

MAL7080 Mathematical Modeling and Simulations

10 marks

Tutorial 2

Due date: 5 April, 2024

- You need to submit this tutorial in Jupyter notebook form.
- Late submissions will not be considered.
- We will have an online lab session on this portion on 6 April. You should have working code with you before that.

1. Implement the following initial value problem (IVP) solvers:

- (a) The forward Euler method
- (b) The mid-point method
- (c) The Heun method
- (d) The RK-4 method

2. Using the above solvers, solve the following IVPs. Play with discretization parameter to get reliable numerical solution. Plot the solution for different values of the discretization parameter and for different numerical method. In all cases, interpret your result.

- (a) $\frac{dP}{dt} = rP \left(1 - \frac{P}{K} \right)$, $P(0) = 90$. Take $r = 5$, $K = 80$. Find the solution for $t \in [0, 200]$.
- (b) $my'' + cy' + ky = 0$, $y(0) = 0$, $y'(0) = 2$. Take $m = 10$, $k = 90$, $c = 10$. Take appropriate time interval.
- (c) $\ddot{x} + \mu(x^2 - 1)\dot{x} + x = 0$. $x(0) = 0$, $\dot{x}(0) = 2$. Take $\mu = 0, 2, -2$. Take appropriate time interval.

3. Solve the above equations using the in-built RK4 method. Discuss your observations.

—*— —*— —*—