Report 1: Steady Convection-Diffusion Problem

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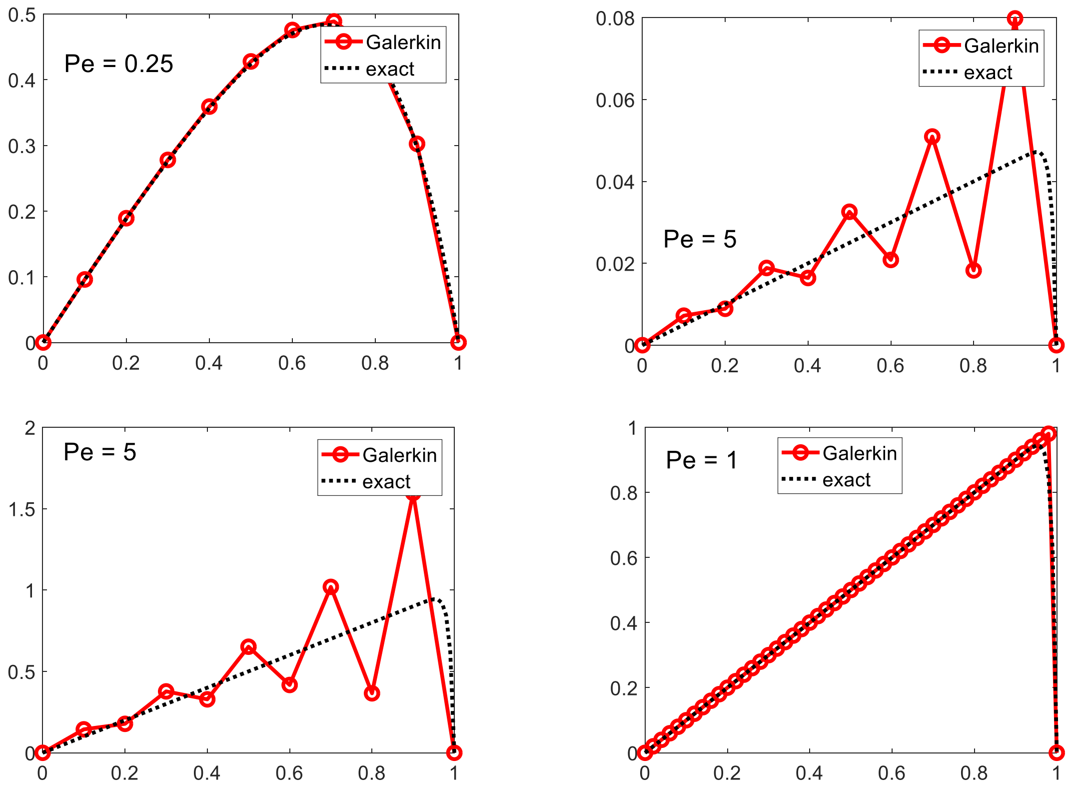
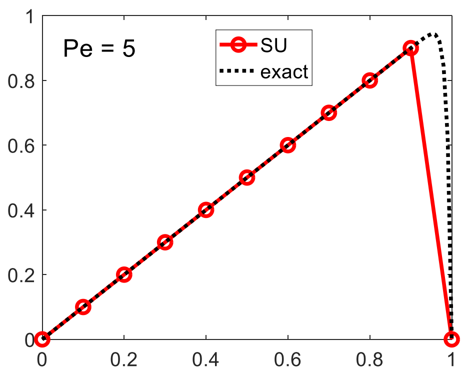
Galerkin method for source f=1



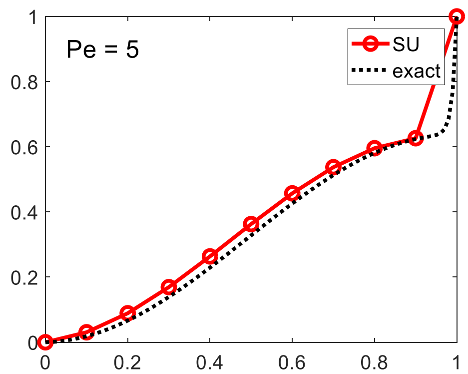
As was expected, for Pe>1 the behaviour of Galerkin method is oscillatory.

<u>SU – Streamline Upwind</u>

F= 1



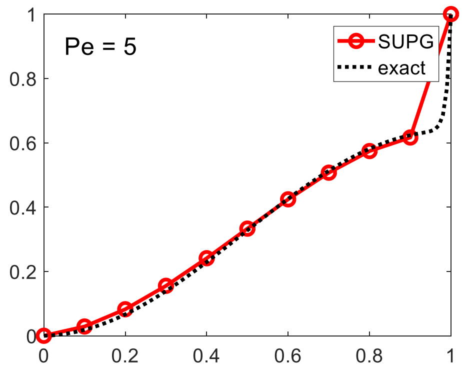
F=f(x)



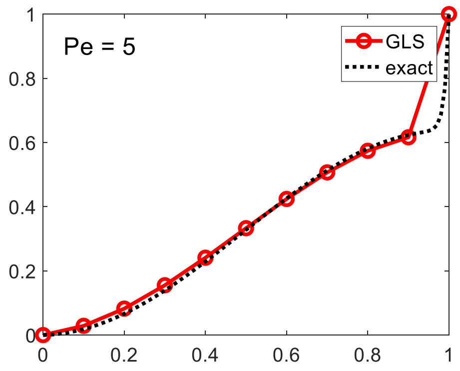
We can check the excact solution t nodes when the source term F is constant. By the way, for a variable source term, it is not possible get a desirable solution with SU method.

