14.41 Midterm
October 12, 2005

Please answer the true/false/uncertain questions all in the same blue book, and use a separate blue book for each of the other problems. You have 90 minutes for the exam.

True/False/Uncertain—EXPLAIN
(15 minutes, 5 minutes each; no credit will be awarded without an *explanation*)

1) A town is trying to decide whether to build a community pool. The pool costs $50,000 to construct and operate for the first year, and costs $5,000 for annual maintenance every year into the future (assume these maintenance costs begin next year). The city estimates that every person who visits the pool benefits by $7 per visit. Because it's an unusually hot summer, the city estimates that 5,000 visits will be made in the current year, but only 1,000 people will visit every year into the future. The social discount rate is 10%. Assume that in fact these are all of the costs and benefits that the town cares about. Because the costs exceed benefits, this project should not be undertaken.

2) Peter enjoys really loud music while driving. Because of this, he purchases a very expensive sound system for his car, so that he can really blast his music. Although there are negative externalities from the extreme noise that results, because the sound system was so expensive to purchase Peter internalizes these externalities– and so the outcome is efficient.

3) There is no reason for state or federal subsidization of education, since people who live in areas with low educational spending prefer low taxes over high educational spending.

<u>Problem 1</u>
(15 minutes)

A community in Massachusetts (Lexington) decides to permanently increase its annual spending on education so that its high school graduates are able to earn higher wages. Ten years later, school officials from Lexington ask you to evaluate the effectiveness of the spending increase. Their data shows that before the spending increase, the average annual salary of recent high school graduates was $25,000. Now (ten years after spending increased), the average annual salary of recent high school graduates is $28,500. Fortunately for your analysis, you also have similar information for a neighboring community (Concord). Ten years ago, recent Concord high school graduates earned an average of $22,500. Now, the average annual salary of recent Concord high school graduates is $23,750.

1) Use a difference-in-difference estimator to determine the effect of Lexington's spending increase on the wages of high school graduates.

2) What underlying assumption do you have to make in order for your estimate to be a valid causal inference of the effects of increased educational spending? What might cause the underlying assumption to be violated? How might you test the underlying assumption?

3) Assuming that this calculation is indeed a proper causal estimate of the effects of increased spending, is this evidence in favor of the human capital or the screening model of the returns to education? Why is this evidence in favor of one and not the other?

Four individuals have identical preferences over two goods: libraries and cigarettes. Each person has an income of 200, and his preferences are represented by the following utility function:

$$U_i = 9\ln C_i + \ln L$$

Here, C_i represents the level of the ith individual's spending on cigarettes, and L represents the level of public spending on libraries.

1) What is the socially optimal level of spending on libraries?

2) Instead, suppose that each person is in fact harmed by the cigarette smoking of all other people. For instance, person 1's utility function now has the following form:

$$U_1 = 9\ln C_1 + \ln L - \sum_{j=2}^{4} \frac{1}{4}\ln C_j$$

The utility functions of person 2, 3, and 4 naturally take a similar form (they're each harmed by the cigarette consumption of the others). Assuming that each person is taxed equally, how will the socially efficient level of libraries differ from (1), and why? There is no need to solve for the actual socially efficient level – just describe how it will compare to (1) (i.e. is it greater than, less than, or equal to the level in (1), and why).

3) Now, suppose again that there are no externalities from cigarette smoking, and some residents move in while others move out. Person 2, 3, and 4 leave town, and two new people enter. Person 5 really likes libraries, while person 6 prefers cigarettes, and they each have an income of 200. Their utility functions are:

$$U_5 = \ln C_5 + 99\ln L, \quad U_6 = 10\ln C_6 + \ln L$$

Assume each person will be taxed equally (lump sum) for the provision of the public good. Consider what happens if the three individuals vote on the level of the lump sum tax used to finance the public good. Will majority voting result in a consistent outcome? If so, why - and what level of tax will emerge from a majority vote? If not, why won't a consistent outcome emerge?

4) Is the amount of public spending on libraries that emerges from the voting process in (3) the socially optimal level? Why or why not? If it isn't, is it greater than or less than the socially optimal level? Explain your reasoning.

<u>Problem 3</u>
(30 minutes)

Asbestos products were used in various construction materials through most of the 20th century. During the 1970s, studies began to appear linking asbestos exposure to various lung diseases, including cancer. Those exposed are generally workers who are involved in construction or renovation of buildings that contain asbestos. Asbestos exposure does not always result in premature death, but is often debilitating.

1) Assuming that workers understand the full health risks from asbestos, are there externalities related to the use of asbestos? If so, what are they?

2) You have data from 1985 (after the dangers of asbestos were well known) and observe that workers in jobs with asbestos exposure faced an 0.02 chance of death from asbestos exposure and made on average $100,000 more during their lifetimes than their counterparts in industries with no exposure (you can assume no discounting). How can you use these facts to estimate the value of life for these workers - and what is your estimate? What are some reasons why this estimate might not be their true valuation of life?

Cleaning up asbestos in certain industrial sites will cost a total of $4X^2$, where X represents each unit of abatement. The total benefits of abatement (assuming you know all of them) are $100X-X^2$.

3) Graph the marginal cost and marginal benefit curves, and identify the optimal level of abatement on the graph. What is this optimal level of abatement? What assumptions are necessary for the private market to reach this level of abatement?

4) The government decides that because tradable permits are in fashion it would like to use these to reduce asbestos in industrial sites. Is asbestos abatement a good venue for tradable permits? Explain.

5) Your colleague is studying the effects of asbestos exposure on lung cancer. She calculates that workers in industries that used asbestos have a 40% higher cancer risk than workers in other industries. She claims that this presents proof that asbestos results in a 40% increase in the risk of lung cancer. Explain the assumptions necessary for her claim to be valid. Are these assumptions likely to hold? Why or why not?