

# MTH 600: Computational Methods in Mathematics

## Lab 7 Exercise

### Question 1.

Assume the stock price follows a geometric Brownian motion

$$dS = rSdt + \sigma SdZ_t.$$

The European Call option price,  $V(S, \tau)$ , satisfies the Black-Scholes equation, i.e.,

$$V_\tau - \frac{\sigma^2}{2} S^2 V_{SS} - rSV_S + rV = 0, \quad V(S, 0) = (S - K)^+,$$

where  $\tau \equiv T - t$  is the time to maturity.

- a). Implement the **Implicit** method with central differencing and upstream weighting to solve the B-S equation on a general grid  $[0, S_{max}] \times [0, T]$  with  $\Delta S = S_{max}/M$  and  $\Delta\tau = T/N$ .
- b). Compute the European call option price through your implementation in (a) with the current value of  $S$  as 1,  $\sigma = 0.3$ ,  $r = 0.05$ ,  $K = 1$ ,  $T = 0.25$ ,  $S_{max} = 3$ ,  $M = 100$  and  $N = 200$ .