AMSC/CMSC 660 Quiz 8 , Fall 2004

1. (10) Let

$$y'' = y' + 6y$$

with $y(0) = 2$ and $y(1) = 3$. Let $h = 1/5$, and write a set of finite difference equations that approximates the solution to this problem at $t = jh$, $j = 0, \ldots, 5$.

Answer: Let y_j approximate $y(jh)$. Then

$$\begin{aligned} y_0 &= 2 \\ \frac{y_{j-1} - 2y_j + y_{j+1}}{h^2} &= \frac{y_{j+1} - y_{j-1}}{2h} + 6y_j \\ y_5 &= 3 \end{aligned}$$

where $j = 1, 2, 3, 4$.

2. (10) Let

$$\begin{aligned} y_1' &= 6y_2 - y_1 \\ y_2' &= y_1^2 - y_2 \end{aligned}$$

with $y_1(0) = 2$ and $y_1(1) = 3$. Write Matlab code to solve this problem using the shooting method. You may use `ode45` and `fzero`.

Answer:

```
initval = fzero(@g, 2); % finds the missing initial value
[t,y] = ode45(@f,[0,1],[2,initval]); % finds the solution to the ode

function fval = f(t,y)
fval = [6*y(2) - y(1)
        y(1)^2 - y(2)];

function gval = g(z)  % assuming z is a scalar value
[t,y] = ode45(@f,[0,1],[2,z]);
gval = y(end,1) - 3;
```