Department of Mathematics | University of Cape Coast, Ghana
MAT 407 - Numerical Analysis I | Assignment 2
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Submission date - Friday, 23th April, 2022

At the end of this assignment, you will learn;

i). Application of mathematical epidemiology and biology models.

ii). The final part will test your ability to to use fundamental control structures in Octave.

1. Consider the SIR model with vital dynamics and constant population

$$dS/dt = \Lambda - \mu S - \beta IS$$
$$dI/dt = \beta IS - \gamma I - \mu I$$
$$dR/dt = \gamma I - \mu R$$

   where S, I and R are susceptible, infected and recovered populations. Consider positive parameters, i.e. $\Lambda = 10 *$ group number, $\mu = 1/7, \beta = 1/3$ and $\gamma = 1/10$ for your work with initial values $S(0) = 100, I(0) = 8$ and $R(0) = 0$.

   (a) plot on the same graph the trajectories for S, I and R against time, t.
   (b) using **subplot**, plot for each trajectory S, I and R against time t.
   (c) using Newton's methods, compute analytically two (3) iterations for the model.

2. Consider a predator-prey (Lotka-Volterra) model for two species

$$dx/dt = ax - bxy$$
$$dy/dt = -cy + dxy$$

   where x and y are the number of preys and predators respectively, a is the prey growth rate, c is the predator death rate and b and d are the rates characterizing the effect of the predator-prey interactions on the prey death and the predator growth resp. Consider $a = 1.2, b = 0.6, c = 0.8$ and $d = 0.3$ Use initial conditions $x = 2$ and $y = 1$ and consider from t=0 to $t = 50$ using a step size of $h = 0.0625$.

   (a) plot x and y against time, t.
   (b) plot y against x.
   (c) using Newton's method, compute analytically three (3) iterations of the model.
   (d) Solve the model problem using Newton's method and plot the solutions.

3. Write an Octave function called **uccgrader** that takes student's exams score as input and displays their grade as output. e.g. >> uccgrader(82) should display **A**, Excellent.

Submit your assignment to the teaching assistant `Solomon Nortey` in a folder named after your group. Also, put your group number as comment in the codes.

Remark

- In the folder, you'll find an illustration of Lorenz equation.