14.03 Exam 1 Fall 2004
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 use a calculator.
- No other reference material is allowed.
- There are 2 parts to the exam:

    1. Part I is TRUE-FALSE-UNCERTAIN AND WHY. **Answer 4 of 6 problems.** (5 points each, 20 points total) You must explain your answers with one or two sentences or graphs. *Answers without explanations will not receive credit.*
    2. Part II has 3 long questions. **Answer 2 of 3 problems.** (30 points each, 60 points total)

(You will **not** receive extra credit for doing extra problems in either section.)

1 True, false, uncertain – and explain why [Answer 4 of 6]

[20 points total – No credit without a valid explanation]

1. [5 points] Utility function U is a monotonic transformation of utility function V. Therefore the expenditure function $E(p, U)$ is a monotonic transformation of the expenditure function $E(p, V)$.

2. [5 points] The introduction of a binding minimum wage produces a shift upward of the marginal cost of labor curve for a monopsonistic employer firm.

3. [5 points] Claudia prefers hamburgers to pizza, and pizza to hot dogs. On Monday, she goes to the Kendall Hot Dog, Pizza and Burger Café to buy a hamburger. The Café is out of hamburgers but they have pizza and hot dogs. Claudia buys a hot dog. Her behavior violates the transitivity property of preferences.

4. [5 points] CNN wants to evaluate the effect of the Bush-Kerry debate on voter preferences. The week before the debate, it polls 1,000 randomly selected voters about which candidate they prefer (Bush or Kerry). The week after the debate, it polls these same 1,000 individuals (all of whom have watched the debate) to ask which candidate they prefer now (Bush or Kerry). CNN calculates the change in voter preferences for Bush (or Kerry), e.g., no change, switched to Kerry, switched to Bush. The change in voter preference for Bush (or Kerry) is a valid estimate of the causal effect of the debate on voter preferences.

5. [5 points] There is only one good that gives George Bush utility: cowboy hats. George Bush's compensated and uncompensated demand curves for cowboy hats are identical.

6. [5 points] Consumer Popeye eats 4 pounds of spinach per day at a price of \$1/pound. When the price rises to \$1.25/pound, his neighbor feels sorry for him and gives him an extra dollar per day as compensation. Popeye is exactly as well off as before.

2 The expenditure function [30 points] [1 of 3 long questions – please answer 2 of them]

A consumer has compensated demand functions of the form

$$\begin{aligned} h_x(p_x, p_y, U) &= \alpha(\frac{p_x}{p_y})^{\alpha-1}U \\ h_y(p_x, p_y, U) &= (1-\alpha)(\frac{p_x}{p_y})^{\alpha}U \end{aligned}$$

where p_x and p_y are the prices of goods x and y and U is the consumer's utility. [Note: If you get stuck on an early part and need the 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. [8 points] Use the expenditure function to find the consumer's indirect utility function, $V(p_x, p_y, M)$, where M is income. [Hint: This uses an identity. How much income M does the consumer need to attain the utility level U in the expenditure function from Part 1?]

3. [8 points] Use the indirect utility function to find the consumer's uncompensated demand for x, $x(p_x, p_y, M)$. [Hint: There are two ways to do this. One way uses the fact that uncompensated and compensated demands are equal at the same prices. The other way uses Roy's identity, which was in the lecture notes but wasn't discussed in class.]

4. [8 points] Now come full circle. Find:
$$\frac{\partial h_x(p_x, p_y, U)}{\partial p_x}$$
by using the Slutsky equation and your answer to (3). DO NOT simply take derivatives of the compensated demand function directly. If you could not solve (3), please simply show how the derivative of the compensated demand function is related to the derivatives of the uncompensated demand function in general.

3 Movie tickets for free [30 points] [2 of 3 long questions – please answer 2 of them]

Your 14.03 TA has utility over books (B) and movie tickets (M)as follows:

$$U(B, M) = B + \ln M$$

Imagine the price of books and movie tickets is $p_B = p_M = 1$ and the income devoted by the TA to these goods is 4.

1. [6 points] What is the TA's consumption of B and M?

2. [6 points] Imagine that MIT president Hockfield decides to give 2 Coupons to Loews to all TA's. Each Coupon allows the TA to attend one movie for free (2 movies total). Assume that these coupons *cannot* be resold. Draw an indifference plot (in M, B space) that shows the budget set faced by the TA after the coupon transfer and indicate the TA's chosen consumption bundle of Movies, M, and Books, B. What is the marginal utility of consuming the first movie ticket? What is the marginal utility of consuming the second movie ticket? Indicate these two values of marginal utility on the graph you just drew.

