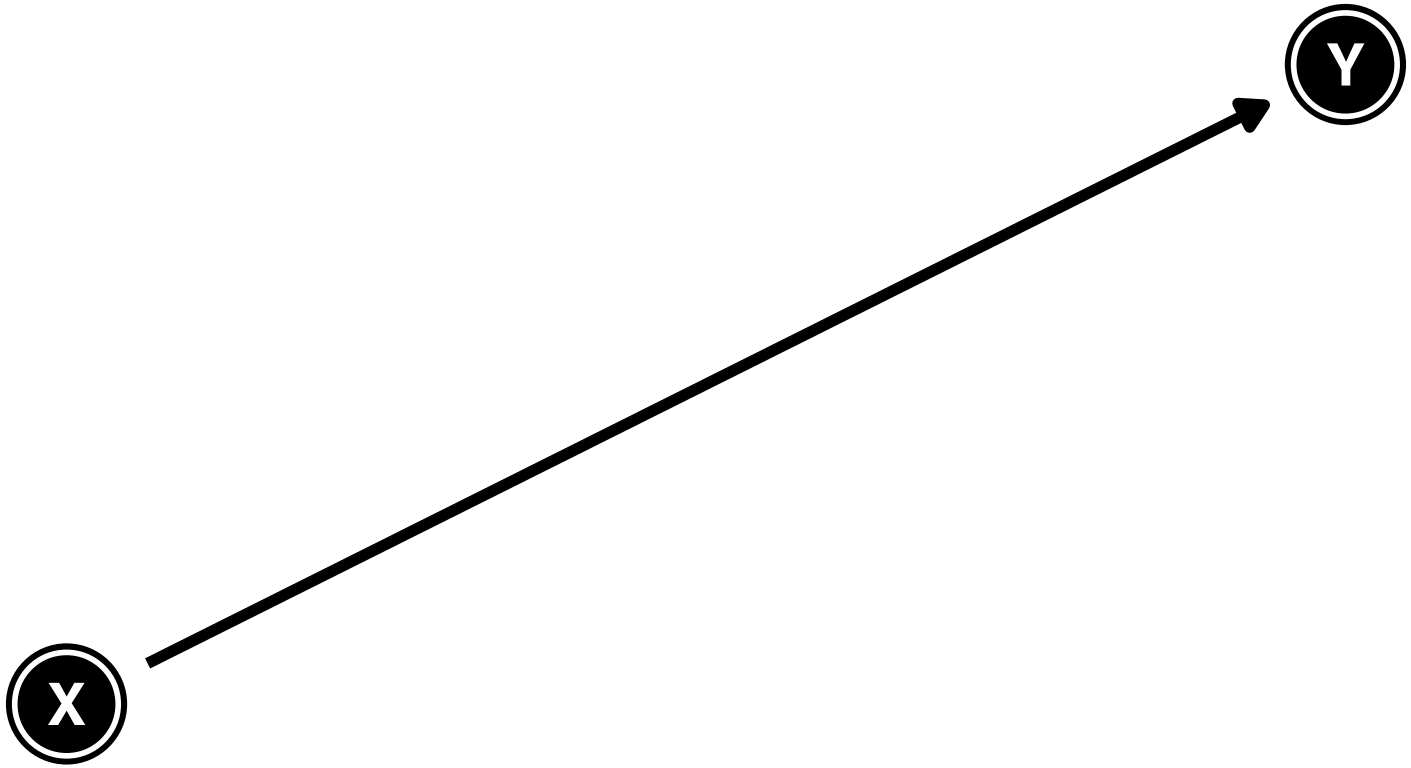
AND DANA MACKENZIE

THE BOOK OF WHY

THE NEW SCIENCE OF CAUSE AND EFFECT

DAGS

Directed acyclic graphs encode our understanding of the causal model (or philosophy)



What is the causal effect of an additional year of education on earnings?

Step 1: List variables

Step 2: Simplify

Step 3: Connect arrows

Step 4: Use logic and math to determine which nodes and arrows to measure

1. LIST VARIABLES

Education (treatment)

Earnings (outcome)

List anything that's relevant

Things that cause or are caused by treatment, especially if they're related to both treatment and outcome

You don't have to actually observe or measure them all

1. LIST VARIABLES

Education (treatment)

Earnings (outcome)

Location

Ability

Demographics

Socioeconomic status

Year of birth

Compulsory schooling laws

Job connections

2. SIMPLIFY

Education (treatment)

Earnings (outcome)

