

Evaluation and the causal revolution

Session 1

PMAP 8521: Program evaluation
Andrew Young School of Policy Studies

Plan for today

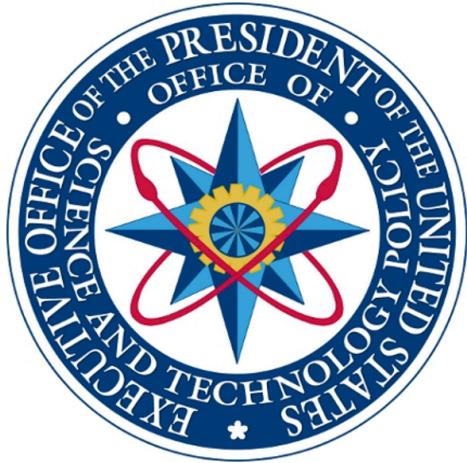
Data science and public service

Evidence, evaluation, and causation

Class details

Data science and public service

Data and government



THE U. S. DIGITAL SERVICE



DJ Patil

**"To responsibly
unleash the
power of data to
benefit all
Americans"**

The White House

Office of the Press Secretary

For Immediate Release

June 30, 2016

FACT SHEET: Launching the Data-Driven Justice Initiative: Disrupting the Cycle of Incarceration

"[O]ur criminal justice system isn't as smart as it should be. It's not keeping us as safe as it should be. It is not as fair as it should be.

Mass incarceration makes our country worse off, and we need to do something about it." -

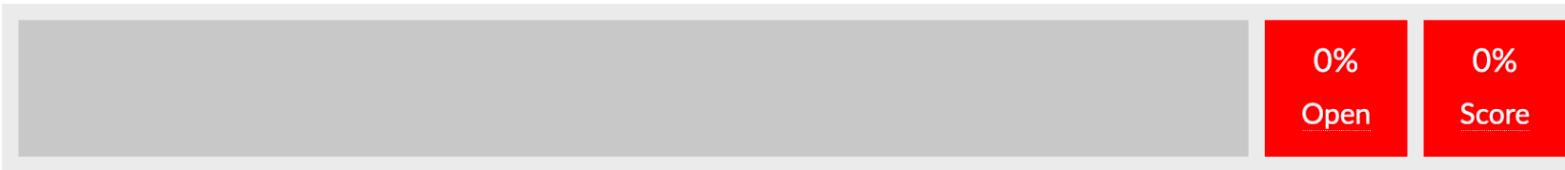
President Barack Obama, July 14, 2015



U.S. CITY OPEN DATA CENSUS

POWERED BY OPEN DATA CENSUS

Rank	Place	Budget	Crime Reports	Parcels	Construction Permits	Zoning	Service Request	Code Violations	Employee Salaries	Business Listings	Spending	Restaurant Inspections	Public Facilities	Traffic Crashes	Property Assessment	Procurement Contracts	Emergency Calls	Lobbyist Activity	Police Use-of-Force	Website Analytics	Property Transfers	Score
1	Cincinnati, OH	<div style="width: 94%;"></div>	94%																			
2	Las Vegas, NV	<div style="width: 89%;"></div>	89%																			
3	San Francisco, CA	<div style="width: 85%;"></div>	85%																			
4	Virginia Beach, VA	<div style="width: 79%;"></div>	79%																			
5	Baton Rouge/E.B.R. Parish, LA	<div style="width: 78%;"></div>	78%																			



Breakdown

Dataset	Breakdown	Year	Score	↑
Budget			<input checked="" type="checkbox"/>	
Business Listings			<input checked="" type="checkbox"/>	
Code Violations			<input checked="" type="checkbox"/>	
Construction Permits			<input checked="" type="checkbox"/>	
Crime Reports			<input checked="" type="checkbox"/>	
Emergency Calls			<input checked="" type="checkbox"/>	
Employee Salaries			<input checked="" type="checkbox"/>	
Lobbyist Activity			<input checked="" type="checkbox"/>	
Parcels			<input checked="" type="checkbox"/>	
Police Use-of-Force			<input checked="" type="checkbox"/>	
Procurement Contracts			<input checked="" type="checkbox"/>	
Property Assessment			<input checked="" type="checkbox"/>	
Property Transfers			<input checked="" type="checkbox"/>	
Public Facilities			<input checked="" type="checkbox"/>	
Restaurant Inspections			<input checked="" type="checkbox"/>	
Service Requests			<input checked="" type="checkbox"/>	
Spending			<input checked="" type="checkbox"/>	

Google Dataset Search Beta

Search for Datasets



Try [boston education data](#) or [weather site:noaa.gov](#)

Google

Dataset Search



salt lake city



Salt Lake City Police
Department
[moto.data.socrata.com](#)
Updated Aug 26, 2018

Salt Lake City Police Department

 [moto.data.socrata.com](#)

254 scholarly articles cite this dataset ([View in Google Scholar](#))



Precipitation Depth Table from
Salt Lake City Zoo Station
[www.hydroshare.org](#)

Dataset created Dec 2, 2015

Dataset updated Aug 26, 2018

Dataset published Dec 2, 2015



Data from: Case Outcomes
Following Investigative
Interviews of Suspected...
[www.icpsr.umich.edu](#)
[datamed.org](#)

Available download formats from providers

[CSV](#) , [RSSXML](#) , [RDFXML](#) , [XML](#)

Description

Salt Lake City Police Department incident dataset

**How do you use all this data
to make the world better?**

Analyze it and
uncover insights!

(and take this class!)

What is "statistics"?

Collecting and analyzing data from a representative sample in order to make inferences about a whole population

What is "data science"?

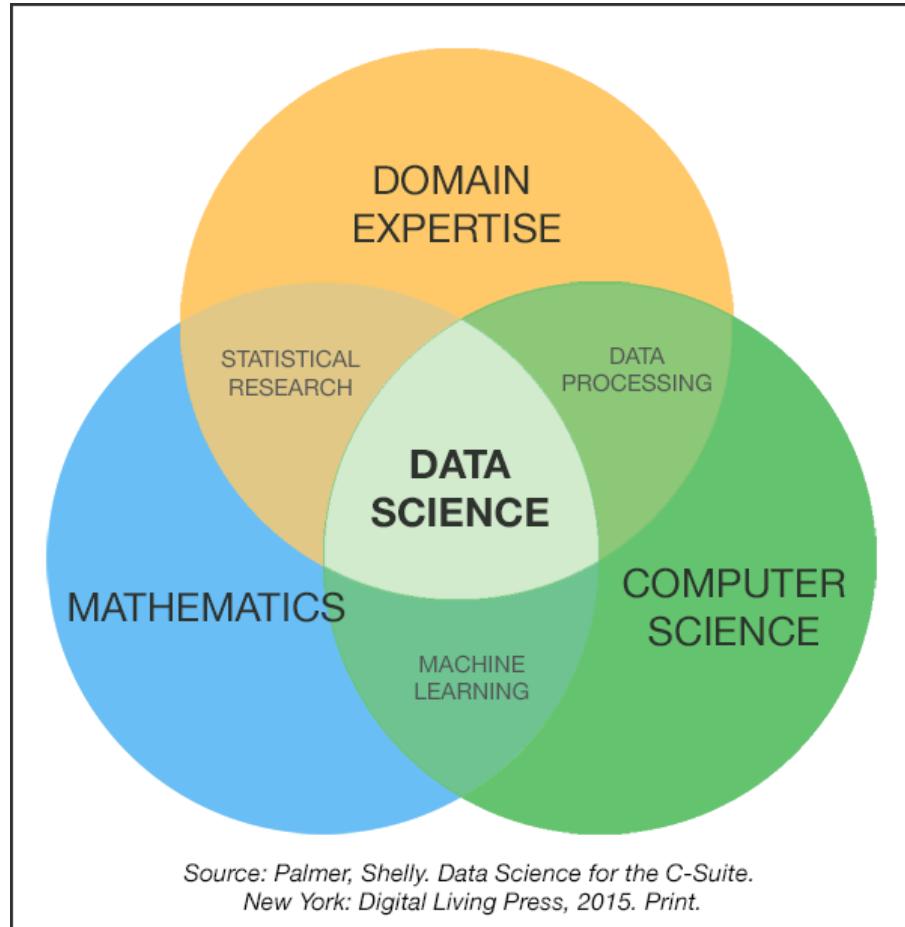
Turning raw data into
understanding, insight,
and knowledge

Collect

Analyze

Communicate

What's the difference?



