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Q)

A) Solve the above modified Black-Scholes PDE for $\varepsilon = 10^{-2}$, 10^{-4} and 10^{-6} by the following schemes:

- (i) Forward-Euler for time & central difference for space (FTCS) scheme.
- (ii) Backward-Euler for time & central difference for space (BTCS) scheme.
- (iii) Crank-Nicolson finite difference scheme

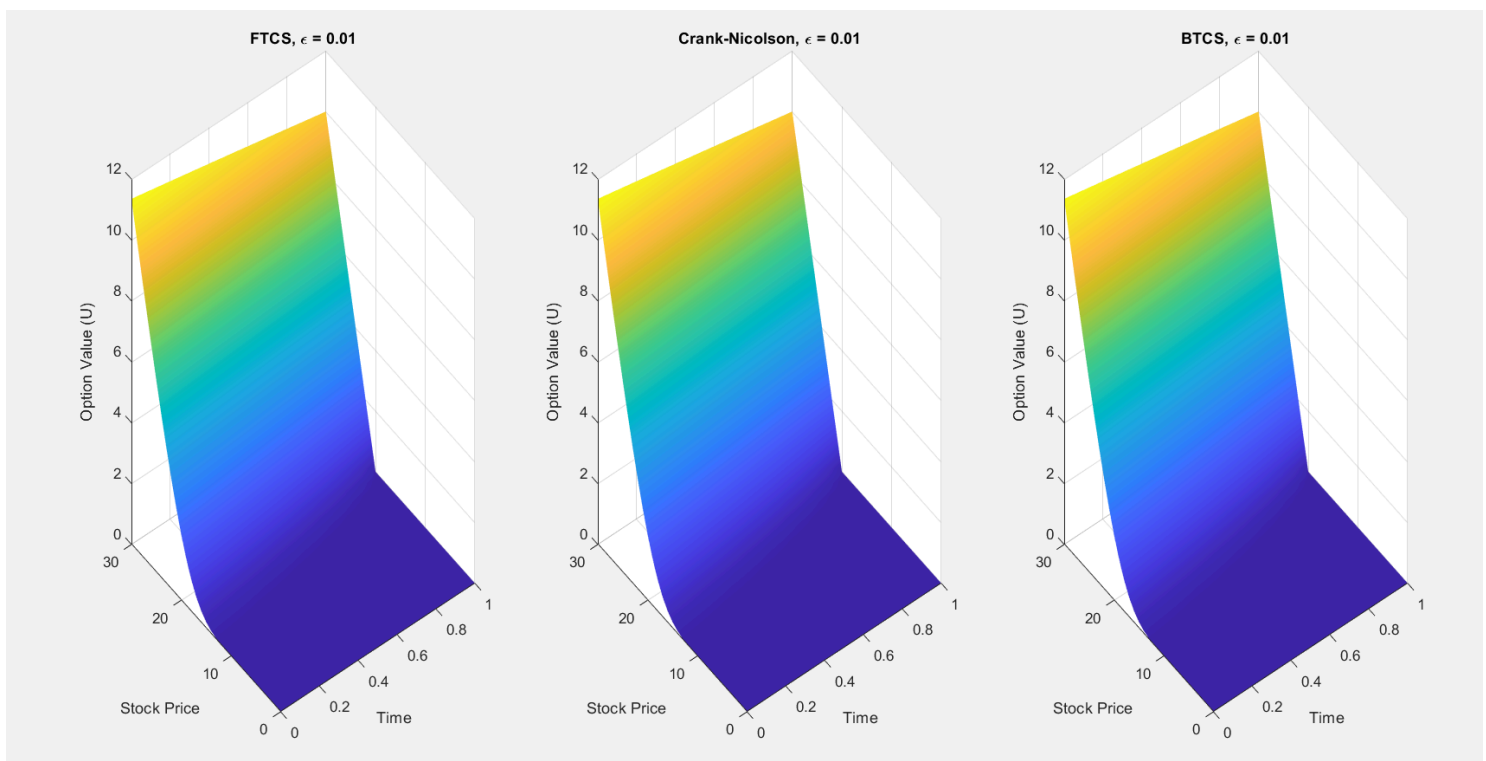
B) Also, calculate the following Greeks

$$\Delta (\text{Delta}) = \frac{\partial U}{\partial S}, \quad \Gamma (\text{Gamma}) = \frac{\partial^2 U}{\partial S^2}, \quad \nu (\text{Vega}) = \frac{\partial U}{\partial \sigma}, \quad \Theta (\text{Theta}) = \frac{\partial U}{\partial t} \quad \text{and} \quad \rho (\text{Rho}) = \frac{\partial U}{\partial r}.$$

