PROBLEM SET 5

Due Tuesday May 9, 2000 by 5 pm in your TA's mailbox (2nd floor Giannini Hall)
(Late assignments will not be graded)

* NOTE: We have decided to base homework grades on the best four out of five homework scores. However, you are still responsible for knowing this material

1. Suppose r=0.1, price (P) of timber is $10 per boardfeet, and the volume of trees in a stand obeys the function $Q(T) = 12\ T^2 - 1/3\ T^3$.

    a) Consider a single rotation. Set up the profit maximization problem and derive the equilibrium condition. Solve for the optimal rotation length (T*). Be sure to check to see if your answer makes sense.
    b) Consider an infinite series of rotation. Again set up the profit maximization problem and derive the equilibrium condition. (Note that you are not required to solve for T* for this case.)
    c) In the case of the repeated rotation, will the optimal rotation length increase or decrease when P increases? Why? What if P remained the same, but r increases. Does T* increase or decrease in this case? Why?

2. <u>Background:</u>

Fox Canyon is a fertile agricultural region extending all the way down to the coast, enveloping the bustling metropolis of Oxnard California. It is one of the premier strawberry growing regions of the country, and relies heavily on groundwater from wells for crop production. Because the canyon ends at the seacoast, when a grower pumps water from a well, some sea water bleeds in the well water and makes the well water a little more salty for everyone in the Canyon. This salt hurts plant growth and therefore increases the cost of production for all growers in the area.

The Fox Canyon Groundwater Management Agency (FCGMA) represents all of the growers in the area. Their goal is to manage the water in a way that is best for all the growers.

Suppose the farmers' demand for water is represented by the following inverse demand function P=P(Q) = 480-0.005Q, where Q is in acre-feet (an acre-foot is the amount of water it takes to cover one acre of land with one food of water)

The energy cost of pumping water to the surface is $80 per acre-foot (the marginal cost of providing water)

Assume the cost imposed on growers using well water due to the increase in salinity for one acre-foot extracted is $150.

Suppose you are asked to present a report for the FCGMA analyzing a variety of management options.

OPTIONS TO ANALYZE

a. CURRENT SITUATION

Suppose the costs due to increase in salinity are ignored by the FCGMA and no limitations are put on pumping

- i) What inefficiencies arise from the situation under the current policy? Explain why production is not at the optimal level. Use economic terms and put your answer in a form that a non-economist from FCGMA could understand
- ii) Sketch a diagram illustrating the quantity of water pumped, consumer surplus, producer surplus, market imperfection and the total cost of that market imperfection.

b. WATER PUMPING LIMITS

The primary option that FCGMA is considering is to put limits on the maximum amount of water that growers can pump, Q-max.

- i) Sketch a diagram with the optimal Q-max. Make sure to show what it costs growers to extract water. Is the marginal value of water to each grower the same as the marginal cost of extraction at the allocated quantity? Explain

c. PUMPING FEES

Another option is to charge the growers a fee for each acre-foot pumped.

- i) In words, to what should this fee be set equal?
- ii) Sketch a diagram showing the equilibrium with this fee; show CS, PS, and the revenue generated to the FCGMA.
- iii) Calculate the competitive equilibrium quantity of water, marginal extraction cost, and per acre-foot fee using the demand and costs given in the problem description.