Symposium

Evaluating and Improving the Validity of Causal Inferences in Child Development Research

SRCD 2017

Exploiting Naturally Occurring Discontinuities to Infer Causal Effects

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Cornell University

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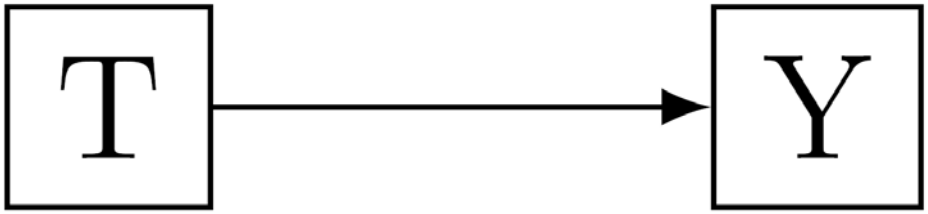
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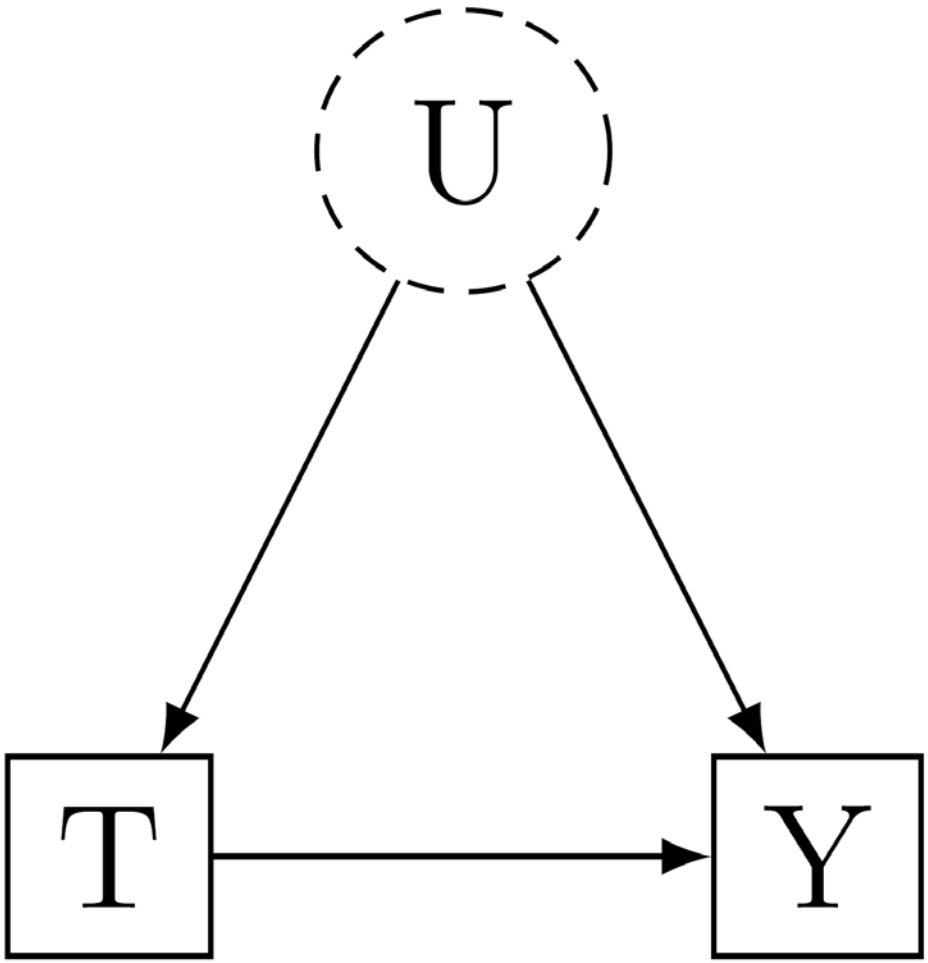