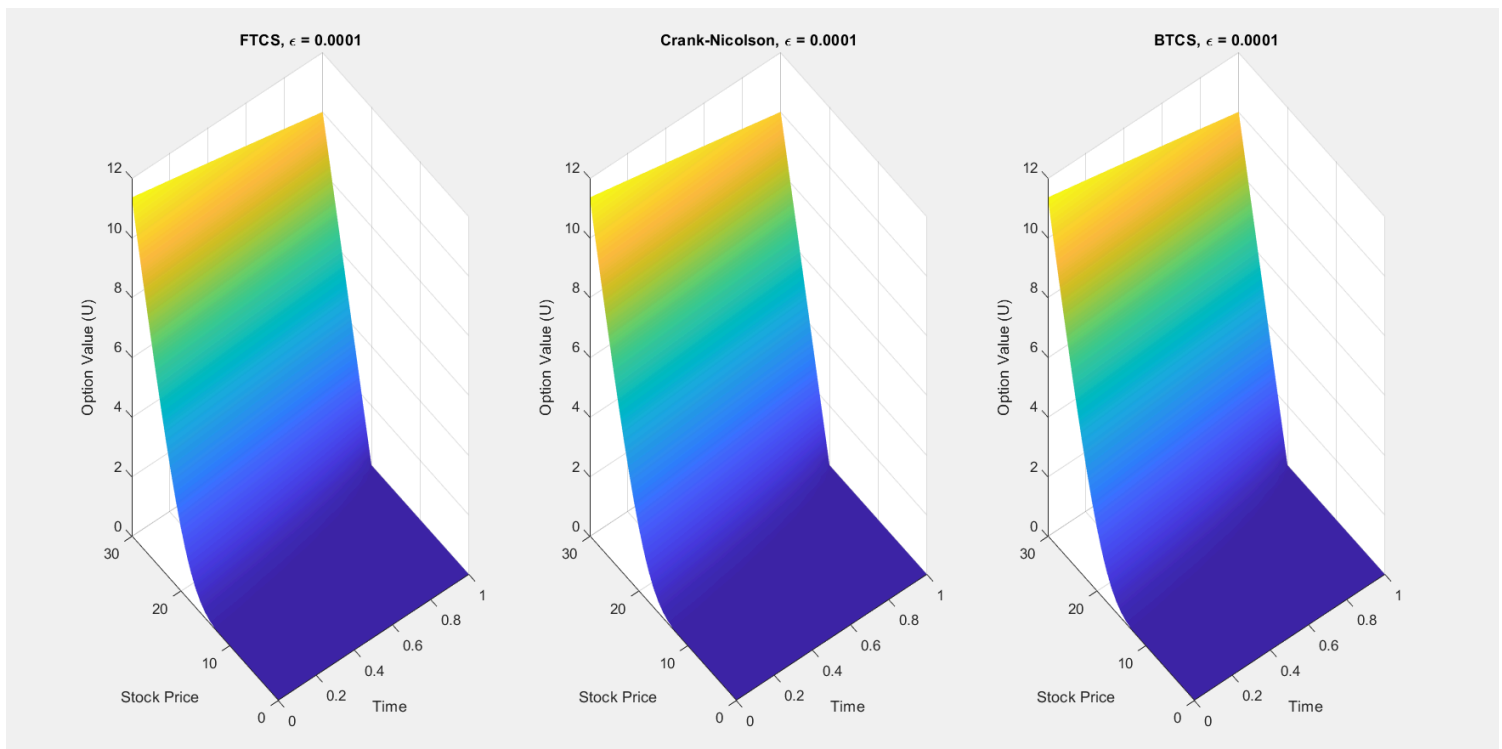
The values of the parameters are $T = 1$, $K = 20$, $r = 0.07$, $\sigma = 0.2$ and $\delta = 0.01$.