Location

Ability

Demographics

Socioeconomic status

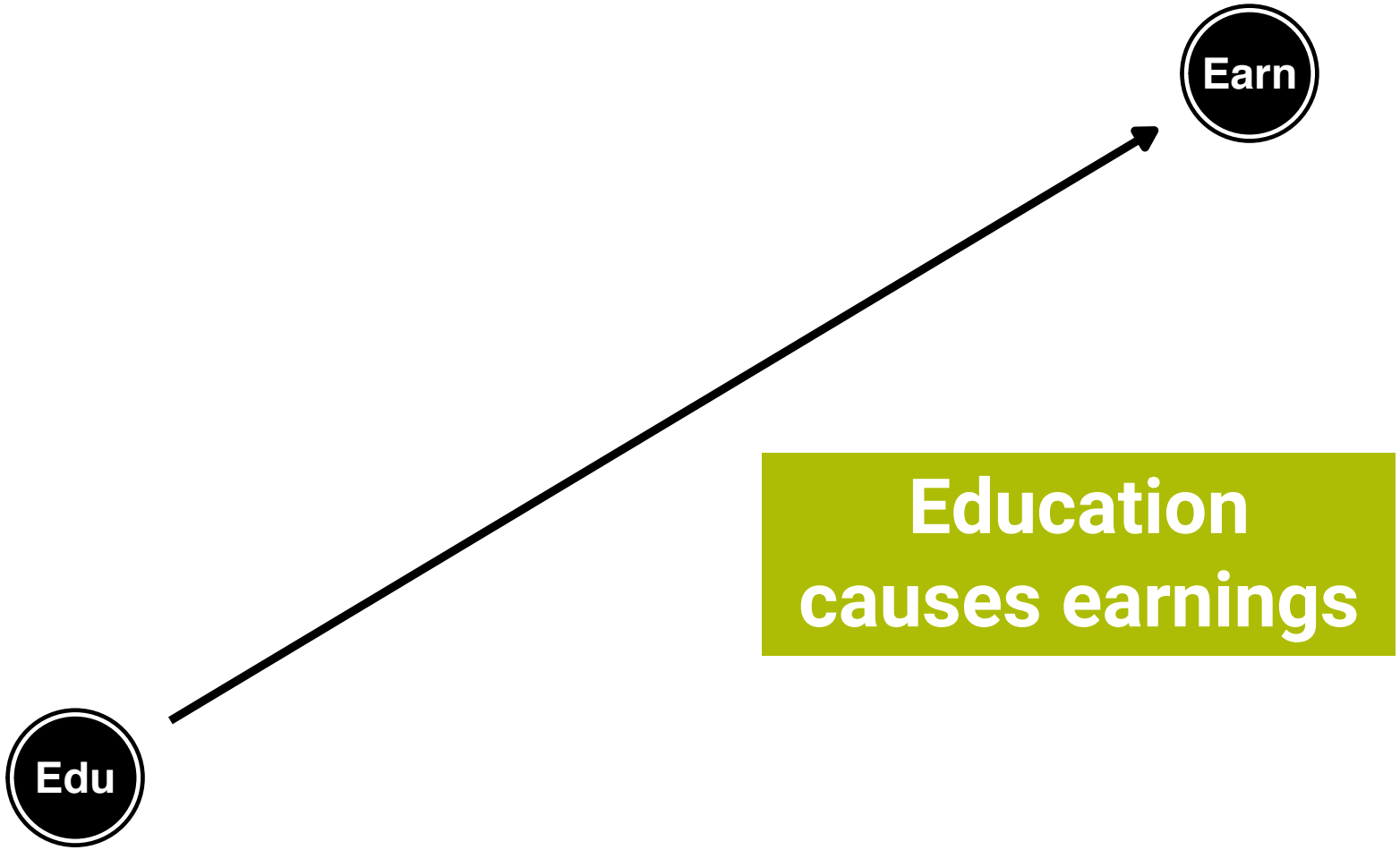
Year of birth

Compulsory schooling laws

Job connections

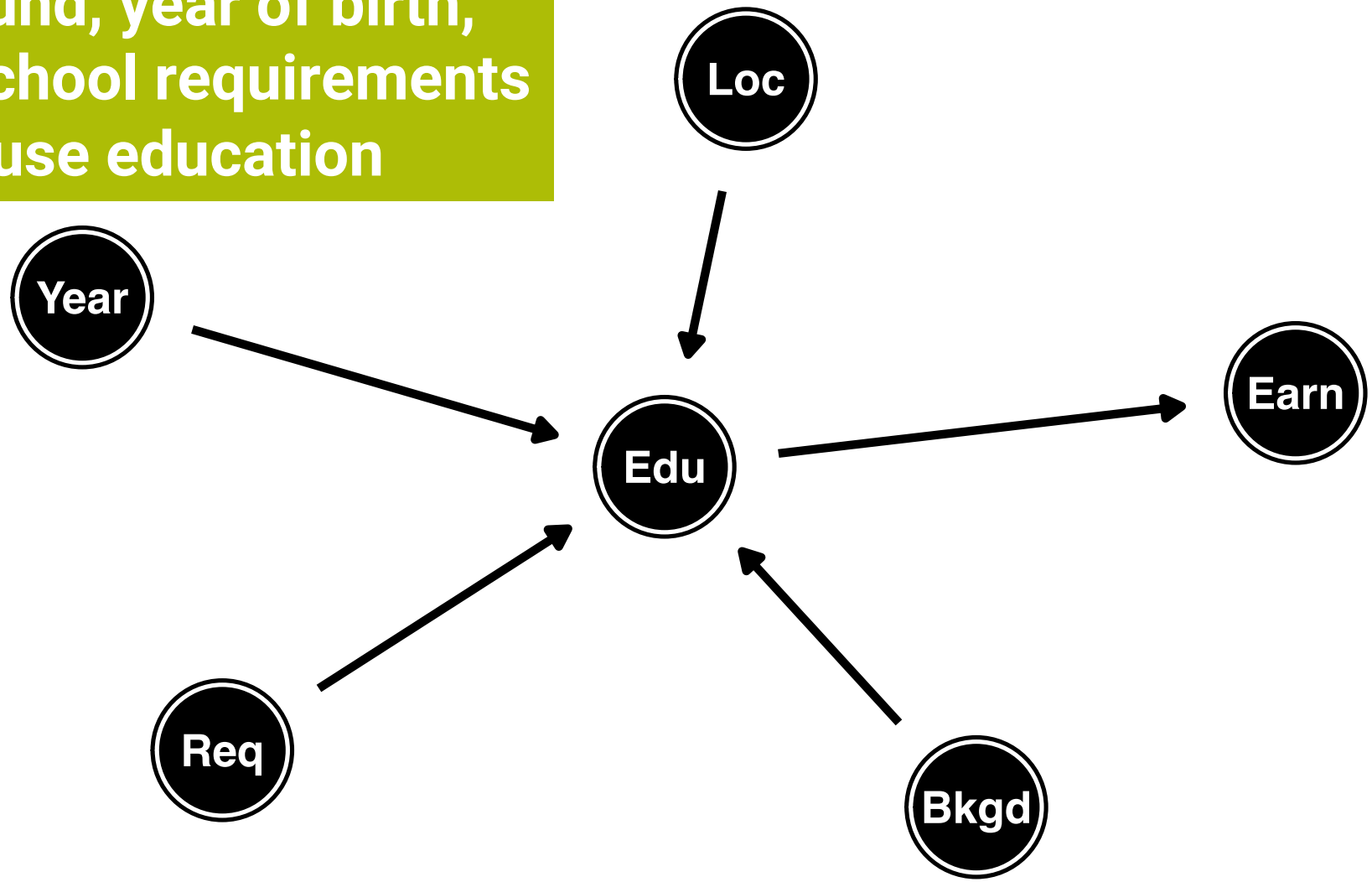
Background

3. DRAW ARROWS

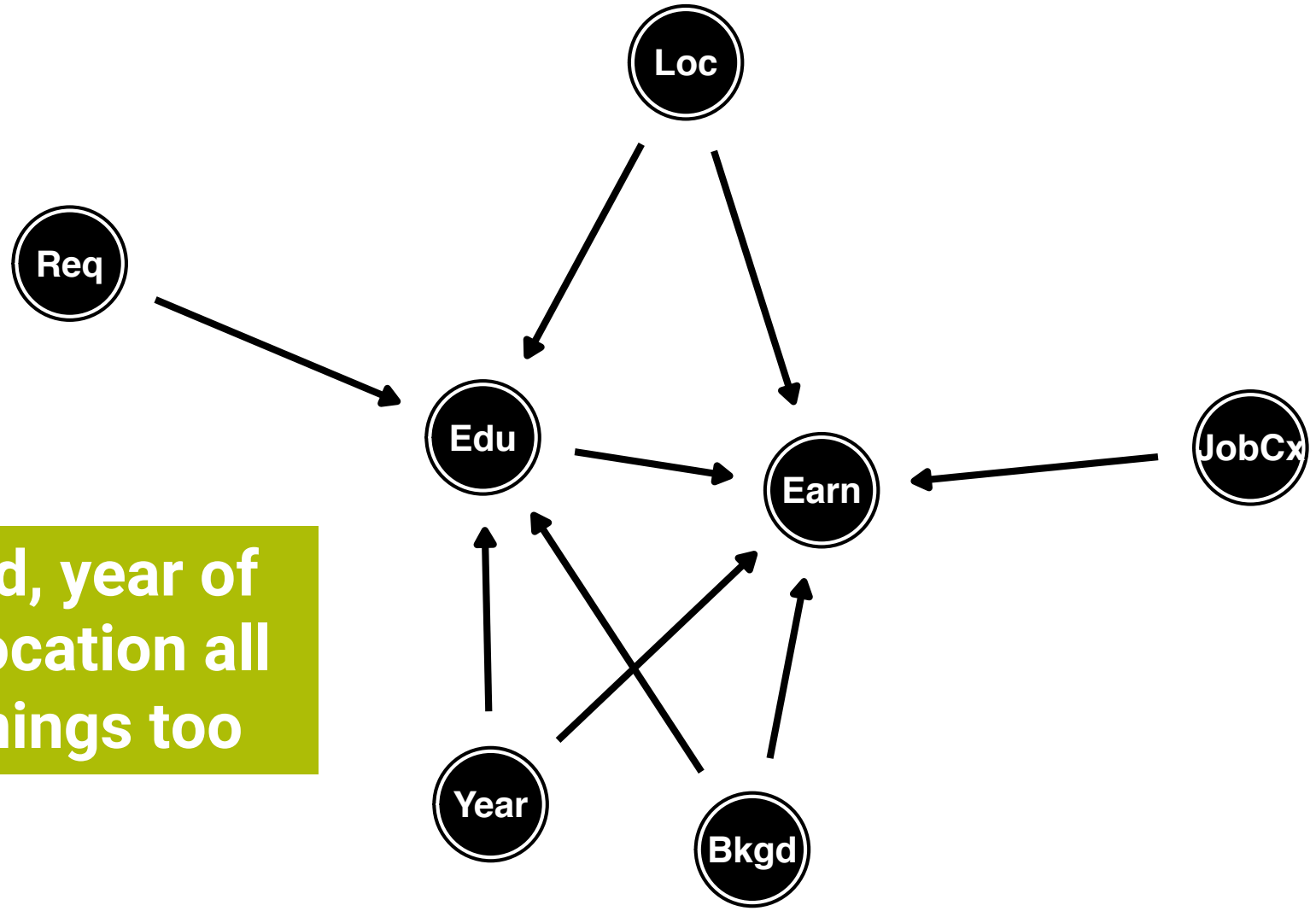


3. DRAW ARROWS

Background, year of birth, location, school requirements all cause education

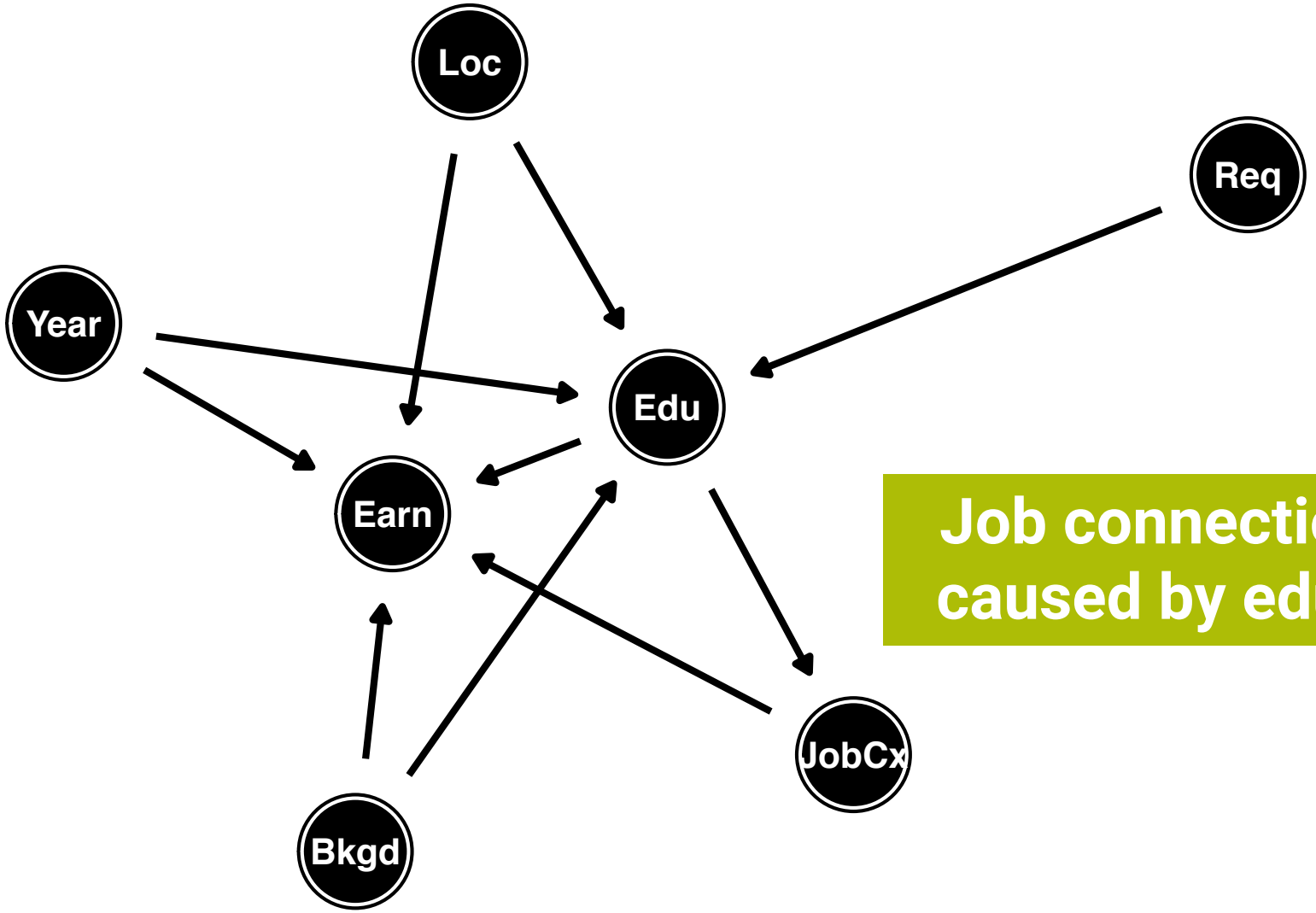


3. DRAW ARROWS



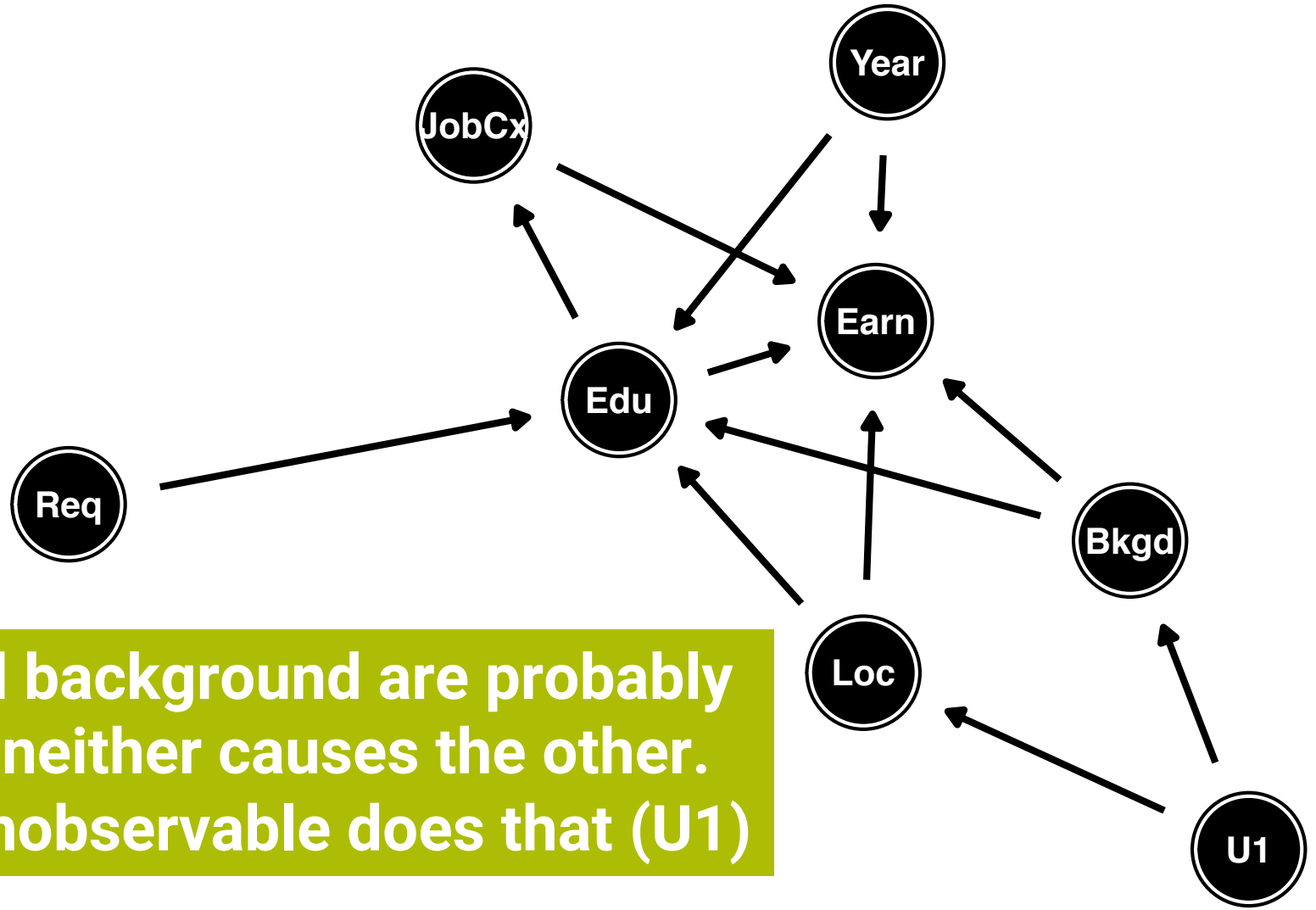
Background, year of birth, and location all effect earnings too

3. DRAW ARROWS



Job connections are caused by education

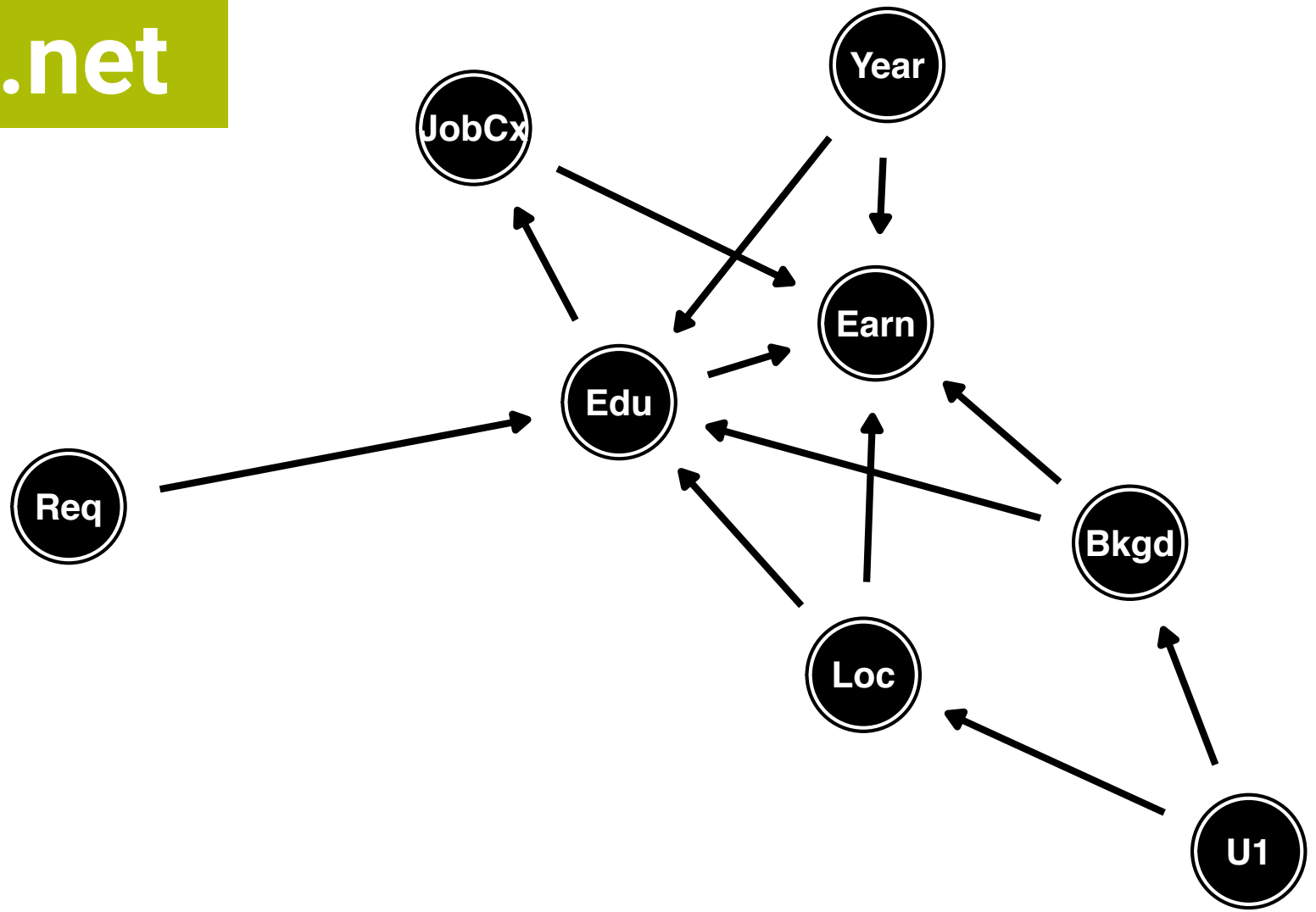
3. DRAW ARROWS



Location and background are probably related, but neither causes the other. Something unobservable does that (U1)

LET THE COMPUTER DO THIS

dagitty.net



YOUR TURN

Does a longer night's sleep extend your lifespan?