Collect

Analyze

Communicate

What is "program evaluation"?

**Measuring the effect of
social programs on society**

Data science
(data + statistics +
communication)

Causal inference
(DAGs + econometrics)

Evidence, evaluation, and causation

Evidence-based medicine



Modern evidence-based medicine

Apply evidence to clinical
treatment decisions

Move away from clinical judgment
and "craft knowledge"

Is this good?

Evidence-based policy

RAND health insurance study

Oregon Medicaid expansion

HUD's Moving to Opportunity

Tennessee STAR

Policy evidence industry

Jameel Poverty Action Lab (J-PAL)

Campbell Collaboration

Should we have evidence for every policy or program?

No!

Science vs. art/craft/intuition



Ellie Murray
@EpiEllie

Follow

IF U DONT SMOKE,
U ALREADY
BELIEVE IN
CAUSAL INFERENCE
WITHOUT
RANDOMIZED TRIALS

(_) ||
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#HistorianSignBunny #Epidemiology

10:13 PM - 12 Jul 2018

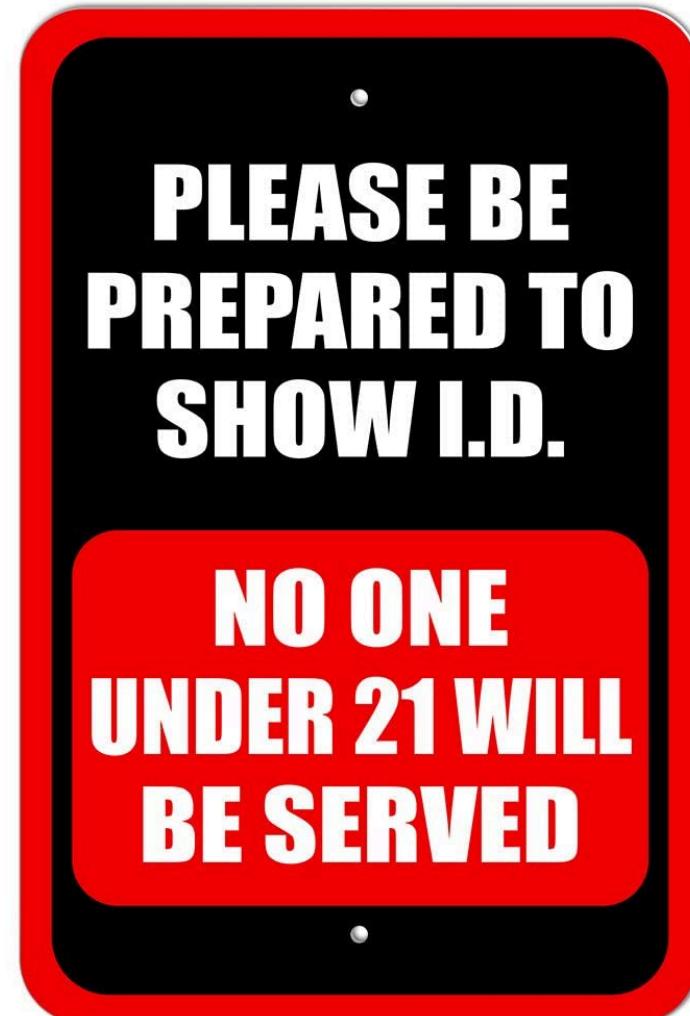
200 Retweets 612 Likes



29

200

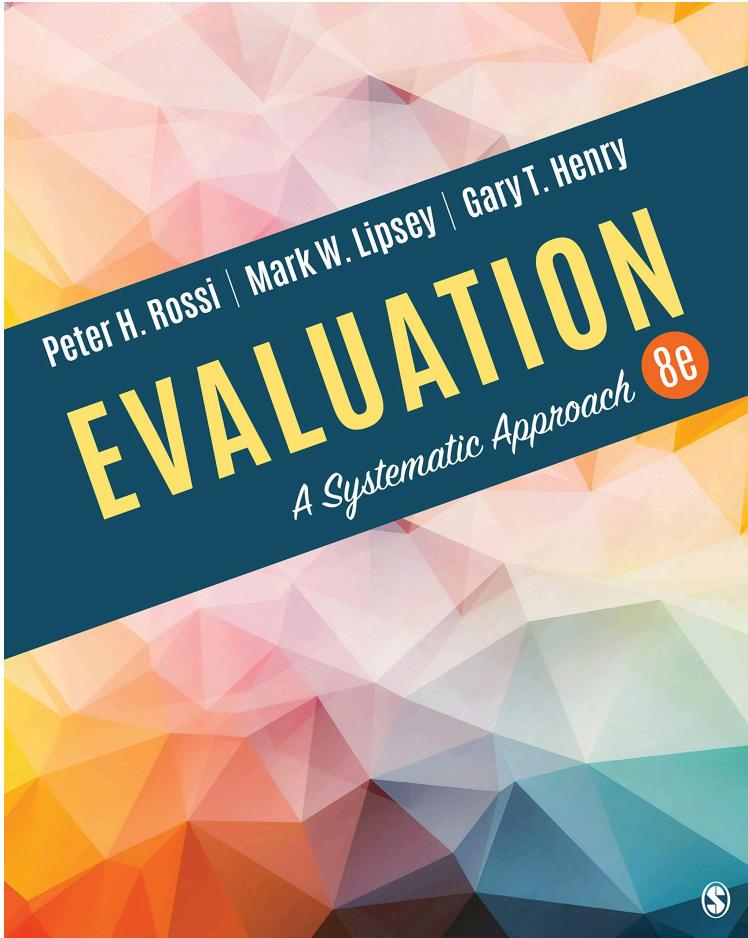
612



Where does program evaluation fit with all this?