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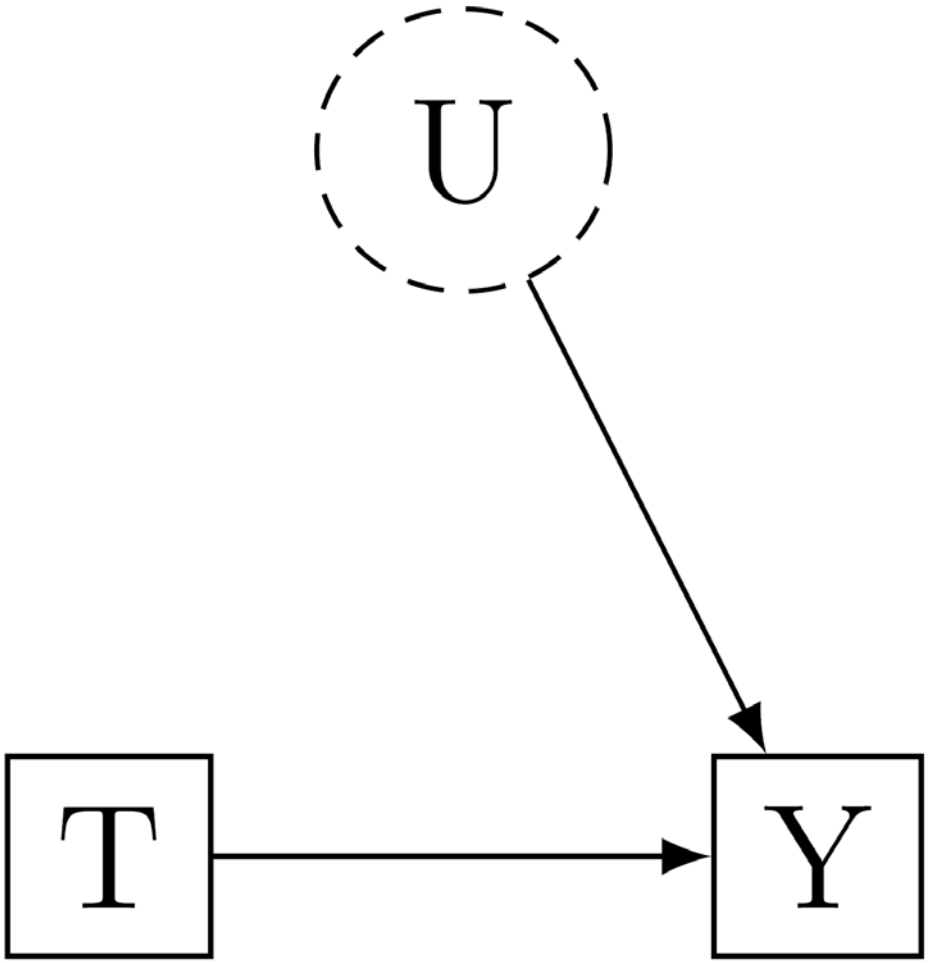
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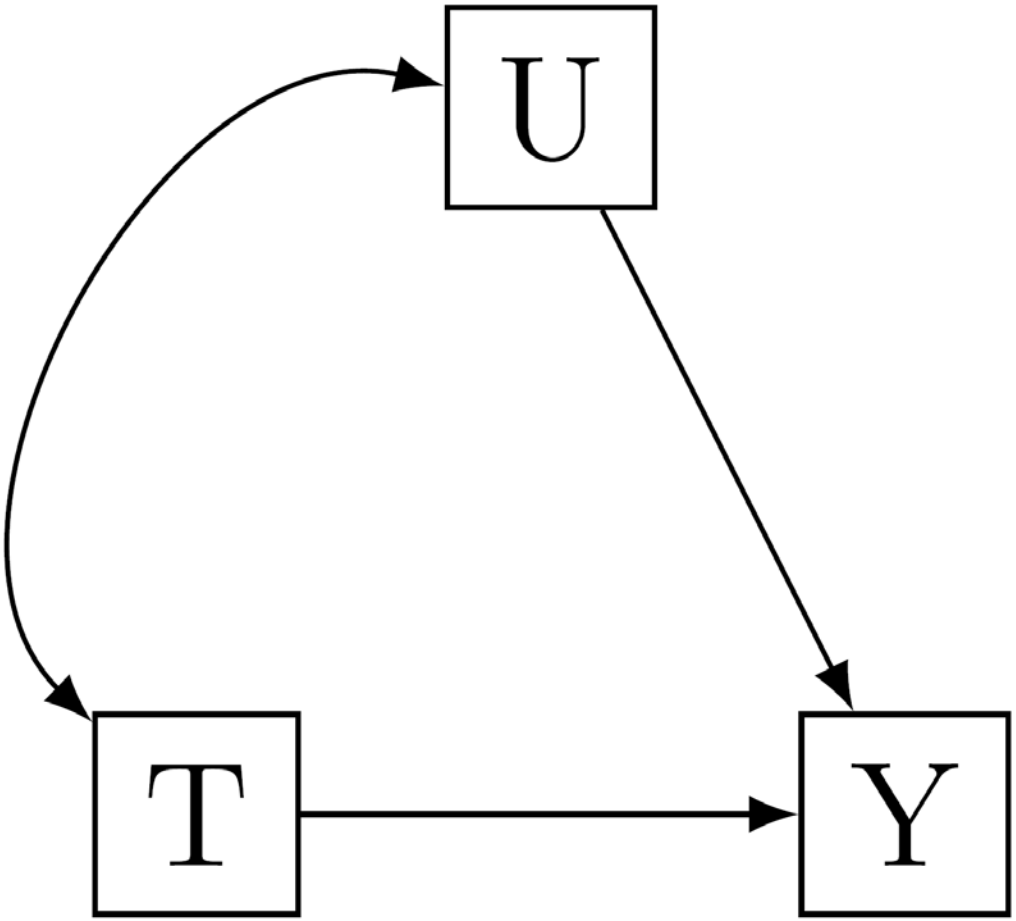
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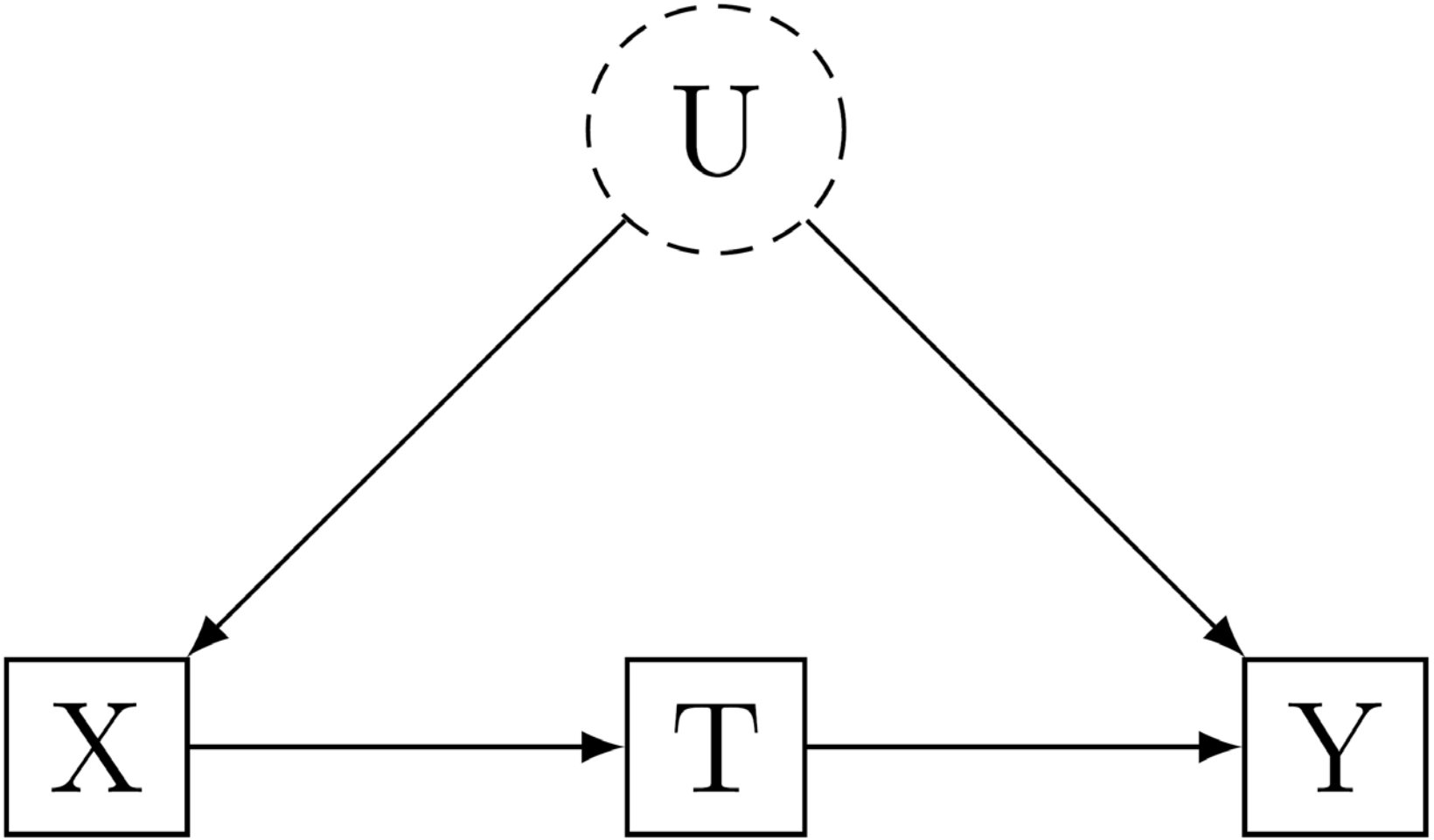
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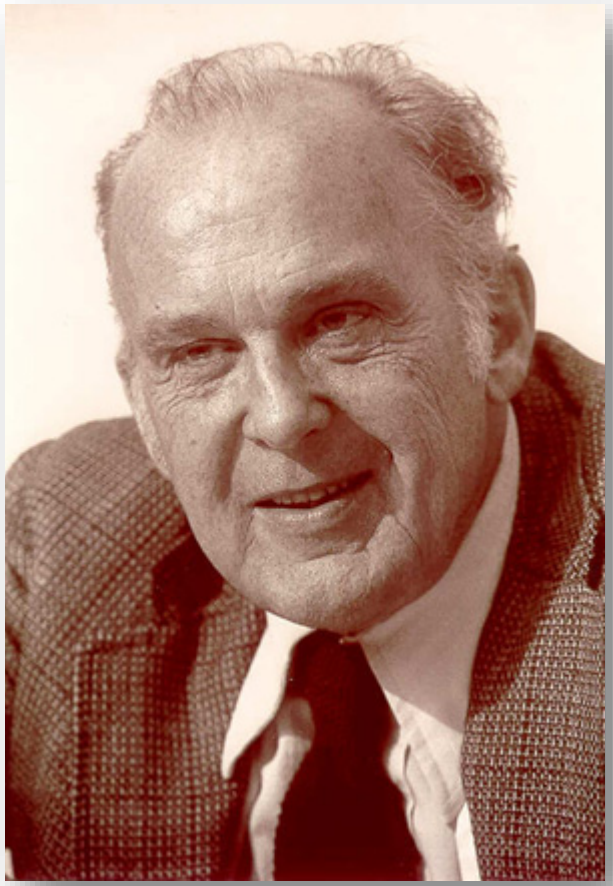

