THE UNIVERSITY OF CHICAGO
Harris Public Policy

Program Evaluation

FINAL REVIEW – SPRING 2020

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Randomized Control Trials (RCT)

- Often called the “Gold Standard”
- Involves assigning participants to a *treatment* or *control* group at random.
- Best way around the *Fundamental Problem of Causal Inference* (missing counterfactual)
- Best way to estimate *average treatment effects (ATE)*
- *Stratification designs:* to ensure “balance” on specific characteristics
- *Saturation designs:* to test for “spillover” effects

Check for balance (via Regression)

- Regress baseline covariates on treatment variable
- Result is not *statistically significant* if treatment and control groups are balanced.
- Also check for the magnitude of your intercept and coefficient, to see whether they make sense (know your data!)
- Example: *TASession9.Rmd*

Selection on Observables (SOO)

- Used when implementing an RCT is not *feasible*
  - A “last-resort” design.
  - Not (very) believable
- Needs strong, strong assumptions
  - **Conditional Independence:** once we control for X_i, we’ve eliminated selection
  - **Common Support:** there are both treated and untreated units for each level of *X.*

SOO: Regression Adjustment

- Controlling for stuff
- *Example:*
  - A regression trying to estimate gender wage gap

$$wage = \alpha + female + \varepsilon$$

  - With regression adjustment, we add covariates, always considering our SOO assumptions

$$wage = \alpha + female + age + education + industry + \varepsilon$$

SOO: Matching

- Does not assume “functional form”
- Goal: matching on observable characteristics
- Types of matching
  - *Exact Matching*
  - *Bandwidth*
- Heavily relies on the SOO assumptions
- Example: *TASession9.Rmd*

Instrumental Variables (IV)

- An “instrument” used to account for unobservables
  - In simpler words: an IV is a “proxy” used instead of your main “X”
- An IV Z is correlated with your X.
- An IV Z is exogenous: no correlation with the error term.
- In other words: IV Z has zero effect on your Y, except through X.

IV Assumptions

Two main IV assumptions:

- **RELEVANCE**
  - $Cov(X, Z) \neq 0$
- **EXCLUSION RESTRICTION**
  - $Cov(Z, \varepsilon) = 0$

Instrumental Variables (IV)

- Can be used to deal with non-compliance issues in an RCT
  - Implemented by measuring the LATE(Local Average Treatment Effect) in an experiment

