Author : Seyed mohammadreza Attar Seyedi

$a = 1, \nu = 0.2, 10$ **linear elements**

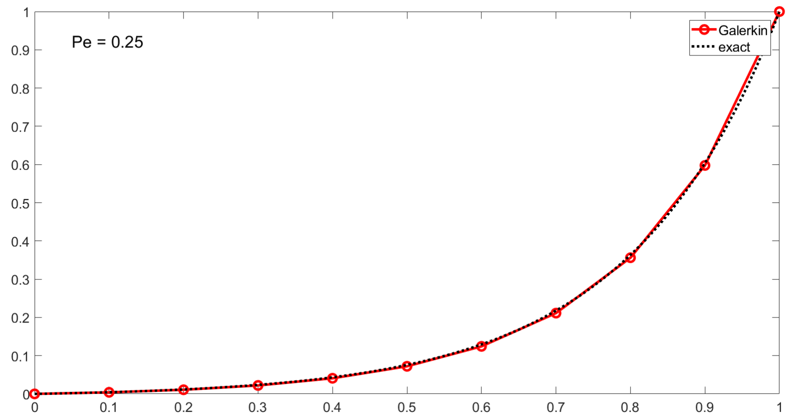

Figure 1: Galerkin

$a = 20, \nu = 0.2, 10$ **linear elements**

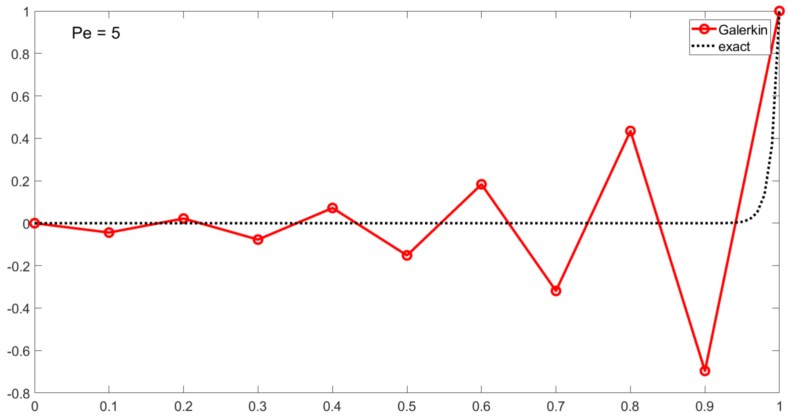

Figure 2: Galerkin

$a = 1, \nu = 0.01, 10$ **linear elements**

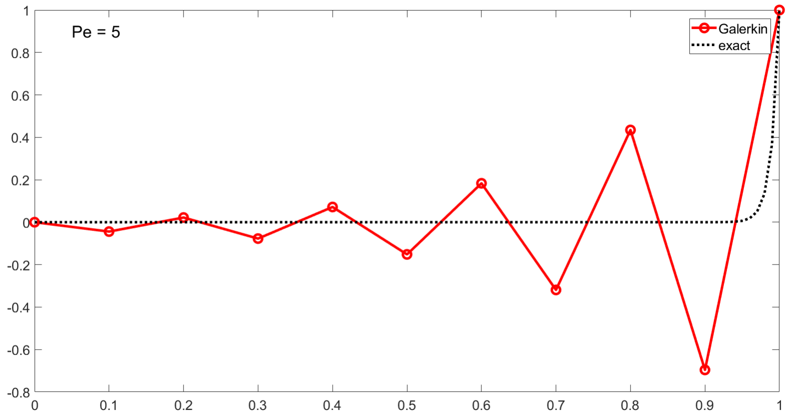

Figure 3: Galerkin

$a = 1, \nu = 0.01, 50$ **linear elements**

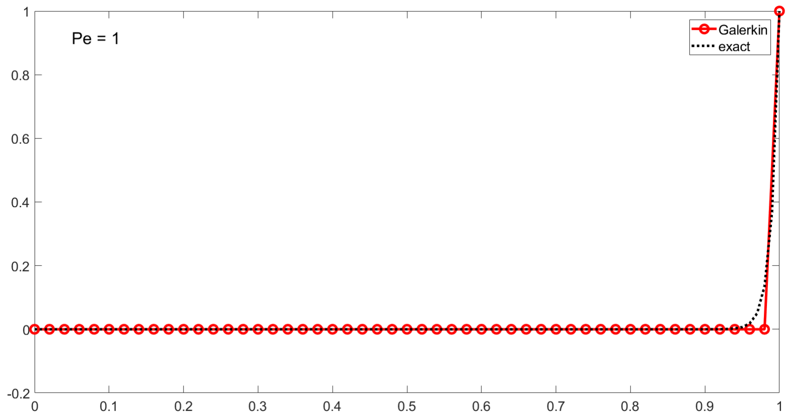

Figure 4: Galerkin

$a = 1, \nu = 0.2, 10$ **linear elements**

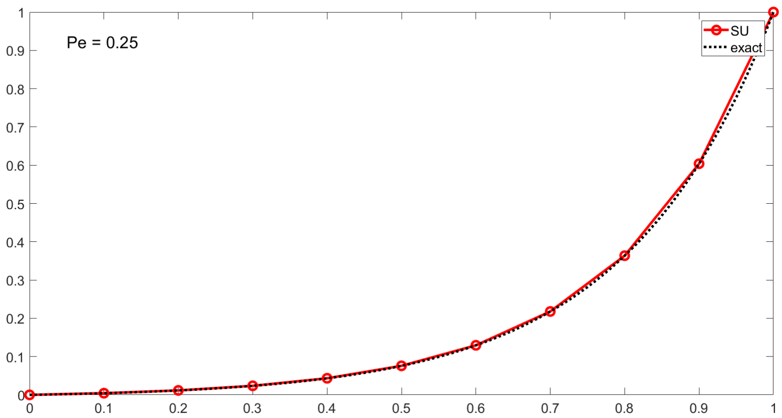

Figure 5: Streamline upwind

$a = 20, \nu = 0.2, 10$ **linear elements**

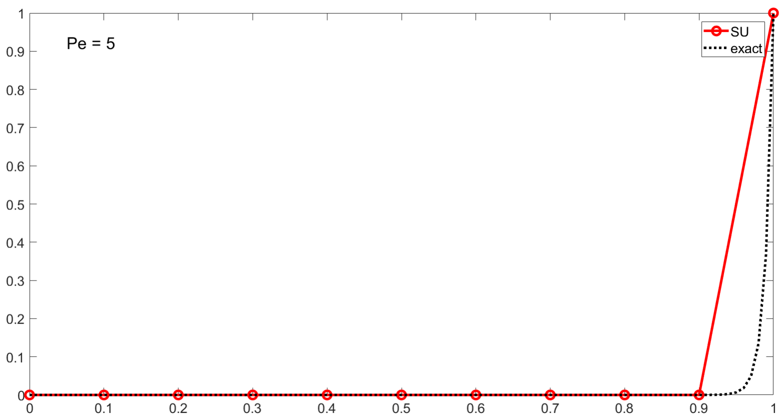

Figure 6: Streamline upwind

$a = 1, \nu = 0.01, 10$ **linear elements**

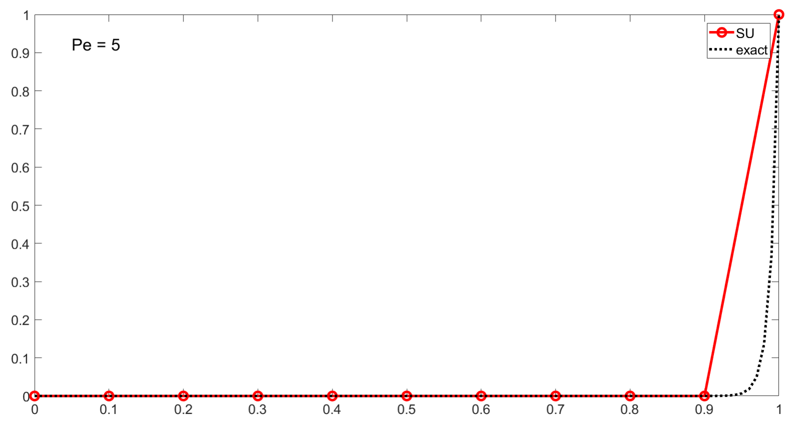

