MA374 Financial Engineering Lab

Assignment - 1

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Question - 1

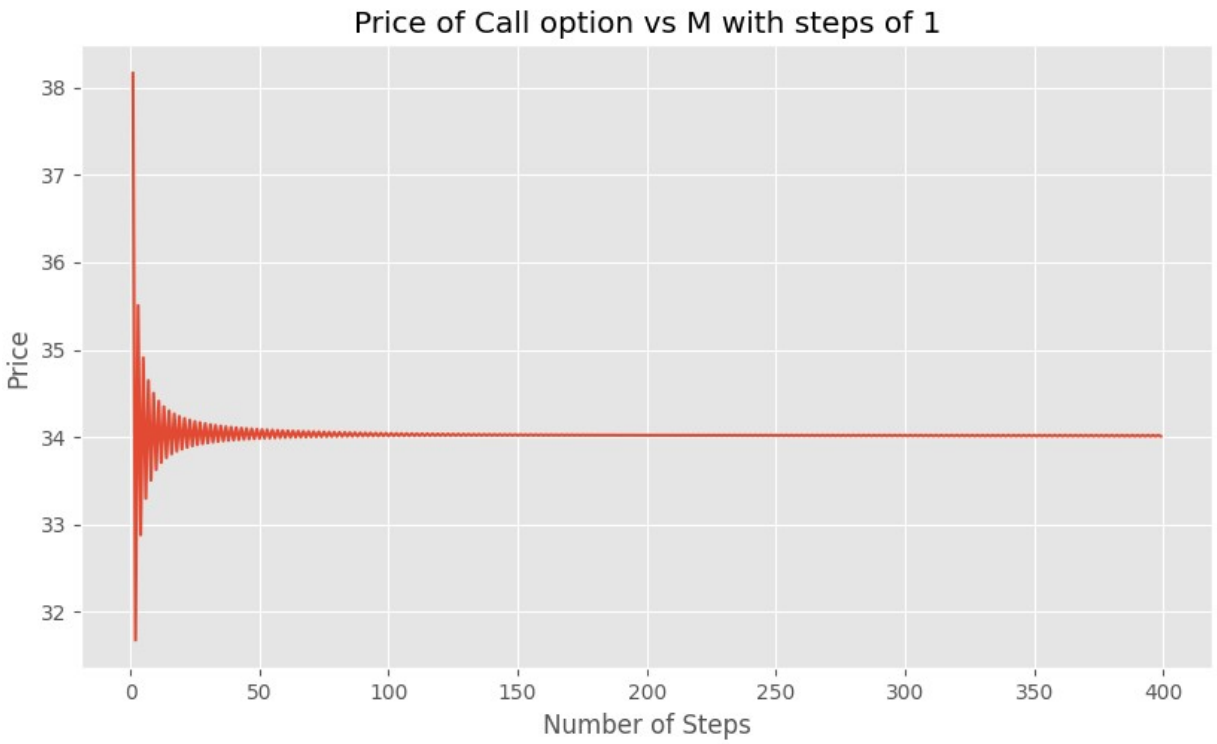
M(Number of Subintervals)	Price of Call Option	Price of Put Option
1	38.16763502522771	19.94171724772522
5	34.90653251138063	16.680614733878123
10	33.62502175314765	15.399103975645158
20	33.85944948849385	15.633531710991278
50	33.98118436571931	15.75526658821741
100	34.011160984790834	15.785243207287396
200	34.01957870440791	15.793660926904362
400	34.01913176900702	15.793213991506963