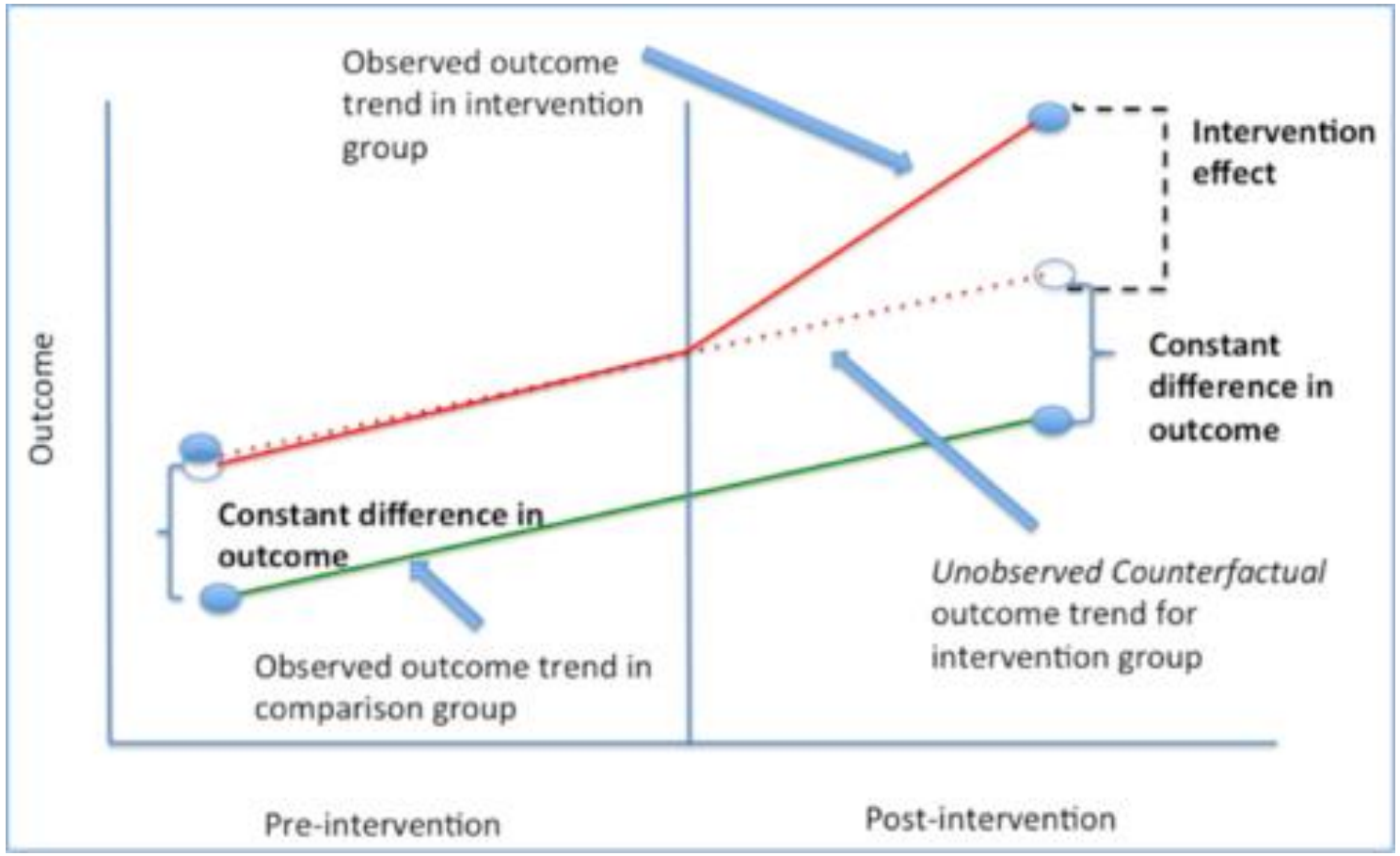
IV 2SLS

- **First Stage**
  - Regress treatment on IV and other covariates.
  - Save predicted values of this regression
- **Second Stage**
  - Regress outcome variable on saved predicted values and other covariates
  - The coefficient in this regression is our IV estimate
- Example: *TASession9.Rmd*

Difference in Difference (DiD)

- Used for Panel Data: many units observed across time
- **Main Assumption:**
  - Common / Parallel Trends
- Main idea:
  - Estimate the difference (Post – Pre) treatment for participants, *minus* the difference (Post-Pre) treatment for non-participants.

Difference in Difference (DiD)



Difference in Difference (DiD)

- In Regression:

$$Y_i = \beta_0 + \beta_1 Treat_i + \beta_2 Post_t + \tau(Treat_i \times Post_t) + \beta_2 X_i + \varepsilon_{it}$$

- Example: *TASession9.Rmd*

Fixed Effects

- Generalized version of DiD
- Used with panel data: useful for many-period, many-unit regression
- **Main Assumption holds:**
  - Common / Parallel Trends
- Common types of Fixed Effects
  - Entity fixed effects: Individual-specific time-invariant piece
  - Time fixed effects: Common time-period-specific piece

Difference in Difference (DiD)

- In Regression:

$$Y_{it} = \beta D_{it} + \gamma_i + \delta_t + \varepsilon_{it}$$

- Example: *TASession9.Rmd*

Regression Discontinuity(RDD)

- Used when we have a continuous variable ("running variable" or "forcing variable") that has a cutoff *above* or *below* which people receive treatment.
- **Key concept:** Bandwidth – How far above or below the cutoff we should go to make sure our estimate is adequate?
  - Wide bandwidth = introduces bias
  - Narrow bandwidth = big variance (sample is smaller)

Sharp vs. Fuzzy RD

- **Sharp RD**
  - Clean or sharp cutoff.
  - Probability of something happening below and above the cutoff is 0 or 1 (or 1 or 0, depending on the variable)
    - Example: when a bill in Congress passes when there is 50.1% of votes, but not at 49.9%.
- **Fuzzy**
  - Probability of something happening below and above the cutoff are between 0 AND 1
    - Example: probability of getting a scholarship may increase with an SAT score of 1390, or 1400, or 1410… but it does not guarantee it!
  - We can use an IV to estimate treatment effect with a Fuzzy RD design.