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

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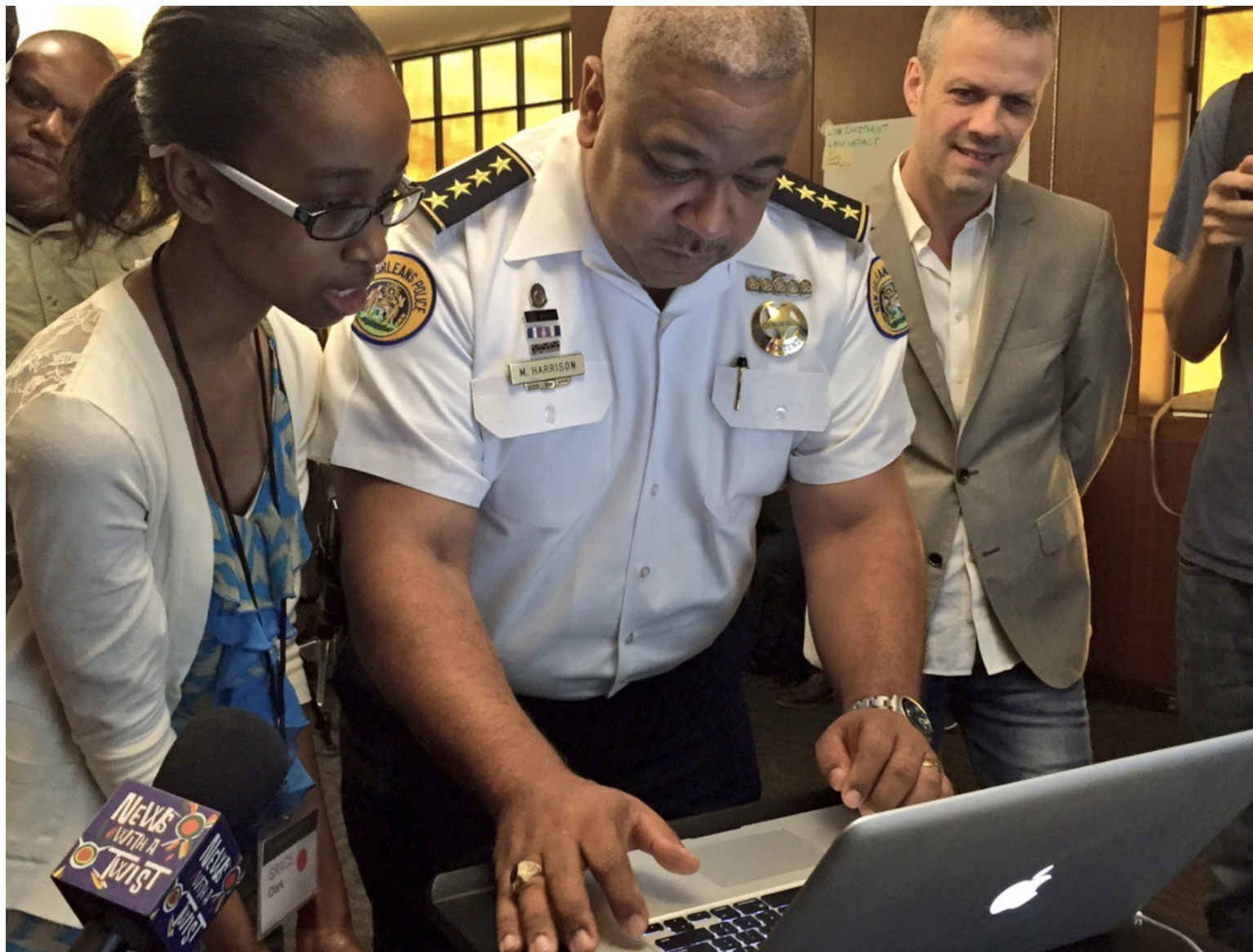
Rank	Place	Budget	Crime Reports	Parcels	Construction Pe...	Zoning	Service Request	Code Violations	Employee Salaries	Business Listings	Spending	Restaurant Inspections	Public Facilities	Traffic Crashes	Property Assessment	Procurement Contracts	Emergency Calls	Lobbyist Activity	Police Use-of-Force	Website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

7 / 63

Atlanta, GA

	0% Open	**0%** Score

Breakdown

Dataset	Breakdown	Year	Score	
Budget	🔓 👁 $ 📑 🕐 ⌨			☑
Business Listings	🔓 👁 $ 📑 🕐 ⌨			☑
Code Violations	🔓 👁 $ 📑 🕐 ⌨			☑
Construction Permits	🔓 👁 $ 📑 🕐 ⌨			☑
Crime Reports	🔓 👁 $ 📑 🕐 ⌨			☑
Emergency Calls	🔓 👁 $ 📑 🕐 ⌨			☑
Employee Salaries	🔓 👁 $ 📑 🕐 ⌨			☑
Lobbyist Activity	🔓 👁 $ 📑 🕐 ⌨			☑
Parcels	🔓 👁 $ 📑 🕐 ⌨			☑
Police Use-of-Force	🔓 👁 $ 📑 🕐 ⌨			☑
Procurement Contracts	🔓 👁 $ 📑 🕐 ⌨			☑
Property Assessment	🔓 👁 $ 📑 🕐 ⌨			☑
Property Transfers	🔓 👁 $ 📑 🕐 ⌨			☑
Public Facilities	🔓 👁 $ 📑 🕐 ⌨			☑
Restaurant Inspections	🔓 👁 $ 📑 🕐 ⌨			☑
Service Requests	🔓 👁 $ 📑 🕐 ⌨			☑
Spending	🔓 👁 $ 📑 🕐 ⌨			☑

Google Dataset Search Beta

Search for Datasets

Try boston education data or weather site:noaa.gov

Google Dataset Search

🔍 salt lake city

S 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)

H 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

U 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?