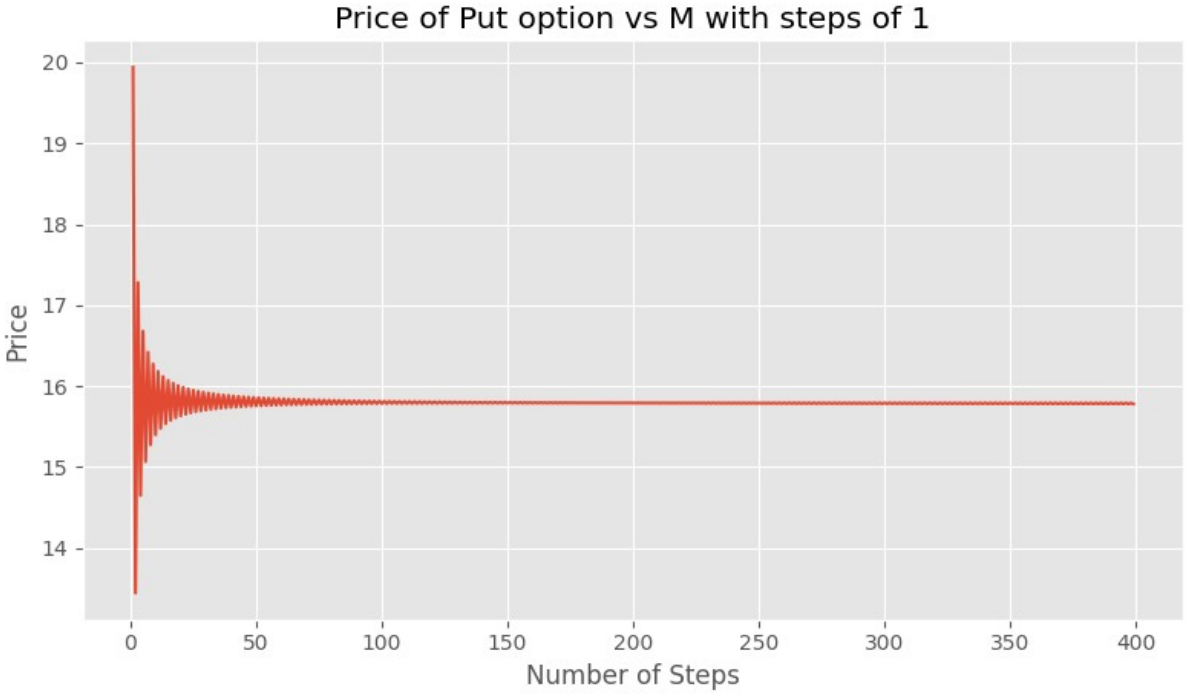
From the table above, we observe that the price of the call option converges to a value around 34.02 as the value of M increases, whereas it converges to a value of 15.79 for the corresponding put option. **Theoretically, the value of M can be any positive integer. However for computation we must set it to a value such that the machine is able to calculate the final stock prices that is S(0)*** $u^n d^{N-n}$

