# Regression Discontinuity Design

POST 8000 – Foundations of Social Science Research for Public Policy

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# Goal for Today

*Discuss regression discontinuity design (RDD) as a means to causal inference.*

# Introduction

RDD allows us to estimate causal treatment effects in non-experimental settings.

- It exploits precise knowledge of the rules determining treatment.
- Identification is based on the idea that some rules are arbitrary and provide good quasi-experiments.

Recent flurry of applied economics research using RDD:

- Seemingly mild assumptions (Hahn, Todd, and van der Klaauw 2001)
- More credible than other non-experimental identification strategies (Lee 2008)

# Origins: Thistlethwaite and Campbell (1960)

Question: what is the effect of merit awards on future academic outcomes?

- However, awards were allocated on the basis of test scores.

There's a cutoff point $c$.

- Below which: no award. Above which: award.

# Origins: Thistlethwaite and Campbell (1960)

Couldn't you just compare those with/without award?

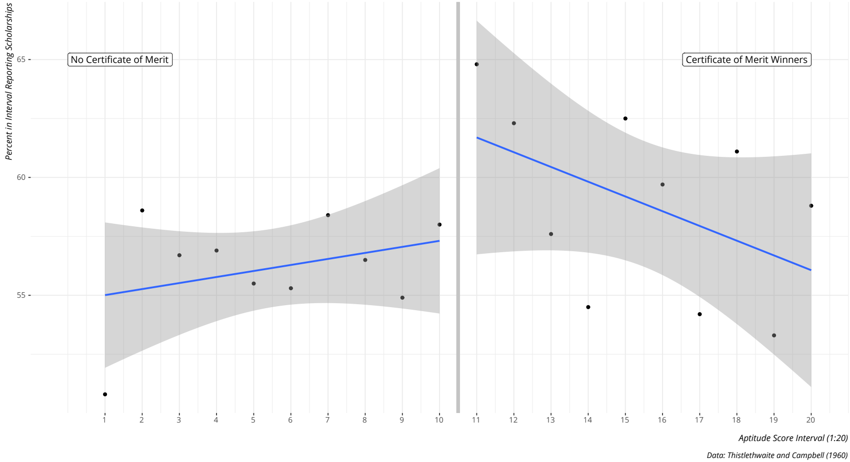
- No: factors that influence the test score are also related to future academic outcomes.

*But* you could compare individuals just above and below the cutoff point $c$.

- That gives you the estimated causal effect of a particular treatment.

## An Example of a Regression Discontinuity Design from Thistlethwaite and Campbell (1960)

Notice the different effect for both groups, but more importantly notice the discontinuity.



# The Intuition Behind RDD (In This Case)

- Assignment mechanism is known.
- The probability of treatment jumps to 1 if test score $\geq c$:
    - We call this a **sharp** discontinuity.
- Individuals cannot manipulate their assignment variable.
- Individuals near cutoff are comparable/similar, save for that one distinction.

Thus, the discontinuous jump in outcome variables at $c$ amounts to the causal effect of merit award.

# Identification in RDD

First:

- All other factors determining the outcome variable should be evolving smoothly with respect to the assignment variable.
- If other factors (variables) also jump at the cutoff point, then the estimates of treatment effect will be biased.

Second:

- Since RD estimate requires data away from $c$, the estimate will be dependent on a chosen functional form.

# Sharp and Fuzzy RDDs

Thistlethwaite and Campbell (1960) is a clear case of a “sharp” RDD.

- Discontinuity precisely determines treatment (i.e. $p(treatment)$ jumps to 1 at $c$).
- Equivalent to random assignment.

Social Security is a nice example of a sharp design in the wild.

- You can elect to take it earlier, but after a certain threshold, you have to take it.
- (Or at least there’s no benefit from delaying payment)

# Sharp and Fuzzy RDDs

"Fuzzy" RDDs are when treatments are just highly correlated with treatments.

- Probability of treatment jumps by less than one when $x$ crosses the threshold $c$.

"Fuzzy" situations make the assignment rule-as-IV an appropriate solution.

# Conclusion

A regression discontinuity design is a way of undertaking causal inference, usually of some policy intervention.

- It can provide robust, convincing estimates of causal impacts under fairly weak conditions or minimal assumptions.

The nature of the intervention will determine whether an RDD is appropriate.

- Caveat: even when it is, data demands are often great

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