MAE 185 Final

Note Title 6/7/2006

Spring 2006.

The advection equation describes the concentration of a given material as a function of space and time under a given flow (wind). It is

$$\frac{\partial c}{\partial t} + u \frac{\partial c}{\partial x} = 0$$

$c \rightarrow$ concentration

$t \rightarrow$ time

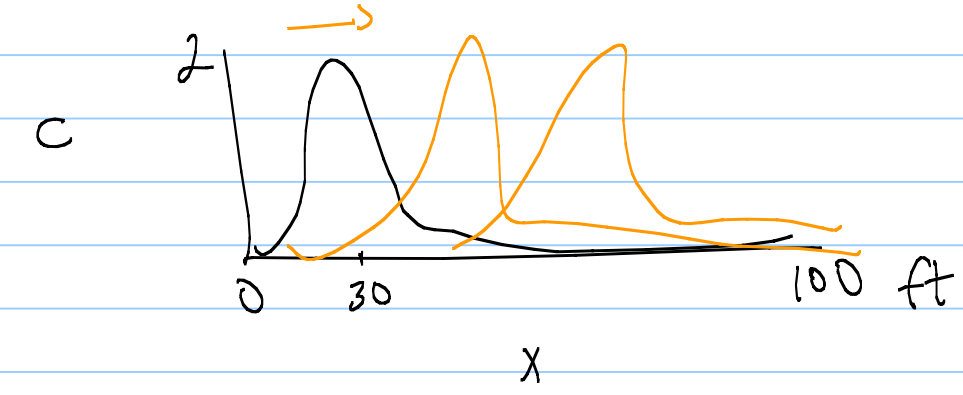
$u \rightarrow$ wind speed

$x \rightarrow$ space

The initial conditions of the problem of interest are:

$$c(t=0, x) = \begin{cases} 1 + \cos\left(\pi\left(\frac{x-30}{5}\right)\right) & 25 < x \leq 35 \\ 0 & \text{otherwise} \end{cases}$$

Namely, the initial conditions is a "cosine hill" more or less like this



The boundary conditions are

$$c(x=0, t) = c(x=100, t) = 0$$

Note $x = 0 \rightarrow 100$ ft

$t = 0 \rightarrow 30$ minutes

① Solve the advection PDE using an explicit approach, fully implicit and Crank-Nicholson scheme

Plot c vs. t for $t = 0, \frac{1}{4}, 30$ min for each case. $u = 2$ ft/min.

Report the C.P.U. time consumed for each case.

In brief, for ① there is a total of 9 plots required. You must also e-mail your code to the T.A. and write a brief discussion of results.

Extra-credit

Same as ① but $u = t/20 \frac{ft}{min}$