It's a method for collecting evidence for policies and programs

Types of evaluation



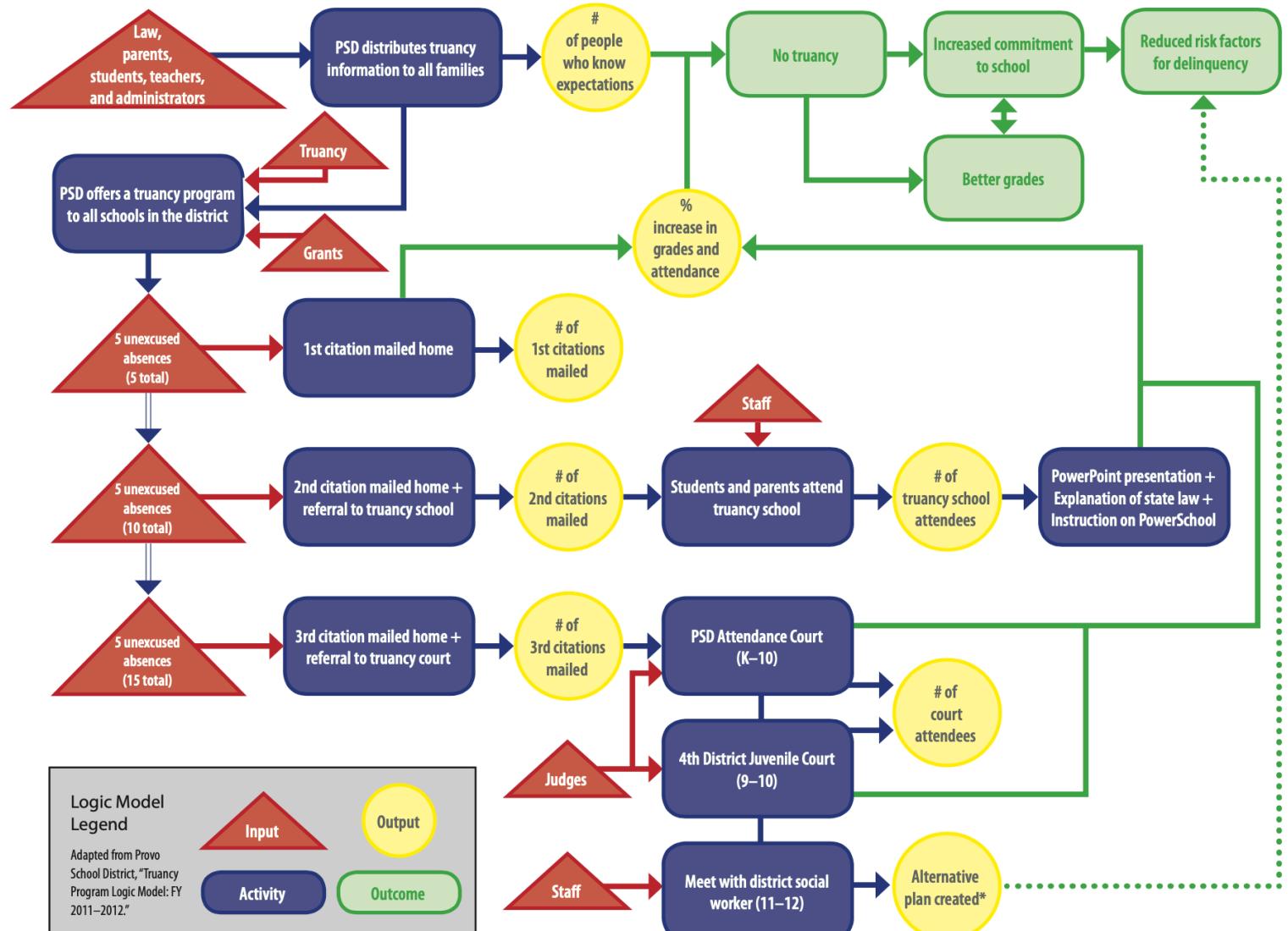
Needs assessment

Design and theory assessment

Process evaluation and monitoring

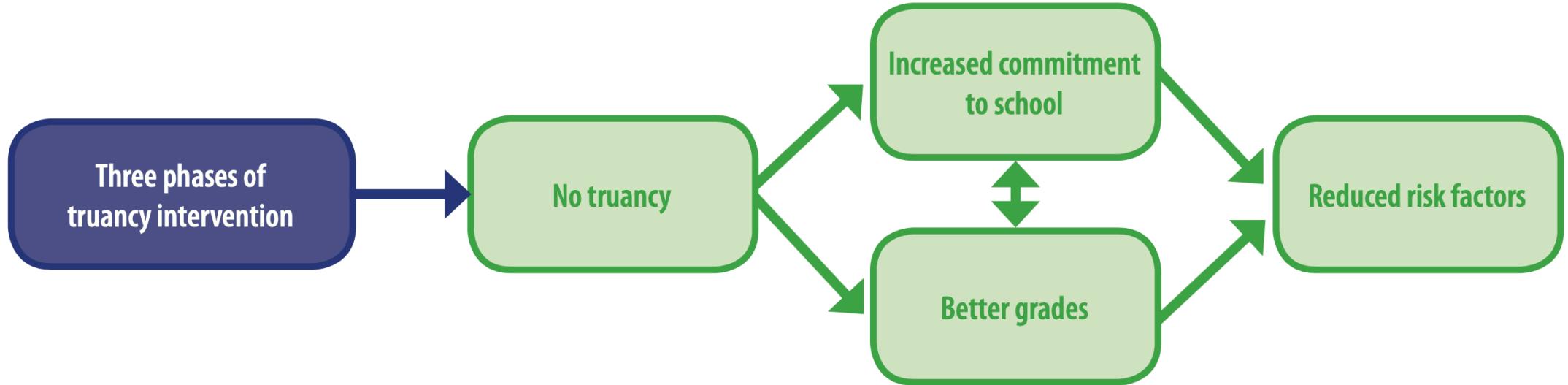
Impact evaluation

Efficiency evaluation (CBA)



* Because 11th and 12th graders who receive 3rd citations are generally unable to graduate from high school, district social workers no longer attempt to increase their commitment to school. As such, any outcomes that occur as a result of the alternative plans made for these students (work study programs, career development assistance, etc.) are only tangentially related to the outcomes of the truancy program itself. The system for creating alternative plans is an entirely separate program with its own logic model, goals, and outcomes.

Theories of change



Impact evaluation!

