

Homework 1: Environmental Economics: ECO 345  
Due: Wednesday, September 14, 2011

**Question 1 (12 points).**

For each of the following, indicate whether or not the allocation is efficient. If not, come up with a Pareto preferred allocation.

- There exists 15 frisbees and 10 pairs of cleats. Dave is allocated 15 frisbees and 10 pairs of cleats, with Luke getting nothing.
- There exists 15 frisbees and 10 pairs of cleats. Dave and Luke are each allocated 7 frisbees and 5 pairs of cleats.
- Dave has 10 frisbees and 4 pairs of cleats and Luke has 5 frisbees and 6 pairs of cleats. At this point, Dave's marginal rate of substitution of frisbees ( $f$ ) for cleats ( $c$ ) is  $MRS_{fc}^D = -2$  (Dave is indifferent between 1 more frisbee and two pairs of cleats). Luke's marginal rate of substitution is  $MRS_{fc}^L = -1$ .

**Question 2 (20 points).**

Ralph owns a coal-fired power plant and wants to install a more efficient generator. The generator costs \$1 million, but would lower Ralph's fuel costs by \$5 million. The utility regulators require that \$3 million of the fuel savings be passed on to his customers in the form of lower rates.

New Source Review (NSR) regulations requires power plants which make major upgrades (routine maintenance is excepted) to submit to an EPA review that generally requires Ralph to install expensive pollution control equipment. The cost of the pollution control equipment is \$7 million.

0.2 million households live downwind of the power plant and are willing to pay \$40 each for the lower emissions the pollution control equipment would provide. 0.1 million households live upwind of the power plant and do not care about pollution. All households use electricity and would split the \$3 million of fuel savings evenly.

For the problems below, it may be helpful to fill in the following table:

Group	Number	Surplus per person				total surplus			
		upgrade	not	control	not	upgrade	not	control	not
Ralph	1								
downwind households	0.2 M								
upwind households	0.1 M								
total surplus									

- Calculate the total surplus from upgrading the generator. Is it efficient to upgrade the generator?
- Calculate the total surplus from installing the pollution control equipment. Is it efficient to install the pollution control equipment?
- Find the allocation that results under NSR. Will NSR result in an efficient allocation? If not, give a Pareto preferred allocation.
- Will NSR pass under majority rule? Explain.
- Suggest an alternative regulation in this case which results in the efficient allocation and will pass unanimously.

**Question 3 (12 points).**

Suppose the production of electricity ( $E$ ) is related to capital ( $K$ ) and labor ( $L$ ), according to:

$$E = \min(K, L) \tag{1}$$

That is, electricity production equals the smaller of the two numbers  $K$  and  $L$ . Are the following allocations efficient? If not, propose a Pareto preferred allocation.

- Firm one  $K = 2$  and  $L = 1$ . Firm two has  $K = 1$  and  $L = 2$ .
- Firm one  $K = 0$  and  $L = 0$ . Firm two has  $K = 5$  and  $L = 5$ .
- Firm one  $K = 3$  and  $L = 2$ . Firm two has  $K = 5$  and  $L = 5$ .

**Question 4 (20 points).**

Suppose the price of a filter which removes one microgram ( $\mu g$ ) of mercury (Hg) from a stream is \$15. The price of a large coffee in Starbucks is about \$3. Suppose Captain Dave fishes in river number one and has a MRS of coffee ( $c$ ) for filters/mercury removed ( $f$ ) of  $MRS_{fc}^D = -7$ . Aaron lives near river number 2 and has  $MRS_{fc}^A = -4$ . The initial allocation has Dave with 4 filters and 6 cups of coffee, while Aaron has 7 filters and 4 cups of coffee.

Draw the Edgeworth box for this problem. Be sure to draw the budget line, the initial allocation, the indifference curves which cross the initial allocation, and the indifference curves at the market equilibrium.

- a. What is Aaron a buyer of? What is Aaron a seller of?
- b. What are Dave and Aaron's MRS at the market equilibrium?

**Question 5 (20 points).**

Suppose the prices are as in question 4 (filters are \$15 and coffee is \$3), and suppose now Starbucks makes both filters and coffee. The production possibilities set is:

$$c \leq 8 - \frac{5}{4}f^2, \tag{2}$$

where  $c$  is coffee and  $f$  is filters. So if no filters are produced, Starbucks can produce up to 9 coffees. If one filter is produced, Starbucks and produce up to 8 coffee's, etc. It is easy to see that the slope of the production possibilities frontier is:

$$\text{slope} = \frac{\partial c}{\partial f} = -\frac{5}{2}f \tag{3}$$

- a. How many filters and how many cups of coffee will Starbuck's produce?
- b. Suppose Starbuck's labor and capital costs are \$20. What are Starbuck's profits?

**Question 6 (16 points).**

Firms  $A$  and  $J$  remove toxic waste using labor ( $L$ ) and earth movers ( $M$ ). Suppose further that  $MRTS_{LM}^A = 0.75$  and  $MRTS_{LM}^J = 0.25$ . Suppose further that the wage rate is 1 and the price of an earth mover is 2.

- a. Is the removal of toxic waste efficient? If not, should firm  $A$  buy or sell earth movers and should firm  $A$  hire or fire workers?
- b. Is firm  $A$  maximizing profits? If not, give a way for firm  $A$  to increase profits.
- c. Is firm  $J$  maximizing profits? If not, give a way for firm  $J$  to increase profits.