Source: Palmer, Shelly. Data Science for the C-Suite.
New York: Digital Living Press, 2015. Print.
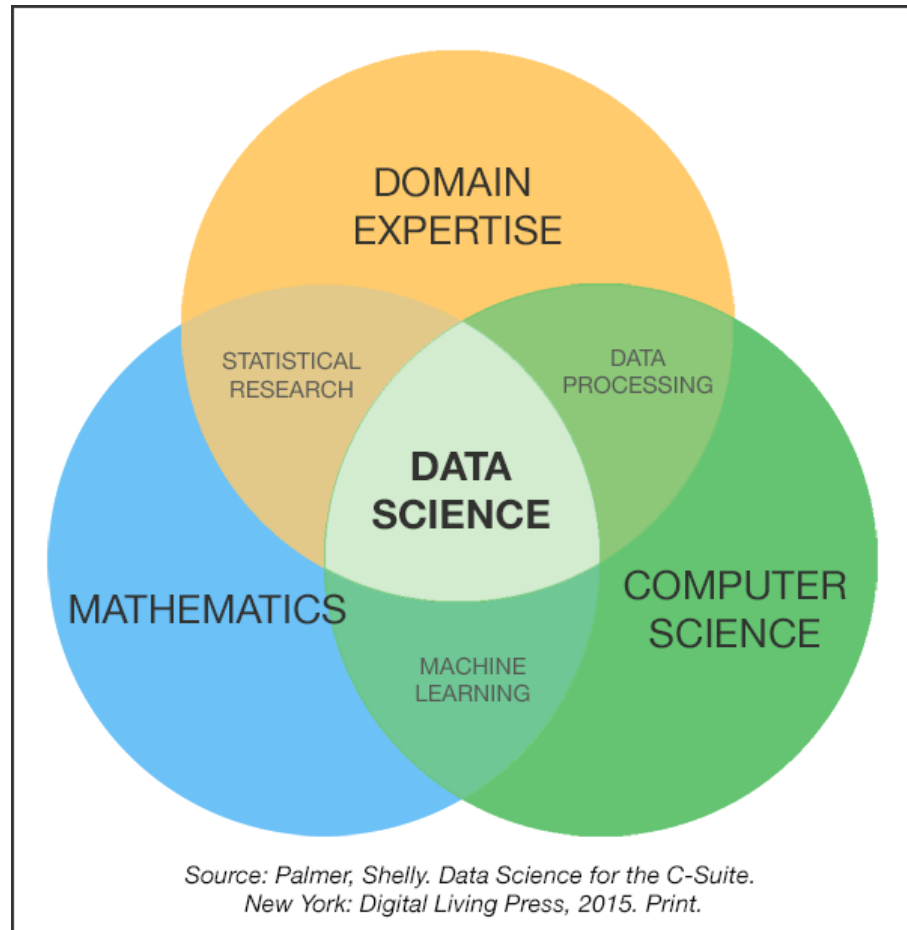
Collect