Step 1: List variables

Step 2: Simplify

Step 3: Connect arrows

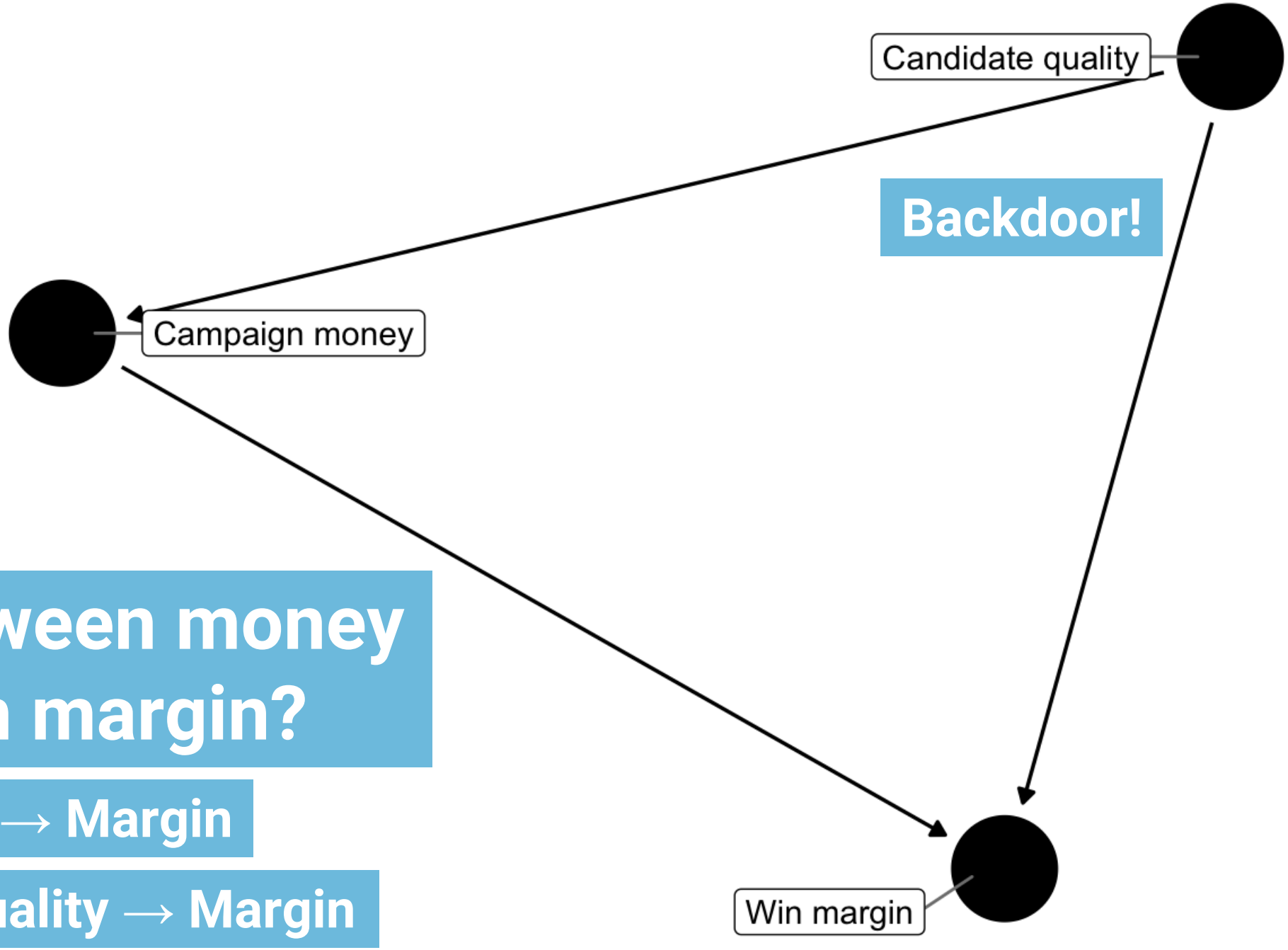
Use dagitty.net

BACKDOORS AND ADJUSTMENT

ISOLATE / IDENTIFY

Goal of causal inference is to isolate specific effects

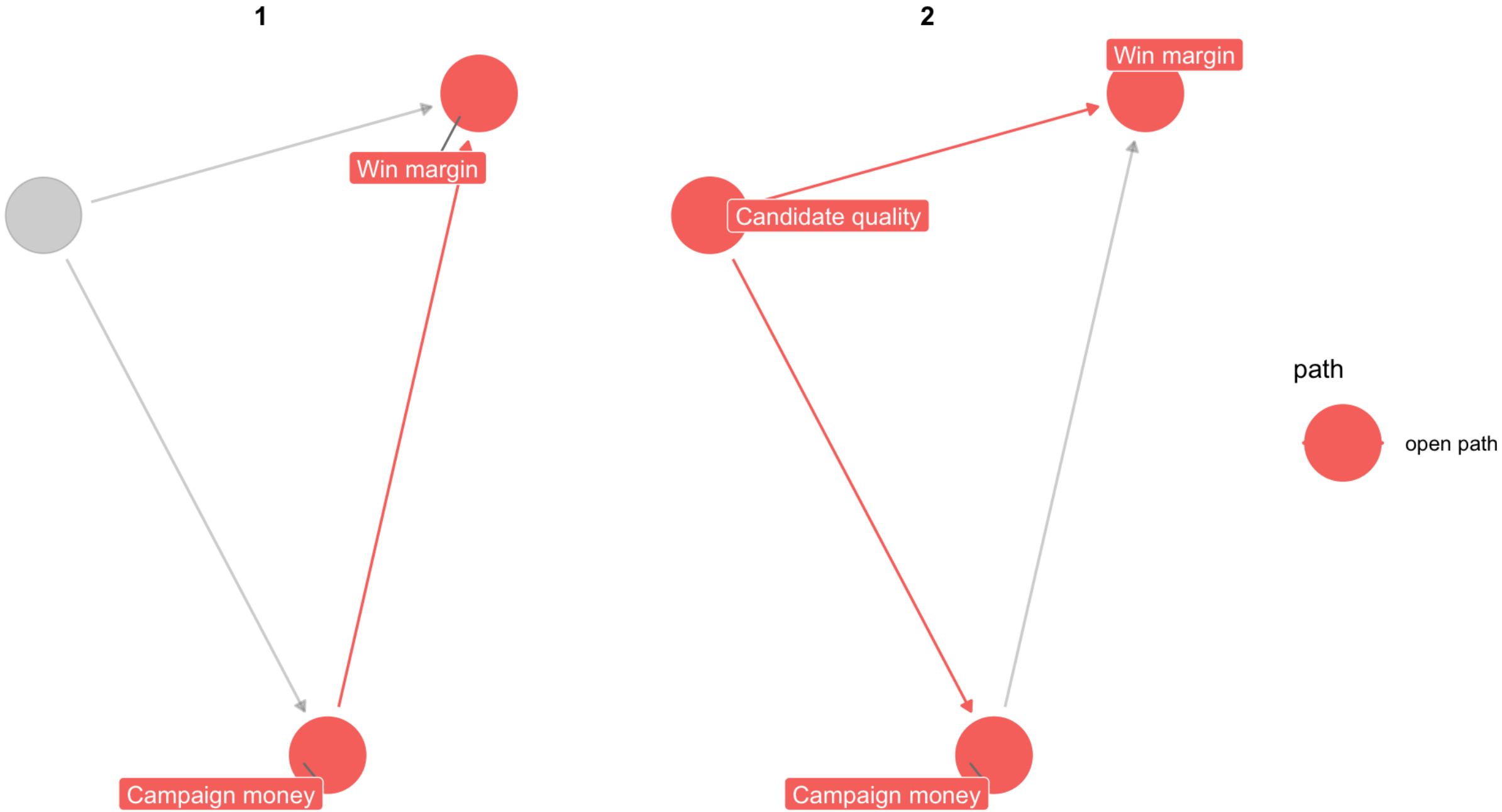
There's not always a single path between treatment and outcome



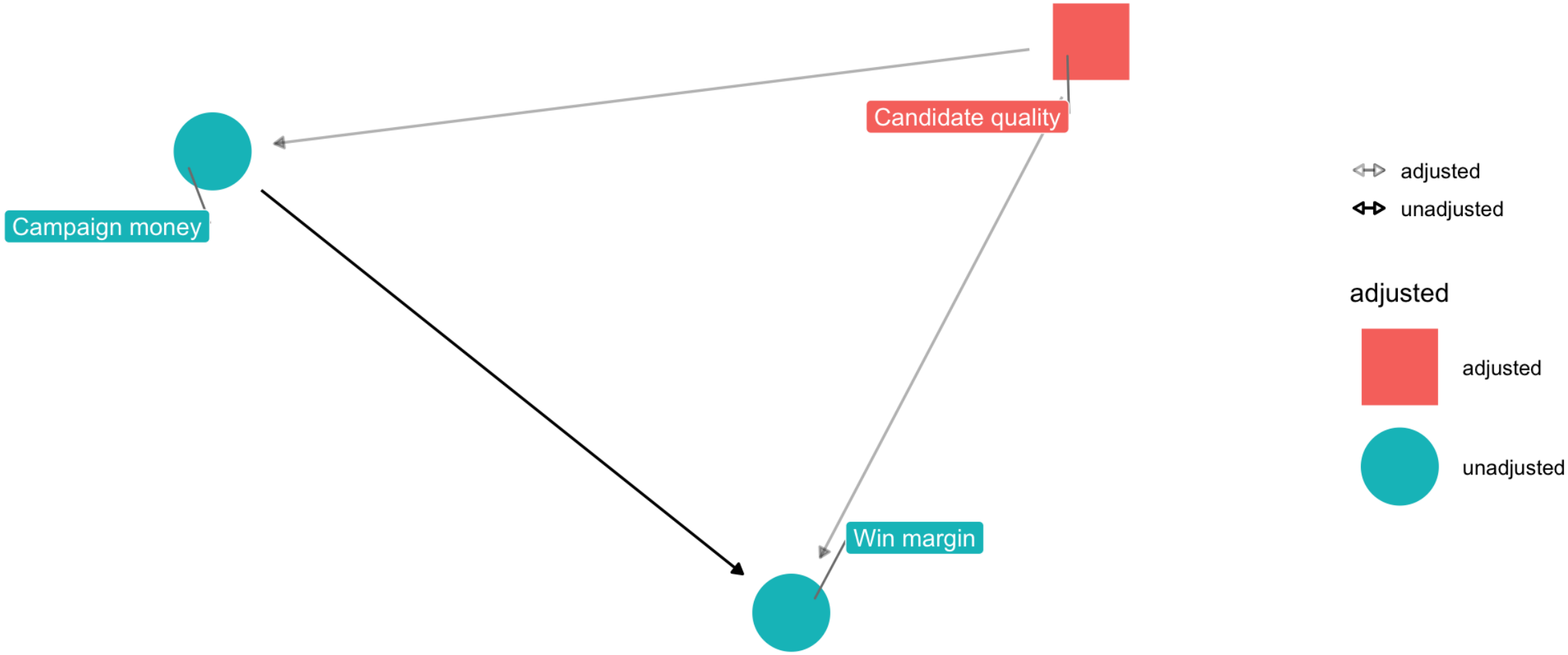
Paths between money and win margin?

