Regression Discontinuity

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Structure

- RDD interpretation
- RDD estimation
- Placebo tests
- Sorting
- Other stuff

Interpretation

- It's a LATE!
- A different kind of LATE!
- It can be interpreted as a weighted average over all units (Lee & Lemieux 2010)
- (W, U) are observed and unobserved factors which explain all heterogeneity.
- $X = c$ is the cutpoint on the running variable, Y is the outcome
  $\lim_{\epsilon \downarrow 0} E[Y|X = c + \epsilon] - \lim_{\epsilon \uparrow 0} E[Y|X = c + \epsilon]$
  $= \sum_{w,u} \tau(w, u) p(W = w, U = u|X = c)$
  $= \sum_{w,u} \tau(w, u) \frac{f(c|W=w,U=u)}{f(c)} p(W = w, U = u)$
- What does this mean?
- It's a weight of individual treatment effects weighted by the likelihood that a unit will lie near the threshhold on the running variable.
- Keep this in mind as you interpret results.

Estimation

- If only someone wrote a package to do this...
- http://github.com/ddimmery/rdd

- The current best pracices is to use local polynomial regression.
- Typically linear
- There are also some interesting methods using randomization inference, though. (Cattaneo et al n.d.)

Replication

- I'll be replicating the recent Meyersson paper that's been making noise.
- Replication materials
- The paper shows a (local) result that when Islamic parties won elections in Turkey, this resulted in better outcomes for women.
- Running variable: vote margin (but not exclusively 2 party system as in Lee)
- Outcome that we'll look at: high school education

. . .

```
require(foreign, quietly = TRUE)
d <- read.dta("regdata0.dta")
summary(d$iwm94)
```

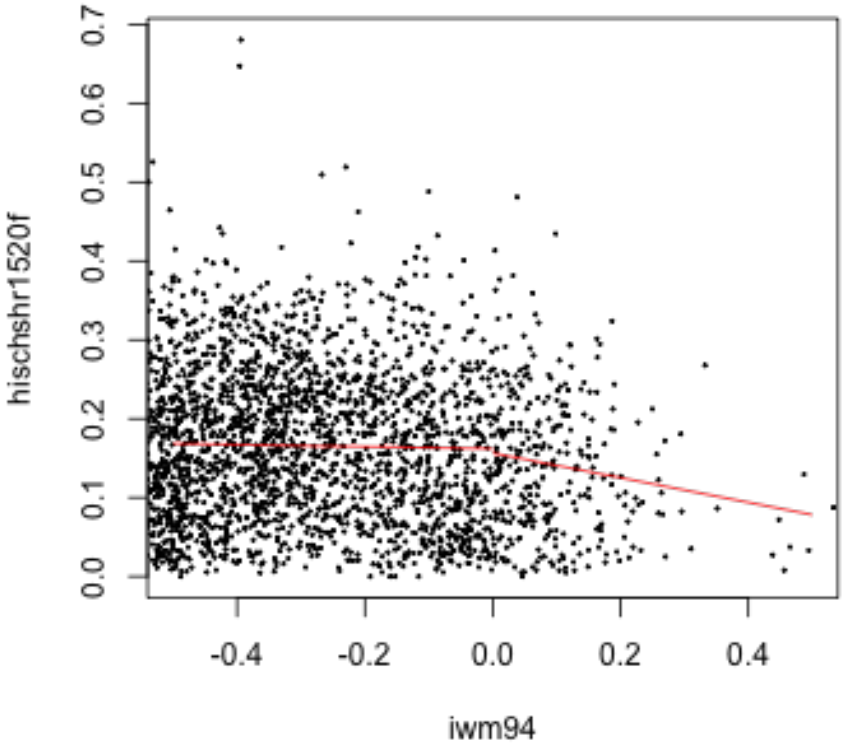
```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##    -1.0    -0.5    -0.3    -0.3    -0.1     1.0     544
```

Explore data

- Plot the raw data.

. . .

```
with(d, plot(iwm94, hischshr1520f, pch = 19, cex = 0.2, xlim = c(-0.5, 0.5)))
left.lm <- lm(hischshr1520f ~ iwm94, d, subset = iwm94 < 0)
right.lm <- lm(hischshr1520f ~ iwm94, d, subset = iwm94 >= 0)
left.x <- seq(-0.5, 0, 0.01)
right.x <- -left.x
lines(left.x, predict(left.lm, newd = data.frame(iwm94 = left.x)), col = "red")
lines(right.x, predict(right.lm, newd = data.frame(iwm94 = right.x)), col = "red")
```


hischshr1520f
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
-0.4
-0.2
0.0
0.2
0.4
iwm94

