PSC4375: Observational Studies

Week 2: Lecture 3

Prof. Weldzius

Villanova University

Slides Updated: 2025-01-27

Do newspaper endorsements matter?

- Can newspaper endorsements change voters' minds?

Do newspaper endorsements matter?

- Can newspaper endorsements change voters' minds?
- Why not compare vote choice of readers of different papers?

Do newspaper endorsements matter?

- Can newspaper endorsements change voters' minds?
- Why not compare vote choice of readers of different papers?
  - Problem: readers choose papers based on their previous beliefs

Do newspaper endorsements matter?

- Can newspaper endorsements change voters' minds?
- Why not compare vote choice of readers of different papers?
  - Problem: readers choose papers based on their previous beliefs
  - Liberals $\rightsquigarrow$ New York Times, conservatives $\rightsquigarrow$ Wall Street Journal

Do newspaper endorsements matter?

- Can newspaper endorsements change voters' minds?
- Why not compare vote choice of readers of different papers?
  - Problem: readers choose papers based on their previous beliefs
  - Liberals $\rightsquigarrow$ New York Times, conservatives $\rightsquigarrow$ Wall Street Journal
- Could do a lab experiment, but there are concerns over **external validity**

Do newspaper endorsements matter?

- Can newspaper endorsements change voters' minds?
- Why not compare vote choice of readers of different papers?
  - Problem: readers choose papers based on their previous beliefs
  - Liberals $\rightsquigarrow$ New York Times, conservatives $\rightsquigarrow$ Wall Street Journal
- Could do a lab experiment, but there are concerns over **external validity**
- Study for today: British newspapers switching their endorsements.

Do newspaper endorsements matter?

- Can newspaper endorsements change voters' minds?
- Why not compare vote choice of readers of different papers?
  - Problem: readers choose papers based on their previous beliefs
  - Liberals $\rightsquigarrow$ New York Times, conservatives $\rightsquigarrow$ Wall Street Journal
- Could do a lab experiment, but there are concerns over **external validity**
- Study for today: British newspapers switching their endorsements.
  - Some newspapers endorsing Tories in 1992 switched to Labour in 1997

Do newspaper endorsements matter?

- Can newspaper endorsements change voters' minds?
- Why not compare vote choice of readers of different papers?
  - Problem: readers choose papers based on their previous beliefs
  - Liberals $\rightsquigarrow$ New York Times, conservatives $\rightsquigarrow$ Wall Street Journal
- Could do a lab experiment, but there are concerns over **external validity**
- Study for today: British newspapers switching their endorsements.
  - Some newspapers endorsing Tories in 1992 switched to Labour in 1997
  - **Treated group**: readers of Tory $\rightarrow$ Labour papers

Do newspaper endorsements matter?

- Can newspaper endorsements change voters' minds?
- Why not compare vote choice of readers of different papers?
  - Problem: readers choose papers based on their previous beliefs
  - Liberals $\rightsquigarrow$ New York Times, conservatives $\rightsquigarrow$ Wall Street Journal
- Could do a lab experiment, but there are concerns over **external validity**
- Study for today: British newspapers switching their endorsements.
  - Some newspapers endorsing Tories in 1992 switched to Labour in 1997
  - **Treated group**: readers of Tory $\rightarrow$ Labour papers
  - **Control group**: readers of papers who didn't switch

Observational studies

- Example of an **observational study**:

Observational studies

- Example of an **observational study**:
    - We as researchers observe a naturally assigned treatment

Observational studies

- Example of an **observational study**:
  - We as researchers observe a naturally assigned treatment
  - Very common: often cna't randomize for ethical/logistical reasons

Observational studies

- Example of an **observational study**:
  - We as researchers observe a naturally assigned treatment
  - Very common: often cna't randomize for ethical/logistical reasons
- **Internal validity**: Are the causal assumptions satisfied? Can we interpret this as a causal effect?

Observational studies

- Example of an **observational study**:
  - We as researchers observe a naturally assigned treatment
  - Very common: often cna't randomize for ethical/logistical reasons
- **Internal validity**: Are the causal assumptions satisfied? Can we interpret this as a causal effect?
  - RCTs usually have higher internal validity

Observational studies

- Example of an **observational study**:
  - We as researchers observe a naturally assigned treatment
  - Very common: often cna't randomize for ethical/logistical reasons
- **Internal validity**: Are the causal assumptions satisfied? Can we interpret this as a causal effect?
  - RCTs usually have higher internal validity
  - Observational studies less so, because pre-treatment variable may differ between treatment and control groups

Observational studies

- Example of an **observational study**:
  - We as researchers observe a naturally assigned treatment
  - Very common: often cna't randomize for ethical/logistical reasons
- **Internal validity**: Are the causal assumptions satisfied? Can we interpret this as a causal effect?
  - RCTs usually have higher internal validity
  - Observational studies less so, because pre-treatment variable may differ between treatment and control groups
- **External validity**: Can the conclusions/estimated effects be generalized beyond this study?