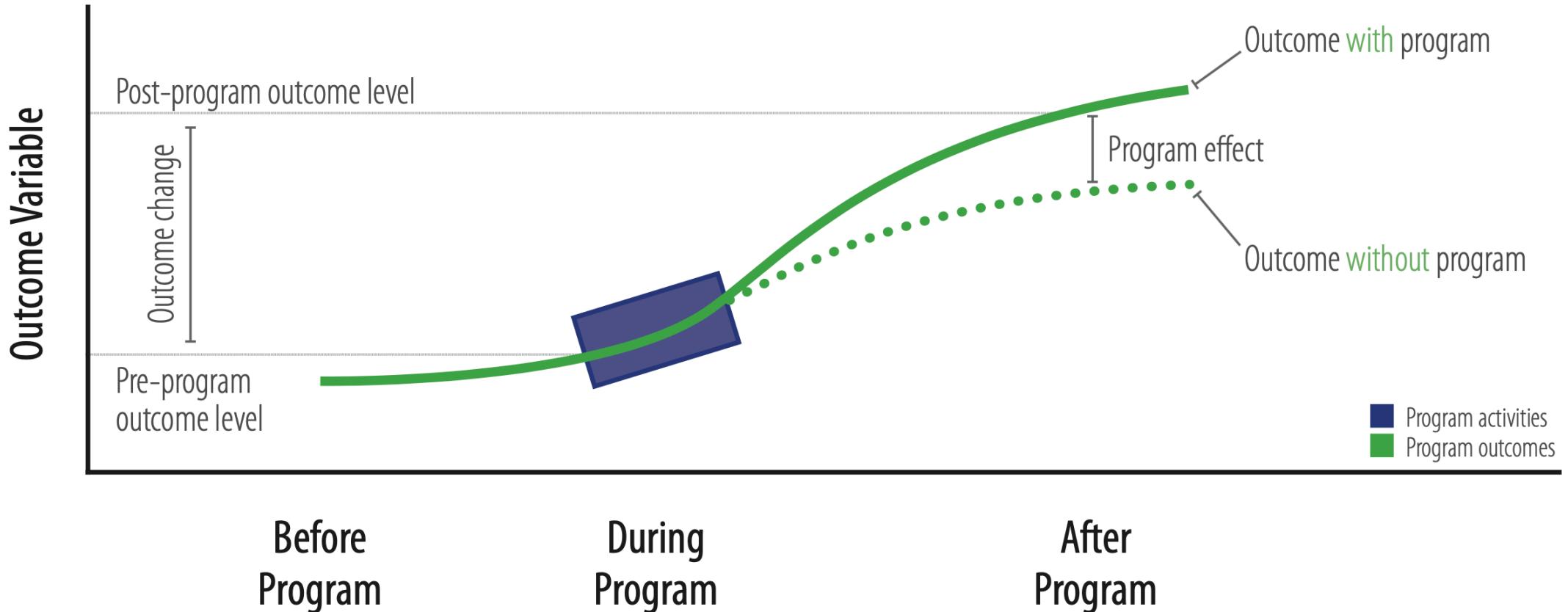
Impact Evaluation in Practice

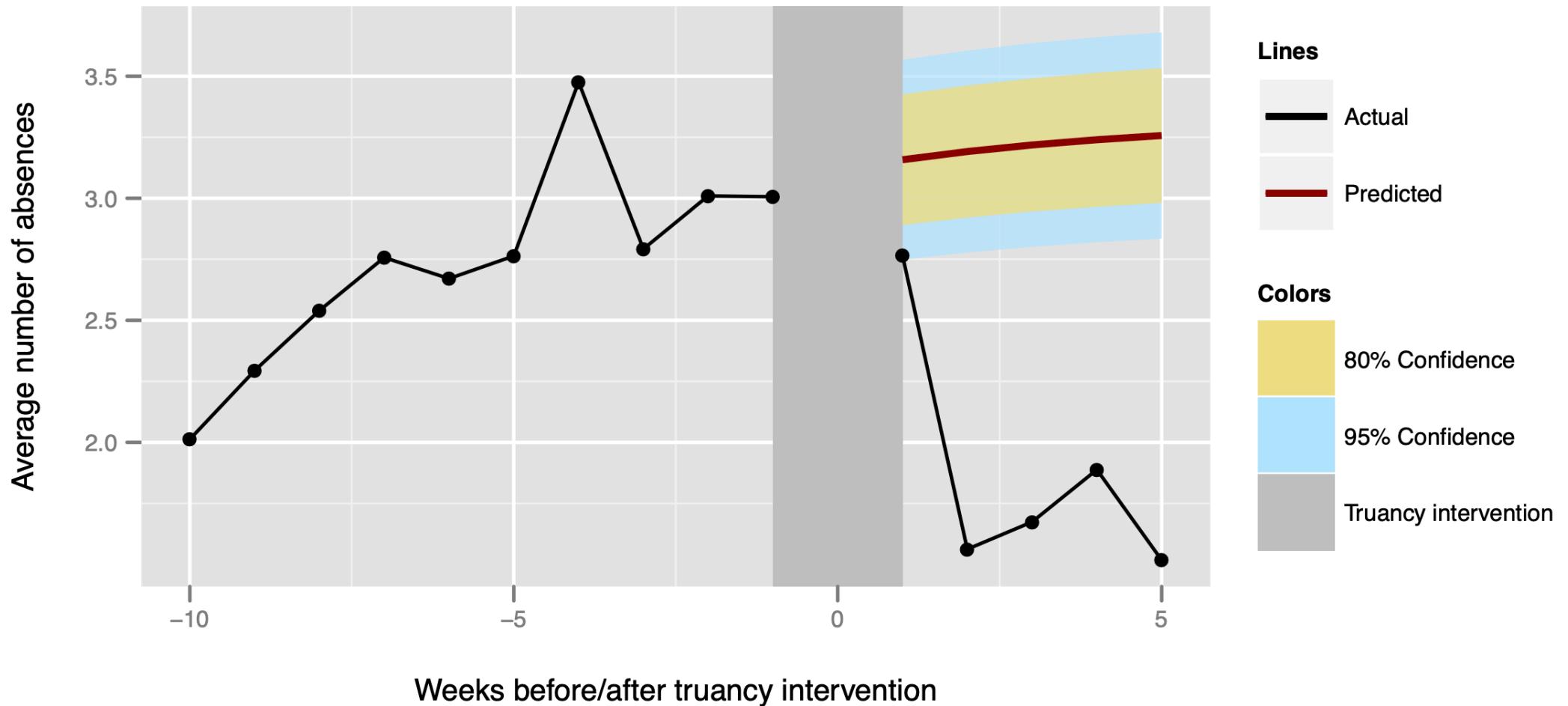
SECOND EDITION

Paul J. Gertler, Sebastian Martinez,
Patrick Premand, Laura B. Rawlings,
and Christel M. J. Vermeersch



Theory → impact





Godwin's law

From Wikipedia, the free encyclopedia

Godwin's law (or Godwin's rule of Hitler analogies)^{[1][2]} is an Internet [adage](#) asserting that "as an online discussion grows longer, the probability of a [comparison involving Nazis or Hitler approaches 1](#)".^{[2][3]} That is, if an online discussion (regardless of topic or scope) goes on long enough, sooner or later someone will compare someone or something to [Adolf Hitler](#) or his deeds, the point at which effectively the discussion or thread often ends.

Promulgated by the American attorney and author [Mike Godwin](#) in 1990,^[2] Godwin's law originally

Godwin's Law for statistics

Correlation does not
imply causation

Except when it does

Even if it doesn't,
this phrase is useless
and kills discussion

The Internet Blowhard's Favorite Phrase

Why do people love to say that correlation does not imply causation?

By DANIEL ENGBER

OCT 02, 2012 • 8:33 AM

Not everyone found the news believable. “Facepalm. Correlation doesn’t imply causation,” wrote one unhappy Internet user. “That’s pretty much how I read this too... correlation is NOT causation,” agreed a Huffington Post superuser, seemingly distraught. “I was surprised not to find a discussion of correlation vs. causation,” cried someone at Hacker News. “Correlation does not mean causation,” a reader moaned at Slashdot. “There are so many variables here that it isn’t funny.”

Correlation vs. causation

How do we figure out correlation?

How do we figure out causation?

Correlation vs. causation

How do we figure out correlation?

Math and statistics

How do we figure out causation?

Correlation vs. causation

**How do we figure
out correlation?**

Math and statistics

**How do we figure
out causation?**

Philosophy. No math.



John B. Holbein @JohnHolbein1 · Apr 7

Causality isn't achieved; it's approached.



3



1



8



[Show this thread](#)



John B. Holbein @JohnHolbein1 · Apr 7

Causality isn't binary; it's a continuum.



1



5



13



[Show this thread](#)

How does we know if X causes Y?

X causes Y if...

**...we intervene and change X
without changing anything else...**

...and Y changes

Y "listens to" X

"A variable X is a cause of a variable Y if Y in any way relies on X for its value.... X is a cause of Y if Y listens to X and decides its value in response to what it hears"

(Pearl, Glymour, and Jewell 2016, 5–6)

Y doesn't necessarily listen only to X

A light switch causes a light to go on, but not if the bulb is burned out (no Y despite X), or if the light was already on (Y without X)

Causal relationships?

Lighting fireworks causes noise

Rooster crows cause the sunrise

Getting an MPA/MPP increases your earnings

**Colds go away a few days
after you take vitamin C**

Causation

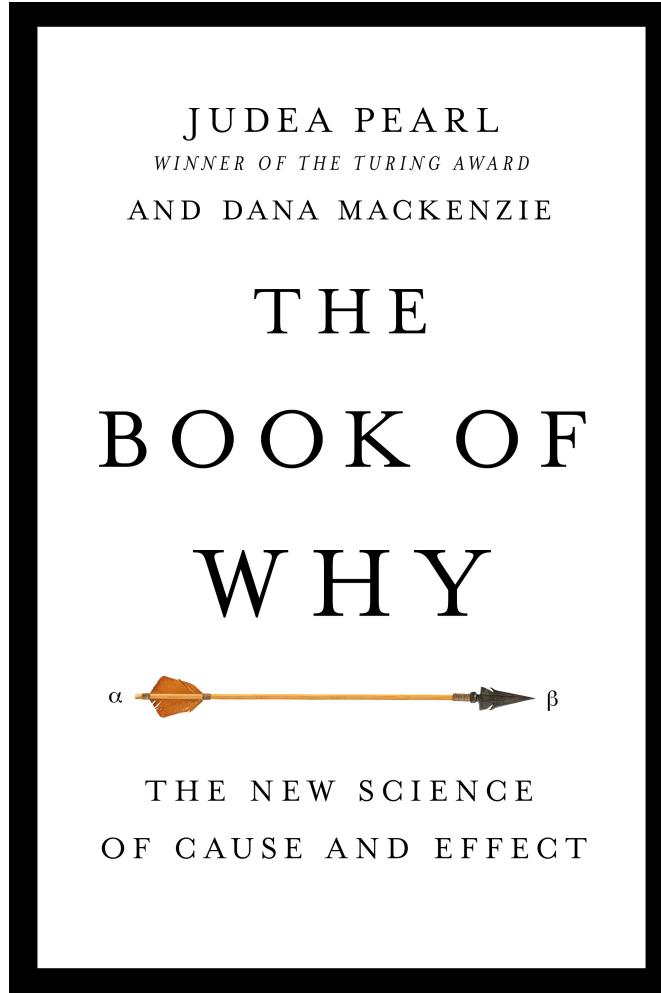
**Causation =
Correlation + time order +
nonspuriousness**

How do you know if you have it right?

You need a philosophical model

That's what this class is for!

