14.03 Exam 1 Fall 2009
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:

- Correct answers without explanation do not receive credit.

  1. Part I is SHORT ANSWER. **Answer 5 problems of 6.** (4 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 5 questions, we will only grade the first 5.*

  2. Part II has 1 long question that you **must** answer. (30 points)

  3. Part III has 1 long question that you **must** answer. (30 points)

Part I. True, false, uncertain – and explain why (Answer 5 of 6; 20 points)

1. [4 points] Diane receives $100 a month in food stamps, which she spends on food. Diane eats only $60 of food per month and throws the other $40 of food away. (She would never break the law by selling her extra stamps on the underground market.) An upper bound on the deadweight loss of giving Diane $100 food stamps rather than $100 in cash is $40 per month.

2. [4 points] A consumer with convex, 'well-behaved' indifference curves is indifferent between two bundles of X and Y: (1,4) and (9,2). She therefore prefers the bundle (4,3) to either of the first two.

3. [4 points] Hawaii has a high minimum wage, currently set at $7.25 per hour. Employers in Hawaii have monopsony power in the labor market. Lowering the minimum wage in Hawaii will *reduce* Hawaiian employment.

4. [4 points] Anton spends his entire income on Russian salad and vodka. Vodka is a Giffen good. If the price of vodka rises and the price of Russian salad remains constant, Anton's demand for Russian salad must fall.

5. [4 points] David was maximizing his utility subject to his budget constraint. Then prices changed, but his income stayed fixed. After the price change, he chose a new bundle, and he found himself better off. Therefore the new bundle costs more at the new prices than the old bundle does at the new prices.

6. [4 points] There is only one good that gives Ben utility: pizza. Ben's compensated and uncompensated demand curves for pizza are identical.

Part II. Consumer Theory (required question; 30 points)

Consider a consumer with indirect utility function

$$V(p_x, p_y, I) = \frac{I^2}{p_x p_y}$$

where p_x and p_y are the prices of goods x and y and I is the consumer's income. [Note: If you get stuck on an early part and need that answer to do a later part, just try to show how you would answer the later part if you had the necessary information.]

1. [6 points] Find the consumer's expenditure function, $E(p_x, p_y, U)$.

2. [6 points] What are the consumer's Hicksian (compensated) demand functions $h_x(p_x, p_y, U)$ and $h_y(p_x, p_y, U)$?

3. [6 points] What are the consumer's Marshallian (uncompensated) demand functions $d_x(p_x, p_y, I)$ and $d_y(p_x, p_y, I)$?

4. [6 points] What is the underlying utility function $U(x, y)$ for this indirect utility function? (hint: you can either derive the underlying utility function $U(x, y)$ directly or guess the underlying utility function $U(x, y)$ and verify that the indirect utility function is given by $V(p_x, p_y, I) = \frac{I^2}{p_x p_y}$ for this underlying utility function $U(x, y)$.)

5. [6 points] Does the indirect utility function $V^1(p_x, p_y, I) = \frac{I^3}{p_x p_y^2}$ correspond to the same underlying preference relation on consumption bundles? Does the indirect utility function $V^2(p_x, p_y, I) = 2\frac{I + \sqrt{p_x p_y}}{\sqrt{p_x p_y}}$ correspond to the same underlying preference relation on consumption bundles? (hint: the same preference relation on consumption bundles (x, y) can be represented by different utility functions $U(x, y)$.)

Part III. Causal Inference (required; 30 points)

President Hockfield is concerned that some MIT students are not buying their required class textbooks (to save money). She proposes a textbook discount program (TDP), which works as follows: For every $1 a MIT student spends on textbooks in a semester, MIT reimburses $0.50, up to a limit of $300 in cash per semester. *For purposes of this problem, assume that textbooks are a normal good.*

1. [5 points] Draw a carefully labelled diagram showing the budget set of MIT students both with and without TDP. Be sure to show how TDP affects both the monetary trade-off between textbooks and other goods and the shape of the feasible budget set.

