14.41 Public Economics
Midterm Exam

Each minute of time is worth one point. The exam is worth a total of 90 points.

True, False, Uncertain (25 minutes, 5 minutes each; 95% of credit is based on your explanation)
1. The value of life can be accurately assessed by comparing the difference between wages at jobs with a relatively high probability of death and wages at jobs with no risk of death.
2. In a large river valley, numerous home owners use fertilizer on their lawns. The fertilizer runs off when it rains and eventually ends up in the river, where it lowers fish yields for the river's fishermen. The Coase Theorem suggests that private markets will force the home owners to internalize the externality associated with their use of fertilizer.
3. The best estimate of cigarette externalities is $0.40 per pack. The U.S. government currently taxes cigarettes at $0.80 per pack. Therefore cigarettes are being taxed too heavily.
4. The Department of Education conducts a study showing that those who graduate from college earn, on average, $15,000 more per year than non-college graduates. Clearly college increases human capital.
5. The governor of Idaho is conducting a cost/benefit analysis of a dam building project. The only cost of the project is labor. The project will employ 100 workers for 100 hours at the minimum wage of $8 per hour. 70 of these workers were previously unemployed and value their leisure at $6 per hour. The project will produce a stream of benefits worth $80,000 in present value. Should the project to undertaken? (Do not discount the costs).

Short Essay (10 minutes)

The State Supreme Court of New Hampshire recently declared that the state's school financing system was unconstitutional because it denied educational resources to children living in relatively poor towns. Prior to the ruling, New Hampshire schools were funded almost entirely from local property taxes. In response to the ruling, towns with relatively high property tax bases were forced to make contributions to towns with relatively low property tax bases. What will happen to the efficiency of education in New Hampshire? What will happen to house prices?

Public Goods (25 minutes)

The state of Florida has only two residents, Bob and Gene. Bob and Gene consume only voting machines and oranges. Voting machines are a public good, so Bob and Gene benefit from the total supply of voting machines. Oranges are a private good. The price of a voting machine is 10. The price of an orange is 1. Both Bob and Gene have income of 90. Bob and Gene's utility functions are as follows:

$$U_B = (o_B)^{0.5} + 5V^{0.5}$$

$$U_G = (o_J)^{0.5} + 10V^{0.5}$$

Where o_B and o_G are the number of oranges purchased by Bob and Gene and V is the total number of voting machines in Florida. (Note that $V = v_B + v_G,$ where v_B and v_G are the number of voting machines purchased by Bob and Gene).

Voting machines and oranges may be purchased in non-integer quantities.

a. How many voting machines are provided if the government does not intervene? How many are purchased by Bob? How many are purchased by Gene?
b. What is the socially optimal number of voting machines? How does this compare to the quantity in a.? Why?
c. The Federal government has decided to encourage the residents of Florida to purchase voting machines. *Both* Bob and Gene are given an income transfer of 30 dollars. How many voting machines are provided?
d. Instead of the income transfer in part c., the Federal government subsidizes the purchase of voting machines. The subsidy results in Bob and Gene facing a price of 8 for voting machines. How many voting machines are provided?
e. Which of the plans to encourage the purchase of voting machines is the most cost effective? (If you cannot explicitly solve for the cost of the two plans, you may give a qualitative answer for partial credit.) Why?

Pollution Externalities (30 minutes)
There are two firms, X and Y, which produce industrial strength cleaning supplies. Both
are located along the shores of Lake Michigan and discharge waste into the lake. The
firms operate in a perfectly competitive industry and receive a price of p for each unit of
output W. The private costs of production and the pollution damage resulting from
production are as follows :

	X	Y
Private cost of production	W_x^2	$\frac{1}{2}W_y^2$
Pollution damage	$5W_x$	$3W_y^2$

  Firms can produce non-integer levels of output.

a. What level of output, W, will each firm produce? What is the socially optimal
   output for each firm?
b. The government wishes to implement the social optimum for firm Y using a
   constant per-unit of production tax. What tax should be assessed in order to
   achieve the socially optimal level of production for firm Y?
c. Happy with the results of the tax in part b, the government decided to apply the
   same tax to firm X. What level of output does firm X produce now that it faces
   the tax? Calculate the dead weight loss that exists after the tax is applied to firm
   X. For part c only, assume that p = 7.
d. Now assume that each firm can use a new technology to eliminate the discharge
   associated with a unit of production at the following cost:

	X	Y
Cost of eliminating discharge	W_x^2	$(1/3)w_y^3$

  Assume that p = 20. What is the socially optimal use of the new technology for
  each firm? What is the socially optimal level of output for each firm given the
  introduction of the new technology? In what ways could the government enforce
  the optimal use of the technology? Which one would you prefer?