Figure 7: Streamline upwind

$a = 1, \nu = 0.01, 50$ **linear elements**

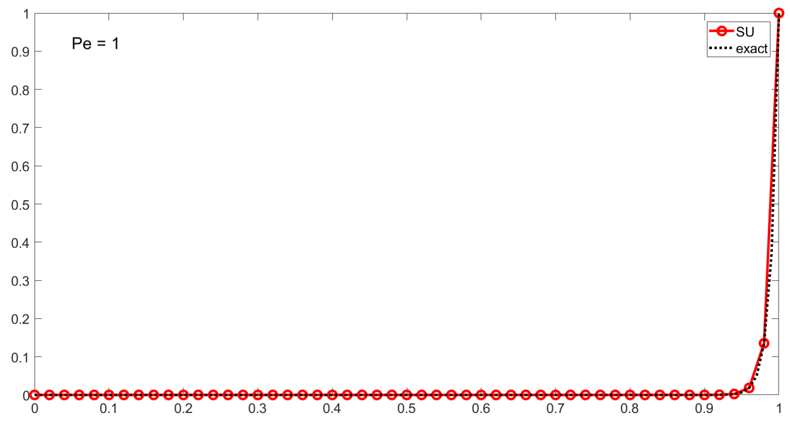

Figure 8: Streamline upwind

$a = 1, \nu = 0.2, 10$ **linear elements**

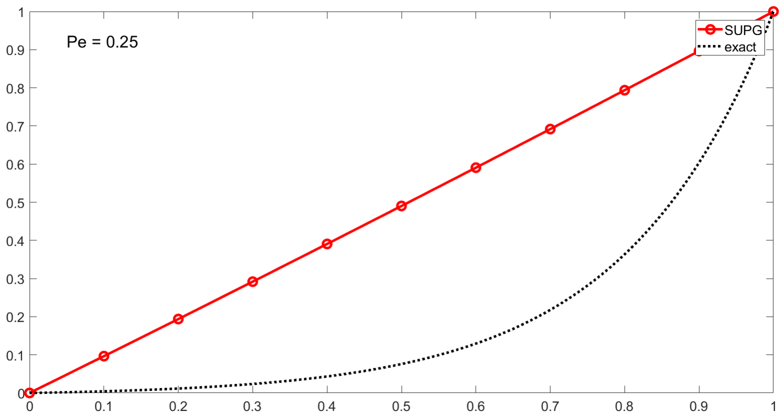

Figure 9: SUPG

$a = 20, \nu = 0.2, 10$ **linear elements**

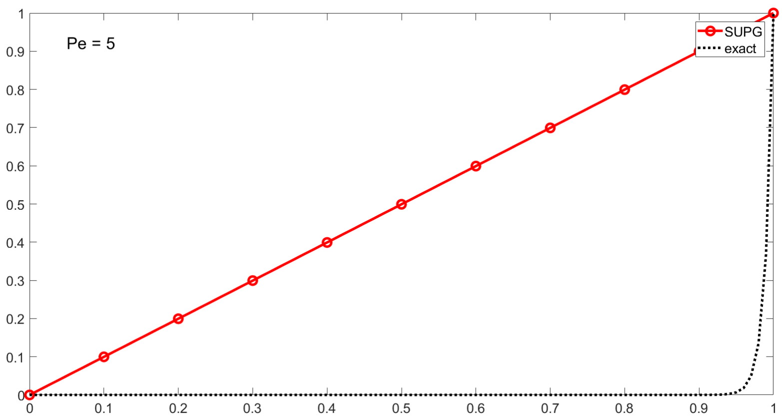

Figure 10: SUPG

$a = 1, \nu = 0.01, 10$ **linear elements**

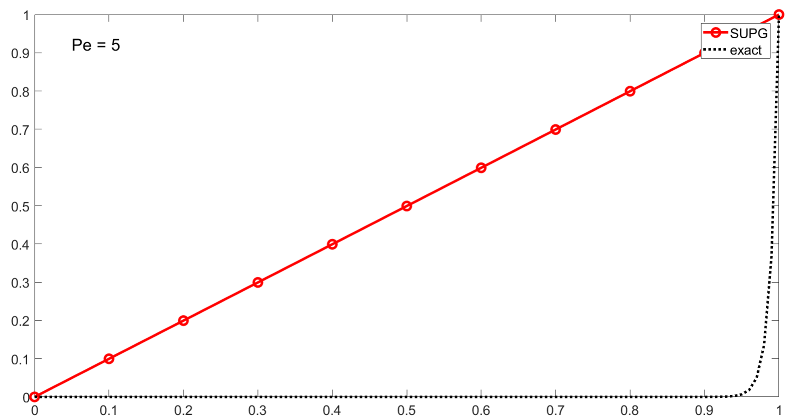

Figure 11: SUPG

$a = 1, \nu = 0.01, 50$ **linear elements**

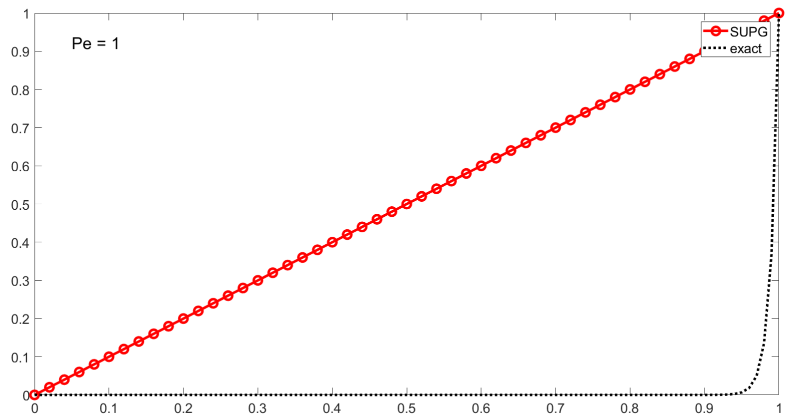

Figure 12: SUPG

$a = 1, \nu = 0.2, 10$ **linear elements**

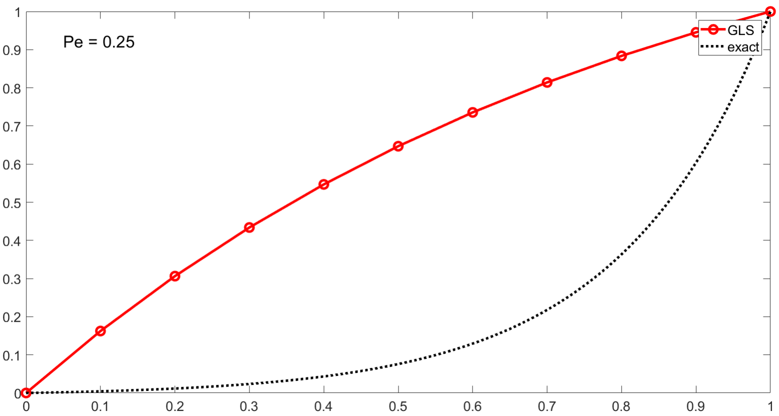

Figure 13: GLS

$a = 20, \nu = 0.2, 10$ **linear elements**

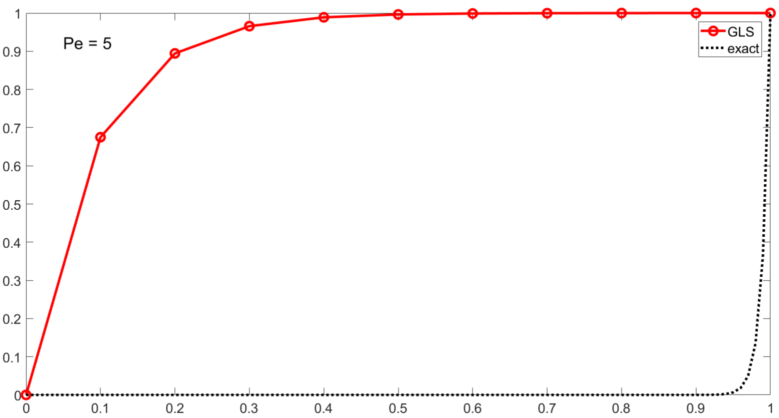

Figure 14: GLS

