MATH 315: Fall, 2024

Assignment 9

Due: Wednesday, October 9

I. Reading

Read Sections VI ("Concluding Remarks On Simple Models In Population Dynamics") and VII ("Biographical Sketches") of Chapter 4: **Ecological Models: Interacting Species** of our text.

II. *MATLAB* Versions of Subsection C "*Modifying the Model* of Section V

1. Consider the revised predator-prey model

$dx/dt = ax - bx^2 - cxy$

$dy/dt = mxy - ny$

where we assume that the gazelles will experience logistic growth in the absence of leopards.

Build a *MATLAB* version of this model. Use the following numerical values for the parameters

$a = .5$ $b = .003$ $c = .03$ $m = .02$ $n = .6$

Run the model with various initial populations. In particular, you should test the model if the system begins with

(a) No gazelles and No leopards
(b) No gazelles, but some leopards
(c) Some gazelles, but no leopards
(d) Equilibrium number of leopards and gazelles
(e) 90 gazelles, 12 leopards with $dt = .1$ and stop time = 75

but try other initial population combinations as well. Display both *time series* and *scatter diagrams*. Discuss what happens in the long run in each of these cases.

2. Consider the second proposed revision of the predator-prey model in which we assume that the predator can survive on an alternative resource:

$dx/dt = ax - bx^2 - cxy$

$dy/dt = mxy + ny - py^2$

Build a *MATLAB* model. Make some reasonable assignment of values for the six parameters and run the model with various initial populations. Are the outcomes qualitatively different from the original predator-prey model?

3. Build a *MATLAB* version of the Leslie-Gower model of the predator-prey system. Use the values of the parameters **a**, **b**, **c** and **e** that are given below Figure 4. 13 of the text. Using the same initial populations given there, does *MATLAB* produce similar results?

III. Optional, Extra Credit Exercise

Complete Exercise 30 of Chapter 4. Note that this problem has eight parts.