Class 9: Strategies for causal inference

API-201
Quantitative Analysis and Empirical Methods I

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Agenda

1. Learn to estimate causal effects from observational data
2. Understand the limitations of these approaches

1854 Broad Street cholera outbreak

Miasma [bad air] theory of disease was the predominant explanation of cholera.

But this theory couldn't explain some of the observed effects. Sailors in docked ships would only become sick when they came to land.

How to test the theory of contaminated water?

Ignore all financial, logistical, and ethical considerations. How would you design a randomized controlled trial to test the theory that contaminated water caused cholera?

Natural experiment

1. The response of treatment group is compared to the response of control group.

2. Assignment of subjects to treatment and control groups is done **as if** at random.

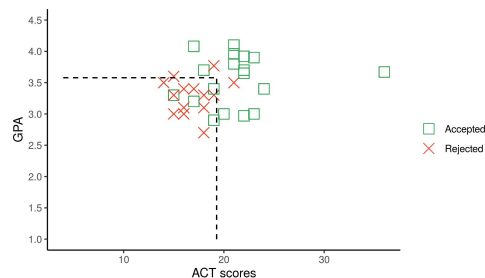3. Assignment is under the control of the experimental researcher.

How does military service affect political attitudes?

Ignore all financial, logistical, and ethical considerations. How would you design a randomized controlled trial to test the effect of military service on political attitudes?
[This type of hypothetical analysis is very useful for thinking about measuring causal effects.]

Naviance

More than 40% of U.S. high school students have access to Naviance, an online, proprietary tool designed to guide **college search** and **application decisions**.
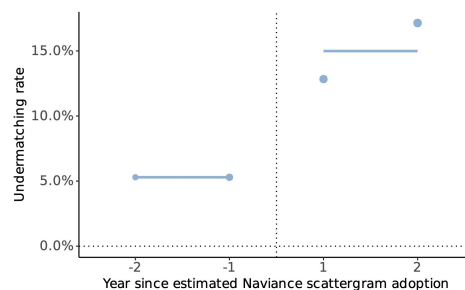
Undermatching

What is the effect of Naviance on undermatching [applying exclusively to schools for which you're overqualified]?

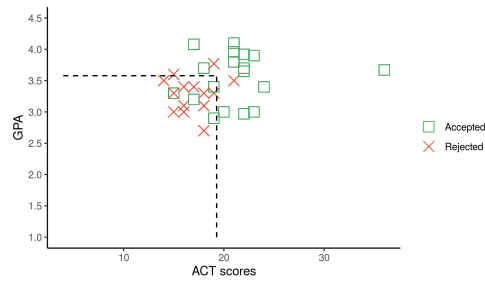**How would you design a randomized controlled trial to test the effect of Naviance on undermatching?**

Pre-post analysis

Among Florida high schools who adopted Naviance in 2016, **undermatching** increased dramatically among the **most competitive students** after the schools introduced Naviance.
[About a factor of two nationwide.]

Unintended consequences

Beware of the unintended consequences of a bad visualization! **How might you design a better visualization?**

Effects of legalizing marijuana on policing
Pierson et al. [2019]

How does police behavior change as a consequence of legalizing recreational marijuana?
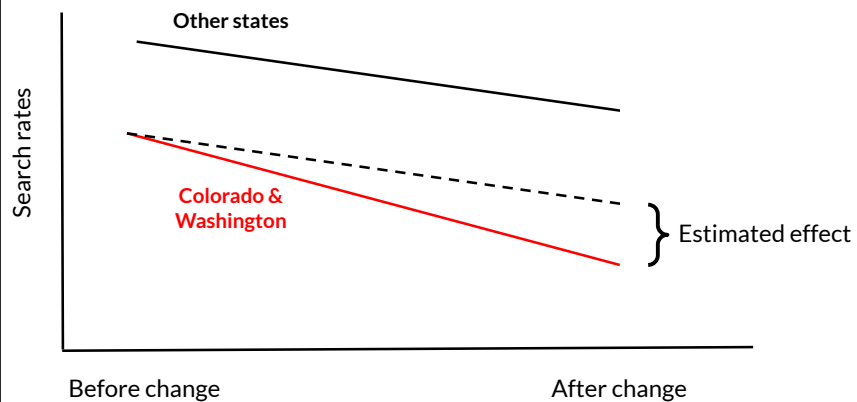
Validity of pre-post analysis

Pre-post analyses are most believable when changes are **sudden**, **large**, and **not contemporaneous** with other potentially shock-inducing events.

