Regression Discontinuity Designs

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Regression Discontinuity Designs

Introduction

- Regression discontinuity designs have wide application in a variety of fields
- Under appropriate assumptions, they allow causal inferences in situations where they seem very counterintuitive
- Rather than being damaged by selection, the design capitalizes on it

A Classic Study on Recidivism

- Shadish, Cook and Campbell (2002, p. 207) discuss the study by Berk and colleagues examining the effect of receiving unemployment compensation support on recidivism rates of newly released ex-convicts.
- Newly released prisoners received unemployment compensation support, but *only if they had worked more than 652 hours over the previous 12 months while in prison*
- Those who had worked fewer hours were ineligible
- There were no exceptions
- Berk and Rauma (1983) found that those receiving compensation had a recidivism rate 13% lower than controls

The Basics of Regression Discontinuity

The Design Structure

- Experimenter must control assignment of participants to 2 or more treatments
- The assignment is made on the basis of a strict *cutoff score* on a *treatment assignment variable*
- The assignment variable can be any measure taken *prior to treatment*

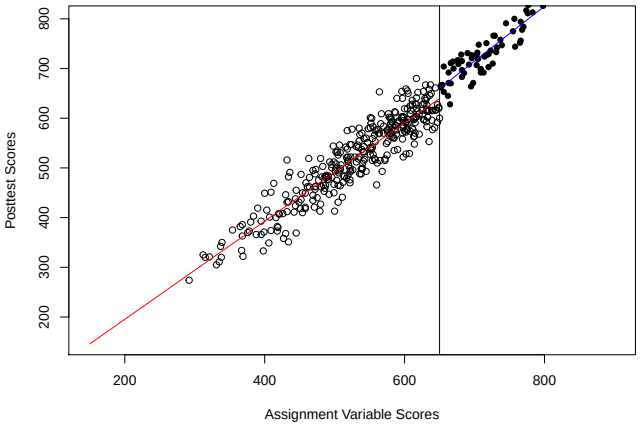
The Basics of Regression Discontinuity

A Graphical Example

- Centennial High is a high school in an upper middle class area of Philadelphia, PA.
- In 1997, every student at Centennial High took the English PSAT, and only those scoring above 650 were given a special training program in writing.
- Subsequently, all students took the Verbal SAT, and scores were recorded.

The Basics of Regression Discontinuity

A Graphical Example



The Basics of Regression Discontinuity

The Model

- The simplest analysis measures the effect of the treatment with the model

$$y_i = \beta_0 + \beta_1 T_i + \beta_2(x_i - x_c) + \epsilon_i \tag{1}$$

- x_c is the cutoff score, and centering the x scores around the cutoff causes the equation to estimate the treatment effect at the cutoff score, where the groups are most similar.

The Basics of Regression Discontinuity

The Model

```
> x.centered <- x-650
> fit <- lm(y~T+x.centered)
> summary(fit)

Call:
lm(formula = y ~ T + x.centered)

Residuals:
    Min      1Q  Median      3Q     Max
-84.983 -19.573  -0.747  20.380  98.041

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 640.43862    2.89906 220.912  < 2e-16 ***
T            26.57391    5.52041   4.814 2.11e-06 ***
x.centered    0.99395    0.02013  49.375  < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 30.19 on 397 degrees of freedom
Multiple R-squared:  0.9272,        Adjusted R-squared:  0.9269
F-statistic:  2530 on 2 and 397 DF,  p-value: < 2.2e-16
```

What Can Go Wrong?

- Key assumptions in RD designs are
  1. The assignment mechanism is fixed and performed exactly according to X and the cutoff value
  2. The functional form of the regression model is correct
- With the above in mind, take out a piece of paper and spend the next couple of minutes imagining one or two ways that the regression discontinuity design can mislead.