empirical_proj_2

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Question 1

The fundamental problem of causal inference is that you cannot see the outcome for a child who both was in a small class and not in a small class. In other words, it is impossible to measure the dual outcomes when a child both is in a small class and not in a small class, because the child can only either be in a small class or not in a small class.

Question 2

The following variables have missing values:

- towncode: 318 missing
- math: 58 missing
- verb: 466 missing
- ses_index: 318 missing
- boy: 1037 missing

```
##    student_id       towncode        schlcode        class_id
##  Min.   :    1   Min.   :  166   Min.   :11005   Min.   :110051
##  1st Qu.:13600   1st Qu.:26104   1st Qu.:31049   1st Qu.:310491
##  Median :27412   Median :62000   Median :41284   Median :412841
##  Mean   :27395   Mean   :50434   Mean   :39776   Mean   :397762
##  3rd Qu.:41158   3rd Qu.:79004   3rd Qu.:51247   3rd Qu.:512471
##  Max.   :54860   Max.   :98004   Max.   :61365   Max.   :613651
##                  NA's   :318
##  school_enrollment   class_size         math           verb
##  Min.   :  9.00    Min.   : 7.00   Min.   : 1.0   Min.   : 1.00
##  1st Qu.: 57.00    1st Qu.:28.00   1st Qu.:23.0   1st Qu.:25.00
##  Median : 75.00    Median :32.00   Median :27.0   Median :27.00
##  Mean   : 80.41    Mean   :31.58   Mean   :25.3   Mean   :25.97
##  3rd Qu.:105.00    3rd Qu.:36.00   3rd Qu.:29.0   3rd Qu.:29.00
##  Max.   :188.00    Max.   :44.00   Max.   :30.0   Max.   :30.00
##                                    NA's   :58     NA's   :466
##    ses_index          boy            born_isr        religious
##  Min.   : 0.00   Min.   :0.0000   Min.   :0.0000   Min.   :0.0000
##  1st Qu.: 4.00   1st Qu.:0.0000   1st Qu.:1.0000   1st Qu.:0.0000
##  Median : 9.00   Median :1.0000   Median :1.0000   Median :0.0000
##  Mean   :13.17   Mean   :0.5078   Mean   :0.9608   Mean   :0.2242
##  3rd Qu.:18.00   3rd Qu.:1.0000   3rd Qu.:1.0000   3rd Qu.:0.0000
##  Max.   :76.00   Max.   :1.0000   Max.   :1.0000   Max.   :1.0000
##  NA's   :318     NA's   :1037
```

