Financial Engineering Lab (MA374)

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Lab - 01

3 Files are made for each question.
To Run the file for q1 type **python3 180123021_Kartikeya_Singh_q1.py** on the terminal.
To Run the file for q2 type **python3 180123021_Kartikeya_Singh_q2.py** on the terminal.
To Run the file for q3 type **python3 180123021_Kartikeya_Singh_q3.py** on the terminal.

Question 1

(The output generated is stored in a file named q1_data.csv)

The Prices of European Call and Put Options are calculated using the continuous compounding convention. Two matrices *call* and *put* are made.
call[t][i] represents the value of a call option at time 't' if the underlying stock goes down 'i' times and goes up 't-i' times.
putl[t][i] represents the value of a put option at the time 't' if the underlying stock goes down 'i' times and goes up 't-i' times.
call[0][0] and put[0][0] would represent the initial option prices for call and put options respectively.

No-Arbitrage condition is also checked using -

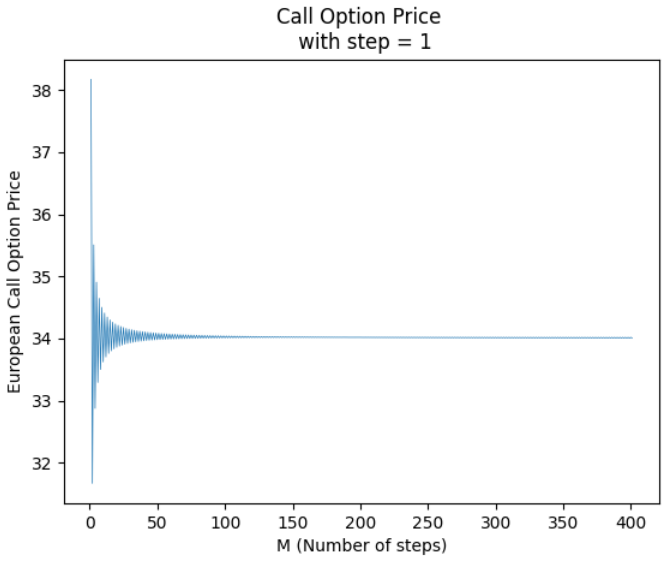
$$d < e^{rt} < u$$

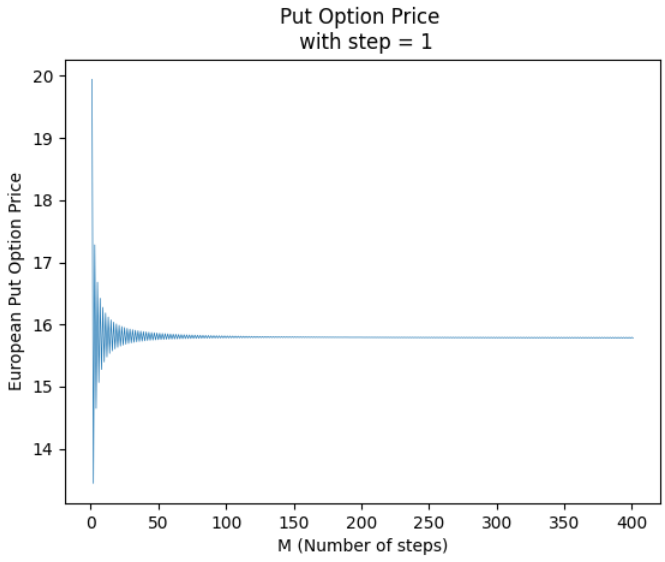
The results obtained are as follows -

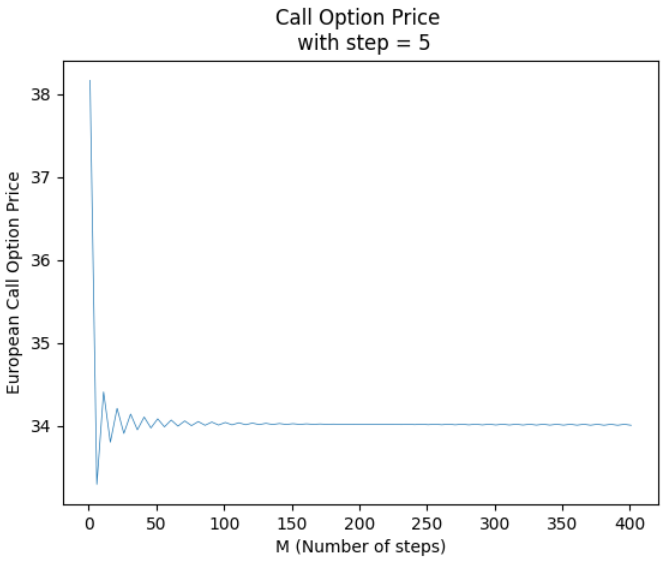
M	Call Price	Put Price
1	38.16763503	19.94171725
5	34.90653251	16.68061473
10	33.62502175	15.39910398
20	33.85944949	15.63353171
50	33.98118437	15.75526659
100	34.01116098	15.78524321
200	34.0195787	15.79366093
400	34.01913177	15.79321399

