PPHA 34600: Program Evaluation
Spring 2020
Problem Set 1
Due: Thursday, April 23, at 9PM Chicago time to Canvas

Instructions:

This problem set consists of two files: (1) this document with instructions and questions; and (2) a dataset which you will use to answer the questions below.

You can work in groups of up to three. Please identify your group members. Groups can share code, but each group member must turn in their own problem set, and must have separate written answers to the questions. You may not share any written work (including drafts) with other members of your group. You should submit both written answers -- which should be parsimonious -- and a file which contains your code and results for the data analysis. You must use R. If you know how to use them, I recommend that you use RMarkdown or knitr, which will allow you to intersperse your code and written answers (but this is not required). Note that you are primarily being graded on your written answers. Problem sets must be submitted in PDF format. Problem sets must be turned in via Canvas; no late submissions will be considered.

Questions:

You have been asked by a well-meaning NGO, the Business Underwriting and Loan International Group (BURLIG), to help them learn about the impacts of their small business loan program on employee income in California. BURLIG provides low-interest loans to small firms, and hypothesizes that these loans are increasing incomes by raising employment.

1. BURLIG would like to know about the income impacts of their loans. They say they're interested in measuring the impact of their loans, but don't exactly know what that means. Use the potential outcomes framework to describe the impact of treatment (defined as "taking a small business loan") for firm i on wages (measured in dollars paid to workers) formally (in math) and in words.

2. BURLIG are extremely impressed. They want to know how they can go about measuring τ_i. Let them down gently, but explain to them why estimating τ_i is impossible.

3. BURLIG are on board with the idea that they can't estimate individual-specific treatment effects. They suggest estimating the average treatment effect instead. They suggest taking some of their early data on wages. They have data on firms with and without loans, and want you to compare the average wages paid across the two sets of firms. Describe what this is actually measuring, and provide an example of why this may differ from the average treatment effect.

4. BURLIG have realized the error of their ways. Their CEO tells you, "Okay, we understand that our data won't let us estimate the average treatment effect. But can't we estimate the average treatment effect on the treated?" First formally (in math) define the ATT in this context, and then explain whether or not BURLIG's data will allow you to estimate it. If so, describe how what you

see in the data corresponds to the necessary components of the ATT. If not, explain why not, and describe what you can't see in the data that you'd need to observe.

5. BURLIG forgot to tell you that they ran a pilot *randomized* study to estimate the effects of their loans on wages. They're happy to share those data with you: find it in *ps1_data.csv*. This experience has made you a little bit skeptical of BURLIG's skills, so start by checking (with a proper statistical test) that the treatment group and control group are balanced in pre-treatment wages (measured in dollars), sales, number of workers, and owner gender. Use *burlig_trt* as your treatment variable. Report your results. What do you find?

6. Plot a histogram of wages for treated firms and control firms. What do you see? Re-do your balance table to reflect any necessary adjustments. What does this table tell you about whether or not BURLIG's randomization worked? What assumption do we need to make on *unobserved* characteristics in order to be able to estimate the causal effect of *burlig_trt*?

7. Assuming that *burlig_trt* is indeed randomly assigned, describe how to use it to estimate the average treatment effect, and then do so. Please describe your estimate: what is the interpretation of your coefficient (be clear about your units)? Is your result statistically significant? Is the effect you find large or small, relative to the mean in the control group?

8. BURLIG is convinced that the reason their loans are effective is because they are leading firms to hire new workers. They want you to estimate the effects of their loans, but controlling for endline number of employees. Is this a good idea? Why or why not? Run this regression and describe your estimates. How do they differ from your results in (7)? What about controlling for *baseline* number of workers? Run this regression and describe your estimates. How do they differ from your results in (7)? How do the two estimates differ? What is driving any differences between them?

9. One of the BURLIG RAs (the real workforce!) informs you that not everybody who was assigned to treatment -- or was offered a loan -- (*burlig_trt* = 1) actually *took out* their loan. She tells you that the actual treatment indicator is *burlig_trt_take*. (Since their loans were unique, we know for a fact that nobody in the control group got one). In light of this new information, what did you actually estimate in question (7)? How does this differ from what you thought you were estimating?

10. BURLIG aren't actually interested in the effect of assignment to treatment - they want to know about the actual effects of their loans. Describe (in math, and then in words) what you can estimate using the two treatment variables we observe, *burlig_trt* and *burlig_trt_take*. Estimate this object (you can ignore standard errors just for this once). Interpret your findings. How does this compare to what you estimated in (7)?