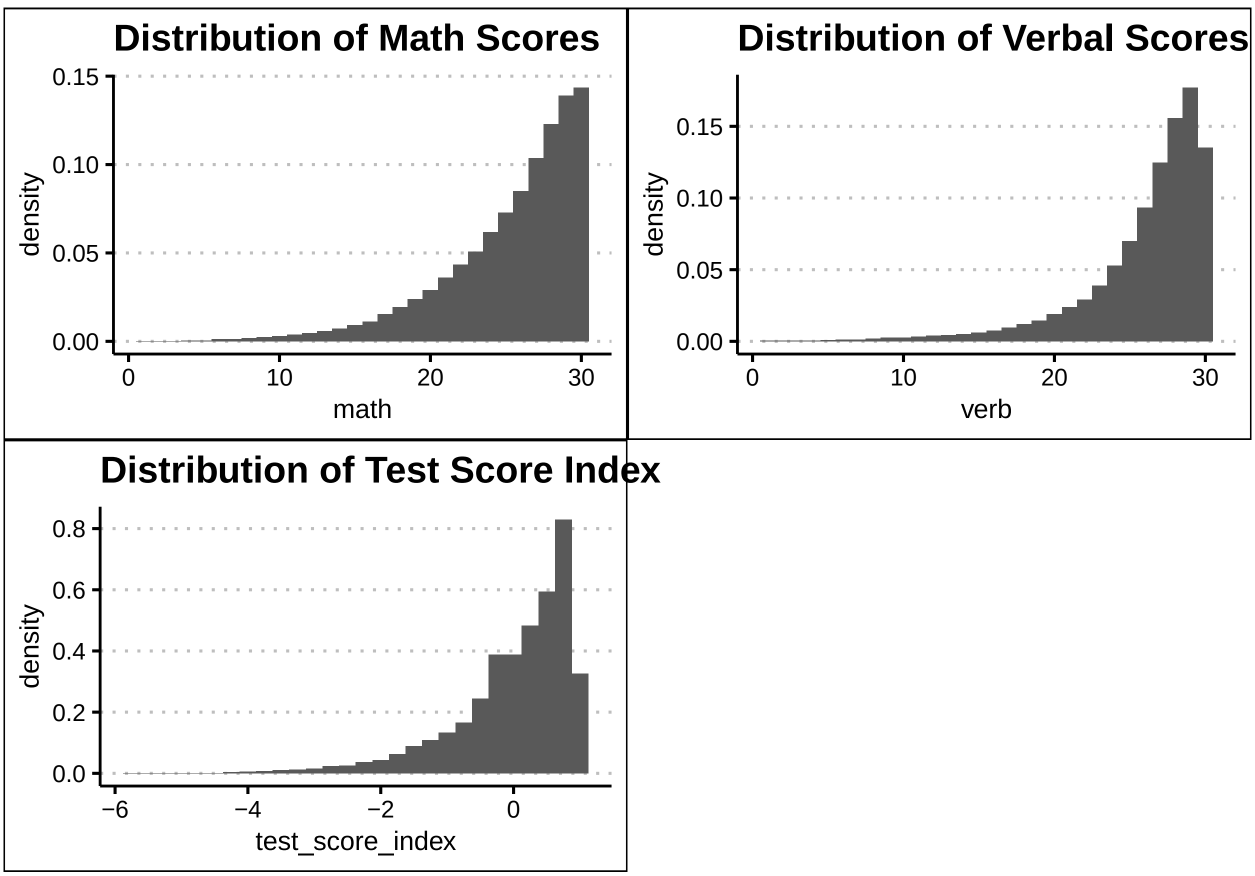
Questions 3 and 4

Table 1: Summary Statistics

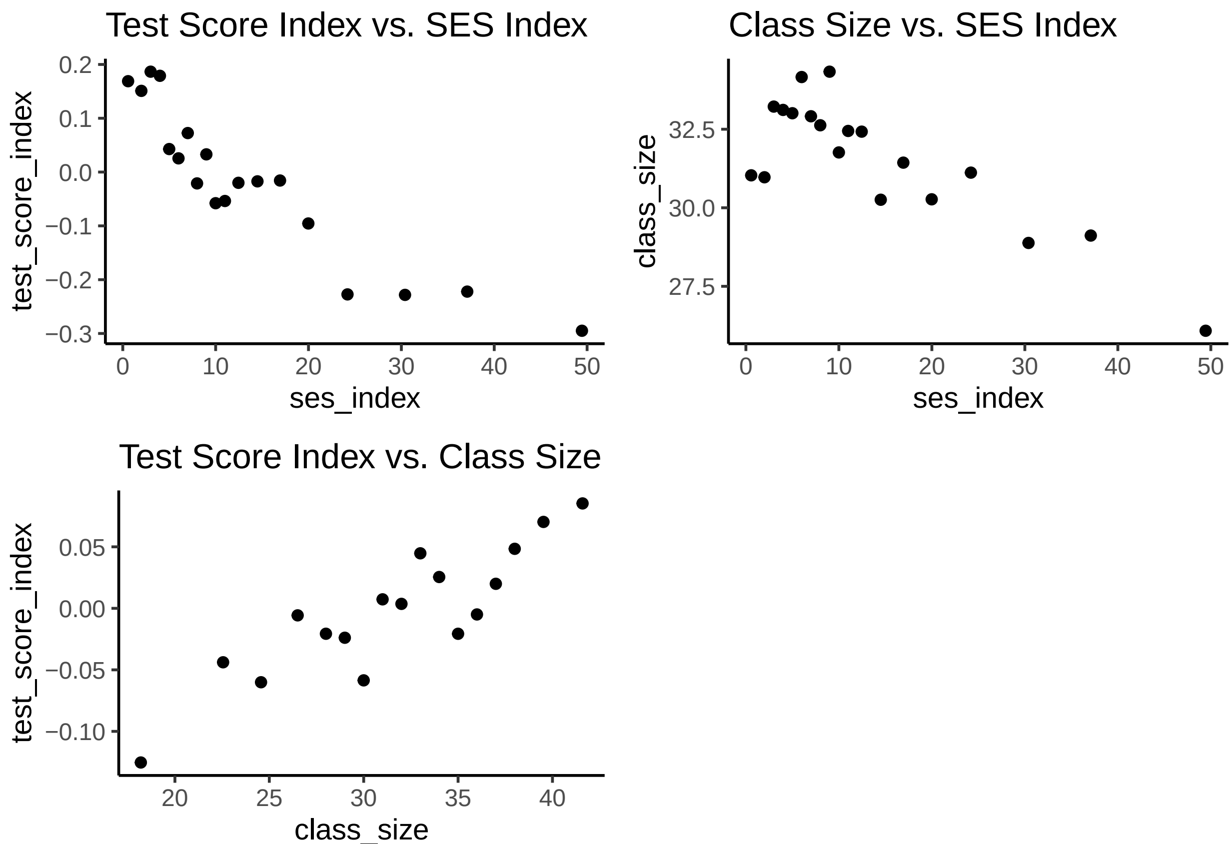
Variable	Mean	Sd	Min	Max
math	25.3	4.527	1	30
verb	26	4.279	1	30
test_score_index	0	0.903	-5.835	1.038

