

Institutt for samfunnsøkonomi

**Eksamensoppgave i SØK3524 / SØK8624**  
**Miljø- og ressursøkonomi**  
**Environmental and Resource Economics**

**Faglig kontakt under eksamen: Anne Borge Johannesen**

**Tlf.: 73 59 05 29**

**Eksamensdato:** 3. desember 2018

**Eksamenstid (fra-til):** 6 timer (09.00-15.00)

**Sensurdato:** 7. januar 2019

**Hjelpemiddelkode/Tillatte hjelpemidler:** C/ 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.

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

**Målform/språk:** Engelsk

**Antall sider (uten forside):** 1

**Antall sider vedlegg:** 0

**Informasjon om trykking av eksamensoppgave**

**Originalen er:**

**1-sidig**       **2-sidig**

**sort/hvit**       **farger**

**skal ha flervalgskjema**

**Kontrollert av:**

\_\_\_\_\_  
Dato

\_\_\_\_\_  
Sign

**Question 1 (40%)**

A landowner controls a wildlife stock which grows according to  $dX_t / dt = F(X_t) - q_t$ . Suppose that the value per unit animal hunted is  $p$  and that the hunting cost depends only on the harvest,  $C_t = C(q_t)$ , such that  $C'(q_t) > 0$ ,  $C''(q_t) > 0$  and  $C(0) = 0$ . The landowner profit per unit of time is thus  $\pi_t = pq_t - C(q_t)$ .

- Formulate the optimal management strategy of the landowner. Find the optimality conditions. Substitute away the shadow price, and find the differential equations of the system in the variables  $q_t$  and  $X_t$ . Find next the isoclines and analyze the dynamics using phase plane diagram. (hint: The marginal profit must be positive all the time;  $\pi'_t = p - C'(q_t) > 0$ )
- Characterize the steady-state, and show how the price  $p$  and the discount rate  $\delta$  influence the optimal steady-state stock and hunting.
- Assume that natural growth is governed by  $F(X_t) = rX_t(1 - X_t / K)$ . Interpret the parameters of this function, and find how these parameters influence the above optimal steady-state.
- The wildlife causes a negative externality due to crop and grazing damages for the farmers living in the area. Assume that the damage function may be written as  $D_t = D(X_t)$  with  $D'(X_t) > 0$ ,  $D''(X_t) \geq 0$  and  $D(0) = 0$ . Formulate the social planner problem, and characterize the steady state. Compare with the landowner optimization problem.

**Question 2 (30%)**

- Explain your understanding of a tradable emission permit system ('cap and trade').
- Discuss the Environmental Kuznets Curve concept and the prospects of 'decoupling' economic growth and environmental degradation.
- Discuss briefly your understanding of an open-access fishery.

**Question 3 (30%)**

Consider an even aged stand of trees planted at a piece of land at  $t = 0$ . The biomass at time  $t \geq 0$  is given as  $V_t$ . How may the time profile of  $V_t$  look like?

- The planting cost is  $c_0$  and the net sale price (net of logging costs) of the biomass is given by  $p_t$ . Characterize and interpret the optimal logging time when the land has no opportunity value after logging. What is the effect of the discount rate?
- Assume now instead that the land after logging has a fixed opportunity value  $Q$  at every point of time. Characterize the optimal logging time when this opportunity value is included. Compare with what you found without this value.