Money → Margin

Money ← Quality → Margin

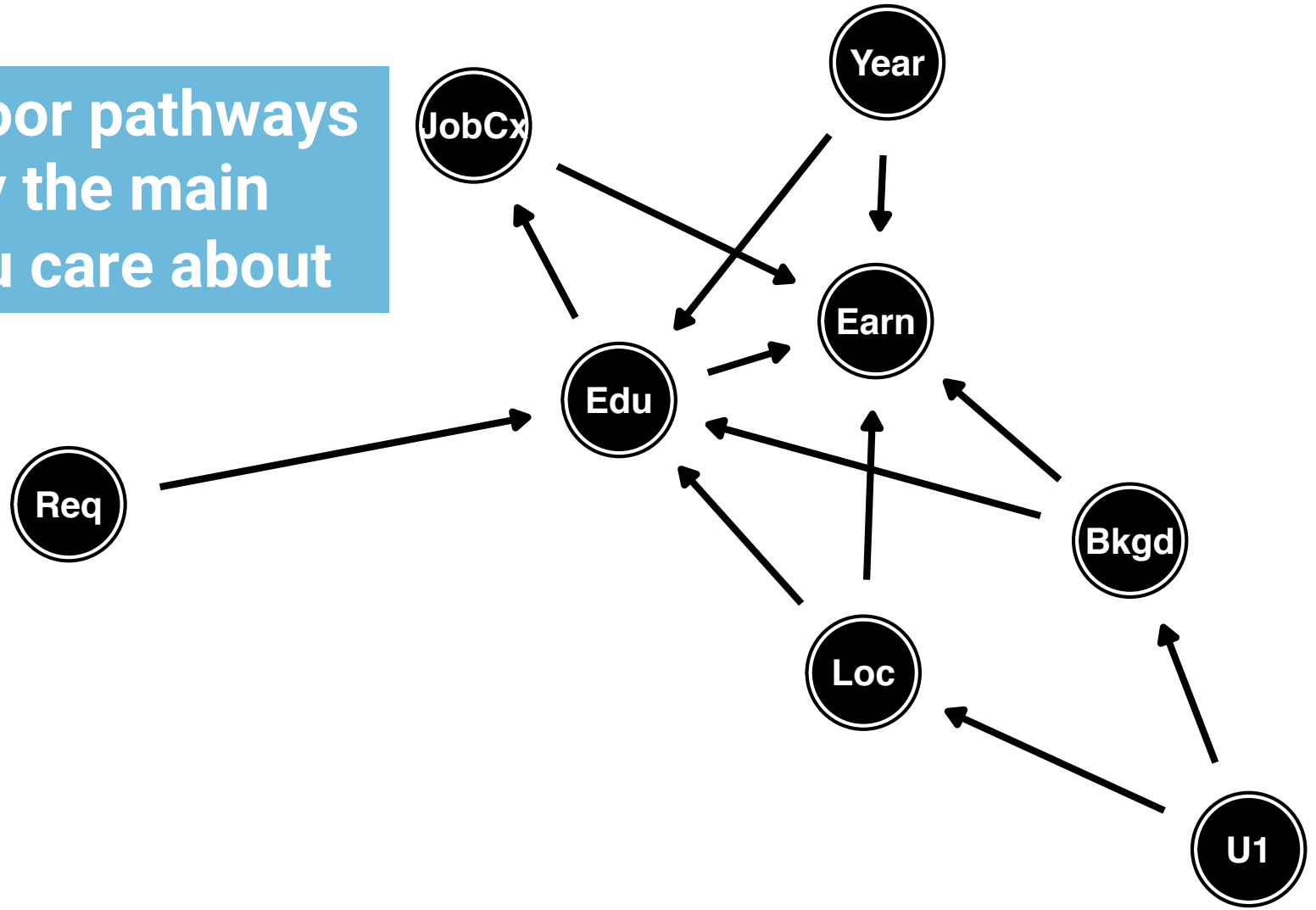

1
Win margin
Campaign money
2
Win margin
Candidate quality
Campaign money
path
open path

CLOSE BACKDOOR PATHS



4. MEASURE AND CONTROL FOR STUFF

Block backdoor pathways to identify the main pathway you care about



ALL PATHS

Education → Earnings

Education → Job connections → Earnings

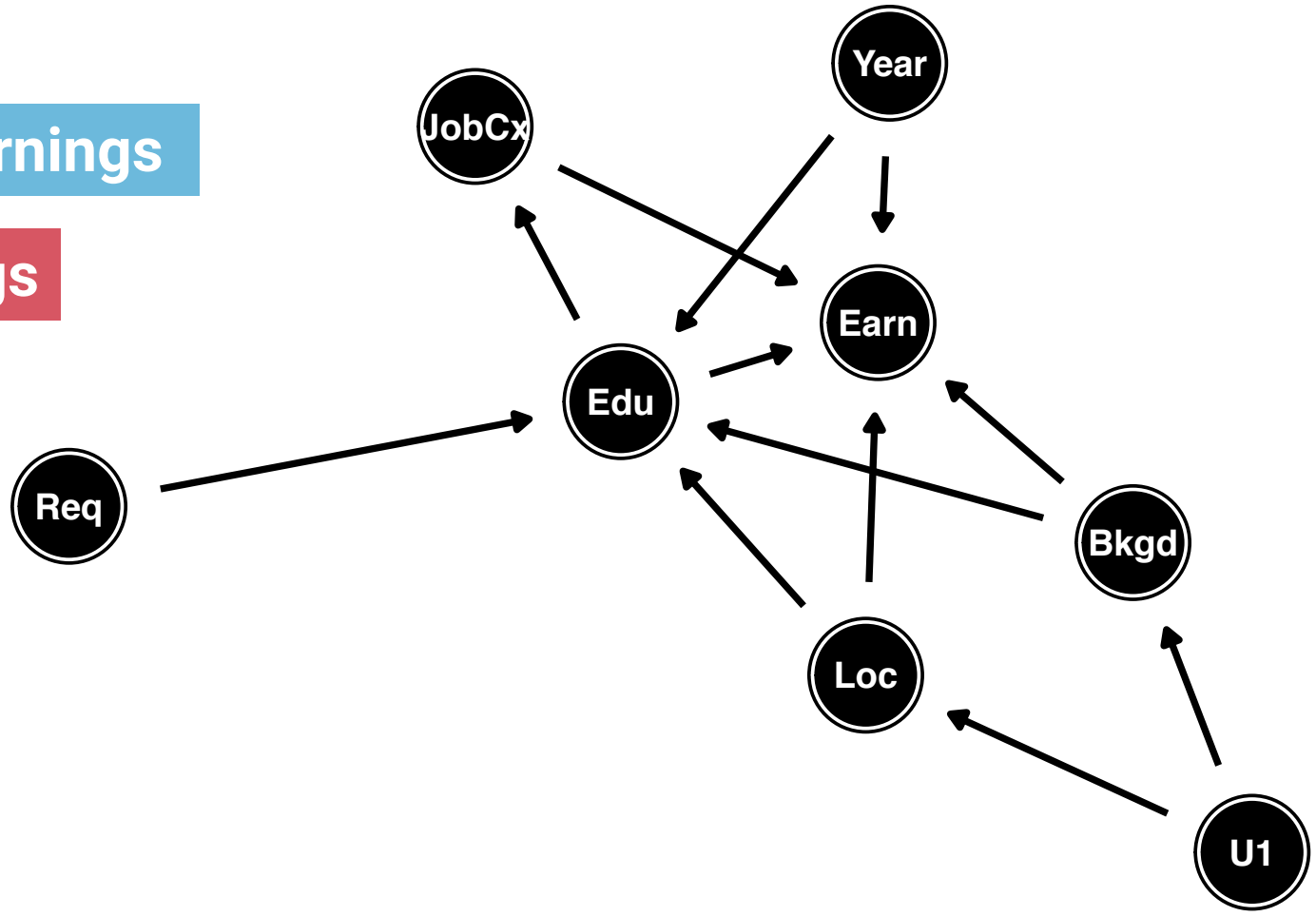
Education ← Background → Earnings

Education ← Background ← U1 → Location → Earnings

Education ← Location → Earnings

Education ← Location ← U1 → Background → Earnings

Education ← Year → Earnings



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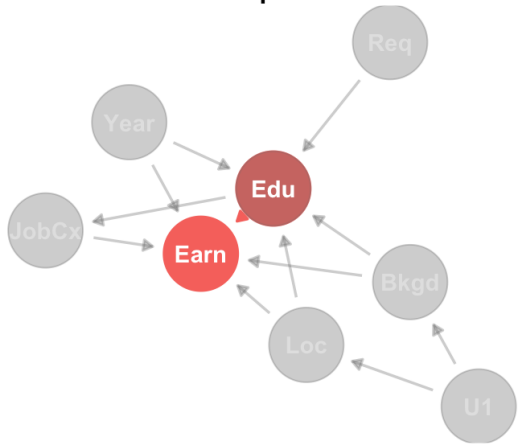

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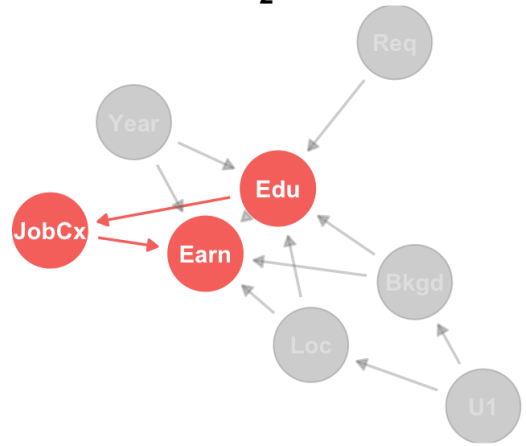

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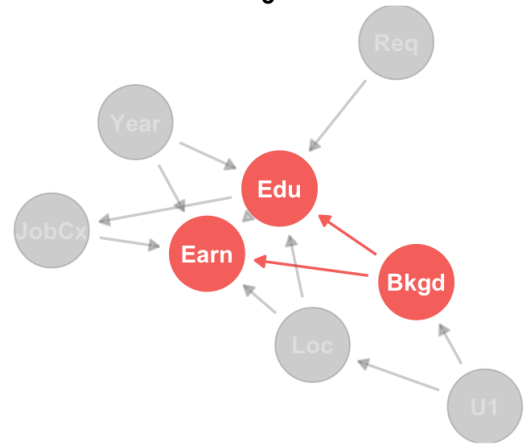

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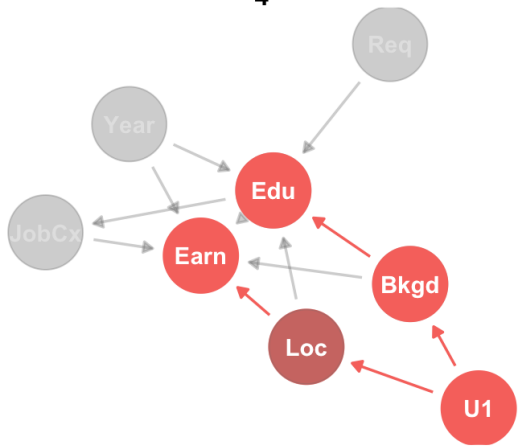

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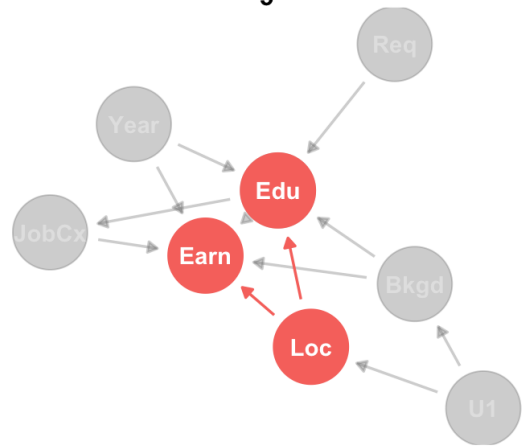

