14.03/14.003 Problem Set 6
Fall 2014

Professor David Autor

Due Thursday, 12/04/2014 at 5pm EST v

- Attempt **any two** out of the three questions. Each question is worth 30 points.
- You are welcome to attempt all three. If you do so, the *average* score will be recorded. That is, there is no bonus for attempting all three questions (except, of course, it will be good practice for you and help you learn the materials)

1 Car talk (30 points)

In the market for used cars, there are high and low quality cars. At a price P, the quantity of high and low quality cars supplied are (in thousands of cars): $\max(2P-8,0)$ and $\max(P-3,0)$ respectively. To buyers, a low quality car is worth 4.5 and a high quality car is worth 7. Buyers are risk neutral, and if they are uncertain about the quality of the car, their valuation is the expected value given their beliefs about the quality. The number of buyers far exceeds the number of sellers, so the demand for cars is infinite if the price is less than the expected value of a car.

1. Suppose that buyers are perfectly informed about the quality of each car. What is the market price and quantity of high and low quality cars? You may find it helpful to graph the supply and demand curves. **(7 points)**
2. Suppose now that buyers have no information about what kind of car they are purchasing. If the prevailing market price for cars is P, what fraction of the cars available for sale are high quality? At that price P, what are the buyers' expected valuation for the cars? **(7 points)**
3. There is some price P such that the buyer's willingness to pay for a car is equal to price P. What is the quantity of high and low quality cars traded in this equilibrium? Make sure these answers are intuitive. **(8 points)**
4. Now suppose instead that the supply for high quality cars was $2P-11$. If you were to solve part 3, you would find that there is no real solution to the quadratic function. What is the equilibrium in this market? Why does the solution change so much? **(8 points)**

2 Regression Discontinuity (30 points)

For policymakers, finding the right level of benefits for a social insurance program like disability insurance is tricky. Low benefits levels will not provide adequate insurance, while high levels of benefits may encourage people to withdraw from the labor market to seek benefits even if they are work-capable.

Denote by $Y_{B,i}$, the potential wage income individual i would earn when receiving disability benefits amount equal to B. You want to find the causal effect of reducing benefit size B_i from B to B' for the participants who were receiving benefit B.

1. **[2 points]** Using the potential outcome notation developed throughout the class, write the causal effect that you are trying to estimate. Call this estimate T^*

2. **[3 points]** One way to estimate T^* is just comparing wage earnings of participants with wages B and B'. That is:
$$T_1 = E\left[Y_i|B_i = B\right] - E\left[Y_i|B_i = B'\right]$$
Why is T_1 unlikely to be an unbiased estimate of T^*?

In Netherlands, a reform in 1993 effectively reduced the benefit of disability insurance received by existing beneficiaries.[1] However, a parliamentary motion made individuals that were aged 45+ years by August 1, 1993 exempt from the effect of the reform (they continued getting the same level of benefits as they would under the old scheme).

3. **[5 points]** Let X_i be the age of the individuals and let Z_i be a dummy variable that is equal to 1 if individual i is above 45 years of age on August 1, 1993. Supposed you wanted to use Z_i as an instrument of B_i and estimate
$$T_{IV} = \frac{E\left[Y_i|Z_i = 0\right] - E\left[Y_i|Z_i = 1\right]}{E\left[B_i|Z_i = 0\right] - E\left[B_i|Z_i = 1\right]}$$
What are the identifying assumptions for T_{IV} to be an unbiased estimator of T^*. Are they met in this setting?

4. Consider an alternative strategy. You observe month of birth of each disability participant, and you want to use the discontinuity at 45 years (as of Aug 1, 1993) to estimate the causal effect of interest.

   (a) **[2 points]** Explain the rationale of this regression discontinuity (RD) strategy relative to the IV strategy. Why would you prefer one or the other?

   (b) **[3 points]** What are the identifying assumptions for the RD strategy?

   (c) **[4 points]** Write down the RD estimator using formal causal notation. Note that this expression involves taking limits. You can follow the notation in the lecture note.

   (d) **[4 points]** Using the information in the two panels of Figure 1 below, what is the estimated increase (or decrease) in earnings in 1999 for one dollar reduction in DI benefits? (Note that the point estimates for benefits received and earnings levels are given in the top of each panel. Your task is to construct the Wald estimator. You do not need to calculate a standard error.)

5. **[4 points]** The authors who studied this reform also wanted to look at the effect of DI benefit reduction on income from other social assistance program. They used the same RD strategy to estimate this effect. Their result is shown in Figure 2. Find the RD estimate of a dollar reduction in DI benefits on social assistance income from other sources.

6. **[3 points]** Based on the information above, how many Euros in total transfer benefits would you anticipate the Dutch government would save per Euro reduction in disability benefits?

