Statistics II

Week 6: **Regression Discontinuity Designs**

Content for Today

1. Review of core concepts from lecture
2. RDD in R

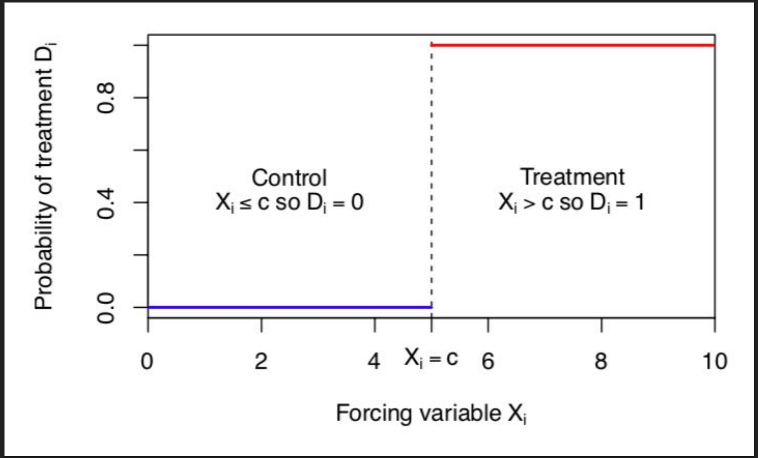
Lecture Review

Core Idea

- Treatment is assigned according to a rule based on another variable (called the **forcing** or **running** variable.
- Treated and untreated units may differ in their potential outcomes (non-random selection into treatment) based on forcing variable. There might be other factors that determine the forcing variable outcome.
- However, whether units end up just below or just above the threshold is assumed to be a matter of chance (**local randomization**).
- Treatment effect is determined by comparing those just on either side of the cut-off.

Sharp RDD

- In sharp RDD, our treatment variable **X perfectly determines** which side of the cut-off you are on.
- For example, being over or under the age of 21 (in the US) determines whether or not you are eligible to legally buy alcohol.



Key Assumption

- **Continuity of average potential outcomes**: basically, units on one side of the threshold need to be essentially the same as units on the other side. Average potential outcomes should be continuous.
- The continuity assumption allows us to do a tiny bit of extrapolation and compensate for the lack of common support at the threshold.
- However, this assumption can easily be violated: It could be that the potential outcomes are actually not continuous and there is some other variable driving differences at the cutoff point.
    - For example, you may be incentivized to report your income just below a threshold for government support - this sorting violates our assumption.

Estimating LATE

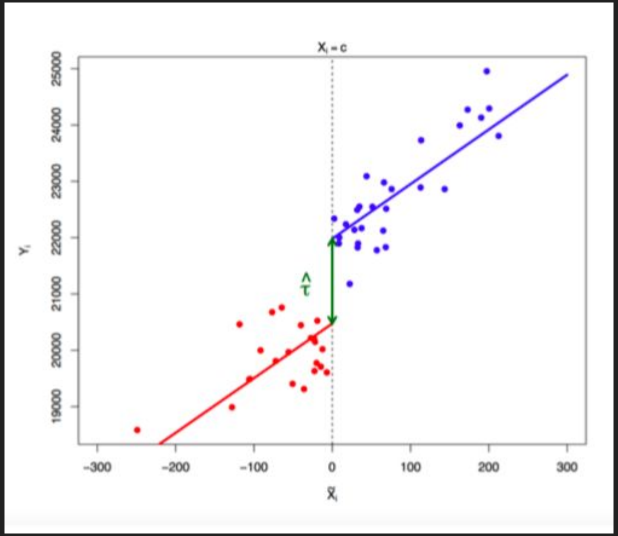
- **Choose a window** around the threshold c.
    - The narrower the better, but can you afford losing many observations?
    - There is a trade off between bias and variance when choosing bandwidth: smaller bandwidth means less precision so higher variance, and therefore lower significance. Higher bandwidth means more observations, but more bias because we're comparing individuals who are more different from each other.
- **Recode forcing variable** X to deviations from threshold.
- **Decide which model** is the most appropriate given the nature of the data: linear with a common slope, linear with different slopes, or non-linear.

