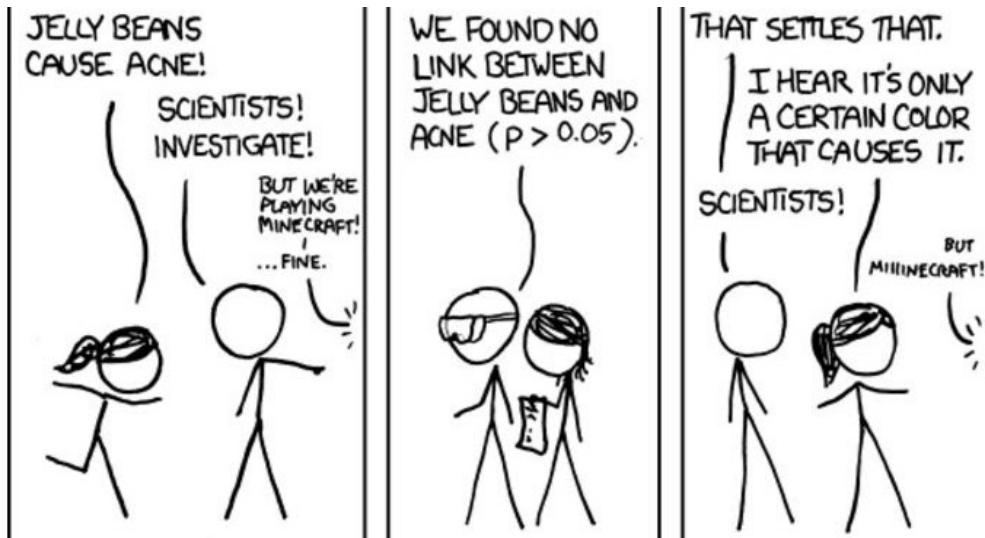


# STA 235H - Randomized Controlled Trials I

Fall 2021

McCombs School of Business, UT Austin

# Today



- Randomized Controlled Trials:

Assumptions: The power of randomization

Design: What should we consider?

Limitations: Gold Standard?

# The Magic of Randomization

# The Fundamental Problem of Causal Inference

- Remember that we can only see one potential outcome
  - E.g. if  $Z$  is binary, either  $Y(0)$  **OR**  $Y(1)$

## Fundamental Problem of Causal Inference

- Need for the **ignorability assumption**

$$Y(z) \perp\!\!\!\perp Z \quad \forall z \in Z$$

- Most times, **the ignorability assumption doesn't hold**
  - Why? (Remember the two types of bias we saw the previous class?)