Surface Plots

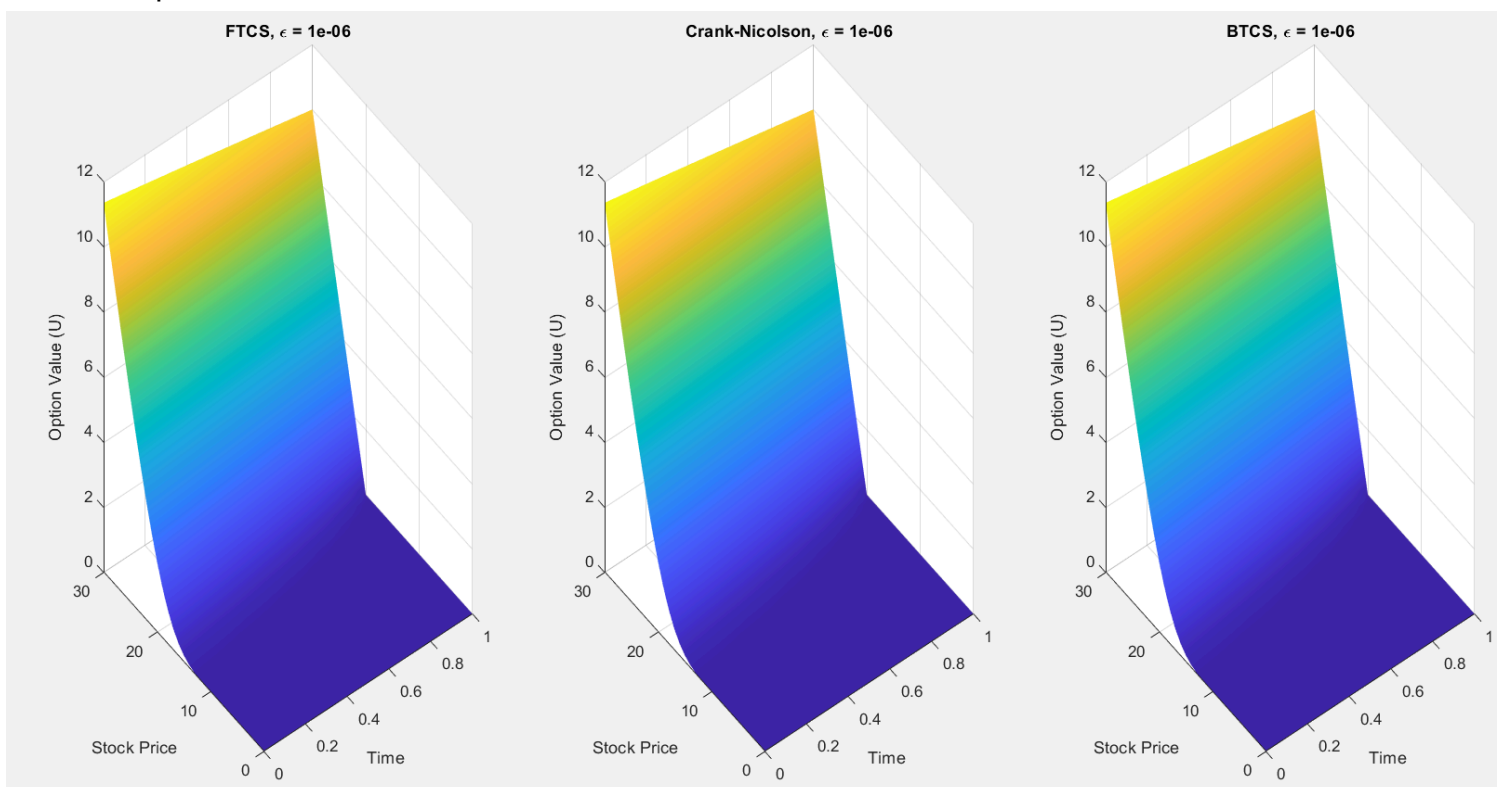
Epsilon = 0.01



Epsilon = 1e-4



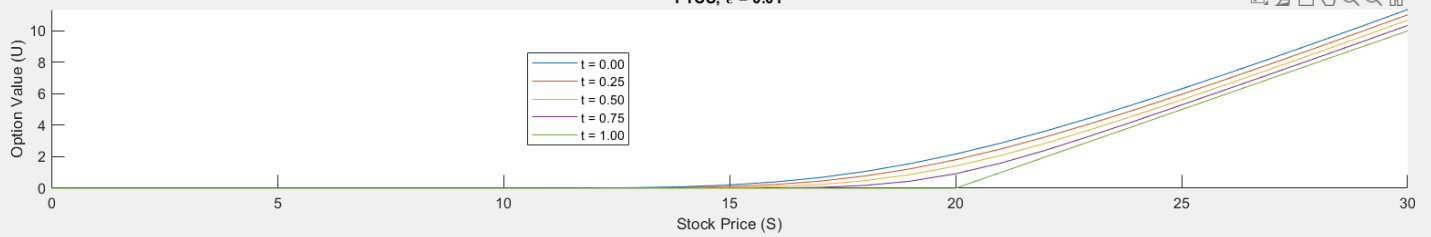
Epsilon = 1e-6



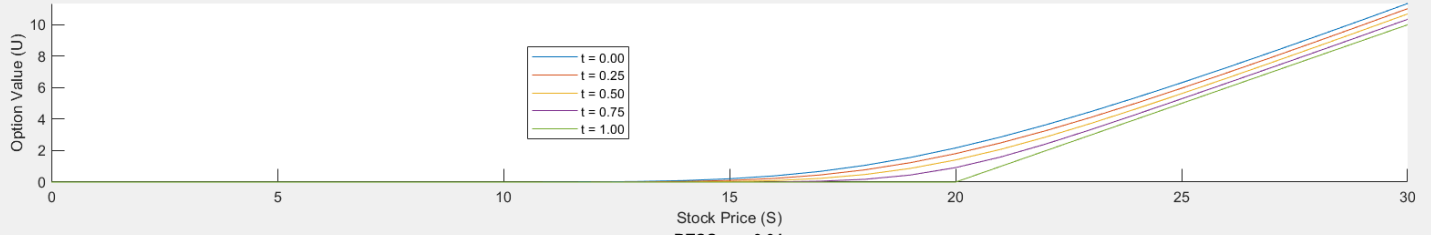
Plot at specific Time Points (For only one value of epsilon. Similar plots for other values in code.)