$a = 1, \nu = 0.01, 10$ **linear elements**

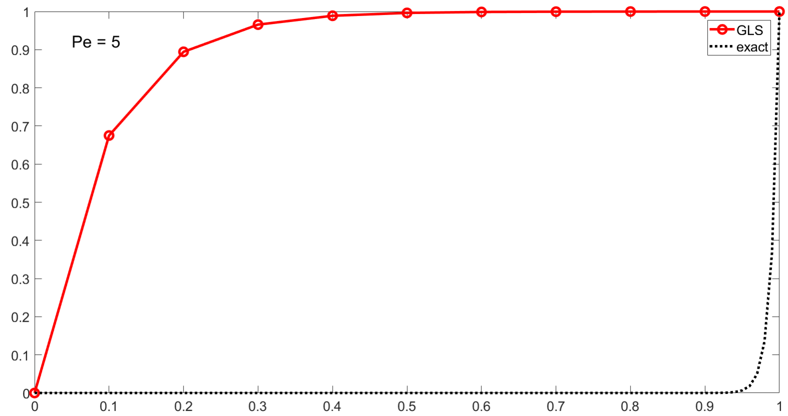

Figure 15: GLS

$a = 1, \nu = 0.01, 50$ **linear elements**

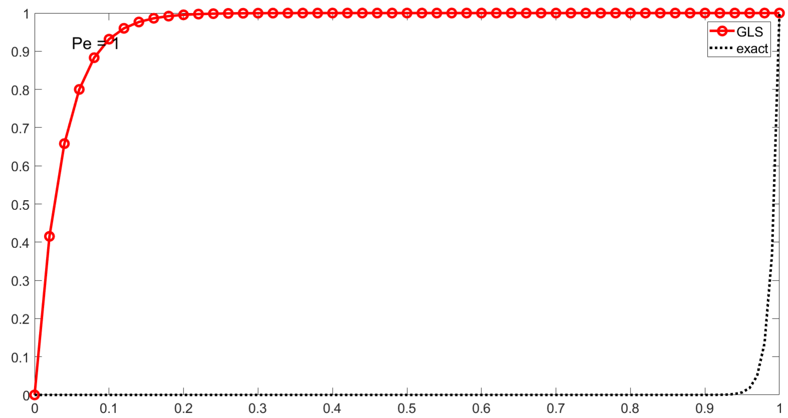

Figure 16: GLS

$a = 1, \nu = 0.2, 10$ **linear elements**

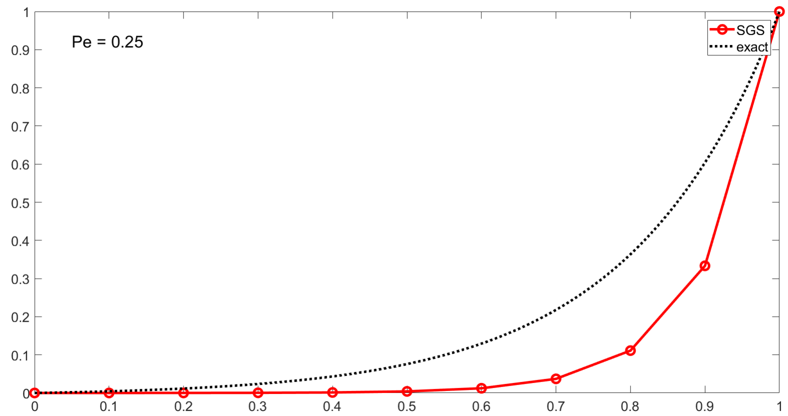

Figure 17: SGS

$a = 20, \nu = 0.2, 10$ **linear elements**

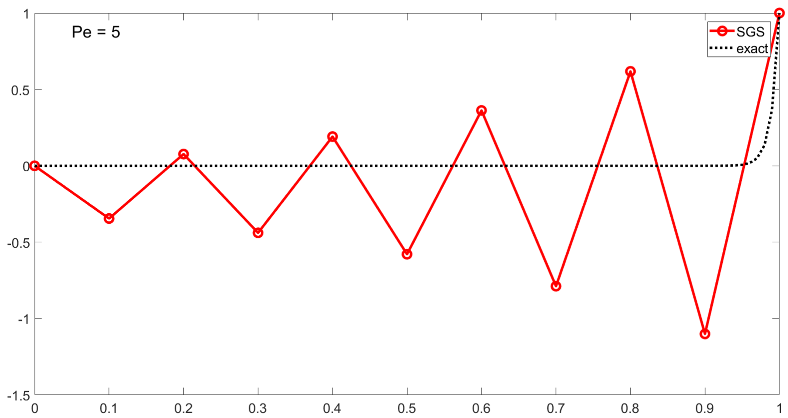

Figure 18: SGS

$a = 1, \nu = 0.01, 10$ **linear elements**

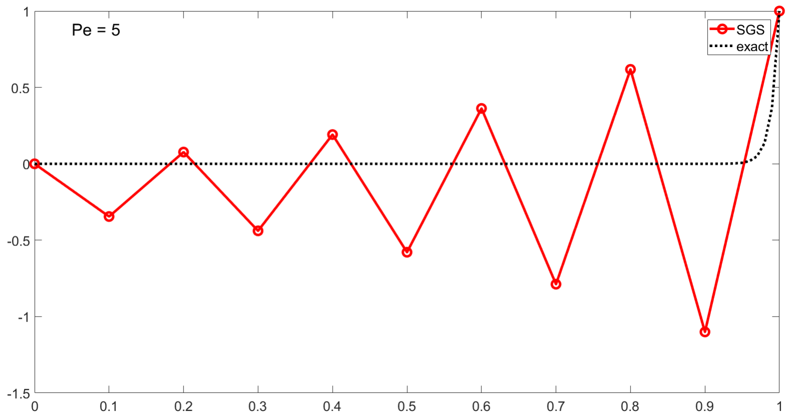

Figure 19: SGS

$a = 1, \nu = 0.01, 50$ **linear elements**

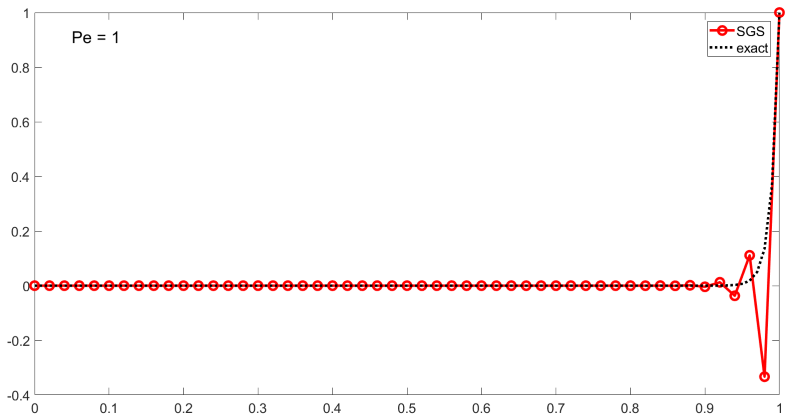

Figure 20: SGS

Galerkin approximation for large Peclet numbers the solution is stable and close to the exact solution and for low value of the Peclet number is accurate. SUPG is the definition of the stabilization parameter τ. The stability and convergence analysis of this method allows us to determine the behaviour of

τ .SUPG close to the exact solution and this method preforms better than SU.
GLS is defined by imposing that the stabilization term is an element by element weighted least squares formulation of the original differential equations. There is no major different between GLS and SUPG

Giving the exact result for all values of the Peclet number when approximation 1D linear convection equation by means of uniform mesh of quadratic finite elements. For small Peclet number, the exact solution varies rather smoothly over the entire domain. The stable and accurate results obtained with SUPG and SU is stable, but inaccurate.

