Efficacy of Small-class Size in Early Education

5 August 2015

The STAR (Student-Teacher Achievement Ratio) Project is a four year *longitudinal study* examining the effect of class size in early grade levels on educational performance and personal development.

This exercise is in part based on: Mosteller, Frederick. 1997. "The Tennessee Study of Class Size in the Early School Grades." *Bulletin of the American Academy of Arts and Sciences* 50(7): 14-25.

A longitudinal study is one in which the same participants are followed over time. This particular study lasted from 1985 to 1989 involved 11,601 students. During the four years of the study, students were randomly assigned to small classes, regular-sized classes, or regular-sized classes with an aide. In all, the experiment cost around $12 million. Even though the program stopped in 1989 after the first kindergarten class in the program finished third grade, collection of various measurements (e.g., performance on tests in eighth grade, overall high school GPA) continued through the end of participants' high school attendance.

We will analyze just a portion of this data to investigate whether the small class sizes improved performance or not. The data file name is `STAR.csv`, which is a CSV data file. The names and descriptions of variables in this data set are:

Name	Description
`race`	Student's race (White = 1, Black = 2, Asian = 3, Hispanic = 4, Native American = 5, Others = 6)
`classtype`	Type of kindergarten class (small = 1, regular = 2, regular with aide = 3)
`g4math`	Total scaled score for math portion of fourth grade standardized test
`g4reading`	Total scaled score for reading portion of fourth grade standardized test
`yearssmall`	Number of years in small classes
`hsgrad`	High school graduation (did graduate = 1, did not graduate = 0)

Note that there are a fair amount of missing values in this data set. For example, missing values arise because some students left a STAR school before third grade or did not enter a STAR school until first grade.

Question 1

Create a new factor variable called `kinder` in the data frame. This variable should recode `classtype` by changing integer values to their corresponding informative labels (e.g., change 1 to `small` etc.). Similarly, recode the `race` variable into a factor variable with four levels (`white`, `black`, `hispanic`, `others`) by combining Asians and Native Americans as the `others` category. For the `race` variable, overwrite the original variable in the data frame rather than creating a new one.

Question 2

How does performance on fourth grade reading and math tests for those students assigned to a small class in kindergarten compare with those assigned to a regular-sized class? Do students in the smaller classes perform better? Use means to make this comparison while removing missing values. Give a brief substantive interpretation of the results. To understand the size of the estimated effects, compare them with the standard deviation of the test scores. Recall that `na.rm = TRUE` can be added to functions in order to remove missing data.

Question 3

Instead of comparing just average scores of reading and math tests between those students assigned to small classes and those assigned to regular-sized classes, look at the entire range of possible scores. To do so, compare a high score, defined as the 66th percentile, and a low score (the 33rd percentile) for small classes with the corresponding score for regular classes. These are examples of *quantile treatment effects*. Does this analysis add anything to the analysis based on mean in the previous question?

Question 4

Some students were in small classes for all four years that the STAR program ran. Others were assigned to small classes for only one year and had either regular classes or regular classes with an aide for the rest. How many such students of each type are in the data set? Create a contingency table of proportions using the `kinder` and `yearsmall` variables. Does participation in more years of small classes make a greater difference in test scores? Compare the average and median reading and math test scores across students who spent different numbers of years in small classes.

Question 5

We examine whether the STAR program reduced the achievement gaps across different racial groups. Begin by comparing the average reading and math test scores between white and minority students (i.e., Blacks and hispanics) among those students who were assigned to regular classes with no aide. Conduct the same comparison among those students who were assigned to small classes. Give a brief substantive interpretation of the results of your analysis.

Question 6

We consider the long term effects of kindergarten class size. Compare high school graduation rates across students assigned to different class types. Also, examine whether graduation rates differ by the number of years spent in small classes. Finally, as done in the previous question, investigate whether the STAR program has reduced the racial gap between white and minority students' graduation rates. Briefly discuss the results.