MATH 172 Fall, 2009 Quiz #3 Name: M2

1. A population P_t of mussels reproduces annually with an intrinsic rate of increase r of 3%. Harvesting removes $h = 60$ tons a year.

   a. Write the updating equation for this discete process; that is write P_{t+1} in terms of P_t and numbers.

$$P_{t+1} = P_t + 0.03P_t - 60 = (1.03)P_t - 60$$

   b. Is there an equilibrium value for this population? If so, compute it.
   (Yes) No value: 2000 tons

$P_{t+1} = P_t$ condition for equilibrium

$(1.03)P_t - 60 = P_t$

$0.03P_t = 60$

$P_t = 2000$ tons

Note: we have no explicit formula solution for this model!

   c. Write the updating equation as you would enter it in your calculator. Hint: It will have the form $u(n) = (\underline{1.03})u(\underline{n-1}) \pm h$ or $u(n) = u(\underline{n-1}) + (\underline{0.03})u(\underline{n-1}) \pm h$.

$$u(n) = 1.03u(n-1) - 60$$

u(nMin) entry

   d. If the population is currently (1000 tons) what will it be in 23 years? in 24 years? How do you interpret what is happening?

Let the calculator do the work!

$u(23) = 26.4$ $u(24) = -32.8$

Somewhere between $t=23$ and $t=24$, the pop. became 0, i.e. the pop. went extinct.

   e. If the population is currently 3000 tons, what will it be in 6 years?

$u(nMin) = 3000$ $u(6) = 3194$

   f. (Bonus) Is the equilibrium value (assuming that there was one) stable or unstable? Explain, perhaps using a graph to help.

unstable - if we start P_0 above 2000, P_t gets larger & larger. If we start P_0 below 2000, then P_t falls to 0. In either case the pop. does not return to 2000.