Gov 50: 5. Observational Studies

Matthew Blackwell

Harvard University

Fall 2018

1. Today's agenda

2. Review of randomized experiments

3. Observational Studies

4. Wrapping up

1/ Today's agenda

What have you been up to?

1. Section
   - Video posted if you missed it.
2. Reading
   - Read sections 2.5 of QSS.

Where are we going?

1. Quick review of randomized experiments
2. Review sections 2.5 of QSS
    - Observational studies
    - Confounding bias
    - Cross-section, before-and-after, and differences-in-differences designs
    - Newspaper endorsements in UK
3. Problem Set 1

2/ Review of randomized experiments

Reviewing experiments

- Fundamental problem of causal inference:
  - Comparison between factual and counterfactual.
  - Counterfactuals not observed.
- Solution: **randomized control trials** (RCTs)
  - Treatment and control groups identical on average
  - Similar in all (observed and unobserved) characteristics
- Difference in means as an estimate of the **Sample Average Treatment Effect** (SATE):

$$\text{difference-in-means estimator} = \overline{Y}_{\text{treated}} - \overline{Y}_{\text{control}}$$

$$\text{SATE} = \frac{1}{n}\sum_{i=1}^{n}\{Y_i(1) - Y_i(0)\}$$

Resume experiment

- Load the data:

```r
## load data
resume <- read.csv("data/resume.csv")
head(resume)
```

```
##   firstname    sex  race call
## 1   Allison female white    0
## 2   Kristen female white    0
## 3   Lakisha female black    0
## 4   Latonya female black    0
## 5    Carrie female white    0
## 6       Jay   male white    0
```

- Estimate the SATE:

```r
mean(resume$call[resume$race == "black"]) -
  mean(resume$call[resume$race == "white"])
```

```
## [1] -0.032
```

3/ Observational Studies

Do newspaper endorsements matter?

- Can newspaper endorsements change voters' minds?
- Problem: people might read newspaper because of political leanings of paper
    - Liberals read the New York Times, conservatives read the Wall Street Journal.
- Could do a lab experiment, but there are concerns over **external validity**

British newspaper readers

- Two political scientists tested this with British newspapers in the 1990s.

Name	Description
`tolabor`	Whether or not the respondent read a newspaper that switched endorsement to the Labour between 1992 and 1997
`vote_l_92`	Indicator for if the respondent voted for Labour in 1992 election
`vote_l_97`	Indicator for if the respondent voted for Labour in 1997 election
`parent_labor`	Did the respondent's parents vote for Labour?
`male`	Is the respondent male (1) or female (0)?

Loading the data

- First we load the data:

```
news <- read.csv("data/newspapers.csv")
dim(news)
```

```
## [1] 1593    7
```

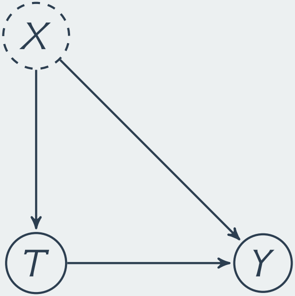
- Next we create subsets for readers of newspapers that switched to Labour (**treatment group**) and readers of those papers who didn't switch (**control group**):

```
switched <- subset(news, subset = tolabor == 1)
stayed <- subset(news, subset = tolabor == 0)
```

Observational studies

- Example of an **observational study**:
  - We as researchers observe a naturally assigned treatment
  - Very common: often can't randomize for ethical/logistical reasons.
- **Internal validity**: are the causal assumption 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**: a pre-treatment variable affecting treatment and the outcome.
  - More liberal people (X) might read newspapers that switch to endorsing Labour (T).
  - More liberal people (X) also more likely to vote for Labour (Y).
- **Confounding bias** in the estimated SATE due to these differences
  - $\overline{Y}_{\text{control}}$ 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?
- Depends on the data we have available.
- Three general types of observational study **reseach 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. **Difference-in-differences design**: use before-and-after information for the treated and control group, but need over-time on treated and control group.

Cross-sectional design

- Compare treatment (readers of switching papers) to control after the switches.
- Treatment and control groups assumed to be identical (on average) in terms of all confounders.
  - Sometimes called **unconfoundedness**.
- SATE estimate:

```
mean(switched$vote_l_97) - mean(stayed$vote_l_97)
```

```
## [1] 0.152
```

- Could there be confounders?

Checking confounders

- Compare means of possible confounders in treated and control groups.
- Proportion male:

```r
mean(switched$male)
```

```
## [1] 0.455
```

```r
mean(stayed$male)
```

```
## [1] 0.556
```

- Proportion whose parents voted for Labour:

```r
mean(switched$parent_labor)
```

```
## [1] 0.436
```

```r
mean(stayed$parent_labor)
```

```
## [1] 0.354
```

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 control groups within levels of a confounding variable.
  - Remaining effect can't be due to the confounder.
- Threat to inference: we can only control for observed variables $\rightsquigarrow$ threat of **unmeasured confounding**

Subclassifying on gender

- Estimate effect within levels of gender. First, for men:

```
switched.males <- switched[switched$male == 1,]
stayed.males <- stayed[stayed$male == 1,]

mean(switched.males$vote_l_97) - mean(stayed.males$vote_l_97)
```

```
## [1] 0.126
```

