14.41 Problem Set #1
Due 10/1/04

Note: In mathematical problems, 50% of credit will be given for correctly laying out how to solve the problem; the other 50% will be given for correctly solving the problem.

(1) The newly elected president of an island nation has pledged to reduce air pollution. The nation has no close neighbors – the only source of air pollution are the two domestic chemical plants run by firm A and firm B. Firm A has been in operation for 50 years and has a pollution abatement (i.e. reduction) cost of x^3, where x is a unit of pollution. Firm B, which operates a 6-month old plant, has a pollution abatement cost of x^2. Assume that neither firm is initially engaging in pollution abatement. The per unit benefit to a unit of pollution abatement experienced by the island's citizens is constant at $300.

    a. What is the socially optimal level of pollution abatement? How is the socially optimal level of abatement split between the two firms?

    b. The president considers engaging in command-and-control style quantity regulation and declares that each firm must engage in 80 units of pollution abatement. Is this socially optimal? Why or why not?

    c. Alternatively, the president considers providing a subsidy of $300 per unit of pollution abatement. What is the per firm and total level of pollution abatement? Is this socially optimal?

The president also considers issuing pollution permits and establishing a market for these permits. For reasons associated with the relative generosity of the firms to his recent election campaign, firm A is given permits such that it must engage in 100 units of pollution abatement if it fails to enter the permit market. Firm B is given permits such that it must engage in 60 units of pollution abatement if it fails to enter the market. Each permit allows the firm holding it to engage in one unit of pollution. Assume the market for pollution permits is perfectly competitive. Also assume that no firm may increase the amount of pollution it is engaged in (i.e. negative abatement is not allowed). This assumption restricts firm A to buying 100 or fewer permits and firm B to buying 60 or fewer permits.[1] What is the market clearing price for pollution permits? What level of pollution abatement does each firm engage in? Is this socially optimal? How does the level of abatement compare here with part c? Dropping the perfect competition assumption, what problems are likely to arise in practice in the permit market?

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[1] Mathematically, this problem has 2 solutions, one of which is nonsensical in the context of the problem. This assumption rules out the nonsensical solution.

2)   The new Bjork album was just released, and Joe is very excited. His utility is increasing in the volume x at which he plays the CD:

$$U_{Joe} = 10\ x^{1/2}$$

The maximum volume on his stereo, unfortunately for Joe, is 100.

Joe's neighbor Maria hates Bjork, and is bothered when she can hear it. Her utility is decreasing in the volume at which Joe plays the CD:
$$U_{Maria} = 100\text{-}x$$

a. What is Joe's private marginal benefit (PMB) of volume? His private marginal cost (PMC)? What is the social marginal benefit (SMB)? The social marginal cost (SMC?) What volume does he choose, assuming it is his right to do so?

b. Maria and Joe both like Outkast, and Maria happens to have in her possession several Outkast t-shirts, each of which both she and Joe value at 25. If she and Joe strike up a conversation and decide to trade volume for t-shirts, what volume will they agree on? Is this the socially optimal volume, i.e. does the Coase Theorem apply here? Explain. How many t-shirts would Maria be willing to give Joe to achieve that volume? How many t-shirts would Joe require?

c. Just after Joe has turned down the volume, Jerome moves into the previously empty apartment on the other side of Joe. His utility is also decreasing in the volume at which Joe plays the CD—in fact, even more so than Maria because he both hates Bjork and really needs to study:
$$U_{Jerome} = 100\text{-}2x$$

What is the new SMC of volume?
Jerome, who also likes Outkast, has in his possession a stack of Outkast stickers, each of which both he and Joe value at 0.25. If Jerome and Joe strike up a conversation and decide to trade volume for stickers (starting from the level Maria negotiated), what volume will they agree on? Is this the socially optimal volume, i.e. does the Coase Theorem apply here? Explain. How stickers would Jerome be willing to give Joe to achieve that volume? How many stickers would Joe require?

d. The landlady catches wind of this problem and decides to intervene. She herself is deaf, and therefore has no opinion about Bjork one way or the other, but she wants what is best for her tenants. What strategy would you recommend she take?

3) Hiro has the following labor supply (in hours) with respect to the wage w (in $):

$$LS= 200w$$

Acme Co., which would like to hire him, has the following demand for Hiro's labor:

$$LD= 2000 - 200w$$

a) Graph LS, LD, and the equilibrium wage and hours, with the wage on the Y-axis and hours on the X-axis.

b) How much surplus does Hiro get from working? How much surplus does Acme Co. get from employing him? Mark each surplus on a graph.

c) The government now imposes a minimum wage of $6/hour. What are the equilibrium wage and hours? How much surplus does Hiro get from working? How much surplus does Acme Co. get from employing him? Mark each surplus on a graph.

d) How has total surplus changed? Explain.

e) The government now eliminates the minimum wage and instead provides Hiro with a $1/hour wage subsidy. What is the new equilibrium hours that Hiro supplies? What is the total wage he receives, and what is the wage Acme pays him?

f) How has Hiro's surplus changed? How has Acme Co.'s surplus changed? Should the government subsidize *every* market? Explain.

4) For each of the examples below, answer the following three questions:

i) Is there an externality? If so, describe it and explain whether it is positive or negative. If you are uncertain, describe the conditions under which there may, or may not, be an externality

ii) If there is an externality, does it seem likely that private markets will arise that allow this externality to be internalized?

iii) If there is an externality, contrast the effectiveness of each of the following corrective measures that the government can use to address the problem:
      1) direct quantity regulation
      2) taxes/subsidies
      3) permits with trading

For each of (1)-(3), discuss the advantages and disadvantages, and conclude as to which would be best, or whether government intervention would do more harm than good. Make use of the Weitzman uncertainty framework where applicable; diagrams are not necessary.

a) Driving a hybrid car (a hybrid saves fuel relative to a conventional car, primarily by storing excess energy created during braking in a battery and using it when needed)
b) Going to a crowded party while sick with the flu
c) Conducting economics research
d) Maintaining your home's smoke alarm