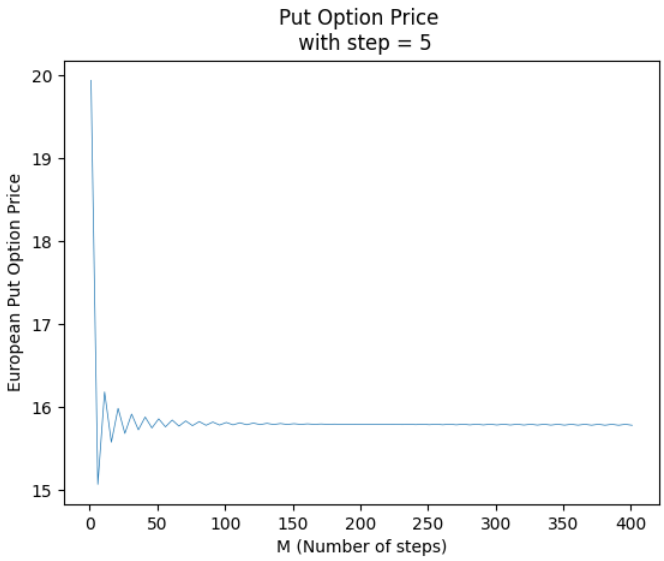
Question 2

(The 4 graphs shown below are generated by running the code and are saved as Call_1.png, Call_5.png, Put_1.png and Put_5.png)









It can be observed from the graph, on increasing the value of M (The number of subintervals), The option prices converge to a fixed value.

The Call Option Price converges to **34.019** (approx.) and The Put option price converges to **15.793** (approx.)

It can also be observed that these option prices satisfy the put-call parity -

$$C^E - P^E = S(0) - Ke^{-rT}$$

As $C^E - P^E = 18.226$ and $S(0) - Ke^{-rT} = 18.226$ using the values S(0) = 100, K = 105, r = 0.05, T = 5, C^E = 34.019 and P^E = 15.793.

Question 3

The values of put and call options are calculated for M = 20 at t = 0,0.50,1,1.50,3,4.5.

(nUmD represents that the price went up ‘n’ times and went down ‘m’ times)

For t = 0, there is only 1 possible option price.
For t = 0.5, there are 3 possible option prices (2U0D*, 1U1D; 0U2D)
For t = 1, there are 5 possible option prices (4U0D, 3U1D, 2U2D, 1U3D, 0U4D)
Similarly for t = 1.5, there are 7 possible prices, for t = 3, there are 13 possible option prices, and for t = 4.5, there are 19 possible prices.

The Call Option prices are -

T	0	0.5	1	1.5	3	4.5
European Call Option Price	33.8594	59.9588 31.8933 15.0959	100.6627 57.7000 29.8040 13.4697 5.1548	160.6114 98.4389 55.2954 27.5732 11.7675 4.1214 1.1250	519.0997 359.9342 242.0302 154.8417 91.1934 46.9762 19.7252 6.1485 1.2360 0.1183 0.0000 0.0000 0.0000	1419.4245 1024.9934 732.7916 516.3232 355.9595 237.1591 149.1496 83.9506 36.2515 8.1492 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000

The Put Option prices are -

T	0	0.5	1	1.5	3	4.5
European Put Option Price	15.6335	8.4792 15.4871 24.6728	3.5042 8.0042 15.2694 24.9833 35.9653	0.9424 2.9982 7.4363 14.9634 25.2710 36.9701 48.3050	0.0000 0.0000 0.0087 0.1721 1.2357 4.9582 13.2218 25.9550 40.5333 53.8548 64.4333 72.3577 78.2282	0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.6015 8.2812 26.6400 46.2776 60.8254 71.6028 79.5868 85.5015 89.8832 93.1293 95.5341