

MCS 471 - Computer Project 4

A classical model used to study interacting populations is the Volterra-Lotka or predator-prey model. Let $y_1(t)$ be the population size of the prey (e.g. rabbits) and $y_2(t)$ be number of predators (e.g. foxes). The dynamics of the populations are described by the system of differential equations:

$$\begin{aligned}y_1' &= ay_1 - by_1y_2, & y_1(0) &= 80 \\y_2' &= -cy_2 + dy_1y_2, & y_2(0) &= 30\end{aligned}$$

where $a = 0.25$, $b = 0.01$, $c = 1.0$ and $d = 0.01$.

1. Write a Matlab program to implement Euler's method to approximate the solution of the system from $t = 0$ to $t = 80$. You should use both $h = 0.4$ ($n = 200$) and $h = 0.1$ ($n = 800$). Graphically display each result in the phase plane (y_1, y_2) . Your program should be a script with all the necessary steps included. Generate two plots.
2. Use the Matlab command `ode45` to construct a numerical solution to the system for t in $[0,80]$ and graphically display the results. Below is some sample code describing the implementation of `ode45`.

```
% sample driver program
options = odeset('RelTol',1e-4,'AbsTol',[1e-4 1e-4]);
tinterval = [0 80];
ic1 = [80 30];
[ta,ya] = ode45(@prey,tinterval,ic1,options)
plot(ya(:,1),ya(:,2))
```

Below is a separate function file

```
function yprime = prey(t,y)
yprime = [a*y(1) - b*y(1)*y(2), -c*y(2) + d*y(1)*y(2)];
```

3. Explain the differences in the your Euler's method solution and the solution found using `ode45`.