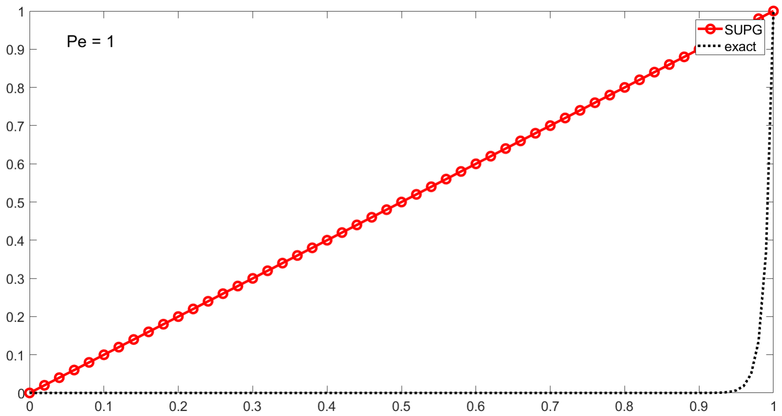

Figure 21: SUPG $\tau = 0.01$

Problem 3

$a = 1, \nu = 0.2, 10$ **linear elements**

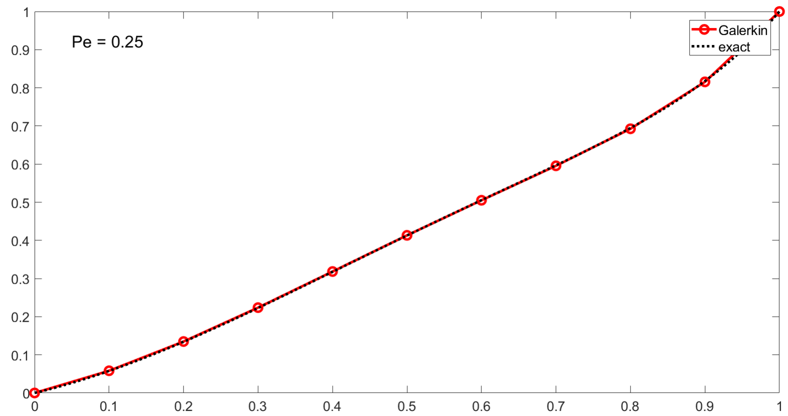

Figure 22: Galerkin

$a = 20, \nu = 0.2, 10$ **linear elements**

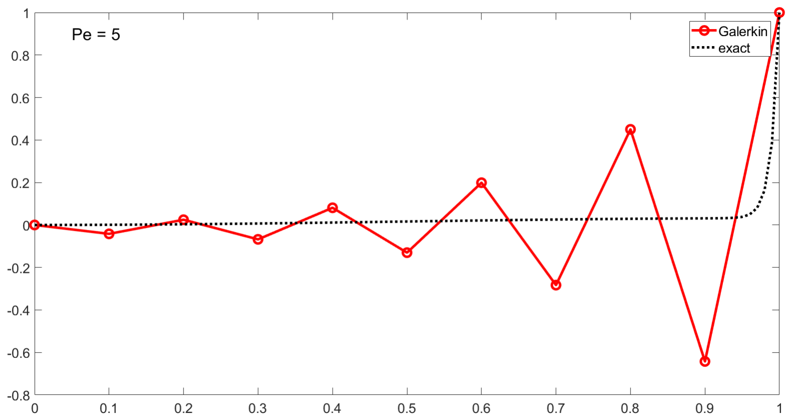

Figure 23: Galerkin

$a = 1, \nu = 0.01, 10$ **linear elements**

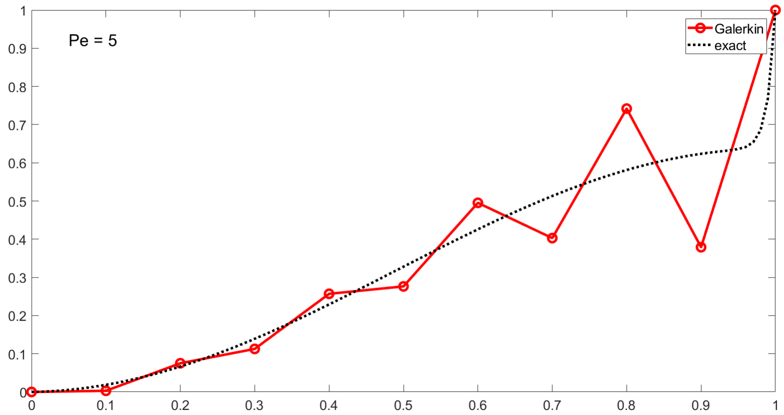

Figure 24: Galerkin

$a = 1, \nu = 0.01, 50$ **linear elements**

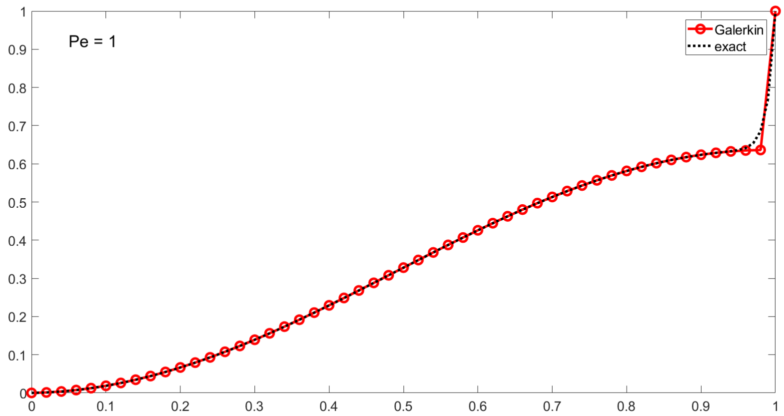

Figure 25: Galerkin

$a = 1, \nu = 0.2, 10$ **linear elements**

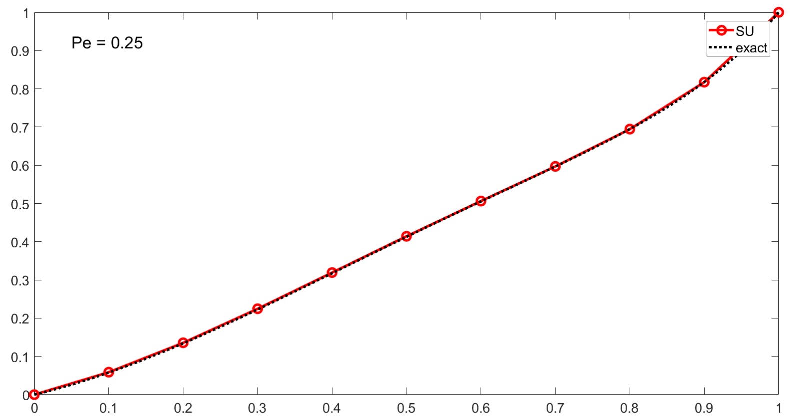

