**Friday exam 2**

**Due date: Monday, May 25, 2020**

Regression discontinuity design

1. A large city has a mental health court where mentally ill defendants can have their charges dismissed. But to get into mental health court, a defendant is first interviewed by a **single therapist**. This therapist uses a rigid interview guide to score each defendant’s mental illness severity on a scale of 1 to 100. Individuals whose score is 60 or higher are immediately placed into the mental health court, and individuals whose score is below 60 bypass mental health court and transition into traditional adjudication. You, the researcher, are interested in the effect that mental health court has on recidivism (i.e., re-committing a criminal offense). Use this information to answer the following questions.
   1. Your colleague says that to estimate the causal effect of mental health court on recidivism, simply compare the recidivism outcomes for people who went through mental health court to those who went through traditional adjudication. Under what assumptions would this simple comparison between the two groups yield a causal effect? Explain your answer both mathematically (using the notation we’ve been using in class) as well as in clear prose.
   2. Do you think that your colleague is right? Would simply comparing the two groups yield a causal effect given your answer in part a? Why/why not?
   3. But let’s assume that you could use regression discontinuity for this project. What would the running variable be? What is the cutoff? Who is the counterfactual inmate for each defendant in mental health court?
   4. What identifying assumptions do you need for RDD to identify a causal effect? (Express your answer both mathematically using the notation we have developed in class as well as interpret that notation).
   5. Say you are worried that therapists are manipulating the data. Maybe they are giving people a 60 if they’re close. What could you do to test that? Describe that procedure.
   6. Describe what a balance test would look like in this context.
   7. Write down a regression model that allows for nonlinearities to be modeled both below 60 and above 60.
   8. Describe three figures (pictures) you would need to create for this project. Draw an example of each figure that shows what a valid RDD would look like. For each figure, explain what the figure is doing, and what evidence is and is not consistent with the underlying hypothesis being investigated in that picture.

Instrumental variables design

1. Now assume another large city has a mental health court, but this time, the scoring is simpler. Defendants enter a correctional facility through a booking process where they are interviewed by a single officer who follows a strict interview guide (i.e., he has no discretion whatsoever in making a mental illness decision). If the officer who sees them believes they have any mental illnesses, the officer will redirect the inmate to see one of a couple dozen therapists. Therapists see inmates on a first come, first serve basis on when the therapist is working. Some therapists work weekdays during the day, some weekends, some evenings. Therapists are no longer following a strict criteria when interviewing inmates. Rather, they rely on their own subjective judgment, beliefs and training to determine whether the inmate has a mental illness of such severity that it warrants mental health court.
   1. You are interested in using a judge fixed effects design to evaluate the causal effect of mental health court on recidivism. What is the instrumental variable you will use in this project?
   2. List the five assumptions needed for this IV design if there are heterogenous treatment effects. For each assumption, explain what this assumption means in the context of this mental health project itself.
   3. Which assumptions can be tested empirically and which ones cannot?
   4. Describe an example for each assumption that in this mental health court example would *violate* the conditions required by the assumption. Be specific. You can use a DAG to help you.
   5. Write down the estimating equation(s) you will use for this IV design if you used 2SLS.
   6. What parameter are you estimating with 2SLS? How does it differ from the ATE or the ATT?
   7. Let’s say that your instrument might suffer from a weak instrument problem. Write down an equation showing the bias that this will create. How can you test whether this bias is a problem?

Empirical exercise: Fulton Fish Market

The Fulton Fish Market is an open air market in New York City, second in size only to another open market fish market in Japan. Fish are heterogenous across every conceivable dimension – size, type, for instance. Graddy hand collected data on fish sales and was interested in estimating the price elasticity of demand by instrumenting for supply using various measures at sea.

1. You are interested in estimating the price elasticity of demand according to the following equation

Where ln q is the natural log of quantity of fish sold measured in pounds, ln p is the average price per pound and X a series of day of week fixed effects. Be sure to create new variables corresponding to ln q and ln p. The data for this can be downloaded at the following Github URL:

https://storage.googleapis.com/causal-inference-mixtape.appspot.com/fish.dta

* 1. As before, create a repository at Github with directories arranged as we’ve been discussing in class so far. Write down the link to your repository. You will only receive credit for this part if you have placed your programs in a separate directory as your data which is in a separate directory as your assignment which is itself in a separate directory as your tables.
  2. Run the above OLS regression and report the coefficient on ln p. Explain why this is not the causal parameter, the price elasticity of demand.
  3. Estimate two stage least squares twice: the first time use *wave2* as an instrument for log price, and the second time use *speed3.* Interpret the coefficients. Are fish elastic or inelastic?
  4. Run the first stage for each model. Interpret the coefficient on the instrument. Report F statistics on the first stage of each model. Are either of these instruments weak? Which instrument do you prefer and why?