14.03/14.003 Exam 1

Fall 2014

Professor David Autor

Wednesday, 10/01/2014

Instructions

- Please do not open this exam until directed
- There are 80 points on this exam and you have 80 minutes to complete it.
- You may not use a calculator (there is no need for it).
- No other reference material is allowed.
- There are 3 parts to the exam: please use a separate exam book for each part.
- Correct answers without explanation do not receive credit.
- Part I is SHORT ANSWER. Answer 4 problems of 6. (5 points each, 20 points total.) You must explain your answers with one or two sentences or graphs. Correct answers without explanation do not receive credit. *If you answer more than 4 questions, we will only grade the first 4.*
- Part II has 1 long question that you must answer. (30 points)
- Part III has 1 long question that you must answer. (30 points)

Part I

Short Questions (Choose any 4 of 6: 5 points each)

Please answer (True/False/Indeterminate) about the statments in bold (assume the rest of the problem is true) and provide a brief explanation. *Correct answers without explanation will not receive credit.*

1. You learn that at the same time as the minimum wage was increased in New Jersey, the U.S. Congress passed a nationwide law that lowered food safety standards for fast food restaurants. **The existence of this legislation invalidates the causal inference strategy used by Card and Krueger.**

2. A researcher is testing whether a new health plan improves health. She selects 200 U.S. cities, and randomly assigns half of these cities to the treatment group and half to the control group. She advertises the health plan in the 100 treatment cities. For adults who sign up for the plan, she measures their health at the beginning and end of the calendar year. In the control cities, she randomly selects an equally-sized sample of adults and measures their health at the beginning and end of the calendar year. **A Difference-in-Difference design would provide a valid estimate of the causal effect of the health plan on participating adults in the 100 treatment cities.**

3. The aggregate elasticity of labor supply to fast food restaurants in the state of Georgia is 0.50, meaning that a 10 percent increase in fast food wages would increase the supply of fast food workers by 5 percent. **This elasticity is consistent with a perfectly competitive labor market for fast food workers in Georgia.**

4. Sergio consumes food and alcohol and has income of $50. If he receives $50 of food stamps, Sergio spends $50 on food and $50 on alcohol. With an unrestricted $50 gift, Sergio spends $30 on food and $70 on alcohol. **The deadweight loss associated with food stamps is equal to $20.**

5. Lily consumes burritos and salads and has standard consumer preferences. Each day, she spends $10 on $1 burritos. In an effort to promote healthy eating, the city of Cambridge increases the price of burritos to $1.1, but also gives $1 to Lily every day to compensate her loss. **This policy will decrease the number of burritos Lily eats.**

6. In Hunan province, households spend all of their income on two goods: Rice and Pork. For some very poor households, rice is a Giffen good. **For the households for whom Rice is a Giffen good, an increase in *either* the price of Rice *or* the price of Pork will strictly increase consumption of Rice.**

Part II

Long Question 1: Consumer Theory

Matt divides his time between grading 14.03 problem sets and research. Since there are only T hours in Matt's day, he is subject to constraint

$$x + y \leq T$$

where x is hours on grading problem sets and y is hours on research. He has some utility $u(x, y)$ and splits his time 50-50 between grading and research at the optimum (i.e. $x^* = y^* = \frac{T}{2}$).

1. **What utility function satisfying all five axioms of consumer theory could result in this behavior?** [there are many possible functions, pick one]

   Suppose instead that Matt has utility $u(x, y) = x + \sqrt{y}$ and that Matt's friend, Donghee, built a form of time machine. For every hour of problem set writing the time machine gives $1 - p_x$ additional hours of time. For every hour of research the time machine gives $1 - p_y$ additional hours of time, with $p_x, p_y < 1$. It follows that Matt faces new time constraint

   $$x + y \leq T + (1 - p_x)\, x + (1 - p_y)\, y$$

2. **Write the utility maximization problem and find Marshallian demands for x and y. Show that time on research (y) does not depend on T. [You may assume that Matt is at an interior solution where he consumes both x and y.] Can you provide any intuition for why time on research (y) does not depend on T?**

