NTNU
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Department of Economics

Examination paper for SØK3524
Environmental and Resource Economics

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Examination time (from-to): 6 hours (09.00 -15.00)

Permitted examination support material: C

Flg formelsamling: Knut Sydsæter, Arne Strøm og Peter Berck (2006): Matematisk formelsamling for økonomer, 4utg. Gyldendal akademiske. Knut Sydsæter, Arne Strøm, og Peter Berck (2005): Economists' mathematical manual, Berlin.

Calculator:

Casio fx-82ES PLUS, Casio fx-82EX Citizen SR-270x, SR-270X College or HP 30S.

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Informasjon om trykking av eksamensoppgave

Originalen er:

1-sidig ☐ **2-sidig** ☐

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skal ha flervalgskjema ☐

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Date Signature

Question 1 (50%)

a) Consider a non-renewable resource extraction problem with current profit given as $\pi_t = pq_t - (c/2)q_t^2$. q_t is the extraction, p is the fixed price and c is a cost parameter. The initial size of the resource is given as X_0. Find the optimal extraction when the extraction time is two periods (years). Which forces are working in the direction of more/less extraction in the first period?

b) Formulate the long-term sole-owner (social planner) management problem of a fishery. Formulate the Hamiltonian function and find the first-order optimality conditions. Discuss, without constructing the phase plane diagram, the expected harvesting pattern (dynamics) before the steady state is reached.

c) What is your understanding of an open-access fishery? Use the Gordon-Schaefer model and find the open-access stock size, effort use and harvest. Discuss forces that may work in the direction of stock depletion. How can stock depletion be avoided?

d) $f(t)$ describes the biomass growth of an even aged stand of trees. How may this growth function look like? The planting cost is given as c, while $p(t)$ gives the time variable timber price. Find the optimal logging time for a single rotation. Assume next that there are maintenance costs $q(t)$ related to the stand. Find the optimal logging time for the single rotation when these costs are included.

Question 2 (30%)

a) Give examples of flow and stock pollution problems.

b) Consider a stock pollution problem where M_t is the emission flow at time t and A_t is the pollution stock level. The damage function is represented by $D(A_t) = \frac{A_t^2}{2}$ while the emission generates a net benefit stream specified as $B(M_t) = 2M_t$. The emission flow adds to the existing pollution stock, governed by the differential equation $\frac{dA_t}{dt} = M_t - \alpha A_t$, where $\alpha > 0$ captures the pollution decay of the recipient. The problem is to maximize the present value net benefit $B(M_t) - D(A_t)$ given an infinite time horizon. Formulate and solve this problem.

Question 3 (20%)

a) What is your understanding of resource rent and Ricardian rent? Use Norwegian aquaculture as an example.

b) What are the most important differences between a biomass fishery model and an age structured fishery model?

c) Give an account of the tradable emission permit system ('cap and trade').

d) Give an account of the Coase Theorem.