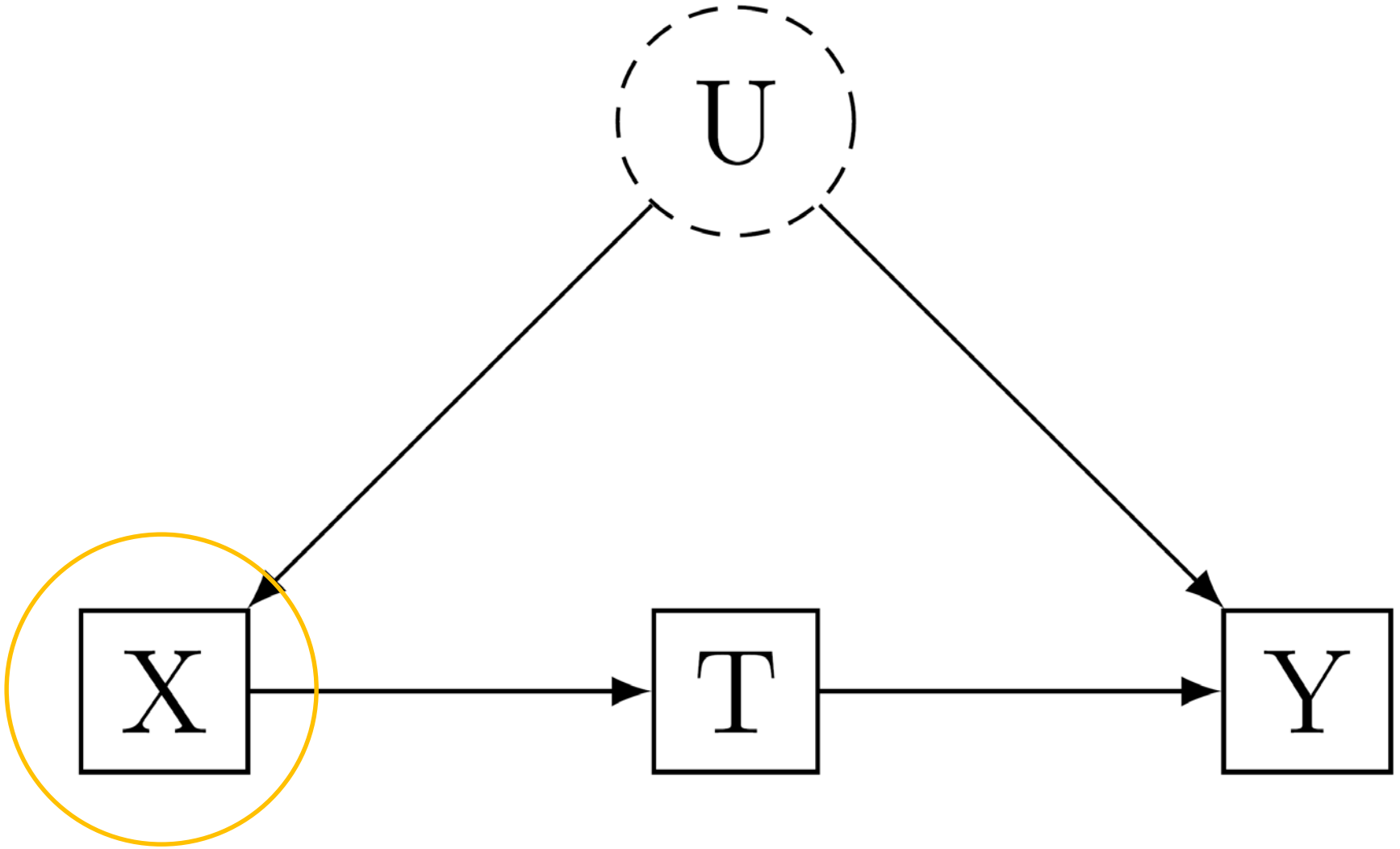
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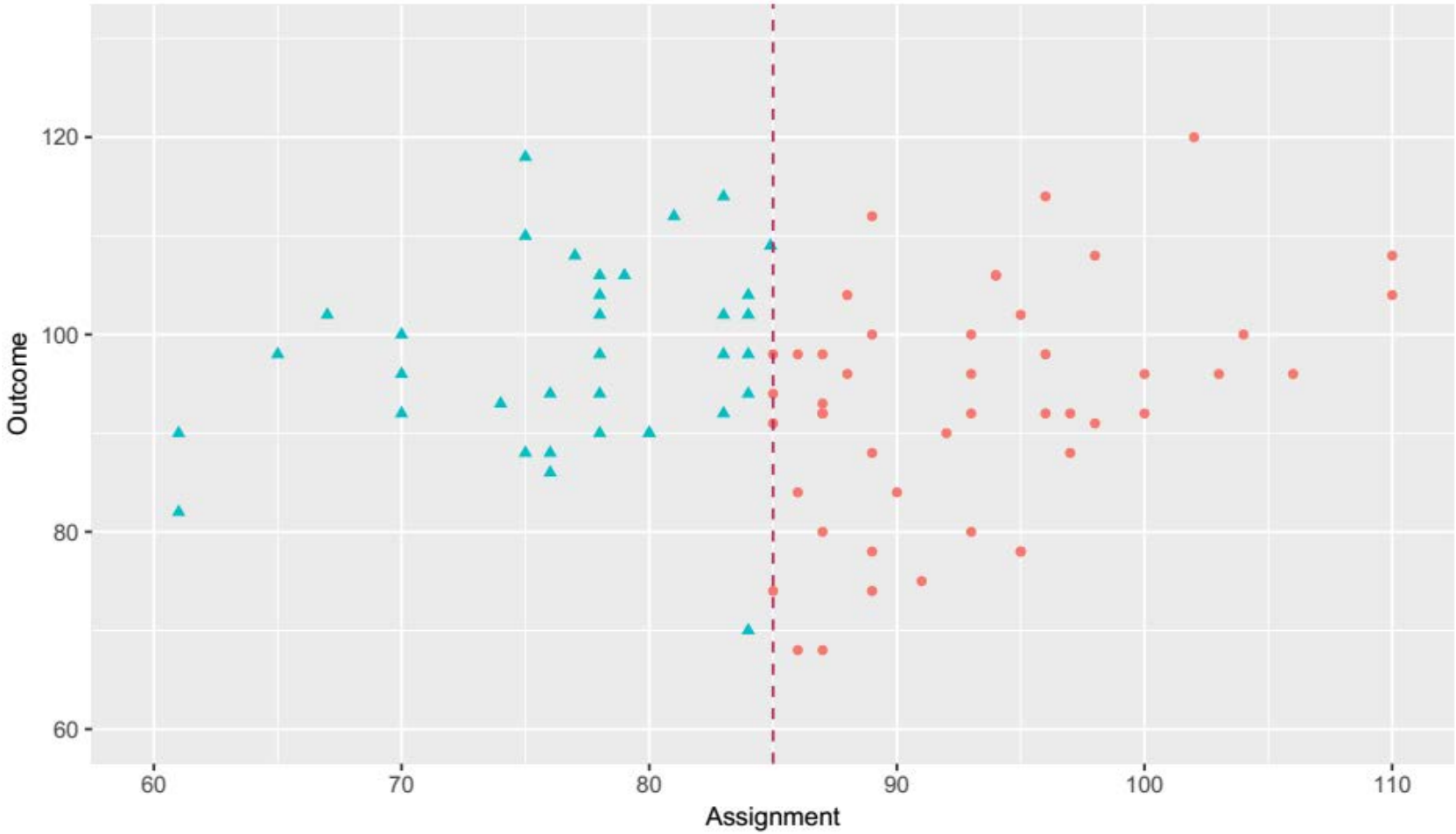
Natural discontinuities