Numerical Solutions at Different Times, $\epsilon = 0.01$

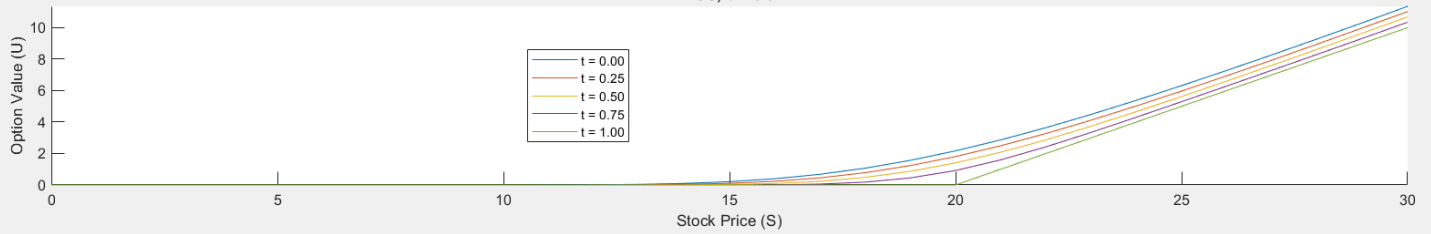
FTCS, $\epsilon = 0.01$



Crank-Nicolson, $\epsilon = 0.01$



BTCS, $\epsilon = 0.01$



Greeks

Option Value and Greeks, $\epsilon = 0.01$

