

MSDM5004 Spring 2024

Project 1 Part II

Due Apr. 7

2. Consider the equation $u_t + u_x = 0$ in $x \in (-1, 1)$. Assume the initial condition is

$$u_0(x) = \begin{cases} 1 & x \leq 0 \\ 0 & x > 0 \end{cases}$$

Use the boundary conditions $u(-1, t) = 1$ and $u(1, t) = 0$ (The latter is not valid after the jump moves out of the simulation region, but we are not going to compute the solution after that time). Choose $\nu = 0.5$. Compute and plot the solution at time $t = 0.5$, using

(1) upwind method, $\Delta t = 0.01$ and $\Delta t = 0.0025$,

(2) Lax-Wendroff method, $\Delta t = 0.01$ and $\Delta t = 0.0025$.

(3) Compare the results with the exact solution and discuss the behavior of these numerical solutions.

Remark: I would like to see four figures (two methods and two Δt 's), with the exact solution plotted in each figure.