DEPARTMENT OF MATHEMATICS
IIT GUWAHATI

MA 473 Computational Finance Lab – IX Date: 01.10.2024

1. Consider the following American put option problem:

$$\begin{cases} \dfrac{\partial V}{\partial t} + \dfrac{1}{2}\sigma^2 S^2 \dfrac{\partial^2 V}{\partial S^2} + (r-\delta) S \dfrac{\partial V}{\partial S} - rV = 0, \quad (0,\infty) \times (0,T],\ T > 0 \\ \text{with suitable initial and boundary (free boundary) conditions.} \end{cases}$$

   (a) Solve the transformed PDE $y_\tau = y_{xx}$ of the above IBVP by using the Backward-Time and Central Space (BTCS) Scheme and the Crank-Nicolson finite difference scheme.

   (b) Plot $V(S,t)$ for $T = 1$, $K = 10$, $r = 0.25$, $\sigma = 0.6$, $\delta = 0.2$, and the payoff.

   (c) Solve the problem by using Δx and $\Delta \tau$, and $\Delta x/2$ and $\Delta \tau/2$ and calculate the error between these two numerical solution. Plot the error.

   (d) Also calculate the error mentioned above for different values of $\Delta x/2$ and $\Delta t/2$ and plot N *versus* the maximum absolute error.

The output files should contain the following for above problem:

i) Plot of the numerical solution $V(S,t)$ and pay-off.

ii) Error between the numerical solutions of parts (c) and (d) and the plot of the error(s).