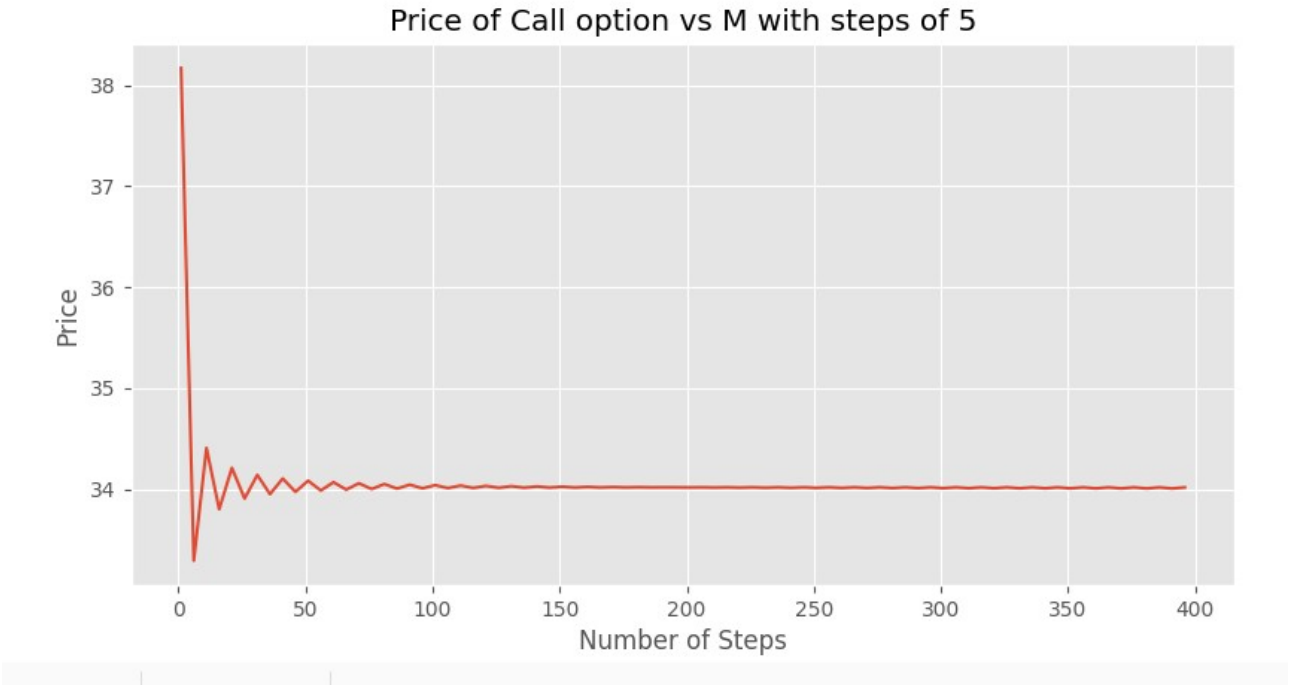
Checking for no arbitrage condition of the model

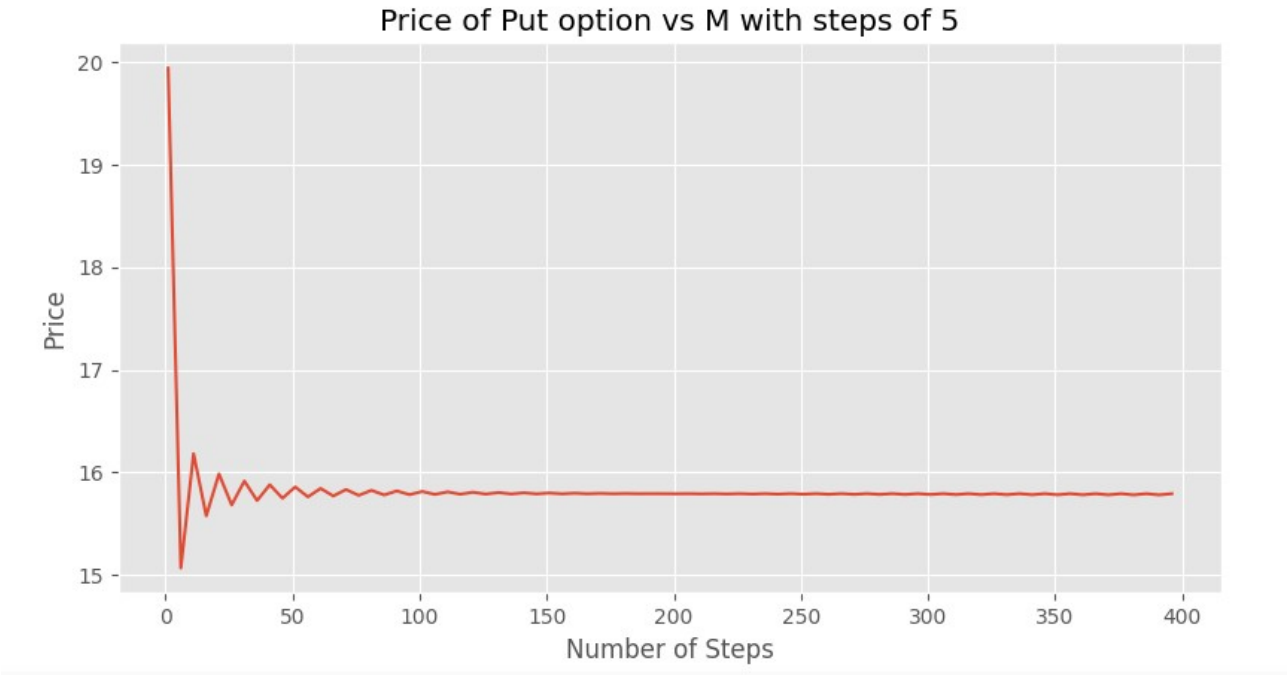
We know that the risk neutral probabilities for binomial asset pricing model is given by $p=(e^{r*\Delta t}-d)/(u-d)$ and q = 1-p. By first fundamental theorem of asset pricing we know that a market has no arbitrage if and only if there exists a risk neutral measure i.e $0 \le p \le 1$ which simplifies to $0 \le d \le e^{r\Delta t} \le u$. I have checked this condition in my programe.

