Name:_____

Evaluation 7

Introductory Programming
Fall 2005

According to my friend the Wikipedia, "The Lorenz attractor, introduced by Edward Lorenz in 1963, is a non-linear three-dimensional deterministic dynamical system derived from the simplified equations of convection rolls arising in the dynamical equations of the atmosphere. For a certain set of parameters the system exhibits chaotic behavior and displays what is today called a strange attractor..."

The system is described by these three differential equations:

$$\frac{dx}{dt} = \sigma(y - x) \tag{1}$$

$$\frac{dy}{dt} = x(r - z) - y \tag{2}$$

$$\frac{dz}{dt} = xy - bz \tag{3}$$

Common values for the parameters are $\sigma = 10$, $b = 8/3$ and $r = 28$.

1. We would like to use `ode45` to estimate a solution to this system of equations. The first step is to fill in the body of this function:

```
function dVdt = f(t, V)
% t is time; V is a vector with three components, x, y, z.
% this function should return a column vector with the three
% components dx/dt, dy/dt and dz/dt
```

More questions on the back!

2. If the previous function were in a file named `lorenz.m`, how would you call it from the command line in order to evaluate the derivatives at $t = 0$ with the values $x = 1$, $y = 2$ and $z = 3$?

3. Assuming that Step 2 works, how would you use `ode45` to estimate the solution for the time interval $t_0 = 0$, $t_e = 30$ with the initial condition $x = 1$, $y = 2$ and $z = 3$.