Question 5

All of the histograms appear to not by symmetrical and all of them have a long left tail.



Question 6



Question 7

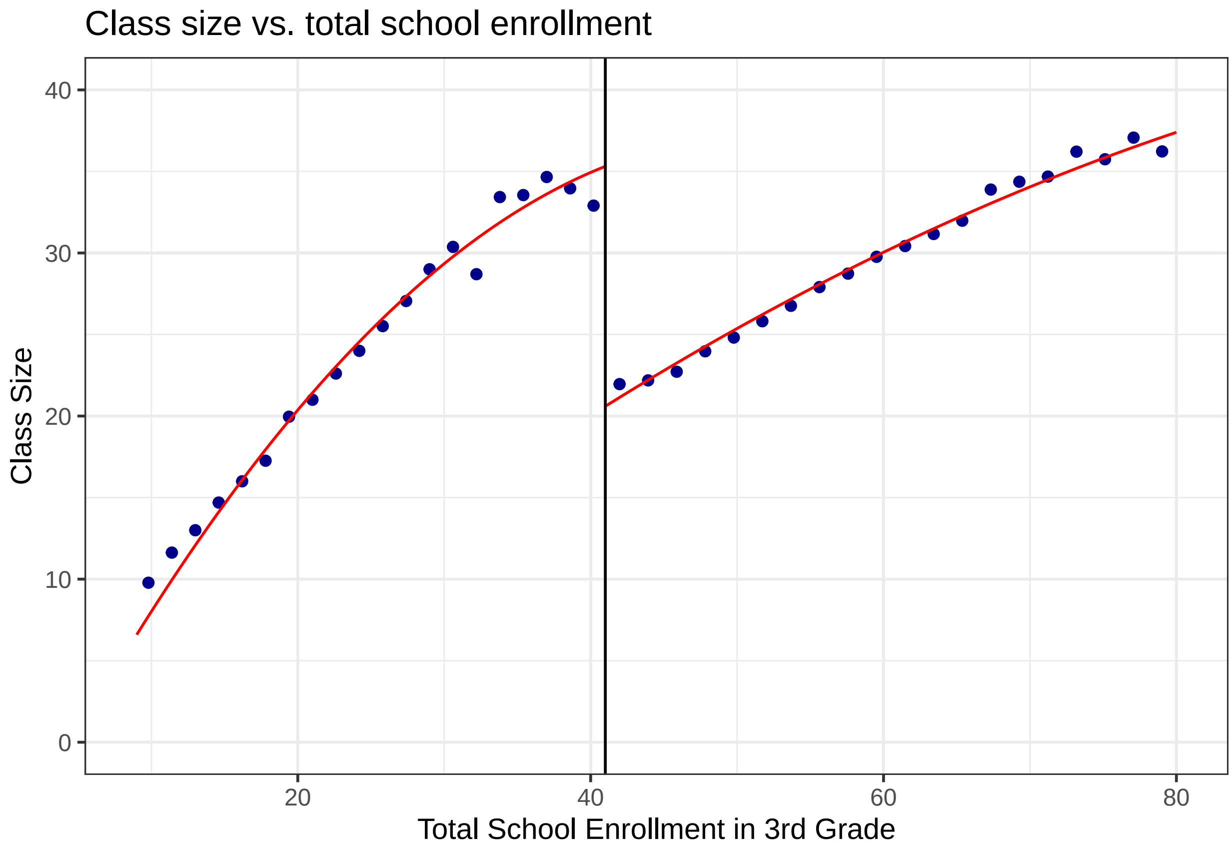
As we can see from the binned scatter plots above, the socio economic index variable is correlated with both class size and test score index. As such, it is a counfounding variable and mean we cannot interpret the relationship between class size and test scores causally because it is likely that a student's socioeconomic status influences both outcomes, meaning that we don't know how greatly class size affects test scores versus ses affects test scores.