Question-2


Price of Call option vs M with steps of 1
Price
38
37
36
35
34
33
32
0
50
100
150
200
250
300
350
400
Number of Steps


Price of Put option vs M with steps of 1
Price
20
19
18
17
16
15
14
0
50
100
150
200
250
300
350
400
Number of Steps





Observations

- Value of the European call converges to a value of around 34.02 and value of the put option convergest to around 15.79 .
- As the value of M increases deviation in the options prices decreases
- Option prices oscillates around the final convergence value

Question - 3

Note - On running the q3.py file csv files will be created with file name Price_n.csv for all the given time values where n denotes the number of steps corresponding to that time or n = 4*t. Below are the screenshot of the csv files

For t = 0

Up Steps	Down Steps	Call Price	Put Price
0	0	33.8594494884939	15.6335317109913

For t = 0.5

Up Steps	Down Steps	Call Price	Put Price
2	0	59.9587689009226	8.47920422853985
1	1	31.8932532222464	15.4871434314014
0	2	15.0958725138798	24.6728171615361

For t = 1

Up Steps	Down Steps	Call Price	Put Price
4	0	100.662665713361	3.50417389797197
3	1	57.6999946871752	8.00422345974074
2	2	29.803955121327	15.2694321085748
1	3	13.469716242797	24.9832865693941
0	4	5.15483112999247	35.9653036163975

For t = 1.5

Up Steps	Down Steps	Call Price	Put Price
6	0	160.611387753017	0.942426524411335
5	1	98.4388692488004	2.99824974526607
4	2	55.2953556785673	7.43626200913782
3	3	27.5732042363838	14.9633718726971
2	4	11.7674969625988	25.2709596397774
1	5	4.12140462102742	36.9700720665165
0	6	1.12500321452092	48.3049508351933

For t = 3

Up Steps	Down Steps	Call Price	Put Price
12	0	519.099688850719	0
11	1	359.934183790789	0
10	2	242.030182820014	0.00870528162829168
9	3	154.841699053599	0.172102756885187
8	4	91.1934332962959	1.23570223423871
7	5	46.9761877848511	4.95818558292697
6	6	19.7252062201026	13.2218286523064
5	7	6.14852046342653	25.9550239252639
4	8	1.2359711338579	40.5333138464162
3	9	0.118330144851688	53.8548417107224
2	10	0	64.4333109439045
1	11	0	72.3576948261289
0	12	0	78.2282227937571

For t = 4.5

Up Steps	Down Steps	Call Price	Put Price
18	0	1419.42451210004	0
17	1	1024.99337281541	0
16	2	732.791598029106	0
15	3	516.323199151878	0
14	4	355.959465061829	0
13	5	237.159088911363	0
12	6	149.149605635256	0
11	7	83.9505768315328	0
10	8	36.2514944912453	0.601546168262668
9	9	8.14917387261674	8.28121121914693
8	10	0	26.6399843026774
7	11	0	46.2775544006557
6	12	0	60.8254241391525
5	13	0	71.6027511135351
4	14	0	79.5867913064023
3	15	0	85.5015137559336
2	16	0	89.8832479168215
1	17	0	93.1293164213907
0	18	0	95.5340631151567