Problem Set #4

W241: Field Experiments

Due before Week 11's live session ("Causality from observational data…" live session)

Some guidelines for submitting problem sets in this course:

- Please upload a PDF rather than a Word document or a link to a Google document.
- Please put your name at the top of your problem set.
- **Please bold or highlight your numerical answers to make them easier to find.**
- If you'll be using R or Python code to calculate your answers, please put the code and its output directly into your Problem Set PDF document.
- You do not need to show work for trivial calculations, but showing work is always allowed.
- For answers that involve a narrative response, please feel free to describe the key concept directly and briefly, if you can do so. Do not feel pressure to go on at length.
- Please ask us questions about the problem set if you get stuck. Don't spend more than 20 minutes puzzling over what a problem means - it may just not be written clearly enough.

1. FE exercise 5.2.
    a. In addition, please also answer this question: Which population is more relevant to study for future decisionmaking: the set of Compliers, or the set of Compliers plus Never-Takers? Why?
2. FE exercise 5.6.
3. FE exercise 5.10.
    a. Find the data [here](#).
        i. Pointer: there are some NAs in the dataset. Remove rows with NAs if you can't get the cluster function to work (just `na.omit(yourDataFrame)`)
    b. The below clarifications may help.
        i. a and b: No assumptions about the leaflet's effect size are required here.
        ii. b: For part (b), you can use regression (with clustered standard errors) or randomization inference, whichever you prefer.
        iii. The goal of parts (c) through (f) is to estimate the treatment effect of *canvassing*, which means having a conversation with those reached, and to separate that from the effect of the leaflet that was distributed at all doors, which is not included in "canvassing." Some further clarifications on these are below.
        iv. c: Assume the leaflet had no effect on turnout on anyone, so neither among compliers nor among never-takers.
        v. d: When they say "write down a model," they mean: Write down a line of algebra showing how the difference between the expected turnout rate in the entire treatment and control groups reflects both the average effect of

the leaflet among those not home and the effects of conversations and the leaflets among those who are home. *We highly recommend you do this before proceeding*.

   vi. d and e: Assume the leaflet had a 1 point effect on both the compliers and never-takers.
   vii. For e: by "the effect of canvassing", we mean the effect of just the conversation, not the leaflet.
   viii. f: Assume the leaflet had no effect on compliers but a 3 point effect among never-takers.
   ix. Remember, never-takers = those who don't answer the door, and compliers = those who do answer the door.

4. FE exercise 5.11
   a. We are rewriting part (a) as follows: "Estimate the proportion of Compliers by using the data on the Treatment group. Then compute a second estimate of the proportion of Compliers by using the data on the Placebo group. Are these sample proportions statistically significantly different from each other? Explain why you would not expect them to be different, given the experimental design."
   b. Hint: ITT_D means "the average effect of the treatment on the dosage of the treatment." I.E., it's the contact rate ($\boldsymbol{\alpha}$ in the async).
5. Determine the direction of bias in estimating the ATE for each of the following situations when we randomize at the individual level. Do we over-estimate, or underestimate? Briefly but clearly explain your reasoning.
   a. In the advertising example of Lewis and Reiley (2014), assume some treatment-group members are friends with control-group members.
   b. Consider the police displacement example from the bulleted list in the introduction to FE 8, where we are estimating the effects of enforcement on crime.
   c. Suppose employees work harder when you experimentally give them compensation that is more generous than they expected, that people feel resentful (and therefore work less hard) when they learn that their compensation is less than others, and that some treatment-group members talk to control group members.
   d. When Olken (2007) randomly audits local Indonesian governments for evidence of corruption, suppose control-group governments learn that treatment-group governments are being randomly audited and assume they are likely to get audited too.
6. FE exercise 8.2.
7. FE exercise 8.6.
   a. Note: while this may be conceptually tricky, this problem does not require very complicated calculations. Your answer will probably be one or two lines of algebra. We want you to do this simple problem because FE 8.9, next, builds on it.

b. Note: Previously when you saw nomenclature like $E[Y_0]$, this meant "the expected value across all possible random assignments." It does **not** mean that here. Gerber and Green want you to imagine that an experiment happened and a particular village were assigned to treatment. Then, *estimate* the spillover effect or the treatment effect as you would if you did the experiment and got that data back with that pattern of treatment assignment.
c. Hint: This problem introduces a new concept we plan to incorporate into async in future iterations of the class. This is explained in the book, however: you need to use weighting for this problem. Look at equation 8.2 for a serious hint on how to answer this problem. To understand how to use the weights correctly, check out equation 8.2 in the book. Or see the discussion on page 270. Or check out this formula, which is similar. The weights for each unit are defined as 1 / (the probability that a unit is assigned to the group that it's in). So, if there's a 20% chance a unit will be assigned to group C and it is, the weight that unit should get is 1 / .2 = 5. This document describes the idea behind pweighting. In the text's discussion of the medical-clinic example, you will notice that the calculations weight observations by the inverse of the probability of treatment assignment. We previously skipped Section 4.5 in FE because it was rather complicated and we wanted to emphasize basic concepts first. Our document here gives what we hope is a useful, more simplified presentation.

8. FE exercise 8.9.
   a. You're going to use pweighting here, too, just like in FE 8.6.
   b. Hint: problems (a) and (b) pertain to the 30 main hotspots and you only need to use the data at the first link below. If you are curious, they used this script to generate this simulated data. They then re-randomized this simulated data many times to figure out the probability that each simulated location would be within the spillover radius of a treatment location. Going through that script may be useful but is not necessary to answer the problem.
   c. Hint: for the entire problem, use the randomly assigned treatments -- that is, use y as your outcome variable. You should **not** need to touch y01, y00, etc. in order to answer the problem. You will need prob 01, prob00, etc. The goal here is to show what you would do if you actually got the y data back, not to compute expectations based off of the full schedule of potential outcomes available in the simulation.
   d. Hint: For part (c): "exposure" records which group a unit is in (with 0 representing "00" and 1 representing "01", in the book's nomenclature). "y" is the outcome. prob00, prob01, prob10, etc. is the probability that in each unit is in each group.
   e. Hint: The answers that Gerber and Green give on page 268-270 refer to the expected value of the estimator, not the value for a particular randomization. This question, as we note above, applies to a particular randomization.
   f. Hint: It may help to run this line:

```
data$exposure <- sprintf("%02d", data$exposure) #this
    turns "1" into "01" and "0" into "00"
```

g. Link to data for main 30 hotspots. (labeled as Exercise 8.9 on the FEDAI site). Look at the table on page 266 to make sure you understand how the data are supposed to look. The “exposure” column is the column that contains treatment assignment, although it may be truncated.
h. Link to data for other ‘non-experimental’ hotspots. (labeled as Exercise 8.9c on the FEDAI site)

9. FE exercise 8.10.
    a. Note: Use regression, not randomization inference, when the book calls for it. (Randomization inference will take you time to program up that we think is a waste, and we also think getting practice with using regression is important.)
    b. Hint: for the second part of part (b), run one regression of today’s score on both today’s treatment assignment and yesterday’s treatment assignment. Then, calculate the p-value that both effects are zero. Hint part 2: this p-value exists in the normal regression output you will get when you type `summary(lm())` in R.
    c. **Also answer, as part e:** Note that the observations in this regression are not necessarily all independent of each other. Given that, would you expect randomization inference to give you a better answer than the regression answer you just obtained in (b)? Which number(s) do you expect to be different in regression than in randomization inference? What is the direction of the bias? (This is a conceptual question, so you do not need to conduct the randomization inference to answer it. However, you are certainly welcome to try that exercise if you are curious.)