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
|_____|
        (\__/)  ||
        (•ㅅ•)  ||
        /     づ
```

#HistorianSignBunny #Epidemiology

10:13 PM - 12 Jul 2018

200 Retweets **612** Likes

💬 29   ♻ 200   ♡ 612   ✉

PLEASE BE PREPARED TO SHOW I.D.

NO ONE UNDER 21 WILL BE SERVED
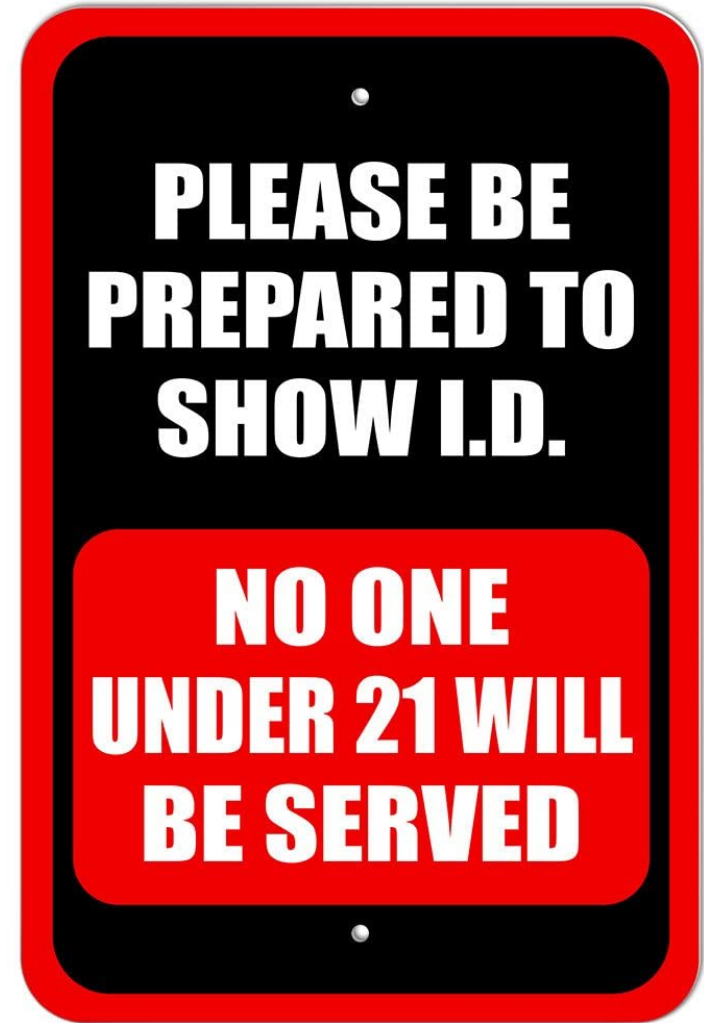
Where does program evaluation fit with all this?

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

Types of evaluation
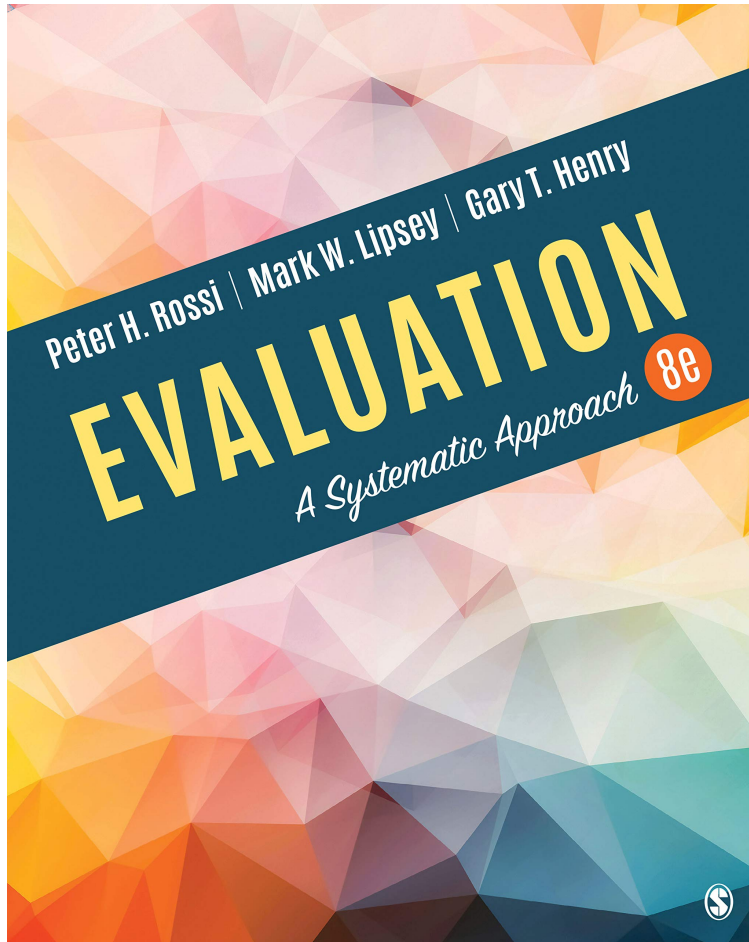
Needs assessment

Design and theory assessment

Process evaluation and monitoring

Impact evaluation

Efficiency evaluation (CBA)

Law, parents, students, teachers, and administrators → **PSD distributes truancy information to all families** → **# of people who know expectations**

No truancy → **Increased commitment to school** → **Reduced risk factors for delinquency**

Better grades

Truancy, **Grants** → **PSD offers a truancy program to all schools in the district**

% increase in grades and attendance

5 unexcused absences (5 total) → **1st citation mailed home** → **# of 1st citations mailed**

5 unexcused absences (10 total) → **2nd citation mailed home + referral to truancy school** → **# of 2nd citations mailed** → **Students and parents attend truancy school** → **# of truancy school attendees** → **PowerPoint presentation + Explanation of state law + Instruction on PowerSchool**

Staff

5 unexcused absences (15 total) → **3rd citation mailed home + referral to truancy court** → **# of 3rd citations mailed** → **PSD Attendance Court (K–10)** → **# of court attendees**

4th District Juvenile Court (9–10)

Judges

Staff → **Meet with district social worker (11–12)** → **Alternative plan created***

Logic Model Legend

Adapted from Provo School District, "Truancy Program Logic Model: FY 2011–2012."

Input (triangle) — Output (circle) — Activity (rounded rectangle) — Outcome (rounded rectangle)

* 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
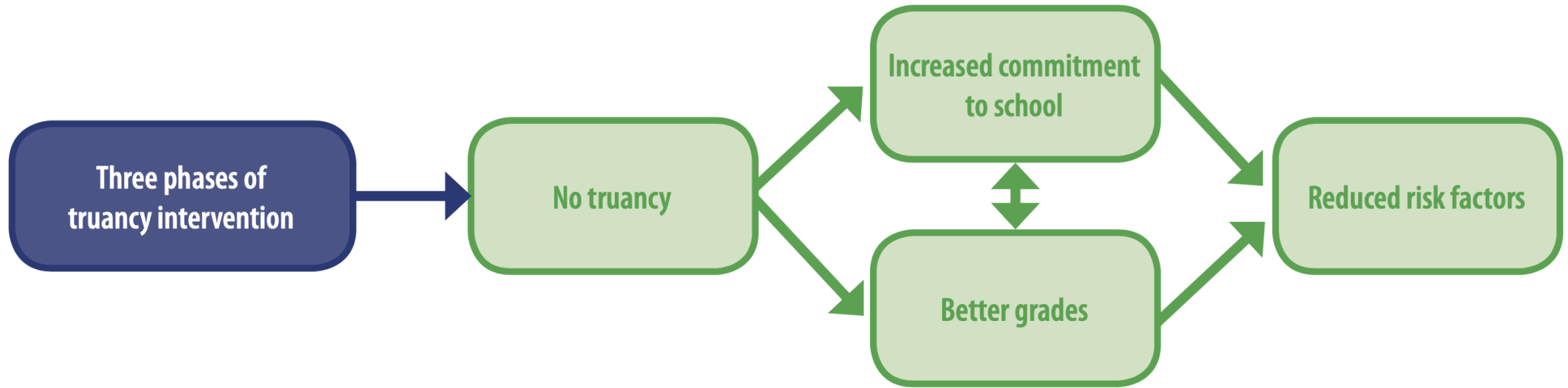

