Math 336 Ordinary Differential Equations Written Assignment 2

Numerical Methods For First Order Equations

1   Reading assignment

Read chapter 9 from the book.

2   Problem set (due Thursday October 15 2015)

1. Section 9.2 problems 2, 4, 7, 8.

2. Section 9.3 problems 2, 4, 6.

3. Section 9.4 problems 2, 4.

4. Section 9.5 problems 2, 4, 7 (use ODE45 in Matlab, and compare to Runge-Kutta).

3   Matlab assignment

1. For ALL the problems above, write Matlab routines that produce:

   (a) (**Tabular results**) A table that specifies the step size h, the exact solution values, and the numerical solution values, the error, for the various methods (Euler, improved Euler, Runge-Kutta) used.

   (b) (**Graphing**) Graphs, with appropriate labels and titles, that compare the numerical solution to the exact solution for various step sizes. Plot a separate graph for each of the three numerical methods. (So for each ODE you have to submit three graphs one corresponding to each numerical method. Each graph should contain the exact solution, and numerical solutions for various step sizes).

2. Consider the initial value problem (IVP) $y' = x^2 + y^2$, $y(0) = 1$. Do you know how to analytically solve this IVP? We can always attempt a numerical solution: Use Euler's method to approximate a numerical solution with $h = 0.1, 0.02, 0.05$. Do you encounter numerical instability? If yes why? Is there a way to avoid your instability?