Numerical PDE HW 9

Mesh refinement and convergence

1. Create a mesh refiner that takes in a 2D triangular mesh and splits every edge into 2. Use this tool to generate a sequence of meshes for the square domain $0 \leq x_1 \leq 1$ and $0 \leq x_2 \leq 1$. Plot the coarsest and finest meshes you created and report the minimum/maximum angles, minimum/maximum edge lengths, and the number of vertices for all your meshes.

2. Verify that the solution of the PDE $\partial^{\{2,0\}} u + \partial^{\{0,2\}} u = \mathrm{Sin}[\pi\, x_1 / 2]\, \mathrm{Cos}[2\,\pi\, x_2]$ with homogeneous Dirichlet conditions at $x_1 = 0$ and Homogeneous Neumann on the other sides is a multiple of $\mathrm{Sin}[\pi\, x_1 / 2]\, \mathrm{Cos}[2\,\pi\, x_2]$. Show your computation and report the solution.

3. Verify that your solver produces appropriate convergence for the test problem in #2 for the meshes you created in #1. Show labelled graphs of the errors measures discussed in Chpt 4 as function of h on appropriate scales.