

## 18.085 MATLAB 1

printouts and short conclusion due Monday Sept 17

This homework is about convection-diffusion, an important equation. There will be a boundary layer of rapid change at one endpoint when the conditions are  $u(0) = u(1) = 0$  and the  $u'$  convection term dominates. The exact solution to  $-Du'' + u' = 1$  is  $u = x - (\exp(x/D) - 1)/(\exp(1/D) - 1)$ .

- 1) Graph that exact solution for  $D = 1/25$
- 2) Approximate  $-Du''$  as usual by  $DK/h^2$  (try 3 different values of  $h$ )
- 3) Approximate  $u'$  by centered and forward and backward differences (same  $h$ )
- 4) With  $\mathbf{f} = \mathbf{ones}(n,1)$  solve the matrix equations and label graphs of  $u$
- 5) Write a SHORT conclusion from your tests—which method(s) to use?