University of Florida

MMB HOMEWORK II DUE: FEB 22, 2012

Name:

ID #:

Instructor:

Directions: You have until 5:00 p.m. on the due date to answer the following questions. You must show all your work as neatly and clearly as possible and indicate the final answer clearly. You may use any books and you can work together but each of you must submit a homework.

Problem	Possible	Points
1	5	
2	5	
All	10	
Total	20	

(1) Population is modeled by the following equation:

$$N'(t) = \frac{rN(K-N)}{K+aN}.$$

The population is subjected to constant-effort harvesting

$$N'(t) = \frac{rN(K-N)}{K+aN} - EN \tag{1}$$

(a) Determine the units of the parameters involved. Derive a non-dimensional form of equation (1).

(b) Find the equilibria of the model (1). Determine the stability of equilibria. Plot the equilibria as a function of the harvesting parameter E (that is draw a bifurcation diagram).

(c) Find the maximum sustainable yield.

(2) Find the general form of the solution of the difference equation:

$$x_{n+1} = c - x_n$$

where c is an arbitrary constant, and the initial value is given by $x_0 = a$ where a is also an arbitrary constant.

(3) The following discrete model is given to model population

$$x_{n+1} = \frac{3x_n^2}{x_n^2 + 2} \tag{2}$$

(a) Determine the nonnegative equilibria of the model (2). Determine the stabilities of the equilibria.

(b) Suppose a fraction a is removed from the population in each generation so that the model becomes

$$x_{n+1} = \frac{3x_n^2}{x_n^2 + 2} - ax_n.$$

For what values of a is there a stable equilibrium only at $x^* = 0$?

(4) Given the population model with delay

$$N'(t) = \frac{rN(t-\tau)}{N(t-\tau)+A} - dN(t) \tag{3}$$

where r, A, d are parameters.

(a) Find the equilibria of model (3).

(b) Find the characteristic equation of model (3).

(c) Find conditions for stability of the equilibria.

(d) Use computer algebra system to graph a representative solution of the model which stabilizes to sustained oscillations. Graph N as a function of t.