Exam 4137 – Spring 2023

IMPORTANT: Always motivate your answers. Show knowledge and understanding of the concepts taught in the course. Make sure not only to repeat material from lectures and curriculum, but engage with the empirical examples and show that you understand what it means in the particular setting. Your answers should be as short as possible and as long as necessary. Each lettered subtask carries 10 marks, for a total of 150 points.

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1. Short questions

   (a) Interpret and compare the following causal estimands:

   i. $\mathbb{E}(Y_i^1 - Y_i^0 \mid T_i = 1)$
   ii. $\mathbb{E}(Y_i^1 - Y_i^0 \mid T_i = 0)$
   iii. $\mathbb{E}(Y_i^1 - Y_i^0 \mid T_i^1 > T_i^0)$

   (b) Explain the following assumptions

   i. $\mathbb{E}(Y_i^0 \mid T_i = 1) = \mathbb{E}(Y_i^0 \mid T_i = 0)$
   ii. $\mathbb{E}(Y_i^1 - Y_i^0 \mid T_i = 1) = \mathbb{E}(Y_i^1 - Y_i^0 \mid T_i = 0)$

   (c) What is the consequence of violations of (b) i? What is the consequence of violations of (b) ii, given that b i) holds?

   (d) What does it mean that the multinomial logit model has the "Independence of Irrelevant Alternatives" property? Provide an example when this property is implausible.

2. According to a new report from Statistics Norway,[1] around 66 percent of all full-time students in Norway in 2021 worked beside studying. Some policymakers worry that this hinders college completion, and argue that the benefits from Lånekassen should be increased. Following this, Lånekassen introduces a higher benefit scheme that students can apply for, and you are tasked with analyzing whether the scheme works in getting students to complete more courses. You measure ECTS credit completion for each student (Y_i) and whether or not the student was given the higher benefits T_i. You first run the regression

$$Y_i = \alpha + \beta T_i + \varepsilon_i$$

   (a) What assumption do you need to make for your estimate β to be given a causal interpretation? How can you interpret β?

[1] Maj-Lisa Lervåg, Maria Engvik and Håvard Bergesen Dalen: *"Studenters levekår 2021 - En levekårsundersøkelse blant studenter i høyere utdanning"*, SSB rapporter 2022/34

(b) If the assumption above does not hold, what does β capture? What do you think is the likely direction of the bias? Argue why.

As an alternative, you instead exploit that you have data from two consecutive years after the introduction of higher benefits, and estimate

$$Y_{it} = \delta_i + \gamma_t + \eta T_{it} + e_{it}$$

(c) What kind of bias would this model control for? How would you estimate the equation above? What variation does this exploit?

You still worry about bias, and figure out that Lånekassen sent emails with information about the higher benefits to a random sample of students. Return to the situation with only one year of observations. You now additionally observe Z_i, whether student i was randomly sent an email with information about the higher benefits. You consider estimating the follwing with two-stage least squares (2SLS)

$$Y_i = \psi + \theta T_i + u_i$$
$$T_i = \lambda + \rho Z_i + \mu_i$$

(d) What assumptions do you need to make for your estimates of ρ and θ to be interpreted as causal? Are these are testable? Are they plausible in this setting?

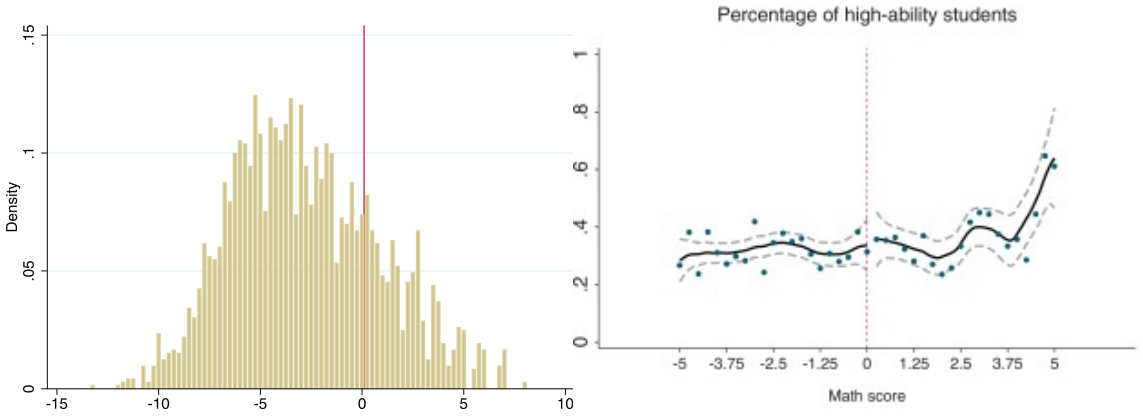
(e) Using 2SLS, you get the estimates for ρ and θ shown in Table 1. How do you interpret these estimates?