3. [6 points] Your TA realizes that Prof. Hockfield could have been more efficient in providing Coupons. The TA makes an appointment with Prof. Hockfield to propose swapping Movie Coupons for Book Coupons. How many Movie Coupons will your TA want to swap? How many Book Coupons will the TA demand in exchange for the Movie Coupons (the TA is worried about efficiency, so she will ask for the *minimum* number of Book Coupons that leaves her as well off)? [Note: Coupons do *not* have to be traded in whole numbers.]

4. [6 points] Show how you would set up the problem to derive the TA's compensated demand for M. Now derive the compensated demand for M. Continue to assume that $P_B = 1$

5. [6 points] Now draw a figure in (p_M, M) space that shows the TA's compensated demand for movie tickets (if you couldn't formally derive it, indicate the shape of the compensated demand function). Finally show in the compensated demand figure the money saved by MIT (for each recipient). Explain why the money saved is a measure of the dead-weight loss of the original policy (i.e., giving 2 Movie Coupons to each TA).

4 Thinking about drinking [30 points] [3 of 3 long questions – please answer 2 of them]

On January 1, 2003, the Cambridge City Council banned smoking in all Cambridge bars. The City Council hires you to estimate the causal effect of the ban on bar sales. They provide you with sales data for 50 randomly chosen Cambridge bars and 50 randomly chosen Somerville bars in 2002 and 2004. *Assume that Somerville continues to allow smoking in bars during the entire time.*

You define the treatment group as "bars in Cambridge" ($X = 1$) and the control group as "bars in Somerville" ($X = 0$). The treatment $X = \{1, 0\}$ is "*smoking is banned.*" Your variable of interest is the expected sales, denoted by $E(S_c)$ at Cambridge bars. You have two periods, $Y = 2002$ and $Y = 2004$. Define T as the causal effect of the ban on Cambridge bar sales.

Let $E(S_i^1|Y)$ equal expected sales for bars in city i in year Y if *treated* (smoking banned). Note that i denotes cities (Cambridge and Somerville). Similarly, let $E(S_i^0|Y)$ equal the expected sales for bars in city i in year Y if *not treated* (smoking not banned).

1. [4 points] Which of the following 8 values do you observe in your study?
   (A) $E(S_c^1|2002)$ (B) $E(S_c^1|2004)$ (C) $E(S_c^0|2002)$ (D) $E(S_c^0|2004)$
   (E) $E(S_s^1|2002)$ (F) $E(S_s^1|2004)$ (G) $E(S_s^0|2002)$ (H) $E(S_s^0|2004)$

2. [4 points] If you *could* observe all 8 values from the previous question, what would be the correct estimate of the causal effect, T, of the smoking ban on sales at Cambridge Bars in 2004?

3. [6 points] Given that you cannot implement your estimator in question 2, consider the following two simple alternatives:

   (a) $E(S_c^1|2004) - E(S_c^0|2002)$
   (b) $E(S_c^1|2004) - E(S_s^0|2004)$

   Under what assumptions will these estimators correctly estimate the causal effect? Discuss the plausibility of those assumptions. Be precise. [Note that a and b do not have the same answer].

4. [4 points] Propose a difference-in-difference estimator to estimate the causal effect, T, of the smoking ban on sales in Cambridge bars. What are the assumptions under which this difference-in-difference estimator will correctly estimate T? [Please use precise notation to the degree possible.]

5. How would each of the following scenarios affect the plausibility of the assumptions for your difference-in-difference estimator in question 4. (Explain rigorously):

   (a) [4 points] On their January 1 2003 meeting, Cambridge Council also banned "Ladies Night" in bars. Assume as before, that Somerville does not prohibit ladies night. ("Ladies night" gives discounted drinks to women. "Ladies Night" promotions are thought to attract female customers – which generally draws more men).
   (b) [4 points] The Somerville Bar Owners association posted billboards throughout Kendall and Harvard Squares saying, "Notice: Smoking is Still Allowed in Somerville Bars."
   (c) [4 points] Since the Internet bust in 2000, many MIT professors have begun drinking heavily. To offset the costs of their drinking habits, many have been moving to Somerville, where rent is cheaper.