The causal revolution



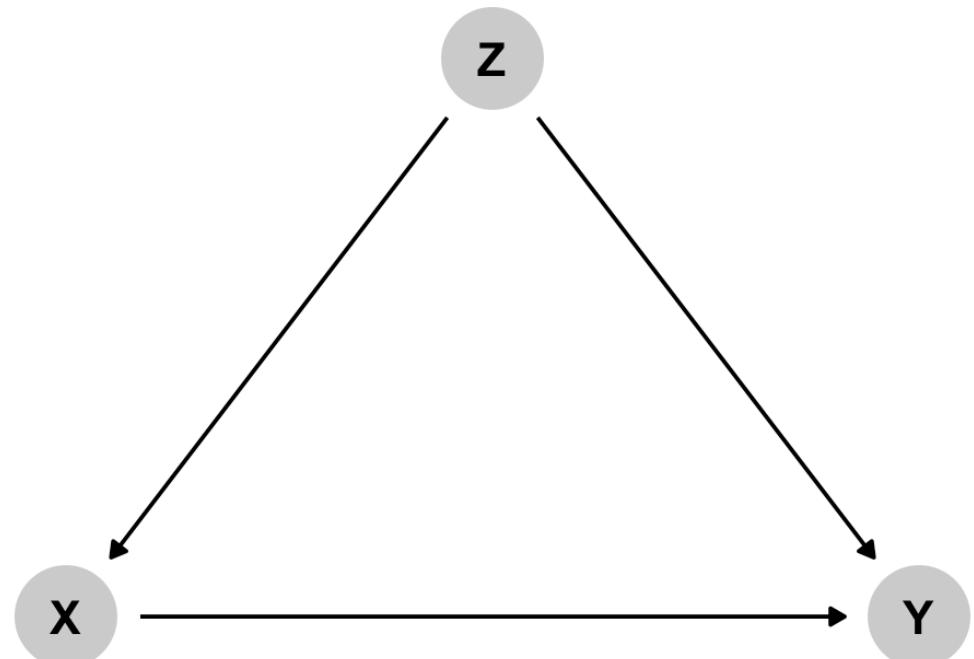
Causal diagrams

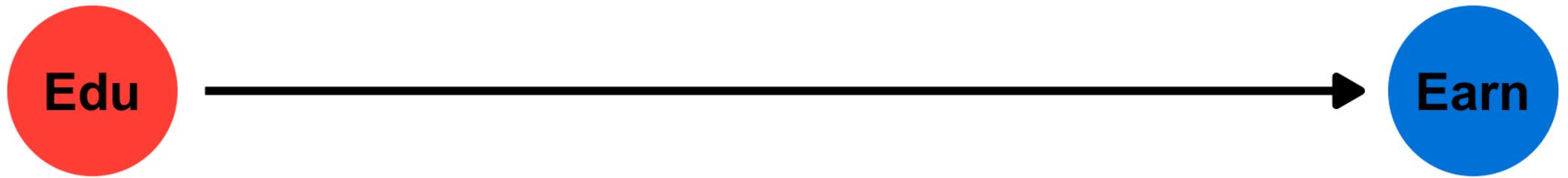
Directed acyclic graphs (DAGs)

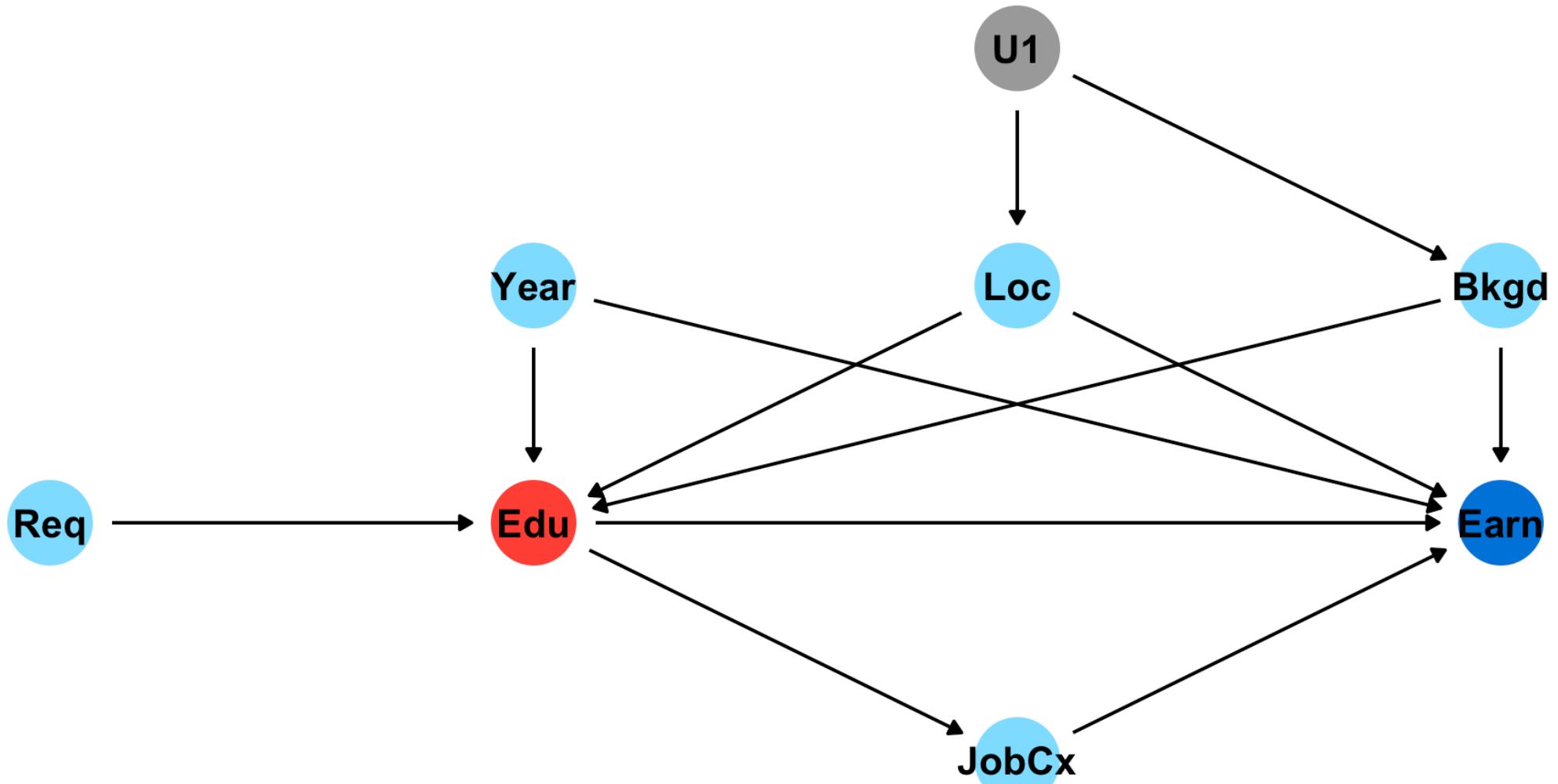
Graphical model of the process
that generates the data