```
Three phases of          →    No truancy    →    Increased commitment
truancy intervention                              to school
                                              ↕
                                              Better grades
                                                                   →   Reduced risk factors
```

Impact evaluation!

Theory → impact
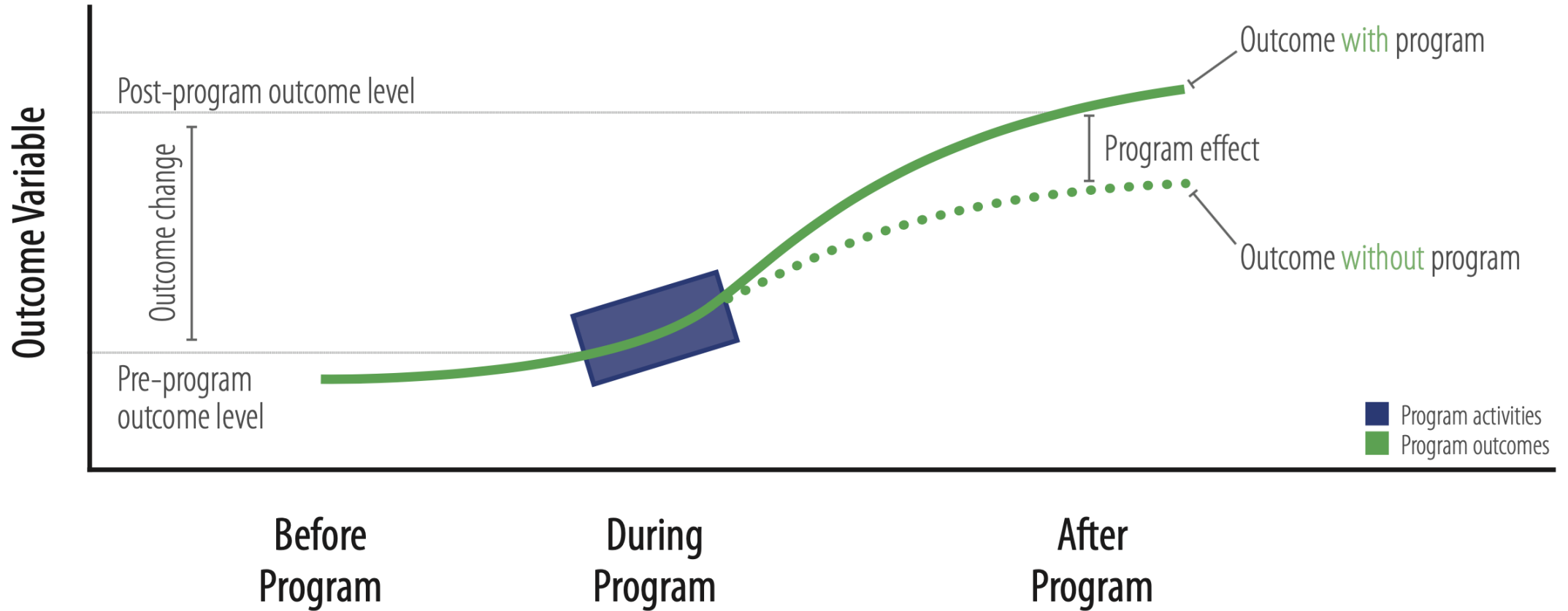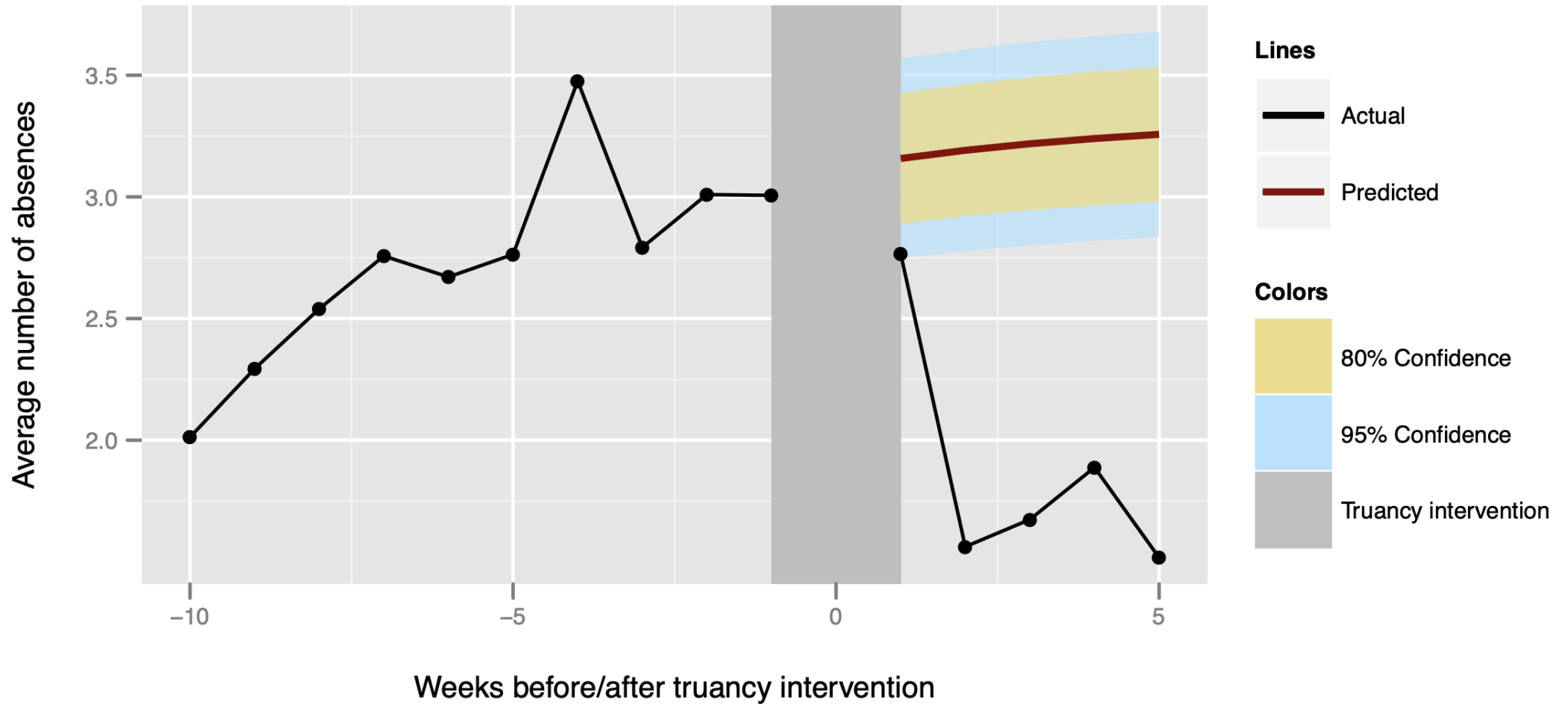
Godwin's law

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?

How do we figure out causation?

Math and statistics