# Ignorability Assumption

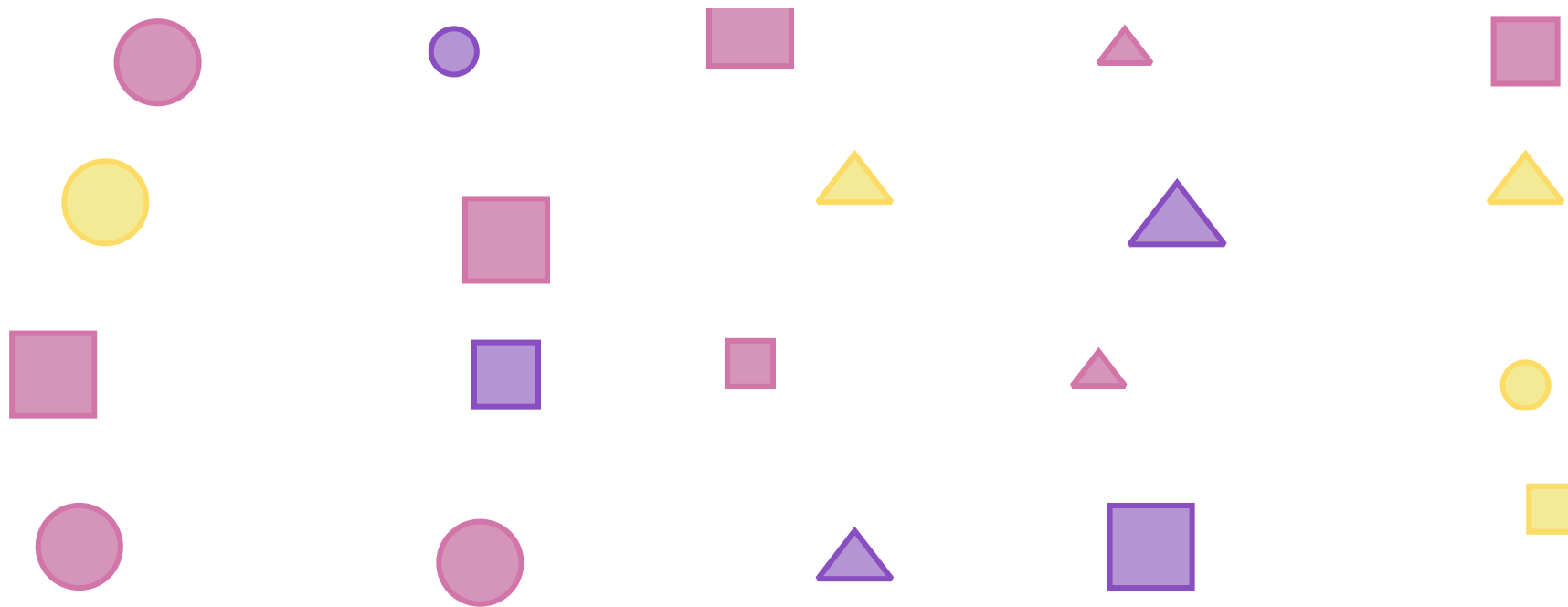
$$(Y(0), Y(1)) \perp\!\!\!\perp Z$$

- Most times, **the ignorability assumption doesn't hold**
  - For ATE:

Selection bias

Heterogeneous treatment effect bias

# The problem with self-selection



Play

# The power of randomization

- One way to make sure the ignorability assumption holds, is to do it by design:

**Randomize the assignment of  $Z$**

i.e. Some units will **randomly** be chosen to be in the treatment group and others to be in the control group.

**What does randomization buy us?**

# The power of randomization

- One way to make sure the ignorability assumption holds, is to do it by design:

**Randomize the assignment of  $Z$**

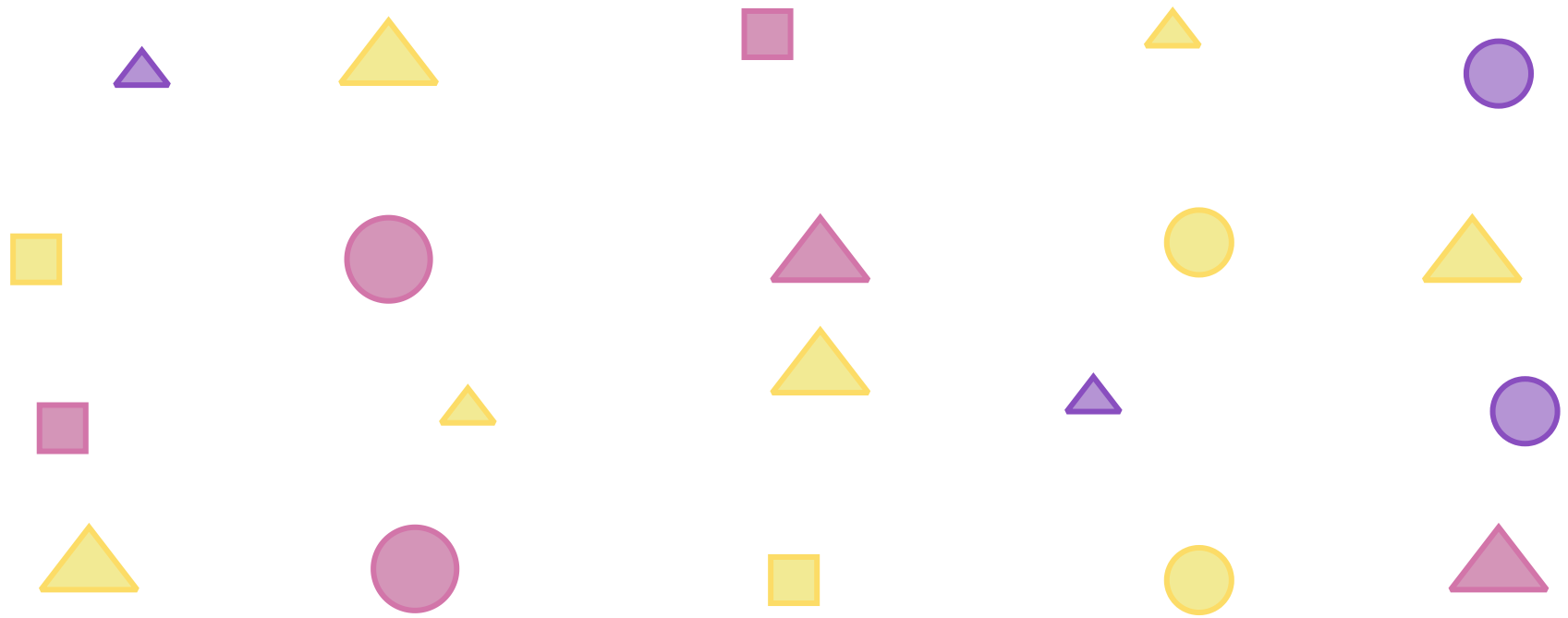
i.e. Some units will **randomly** be chosen to be in the treatment group and others to be in the control group.