- Laws (e.g., class size cutoff)
- Geographical boundaries (e.g., rivers)
- Educational policies (e.g., test scores)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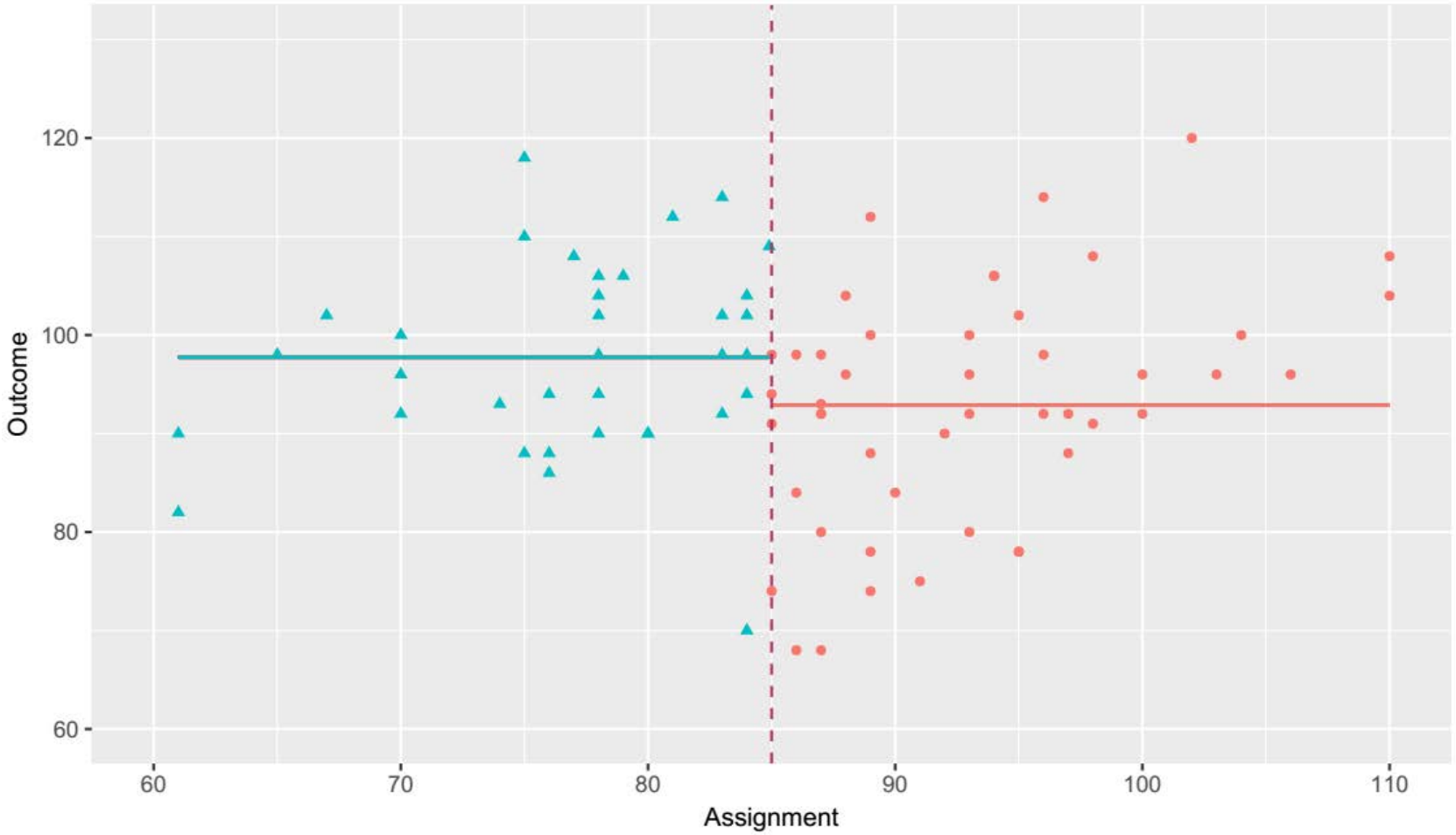
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