Question 8

Part a

I chose a quadratic model it seems to fit the data better than a linear model, especiaally for the data to the left of the break

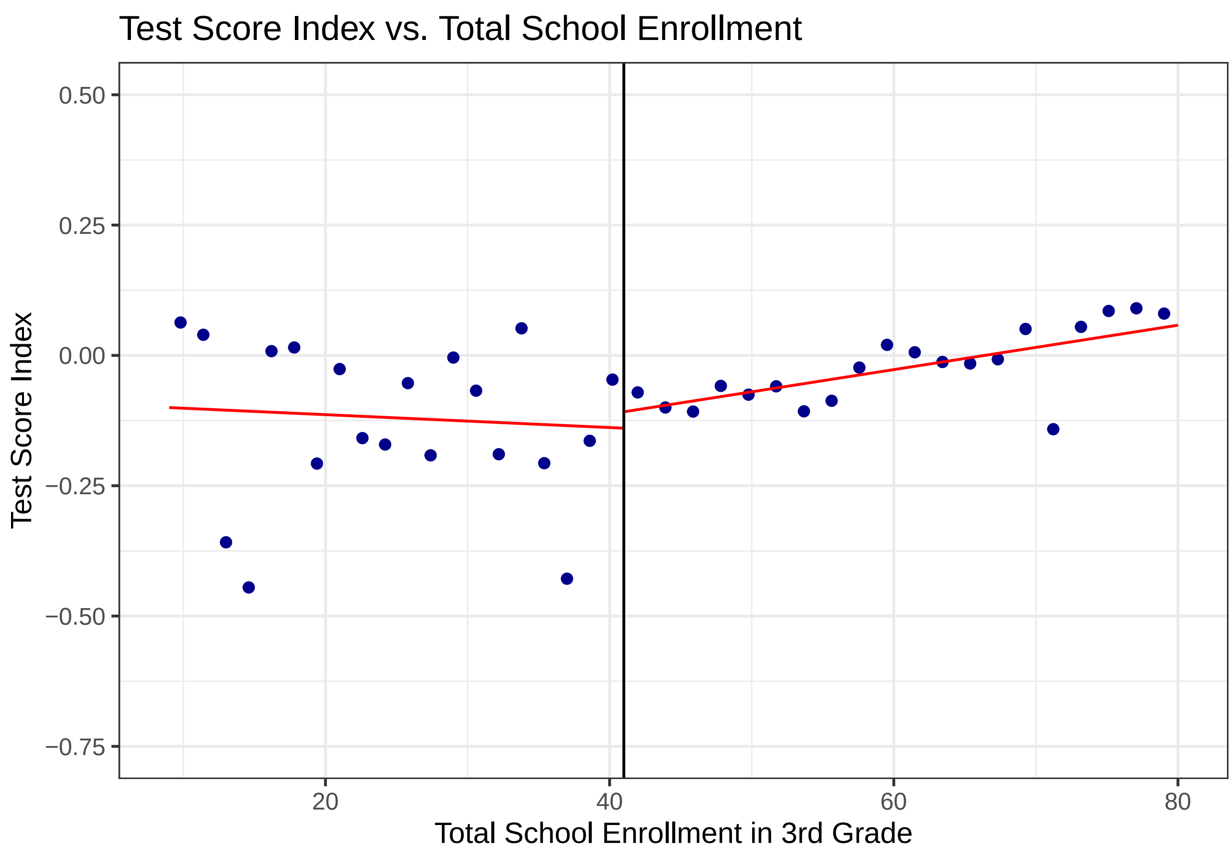
```
## [1] "Mass points detected in the running variable."
```



Part b

I chose to use a linear model because it seems to fit the data better than a quadrtatic model. When I chose a quadrataic model, it seemed like residuals on the right side of the break were much more in the positive than the negative, which would be bad. Looking at the graph, it doesn't seem like there is a wide gap in schools with 40 kids and schools with 41 kids enrolled.

