

**Environmental Economics and Policy (Econ 231-01)**  
**Homework 1: Due Tuesday, September 21**  
**60 points**  
**Label and explain all graphs**

**1. (10 points)** Robert and Jimmy live in a region whose air is polluted. Both would like to have some pollution abatement, depending upon the price of that abatement. Robert's demand for air quality can be represented by the equation  $Q_R = 4 - 2P$ . Jimmy's demand for air quality can be represented by the equation  $Q_J = 2 - P$ . The supply of air quality can be represented by the equation  $Q = P$ .

- a. Graph Robert's and Jimmy's demands for air quality, the aggregate demand for air quality, and the supply of air quality. What is the socially efficient amount and price of air quality?
- b. Under what conditions would the socially optimal air quality be equal to zero? Explain in math and in words.

**2. (10 points)** Find one example of a negative externality and one of a public good (or bad) on Macalester's campus (you may not use any examples I give in class), and explain why you have identified them as such. Why aren't your externalities public goods (or bads)?

**3. (15 points)** Consider the market for paper products. This market is perfectly competitive, and the production of paper results in externalities in the form of water pollution from paper mills. This market can be characterized by the following equations (where  $Q$  is expressed in thousands of reams):

$$\begin{array}{ll} \text{Supply:} & P = 20 + 1.5Q \\ \text{Demand:} & P = 40 - 0.5Q \\ \text{Marginal External Cost:} & 0.75Q \end{array}$$

- a. Graph and solve for the competitive market's equilibrium price and quantity of paper.
- b. Graph and solve for the socially optimal price and quantity of paper.
- c. What are the social welfare gains from internalizing the externality (indicate the area on the graph and solve for the actual number)?

#### 4. Sustainability (15 points)

Consider the problem of optimally allocating the water from Mexico City's aquifer across generations. For simplicity's sake, you may assume that there are only two generations: one that lives this year, and another that will live next year (you can assume this because you know that the results can be easily generalized to consider more generations). You have the following information:

The demand for water in both periods can be represented by the equation:  
 $P = 15 - 0.5Q_i$ , where  $Q_i$  is the quantity of water in each period ( $i = 1, 2$ ).

The supply of water is equal to 30 units. For the math in this problem, you may assume that the rate of aquifer recharge (the rate at which it refills) is negligible.

The marginal cost of extraction is constant, and it equals \$1 per unit.

The real interest rate is equal to 3%.

- a. Solve for the efficient allocation of water between the two periods, and depict the solution on a graph.
- b. How would the solution to this problem change if the rate of aquifer recharge is significant? Redraw your graph from part (a) and then use it to explain the answer to this subquestion.
- c. Drawing down the water from Mexico City's aquifer causes buildings to sink ("subside"), which imposes costs on the city and its residents (see an article about the subsidence at [http://www.geotimes.org/july01/sinking\\_titanic\\_city.html](http://www.geotimes.org/july01/sinking_titanic_city.html) and some other pictures of subsidence at <http://ga.water.usgs.gov/edu/earthgwlandsubside.html>). How would the solution to this problem change if you were to factor in these costs? Assuming that aquifer recharge is zero, redraw your graph from part (a) and then use it to explain the answer to this subquestion.

#### 5. Important Websites (10 points)

Visit the Environmental Protection Agency's website at <http://www.epa.gov> to answer the following:

- a. On what issues does the EPA appear to be focusing? Do these areas of focus suggest a preference for a particular approach to pollution control?
- b. How is the air quality today in St. Paul? (Tell me what date's data you looked at.) How is it in Houston and in Los Angeles? If the air quality is not "Good", what pollutants are at moderate or high levels in those cities? How do these pollutants affect human health?