Observational studies

- Example of an **observational study**:
  - We as researchers observe a naturally assigned treatment
  - Very common: often cna't randomize for ethical/logistical reasons
- **Internal validity**: Are the causal assumptions satisfied? Can we interpret this as a causal effect?
  - RCTs usually have higher internal validity
  - Observational studies less so, because pre-treatment variable may differ between treatment and control groups
- **External validity**: Can the conclusions/estimated effects be generalized beyond this study?
  - RCTs weaker here because often very expensive to conduct on representative samples

Observational studies

- Example of an **observational study**:
  - We as researchers observe a naturally assigned treatment
  - Very common: often cna't randomize for ethical/logistical reasons
- **Internal validity**: Are the causal assumptions satisfied? Can we interpret this as a causal effect?
  - RCTs usually have higher internal validity
  - Observational studies less so, because pre-treatment variable may differ between treatment and control groups
- **External validity**: Can the conclusions/estimated effects be generalized beyond this study?
  - RCTs weaker here because often very expensive to conduct on representative samples
  - Observational studies often have larger/more representative samples that improve external validity

Confounding

- **Confounder**: pre-treatment variable affecting treatment and the outcome

Confounding

- **Confounder**: pre-treatment variable affecting treatment and the outcome
  - Leftists (X) more likely to read newspapers switching to Labour (T)

Confounding

- **Confounder**: pre-treatment variable affecting treatment and the outcome
  - Leftists (X) more likely to read newspapers switching to Labour (T)
  - Leftists (X) also more likely to vote for Labour (Y)

Confounding

- **Confounder**: pre-treatment variable affecting treatment and the outcome
    - Leftists (X) more likely to read newspapers switching to Labour (T)
    - Leftists (X) also more likely to vote for Labour (Y)
- **Confounding bias** in the estimated SATE due to these differences

Confounding

- **Confounder**: pre-treatment variable affecting treatment and the outcome
  - Leftists (X) more likely to read newspapers switching to Labour (T)
  - Leftists (X) also more likely to vote for Labour (Y)
- **Confounding bias** in the estimated SATE due to these differences
  - $\bar{Y}_{control}$ not a good proxy for $Y_i(0)$ in treated group

Confounding

- **Confounder**: pre-treatment variable affecting treatment and the outcome
  - Leftists (X) more likely to read newspapers switching to Labour (T)
  - Leftists (X) also more likely to vote for Labour (Y)
- **Confounding bias** in the estimated SATE due to these differences
  - $\bar{Y}_{control}$ not a good proxy for $Y_i(0)$ in treated group
  - one type: **selection bias** from self-selection into treatment

Research designs

- How can we find a good comparison group?

Research designs

- How can we find a good comparison group?
- Depends on the data we have available

Research designs

- How can we find a good comparison group?
- Depends on the data we have available
- Three general types of observational study **research designs**:

Research designs

- How can we find a good comparison group?
- Depends on the data we have available
- Three general types of observational study **research designs**:
  1. **Cross-sectional design**: compare outcomes treated and control units at one point in time

Research designs

- How can we find a good comparison group?
- Depends on the data we have available
- Three general types of observational study **research designs**:
  1. **Cross-sectional design**: compare outcomes treated and control units at one point in time
  2. **Before-and-after design**: compare outcomes before and after a unit has been treated, but need over-time data on treated group

Research designs

- How can we find a good comparison group?
- Depends on the data we have available
- Three general types of observational study **research designs**:
    1. **Cross-sectional design**: compare outcomes treated and control units at one point in time
    2. **Before-and-after design**: compare outcomes before and after a unit has been treated, but need over-time data on treated group
    3. **Differences-in-differences design**: use before/after information for the treated and control group; need over-time data on treated and control group

Cross-sectional design

- Compare treatment and control groups after treatment happens

Cross-sectional design

- Compare treatment and control groups after treatment happens
  - Readers of switching papers vs. readers of non-switching papers in 1997

Cross-sectional design

- Compare treatment and control groups after treatment happens
  - Readers of switching papers vs. readers of non-switching papers in 1997
- Treatment and control groups assumed identical on average as in RCT