Estimation

- So the basic estimation would just take the difference of the intercepts from `left.lm` and `right.lm`.
- And there's an equivalency to just running a single regression as Cyrus showed in class.
- But I'm just going to use `rdd`

. . .

```
require(rdd, quietly = TRUE)
```

```
## Loading required package: zoo
##
## Attaching package: 'zoo'
##
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
##
## Loading required package: car
## Loading required package: survival
## Loading required package: splines
```

```
rd.out <- RDestimate(hischshr1520f ~ iwm94, d)
rd.out
```

```
##
## Call:
## RDestimate(formula = hischshr1520f ~ iwm94, data = d)
##
## Coefficients:
##      LATE    Half-BW  Double-BW
##    0.0296     0.0250     0.0228
```

Full Results

```
summary(rd.out)
```

```
##
## Call:
## RDestimate(formula = hischshr1520f ~ iwm94, data = d)
```

```
##
## Type:
## sharp
##
## Estimates:
##             Bandwidth  Observations  Estimate  Std. Error  z value
## LATE        0.24       1020          0.0296    0.0124      2.39
## Half-BW     0.12        589          0.0250    0.0165      1.52
## Double-BW   0.48       2050          0.0228    0.0101      2.26
##             Pr(>|z|)
## LATE        0.0169    *
## Half-BW     0.1286
## Double-BW   0.0240    *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## F-statistics:
##             F      Num. DoF  Denom. DoF  p
## LATE         4.99  3         1016        3.86e-03
## Half-BW      1.70  3          585        3.30e-01
## Double-BW   25.77  3         2046        4.44e-16
```

Plot it

```
plot(rd.out, range = c(-0.4, 0.4))
title(xlab = "Islamic Party Vote Margin", ylab = "Female High School Education Share")
```

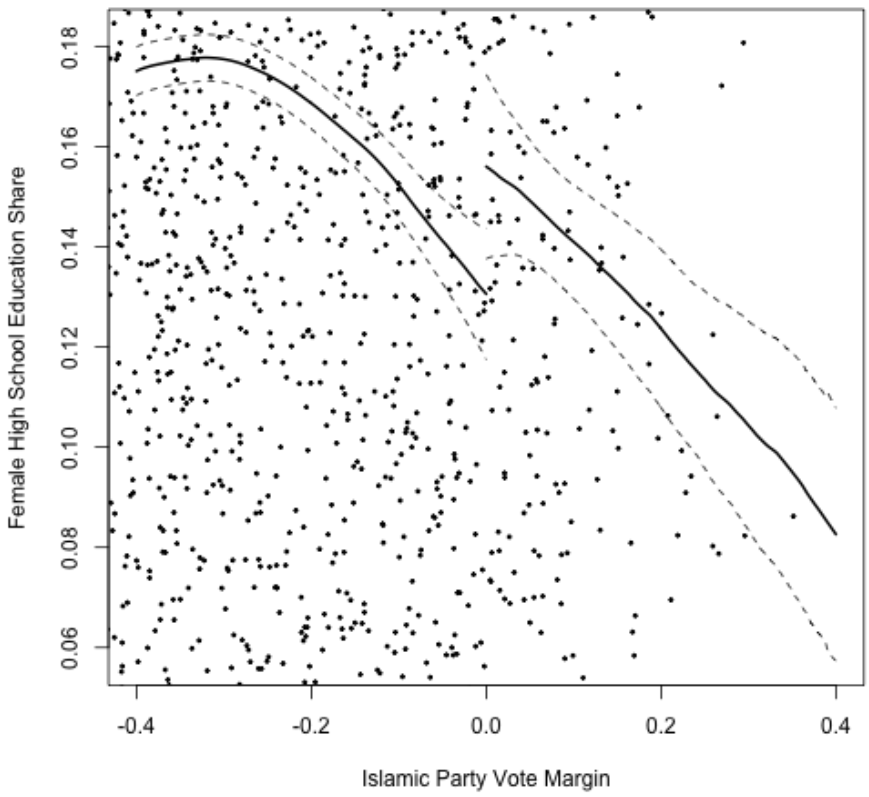
Placebo tests

- Do placebo tests on other covariates and other outcomes.
- They're "placebo" because there "shouldn't" be an effect on them (except occasionally by chance)

. . .

```
# Age 19+
RDestimate(ageshr19 ~ iwm94, d)[c("est", "se")]
```

```
## $est
##      LATE   Half-BW Double-BW
## -0.003737  0.006946 -0.004117
```