SUPG – Streamline Upwind Petrov-Galerkin & GLS Galerkin Least Square

F=f(x)



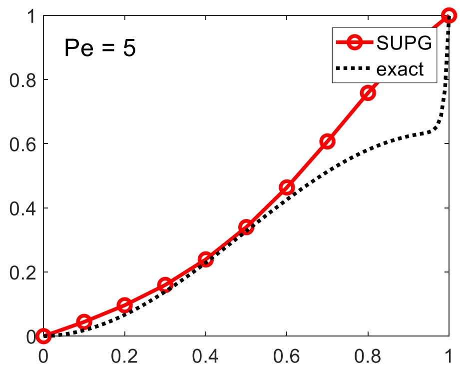
F=f(x)



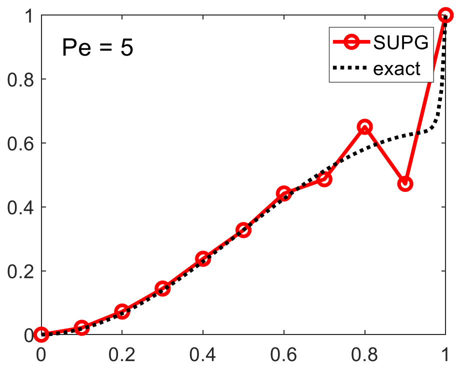
For linear elements both methods are the same, giving as it is expected the same results.

SUPG – Streamline Upwind Petrov-Galerkin

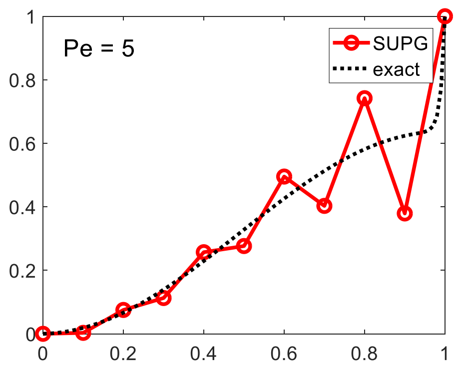
Tau = 1



Tau = 0.01



Tau = 0



With that plots, we can emphasise the importance of the parameter tau (stabilizing term)

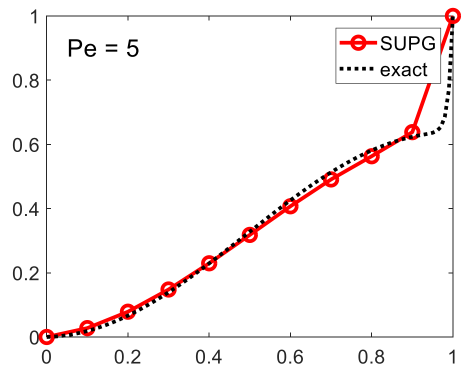
Code modified for GLS

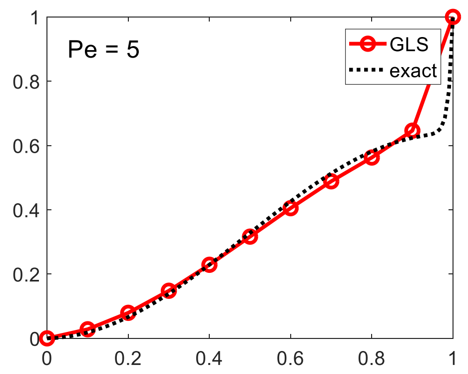
```
for ig = 1:ngaus
    N_ig = N(ig,:);
    Nx_ig = Nxi(ig,:)*2/h;
    N2x_ig = N2xi(ig,:)*4/(h^2);
    w_ig = wgp(ig)*h/2;
    x = N_ig*Xe; % x-coordinate of the gauss point
    s = SourceTerm(x,example);
    Ke = Ke + w_ig*(N_ig'*a*Nx_ig + Nx_ig'*nu*Nx_ig) ...
        + w_ig*((a*Nx_ig-nu*N2x_ig)'*tau*(a*Nx_ig-nu*N2x_ig-s));

    fe = fe + w_ig*(N_ig)'*s;
```

Code modified for SUPG

```
for ig = 1:ngaus
    N_ig = N(ig,:);
    Nx_ig = Nxi(ig,:)*2/h;
    N2x_ig = N2xi(ig,:)*4/(h^2);
    w_ig = wgp(ig)*h/2;
    x = N_ig*Xe; % x-coordinate of the gauss point
    s = SourceTerm(x,example);
    Ke = Ke + w_ig*(N_ig'*a*Nx_ig + Nx_ig'*nu*Nx_ig) ...
        + w_ig*(tau*a*Nx_ig)'*(a*Nx_ig-nu*N2x_ig-s);
    fe = fe + w_ig*(N_ig)'*s;
end
```

For Quadratic element with P = 2






```
% Discretization
disp(' ')
nElem = cinput('Number of elements',10);
nPt = 2*nElem + 1;
h = (dom(2) - dom(1))/nElem;
X = (dom(1):h/2:dom(2))';
T = [1:2:nPt-2; 2:2:nPt-1; 3:2:nPt]';
```