Regression Discontinuity Design

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Motivating example

- Many districts have summer school to help kids improve outcomes between grades
  - Enrichment, or
  - Assist those lagging
- Research question: does summer school improve outcomes
- Variables:
  - x=1 is summer school after grade g
  - y = test score in grade g+1

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- Equation of interest
- $y_i = \beta_0 + x_i\beta_1 + \varepsilon_i$

- Problem: what do you anticipate is $cov(x_i, \varepsilon_i)$?

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LUSDINE

- To be promoted to the next grade, students need to demonstrate proficiency in math and reading
  - Determined by test scores
- If the test scores are too low – mandatory summer school
- After summer school, re-take tests at the end of summer, if pass, then promoted

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Situation

- Let Z be test score – Z is scaled such that
  - $Z \geq 0$ not enrolled in summer school
  - $Z<0$ enrolled in summer school
- Consider two kids
  - #1: $Z=\varepsilon$
  - #2: $Z=-\varepsilon$
  - Where ε is small

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Intuitive understanding

- Participants in SS are very different
- However, at the margin, those just at Z=0 are virtually identical
- One with $z=-\varepsilon$ is assigned to summer school, but $z= \varepsilon$ is not
- Therefore, we should see two things

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- There should be a noticeable jump in SS enrollment at $z<0$.
- If SS has an impact on test scores, we should see a jump in test scores at $z<0$ as well.

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Variable Definitions

- y_i = outcome of interest
- x_i =1 if NOT in summer school, =1 if in
- $D_i = I(z_i \geq 0)$ -- I is indicator function that equals 1 when true, =0 otherwise
- z_i = running variable that determines eligibility for summer school. z is re-scaled so that $z_i=0$ for the lowest value where $D_i=1$
- w_i are other covariates

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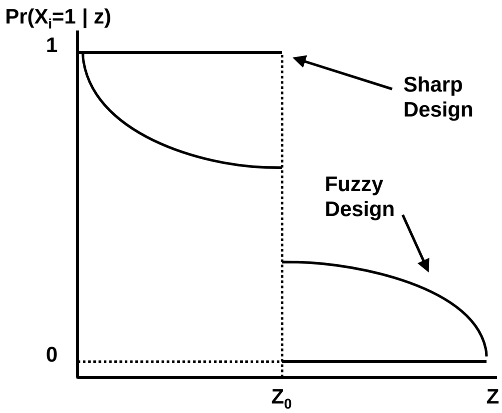

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Key assumption of RDD models

- People right above and below Z_0 are functionally identical
- Random variation puts someone above Z_0 and someone below
- However, this small different generates big differences in treatment (x)
- Therefore any difference in Y right at Z_0 is due to x

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Limitation

- Treatment is identified for people at the z_i=0
- Therefore, model identifies the effect for people at that point
- Does not say whether outcomes change when the critical value is moved

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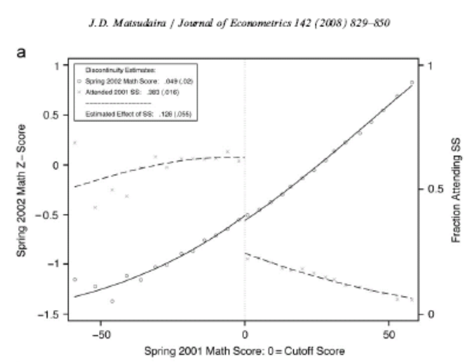

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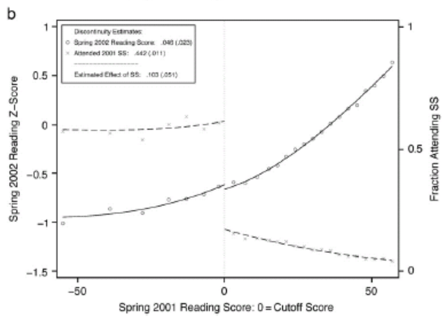

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Table 1

	Grade 3		
		Attended SS	
	Total	Yes	No
Outcomes			
2002 math score	641.8	620.4	648.5
	(.142)	(.241)	(.16)
	[36.57]		
2002 reading score	649.7	621.6	658.6
	(.176)	(.241)	(.204)
	[46.40]		
Summer school attendance			
Attended summer school 2001	.24	1	0
	(.002)	(0)	(0)
Days attended	4.373	18.208	0

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Table 2

	Effect of being mandated		Effect of SS attendance	
	Attendance (1st Stage)	Math (Reduced form)	Math (TSLS)	Reading (TSLS)
Strong 1st stage discontinuity				
Grade 3	.383	.049	.128	.087
	(.016)	(.02)	(.055)	(.065)
Grade 5	.385	.093	.241	.083
	(.006)	(.015)	(.039)	(.055)
Grade 6	.320	.061	.19	n.a.
	(.011)	(.014)	(.047)	(–)

Math:
Grade 3: 0.049/0.383=0.128
Grade 5: 0.093/0.385=0.241
Grade 6: 0.061/0.320=0.190

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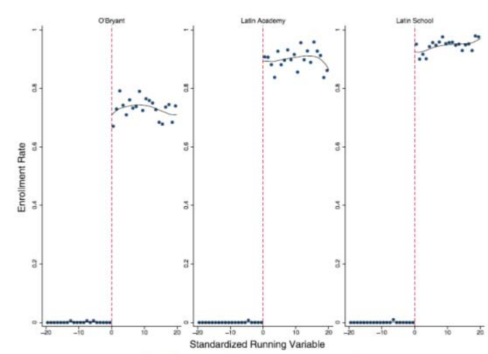
Example: Selective High Schools



