Problem Set #5
Due Thursday, May 9th

Assignments turned in after the beginning of lecture will not be graded.

1) Assume that there are two types of farmers in a region – those who grow cotton, and those who grow roses. Let \( w \) denote the applied water. The marginal benefit of water to the cotton growers (for one season) is \( \text{MB}_C = 100 - \frac{1}{5}w \). The marginal benefit of water to the rose growers is \( \text{MB}_R = 400 - 2w \). Let \( S \) denote the amount of water available for the season. \( S \) is measured in acre-feet. There are two states of nature in this region – high rain (flood) years, and low rain (drought) years. In a flood year, the supply of water is \( S \), and in a drought year, the supply of water is \( S' \).

Let \( S = 600 \), and \( S' = 400 \).

(i) In one or two paragraphs, describe the system of water rights in the United States. How and why did it develop? Discuss the economic efficiency of the system.

For the following questions, be sure to show your work.

(ii) Draw the graph showing each MB curve, along with the aggregate MB, against the total supply. Be sure to label the graph clearly.

(iii) **No-trade regime.** Assume that trade in water is not allowed, and the cotton growers have senior rights relative to rose growers. For each state of nature, calculate the quantity of water used by each group, and the marginal benefit of water use to each group.

(iv) **Water market regime.** Now suppose that trade in water is allowed, and that there is no transaction or conveyance costs of water trading. Under each state of nature, calculate the quantity of water used by each group, and the marginal benefit (price) of water in the water market.

(v) **Third Party Effects.** These cotton growers use flood irrigation on their fields. Using flood irrigation results in only 60% of applied water going to the cotton crop. The other 40% of applied water is residual. This recharges the groundwater table, which is used by the nearby town of Scarcityville for consumptive purposes (drinking, cleaning, etc). In each state of nature, how much water did the town receive before trading was allowed? After trading was allowed? What potential solutions could compensate for the third party effects associated with water trading?
Conveyance Costs. The residents of Scarcityville have gotten fed up with fighting for water and have all moved to Abundanceville (so you can now neglect the third party effects). However, there is now a cost of moving the water from the cotton region to the rose region. The cost is $50 per acre-foot of water. Under each state of nature, calculate the quantity of water used by each group, and the marginal benefit of water use to each group. In general, do you expect the conveyance cost of water to be small or large? How might this change the effectiveness of water markets?

2) Suppose that Rip Van Winkle plants a single stand of trees on an empty plot. The volume of timber at time T (measured in board-feet) is \( Q(T) = 20T^2 - 2/3T^3 \). The interest rate is 10%, and the price of wood in the market is $10/board-foot.

If Rip decides to go to sleep at time \( T=0 \), when does he have to wake up to maximize his profits from a one-time harvest (single rotation)? When does he have to wake up to maximize the average yield (maximum sustainable yield, or mean annual increment)?

Note: to find the roots of \( ax^2 + bx + c = 0 \), use the quadratic equation. This equation says that:

\[
x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}
\]

Essay

Pretend that the year is 1960. Elvis is king of the jukebox, big cars rule the roads, and Floyd Dominy is king at the Bureau of Reclamation. The State of California is trying to convince residents to pass a referendum to develop the State Water Project – a giant water project that uses water from the Upper Feather River area to provide water to users downstream. The project will cost approximately $1.75 billion and will provide water to agriculture in the San Joaquin Valley and to urban consumers throughout the state. Discuss the benefits and the costs of the project. Be sure to consider all of those affected – residents, agricultural producers, consumers, industry, and the environment.

In 1973, the United States government passed the Endangered Species Act. This Act protects the habitat of any endangered species. How does the Endangered Species Act value the preservation of species relative to other uses, such as agriculture or development? How could this Act affect the environmental costs and benefits discussed above?