- For women:

```
switched.females <- switched[switched$male == 0,]
stayed.females <- stayed[stayed$male == 0,]

mean(switched.females$vote_l_97) - mean(stayed.females$vote_l_97)
```

```
## [1] 0.172
```

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.
- Estimate:

```
switchedDiff <- mean(switched$vote_l_97) -
  mean(switched$vote_l_92)
switchedDiff
```

```
## [1] 0.194
```

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

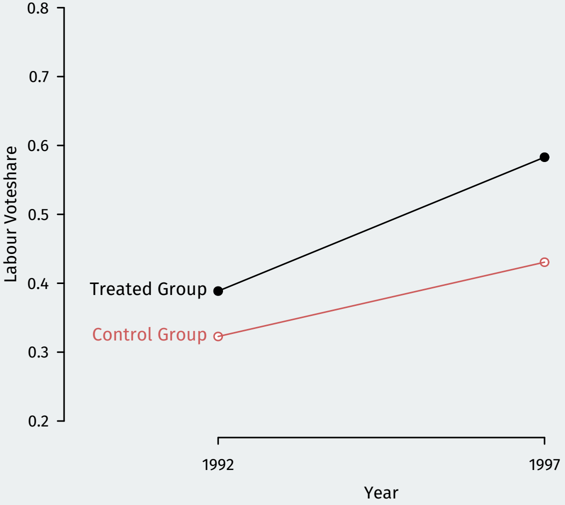
Differences in differences

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

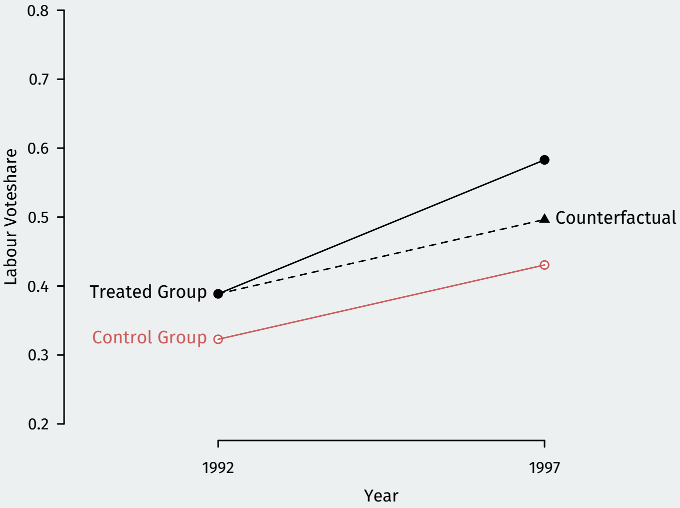
```
stayedDiff <- mean(stayed$vote_l_97) -
  mean(stayed$vote_l_92)
switchedDiff-stayedDiff
```

```
## [1] 0.0865
```

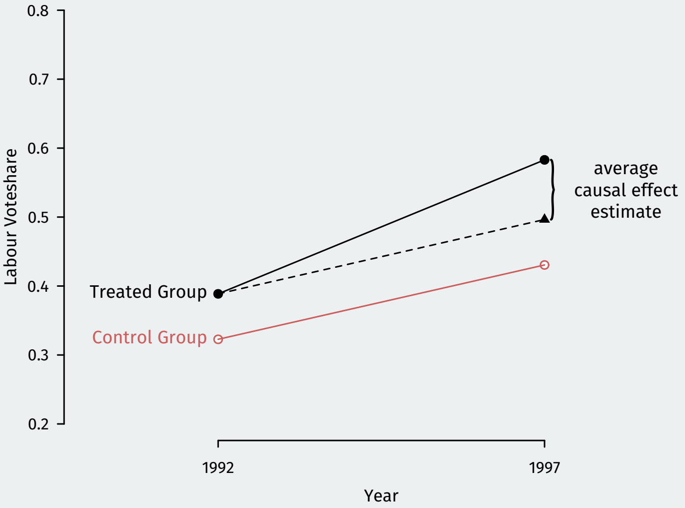
Visualizing DiD



Visualizing DiD



Visualizing DiD



Summarizing approaches

1. **Cross-sectional comparison**
    - Compare treated units with control units after treatment
    - Assumption: treated and controls 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 three rely on assumptions that can't be verified to handle confounding.
- RCTs handle confounding by design.

4/ Wrapping up

Homework 1

- On Canvas/rstudio.cloud now—you should start.
- See Rmarkdown tutorials and section videos/notes for help with Rmarkdown.
- Post questions and answers to Canvas, but avoid posting solutions.
- Submission:
  - electronic copy of your Rmd file
  - electronic copy of your compiled PDF
- Harvard College students:
  - Study Halls begin tonight 6-9pm in Lowell Dining Hall (location may change in future weeks).
  - 3 CAs (T.J., Hana, and Kayla) will be there to help answer questions.

Next time

- Start to talk more about measurement and descriptive statistics.
- Read: QSS 2.6, 3.1–3.2