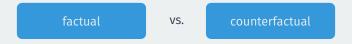
Gov 51: Introduction to Causality

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What is a causal effect?



- Does the minimum wage increase the unemployment rate?
 - Unemployment rate went up after the minimum wage increased
 - · Would it have gone up if the minimum wage increase not occurred?
- · Does race affect one's job prospect?
 - · Jamal applied for a job but did not get it
 - · Would Jamal have gotten a job if he were white?
- Fundamental problem of causal inference:
 - Can never observe counterfactuals, must be inferred.

Criminal record experiment

- Does having a criminal record affect job prospects?
- · Experimental setting:
 - Randomly assign 4 hired "confederates" (2 white, 2 black) to apply to different jobs in Milwaukee.
 - Men were matched on physical appearance, self-presentation, age, etc.
 - Confederates would alternate indicating they had a criminal record.
- Outcome of interest: receiving a callback from a potential employer.

A tale of two applications

	Criminal Record	Callback?
Applicant 1		No
Applicant 2	No criminal record	Yes

 Did the first applicant not callback the applicant because they had a criminal record?

Notation

- **Unit** (indexed by i): job application for employer
- **Treatment variable** T_i : criminal record or not
- · Treatment group (treated units): applications with criminal record
- · Control group (untreated units): applications without criminal record
- Outcome variable Y_i : callback

	T_i (ex-felon)	Y_i (callback)
Ex-felon applicant	1	0
Non-ex-felon applicant	0	1

Causal effects & counterfactuals

- What does " T_i causes Y_i " mean? \rightsquigarrow counterfactuals, "what if"
- · Would an employer treat criminal & noncriminal applicants differently?
- · Two potential outcomes:
 - $Y_i(1)$: would employer i callback if applicant is an ex-felon?
 - $Y_i(0)$: would employer i callback if applicant is **not** an ex-felon?
- Causal effect: $Y_i(1) Y_i(0)$
 - $Y_i(1) Y_i(0) = -1 \rightsquigarrow \text{ criminal record prevents callback}$
 - $Y_i(1) Y_i(0) = 0 \rightsquigarrow$ criminal record has no impact on callback
 - $Y_i(1) Y_i(0) = +1 \rightsquigarrow \text{ criminal record leads to callback}$

Potential outcomes

	T_i (ex-felon)	Y_i (callback)	$Y_i(1)$	$Y_i(0)$
Ex-felon applicant	1	0	0	???
Non-ex-felon applicant	0	1	???	1

• Fundamental problem of causal inference:

- · We only observe one of the two potential outcomes.
- Observe $Y_i = Y_i(1)$ if $T_i = 1$ or $Y_i = Y_i(0)$ if $T_i = 0$
- To infer causal effect, we need to infer the missing counterfactuals!

How can we figure out counterfactuals?

- Find a similar unit! \(\sim \) matching (Mill's method of difference)
- · Did applicant fail to get a job offer because of his criminal record?
 - → find a non-ex-felon who is just like ex-felon applicant.
- NJ increased the minimum wage. Causal effect on unemployment?
 - \rightsquigarrow find a state similar to NJ that didn't increase minimum wage.
- · The problem: imperfect matches!
 - Say we match i (treated) and j (control)
 - $Y_i(1)$ may not be the same as $Y_i(1)$ due to **selection bias**
 - Those who take treatment may be different that those who take control.