Let Y_1 equal the average textbook spending of all MIT students *if* they were receiving TDP. Let Y_0 equal the average textbook spending of all MIT students *if* there were not receiving TDP. Y_1 and Y_0 are counterfactuals of one another. The causal effect of TDP on MIT student textbook spending is therefore:

$$T^* = E[Y_1] - E[Y_0].$$

T^* can never be observed; it can only be estimated.

2. [5 points] To estimate T^*, President Hockfield's chief economic advisor, Dr. Deborah Discount, conducts an experiment. She chooses 100 MIT undergrads who did not buy all of their assigned textbooks in the fall semester. Call this group 1. She chooses another 100 MIT undergrads at random. Call this group 0. In the spring semester, group 1 receives TDP (as above). Group 0 receives no treatment. Dr. Discount tracks textbook spending over the spring semester. Dr. Discount calculates:

$$\hat{T}_1 = \hat{E}[Y|G = 1] - \hat{E}[Y|G = 0]$$

equal to the difference in average textbook spending between the two groups ($\hat{E}[\cdot|G = 1]$ denotes the average over group 1, and $\hat{E}[\cdot|G = 0]$ denotes the average over group 0). State formally the conditions under which $\hat{T}_1$ provides an unbiased estimate of the causal effect of TDP on textbook spending. Do you expect $\hat{T}_1$ to be unbiased? If not, how do you expect $\hat{T}_1$ to compare to T^* (smaller, larger, or indeterminate), and why?

3. [5 points] President Hockfeld hires you to design an alternative experiment to obtain an unbiased estimate of T^*. Describe your experimental procedure, state your formal assumptions, and explain how you would calculate your estimate, which we will refer to as $\hat{T}_2$.

President Hockfield would like to understand why TDP has the causal effect $(\hat{T}_2)$ that you found above. She proposes the following 'cash-out' experiment:

- Select 200 MIT students at random.

- Assign 100 to the control group, and 100 to the cash-out treatment group.

- For both groups, measure $Y_{i,t0}$, equal to the textbook spending of each student in the fall semester (prior to the experiment).

- In the spring semester, give each *treatment* group member a cash payment equal to one-half of their textbook spending in the fall semester up to $300. So, the cash payment for student i is

$$C_i = \begin{cases} 0.50 \times Y_{i,t0} & \text{if} \quad 0.50 \times Y_{i,t0} \leq 300 \\ 300 & \text{if} \quad 0.50 \times Y_{i,t0} > 300 \end{cases}$$

(Assume that treatment group students do not know when buying textbooks in the fall that they will receive cash in spring.)

- Give no payment to the control group.

- Measure $Y_{i,t1}$, equal to the textbook spending of each student (treatment and control) in the spring semester.

- Calculate the following treatment effect

$$\hat{T}_3 = \hat{E}\left[Y_{t1}|C = 1\right] - \hat{E}\left[Y_{t1}|C = 0\right].$$

Thus, $\hat{T}_3$ is the difference in textbook spending between the cash-out and control students in the spring semester.

4. [5 points] Based on your knowledge of consumer theory, how would you expect to $\hat{T}_3$ to compare $\hat{T}_2$ (smaller, larger, same, or indeterminate), and why? How would you expect $\hat{T}_3$ to compare to T^* (smaller, larger, same, or indeterminate), and why?

Please state whether each of the following claims made by Dr. Discount is true, false, indeterminate, and why. You will want to refer to your diagram in (1) to answer these questions.

5. [5 points] Students who do not use the entire $300 TDP credit (that is, they buy less than $600 in books) would spend the same amount of money on textbooks if MIT gave them an equivalent amount of cash instead. [For example, a student who spends $400 on textbooks receives $200 from TDP. The claim is that this student would have spent $400 on textbooks if MIT had instead given her $200 in cash.]

6. [5 points] Students who spend exactly $600 on textbooks under TDP (so their TDP payment is $300) would have been at least weakly better off if they had instead received $300 in cash.

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