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
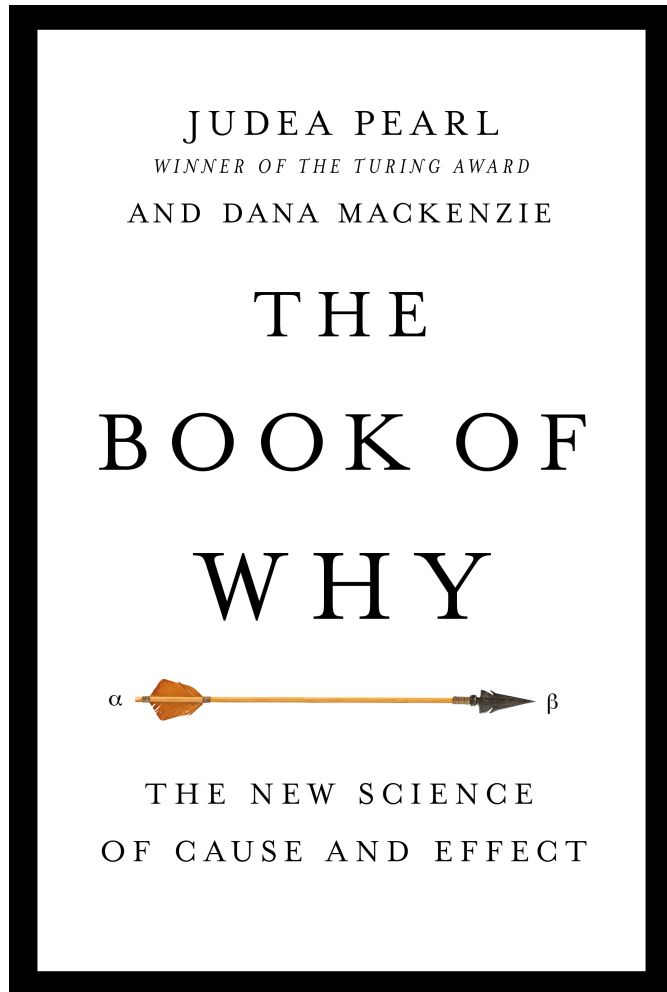
Causal diagrams

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
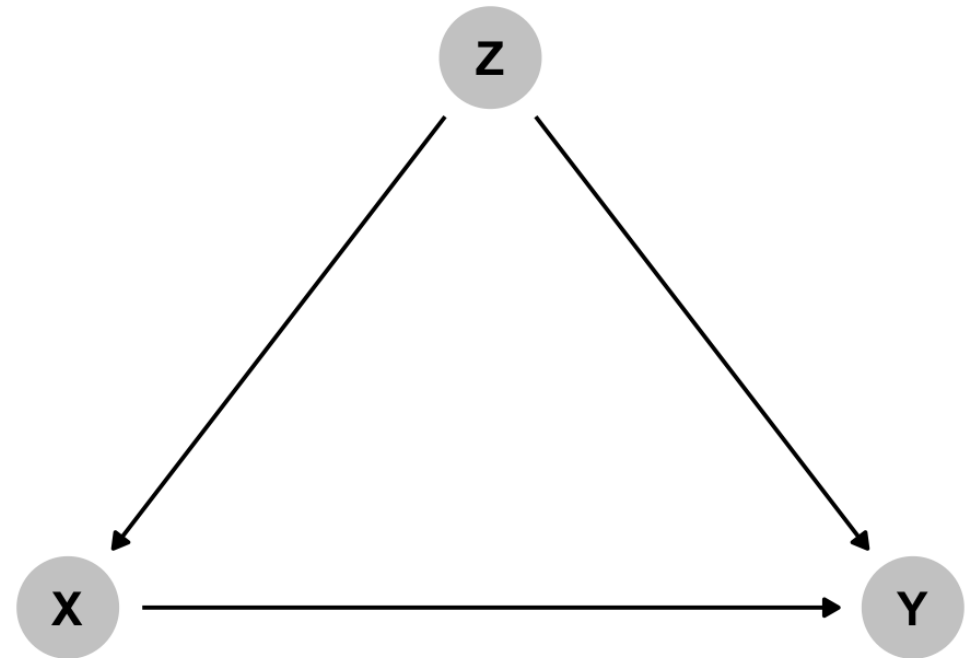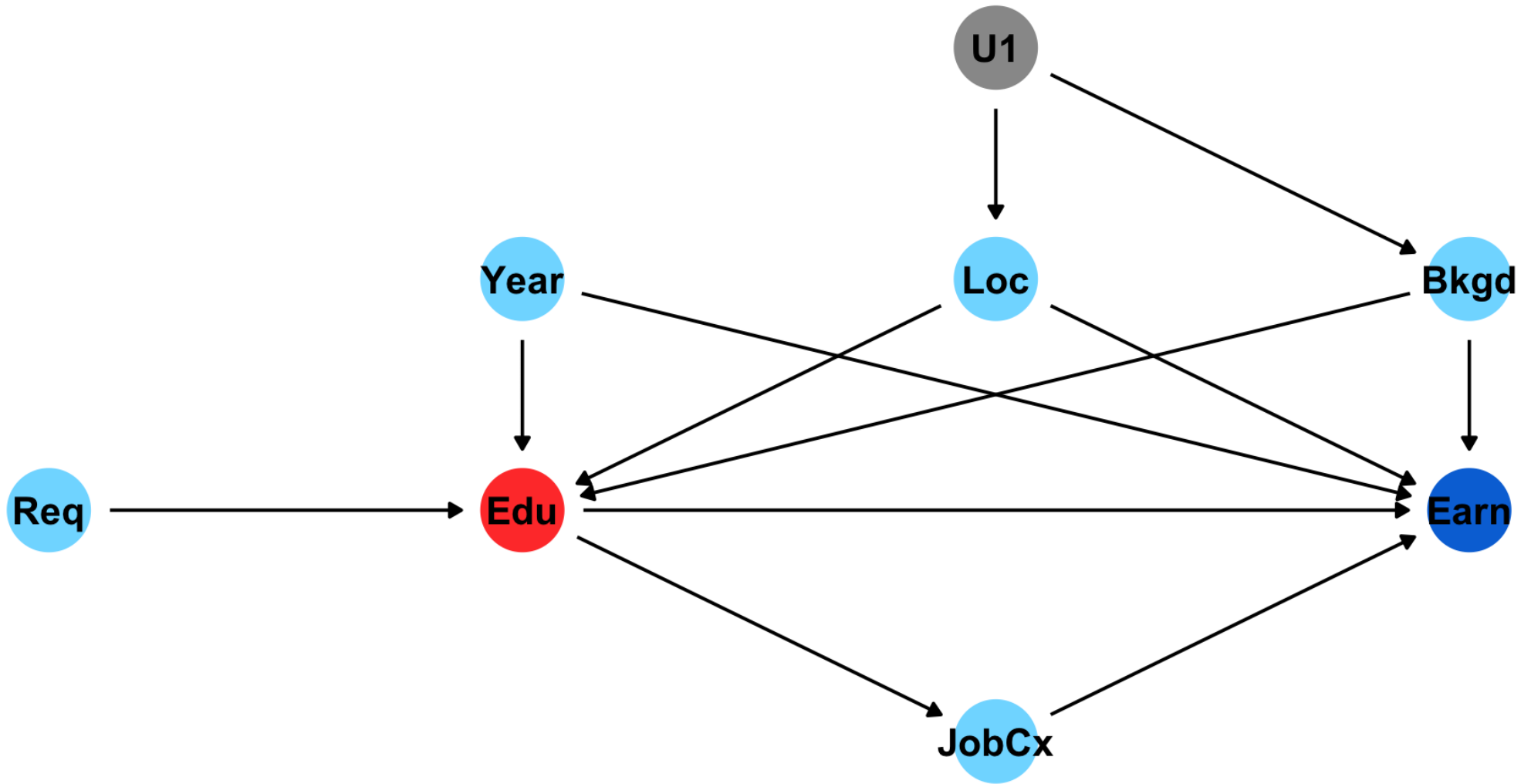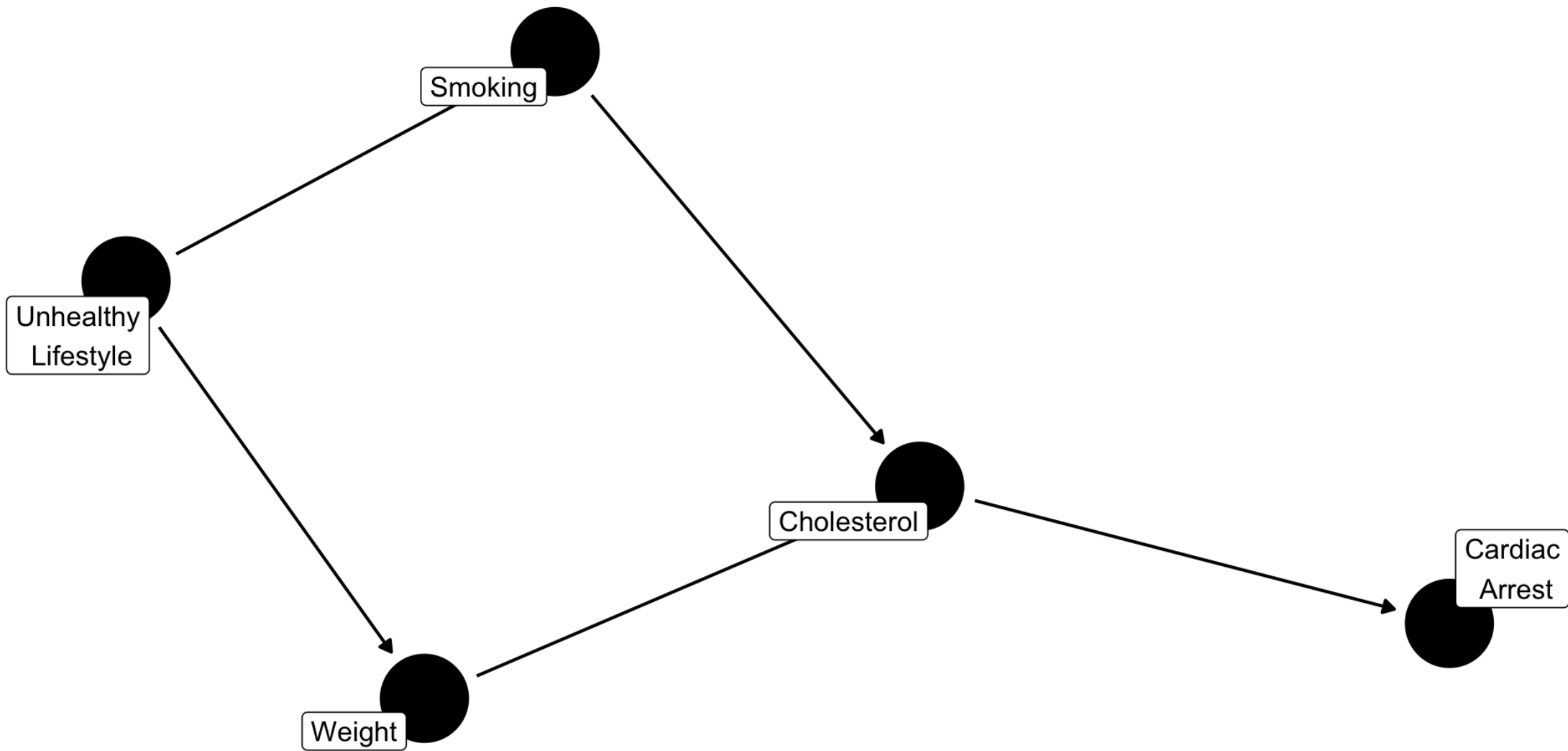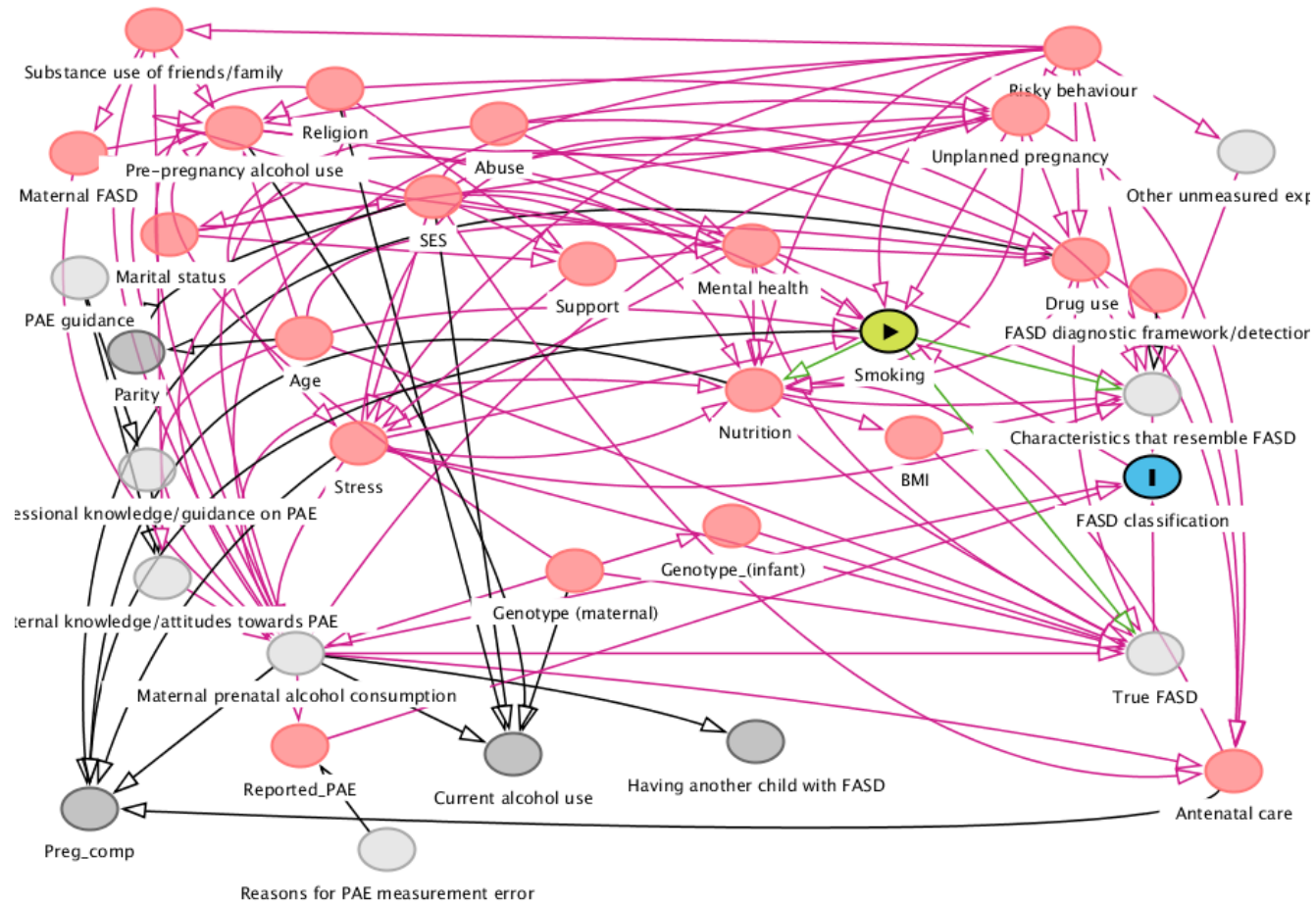
Effect of smoking on fetal alcohol syndrome

NYT Health
@NYTHealth

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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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!

Being_filthy_rich

