

Output:

A1

(a)

```
Batch 1: C= 2.13337,P= 5.84628
Batch 2: C= 7.96557,P= 7.96557
Batch 3: C= 0.204058,P= 4.07326
Batch 4: C= 92.1757,P= 1.2475
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(b)

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check the put-call parity for Batch 1 (1:True, 0:False)
1
calculate the option price by put-call parity for Batch 1
C= 2.13337,P= 5.84628
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(c) $T = 0.25$, $K = 65$, $\sigma = 0.30$, $r = 0.08$

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variation of S (from 10 to 100, interval=5)
C= 7.792e-36,P= 53.7129
C= 1.24529e-22,P= 48.7129
C= 3.76503e-15,P= 43.7129
C= 2.0405e-10,P= 38.7129
C= 3.11926e-07,P= 33.7129
C= 5.19359e-05,P= 28.713
C= 0.00199417,P= 23.7149
C= 0.0278174,P= 18.7407
C= 0.189181,P= 13.9021
C= 0.76652,P= 9.47943
C= 2.13337,P= 5.84628
C= 4.5252,P= 3.23811
C= 7.90027,P= 1.61319
C= 12.0153,P= 0.728169
C= 16.5879,P= 0.300857
C= 21.4021,P= 0.115044
C= 26.3282,P= 0.0411543
C= 31.301,P= 0.0139094
C= 36.2916,P= 0.00448099
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(d) $T = 0.25$, $K = 65$, $\sigma = 0.30$, $r = 0.08$, $S = 60$

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variation of T (from 0.1 to 1, interval=0.1)
C= 35.5179,P= 2.8421e-06
C= 36.0329,P= 0.0012151
C= 36.5525,P= 0.0110657
C= 37.0833,P= 0.0362458
C= 37.6259,P= 0.0771867
C= 38.1775,P= 0.131211
C= 38.735,P= 0.195039
C= 39.2954,P= 0.265729
C= 39.8564,P= 0.340906
C= 40.4162,P= 0.418731
variation of K (from 10 to 100, interval=10)
C= 90.7688,P= 1.09641e-15
C= 81.5377,P= 1.91228e-08
C= 72.3065,P= 3.11436e-05
C= 63.0775,P= 0.00212087
C= 53.876,P= 0.0317788
C= 44.8169,P= 0.203875
C= 36.157,P= 0.77519
C= 28.2411,P= 2.09039
C= 21.372,P= 4.45244
C= 15.7113,P= 8.02295
variation of sigma (from 0.1 to 1, interval=0.1)
C= 8.84245,P= 1.15409
C= 12.1058,P= 4.41747
C= 15.7113,P= 8.02295
C= 19.3864,P= 11.698
C= 23.0638,P= 15.3755
C= 26.7151,P= 19.0267
C= 30.323,P= 22.6346
C= 33.875,P= 26.1867
C= 37.3612,P= 29.6728
C= 40.7728,P= 33.0845

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A2

(a)

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Batch 5: C= 0.594629,P= -0.356601
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(b) $K = 100$, $T = 0.5$, $r = 0.1$, $b = 0$, $\text{sig} = 0.36$.

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variation of S (from 10 to 100, interval=5)
C_Delta= 2.25551e-19,P_Delta= -0.951229
C_Delta= 1.1336e-13,P_Delta= -0.951229
C_Delta= 2.76878e-10,P_Delta= -0.951229
C_Delta= 4.97346e-08,P_Delta= -0.951229
C_Delta= 1.98667e-06,P_Delta= -0.951227
C_Delta= 3.05351e-05,P_Delta= -0.951199
C_Delta= 0.000245471,P_Delta= -0.950984
C_Delta= 0.00124435,P_Delta= -0.949985
C_Delta= 0.00449025,P_Delta= -0.946739
C_Delta= 0.012525,P_Delta= -0.938704
C_Delta= 0.028625,P_Delta= -0.922604
C_Delta= 0.0559246,P_Delta= -0.895305
C_Delta= 0.0964112,P_Delta= -0.854818
C_Delta= 0.150264,P_Delta= -0.800965
C_Delta= 0.215772,P_Delta= -0.735458
C_Delta= 0.289765,P_Delta= -0.661465
C_Delta= 0.368319,P_Delta= -0.58291
C_Delta= 0.447475,P_Delta= -0.503754
C_Delta= 0.523785,P_Delta= -0.427444

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(c)

Delta: K = 100, S = 105, T = 0.5, r = 0.1, b = 0, sig = 0.36.

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variation of T (from 0.1 to 1, interval=0.1)
C_Delta= 0.517495,P_Delta= -0.472555
C_Delta= 0.521544,P_Delta= -0.458655
C_Delta= 0.52333,P_Delta= -0.447115
C_Delta= 0.523936,P_Delta= -0.436853
C_Delta= 0.523785,P_Delta= -0.427444
C_Delta= 0.523097,P_Delta= -0.418667
C_Delta= 0.522004,P_Delta= -0.41039
C_Delta= 0.520593,P_Delta= -0.402523
C_Delta= 0.518925,P_Delta= -0.395006
C_Delta= 0.517046,P_Delta= -0.387792
variation of K (from 10 to 100, interval=10)
C_Delta= 0.904837,P_Delta= -2.18539e-11
C_Delta= 0.904836,P_Delta= -1.49693e-06
C_Delta= 0.904645,P_Delta= -0.000192048
C_Delta= 0.901931,P_Delta= -0.0029069
C_Delta= 0.888887,P_Delta= -0.0159504
