Assignment #2

Due on Friday January 29, 2010

Read Section 1.1 on *The Malthusian Model,* pp. 2–5, n Allman and Rhodes.

Read Section 1.2 on *Nonlinear Models,* pp. 11–17, in Allman and Rhodes.

Do the following problems

1. Consider the population model given by the difference equation

$$N_{t+1} - N_t = m,$$

where m is a constant, for $t = 0, 1, 2, \ldots$.

   (a) Give an interpretation for this model.

   (b) If the initial population density is N_o, what does this model predict in the long run? Consider the two possibilities $m < 0$ and $m > 0$.

   (c) How does this model compare with the Malthusian model?

2. Assume that the *per–capita* growth rate λ of a population is less than 1; that is, left on its own, the population will go extinct. To avoid extinction, suppose that after each unit of time, a constant number m of individuals of the same species is added to the population.

   (a) Write down a difference equation that models this situation.

   (b) Solve the difference equation and discuss what this model predicts in the long run.
   For this problem, it will be helpful to know that

$$1 + \lambda + \lambda^2 + \cdots + \lambda^{n-1} = \frac{\lambda^n - 1}{\lambda - 1} \quad \text{for } \lambda \neq 1,$$

   and that

$$\lim_{n\to\infty} \lambda^n = 0 \quad \text{if } |\lambda| < 1.$$

   (c) How does this model compare with the Malthusian model?

3. Problem 1.1.2 on page 6 in Allman and Rhodes.

4. Problem 1.1.6 on page 7 in Allman and Rhodes.

5. Problem 1.1.10 on page 7 in Allman and Rhodes.