14.41 Midterm
October 13, 2004

True/False/Uncertain—EXPLAIN
(25 minutes, 5 minutes each; 95% of credit is based on your explanation; limit yourself to one page per part.)

1) If research shows that the increased health costs caused by smoking are exactly offset by decreased Social Security benefits due to the early deaths of smokers, then the optimal tax on cigarettes is zero.

2) In Eden, Eve does the fishing and Adam makes the clothes—they then barter clothes for fish. Adam dumps dye into the lake, which lowers Eve's fishing yield. There is no need for a higher power to intervene to address Adam's negative externality on Eve.

3) "Deficits don't matter."—Vice President Dick Cheney

4) Research shows that the children of single mothers who work perform better in school than the children of single mothers who don't work. Therefore, the government should decrease welfare benefits.

5) If research shows that the marginal social benefit of education in Sudan is $200 and can be captured entirely by the Sudanese people, then there is no need for international subsidization of Sudanese education—the Sudanese government will provide education until its marginal cost exceeds $200.

Problem 1
(25 minutes)

In Old Smoky, there is a factory that produces fumes that cause deaths among the town's population. The town hires you to determine what it should do about the fumes.

a) Should the town do anything? Explain why or why not, stating any assumptions clearly.

b) Regardless of what you said in part a), you are being paid to come up with policy, and your first task is to determine the valuation of life among Old Smoky's residents. You are told that all residents have identical preferences about job risk, and that there are two different jobs in Old Smoky: teaching, which pays $30,000 per year; and firefighting, which has a 0.2% higher chance of death per year than teaching and pays $50,000 per year. The residents are completely aware of the difference in risk of death. Solve for their valuation of a life.

c) A reduction of 1 million pounds of fumes would result in one fewer death per year among the town's population.
Draw the marginal social benefit of fume abatement, with pounds abated on the X-axis and benefit in dollars on the Y-axis.
If there is uncertainty about the cost of abatement faced by the factory, is quantity or price regulation a better policy? Explain.

d) You learn (with certainty) that the factory's total cost of abatement per year is

$$TC= X^2$$

where X is the total pounds of fumes abated.
Graph the marginal social cost of abatement.
What would be the optimal quantity regulation? What would be the optimal price regulation?

e) A new machine becomes available that could reduce fumes more efficiently, reducing the factory's cost of abatement to $0.5X^2$. The machine costs $50 million and lasts forever, and the discount rate is 5%.

Assuming that you have implemented optimal price regulation, will the factory choose to purchase the machine?

Problem 2
(30 minutes)

In the schools of Funkytown, students are educated to play music, which they then perform at home for their parents. When more money is spent on the schools, the students learn more songs, and their parents are more entertained. The family utility function for each Funkytown family is:

$$U = 9 \ln (C) + \ln (S)$$

where S is Funkytown's per-student expenditure on schooling and C is the amount of money the family has left over for other consumption after paying the school tax.

a) Although all the families in Funkytown have the same utility function, they have different incomes. 100 families each earn $20,000; 100 families each earn $50,000; and 100 families each earn $80,000.
   How much does each type of family want to spend on schools, assuming there is a lump-sum tax levied on all families?
   If the town votes on the level of the lump-sum tax, what level will win?

b) Lump-sum taxes are declared unconstitutional, and Funkytown must substitute a flat percentage income tax.
   If the town votes on the single income tax rate, what rate will win?
   How will social welfare (the sum of all of the utilities of Funkytown residents) change? Explain.

c) Two new empty towns become available for occupation, for a total of three towns available for residence.
   How will the residents sort themselves?
   What will be the per-student spending in each town?
   How will total social welfare (i.e. efficiency) change? What will happen to the utility of each income group relative to part b)? Explain.

d) The state that governs all three towns decides it wants to increase the amount of schooling students get. It considers three proposals: i) providing matching grants to the towns for each dollar of per-student spending; ii) establishing state-funded schools that spend $6000 per student; iii) providing unconditional grants to each town.
   Compare the effects of the proposals on the level of total education spending in each town.