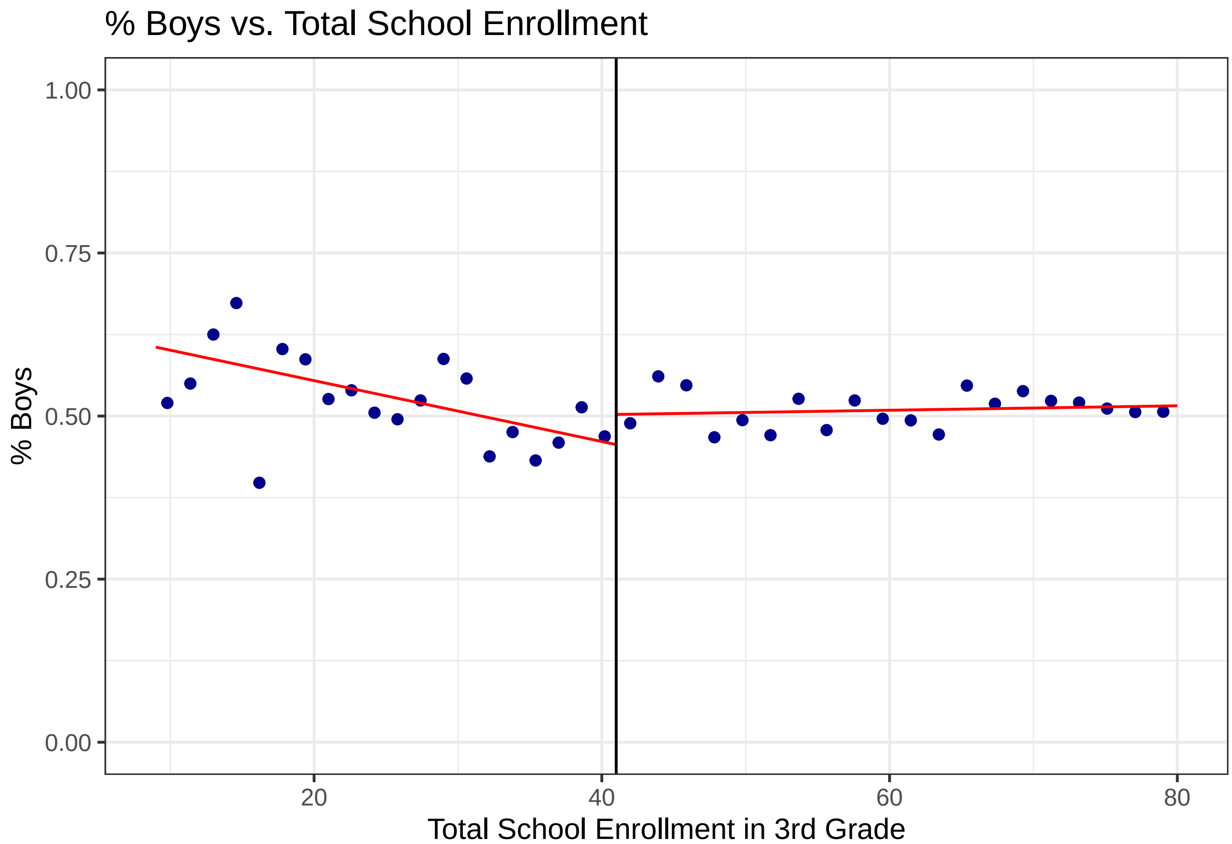
```
## [1] "Mass points detected in the running variable."
```