Table 1: 2SLS estimates

Coefficient	Estimate	Standard error
θ	5.78	2.32
ρ	0.12	0.011

(f) Explain how you could characterize the compliers to the email reminders in terms of their background characteristics. What would you compare these to? How you could estimate the mean potential outcomes among compliers - $\mathbb{E}(Y_i^1 \mid T_i^1 > T_i^0)$ and $\mathbb{E}(Y_i^0 \mid T_i^1 > T_i^0)$. What can we learn from this?

3. Many colleges and universities have "remedial education programs", where struggling first year students are assigned an extra remedial course to repeat prerequisite knowledge they were supposed to have learned in high school and better prepare them for college. "*Is college remedial education a worthy investment?*" (Emma Duchini, Economics of Education Review, 2017) investigates the impact of one such program at an undergraduate Economics program in Italy.



(a) Distribution of the normalized Score variable

(b) Baseline characteristics vs. math score

Figure 1: Figures from Duchini (2017)

Students who want to enroll in this department have to take an exam that assesses their readiness in math, logic, and verbal comprehension. If they score below a certain threshold c in the math section, they are assigned to remediation and have to take a remedial math course and pass an exam before they can continue.

The paper uses the following estimating equation:

$$Y_i = \alpha + \beta_1 D_i + \beta_2 S_i + \beta_3 D_i \times S_i + W_i \pi + \gamma_{c(i)} + \varepsilon_i$$

where Y_i is an outcome such as the number of credits obtained at the end of the first year. S_i is the score at the math section of the entry exam, and $D_i = S_i \leq c$ is a dummy variable for scoring below or at the cutoff for assignment to the remedial programs, W_i is a vector of controls (sex, immigrant, high school performance) and $\gamma_{c(i)}$ is a set of cohort fixed effects.

(a) What kind of identification strategy is this? What is the identifying assumption? Explain, interpret and provide an example of a violation.

(b) The author provides Figure 1a in support of the validity of the empirical design. What is this figure intended to test? Does it support the strategy?

(c) The author also provides Figure 1b in support of the empirical design. Explain the logic of this figure, and why it supports the identifying assumption. How would these figure look if they would make you doubt the design?

(d) The author shows Figure 2 as a visualization of the main results of taking a remedial math class on later performance. Is this evidence that the program works? Why or why not?

(e) Based on these results, the Head of Department suggests to drop the remedial course. What is the relevant treatment effect parameter to make this decision? How does this relate to the treatment effect parameter estimated above? Could you come up with an alternative policy based on the evidence above?

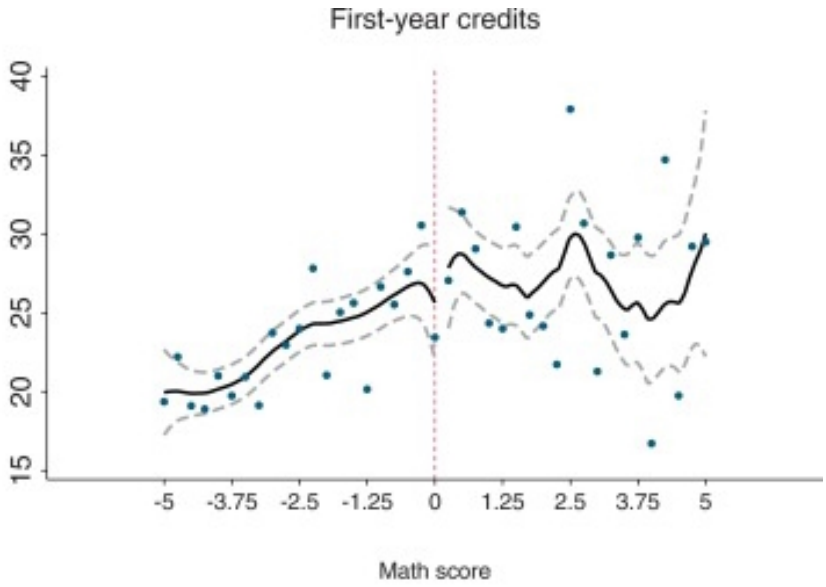


Figure 2: Post-entry outcomes as a function of the assignment variable in Duchini (2017)