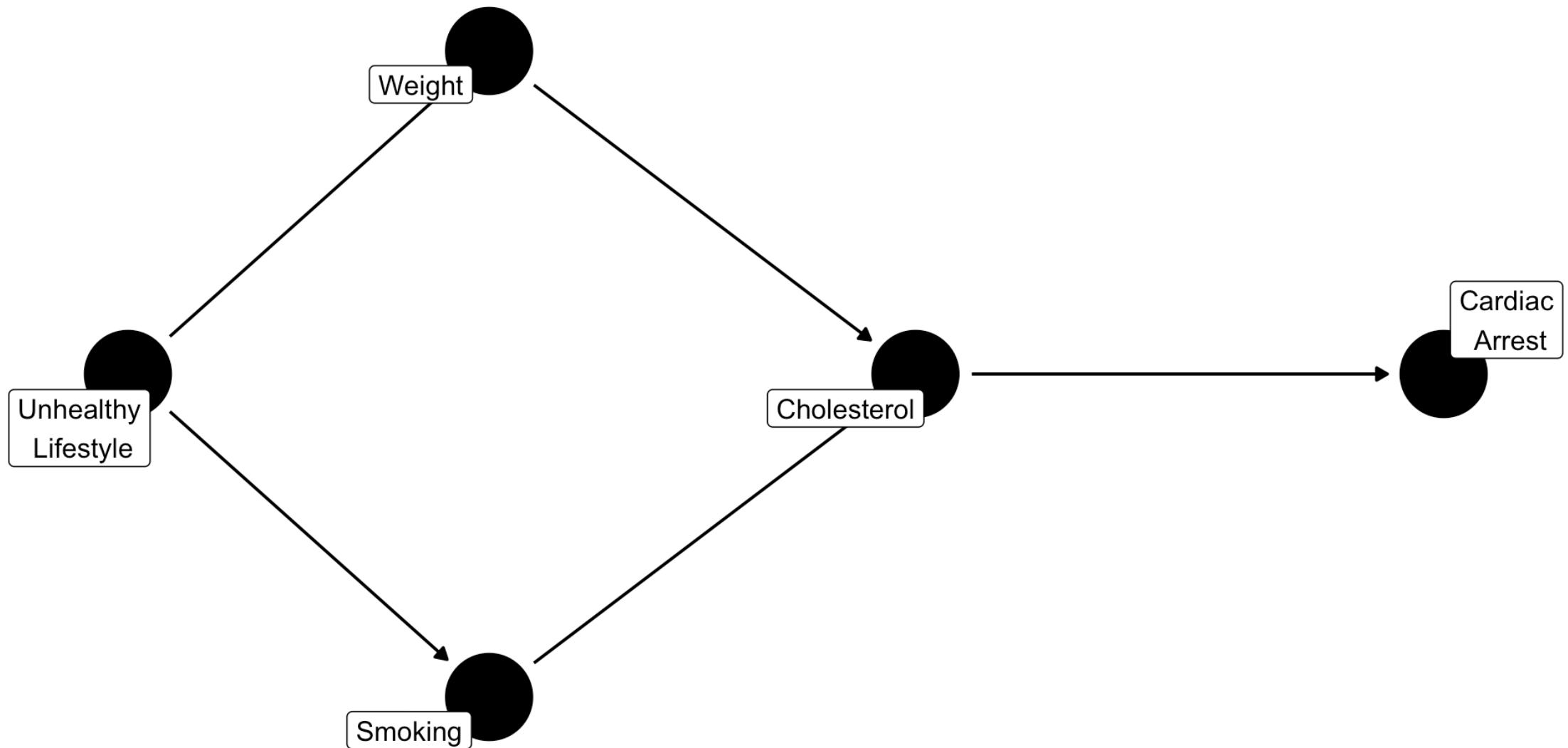
Maps your philosophical model

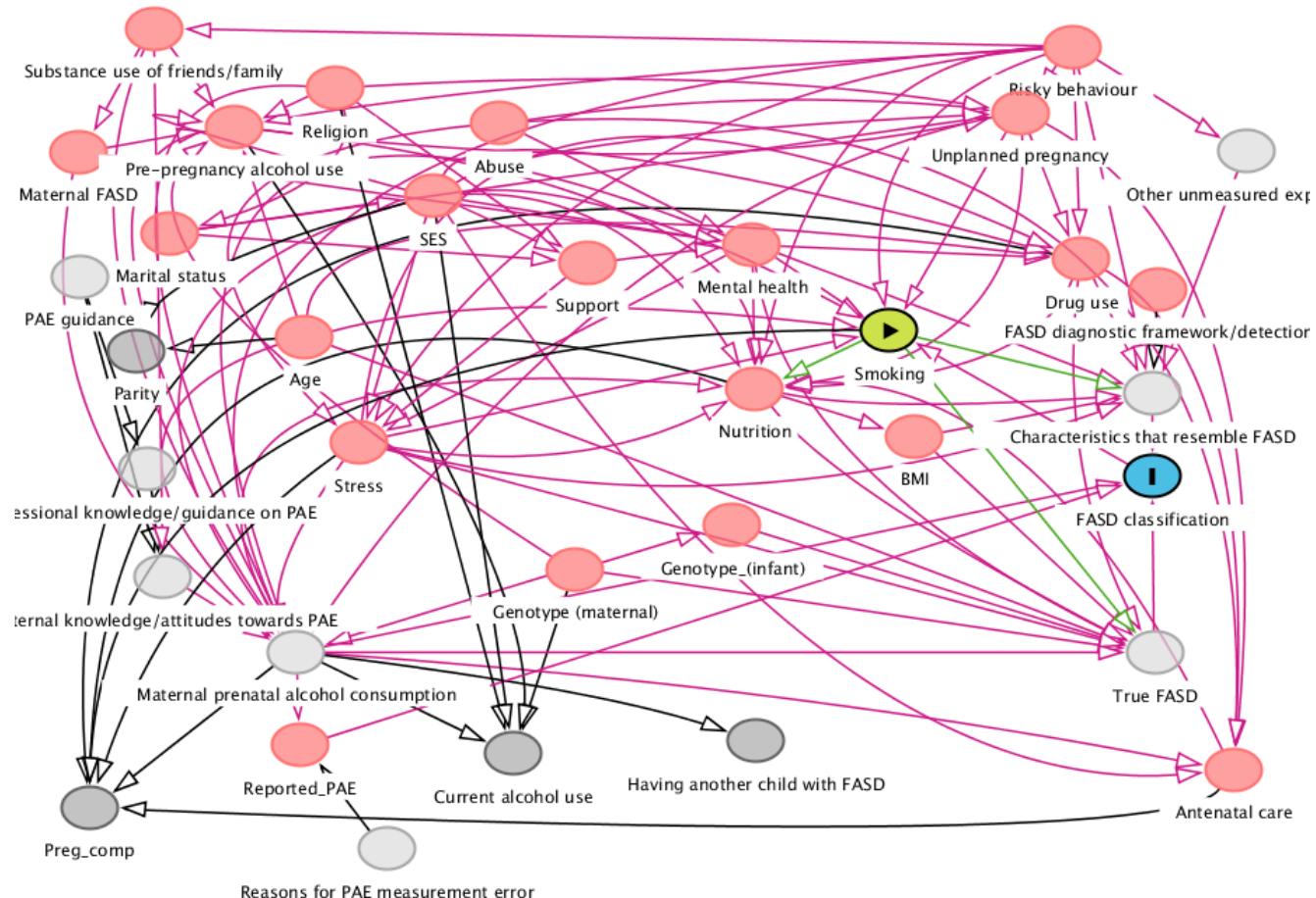
Fancy math ("*do*-calculus") tells
you what to control for to isolate
and identify causation







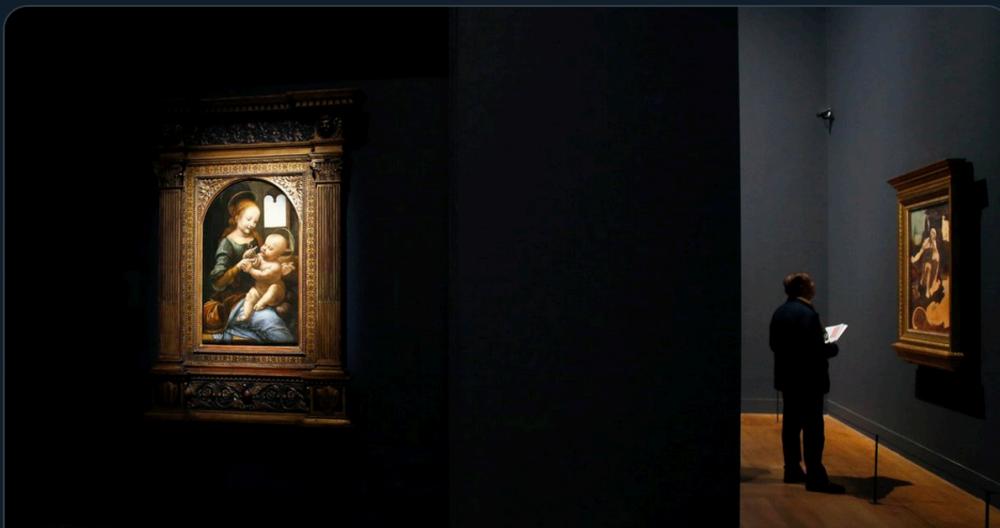




Effect of smoking on fetal alcohol syndrome



Want to live longer? Try going to the opera. Researchers in Britain have found that people who reported going to a museum or concert even once a year lived longer than those who didn't.