**What does randomization buy us?**

**No (systematic) selection on observables OR unobservables**

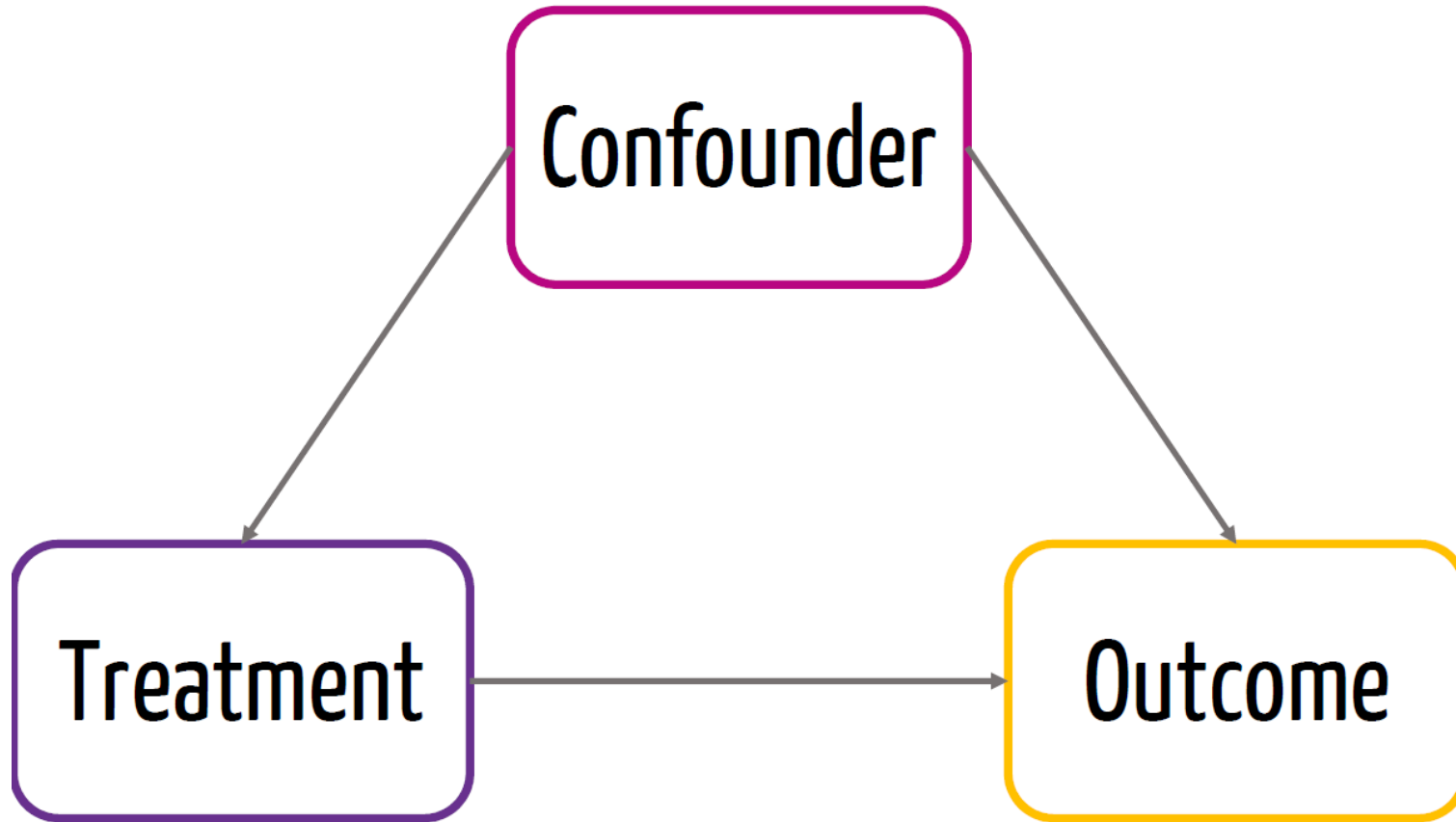


# Randomization of z

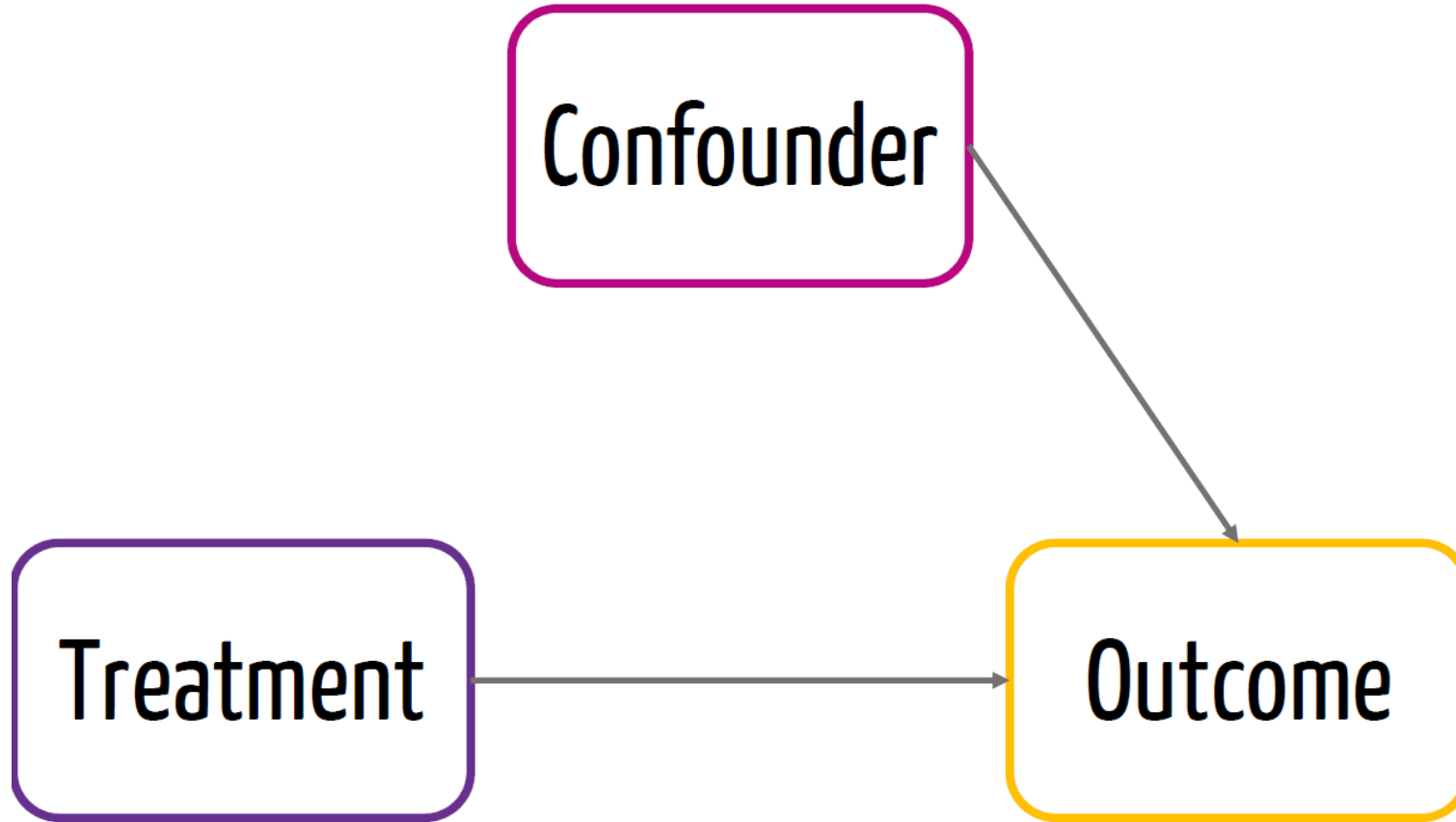


Play

# Observational Causal Graph



# Experimental Causal Graph

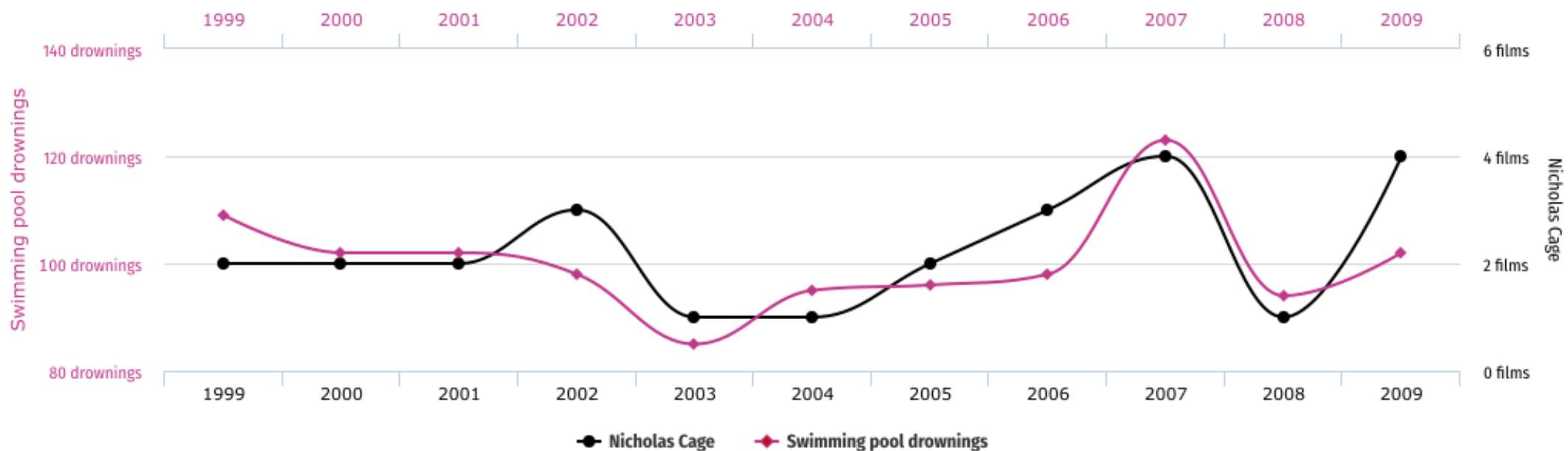


**If I randomize treatment allocation...**

**Can the treatment be potentially  
correlated with a confounder?**

# Just by chance!

**Number of people who drowned by falling into a pool**  
correlates with  
**Films Nicolas Cage appeared in**



# Definition: Identification Strategy

According to Keele (2015):

"A **research design** intended to solve the identification problem"

"Consists of an assumption or set of assumptions that will **identify the causal effect** of interest"

# RCTs: The Gold Standard

The New York Times

## *Nobel Economics Prize Goes to Pioneers in Reducing Poverty*

Three professors, Abhijit Banerjee and Esther Duflo, both of M.I.T., and Michael Kremer of Harvard, were honored.