(b) Enrollment at each Boston exam school

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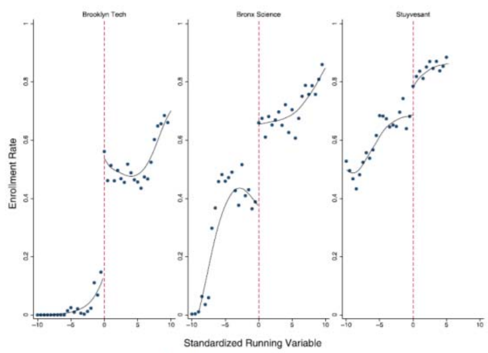

(b) Enrollment at any NYC exam school

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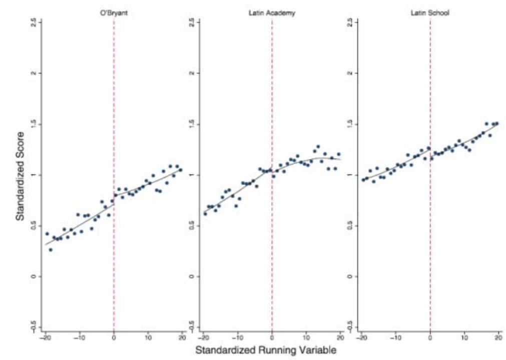

(a) 10th grade math at Boston exam schools for 7th and 9th grade applicants

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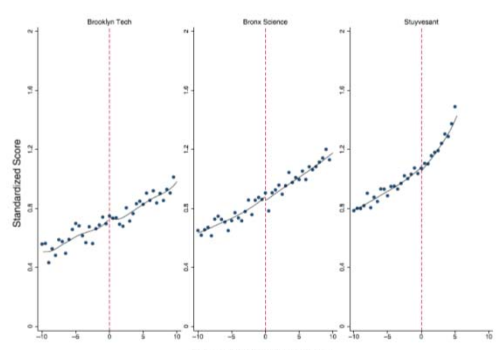

(a) Regents Advanced Math at NYC exam schools

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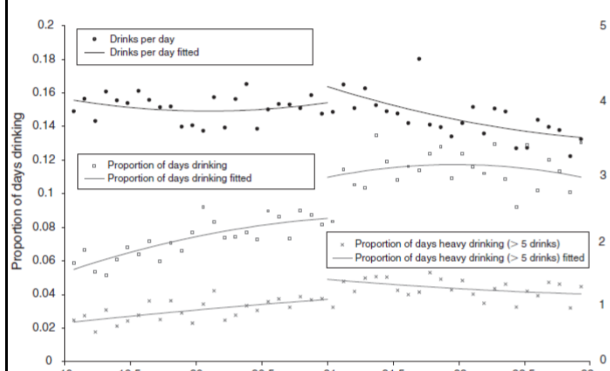

FIGURE 2. AGE PROFILE OF DRINKING INTENSITY

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Table 1: Participation

	(1)
12 or more drinks in lifetime	
Over 21	0.0418
	(0.0242
Observations	16,107
R^2	0.02
Prob > Chi-Squared	
12 or more drinks in one year	
Over 21	0.0796
	(0.0254
Observations	16,107
R^2	0.02
Prob > Chi-Squared	
Any heavy drinking in last year	
Over 21	0.0761
	(0.0248
Observations	16,107
R^2	0.01
Prob > Chi-Squared	
Covariates	N
Weights	N
Quadratic terms	Y
Cubic terms	N
LLR	N

Table 2: Intensity

	(1)
Proportion of days drinking	
Over 21	0.0245
	(0.0086)
Observations	16,107
R^2	0.02
Prob > Chi-Squared	
Proportion of days heavy drinking	
Over 21	0.0120
	(0.0061)
Observations	15,825
R^2	0.00
Prob > Chi-Squared	
Drinks per day on days drinking	
Over 21	0.2387
	(0.2810)
Observations	9,906
R^2	0.00
Prob > Chi-Squared	
Covariates	N
Weights	N
Quadratic terms	Y
Cubic terms	N
LLR	N

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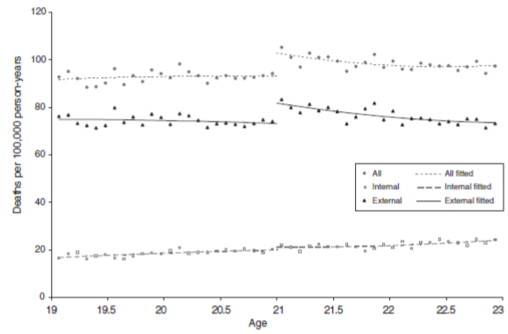

Figure 3. Age Profile for Death Rates

Notes: Deaths from the National Vital Statistics Records. Includes all deaths that occurred in the United States between 1997–2003. The population denominators are derived from the census. See online Appendix C for a list of causes of death.

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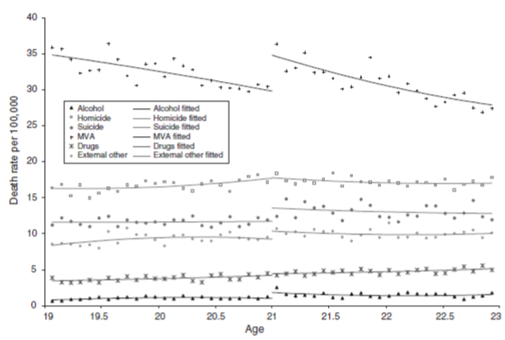

Figure 4. Age Profiles for Death Rates by External Cause

Notes: See notes to Figure 3. The categories are mutally exclusive. The order of precedence is homicide, suicide, MVA, deaths with a mention of alcohol, and deaths with a mention of drugs. The ICD-9 and ICD-10 Codes are in Appendix C.

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