Another Benefit to Going to Museums? You May Live Longer

Researchers in Britain found that people who go to museums, the theater and the opera were less likely to die in the study period than those who didn't.

nytimes.com

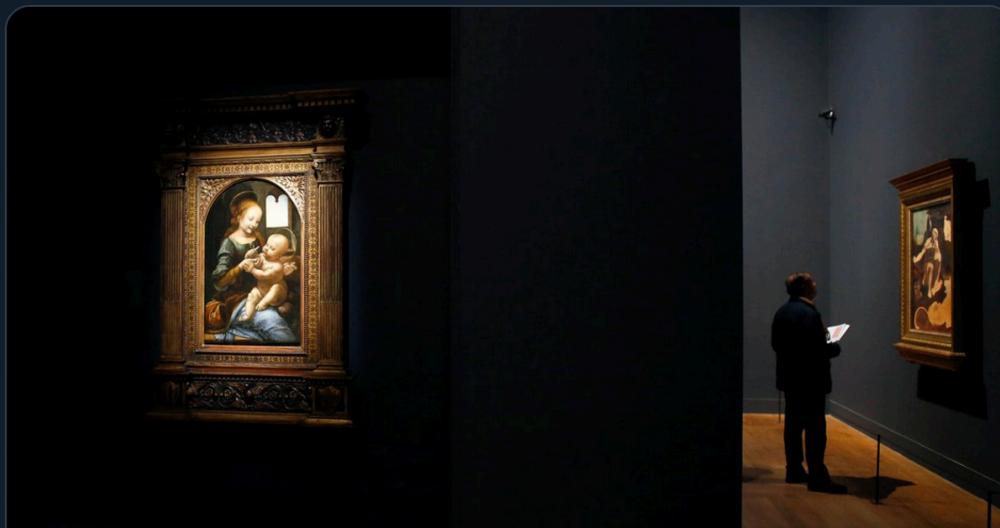
9:19 AM · Dec 22, 2019 · [SocialFlow](#)

336 Retweets 1.3K Likes





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nytimes.com

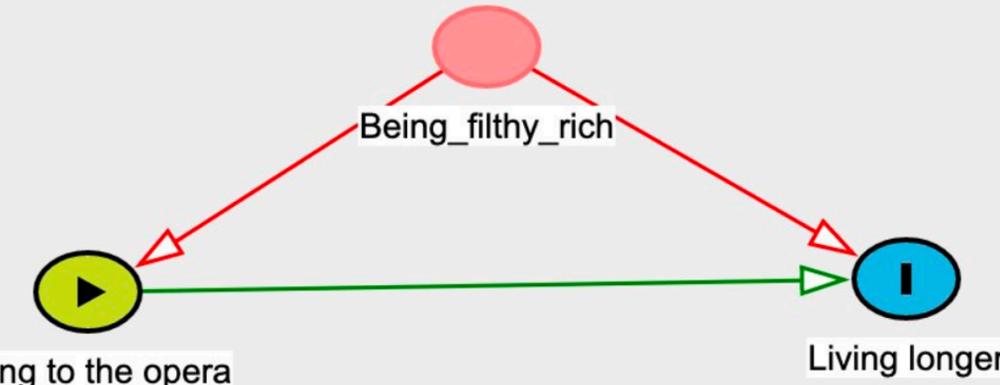
9:19 AM · Dec 22, 2019 · SocialFlow

336 Retweets 1.3K Likes



Andrew Heiss
@andrewheiss

ooh ooh i can draw the dag for this one!



NYT Health @NYTHealth · Dec 22, 2019

Want to live longer? Try going to the opera. Researchers in Britain have found that people who reported going to a museum or concert even once a year lived longer than those who didn't. nyti.ms/2Q9AmZV

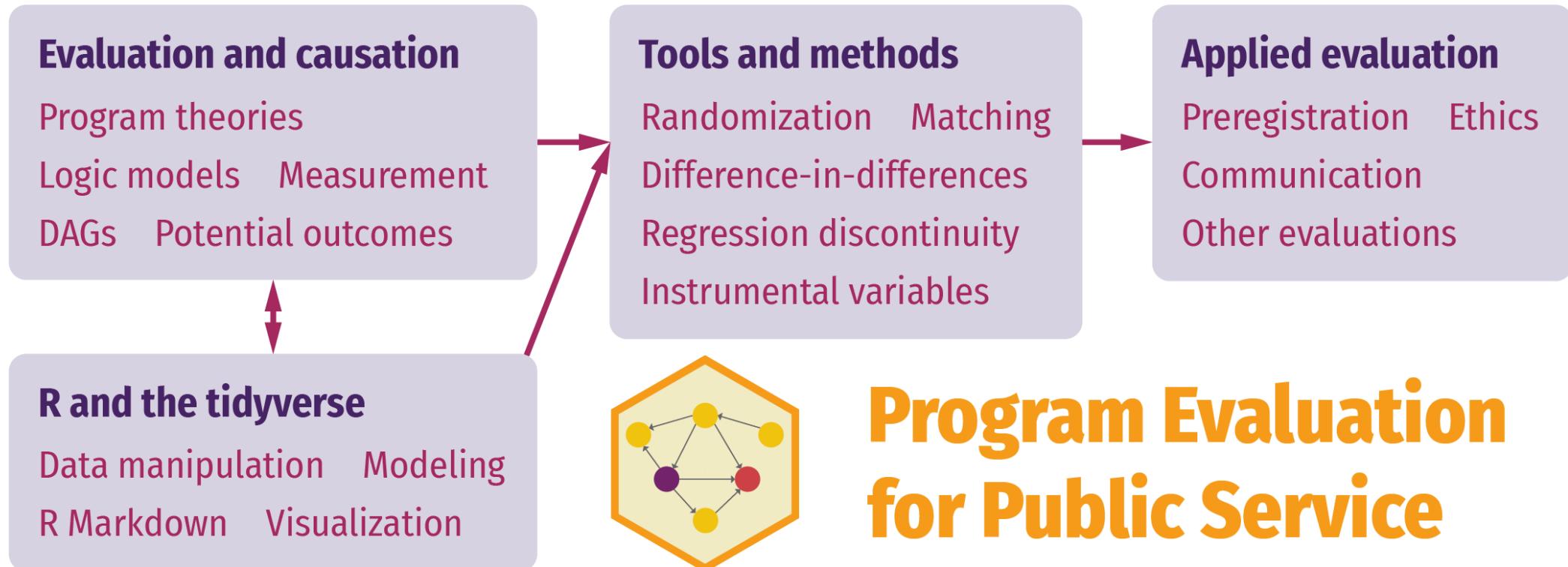
2:47 PM · Dec 22, 2019 · Twitter Web App

[View Tweet activity](#)

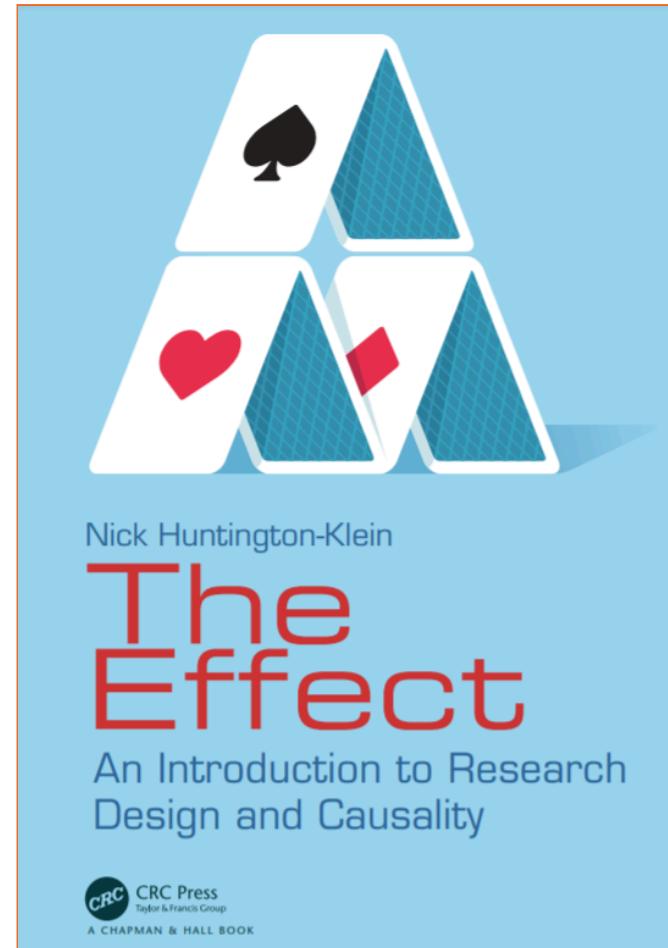
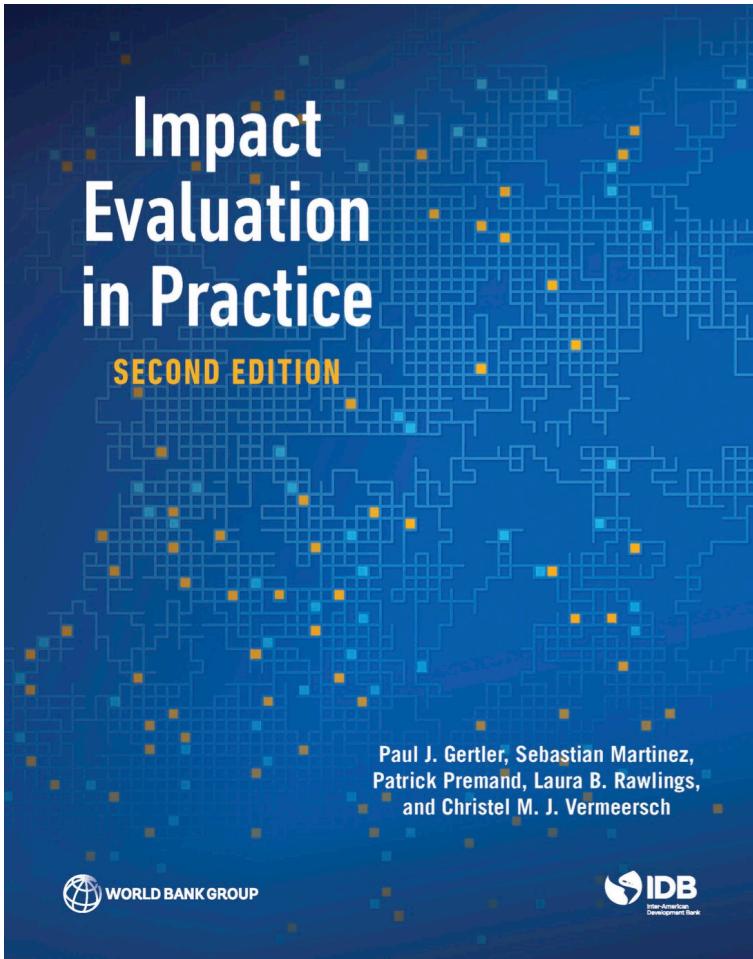
837 Retweets 3.9K Likes