Cross-sectional design

- Compare treatment and control groups after treatment happens
  - Readers of switching papers vs. readers of non-switching papers in 1997
- Treatment and control groups assumed identical on average as in RCT
  - Sometimes called **unconfoundedness** or **as-if randomized**

Cross-sectional design

- Compare treatment and control groups after treatment happens
  - Readers of switching papers vs. readers of non-switching papers in 1997
- Treatment and control groups assumed identical on average as in RCT
  - Sometimes called **unconfoundedness** or **as-if randomized**
- Cross-section comparison estimate:

Cross-sectional design

- Compare treatment and control groups after treatment happens
  - Readers of switching papers vs. readers of non-switching papers in 1997
- Treatment and control groups assumed identical on average as in RCT
  - Sometimes called **unconfoundedness** or **as-if randomized**
- Cross-section comparison estimate:

$$\bar{Y}^{after}_{treated} - \bar{Y}^{after}_{control}$$

Cross-sectional design

- Compare treatment and control groups after treatment happens
  - Readers of switching papers vs. readers of non-switching papers in 1997
- Treatment and control groups assumed identical on average as in RCT
  - Sometimes called **unconfoundedness** or **as-if randomized**
- Cross-section comparison estimate:

$$\bar{Y}^{after}_{treated} - \bar{Y}^{after}_{control}$$

- Could there be confounders?

Statistical control

- **statistical control**: adjust for confounders using statistical procedures

Statistical control

- **statistical control**: adjust for confounders using statistical procedures
  - Can help to reduce confounding bias

Statistical control

- **statistical control**: adjust for confounders using statistical procedures
  - Can help to reduce confounding bias
- One type of statistical control: **subclassification**

Statistical control

- **statistical control**: adjust for confounders using statistical procedures
  - Can help to reduce confounding bias
- One type of statistical control: **subclassification**
  - Compare treated and controls groups within levels of a confounder

Statistical control

- **statistical control**: adjust for confounders using statistical procedures
  - Can help to reduce confounding bias
- One type of statistical control: **subclassification**
  - Compare treated and controls groups within levels of a confounder
  - Remaining effect can't be due to the confounder

Statistical control

- **statistical control**: adjust for confounders using statistical procedures
    - Can help to reduce confounding bias
- One type of statistical control: **subclassification**
    - Compare treated and controls groups within levels of a confounder
    - Remaining effect can't be due to the confounder
- Threat to inference: we can only control for observed variables $\rightsquigarrow$ threat of **unmeasured confounding**

Before-and-after comparison

- Compare readers of party-switching newspapers before and after switch

Before-and-after comparison

- Compare readers of party-switching newspapers before and after switch
- Advantage: all person-specific features held fixed

Before-and-after comparison

- Compare readers of party-switching newspapers before and after switch
- Advantage: all person-specific features held fixed
  - comparing within a person over time

Before-and-after comparison

- Compare readers of party-switching newspapers before and after switch
- Advantage: all person-specific features held fixed
  - comparing within a person over time
- Before-and-after estimate:

Before-and-after comparison

- Compare readers of party-switching newspapers before and after switch
- Advantage: all person-specific features held fixed
  - comparing within a person over time
- Before-and-after estimate:

$$\bar{Y}^{after}_{treated} - \bar{Y}^{before}_{treated}$$

Before-and-after comparison

- Compare readers of party-switching newspapers before and after switch
- Advantage: all person-specific features held fixed
  - comparing within a person over time
- Before-and-after estimate:

$$\bar{Y}^{after}_{treated} - \bar{Y}^{before}_{treated}$$

- Threat to inference: **time-varying confounders**
  - Time trend: Labour just did better overall in 1997 compared to 1992

Differences in differences (Diff-in-Diff)

- Key idea: use the before-and-after difference of **control group** to infer what would have happened to **treatment group** without treatment

Differences in differences (Diff-in-Diff)

- Key idea: use the before-and-after difference of **control group** to infer what would have happened to **treatment group** without treatment
- DiD estimate:

Differences in differences (Diff-in-Diff)

- Key idea: use the before-and-after difference of **control group** to infer what would have happened to **treatment group** without treatment
- DiD estimate:

$$\left(\bar{Y}^{after}_{treated} - \bar{Y}^{before}_{treated}\right) - \left(\bar{Y}^{after}_{control} - \bar{Y}^{before}_{control}\right)$$

Differences in differences (Diff-in-Diff)

