Problem Set 4 - Regression Discontinuity

HCMG 901

Due: April 12, 2023

One of the seminal economics papers implementing the RD design, Angrist and Lavy (*QJE*, 1999), investigates the relationship between class size and student achievement in Israel, while also illustrating the relationship between the fuzzy RD design and IV. This problem set asks you to investigate this relationship. The authors have generously made their data (and programs) available at: http://economics.mit.edu/faculty/angrist/data1/data/anglavy99. In 2019, the authors published another paper (Angrist et al., *AER Insights*, 2019) on the same topic with newer data that cast doubt on the earlier findings. The data, code, and online appendix are available on the journal website. Two questions at the end involve replicating some of the new analysis.

1. It will help you to first read the 1999 QJE article so you become familiar with what was done there and why.

2. Estimate basic bivariate regressions of students' test scores on class size. What patterns do you find? Describe one source of endogeneity and discuss how this might bias these estimates.

3. Calculate the average class size and number of classes in a grade and school that would result if schools mechanically applied Maimonides' Rule (that is, calculate the predicted average class size and the predicted number of classes). Note that the predicted average class size in school s and grade g is given by

   $$\hat{cs}_{sg} = \frac{X_{sg}}{int(\frac{X_{sg}-1}{40}) + 1}$$

   where X_{sg} is total enrollment for school s in grade g. Graph the relationship between enrollment and predicted class size. Describe potential sources of variation in class size that you might be able to use for identification.

4. Calculate the average class size students in a given school and grade actually experience. Present descriptive statistics on this variable and overlay actual class size and predicted class size against enrollment on a graph. What percentage of schools either overshoot the class size cap or create a new class before they are required to do so by Maimonides' Rule? How do these schools' characteristics compare with schools who 'comply' with Maimonides' Rule? Discuss whether (or in what circumstances) noncompliance with Maimonides' Rule might affect your identification strategy.

5. Next, you will use an RD design to estimate the impact of class size on achievement at the first "discontinuity" created by Maimonides' rule. Assume that class size is a function of enrollment plus noise:

   $$\mathbb{E}[cs_{sg}|X_{sg}] = \eta 1[X_{sg} > 40] + f(X_{sg}) + \epsilon_{sg}$$

Also assume that the impact of class size on test scores does not vary across schools or grades:

$$A_{sg} = \gamma \mathbb{E}[cs_{sg}|X_{sg}] + g(X_{sg}) + \nu_{sg}$$

Here, A_{sg} is the average achievement (test score) for students in school s and grade g, and $f(\cdot)$ and $g(\cdot)$ are flexible functions of enrollment. Following Lee and Lemieux's Table 2 that we saw in the RD class, estimate a series of fuzzy RD (IV) models, in which you vary the bandwidth (i.e., window around the discontinuity) and degree of polynomial in the running variable. How robust are you estimates to smaller bandwidths and higher degree polynomials?

6. The 2019 AER Insights article revisits this setting with newer data and finds that there was some manipulation in class size after all and once they account for this, there are zero effects of class size on test scores! Unfortunately the newer data is non-public so we cannot replicate the new analysis. However, the new paper also looks for manipulation on the older data. In particular, I'd like you to replicate their Figure A6 where they look for jumps in enrollment at the thresholds and perform a McCrary test. This analysis reveals some jumps in enrollment frequency at the thresholds. How should we interpret this?

7. In response, the authors do a robustness check where they drop data close to the thresholds. They refer to this as a 'donut' analysis. This is presented in Table A6. Replicate this table. What does this tell us? How is it helpful?