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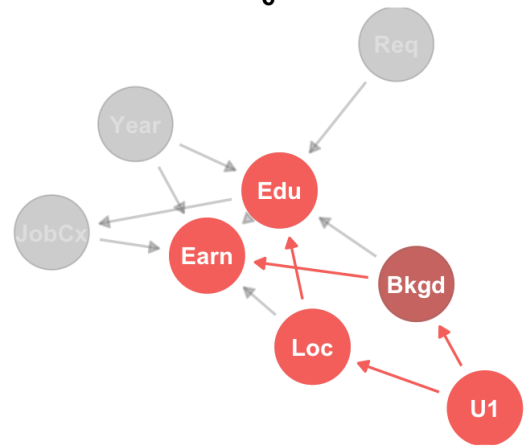
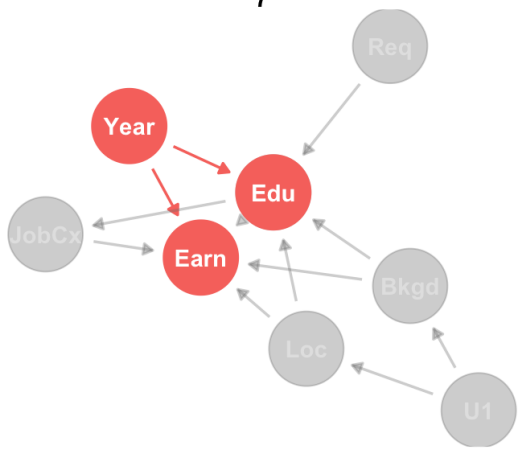


path

a open path

7



CLOSING DOORS

Education → Earnings

Education → Job connections → Earnings

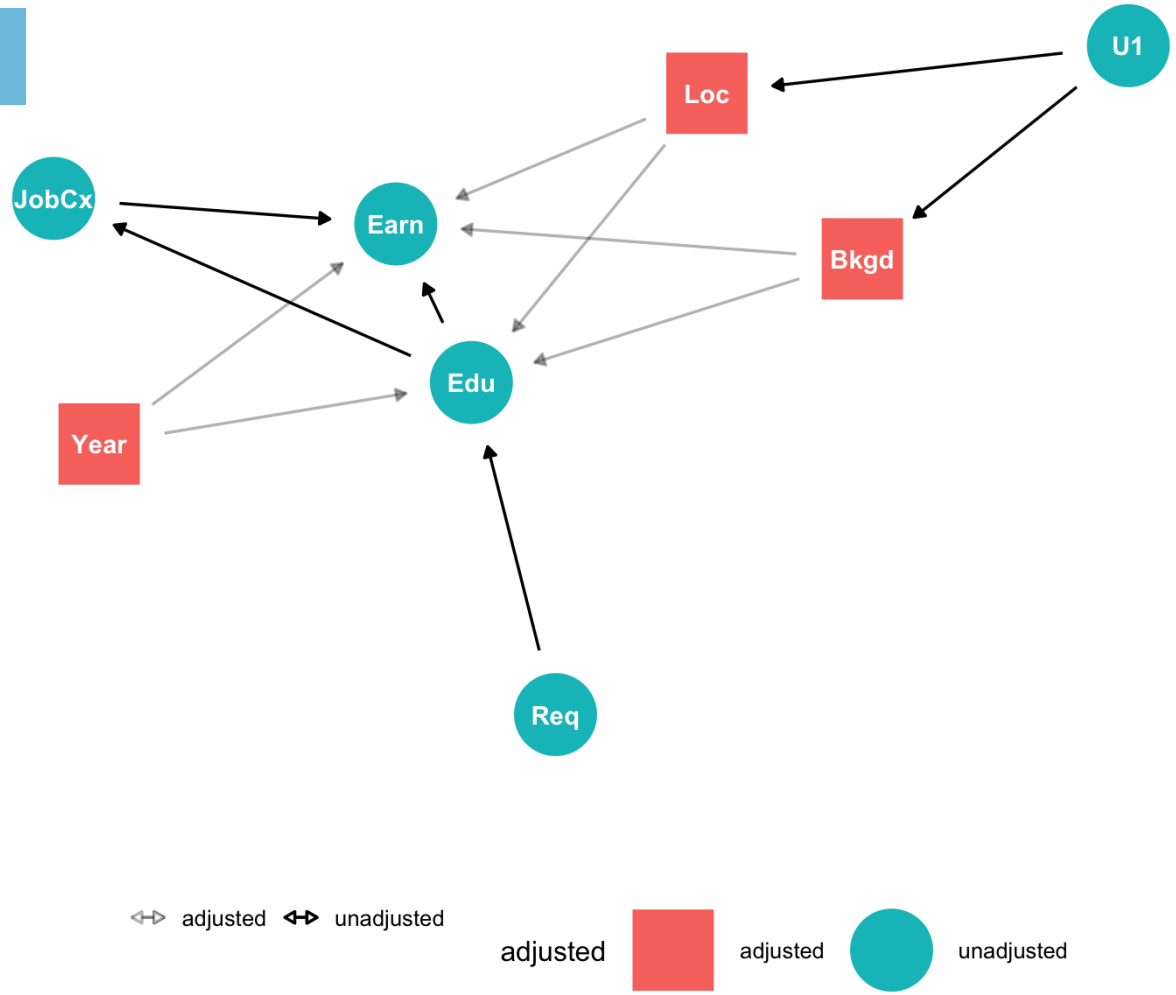
Education ← Background → Earnings

Education ← Background ← U1 → Location → Earnings

Education ← Location → Earnings

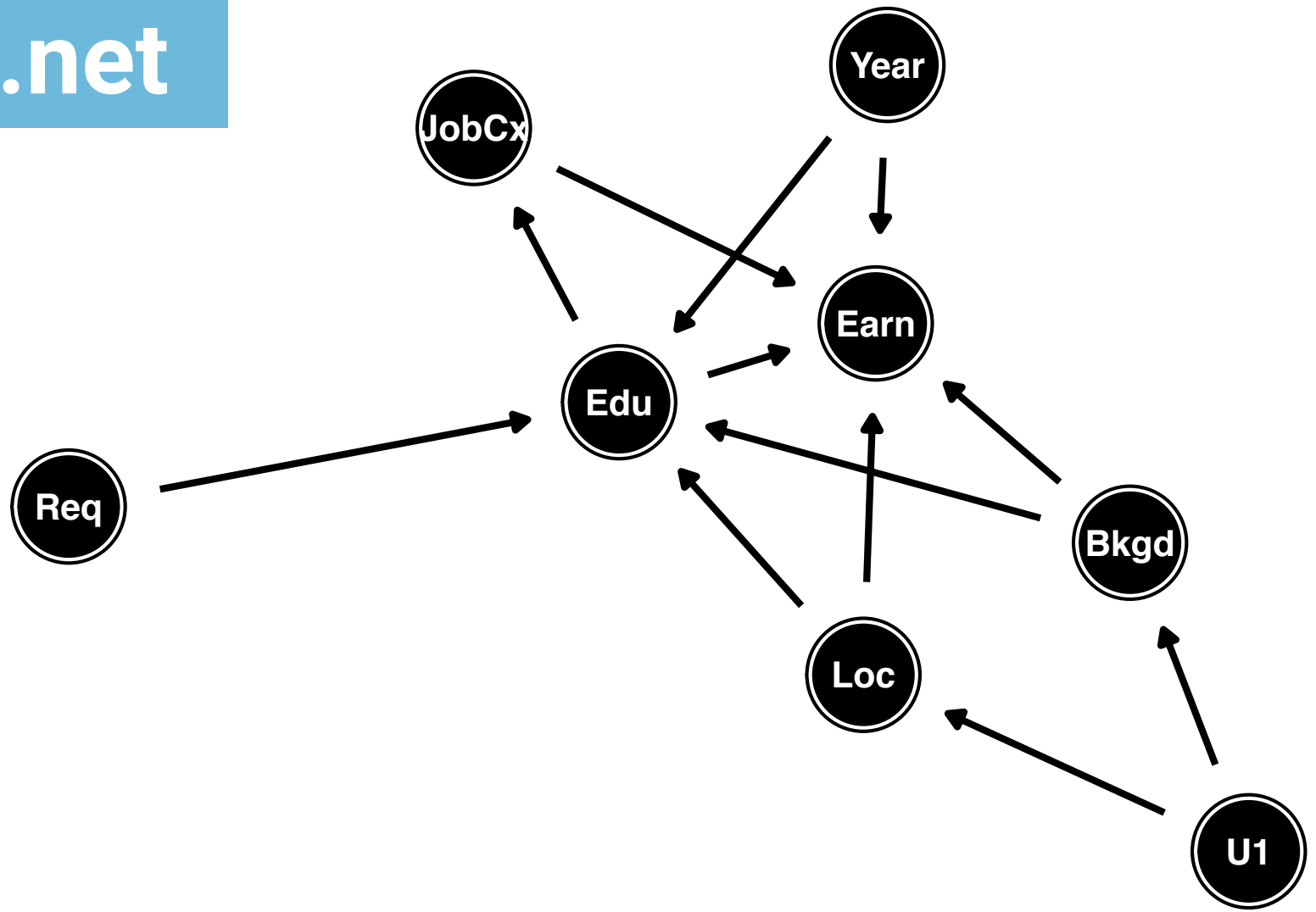
Education ← Location ← U1 → Background → Earnings

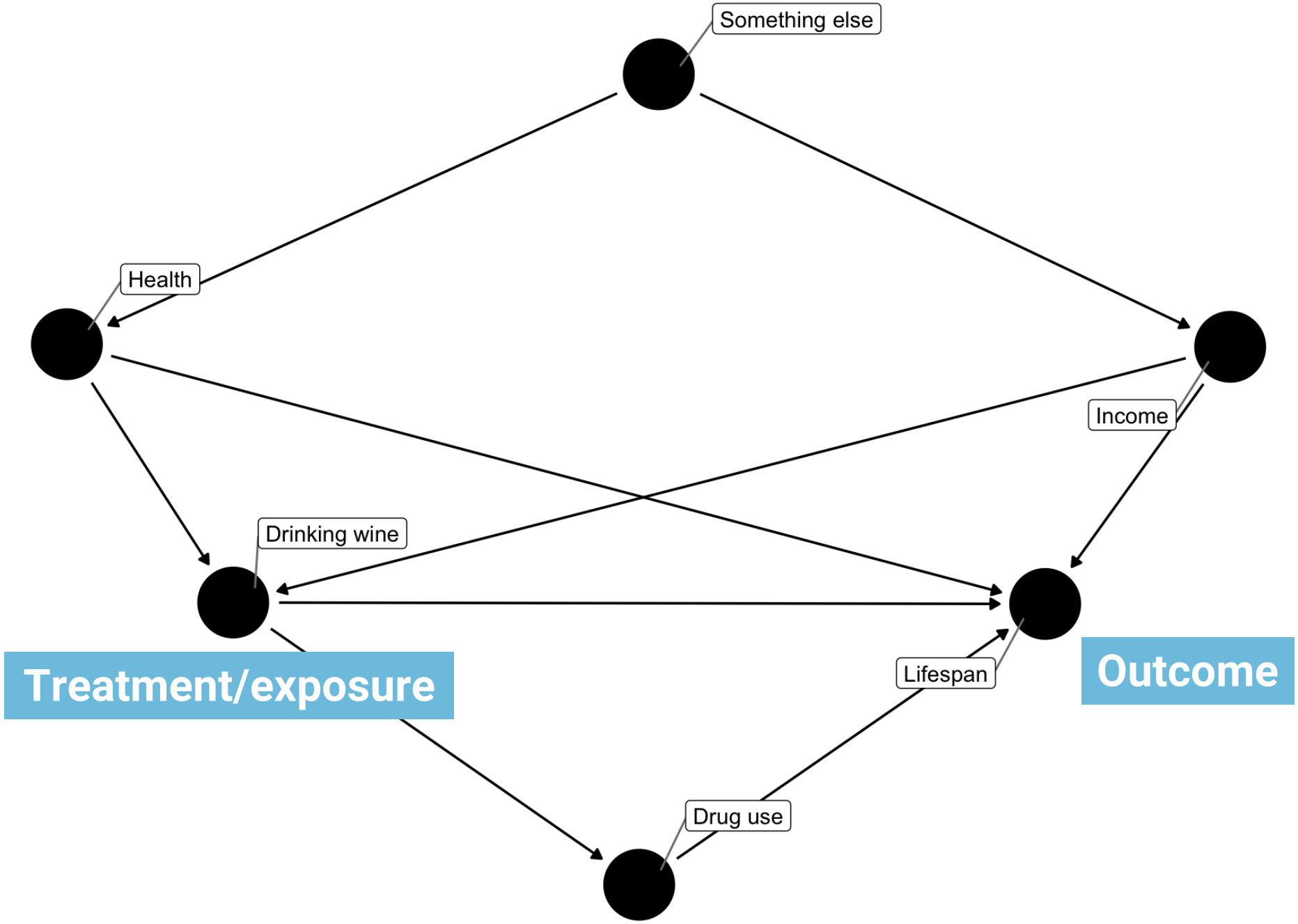
Education ← Year → Earnings



LET THE COMPUTER DO THIS AGAIN

dagitty.net




Something else
Health
Income
Drinking wine
Treatment/exposure
Lifespan
Outcome
Drug use

