Intermediate Microeconomics
Fall 2009

Problem Set 5

1. George has an endowment of 50 nuts (n) and 80 apples (a). Bob has an endowment of 200 nuts (n) and 120 apples (a). Assume both have the same utility function $U = n \cdot a$, so their $MRS = n / a$.
   a) Is there room for beneficial exchange?
   b) What is the equilibrium price ratio, $\frac{p_a}{p_n}$?
   c) How many nuts and apples will George and Bob consume in the competitive equilibrium?
   d) Draw the contract curve.

2. Harry is endowed with 10 coupons that can be redeemed for video rentals during the next week and 2 bags of microwave popcorn. Susan is endowed with 1 coupon that can be redeemed for video rentals during the next week and 7 bags of microwave popcorn. At these endowments, Susan's marginal rate of substitution ($MRS_{c,p}$) of coupons for popcorn equals $\frac{1}{3}$ and Harry's $MRS_{c,p}$ equals 4.
   a) Construct an Edgeworth box diagram of the initial endowments of Harry and Susan.
   b) Is the initial endowment efficient? Explain how their allocation will change as Harry and Susan move to a point on the contract curve.

3. Assume that scientific studies provide you with the following information concerning the costs and benefits of sulfur dioxide emissions:
   Benefits of abating (reducing) emissions MB = 500 – 20A
   Cost of abating emissions: MC = 200 + 5A
   where A is the quantity abated in millions of tons and the benefits and costs are given in dollars per ton.
   a) What is the socially efficient level of emissions abatement?
   b) What are the marginal benefit and marginal cost of abatement at the socially efficient level of abatement?
   c) What happens to net social benefits (benefits minus costs) if you abate one million more tons than the efficient level? One million fewer?
   d) Why is it socially efficient to set marginal benefits equal to marginal costs rather than abating until total benefits equal total costs?

4. Suppose that the oil industry in Utopia is perfectly competitive and that al firms draw oil from a single (and practically inexhaustible) pool. Assume that each competitor believes that he or she can sell all the oil he or she can produce at a stable world price of $10 per barrel and that the cost of operating a well for one year is $1,000.
   Total output per year (Q) of the oil field is a function of the number of wells (N) operating in the fields. In particular
   $$Q = 500N - N^2$$

And the amount of oil produced by each well (q) is given by

$$q = 500 - N$$

a) Describe the equilibrium output and the equilibrium number of wells in this perfectly competitive case. Is there a divergence between private and social marginal cost in the industry?
b) Suppose now that the government nationalizes the oil field. How many oil wells should it operate? What will total output be? What will the output per well be?
c) As an alternative to nationalization, the Utopian government is considering an annual license fee per well to discourage overdrilling. How large should this license fee be if it is to prompt the industry to drill the optimal number of wells?

5. Suppose that the inverse demand curve for paper is $p = 200 - Q$, the private marginal cost (unregulated competitive market supply) is $MC^p = 80 + Q$, and the marginal harm from gunk is $MC^g = Q$.
   a) What is the unregulated competitive equilibrium?
   b) What is the social optimum? What specific tax (per unit of output or gunk) results in the social optimum?
   c) What is the unregulated monopoly equilibrium?
   d) How would you optimally regulate the monopoly? What is the resulting equilibrium?

6. There are three groups in a community. Their demand curves for public television in hours of programming, T, are given respectively by

$$W_1 = \$150 - T,\ W_2 = \$200 - 2T, \text{ and } W_3 = \$250 - T.$$

Suppose public television is a pure public good that can be produced at a constant marginal cost of $200 per hour.
   a) What is the efficient number of hours of public television?
   b) How much public television would a competitive private market provide?