

Math 3120 - Differential Equations II

Homework #4 – Due end of term

Hand in printouts of all program listings as well as output with the homework assignment. You can use the command `diary filename` to store your session in a text file `filename`. Use `diary off` when you are done. To put more than one plot on a graph type `hold on` between plot commands. Let me know if you have any issues with the computers.

1. Consider the initial value problem,

$$y' = \frac{2y}{t} - \frac{3y^2}{t^3}, \quad 1 \leq t \leq 2, \quad (1a)$$

$$y(1) = 1. \quad (1b)$$

The exact solution to (1) is $y(t) = \frac{t^2}{1+3\ln(t)}$.

- (a) Approximate the solution to (1) using Euler's method with $h = .02$ and $h = 0.01$. Verify that the global error is $O(h)$.
 - (b) Approximate the solution to (1) using a Runge-Kutta method of order 2 with $h = .02$ and $h = 0.01$. Verify that the global error is $O(h^2)$.
2. Use the built in routines `lsode` in Octave or `ode45` in Matlab or any other ready made software to find a approximation to the solution to the differential equation

$$y'' + y = \sin(t), \quad y(0) = 0, \quad y'(0) = 0$$

for $0 \leq t \leq 1$. Compare the results to the exact solution $y(t) = \frac{\sin(t) - t \cos(t)}{2}$.