

1. Write a program to determine the initial price of an European call and an European put option in the binomial model with the following data :

$$S(0) = 100; K = 100; T = 1; M = 100; r = 8\%; \sigma = 20\%.$$

Use the following two sets of  $u$  and  $d$  for your program.

- (a) Set 1 :  $u = e^{\sigma\sqrt{\Delta t}}$  ;  $d = e^{-\sigma\sqrt{\Delta t}}$ .  
(b) Set 2 :  $u = e^{\sigma\sqrt{\Delta t} + (r - \frac{1}{2}\sigma^2)\Delta t}$  ;  $d = e^{-\sigma\sqrt{\Delta t} + (r - \frac{1}{2}\sigma^2)\Delta t}$ .

Here  $\Delta t = \frac{T}{M}$ , with  $M$  being the number of subintervals in the time interval  $[0, T]$ . Use the continuous compounding convention in your calculations (i.e., both in  $\tilde{p}$  and in the pricing formula).

Now, carry out a sensitivity analysis of the initial price as follows: Plot the initial prices of both call and put options (for both the above sets of  $u$  and  $d$ ) by varying one of the parameters at a time (as given below) while keeping the other parameters fixed (as given above):

- (a)  $S(0)$ .  
(b)  $K$ .  
(c)  $r$ .  
(d)  $\sigma$ .  
(e)  $M$  (Do this for three values of  $K$ ,  $K = 95, 100, 105$ ).

Please do plots in 3-D also (by considering two parameters at a time).

2. Now take any path-dependent derivative of your choice and do the above exercise for both set of  $(u, d)$ .