Going to the opera   Living longer
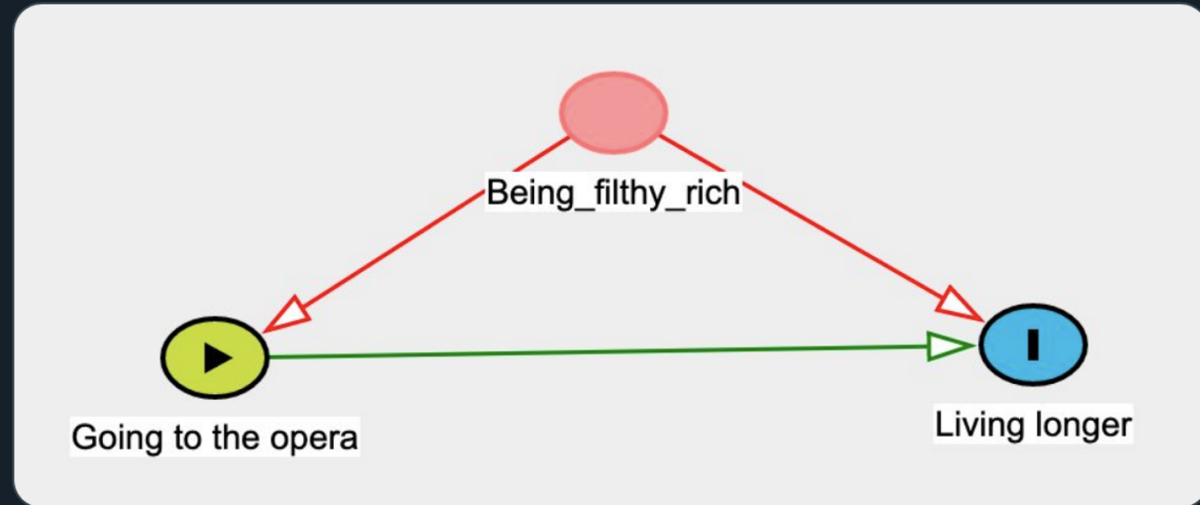
NYT Health @NYTHealth · Dec 22, 2019
Want to live longer? Try going to the opera. Researchers in Britain have found that people who reported going to a museum or concert even once a year lived longer than those who didn't. nyti.ms/2Q9AmZV

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

ıl View Tweet activity

837 Retweets   **3.9K** Likes

Class details

Plan for the class

Evaluation and causation

Program theories

Logic models   Measurement

DAGs   Potential outcomes

Tools and methods

