7. Options I

Exercises
1. Use a two period binomial model and the CRR up and down steps with the following parameters…
$S_0 = 30$
$r = 0.05$
$q = 0$
$T = 0.5$
$\sigma = 0.4$
…to price each of the following options:

(a) A European call option with strike $K = 25$
(b) A European put option with strike $K = 25$

At each node in your lattice, give:
      the spot price
      the value of the option
      the delta of the option

2. Use a two period binomial model and the CRR up and down steps with the following parameters…
$S_0 = 50$
$r = 0.03$
$q = 0.025$
$T = 0.25$
$\sigma = 0.6$
…to price each of the following options:

(a) An American call option with strike $K = 41$
(b) An American put option with strike $K = 52$

At each node in your lattice, give:
      the spot price
      the value of the option if its holder chooses not to exercise (the continuation value)
      the value of the option if its holder chooses to exercise (the intrinsic value)
      the value of the option
      the delta of the option

Applications
1. *A binomial tree pricer*
The purpose of this problem is to use a binomial tree pricer to value options on the following assets:

Asset	S0	vol	q
A	100	0.3	0.02
B	30	0.45	0

The risk-free rate to all maturities is 1%, expressed with continuous compounding.

(a) Use the averaging binomial method (pricing with N time steps and then $N+1$ time steps, averaging the results) to price the following options, with $N = 2500$:

       (i)   Long European call on asset A with strike 80 and expiry in 3 months.
       (ii)   Short ATM European put on asset B with expiry in 6 months.
       (iii)   Long American call on asset A with strike 80 and expiry in 3 months.
       (iv)   Short ATM American put on asset B with expiry in 6 months.

(b) Use $N = 5000$ and no averaging to determine the price and the delta of the following European payoff on asset A with expiry 1 year:

$$V_T = \max\left[-((S_T - 115)^2) + 200, 0\right]$$

(c) Determine the forward price in 6 months of a European put option on asset B struck at 25 with expiry 1 year. Use $N = 10000$ with no averaging.

(d) A compound option is an option on an option: Using $N = 10000$ and no averaging, determine the value and delta of:

       (i)   A long European call on the option in part (c) with expiry 6 months and strike 2.7.

       (ii)   A short European put on the option in part (c) with expiry 6 months and strike 2.7.