Abhijit Banerjee and Esther Duflo, both of M.I.T., and Michael Kremer of Harvard University won the Nobel Memorial Prize in Economic Sciences. Jonathan Nackstrand/Agence France-Presse — Getty Images

## **The Nobel went to economists who changed how we help the poor. But some critics oppose their big idea.**

Randomized controlled trials and the debate over them, explained.

By Kelsey Piper | Dec 11, 2019, 9:00am EST



The Laureates of The Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel (L-R) Michael Kremer, Esther Duflo and Abhijit Banerjee pose after their Nobel Lectures at Stockholms University in Stockholm, Sweden, on December 8, 2019. | Photo by CHRISTINE OLSSON/TT News Agency/AFP via Getty Images

# How to analyze RCTs?



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**Easy! (Statistically speaking)**

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**Easy! (Statistically speaking)**

**1) Check for balance**

**2) Calculate difference in sample means between treatment and control group**

**Let's see an example**

# Are Emily and Greg More Employable Than Lakisha and Jamal?

- Actual **field experiment** conducted in Boston and Chicago.
- Send out resumes with **randomly assigned names**:
  - Female- and male-sounding names.
  - White- and African American-sounding names
- Measure whether **applicant was called back**

**Let's go to R**

# Next class

- Finish with **randomized controlled trials**:
  - How do we assign treatment randomly in practice?
  - Stratification
  - Limitations of RCTs.
- Selection on **observables**
- The wonderful world of **matching!**



# References

- Angrist, J. and S. Pischke. (2015). "Mastering Metrics". *Chapter 1*.
- Heiss, A. (2020). "Program Evaluation for Public Policy". *Class 7: Randomization and Matching, Course at BYU*
- Imbens, G. and D. Rubin. (2015). "Causal Inference for Statistics, Social, and Biomedical Sciences: An Introduction". *Chapter 1*