Wine → Lifespan

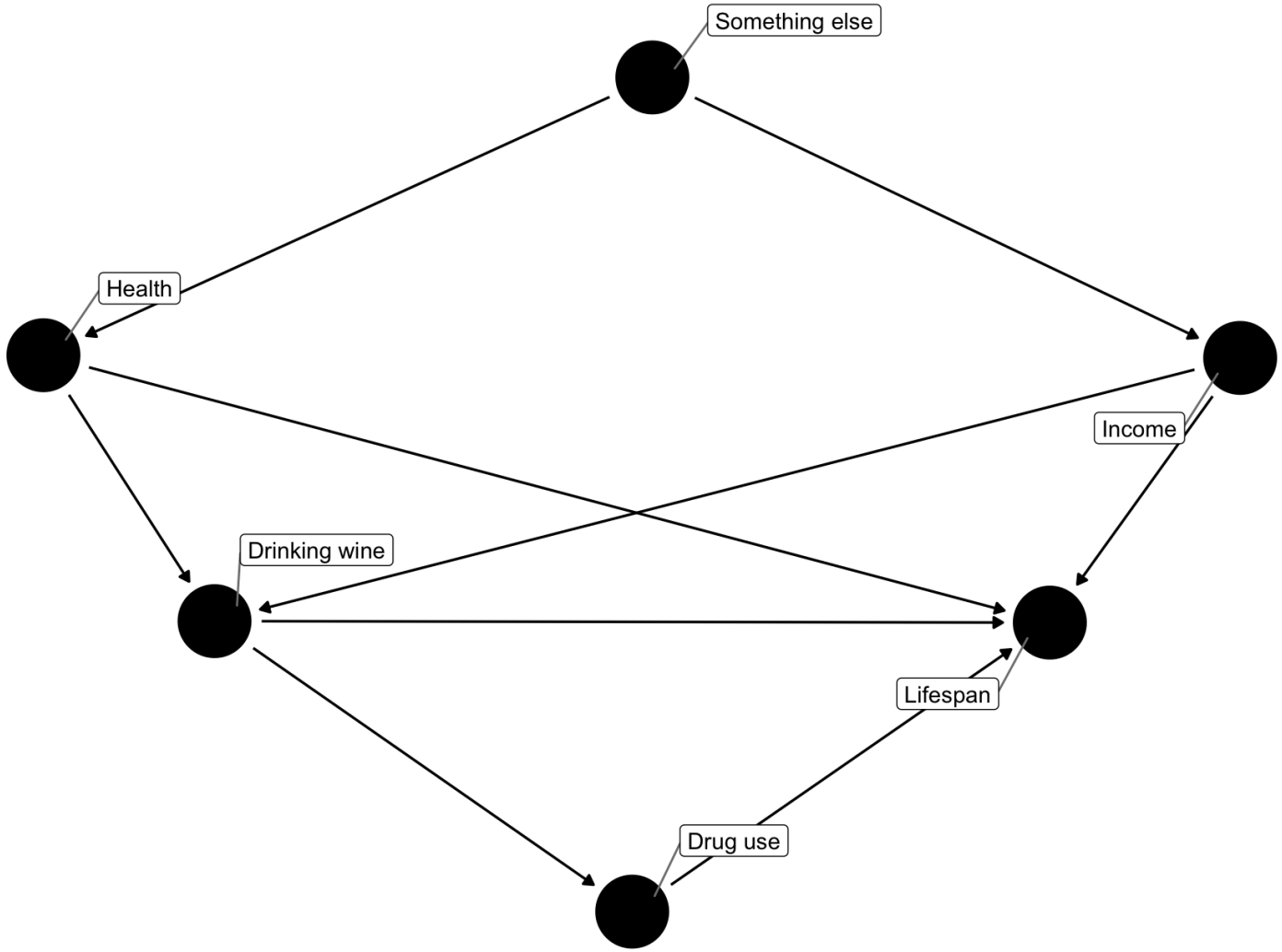
Wine → Drugs→ Lifespan

Wine ← Health → Lifespan

Wine ← Health ← Something → Income → Lifespan

Wine ← Income → Lifespan

Wine ← Income ← Something → Health → Lifespan



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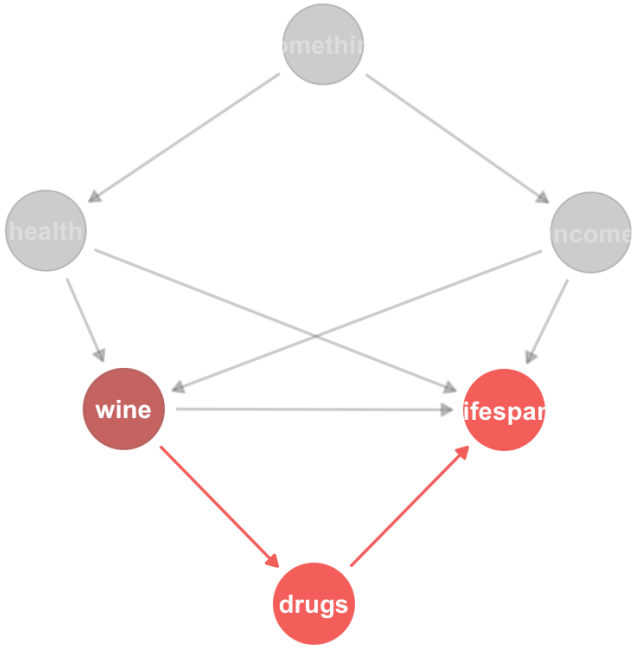
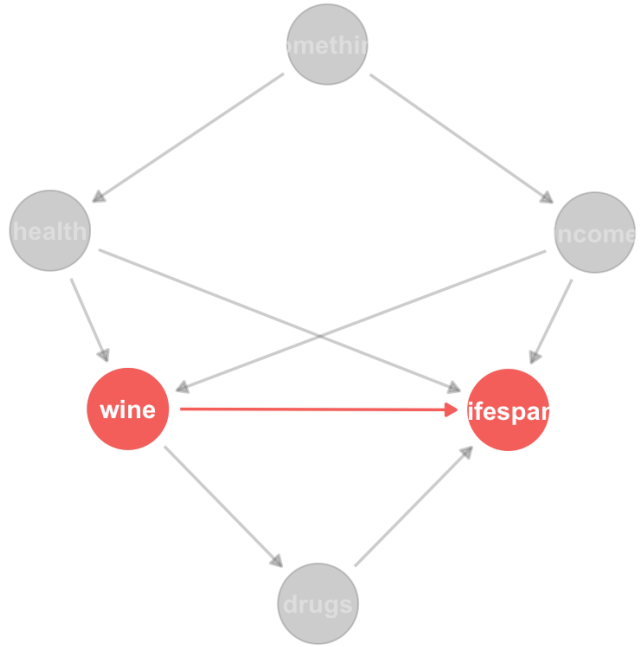
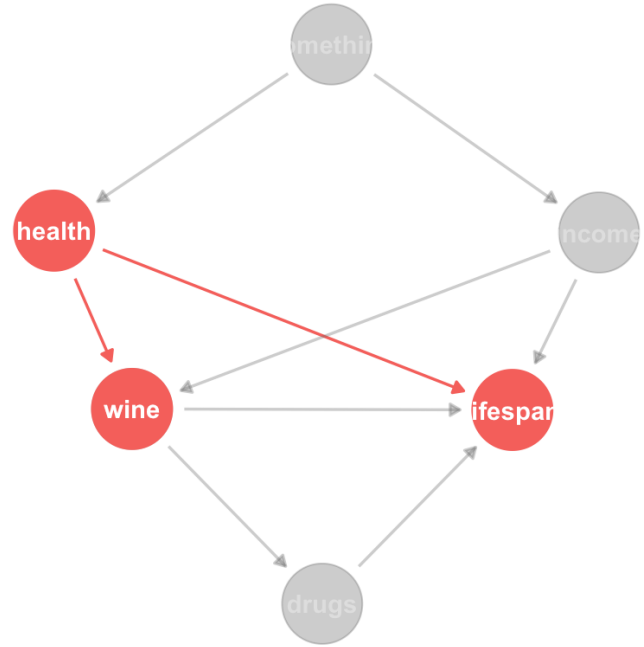

