



Computational Finance - Exercise Sheet 9

Exercise 1 Recall the 6 point scheme. Draw the points for the explicit/implicit Euler schemes and the Crank Nicolson time stepping scheme.

Exercise 2 Implement the Crank-Nicolson time stepping scheme for the heat equation on $(0, 1)$ and time $T = 0.03$ with right-hand side given by $f(t, x) = \sin(2\pi x)$, initial value $u_0(x) = \sin(\pi x)$ and homogenous boundary conditions ($u_1 = u_2 = 0$). Plot the error

$$\max_{i,k} |u(t^k, x_i) - u_i^k|$$

in dependence on the step size h for a constant step size Δt and the other way around. Hint: compute the reference solution $u(t^k, x_i)$ by the FD method on a finer grid, e.g. consider $N = 2^k$ for $k = 1, \dots, 5$ with fix $M = 2^6$ for the convergence study and compute the reference solution on $N = M = 2^6$. Use the backslash operator to solve the arising linear system of equations.