Randomization   Matching

Difference-in-differences

Regression discontinuity

Instrumental variables

Applied evaluation

Preregistration   Ethics

Communication

Other evaluations

R and the tidyverse

Data manipulation   Modeling

R Markdown   Visualization

Program Evaluation for Public Service

Textbooks

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

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

and save the predicted values:

$$\widehat{X} = Z\hat{\delta} = Z(Z^{\mathrm{T}} Z)^{-1} Z^{\mathrm{T}} X = P_Z X.$$

Stage 2: Regress **Y** on the predicted values from the first stage:

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

which gives

$$\beta_{2SLS} = \left(X^{\mathrm{T}} P_Z X\right)^{-1} X^{\mathrm{T}} P_Z Y.$$
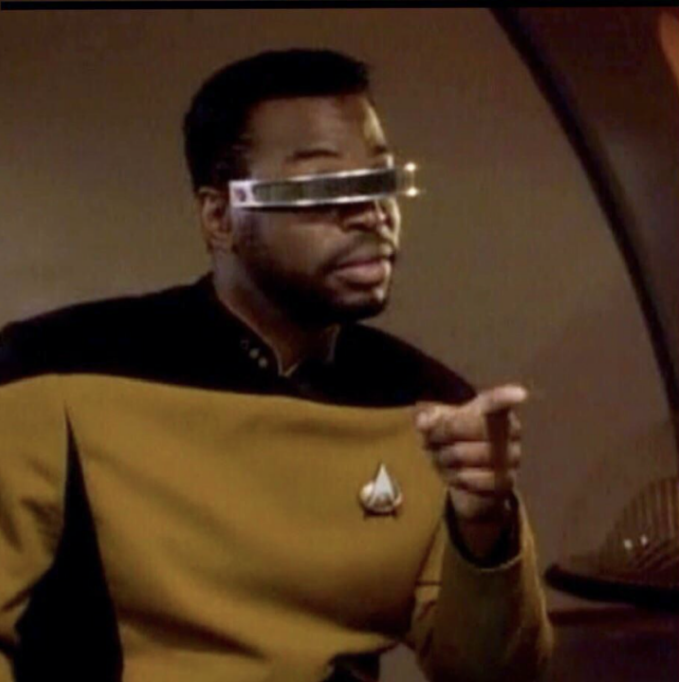
```r
model_2sls <- iv_robust(
  health ~ bed_net | treatment,
  data = bed_nets)
```
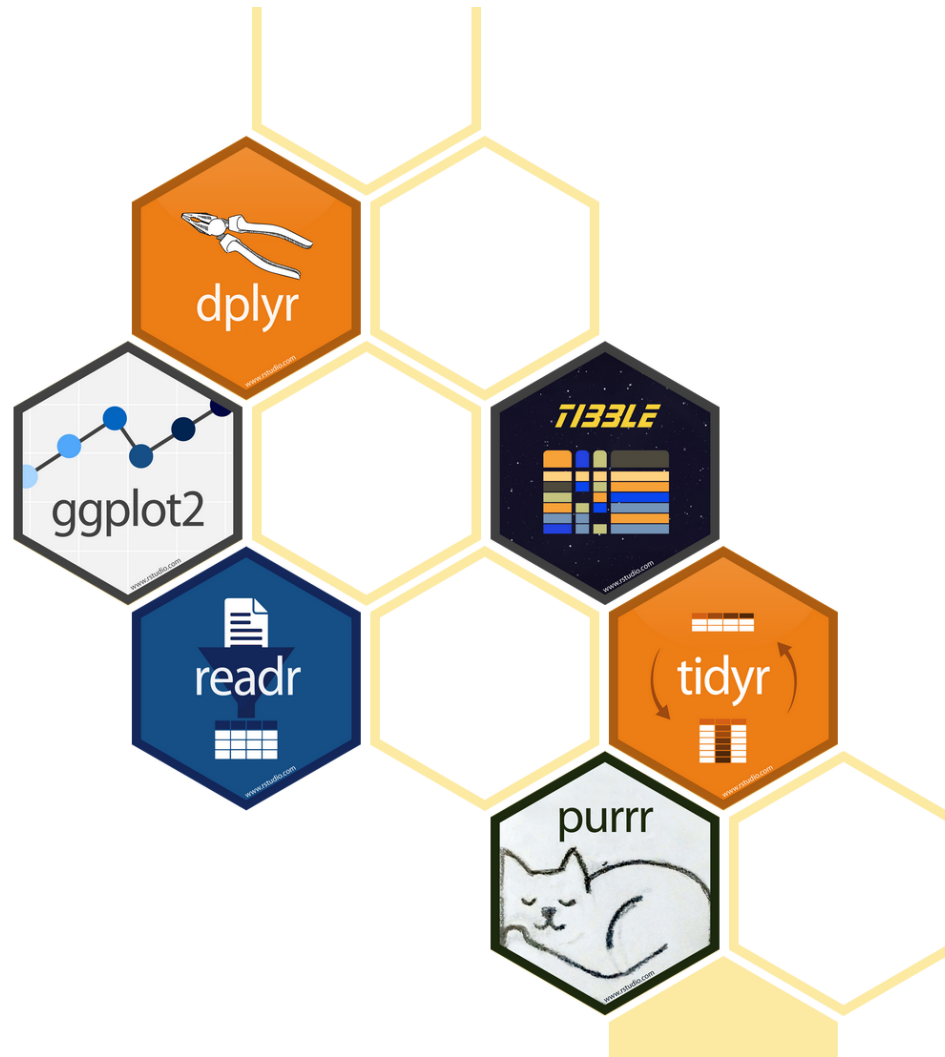
The tidyverse

The tidyverse
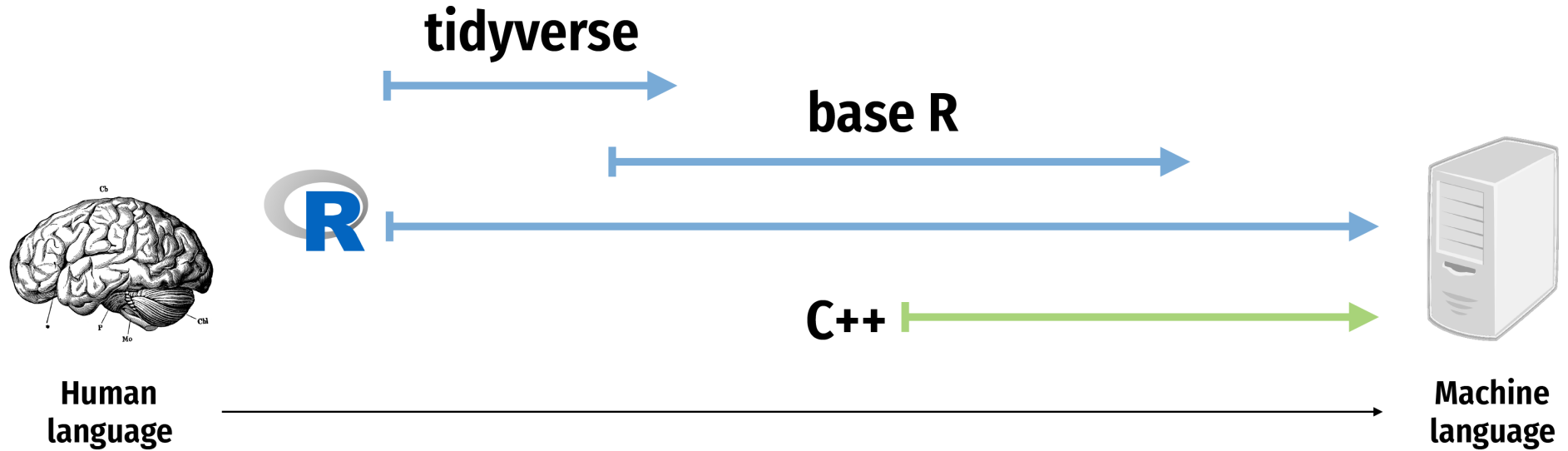
R code, but reads like English!

```r
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

225

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