Figure 26: Streamline upwind

$a = 20, \nu = 0.2, 10$ **linear elements**

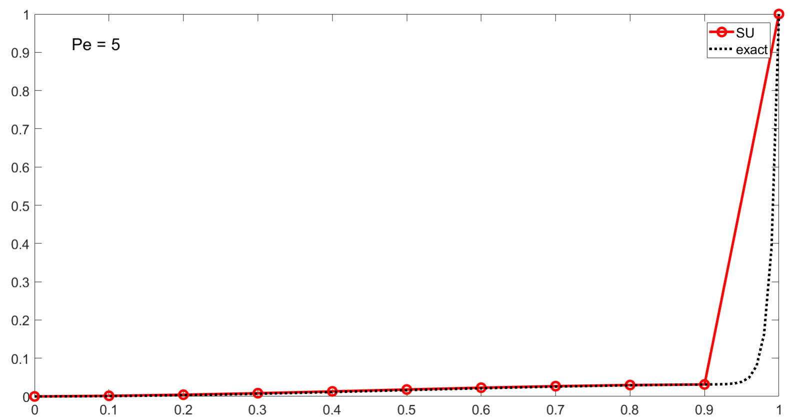

Figure 27: Streamline upwind

$a = 1, \nu = 0.01, 10$ **linear elements**

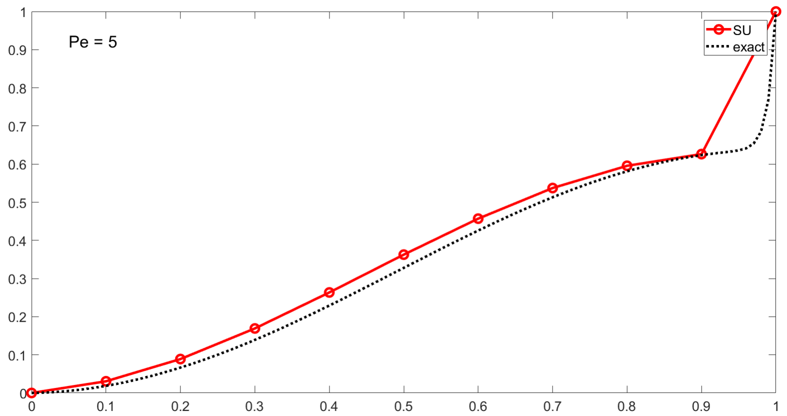

Figure 28: Streamline upwind

$a = 1, \nu = 0.01, 50$ **linear elements**

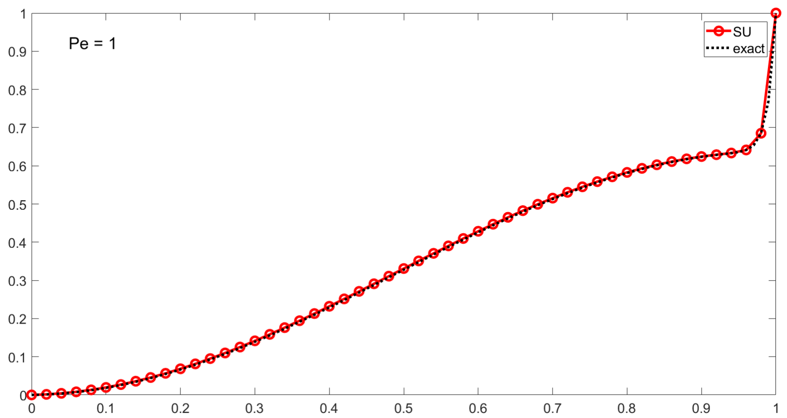

Figure 29: Streamline upwind

$a = 1, \nu = 0.2, 10$ **linear elements**

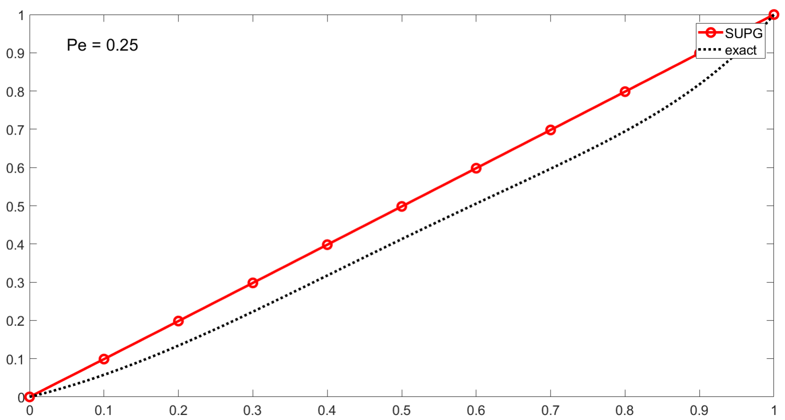

Figure 30: SUPG

$a = 20, \nu = 0.2, 10$ **linear elements**

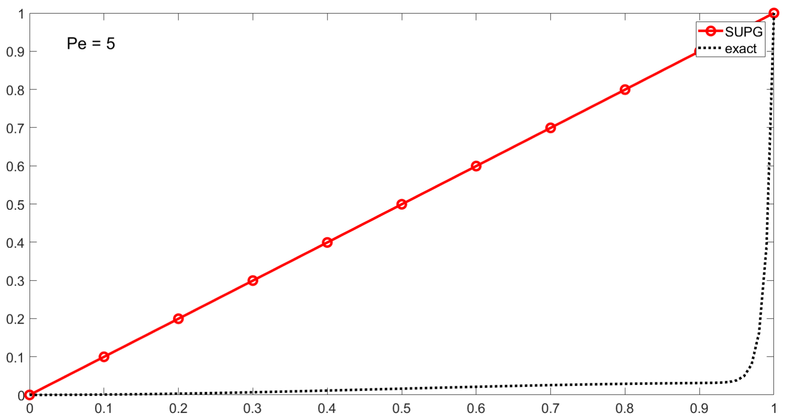

Figure 31: SUPG

