

**Exercise Sheet 11 to the Lecture Course “Computational Finance”**  
(von Neumann’s Stability Analysis and TVD Property)

**Task 1 (Upwind Scheme)** (5 Points)

Apply von Neumann’s stability analysis to

$$\frac{\partial u}{\partial t} + a \frac{\partial u}{\partial x} = b \frac{\partial^2 u}{\partial x^2}, \quad b > 0$$

using the upwind scheme for the left-hand side and the centered second-order difference quotient for the right-hand side.

**Task 2 (TVD of a Model Problem)** (5 Points)

Analyze whether the upwind scheme (6.22), the Lax-Friedrichs scheme (6.25) and the Lax-Wendroff scheme (6.30) applied to the scalar partial differential equation

$$u_t + au_x, \quad a > 0, \quad t \geq 0, \quad x \in \mathbb{R}$$

satisfy the TVD property.

*Hint:* Apply Lemma 6.3.

- **Return** the solutions until Monday, January 30, **before** the lectures.