SUID:

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Take Home Exam 2

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Due at the beginning of class on 4/25.
Do not open this exam until you are ready to begin.

Instructions

1. Please write your answers on regular paper. You do NOT need to type your answers.

2. Write your SUID in the upper right corner. Please do NOT write your name.

3. Please do the exam in one sitting of no more than 3 hours. The time limit is there to keep it from eating up more of your week than it warrants.

4. Show all your work. Answers without supporting work will receive little or no credit.

5. The exam is "open book/open notes": you are welcome to refer to your notes, to the exercises and their answer sheets, or to readings listed on the syllabus.

6. It is NOT "open friend": you must do the exam yourself MAY NOT talk with anyone about it until after the due date.

7. The item above includes your friend Google: you can use materials that you already have on hand but please don't go hunting for more.

8. Using a spreadsheet is OK as long as you attach a printout showing the details of your calculations. However, you should have no problem doing the exam with a calculator.

Question 1: Multiple Source Pollution

A regulator wants to reduce pollution from three firms. Each firm is currently emitting 520 tons for a total of 1560. The marginal costs of abatement for the firms are given below, where each *Q* is the corresponding firm's quantity of abatement:

$$MCA_1 = 2 * Q_1$$
$$MCA_2 = 3 * Q_2$$
$$MCA_3 = 4 * Q_3$$

The marginal benefit of total abatement, Q_T, is given by $MBA = 1000 - Q_T$.

(1) Compute the efficient total amount of abatement and the amount that should be done by each firm. What is the total cost of abatement at this allocation?

(2) Suppose the regulator wishes to use an emissions tax to control the pollutant. What should the tax rate be? What will the total cost of the policy be to each firm, including both abatement costs and tax payments?

(3) Alternatively, suppose the regulator were to use a tradable permit policy. Please design a permit system that would achieve the efficient level of pollution while keeping total compliance costs (including revenue from permit trades) equal across the firms. What would the equilibrium permit price be? How many permits should be initially distributed to each firm?

Real policies often exempt certain sectors or treat them differently for political reasons. Suppose in this case that the regulator imposes a $200 tax on emissions from sector 1 but wants to use a permit system for sources 2 and 3. The regulator wants the complete system (tax on 1, permits for 2 & 3) to achieve the same abatement as in part 1.

(4) How many total emissions permits should be issued? What will the equilibrium price of a permit be? What is the cost of abatement for each of the three firms? What is the total cost of abatement? Please note that you only need to compute abatement costs: you do NOT need to compute transfer payments between firm 1 and the government, or between firms 2 and 3.

(5) How large is the deadweight loss created by this policy? How large is that as a percentage of the minimum cost approach? Give a brief intuitive explanation for why it occurs.

Question 2: Taxes and Permits under Uncertainty

Two sources of a pollutant were recently regulated. Just before regulation each was emitting 1000 pounds of the pollutant (2000 pounds total). The MBA for the pollutant is $40 per pound. At the time of regulation, the sources are believed to be able to abate at the following costs:

$$MCA_1 = (1/20) * Q_1$$
$$MCA_2 = (1/10) * Q_2$$

A permit system was established and each firm was given exactly the number of permits that the regulator expected it to need at the efficient pattern of abatement. (No tweaking to equalize costs.) However, the projected MCA for source 1 turned out to be wrong. The true curve was $MCA_1 = (1/10) * Q_1$.

(1) How many permits were given to each firm when the policy was established and what would the expected price of a permit have been?

(2) What is the efficient total amount of abatement given the true MCA_1?

(3) What will the price of a permit be? How much abatement will actually be done by each source? What will be the value of permit sales, if any, between the firms? What is the deadweight loss due to the policy?

(4) Finally, suppose that a tax had been used instead of a permit policy. What would the tax rate have been given what the regulator believed at the time of regulation? How much abatement would actually be done? What would be the deadweight loss due to the policy?

(5) Briefly explain why the deadweight loss is so different under the two policies.

Question 3: Effects of a Hybrid Policy

A pollutant is currently uncontrolled and 600 tons are being emitted. The marginal benefits and marginal costs of abatement are believed to be the following:

$$MBA = 1000 - Q_a$$
$$MCA_e = 100 + 5 * Q_a$$

(1) Determine the efficient amount of abatement, the efficient amount of pollution, and the marginal cost and marginal benefit of abatement at that point provided that the curves above are correct.

The regulator would like to use a hybrid policy to control the pollutant and establishes a regime with the following features: (a) the initial quantity of permits distributed is equal to the efficient amount of pollution from part 1, and (b) the price of additional permits is set to the expected marginal cost from part 1.

(2) Suppose the actual marginal costs of abatement turn out to be higher than expected: $MCA_h = 160 + 5 * Q_a$. Please determine the equilibrium price of a permit and the number of extra permits purchased from the government, if any.

(3) Finally, now suppose that instead the actual marginal costs of abatement turn out to be lower than expected: $MCA_l = 40 + 5 * Q_a$. Please determine the equilibrium price of a permit and the number of extra permits purchased from the government, if any.

Question 4: Banking and Borrowing

A regulator wishes to control cumulative emissions over three periods (0, 1 and 2) using a tradable permit system with full banking and borrowing. In the absence of the policy, total emissions over the three periods are expected to be 4200. The regulator would like to reduce that to 2100 but with the policy phased in gradually by giving early periods more permits than later periods. Each period's initial emissions, marginal abatement cost curve, and permits allocated under the policy are shown in the table below. Note that the MCA curve is the same across the periods. The interest rate between the periods is 100%.

Period	Initial Emissions	MCA	Allocated Permits
1	1000	$MCA_1 = 1 * Q_1$	800
2	1500	$MCA_2 = 1 * Q_2$	700
3	1700	$MCA_3 = 1 * Q_3$	600
Total	4200		2100

(1) Please compute the outcome that would occur if banking and borrowing were NOT allowed (that is, if each period were constrained to use exactly the number of permits it was allocated). What would the price be in each period? What would each period's total abatement cost be? What would be the present value of abatement costs?

(2) Now determine equilibrium in the permit market when banking and borrowing are allowed. What will the price of a permit be in each period? How many permits will be used in each period? How many will be banked or borrowed (or repaid) in each period? What will each period's abatement costs be? What is the present value of abatement costs?