$a = 1, \nu = 0.01, 10$ **linear elements**

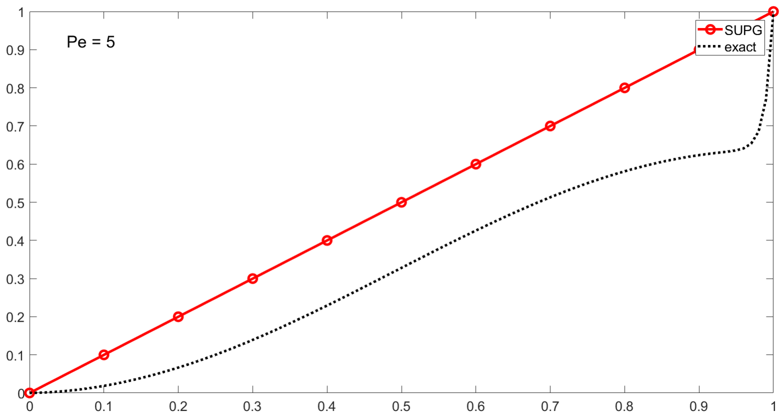

Figure 32: SUPG

$a = 1, \nu = 0.01, 50$ **linear elements**

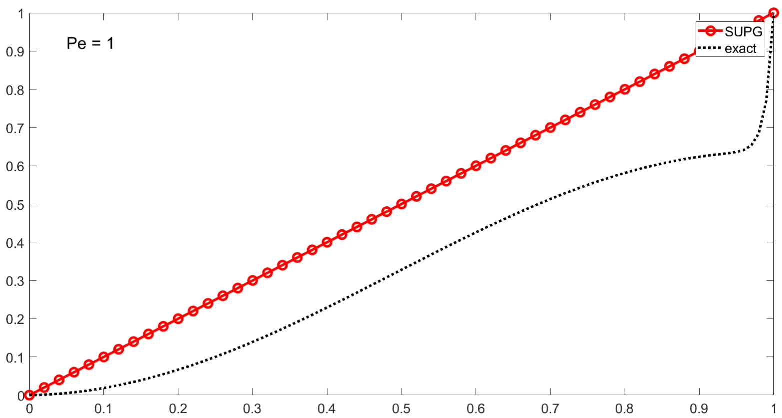

Figure 33: SUPG

$a = 1, \nu = 0.2, 10$ **linear elements**

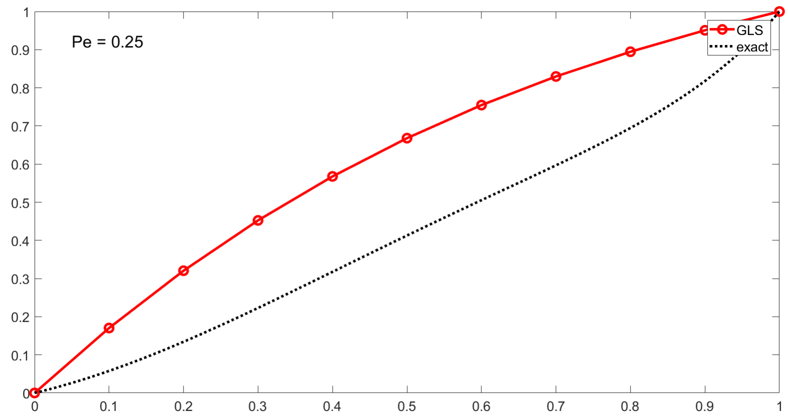

Figure 34: GLS

$a = 20, \nu = 0.2, 10$ **linear elements**

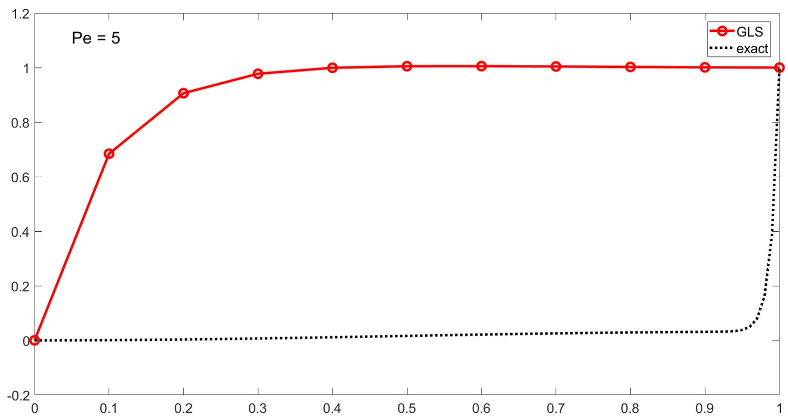

Figure 35: GLS

$a = 1, \nu = 0.01, 10$ **linear elements**

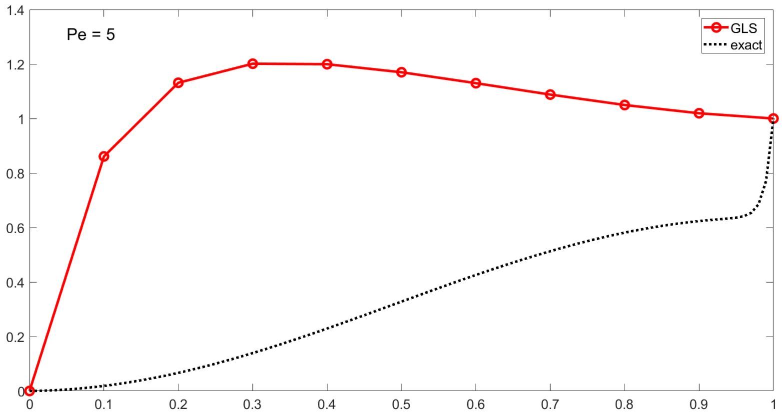

Figure 36: GLS

$a = 1, \nu = 0.01, 50$ **linear elements**

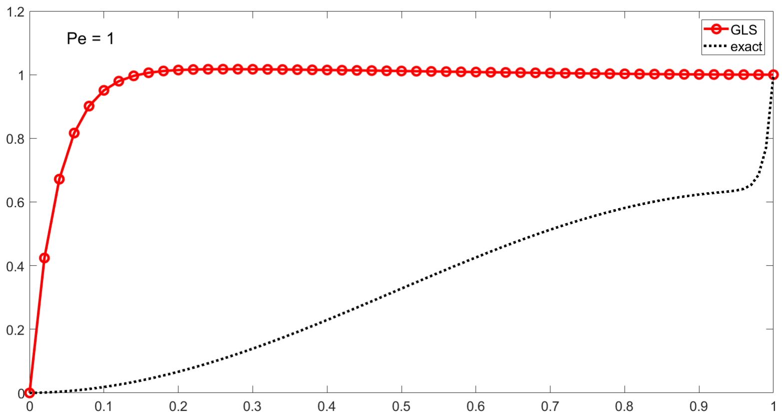

