MATH 3046, Differential Equations with Computer Lab
Spring 2017

Lab 10

The focus of this lab is using `ode45` to solve first-order differential equations involving parameters and to solve systems of first-order equations.

Example 1. Use `ode45` to approximate the solution of the IVP

$$x' = ax + b, \quad x(0) = 1, \quad 0 \le t \le 5,$$

where $a = 2$ and $b = 1$, and plot the solution.
Note: Parameters must be included in the declaration statement of the function file.

Example 2. Use `ode45` to approximate the solutions of the following systems, and plot the solutions:

(a) $x' = y, \quad y' = x, \quad x(0) = 1, \quad y(0) = 2, \quad 0 \le t \le 3$

(b) $x' = y - \sqrt{x}, \quad y' = -x - 2xy, \quad x(0) = 0, \quad y(0) = 1, \quad 0 \le t \le 25$

Note: To use `ode45` for a system of first-order equations, the function file must return a column vector containing the right-hand side functions for the equations in the system.

1. Use `ode45` to approximate solutions of

$$P' = rP\left(1 - \frac{P}{N}\right) - H$$

with $P(0) = 10, 20, 30, \ldots, 150$ for

(a) $r = 0.4, N = 100$, and $H = 2$

(b) $r = 0.15, N = 1000$, and $H = 1$

(c) $r = 0.5, N = 50$, and $H = 4$

Plot the solutions for a specific set of parameters on the same coordinate axes (choosing a range of values for t that shows the long term behavior of solutions).

2. Use `ode45` to approximate the solutions of the following systems, and plot the solutions:

(a) $x' = x + 3y, \quad y' = 4x + 2y, \quad x(0) = -1, \quad y(0) = 2, \quad 0 \le t \le 1$

(b) $x' = \frac{1}{5}(x + y)(1 - y), \quad y' = -x(1 - y^2), \quad x(0) = 1, \quad y(0) = 2, \quad 0 \le t \le 2$