Consider the model problem, with $f = x$, $g = 0$, and $h = 0$.

1. Compute the consistent global force vector $\mathbf{F}$ for a uniform mesh of $n_{\text{el}}$ linear elements. Write a program that accepts $n_{\text{el}}$ as input and outputs the force vector in a format that is suitable for your favorite finite element code.

2. Using the consistent global force vector computed in Item 1, solve the problem on uniform meshes of one, two, four, eight, and 16 linear rod elements (with suitable physical coefficients). Verify your results by superconvergence.

3. Plot the convergence of the error in the energy norm as a function of the mesh parameter on a log-log scale. The energy norm is simply the $H^1$ semi-norm in this case

$$ |u|_1^2 = \int_0^1 (u_x)^2 \, dx $$

Note: In case your code outputs the derivative (stress/strain) with insufficient digits, use

$$ u_{,x}^h = \frac{d_2^e - d_1^e}{h^e} $$