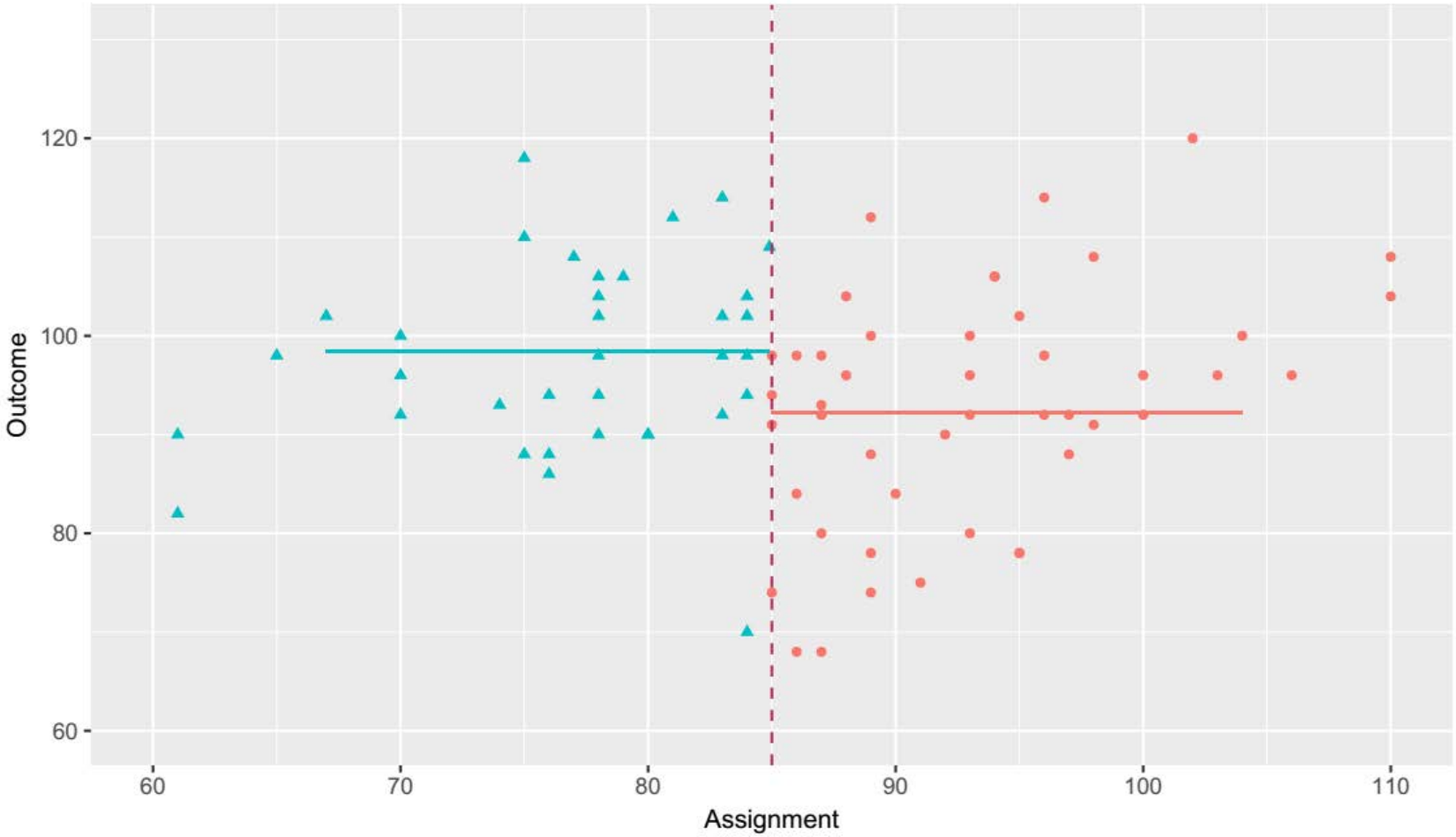
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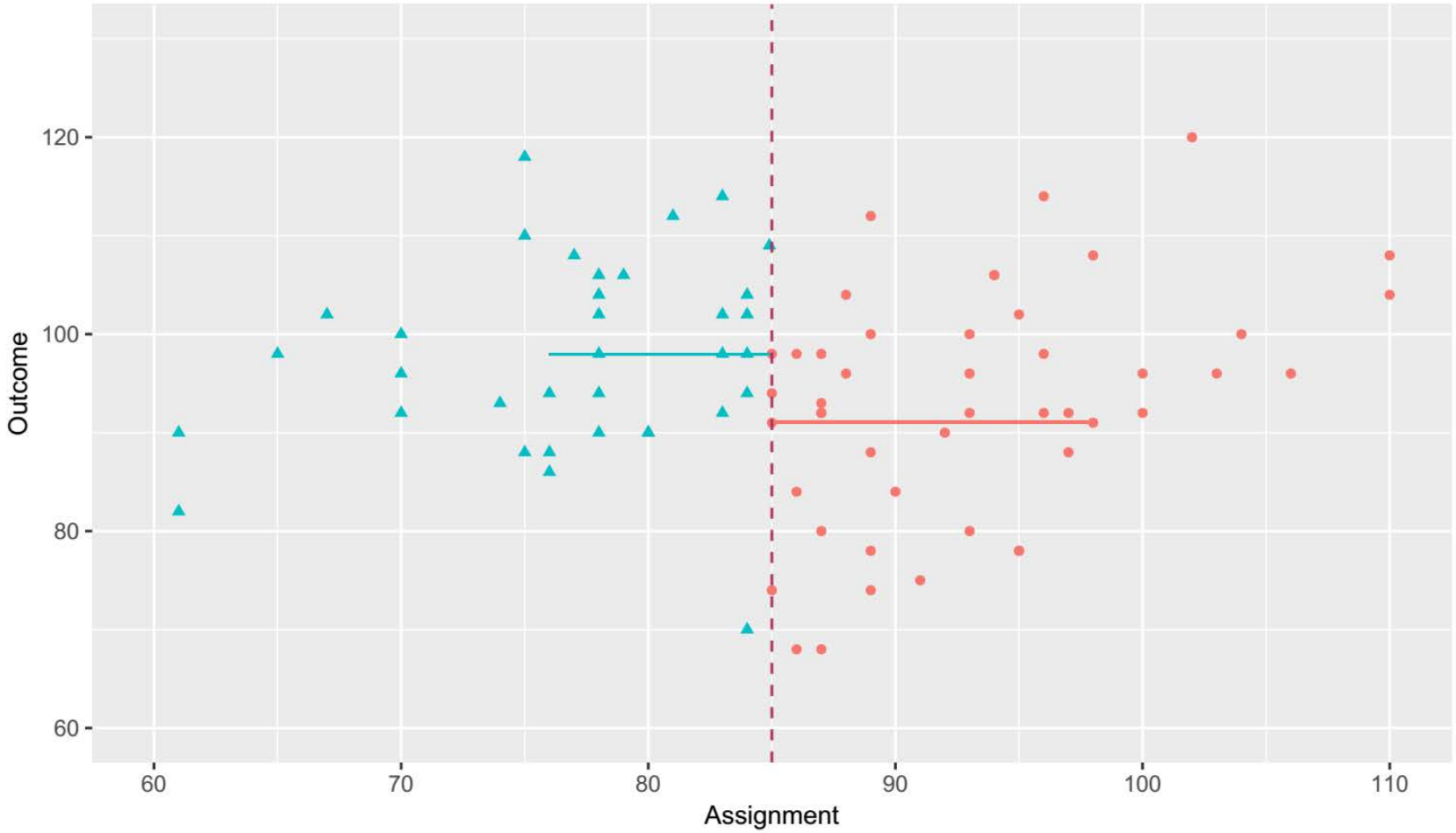
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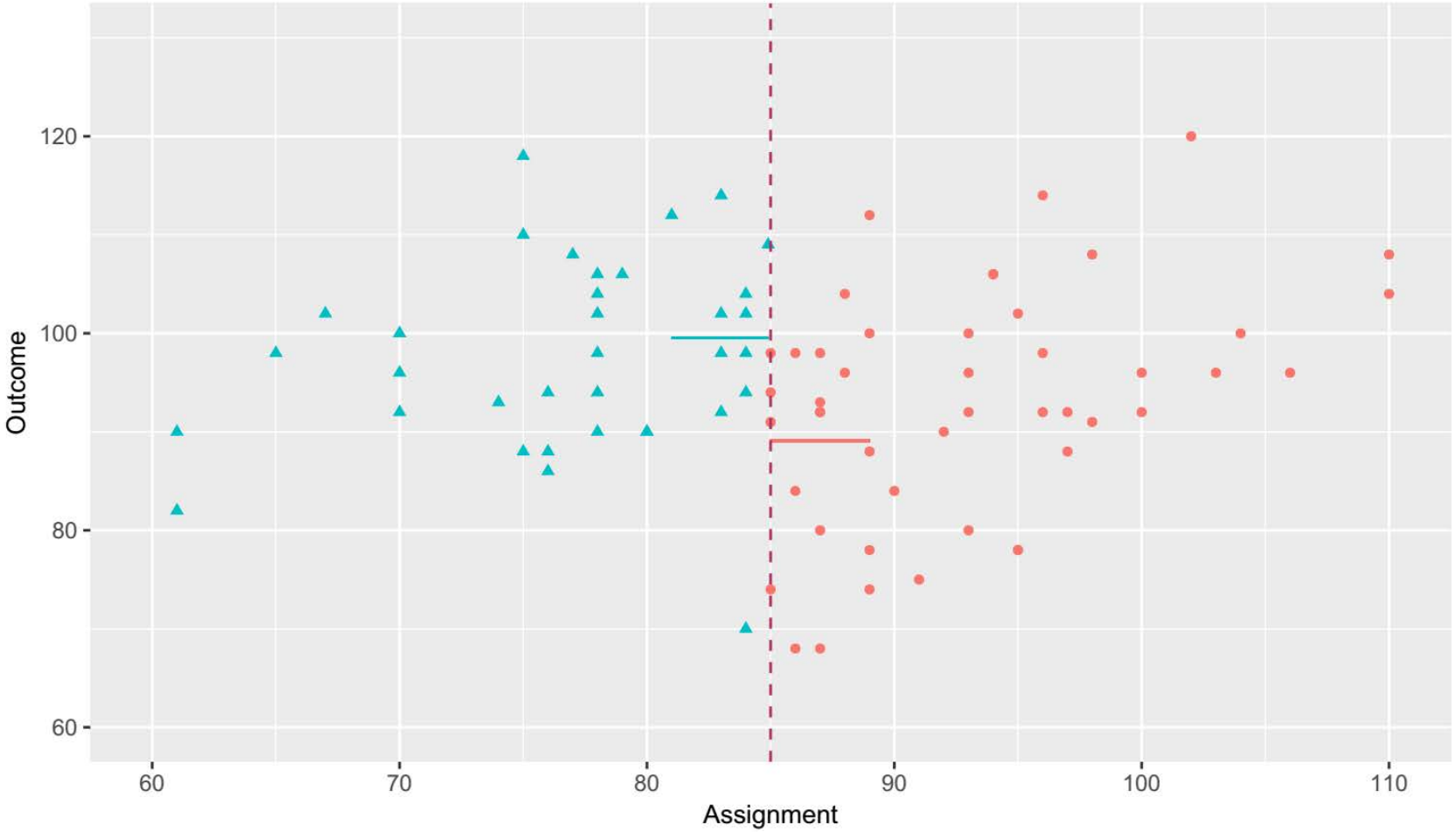
