

Required:

As an analyst with extensive experience in option trading, you have noticed that your new interns are confused about the characteristics of American and European call/put options and how early exercise impacts option prices. To provide clarification, assume that the underlying asset is a large-cap stock, Xamazon, with no dividend payments. Use Python to create two figures based on the given parameters. Consider a range of possible stock prices, $S = [50, 55, \dots, 150]$, and set the number of time steps, N , to 100 using the Binomial Tree method. Create reusable function(s) to ensure the code is efficient and flexible.

Parameters:

| | |
|-----------------|--|
| $K = 100$ | # option strike price |
| $T = 1$ | # time to maturity (in years) |
| $r1 = 0.05$ | # annualized, continuously compounded return of 3-month T-bill |
| $r2 = 0.10$ | # annualized, continuously compounded return of S&P 500 index |
| $r3 = 0.20$ | # annualized, continuously compounded return of Xamazon |
| $\sigma2 = 0.2$ | # volatility (i.e. annualized standard deviation) of S&P 500 index |
| $\sigma3 = 0.3$ | # volatility (i.e. annualized standard deviation) of Xamazon |

- Figure 1:
 - Plot the payoff function for a Call option at different stock prices. (10 marks)
 - Plot the American Call option price at $t = 0$ for different stock prices. (20 marks)
 - Plot the European Call option price at $t = 0$ for different stock prices. (20 marks)
- Figure 2:
 - Plot the payoff function for a Put option at different stock prices. (10 marks)
 - Plot the American Put option price at $t = 0$ for different stock prices. (20 marks)
 - Plot the European Put option price at $t = 0$ for different stock prices. (20 marks)

Deadline: Wednesday, 4 December 2024, 14:00 GMT