Class details

Plan for the class



Textbooks





Stage 1: Regress each column of \mathbf{X} on \mathbf{Z} , ($X = Z\delta + \text{errors}$):

$$\hat{\delta} = (Z^T Z)^{-1} Z^T X,$$

and save the predicted values:

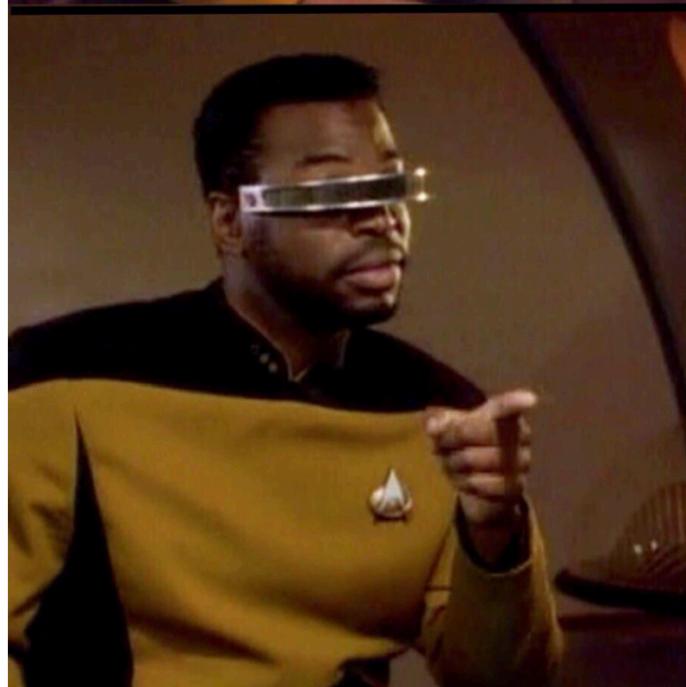
$$\widehat{X} = Z\hat{\delta} = \mathbf{Z}(Z^T Z)^{-1} Z^T X = \mathbf{P}_Z X.$$

Stage 2: Regress \mathbf{Y} on the predicted values from the first stage:

$$Y = \widehat{X}\beta + \text{noise},$$

which gives

$$\beta_{2SLS} = (X^T \mathbf{P}_Z X)^{-1} X^T \mathbf{P}_Z Y.$$



```
model_2sls <- iv_robust(  
  health ~ bed_net | treatment,  
  data = bed_nets)
```

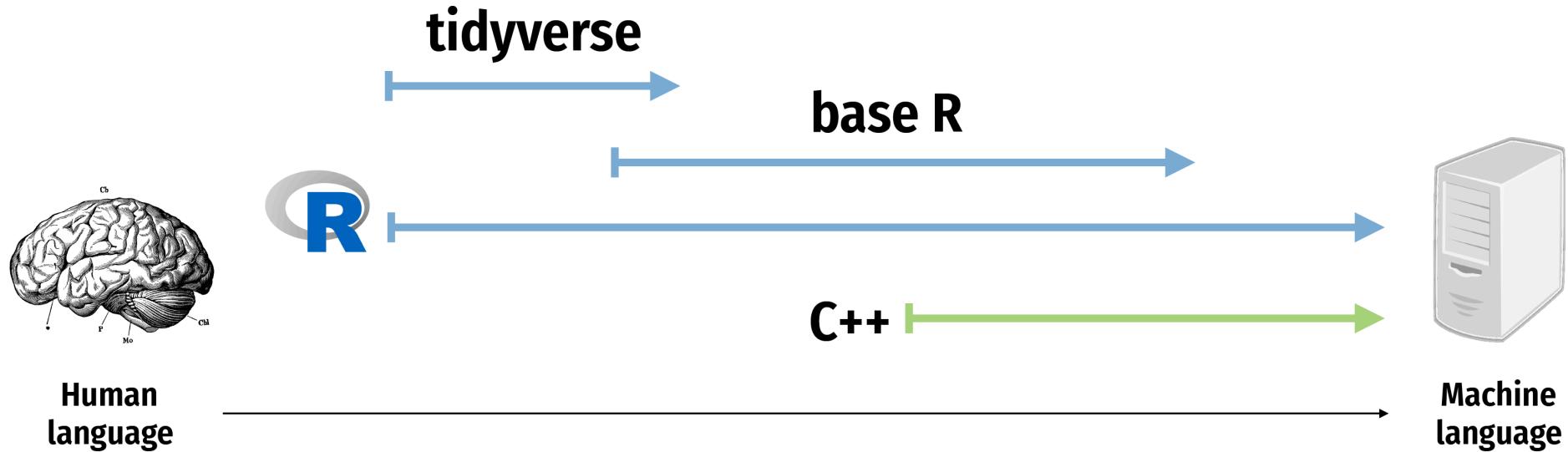
Class technology



The tidyverse



The tidyverse



R code, but reads like English!

```
strike_damages_month <- bird_strikes |>  
  group_by(Month) |>  
  summarize(total_damages = sum(Cost, na.rm = TRUE),  
            average_damages = mean(Cost, na.rm = TRUE))  
  
ggplot(data = strike_damages_month,  
       mapping = aes(x = Month, y = total_damages)) +  
  geom_col() +  
  scale_y_continuous(labels = dollar) +  
  labs(x = "Month",  
       y = "Total damages",  
       title = "Really expensive collisions happen in the fall?",  
       subtitle = "Don't fly in August or October?",  
       caption = "Source: FAA Wildlife Strike Database")
```

Sucking

“There is no way of knowing nothing about a subject to knowing something about a subject without going through a period of much frustration and suckiness.”

“Push through. You’ll suck less.”

Hadley Wickham, author of `ggplot2`

Sucking



Dude, sucking at something is the first step towards being sort of good at something

The New York Times

Opinion

SPORTING

(It's Great to) Suck at Something

By Karen Rinaldi

April 28, 2017



Karen Rinaldi, "(It's Great to) Suck at Something"

Am I making you computer scientists?

No!

You don't need to be a mechanic to drive a car safely

You don't need to be a computer scientist
or developer to use R safely

Learning R



Jesse Maegan

@kierisi

Following



My **#rstats** learning path:

1. Install R
2. Install RStudio
3. Google "How do I [THING I WANT TO DO] in R?"

Repeat step 3 ad infinitum.

7:19 AM - 18 Aug 2017

You can do this.

Goals for the class

Become an expert with R

Speak and do causation

Design rigorous evaluations

Change the world with data

Prerequisites

Math skills

Basic algebra

Computer science skills

None

Statistical skills

Regression, differences in means, and statistical significance