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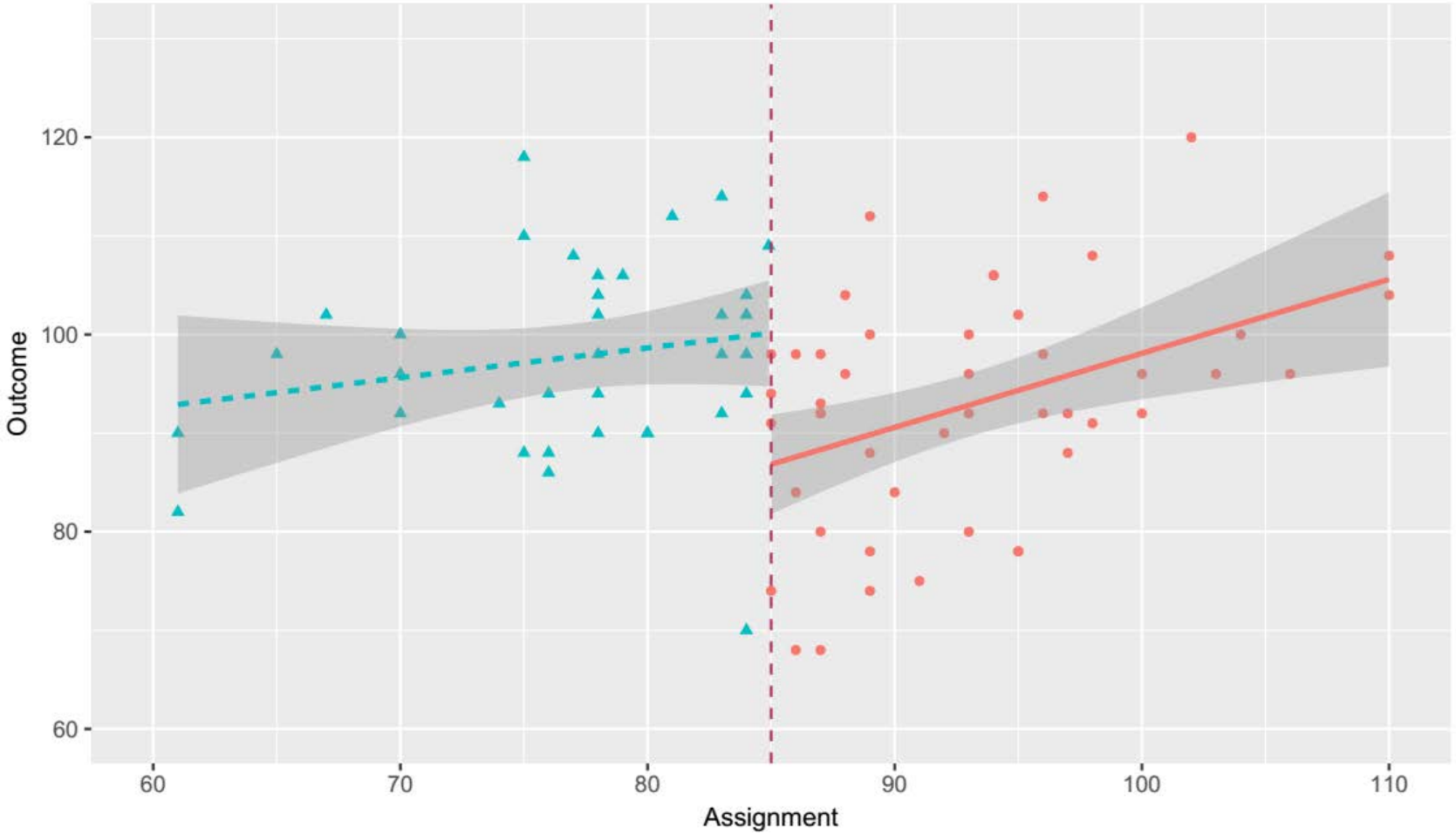
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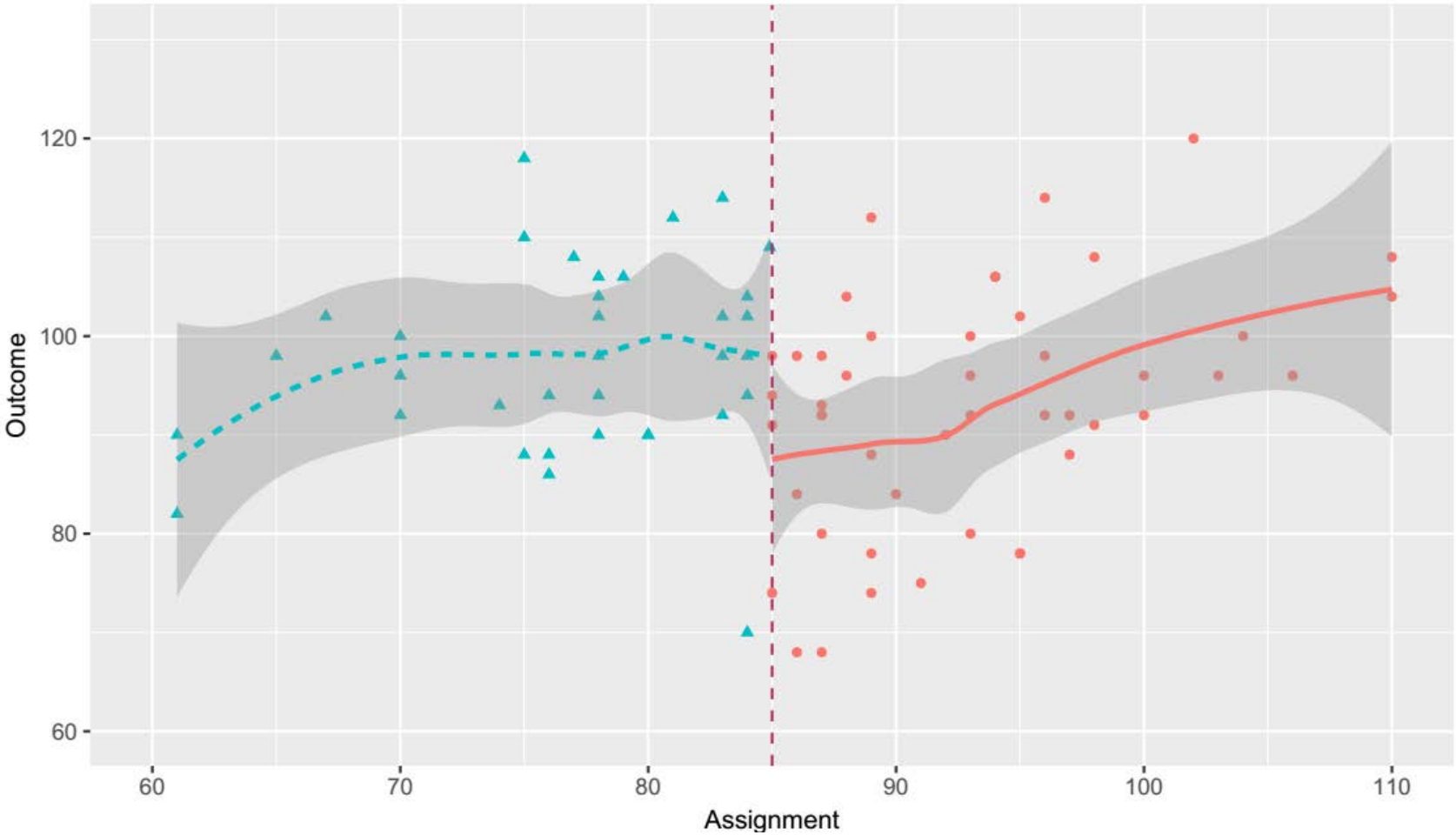
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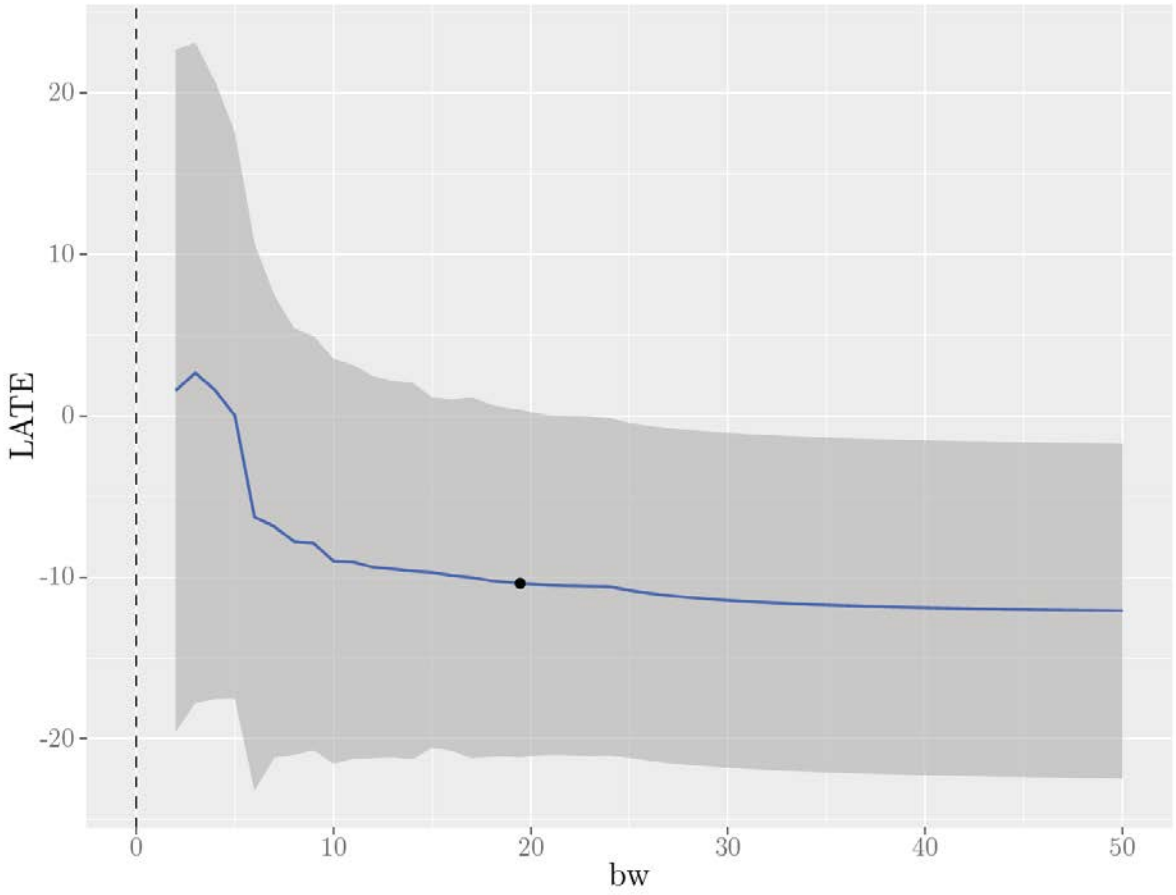
Assignment