Figure 37: GLS

$a = 1, \nu = 0.2, 10$ **linear elements**

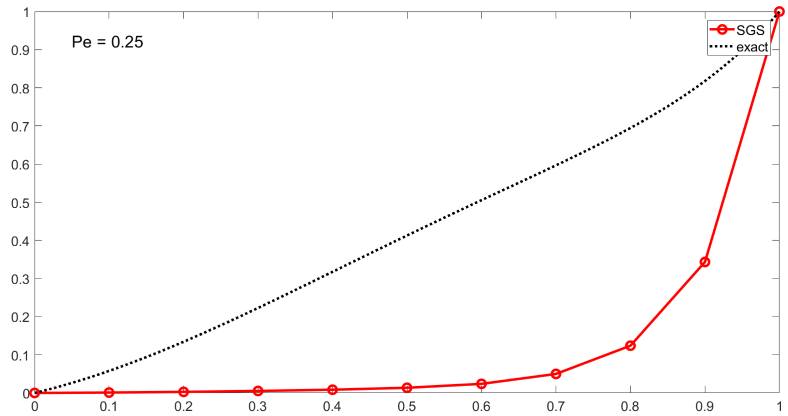

Figure 38: SGS

$a = 20, \nu = 0.2, 10$ **linear elements**

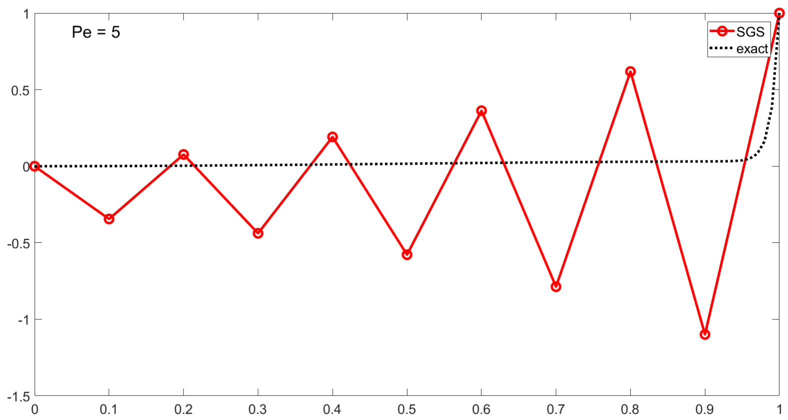

Figure 39: SGS

$a = 1, \nu = 0.01, 10$ **linear elements**

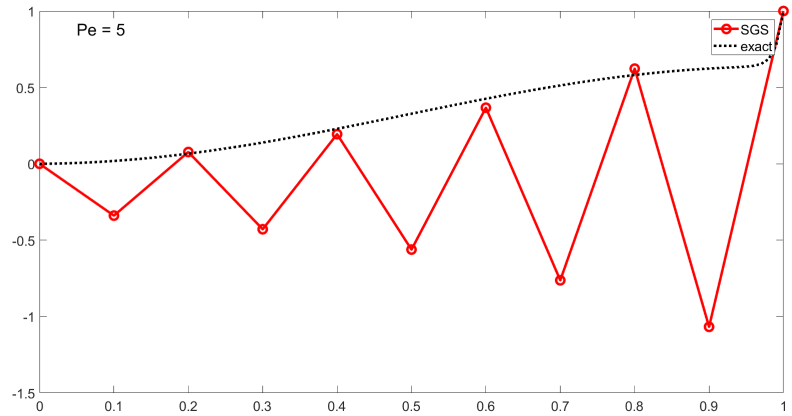

Figure 40: SGS

$a = 1, \nu = 0.01, 50$ **linear elements**

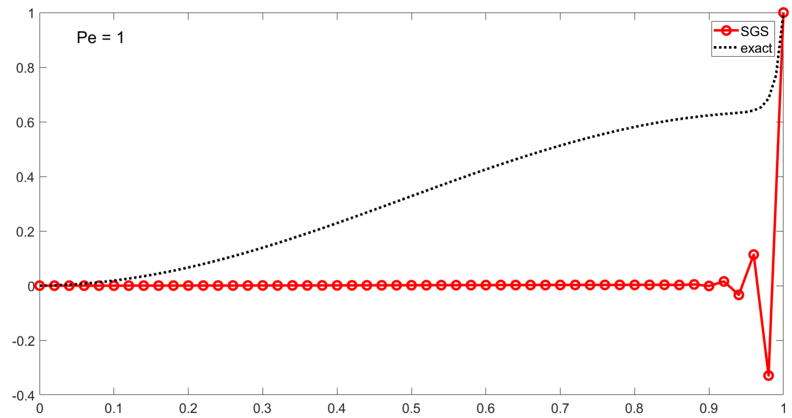

Figure 41: SGS

Galerkin method is not able to satisfactory resolve the discontinuity and produces spurious oscillation. SU and SUPG method yield better results.