[1] If you are interested in more details, you can refer to Borghans, Gielen and Luttmer (2014) article: http://pubs.aeaweb.org/doi/pdfplus/10.1257/pol.6.4.34

Figure 1: RD estimates of DI Benefit and Earnings

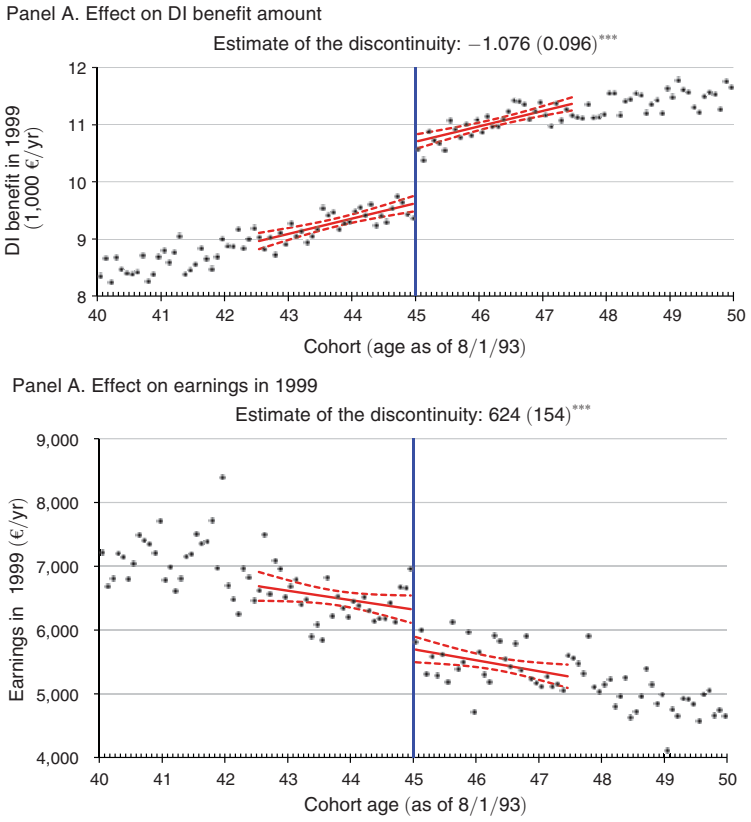
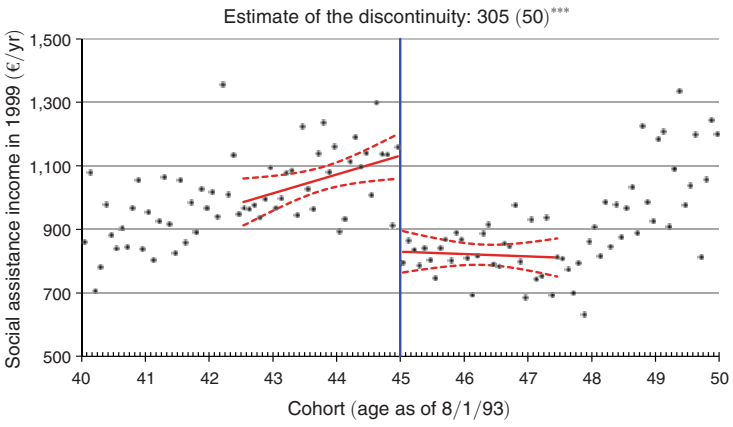


Figure 2: RD estimates of other social assistance program



3 Signaling Spontaneity [30 points]

Robin would like a spontaneous boyfriend. Men have a level of spontaneity (known to them) s_i distributed uniformly on interval $[0, 1]$. Robin doesn't observe spontaneity directly, but knows its distribution in the population. You can imagine that $s_i = 1$ corresponds to the type of person who would take you to Paris out of the blue, whereas a person with $s_i = 0$ wouldn't even take you to Somerville with less than 3 weeks' notice.

Robin goes on dates to a restaurant "Carmichaels" with randomly chosen men from the zero-one interval. Unfortunately, men cannot reveal that they are spontaneous since talk is cheap.[2] That said, these potential partners *can* take a costly action that may signal that they are spontaneous: they can choose whether or not to steal the blue French horn that hangs on the restaurant wall, and give it to Robin.[3] Stealing the French horn costs $1 - s_i^2$ for a person with level of spontaneity s_i (i.e. the action is costless for those with $s_i = 1$ who would go to Paris on a whim).

Robin decides which dates to accept as boyfriends [she can have more than one]. She gets utility $4s_i - 3$ from accepting a person with spontaneity s_i, and zero from not accepting. All candidates want to be Robin's boyfriend, which gives them utility $\frac{2}{3}$.

1. Find a separating equilibrium, i.e. an equilibrium where some dates steal the blue French horn and others don't bother. You should take the following steps to solve the problem: **(12 points)**

   (a) Find which potential partners will steal the blue French horn if only those that steal it become Robin's boyfriends.

   (b) Determine which people Robin will accept as a function of her beliefs about their level of spontaneity (assuming again that only those who steal the French horn are eligible).

   (c) Confirm that if potential partners act according to (a), then Robin will indeed accept them if and only if they steal the blue French horn.

2. Suppose Robin can only go on one date, with a randomly chosen man from the zero-one interval. What is Robin's expected utility of the date given this separating equilibrium? **(5 points)**

3. The company Spontaneous Combustion, Inc. has developed a clever app that reveals a potential partner's exact level of spontaneity by scanning the iris of the person. The company sells use of the app for price p per person tested [assume that all utilities are measured in money, so buying the test also costs p units of utility]. What is the maximum price Robin would be willing to pay for use of the app? [You can again consider that she goes on only one date.] **(6 points)**

4. Now find a pooling equilibrium. What expected utility does Robin get per date? Is this less or more than in the separating equilibrium without the app? **(7 points)**

[2] I recently heard a guy in a coffee shop tell his date the words "I am actually a very spontaneous person". I thought that this would be meaningless since anyone can say that, spontaneous or not. But it does seem that the rest of the date went pretty well.

[3] https://www.youtube.com/watch?v=FDHi-Qe0DR0

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