## DEPARTMENT OF MATHEMATICS, I.I.T. GUWAHATI

## MA 473: Computational Finance Lab – III, August 23, 2021

1. Consider the following Black-Scholes PDE for European call:

$$\begin{cases} \frac{\partial V}{\partial t} + \frac{1}{2}\sigma^2 S^2 \frac{\partial^2 V}{\partial S^2} + (r - \delta) S \frac{\partial V}{\partial S} - rV = 0, & (0, \infty) \times (0, T], \ T > 0 \\ V(S, t) = 0, & \text{for } S = 0, \\ V(S, t) = S - K e^{-r(T - t)}, & \text{for } S \to \infty \\ \text{with suitable initial/terminal condition } V(S, 0) \text{ or } V(S, T). \end{cases}$$

Solve the above Black-Scholes PDE 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

The values of the parameters are  $T=1, K=10, r=0.06, \sigma=0.3$  and  $\delta=0$ .

2. Consider the following Black-Scholes PDE for European put:

$$\begin{cases} \frac{\partial V}{\partial t} + \frac{1}{2}\sigma^2 S^2 \frac{\partial^2 V}{\partial S^2} + (r - \delta) S \frac{\partial V}{\partial S} - rV = 0, & (0, \infty) \times (0, T], \ T > 0 \\ V(S, t) = K e^{-r(T - t)} - S, & \text{for } S = 0, \\ V(S, t) = 0, & \text{for } S \to \infty \\ \text{with suitable initial/terminal condition } V(S, 0) \text{ or } V(S, T). \end{cases}$$

Solve the above Black-Scholes PDE by the following schemes:

- (i) Forward-Euler for time & central difference for space (FTCS) scheme.
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