ECN 275/375 – Natural resource and environmental economics
12:15-15:15 April 6, 2022

All help aids allowed except assistance from others.
This test consists of 3 questions, for a total score of 100 points.
All questions are to be answered. You may answer in English or Norwegian.

In the case that you find a question unclear, or you are uncertain about what is meant, state your extra assumptions needed to be able to answer the question.

When I submit my answers on this exam, I confirm that I have worked alone on my answers and not cooperated with others. I am aware that cooperation with others is to be considered an attempt or a contribution to cheat.
I am aware of the consequences of cheating (Ch. 39, Academic regulations for NMBU).

Your name: NN

Question 1 (30 points)

The basic forestry model with extensions.

(a) (i) State the expression for the single rotation optimal harvest age for a basic forest model with timber benefits only. (ii) State the standard assumption(s) for this result to hold. (iii) Show how you find this expression. **(10 points)**

Answer: (i) here

(ii) here

(iii) here

(b) Assume that the net timber price changes over time as follows: $p_T = p_0 e^{iT}$ where i is the annual growth rate in the net timber price. (i) If the annual net price growth is positive, what impact would that intuitively have on the optimal rotation age? Explain your reasoning. (ii) How would you go about showing this mathematically? (you only need to set up the revised expression). **(10 points)**

Answer: (i) here

(ii) here

Economists tend to favor simple models as that makes it easier to get data and interpret model findings. Single rotation models are less complicated than multiple rotation models.

(c) Under what conditions do multiple rotation models provide extra insights compared to single rotation models? **(10 points)**

Answer: here

Question 2 next page

Question 2 (30 points)

Formulate a model for maximizing social welfare with the following characteristics:

- Utility originates from consumption.
- Production takes place using natural resources, N, and manmade capital, K.
- There is a negative production externality, $E(N_t)$, from the use of natural resources. The immediate negative impacts of this externality can be reduced with the cost $V(E(N_t))$, where $V_N > 0$ and $V_{NN} > 0$.

(a) Write down the objective function, and the capital and resource constraints that correspond to the problem description. Briefly describe the reasoning behind your chosen formulations. **(10 points).**

Answer: here

(b) What is the interpretation of the Lagrangian multiplier for the capital constraint in this model (and for many similar style models)? Explain briefly. **(10 points)**

Answer: here

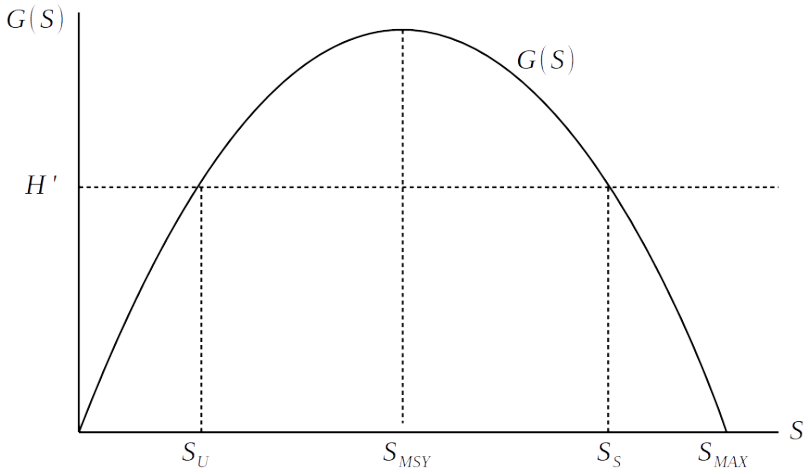
(c) Suppose that a pollutant has limited instantaneous impacts, but that its cumulative effects are large. Assume there is massive progress on the cleaning technology, leading to large expected reductions in the costs of reducing accumulated emissions. What are the effects on current and future accumulated emissions. **(10 points)**

Answer: here

Question 3 next page

Question 3 (40 points)

The figure below shows a standard growth-stock size relationship for fish with the harvest level H' and two equilibrium solutions, H', S_S and H', S_U.



(a) 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 gradually adjust the fishery to the unstable equilibrium, $\{H', S_U\}$. **(10 points)**

Answer: here

(b) What is the size of the discount rate? Explain why. **(10 points)**

Answer: here

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. Suppose this is a virgin fishery, i.e., we start fishing on a newly detected fish species.

(c) 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. **(10 points)**

Answer: here

(d) What are the implications of what we have learned for fisheries management under uncertainty? **(10 points)**

Answer: here

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