

Math 5110/6830
Instructor: Alla Borisjuk
Homework 4.2
Due: September 26

1. Consider the Love Affairs model:

$$R_{n+1} = a_R R_n + p_R J_n,$$

$$J_{n+1} = a_J J_n + p_J R_n.$$

Using initial conditions $R_0 = J_0 = 1$, plot in Matlab and print out the time courses of the solutions and also show the same solutions in the phase plane for the following parameter sets:

- a) $a_R = 0.5, a_J = 0.7, p_R = 0.2, p_J = 0.5$.
- b) $a_R = 0.5, a_J = 0.7, p_R = 0.7, p_J = 0.9$.
- c) $a_R = 1, a_J = 1, p_R = 0.2, p_J = -0.2$.
- d) $a_R = 0.5, a_J = 0.8, p_R = 0.2, p_J = 0.5$.

2. For the discrete logistic model

$$x_{n+1} = r\left(1 - \frac{x_n}{K}\right)x_n :$$

- a) Plot first 4 iterations (i.e. up to x_4) of a cobwebbing diagram for $r = 2.8, K = 1, x_0 = 0.3$.
- b) Explain just by looking at your diagram from a) the stability of all fixed points.
- c) Plot the solution (up to time 4) that you found in a) as a function of time in a separate figure.
- d) Find (from the notes is fine) the stability of the fixed points analytically and make a plot of the bifurcation diagram. (You do need to include cycles in this diagram)
- e) **(extra credit)** Plot the orbital bifurcation diagram (Feigenbaum diagram) for the discrete logistic equation. Describe what procedure you use.