

MA4523 (Introduction of FEM) Project 1

1. Write a 1-D linear (piecewise) FEM subroutine (or function) for the following problem

$$\begin{aligned} -\frac{d}{dx} \left(p(x) \frac{du}{dx} \right) + q(x)u &= f(x) & x \in (a, b) \\ u(a) = a_0 & \quad u(b) = b_0 \end{aligned}$$

with user-input functions

$$p(x) > 0, \quad q(x) \geq 0, \quad f(x)$$

and parameters

$$a, b, a_0, b_0, N$$

where N is the number of elements. A uniform mesh with linear FEM should be used and the code should be designed for public users with any user-input data.

2. Use the subroutine to solve the problem with

$$p(x) = 1, \quad q(x) = \pi^2, \quad f(x) = \frac{5\pi^2}{4} \sin(\pi x/2) \quad a = 0, \quad b = 1, \quad a_0 = 0, \quad b_0 = 1$$

and $N = 10, 20, 40$, respectively.