ECN 275/375: Renewables (fisheries and forests)

(EX6-1) Fisheries

This exercise deals with the tradeoff between avoiding extinction of a fish species and treating fish stocks as a capital asset under varying degrees of uncertainty about the stock size or the growth function.

(a) Draw a standard stock-growth function $G(S)$ of stocks S diagram. Insert a harvest level, H', such that we get two equilibria, a stable $\{H', S_S\}$ and an unstable $\{H', S_U\}$ equilibrium.

(b) Suppose that H' is the steady state (long run) harvest level that maximizes economic rents (profits) from this fishery. Explain why under full certainty about the stock size, S, and the growth function $G(S)$, it is profitable to seek to gradually adjust the fishery to the unstable equilibrium, $\{H', S_U\}$.

(c) What is the size of the discount rate? Explain why.

Now move to a situation that is more relevant for real life fisheries management. To keep things as simple as possible, we assume the fish lives for one year when it is mature for harvest after spawning (not so realistic as the quality of the fish is much higher before spawning, but not to complicate matters :-)). Suppose this is a virgin fishery, i.e., we start fishing on a newly detected fish species.

(d) At the start of the fishery for this species, we know little about the growth function, $G(S)$. Explain the learning process as the fishery proceeds. Hint: use the change in the stock and the stability properties of the equilibria to learn about the growth function

OR think in terms of the steady state economically optimal harvest $H^{\delta=r}(S)$ ..

(e) What are the implications of what we have learned for fisheries management under uncertainty?

(EX6-2) The single rotation period even aged stand forest model.

Lecture note 17 expressed the single rotation periond even aged stand profit maximization problem as follows: maximize the rents from timber harvest, choosing the rotation age, T, of the stand:

$$\left\{\begin{matrix} MAX \\ T \end{matrix}\right\} \pi(T) = \left\{\begin{matrix} MAX \\ T \end{matrix}\right\} \left(pS_T e^{-rT} - k \right)$$

where: $p = (P - C)$ is the net price, S_T is the standing timber volume at the time of harvest, and k is replanting costs at the beginning of the rotation.

(a) Rewrite the profit maximization problem when thinning occurs at time $\tau < T$.

(b) Assuming that thinning does not affect $\dot{S}_T$ and S_T : (i) how does thinning influence the optimal rotation age? (ii) What is the condition for thinning to be profitable?

(c) Now, suppose that thinning increases $\dot{S}_T$. How will that affect the optimal rotation age?

(EX6-3) Multiple use forest management

What is the impact of the non-timber benefits from moose hunting on the optimal rotation age under single and multiple rotations? When explaining your answer, emphasize the difference between the single and multiple rotation cases.