Advantages

- (Local) causal effect *without* randomization
- No assessment of confounders, only assignment variable

Disadvantages

- Requires (deterministic) assignment variable
- Must model functional form
- Vulnerable to manipulations of assignment
- Lower power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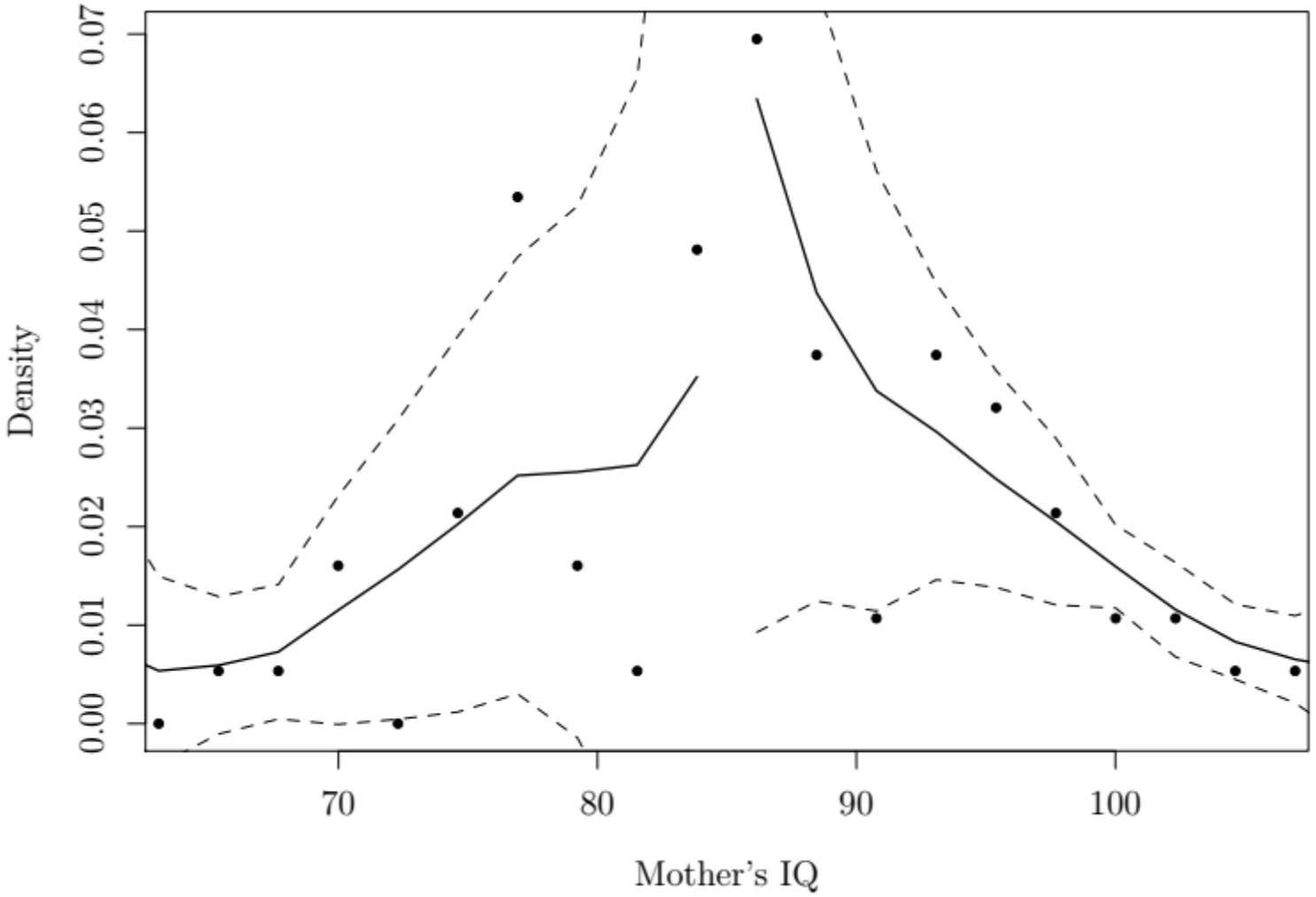
Assumption checks



