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Economics 437

The Maxwell School
Syracuse University

Exam 1

Spring 2015

VERSION M

Instructions

1. Write your **SUID NUMBER** on your bluebook and DO NOT write your name.
2. Write the **EXAM VERSION** from the box above on your bluebook.
3. Do not open the exam until you are told to do so.
4. Please turn off the ringer on your phone right now – before the exam begins.
5. If you are wearing a baseball cap, please remove it or turn it backward.
6. **SHOW ALL YOUR WORK**. Numerical answers without supporting work will receive little or no credit and may be presumed to be copied from another exam.
7. You have 80 minutes to work on the exam. There are 80 points possible; please budget your time accordingly. Also note that many of the questions have (a), (b), etc., inserted into the text to help you avoid overlooking part of the answer.
8. Collaboration of any kind on the exam is not allowed. *Use of phones or other wireless devices at any time during the exam will be presumed to be collaboration – so don't do it.* Cheating of any kind will result in an F on the exam and referral of the case to the Dean's office for further sanctions.
9. Calculators *may not* be shared.
10. Some handy formulas:

Present Value: $PV = \frac{B}{(1+r)^t}$ $PV = \frac{B}{r}$

Areas: $\text{Triangle} = \frac{bh}{2}$ $\text{Trapezoid} = \left(\frac{b_1 + b_2}{2}\right)h$

Question 1 (20 points)

Underground injection wells are used to dispose of certain kinds of toxic chemicals. Liquid waste is pumped at high pressure into porous rock deep underground. A similar process is used to dispose of wastewater produced when hydraulic fracturing is used in oil and gas production. However, underground injection can lead to earthquakes.

Suppose underground injection is currently being used in a particular area to dispose of 1000 tons of waste per year. At this rate, it has been determined that injection causes a 0.4% chance each year of a minor earthquake and a 0.2% chance each year of a moderate earthquake. A minor quake causes $10 million of damage and a moderate quake causes $50 million of damage. You may assume that in any given year there is either a minor quake, a moderate quake, or no quake: there will not be both a minor and a moderate quake in a single year.

A government agency is considering two options to reduce the problem. Option T would build a $1 million treatment (T) plant that would cut the amount of injected waste in half and lower the chances of minor and moderate earthquakes to 0.2% and 0.1%. The plant would be paid for in year 0, would begin operating in year 5, and would operate forever. Option M would move the well to a safer geologic location. It would cost $1 million in year 0 (same as T) but would not begin operating until year 9. It would have no effect on the chances of a minor quake (the probability would remain 0.4%) but it would completely eliminate the chance of a moderate quake (the probability goes to 0). You may assume that the existing system will continue to be used until either T or M begins operation.

Using an interest rate of 5%, please determine: (a) the expected NPV of option T; (b) the expected NPV of option M; and (c) indicate which one (or neither) the agency should choose.

Question 2 (20 points)

Consider a good purchased by two types of buyers, X and Y. There 10 type-X buyers and 20 type-Y buyers. The WTP equations for an individual *i* of each type are shown below. The WTA curve for suppliers as a group (that is, the market supply) is also given. In addition, it is known that production of the good creates a negative externality according to the MCext curve shown below.

Type-X individual:	$WTPxi = 1200 – (1/2)*Qxi$
Type-Y individual:	$WTPyi = 600 – (1/4)*Qyi$
Market WTA:	$WTA = Qt/50$
Externality:	$MCext = Qt/100$

Please determine: (a) the market equilibrium price and quantity; (b) the efficient level of total output given the externality; (c) the tax rate that would move the market to the efficient level of output; (d) the change in CS; (e) the change in PS; (f) the total revenue raised by the tax; and (g) the overall gain in social surplus (reduction in DWL) from the policy.

Exam continues on the next page…

Question 3 (20 points)

A city government would like to achieve two goals: (1) reduce an air pollutant associated with production of good D, and (2) repair part of its water treatment plant. Repairing the plant will cost $1 million immediately (in year 0) but the city can only go ahead if it finds a new source of revenue that has an expected PV of at least $1 million or more (so that the combination of the new revenue and spending on the plant has a positive NPV overall). An analyst has suggested imposing an emissions tax on D to generate the needed revenue. The tax would start in year 1 and continue forever. The supply of D is known to be perfectly elastic at MCd = $50 and the cost of the externality is given by MCext = $10. Initially, there is no tax on D, the market is in equilibrium, and 10,000 units of D are being sold. However, the demand elasticity for D is uncertain: there is a 60% chance it is equal to -1 and a 40% chance it is equal to -2.

Please determine: (a) the efficient tax on good D; (b) the amount of revenue that would be raised each year under each of the possible elasticities; (c) the expected amount of revenue the tax will raise each year; (d) the expected present value of the revenue; and (e) explain whether the analyst is right: will the expected revenue be high enough to offset the cost of the plant? You may assume the city uses an interest rate of 5% in PV calculations. You may also assume there's no relationship between the air pollution externality from D and the water treatment plant except for the revenue issue (the plant doesn't clean up the air pollutant).

Question 4 (20 points)

The marginal benefit of reducing a pollutant is given by the curve MBA = 160 – (3/4)*Qat, where Qat is the total amount of abatement. The pollutant is emitted by three firms: 1, 2 and 3. Information about their initial emissions and MCA curves is given in the table below:

Firm	Initial Emissions	MCA Curve
1	300	MCA1 = 2*Qa1
2	200	MCA2 = 5*Qa2
3	100	MCA3 = 10*Qa3

Using the information above, please calculate: (a) the efficient total abatement and the marginal cost of abatement at that point; (b) the efficient abatement by each firm; and (c) the total cost of abatement to each firm. Then design a tradable permit system that will achieve the efficient amount of abatement while shifting the total compliance cost to firm 3 and indicate: (d) the equilibrium price of a permit; and (e) the number of permits that should be distributed to each source. Finally, please calculate: (f) the overall gain in social surplus produced by the policy.