ECON 20: Lecture #2
Practice Problems

1 Rubin causal model

In the Rubin causal model, Y_i represents the outcome of interest and D_i is the treatment status indicator ($D_i = 1$ if treated; $D_i = 0$ if not treated) for person i. For concreteness, suppose the outcome Y_i is "earnings at age 30" and the treatment is "attend Dartmouth." Answer the following questions.

1. Suppose you are person i. In this framework, what do Y_{i1} and Y_{i0} repersent in words? What does D_i represent in words? What value does it take for you?

2. Which of the following are *counterfactual*?

   (a) $E[Y_{i1}|D_i = 0]$

   (b) $E[Y_{i1}|D_i = 1]$

   (c) $E[Y_{i0}|D_i = 0]$

   (d) $E[Y_{i0}|D_i = 1]$

3. For Dartmouth students, what is the causal effect of attending Dartmouth on earnings at age 30 using the notation of the Rubin model?

4. Now, suppose that you want to figure out the causal effect of attending Dartmouth on earnings. To do so, you compare the average earnings of people who did and did not attend Dartmouth. How would you describe this calculation in the notation of the Rubin model?

5. In the context of the research approach described in part (4), you conduct a *balance test*. What would that consist of? Please provide a specific example. And what is the purpose of the balance test?

6. Under what conditions does the approach in part (4) deliver the causal effect of attending Dartmouth? I recommend trying to write the answer both mathematically and in words. Ultimately, being able to answer this type of question cleanly and clearly in words is one of the goals of this class.

7. Suppose you had some data that included a random sample of 50 Dartmouth graduates and a random sample of 50 non-Dartmouth grads. You calculate the mean earnings of the two groups and take the difference. Name two reasons why this difference may not necessarily represent the causal effect of attending Dartmouth?

8. Is the question "does attending Dartmouth raise your earnings at age 30" well-posed? Choose yes or no and briefly justify your answer.