Software

- R packages
  - rdd (Dimmery)
  - rddtools (Stigler & Quast)
  - rdrobust (Calonico, Cattaneo, Farrell, & Titiunik)
- Stand-alone software
  - shinyrdd

ShinyRDD | Model | Power | More

Upload Data

CARE

Model Specification - **sharp**

Treatment

DC_TRT

Assignment ≥ Cutoff

MOMWAIS0 | 85

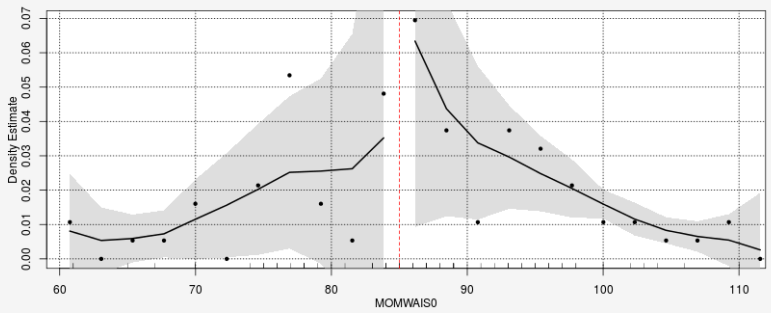
Outcome

SBIQ48

Auxiliary Variables (optional)

Data | Assumptions | Estimates | Sensitivities | Code

Figure 2.1 **Sorting Test (McCrary, 2008)** (Save as PDF)



Assignment [Cutoff]

MOMWAIS0 [85]

Bin Size 2.31

Band Width 8.93

Test Summary

theta	0.570
se	0.490
z	1.162
p	0.245

Table 2.1 **Attrition Analysis**

	Overall [a]		Control [b]		Treatment [b]	
	N	%	*N*	%	*N*	%
Total Sample Size	81	100.00%	47	58.02%	34	41.98%
Missingness						
- Treatment (DC_TRT)	0	0.00%	-	-	-	-
- Outcome (SBIQ48)	0	0.00%	0	0.00%	0	0.00%
- Assignment (MOMWAIS0)	0	0.00%	0	0.00%	0	0.00%

Note. [a] Number of observations or missing cases marginalized over treatment groups. [b] Number of observations or missing cases in each treatment group.

ShinyRDD | Model | Power | More

Upload Data

CARE

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Treatment

DC_TRT

Assignment ≥ Cutoff

MOMWAIS0 | 85

Outcome

SBIQ48

Auxiliary Variables (optional)

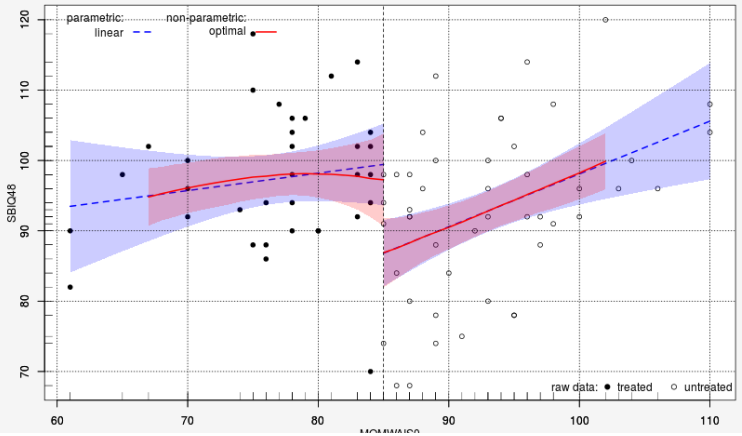
Data | Assumptions | Estimates | Sensitivities | Code

Table 3.1 **Model Estimates**

	Band Width	*N*	Treatment Effect					*F*-statistics			
			Est.	*SE*	*z*	*p*	*95% CI*	*F*	*DF*	*DDF*	*p*
Parametric											
- Linear		81	12.61	3.96	3.19	.001	[4.86, 20.37]	5.00	3	77	.003
- Quadratic		81	8.95	5.73	1.56	.118	[-2.28, 20.17]	3.27	5	75	.010
- Cubic		81	9.10	7.32	1.24	.214	[-5.25, 23.45]	2.29	7	73	.036
Nonparametric											
- Optimal	19.47	75	10.37	5.07	2.05	.041	[0.44, 20.3]	4.05	3	71	.010
- Half	9.73	52	8.78	6.21	1.41	.157	[-3.38, 20.95]	2.79	3	48	.050
- Double	38.94	81	11.85	4.19	2.83	.005	[3.63, 20.06]	4.66	3	77	.005

Note. Parametric = two-Stage least square (2SLS) polynomial regression, Non-parametric = 2SLS local linear regression with optimal bandwidth (Imbens & Kalyanaraman, 2012).

Figure 3.1 **Graphical Illustration RDD Estimates** (Save as PDF)



ShinyRDD | Model | Power | More

Upload Data

CARE

Model Specification - **sharp**

Treatment

DC_TRT

Assignment ≥ Cutoff

MOMWAIS0 | 85

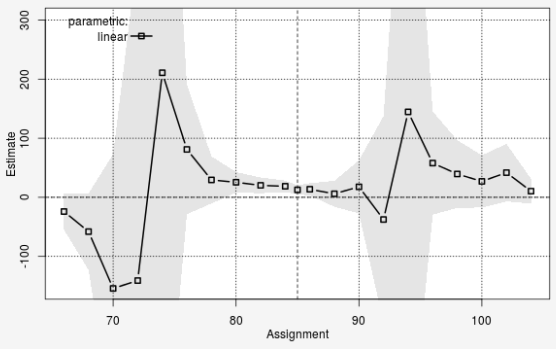
Outcome

SBIQ48

Auxiliary Variables (optional)

Data | Assumptions | Estimates | Sensitivities | Code

Figure 4.1 **Cutpoint Sensitivity (Placebo Test)**



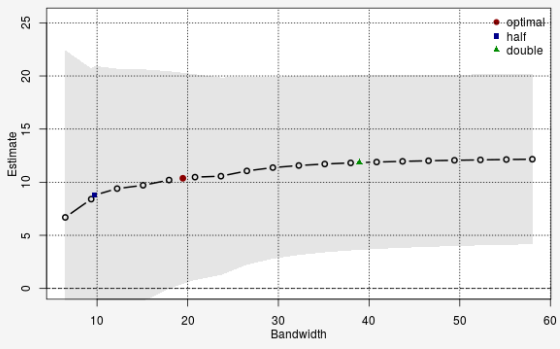
CI (%) 95

Models Linear

Assignment 61 66 104 110

Steps 20

Table 4.2 **Bandwidth Sensitivity**



CI (%) 95

Range of Bandwidth 6.5 58

Steps 20

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Future developments

- Bootstrapped standard errors
- Robust discontinuity tests
- Time-varying discontinuities