

Assignment #2

Due on Friday September 14, 2007

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. Consider the population model given by the difference equation

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

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

- (a) Give an interpretation for this model.
 - (b) If the initial population density is N_0 , 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

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

and that

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

- (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.