3. **Write the expenditure minimization problem (you do *not* need to solve it). Explain in words what the expenditure minimization problem is. What does it mean to minimize expenditure in this context?**

4. Matt's boss Rotua Divad broke the time machine (as punishment for not writing exam questions on time) so it can't be used anymore. **What are Matt's demands for y and x now?**

5. Matt's nephew William is interested in buying Matt's time machine. William's preferences follow the five axioms of consumer theory. At William's existing consumption bundle, Time machines are Giffen goods. He has Hicksian demand $h_t(p_t, p_z, U_0)$ and Marshallian demand $d_t(p_t, p_z, I)$ for time machines where p_t is the price of time machines, p_z is the price of all other goods and I is income. **What is the sign of $\frac{\delta h_t}{\delta p_t}$? What is the sign of $\frac{\delta d_t}{\delta p_t}$?**

6. William's close friend Miss Meager does not consume any time machines. **Can time machines be a Giffen good from her point of view? Explain using the Slutsky equation.**

Part III

Long Question 2: Causal Inference

Malaria is one of the biggest killer of infants in Sub-Saharan Africa. In Kenya, insecticide treated bednets are sold at prenatal clinics where pregnant women come for medical checkups. Bednets are often sold at subsidized prices. You conduct an experiment to measure the causal effect of the price of bednets on consumption (purchases) of bednets. You choose 100 clinics to participate in this experiment and randomly select 50 to receive a price subsidy. They sell the bednets at price $p = p_L$. The remaining 50 clinics continue selling the bednets at the prevailing price $p = p_H$. (Note that because of the subsidy $p_L < p_H$).

Let $X_i = 1$ represent the clinics that were chosen to receive the subsidy and $X_i = 0$ represent the clinics that were not chosen to receive the subsidy. Let Y_i represent the total sales of bednets in clinic i. The sales data are collected 6 months after the subsidy is rolled out.

1. **Using the notation of the Rubin Causal Model framework, write the expression for the causal effect of the subsidy on bednet sales in clinic i. Call this T_i^*. Explain why you cannot compute T_i^*.**

2. Instead, you choose to estimate $T^* = E\left[T_i^* | X_i = 1\right]$. Using the data collected, you estimate

$$T_1 = E\left[Y_i | X_i = 1\right] - E\left[Y_i | X_i = 0\right]$$

   What is T^* called? Show mathematically what assumption(s) you need to make in order to interpret T_1 as the causal effect. Is the assumption likely to be satisfied in this context? Explain.

3. A government official in Kenya objects, "You did not collect baseline data on sales in each village prior to your price subsidy. Why do you assume that any difference in bed net sales in the treatment relative to the control villages is due to the subsidy?" **How would you answer this official?**

4. Suppose that instead of random assignment, the clinics located in the most malaria-ridden parts of Kenya were provided with the subsidy. You proceeded to compute similar estimate as above. Call this estimate T_2. **Why is T_2 likely to be biased? Do you think this source of bias will lead to an overestimate of the causal effect ($T_2 > T^*$) or an underestimate of the causal effect, ($T_2 < T^*$). Explain.**

Continue to assume that you have random assignment. But instead of just one level of subsidy as described above (that reduces price to $p = p_L$), suppose you had given different levels of subsidies to the different clinics. For example, among the 50 clinics in the control group, 10 were randomly selected for a 40% subsidy, 10 for a 50% subsidy, 10 for a 60% subsidy, etc.

5. **Using the data from this experiment, you find the following relationship between randomly allocated prices p and the sale of bednets**

$$\ln(Bednets) = \quad -0.51 \cdot \ln(p)$$

This equation represents a demand curve. (Note that is a constant.) Which demand curve is it? Interpret the coefficient -0.51.

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