Female High School Education Share
0.06
0.08
0.10
0.12
0.14
0.16
0.18
-0.4
-0.2
0.0
0.2
0.4
Islamic Party Vote Margin

```
##
## $se
## [1] 0.010314 0.013783 0.008307
```

```
# Log Population
RDestimate(lpop1994 ~ iwm94, d)[c("est", "se")]
```

```
## $est
##      LATE   Half-BW Double-BW
##   0.06921  -0.04339   0.03000
##
## $se
## [1] 0.2384 0.3276 0.1879
```

```
# Household Size
RDestimate(shhs ~ iwm94, d)[c("est", "se")]
```

```
## $est
##      LATE   Half-BW Double-BW
## -0.006963  0.321148 -0.091759
##
## $se
## [1] 0.3543 0.5431 0.2557
```

More Placebos

```
# Men in 2000
RDestimate(hischshr1520m ~ iwm94, d)[c("est", "se")]
```

```
## $est
##      LATE   Half-BW Double-BW
##  0.009632  0.016188  0.007619
##
## $se
## [1] 0.009037 0.011807 0.007435
```

```
# Women in 1990 (pre-treatment)
RDestimate(c90hischshr1520f ~ iwm94, d)[c("est", "se")]
```

```
## $est
##      LATE   Half-BW Double-BW
## 0.0079389 0.0007974 0.0130517
##
## $se
## [1] 0.012239 0.017631 0.009308
```

```r
# Men in 1990 (pre-treatment)
RDestimate(c90hischshr1520m ~ iwm94, d)[c("est", "se")]
```

```
## $est
##      LATE   Half-BW Double-BW
##  0.005930  0.002779  0.003861
##
## $se
## [1] 0.009770 0.013259 0.007891
```

Sorting

- As Cyrus discussed, density tests are also a good way to examine the possibility of sorting.

. . .

```r
DCdensity(d$iwm94, verbose = TRUE, plot = FALSE)
```

```
## Assuming cutpoint of zero.
## Using calculated bin size:  0.009
## Using calculated bandwidth:  0.165
## Log difference in heights is  -0.095  with SE  0.147
##   this gives a z-stat of  -0.650
##   and a p value of  0.515
```

```
## [1] 0.5154
```

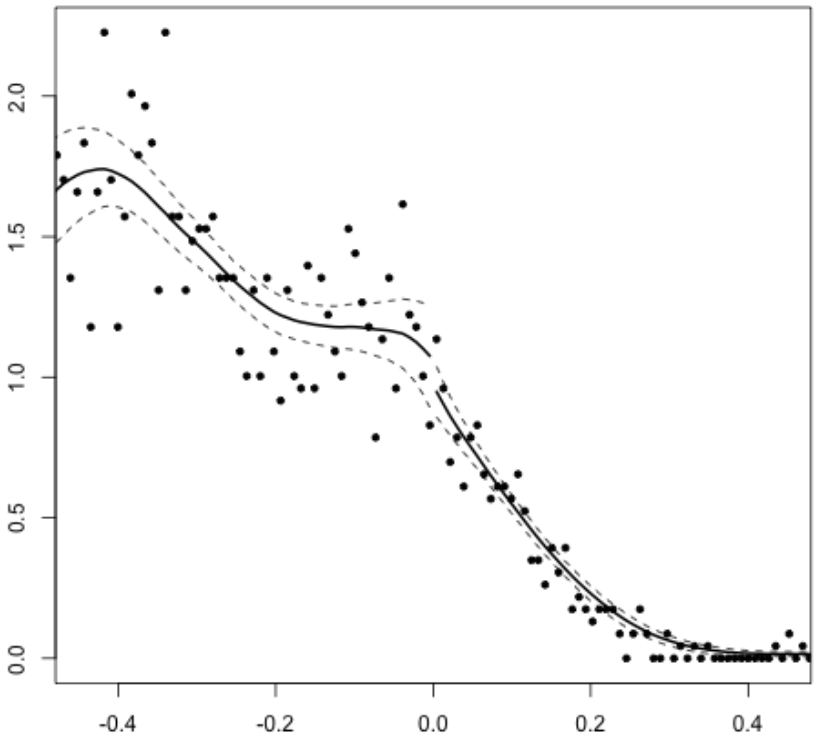
Density Plot

```r
DCdensity(d$iwm94)
```

```
## [1] 0.5154
```

Fuzzy designs

- I don't have an example for this, but it's quite easy.
- Do it the same way as before, but with `RDestimate(Y~runvar+treatment)`


2.0
1.5
1.0
0.5
0.0
-0.4
-0.2
0.0
0.2
0.4

Overall

- Some big things for RDD:
  - Lots of plots
  - Think about locality in interpretation
  - Use your covariates for robustness/placebo tests
  - Everything should be robust to different bandwidths, etc
  - If effects start disappearing as bw goes down, that's a bad sign.
  - Your bandwidth is probably to wide.
- If there's still more time, maybe I'll go through some high points of the `rdd` code.