wine
drugs

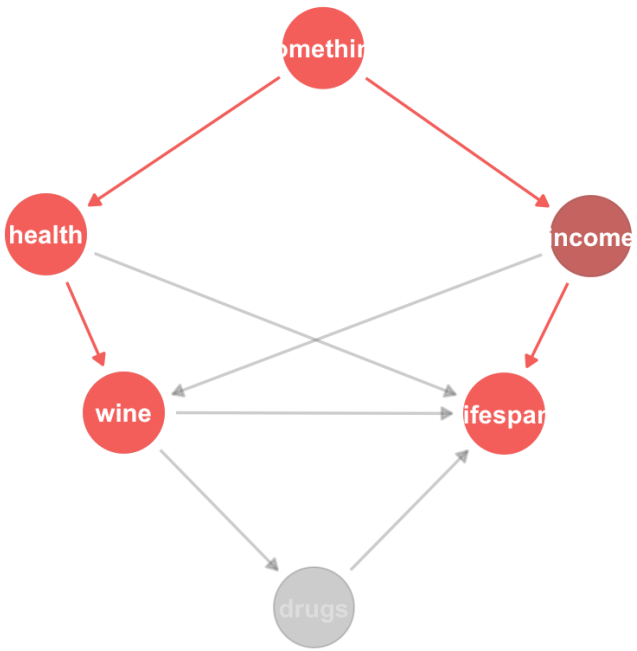
2


wine
drugs

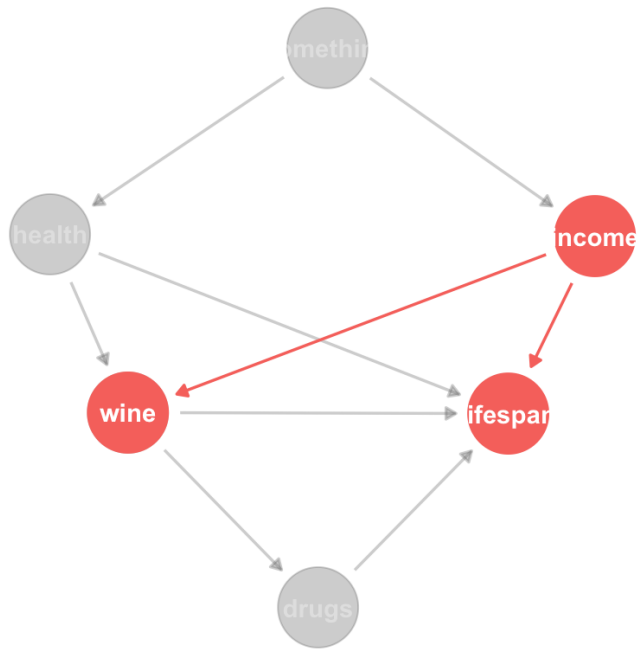
3


health
wine
drugs

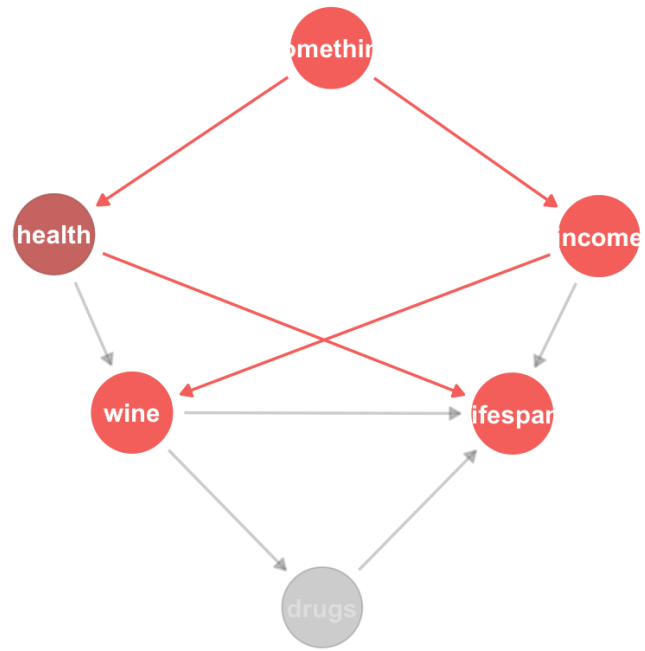
4

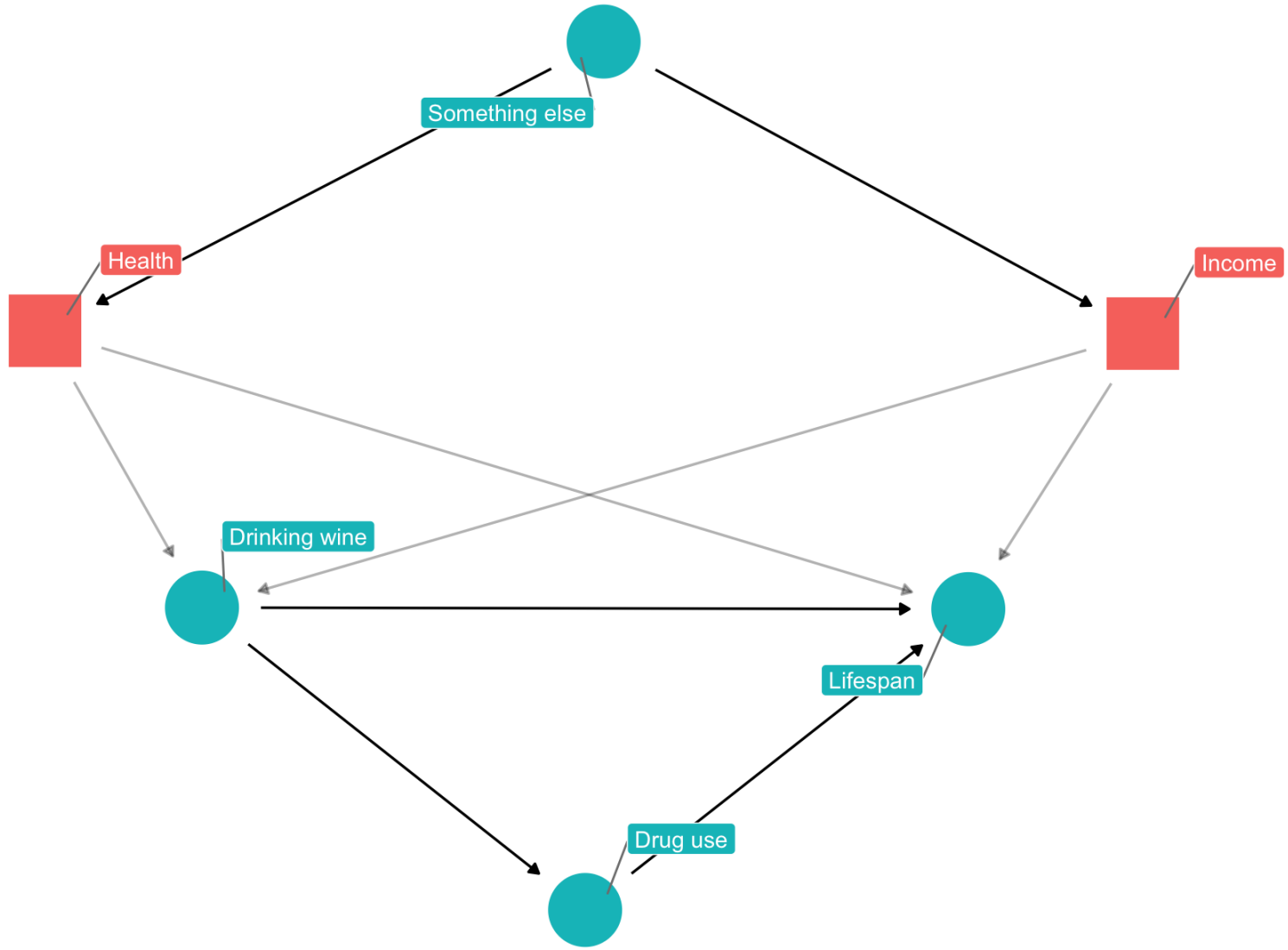

health
wine
drugs

5


wine
drugs

6


health
wine
drugs



adjusted unadjusted

adjusted adjusted unadjusted

PRACTICE!

Go to andhs.co/nyt and read the article

Pick one of the causal claims in the article

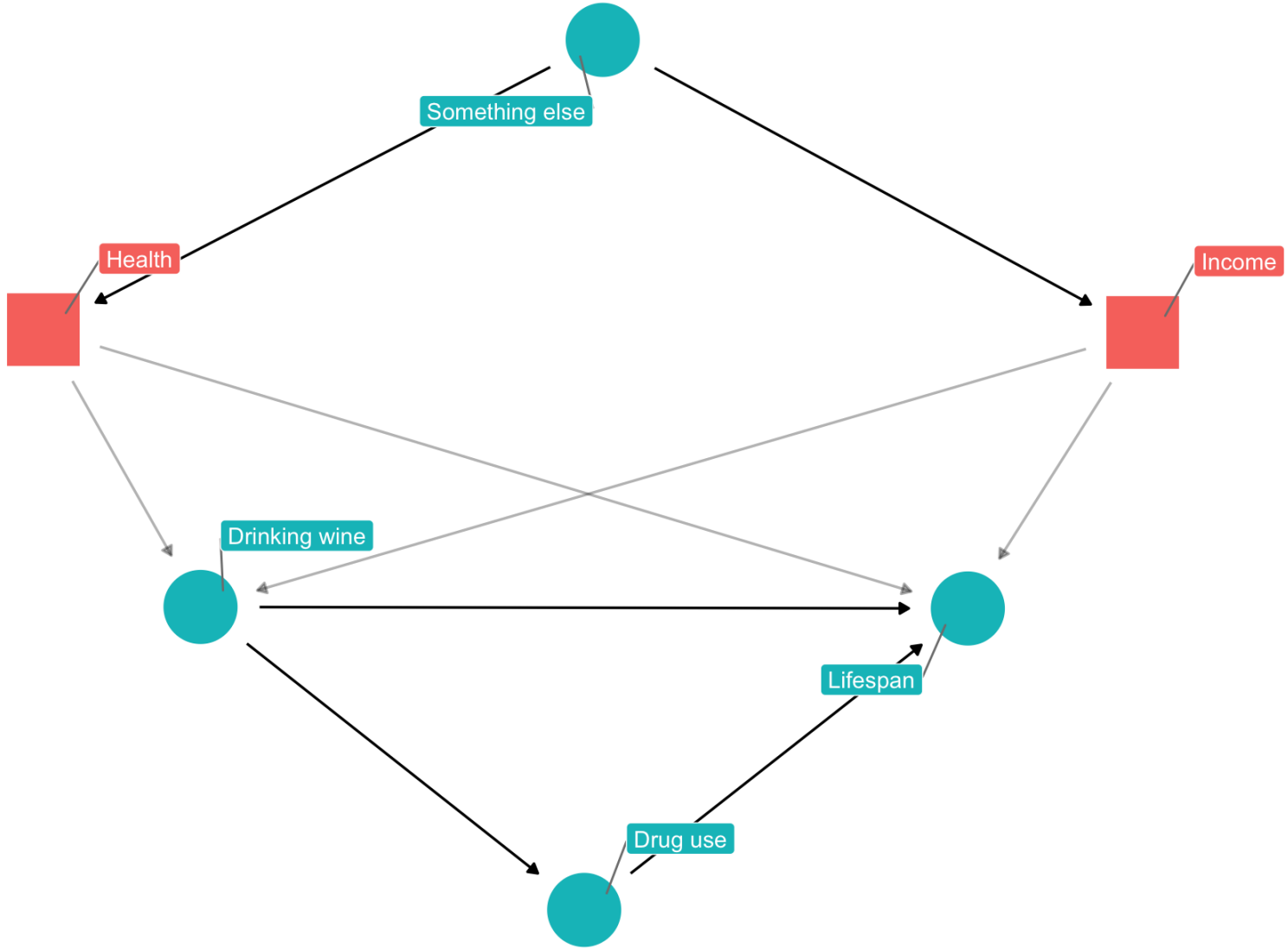
(There are a lot! Look for words like “improve”, “affect”, and “reduces)

Draw a diagram for that causal claim

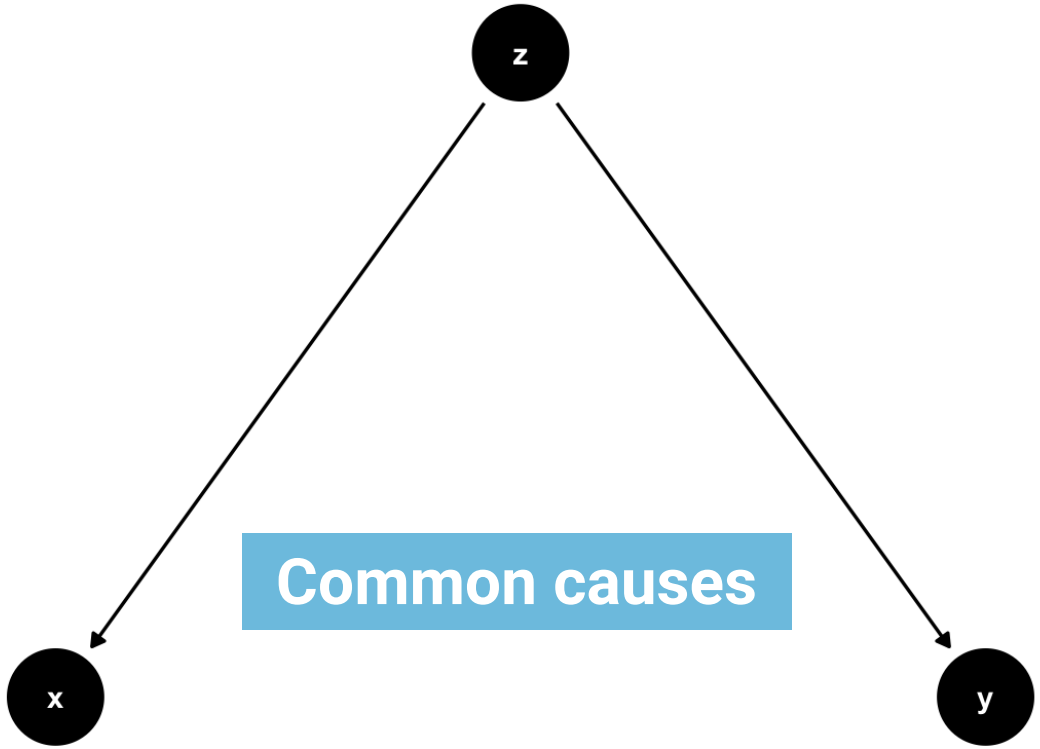
Determine what needs to be controlled for to identify the effect

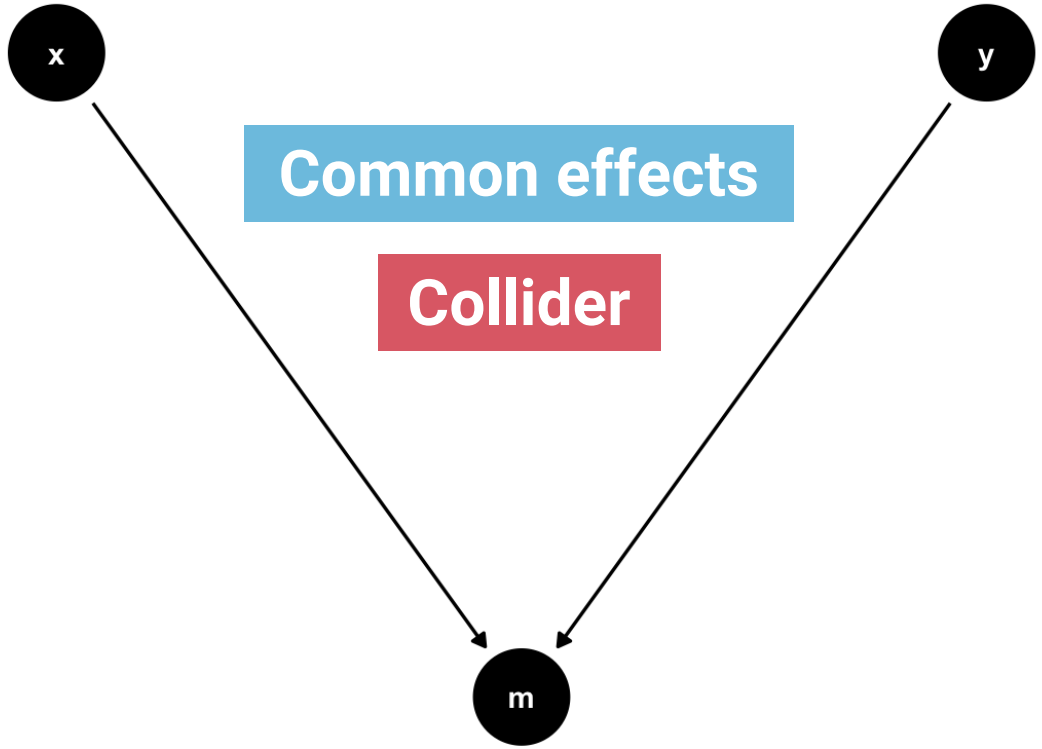
Do another claim if time

What would happen if we controlled for drug use?



