14.42/14.420: Environmental Economics
Problem Set 5
Due at 3:00pm, May 6, 2011

This problem set will be due at the beginning of recitation on May 6th. You are welcome to work with your classmates, but please turn in your own set of solutions in your own words.

1. Kolstad, Chapter 8: problems 2, 3

2. Kolstad, Chapter 9: problems 3, 4, 5

3. Consider a two-period model of extraction of a nonrenewable resource with a finite stock of 20 units. Marginal extraction costs are constant at $c_t = 2$, and the interest rate is $r = .10$. (The discount rate δ is therefore $\delta = 1/(1+r) = 1/1.1$.) Firms are price takers, with profits given by

$$\pi_f = \sum_{t=1}^{2} \delta^t (p_t - c_t) E_t.$$

   (a) Suppose that demand is constant over time, and the inverse demand function is given by

$$p_t = 8 - 0.4 q_t$$

   Find the optimal extraction levels and corresponding prices in each period as well as the scarcity rent (λ). Plot the marginal net benefits in each period using the same setup that we used in class to confirm the results of your mathematical optimization.

   (b) Now suppose that demand changes over time, so

$$\begin{aligned} p_1 &= 8 - 0.4 q_1 \\ p_2 &= 5 - 0.4 q_2 \end{aligned}$$

      i. What are the optimal extraction levels, prices and scarcity rent now? Plot the new marginal net benefit curves as above.
      ii. How do the new extraction levels compare to your results from (a)? Why?
      iii. Explain the similarity or difference between the price path you just calculated and the one in (a).
      iv. Does the new price path satisfy the Hotelling Rule? Why or why not?

4. Tietenberg chapter 5, Discussion Question 1

   The notion of sustainability is not the same in the natural sciences as in economics. In the natural sciences, sustainability frequently means maintaining a constant physical flow of each and every reource (e.g. fish from the sea or wood from the forest), while in economics it means maintaining the *value* of those service flows. When might the two criteria lead to different choices? Why?

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