C_Delta= 0.855149,P_Delta= -0.0496889
C_Delta= 0.795491,P_Delta= -0.109347
C_Delta= 0.713102,P_Delta= -0.191736
C_Delta= 0.616896,P_Delta= -0.287942
C_Delta= 0.517046,P_Delta= -0.387792
variation of sigma (from 0.1 to 1, interval=0.1)
C_Delta= 0.47046,P_Delta= -0.434377
C_Delta= 0.488456,P_Delta= -0.416381
C_Delta= 0.506363,P_Delta= -0.398474
C_Delta= 0.524136,P_Delta= -0.380702
C_Delta= 0.541732,P_Delta= -0.363106
C_Delta= 0.559109,P_Delta= -0.345728
C_Delta= 0.576228,P_Delta= -0.328609
C_Delta= 0.59305,P_Delta= -0.311787
C_Delta= 0.609539,P_Delta= -0.295298
C_Delta= 0.625661,P_Delta= -0.279176

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Gamma: K = 100, S = 105, T = 0.5, r = 0.1, b = 0, sig = 0.36.

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variation of T (from 0.1 to 1, interval=0.1)
C_Gamma= 0.0176207, P_Gamma= 0.0176207
C_Gamma= 0.012898, P_Gamma= 0.012898
C_Gamma= 0.0107707, P_Gamma= 0.0107707
C_Gamma= 0.00948074, P_Gamma= 0.00948074
C_Gamma= 0.00858484, P_Gamma= 0.00858484
C_Gamma= 0.00791169, P_Gamma= 0.00791169
C_Gamma= 0.00737912, P_Gamma= 0.00737912
C_Gamma= 0.00694215, P_Gamma= 0.00694215
C_Gamma= 0.00657375, P_Gamma= 0.00657375
C_Gamma= 0.00625661, P_Gamma= 0.00625661
variation of K (from 10 to 100, interval=10)
C_Gamma= 0.00902544, P_Gamma= 0.00902544
C_Gamma= 0.00889045, P_Gamma= 0.00889045
C_Gamma= 0.0086485, P_Gamma= 0.0086485
C_Gamma= 0.00833948, P_Gamma= 0.00833948
C_Gamma= 0.00799509, P_Gamma= 0.00799509
C_Gamma= 0.00763638, P_Gamma= 0.00763638
C_Gamma= 0.00727659, P_Gamma= 0.00727659
C_Gamma= 0.00692385, P_Gamma= 0.00692385
C_Gamma= 0.00658297, P_Gamma= 0.00658297
C_Gamma= 0.00625661, P_Gamma= 0.00625661
variation of sigma (from 0.1 to 1, interval=0.1)
C_Gamma= 0.047046, P_Gamma= 0.047046
C_Gamma= 0.0244228, P_Gamma= 0.0244228
C_Gamma= 0.0168788, P_Gamma= 0.0168788
C_Gamma= 0.0131034, P_Gamma= 0.0131034
C_Gamma= 0.0108346, P_Gamma= 0.0108346
C_Gamma= 0.00931849, P_Gamma= 0.00931849
C_Gamma= 0.00823183, P_Gamma= 0.00823183
C_Gamma= 0.00741313, P_Gamma= 0.00741313
C_Gamma= 0.00677266, P_Gamma= 0.00677266
C_Gamma= 0.00625661, P_Gamma= 0.00625661

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(d) $K = 100$, $S = 105$, $T = 0.5$, $r = 0.1$, $b = 0$, $\text{sig} = 0.36$.

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variation of S (from 15 to 105, interval=10) and using divided differences approximation and h
= 0.01
C_Delta= 0.0734626, P_Delta= -0.831375
C_Delta= 0.169865, P_Delta= -0.734973
C_Delta= 0.263507, P_Delta= -0.64133
C_Delta= 0.346243, P_Delta= -0.558594
C_Delta= 0.417158, P_Delta= -0.487679
C_Delta= 0.477385, P_Delta= -0.427453
C_Delta= 0.528489, P_Delta= -0.376349
C_Delta= 0.571968, P_Delta= -0.332869
C_Delta= 0.609117, P_Delta= -0.29572
C_Delta= 0.64101, P_Delta= -0.263828
variation of S (from 15 to 105, interval=10) and using divided differences approximation and h
= 0.001
C_Gamma= 0.00906839, P_Gamma= 0.00906839
C_Gamma= 0.00974917, P_Gamma= 0.00974917
C_Gamma= 0.00886682, P_Gamma= 0.00886682
C_Gamma= 0.00767218, P_Gamma= 0.00767218
C_Gamma= 0.00653189, P_Gamma= 0.00653189
C_Gamma= 0.00554022, P_Gamma= 0.00554022
C_Gamma= 0.00470576, P_Gamma= 0.00470576
C_Gamma= 0.00401172, P_Gamma= 0.00401172
C_Gamma= 0.00343586, P_Gamma= 0.00343586
C_Gamma= 0.00295729, P_Gamma= 0.00295729

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B

(b)

Batch 6: C= 18.5035, P= 3.03106

(c) K = 100, sig = 0.1, r = 0.1, b = 0.02, S = 110

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variation of S (from 10 to 100, interval=5)
C= 0.00826235, P= 9.03489e+06
C= 0.03045, P= 726383
C= 0.076827, P= 121457
C= 0.157497, P= 30334.3
C= 0.283138, P= 9764.83
C= 0.464906, P= 3745.05
C= 0.714373, P= 1632.76
C= 1.04347, P= 785.068
C= 1.46448, P= 407.787
C= 1.98995, P= 225.473
C= 2.63274, P= 131.27
C= 3.40595, P= 79.8084
C= 4.32291, P= 50.345
C= 5.39718, P= 32.785
C= 6.64256, P= 21.9493
C= 8.07301, P= 15.0569
C= 9.7027, P= 10.5537
C= 11.546, P= 7.54093
C= 13.6174, P= 5.48192
```

