

Write a program to determine the price of an European (both call and put) option and an American put option, in the binomial model framework, with the following data:

$$S_0 = 50, K = 50, T = 1, r = 8\% \text{ and } \sigma = 30\%.$$

For u and d , consider the following sets:

- (1) $u = e^{\sigma\sqrt{\delta t}}$ and $d = e^{-\sigma\sqrt{\delta t}}$.
- (2) $u = \beta + \sqrt{\beta^2 - 1}$ and $d = \beta - \sqrt{\beta^2 - 1}$, where, $\beta = \frac{1}{2} \left(e^{-r\delta t} + e^{(r+\sigma^2)\delta t} \right)$.

Note that,

$$q = \frac{e^{r\delta t} - d}{u - d},$$

and,

$$\delta t = \frac{T}{M},$$

with M being the number of sub-intervals in the time interval $[0, T]$.

- (1) Run your program for $M = 5, 10, 20$.
- (2) Tabulate the values of the options at $t = 0, 0.25, 0.50, 0.75, 0.95$, for the case $M = 20$.
- (3) Plot the values of the options against time and against the stock price, for the case $M = 20$.

Submission Deadline: 7th August 2022, 11:59 PM