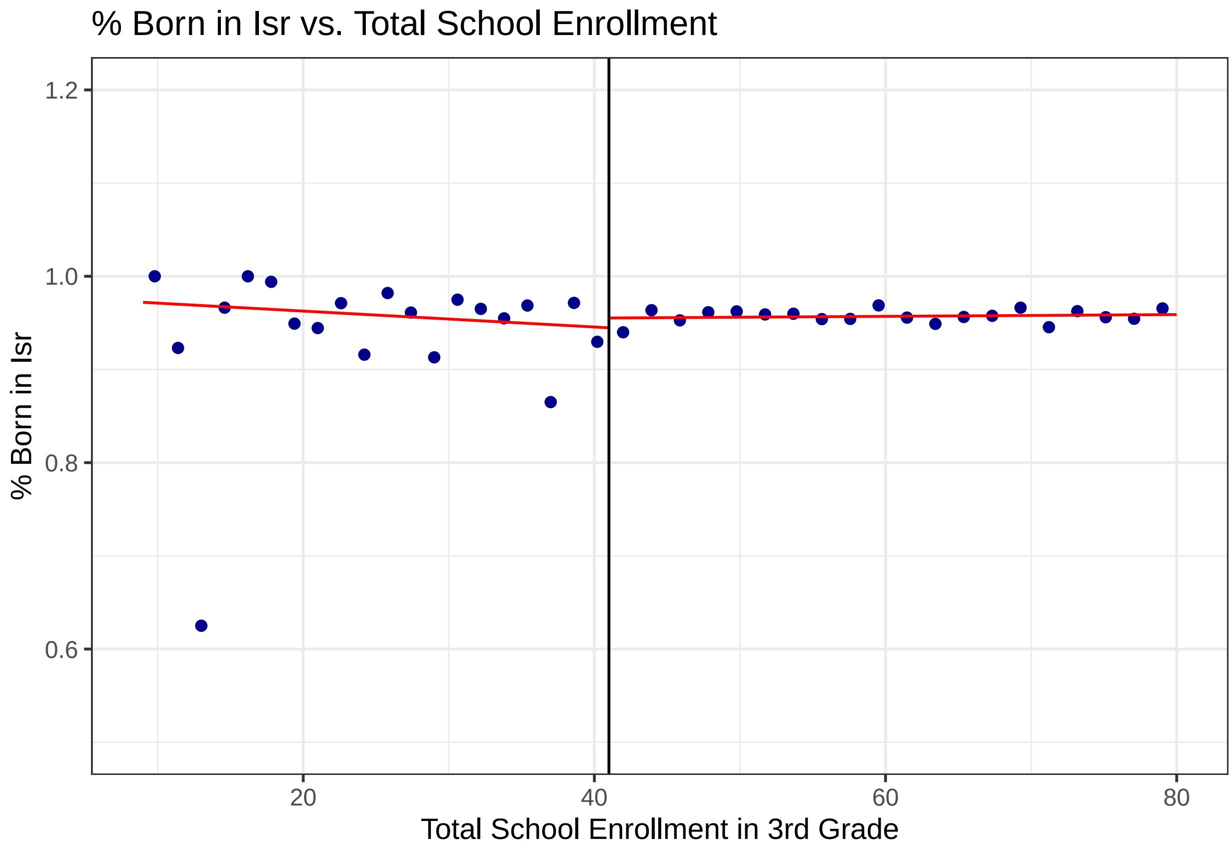
Question 9

Part a

```
## [1] "Mass points detected in the running variable."
```




```
## [1] "Mass points detected in the running variable."
```



Part b

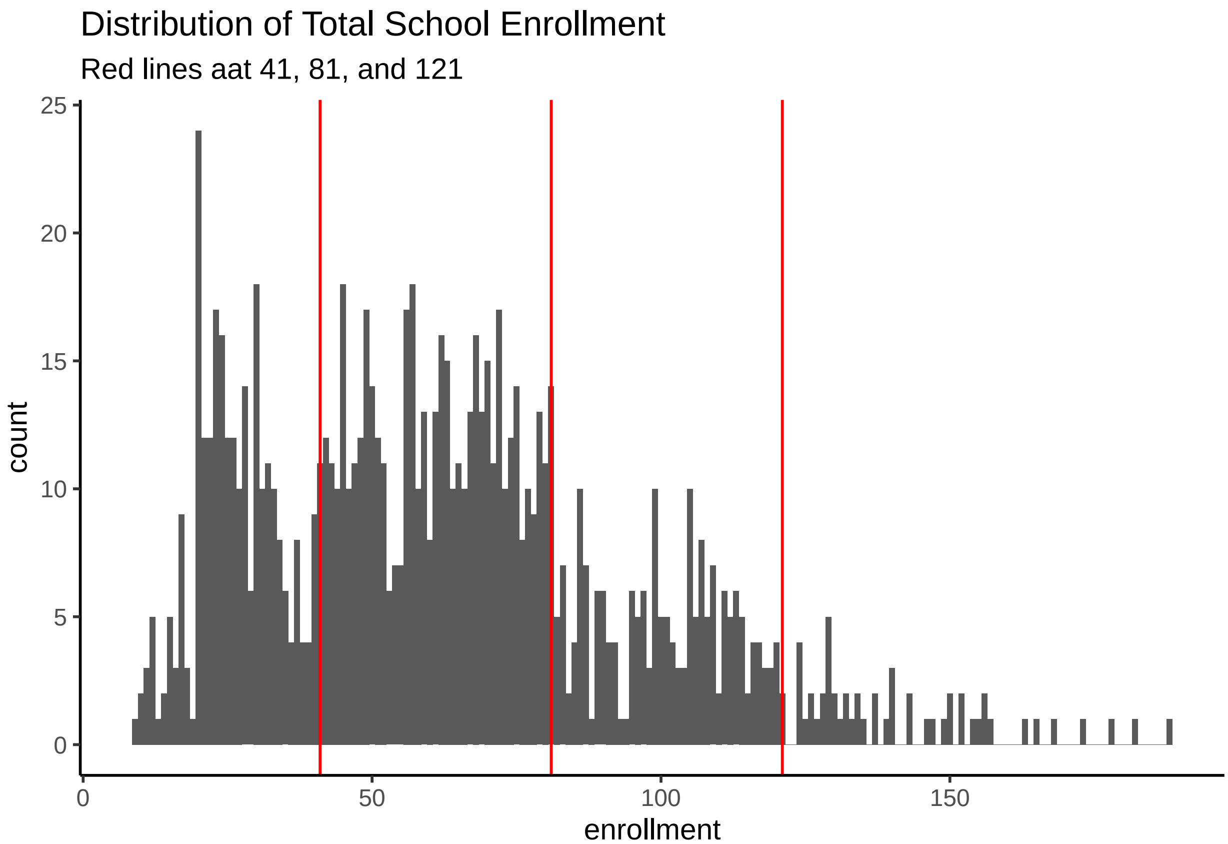
The identification assumption for the regression discontinuity design is that schools on either side of the cutoff are similar in all ways and as such the fact that they have school enrollment over or under the cutoff is as if random. The graphs from part a above are consistent with this identification assumption, as schools just at either side of the cutoff do not seem to have different percentages of boys or kids born in Israel enrolled.

