MTH4033 HW2 (Fall 2022)

Professor Youngjoon Hong — Due Date: October. 05 (3:00 pm)

Problem 1 *(Theory) Show that the BTCS (backward-time central-space) scheme is consistent with equation* $u_t + au_x = 0$ *and is unconditionally stable.*

Problem 2 *(Theory) Show that the box scheme*

$$\frac{1}{2k}\left[(v_m^{n+1} + v_{m+1}^{n+1}) - (v_m^n + v_{m+1}^n)\right] + \frac{a}{2h}\left[(v_{m+1}^{n+1} - v_m^{n+1}) + (v_{m+1}^n - v_m^n)\right] = 0$$

is consistent with the one-way wave equation $u_t + au_x = 0$. *Describe numerical stability with respect to* λ *for this scheme.*