ECON 482/530: RESOURCE ECONOMICS
Homework #1
Due: September 18, 2018

1. The International Whaling Commission wishes to maximize the use plus non-use benefits of the whale stock:

$$\text{Maximize} \qquad \sum_{t=0}^{\infty} \beta^t [ph_t + U(x_t) - ch_t]$$

where p=\$19,500 is the per unit price of whales for consumption, h_t is harvest at time t, c=\$2,500 is per unit cost of harvest, $U(x_t)$ is the utility people get at time t from knowing there are x_t whales in the ocean, and β = 1/1.05 is the social discount factor (r = 0.05 is the discount rate).

The constraints are the population dynamics and non-negativity conditions:

$$x_{t+1} - x_t = g(x_t) - h_t \qquad \text{and} \qquad x_t, h_t \geq 0, \ \forall t,$$

where $g(x_t) = 0.1\ x_t\ (1 - x_t/100{,}000)$ is the whale (logistics) growth function. Assume that the annual marginal preservation value (utility) of whales is $U'(x_t) = 1000 - 0.01x_t$.

(a) Write out the current value Hamiltonian

(b) Find the equation of the maximum principle, the co-state equation and the state equation.

(c) Find the steady-state solution for this problem.

2. Solve the following problems in GAMS. Show your GAMS code and answers.

(a) Th following is a linear programming (LP) problem

$$\begin{aligned} \min \quad & Z = X_1 + 3X_2 + 3X_3 \\ \text{s.t.} \quad & X_1 + X_2 \geq 3 \\ & X_2 + X_3 \geq 5 \\ & X_1 + X_3 = 4 \end{aligned}$$

(b) The following is a mixed integer programming (MIP) problem

$$\begin{aligned} \max \quad & Z = x + y \\ \text{s.t.} \quad & -3x + 2y \geq 1 \\ & -8x + 10y \leq 10 \\ & y \in \{0,1\},\ x \geq 0.3 \end{aligned}$$