

1 What is the value added of grade 13 for high school students who are going to college?

- Ontario eliminated grade 13. Did this hurt high school students who are going to college?
- The high schools revised the curriculum in math and eliminated one year of high school math. Biology and chemistry continued to be 2 year courses with and without grade 13.
- Let g^{13} be the average grade of grade 13 graduates in calculus at University of Toronto from 2000/2001 to 2003/2004. g_{0i}^{13} is the average grade of students who took the course in year i .

$$g^{13} = \frac{g_{00}^{13} + g_{01}^{13} + g_{03}^{13}}{3}$$

- Let g^{12} be the average grade of grade 12 graduates in calculus at University of Toronto from 2003/2004 to 2005/2006. g_{0i}^{12} is the average grade of students who took the course in year i .

$$g^{12} = \frac{g_{03}^{12} + g_{04}^{12} + g_{05}^{12}}{3}$$

- The first difference estimator

$$\Delta g = g^{13} - g^{12}$$

measures the value added of grade 13. Does Δg measure how much more math grade 13 graduates know compared with grade 12 graduates?

- Grading on a curve is university policy. I.e. the grade distribution is the same for all sections of calculus for all years. How does this affect your inference?

- g_{03}^{13} and g_{03}^{12} are the double cohort. How about the double cohort difference estimator?

$$\begin{aligned}\Delta^{dc}g &= g_{03}^{13} - g_{03}^{12} \\ &= 70.3 - 69.4 = 0.9\end{aligned}$$

- Does $\Delta^{dc}g$ measure how much more math grade 13 graduates know compared with grade 12 graduates? What is the advantage relative to Δg ?
- Some high ability grade 13 students fast tracked and graduate the year before the double cohort. So what does this mean about the average ability of the grade 13 students in the double cohort?
- Some lower ability grade 12 students delayed their graduation by a year to avoid the double cohort. So what does this mean about the average ability of the grade 12 students in the double cohort?

- So will $\Delta^{dc}g$ over or under estimate how much more grade 13 graduates know compared with grade 12 graduates?
- What can we do about the change in average abilities of the double cohorts?
- Let γ_{03}^{13} and γ_{03}^{12} be the average introductory biology grades of the double cohort at UT. If the average ability of grade 12's are higher than the average ability of the grade 13's in the double cohort, we expect

$$\begin{aligned}\Delta^{dc}\gamma &= \gamma_{03}^{13} - \gamma_{03}^{12} < 0 \\ &= 74.3 - 75.3 = -1.0\end{aligned}$$

- Note that it is important that the high school curriculum in biology did not change. We want to interpret $\Delta^{dc}\gamma$ as the difference in the average abilities between the two cohorts.

- Now consider the difference in differences estimator:

$$\begin{aligned}\Delta^2 g &= [g_{03}^{13} - g_{03}^{12}] - [\gamma_{03}^{13} - \gamma_{03}^{12}] \\ &= \Delta^{dc} g - \Delta^{dc} \gamma \\ &= 0.9 - [-1.0] = 1.9\end{aligned}$$

- Will $\Delta^2 g$ measure how much more math grade 13 graduates know compared with grade 12 graduates?
- Is this a big deal? The standard deviation of math grades is 13. Should high school students do grade 13 to get an additional two points in college?