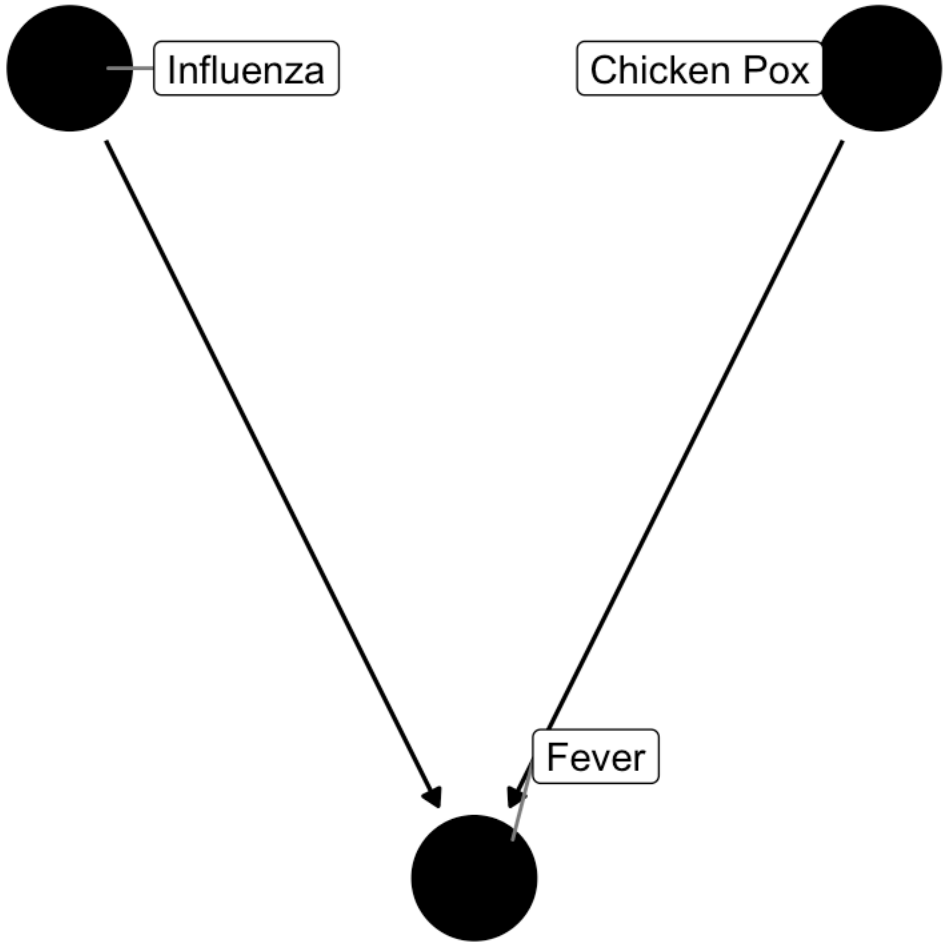
OVERCONTROLLING AND COLLIDERS

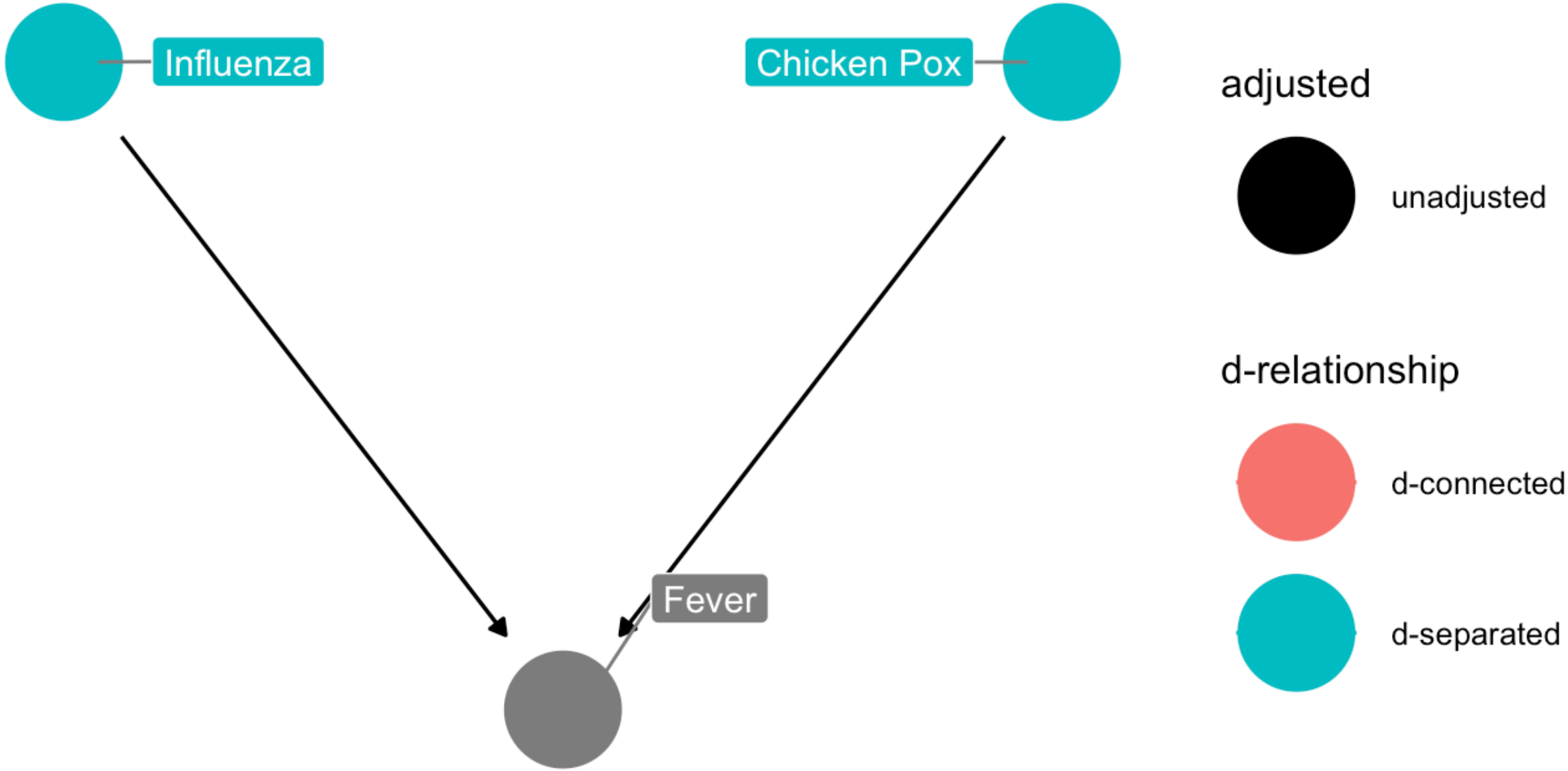


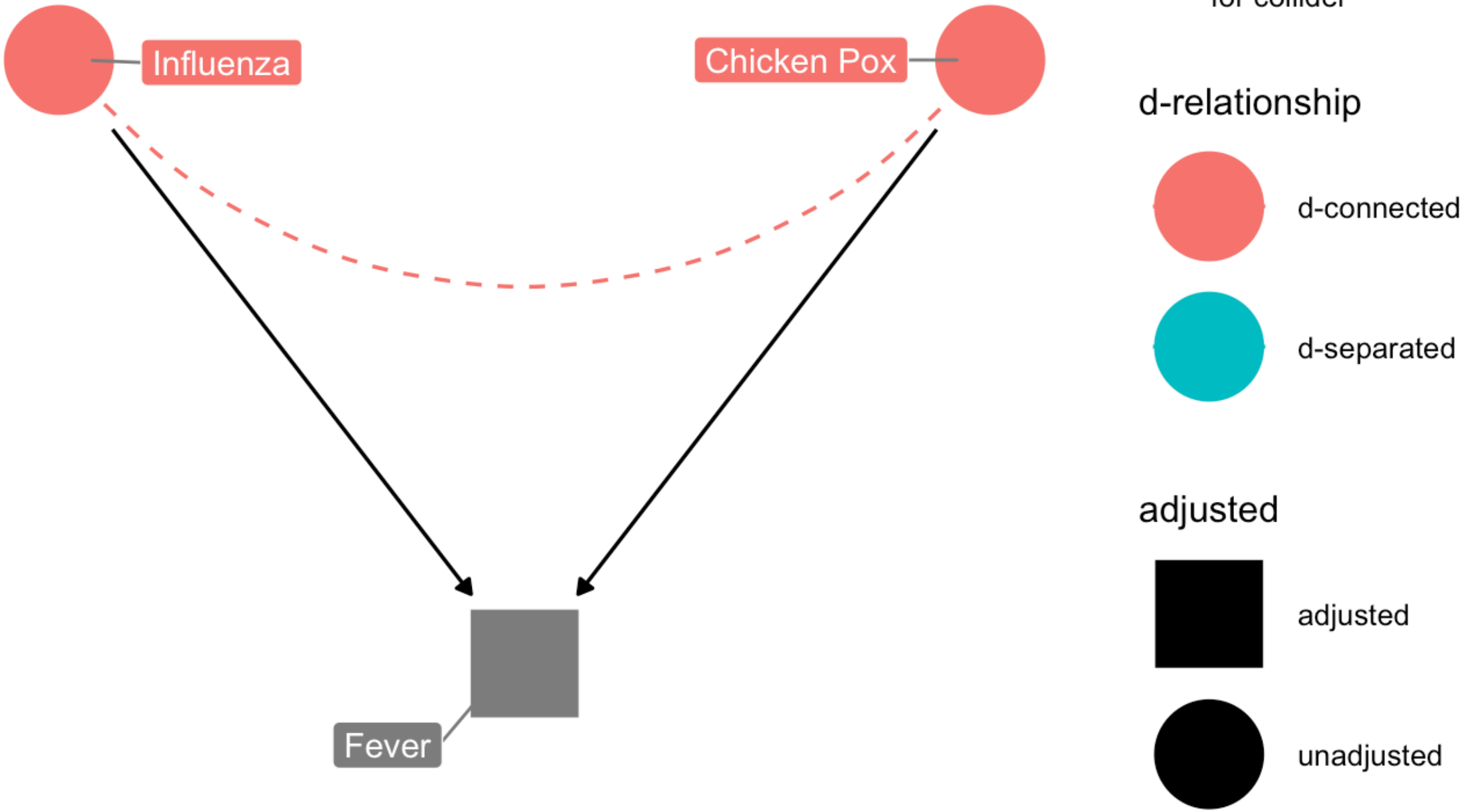


Don’t control for M

OVERCONTROLLING AND COLLIDERS




Influenza
Chicken Pox
Fever
adjusted
unadjusted
d-relationship
d-connected
d-separated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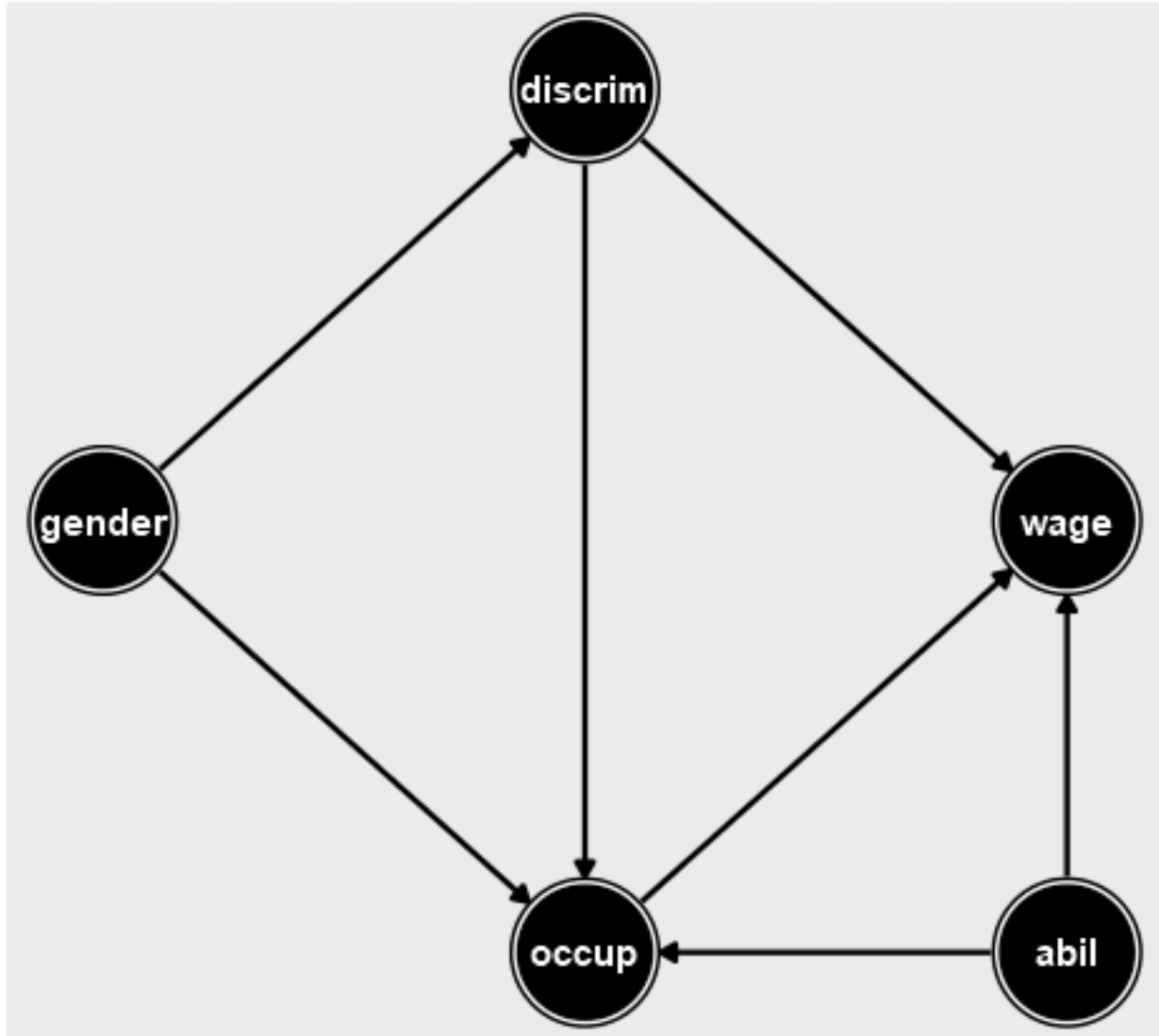
Influenza
Chicken Pox
Fever
d-relationship
d-connected
d-separated
adjusted
adjusted
unadjusted


discrim
gender
wage
occup
abil