AAE / ECON / FOREST 531 (Natural Resource Economics)
Homework #2
Due in Class on Thursday, October 2, 2008

1. Consider a fishery where $F(X_t)=rX_t\ln(K/X_t)$, $Y_t=qX_tE_t$, and $C_t=cE_t$, and where r, K, q, and c are positive parameters.
   a. What are the analytic expressions defining the open access equilibrium ($X_\infty, E_\infty, Y_\infty$)? (Recall the calculus rule: exp(ln(G)) = G).

   Suppose the fishery were to be managed so as to maximize the present value of net revenue given a positive discount rate of δ.

   b. What is the expression for F'(X)? (Recall the calculus rule: $D_x \ln u = (1/u) D_x u$, where u=f(x))
   c. What is the fundamental equation of renewable resources for this problem? Re-arrange this equation such that Y is written as a function of X and model parameters ($Y = \phi(X)$).
   d. If δ=0.05, use Excel to graph $Y = \phi(X)$ and F(X) for the following parameter values: r=0.1, K=1, q=0.01, p=200, and c=1. (Hint: start with a column of X's from X=0 to X=1 in intervals of 0.01; then write formulas for $Y = \phi(X)$ and F(X) in neighboring columns and graph.)
   e. Using your graph from part d, what is the optimal steady state (X*, Y*)? Compare to the open access equilibrium (X_∞, Y_∞) calculated from part a with the same parameter values.
   f. Given the optimal steady state calculated in part e, is the marginal stock effect greater than, less than, or equal to the discount rate? Explain.

2. Consider the optimal management of the renewable resource from homework #1, question #4. The net benefits of using the resource in time t are defined as $\pi(X_t, Y_t) = 3X_t + 3Y_t$, and the resource has a natural rate of growth described by $F(X_t) = 2X_t - 0.5X_t^2$. Suppose X_0=0.05. Use Excel's Solver to determine the optimal approach to steady state over a ten year period (t=0,1,….9) when the discount rate (δ) is 0.05. (Hint: start with an initial guess of Y_t = 0.01 for each t). Graph the approach to steady state.[1]

3. E1.1 and E1.2 in Conrad (pages 16 & 17).

4. E2.1 in Conrad (page 31).

5. E2.2 in Conrad (page 31).

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[1] Note: I won't collect it, but you should feel free to play with different parameter values and use Solver to determine the approach to steady state under different assumptions. Before running solver, think intuitively about what you expect to happen to the dynamics of the solution, and then check your intuition after running solver.