Question 10

Part a

Manipulation of school enrollment could possibly invalidate the identification assumption because it means that schools could intentially stay right below the discontinuity cutoff, meaning that the schools on either side of the cutoff would be different in this way.

Parts b, c, and d



Looking at the histogram above, it seems like there is a spike in enrollment number right after the break at 41. However, there seems to be a drastic drop off in enrollment right at the 81 threshold line. As such, it certainly seems possible that there was manipulation in enrollment, but there are conflicting behvaviors at the two cutoffs. There doesn't appear to be any spike at the 121 line.

Question 11

% Table created by stargazer v.5.2.3 by Marek Hlavac, Social Policy Institute. E-mail: marek.hlavac at gmail.com % Date and time: Mon, Apr 25, 2022 - 11:35:17

Table 2:

	Dependent variable:	
	avg_class_size	avg_test_score_index
	(1)	(2)
above41	-16.610^{***}	0.026
	(0.502)	(0.070)
dist_from_41	0.857^{***}	-0.001
	(0.026)	(0.004)
interaction41	-0.429^{***}	0.005
	(0.028)	(0.004)
Constant	38.175^{***}	-0.135^{**}
	(0.424)	(0.060)
Observations	744	744
R^2	0.790	0.021
Adjusted R^2	0.789	0.017
Residual Std. Error (df = 740)	2.971	0.417
F Statistic (df = 3; 740)	927.181^{***}	5.193^{***}
Note:		*p<0.1; **p<0.05; ***p<0.01

- For the test score model, the estimate of the discontinuity at the 41 threshold = .026.
- For the class size model, the estimate of the discontinuity at the 41 threshold = -16.6

Question 12

- Class size model: The 95% confidence interval for the above41 estimate = [-18.38, -14.8]. Because the CI does not include 0, we can conclude that the results are statistically significant from 0 at the 95% confidence level
- Test score model: The 95% confidence interval for the above41 estimate = [-.14, .19]. Because the CI includes 0, we can conclude that the results are not statistically significant from 0 at the 95% confidence level