Linear with a Common Slope

Assumptions:

- PO under control is linear in X
- Treatment effect does not depend on the value of Xi.

In this case, we just **regress the observed outcome Y on D and X**.

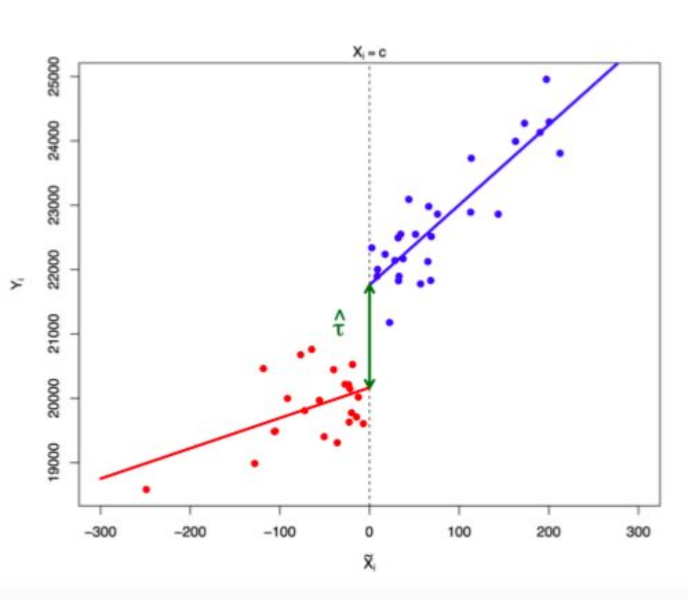


Linear with a Different Slope

Assumptions:

- POs for treatment and control groups are both linear in X
- But we now allow treatment effect to vary with Xi

We regress Yi on Xi, Di and the **interaction DiXi.**



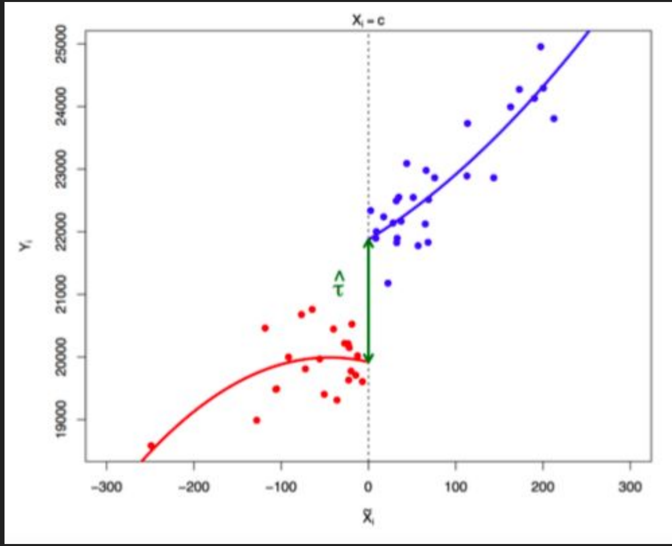
Non-linear

Assumptions:

- POs are now allowed to be non-linear in x, but must be correctly specified
- Treatment effect is allowed to vary across Xi

Can include **quadratic, cubic**, etc. terms in Xi and their interactions with Di in the equation.

- Be cautious about high-order polynomials: they are difficult to fit, make lots of assumptions about the data, and are sensitive to outliers.



Falsification Checks

1. **Sensitivity**: Are results sensitive to alternative specifications?
   a. Nonlinear relation ≠ discontinuity
   b. If units start curving up near lower threshold and down near upper, it might just be non-linearity vs. a discontinuity jump.
2. **Balance checks**: Does any covariate Zi jump at the threshold?
   a. Aiming for scenario where comparing individuals that are pretty much identical except for what side of the cut off they ended up on. Only want to see a jump in Y, no other variables.
3. Do jumps occur at **placebo thresholds** $c*$?
4. **Sorting**: Do units sort around the threshold?
   a. Sometimes there is an incentive to end up above or below a threshold. An agent's behavior can invalidate the continuity assumption

Questions?