Assignment #4

Due on Friday, February 5, 2010

Read Section 1.1 on *The Malthusian Model,* pp. 2–5, and Section 1.2 on *Nonlinear Models,* pp. 11–17, in Allman and Rhodes.

Do the following problems

1. *(Numerical Analysis of the Logistic Equation).* In this problem and the next two, you are asked to use the MATLAB® program `Logistic.m` to explore how the nature of the solutions to the logistic difference equation
$$N_{t+1} = N_t + rN_t(1 - N_t) \tag{1}$$
changes as one varies the parameter r and the initial condition N_o. The code for `Logistic.m` may be found in the Math 36 section of my courses website at `http://pages.pomona.edu/~ajr04747`.

   Start out with the initial condition $N_o = 0.1$ and consider the following values of r: 1, 1.5, 2, 2.1, 2.25, 2.5 and 2.7. Describe in words the long term behavior of the solution to (1) for each value of r. Is there any significant change in the structure of the solution? Is there anything striking?

2. *(Numerical Analysis of the Logistic Equation, continued).* Keep the value of r at 2.7 and try the following initial conditions:
$$N_o = 0.1 \quad \text{and} \quad N_o = 0.101.$$
Before you try the second initial condition, type the MATLAB® command `hold on`. This will allow you to see the plots of the two solutions on the same graph. Is there anything that strikes you? What implications does this result might have on the question of predictability?

3. *(Numerical Analysis of the Logistic Equation, continued).*

   (a) What happens when $r = 3$ and t is allowed to range from 0 to 100? How would you describe the solution?

   (b) What happens when $r = 3.01$? Does this result suggest that we need to impose a restriction on r? What should that restriction be?

4. Problems 1.1.16 (a)(b) on pages 9 and 10 in Allman and Rhodes.

5. Problems 1.1.16 (c)(d) on page 10 in Allman and Rhodes.