- Key idea: use the before-and-after difference of **control group** to infer what would have happened to **treatment group** without treatment
- DiD estimate:

$$\left(\bar{Y}^{after}_{treated} - \bar{Y}^{before}_{treated}\right) - \left(\bar{Y}^{after}_{control} - \bar{Y}^{before}_{control}\right)$$

- Change in treated group above and beyond the change in control group

Differences in differences (Diff-in-Diff)

- Key idea: use the before-and-after difference of **control group** to infer what would have happened to **treatment group** without treatment
- DiD estimate:

$$\left(\bar{Y}^{after}_{treated} - \bar{Y}^{before}_{treated}\right) - \left(\bar{Y}^{after}_{control} - \bar{Y}^{before}_{control}\right)$$

- Change in treated group above and beyond the change in control group
- **Parallel time trend assumption**

Differences in differences (Diff-in-Diff)

- Key idea: use the before-and-after difference of **control group** to infer what would have happened to **treatment group** without treatment
- DiD estimate:

$$\left(\bar{Y}_{treated}^{after} - \bar{Y}_{treated}^{before}\right) - \left(\bar{Y}_{control}^{after} - \bar{Y}_{control}^{before}\right)$$

- Change in treated group above and beyond the change in control group
- **Parallel time trend assumption**
  - Changes in vote of readers of non-switching papers roughly the same as changes that readers of switching papers would have been if they read non-switching papers

Differences in differences (Diff-in-Diff)

- Key idea: use the before-and-after difference of **control group** to infer what would have happened to **treatment group** without treatment
- DiD estimate:

$$\left(\bar{Y}^{after}_{treated} - \bar{Y}^{before}_{treated}\right) - \left(\bar{Y}^{after}_{control} - \bar{Y}^{before}_{control}\right)$$

- Change in treated group above and beyond the change in control group
- **Parallel time trend assumption**
  - Changes in vote of readers of non-switching papers roughly the same as changes that readers of switching papers would have been if they read non-switching papers
  - Threat to inference: non-parallel trends

Summarizing approaches:

1. **Cross-sectional comparison** - compare treated units with control units after treatment - Assumption: treated and control units are comparable - Possible confounding

Summarizing approaches:

1. **Cross-sectional comparison** - compare treated units with control units after treatment - Assumption: treated and control units are comparable - Possible confounding
2. **Before-and-after comparison** - Compare the same units before and after treatment - Assumption: no time-varying confounding

Summarizing approaches:

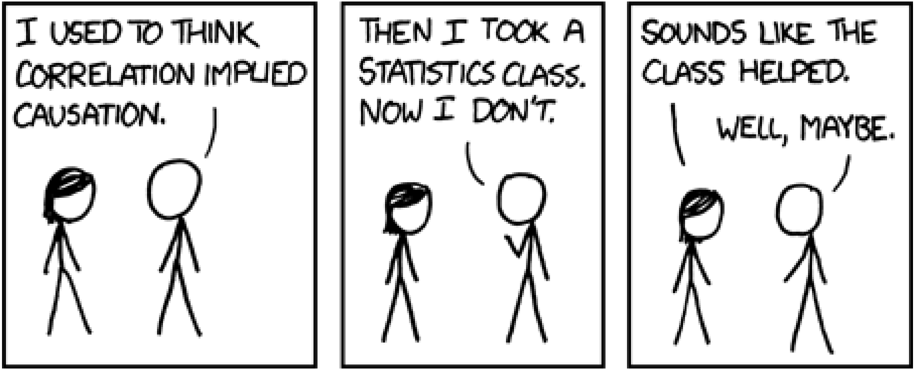
1. **Cross-sectional comparison** - compare treated units with control units after treatment - Assumption: treated and control units are comparable - Possible confounding
2. **Before-and-after comparison** - Compare the same units before and after treatment - Assumption: no time-varying confounding
3. **Differences-in-differences** - Assumption: parallel trends assumptions - Under this assumption, it accounts for unit-specific and time-varying confounding

Summarizing approaches:

1. **Cross-sectional comparison** - compare treated units with control units after treatment - Assumption: treated and control units are comparable - Possible confounding
2. **Before-and-after comparison** - Compare the same units before and after treatment - Assumption: no time-varying confounding
3. **Differences-in-differences** - Assumption: parallel trends assumptions - Under this assumption, it accounts for unit-specific and time-varying confounding

- All rely on assumptions that can't be verified to handle confounding
- RCTs handle confounding by design

Causality understanding check



See also: https://www.tylervigen.com/spurious-correlations