What might you be concerned about in our marijuana analysis? How would you address those concerns?
[Discuss with your neighbor.]

Difference in differences
Parallel trends assumption

How does the minimum wage affect unemployment?

Regression discontinuity designs

Treatment determined by the value of a covariate.
[Forcing variable]

Sharp discontinuity in receiving treatment around some value of the variable.

What is the effect of electronic voting machines on enfranchisement?

Between 1980 & 1998, one-third of ballots in Brazil were invalid.

Does past voting affect subsequent turnout?

Racial discrimination

One common way of conceptualizing discrimination is to imagine what would have happened in a "color-blind" world, if the race of an individual weren't known.

The "veil of darkness" test
Grogger and Ridgeway, 2006

It's harder to infer the race of a driver at night, when there is a "veil of darkness".

If Black drivers comprise a smaller fraction of those stopped at night than those stopped during the day, it could mean that race affects stop decisions.

The "veil of darkness" test
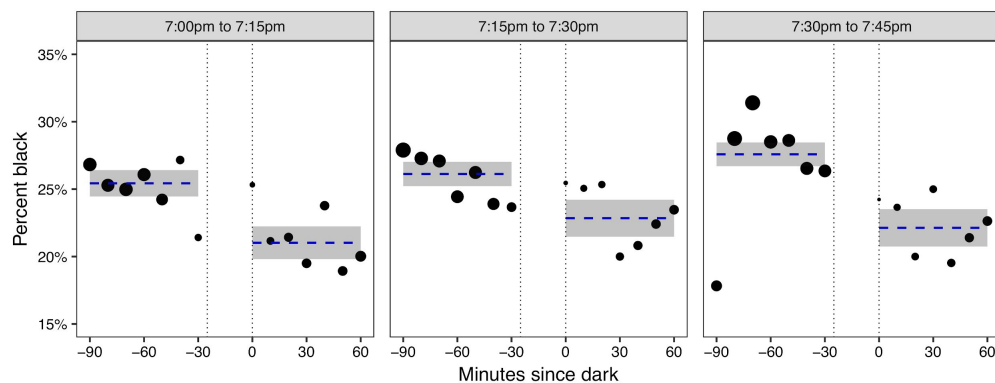**Grogger and Ridgeway, 2006**

Driving patterns might also change by time of day. Black drivers, hypothetically, may be disproportionately out on the road during the day [e.g., due to employment patterns].

To account for this possibility, one can use the fact that the sun sets at different times throughout the year.
[7pm is dark in the winter but light in the summer; sharp discontinuities around beginning and end of daylight savings.]

The "veil of darkness" in Texas

Pierson et al., "A large-scale analysis of racial disparities in traffic stops across the United States", 2019.

Discrimination in traffic stops

Are there forms of discrimination that cannot be captured by the "veil of darkness" test? [Discuss with your neighbor.]

Validating as-if random
Quantitative assessment

1. Covariate balance between treatment / control
2. Uniform density along discontinuity threshold
3. Absence of discontinuities at other points

Validating as-if random
Qualitative assessment

1. Foreknowledge of assignment
2. Ability to predict assignment
3. Ability to influence assignment
4. Incentives to influence assignment

Key takeaways

There are several strategies for estimating causal effects from observational data [natural experiments, pre-post designs, difference-in-differences, regression discontinuity].

These techniques can help us answer critical questions in public policy, but they also come with important limitations.