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MECH534: Computer Based Modeling & Simulation

Spring 2022

Homework 5 Report

Simplified model of population growth is referred as the Lotka-Volterra system where x_1 and x_2 are the population levels of the prey and the predators, respectively. The system is resolved non-linear differential equations using numerical recipes library in C++. These equations are given as:

$$\frac{dx_1}{dt} = (b_1 - c_1 x_2)x_1 \quad (1)$$

$$\frac{dx_2}{dt} = (-b_2 + c_2 x_1)x_2 \quad (2)$$

Initial conditions are provided as below:

Parameters:

$b_1 = b_2 = c_1 = c_2 = 1$

Initial condition:

$x_1(t = 0) = 0.5$

$x_2(t = 0) = 0.5$

Figure 1: Provided initial conditions

For part 2 of the homework, the system is solved where step size is equal to 100 everywhere and it is visualized in Figure 2:

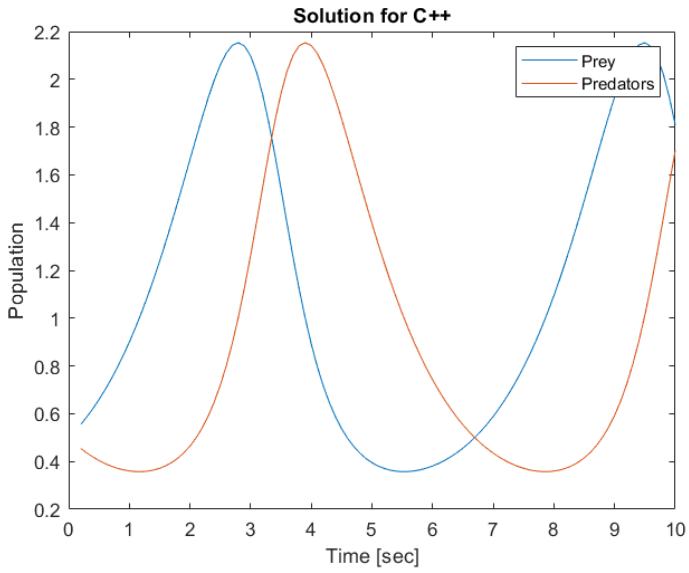

Figure 2: Solution with C++ method

When equation 1 is considered, change in population of preys is equal to difference between its own growth rate and the rate at which they killed by the predators. When equation 2 is considered, change population of predators is equal to difference how much they hunt the preys and their death rate. Therefore, the resulting solution forms a closed trajectory, and its reasons may be:

- Predator's supply depends directly on the number of prey group.
- The change rate of population is proportional to its size.