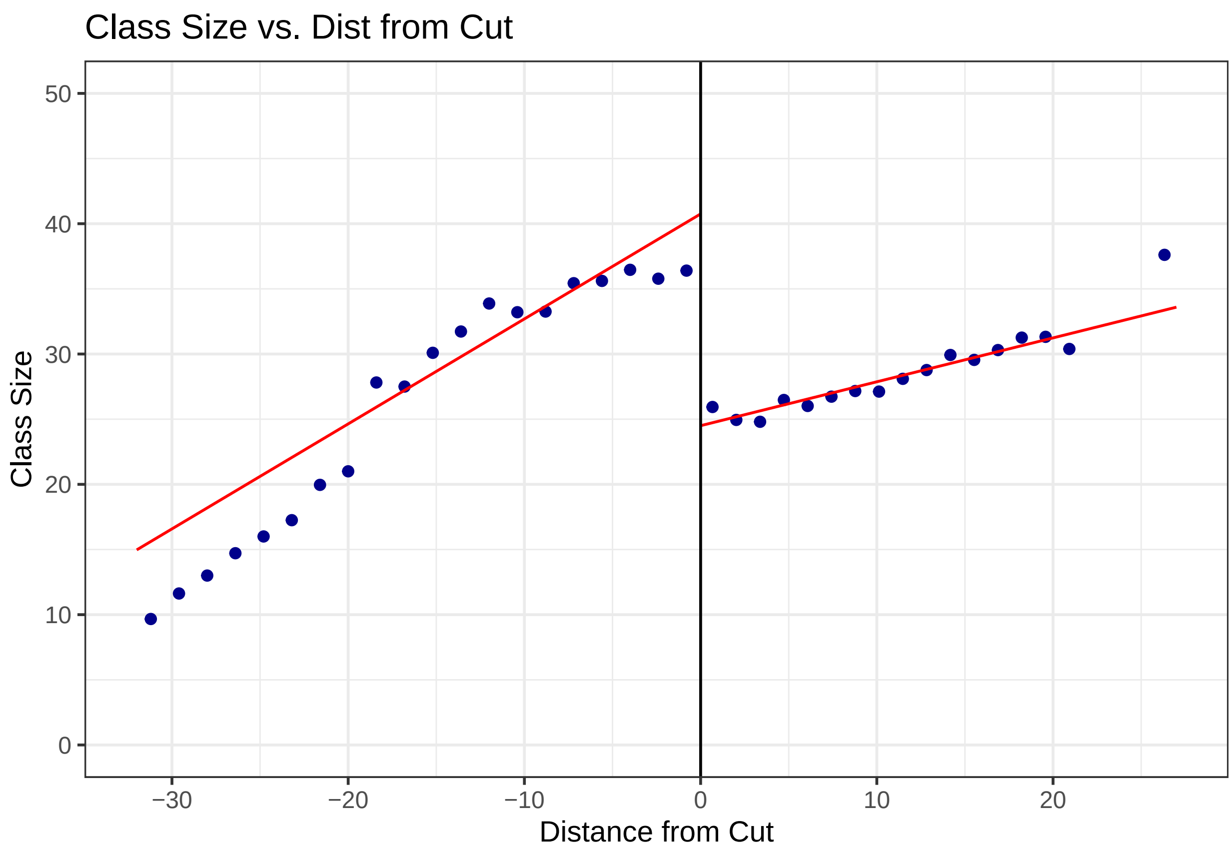
Question 13

Table 3: Summary Statistics

Variable	Mean	Sd	Min	Max
dist_from_cut	-3.6	12.598	-32	27

Question 14

```
## [1] "Mass points detected in the running variable."
```




```
## [1] "Mass points detected in the running variable."
```


Test Score Index vs. Dist from Cut
Test Score Index
0.50
0.25
0.00
−0.25
−0.50
−30
−20
−10
0
10
20
Distance from Cut

Question 15

- The estimated discontinuity for the class size model = -14.202.
- The estimated discontinuity for the test score model = -.008

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Table 4:

	Dependent variable:	
	avg_class_size	avg_test_score_index
	(1)	(2)
above_cut	−14.202***	−0.008
	(0.569)	(0.052)
dist_from_cut	0.580***	0.002
	(0.033)	(0.003)
interaction_cut	−0.247***	−0.002
	(0.048)	(0.004)
Constant	38.732***	−0.009
	(0.414)	(0.038)
Observations	937	937
R^2	0.415	0.001
Adjusted R^2	0.413	−0.002
Residual Std. Error (df = 933)	4.211	0.383
F Statistic (df = 3; 933)	220.695***	0.321
Note:		*p<0.1; **p<0.05; ***p<0.01

Question 16

The standard error (and thus width of the confidence interval) is smaller in this model (both the class size and the test score model than the previous model (the one limited to the first cutoff point), meaning that this model gives us more precise estimates than the model just including the 41 student enrollment cutoff.

- The 95% CI for above_cut variable in the class size model is [-15.6, -12.79]. Because this interval does not contain 0, the can conclude the estimate is statistically siignificant from 0 at the 95% confidence level.
- The 95% CI for above_cut variable in the test score model is [-.106, .09]. Because this interval contains 0, the can conclude the estimate is not statistically siignificant from 0 at the 95% confidence level.

Question 17

It is illegal for schools to have a class size of over 40 students in Israel. Assuming the difference between a school with 40 students enrolled and a school with 41 students enrolled is as-if random, the variability in class size presents an optimal opportunity for quasi-experimental analysis. Using a regression discontinuity design, I find that the effect of enrolling 1 additional student from the 40 (or multiple of 40) cutoff is **not** associated with a statistically significant change in test scores. However, I also find evidence that schools may manipulate enrollment numbers around the cutoff.