

## Math 686: Chapter 7 Homework – Spring 2020

DUE: TUESDAY, MARCH 17, 2020

1. Write a backward Euler solver for the system of equations (Competitive Lotka-Volterra Problem) that we discussed a few weeks ago in class:

$$\begin{aligned}\frac{dx}{dt} &= ax - bxy, \\ \frac{dy}{dt} &= -cy + dxy - eyz, \\ \frac{dz}{dt} &= -fz + gyz,\end{aligned}$$

subject to the initial conditions  $x(0) = x_0$ ,  $y(0) = y_0$ ,  $z(0) = z_0$ . Here  $a$ ,  $b$ ,  $c$ ,  $d$ ,  $e$ ,  $f$ , and  $g$  are positive constants. In class we explored the set of parameter values  $a = b = d = e = 1$ ,  $c = 2$ ,  $f = 100$ ,  $g = 0.1$  along with  $x_0 = 0.5$ ,  $y_0 = 1$ ,  $z_0 = 2$ . You can feel free to use these parameter values or explore the solution for other cases.

Your task is to implement the Backward Euler method for this system and explore its numerical properties with particular comparison to the Forward Euler approach (I'll send you my code `euler_system.m` and `feuler_system.m` for comparison although feel free to implement your own version of it). This is a loosely defined homework assignment so be creative. Turn in your code as well as a written description of some pros/cons and comparisons/contrasts between these two methods and how they behave.