

MA573 - Fall 2019 Homework 2 - Due September 13th

Hirsh-Smale-Devaney Problems

Chapter 1: 2(b),2(d), 3(a),(c), 5,11,12, 13,

Additional Problem(s):

Problem 1: *We wish to test the Euler method on the simple initial value problem $x' = -x$, $x(0) = 1$.*

- (i) Find the solution analytically, and calculate the exact value of $x(1)$.*
- (ii) Write up Euler's method for this equation in the coding language of your choice. With step size $\Delta t = 1$, estimate $x(1)$ numerically; call it $\tilde{x}_0(1)$. Repeat using the step-sizes $\Delta t = 10^{-n}$ to obtain new approximations $\tilde{x}_n(1)$, of $x(1)$ for $n = 1, 2, 3, 4, 5$*
- (iii) Plot the error, $E = |\tilde{x}_n(1) - x(1)|$, between approximate and actual solution as function of the step-size Δt . Now plot $\log E$ vrs. $\log t$ and explain the results.*
- (iv) Repeat parts (ii) - (iii) for the Improved Euler's method and the Runge-Kutta method, comparing all three methods.*
- (v) (optional, but will be useful later on) Also try using one of MATLAB's built in solver packages such as "ode45" (which is a fancier version of the Runge-Kutta method) or "ode15s."*

Provide all of your codes at the end of your write-up.