(d) K = 100, sig = 0.1, r = 0.1, b = 0.02, S = 110

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B(u).
variation of r (from 0.01 to 0.1, interval=0.01)
C= -nan(ind),P= 9.08062
C= 100,P= 8.192
C= 44.8366,P= 7.56376
C= 31.5649,P= 7.08341
C= 25,P= 6.69796
C= 21.0094,P= 6.37828
C= 18.2994,P= 6.10668
C= 16.3251,P= 5.87165
C= 14.8148,P= 5.66528
C= 13.6174,P= 5.48192
variation of K (from 10 to 100, interval=10)
C= 2244.32,P= 3.32615e-07
C= 482.73,P= 4.94849e-05
C= 196.477,P= 0.000923255
C= 103.83,P= 0.00736213
C= 63.3103,P= 0.036847
C= 42.2601,P= 0.137357
C= 30.0269,P= 0.417837
C= 22.3328,P= 1.0953
C= 17.2004,P= 2.56272
C= 13.6174,P= 5.48192
variation of sigma (from 0.1 to 1, interval=0.1)
C= 13.6174,P= 5.48192
C= 21.4931,P= 13.5214
C= 29.1774,P= 21.4609
C= 36.3311,P= 28.9393
C= 42.8398,P= 35.8187
C= 48.6733,P= 42.0476
C= 53.8499,P= 47.6265
C= 58.4148,P= 52.5879
C= 62.4269,P= 56.9818
C= 65.9487,P= 60.8655

```

Justifications for design decisions

In Group A and B, there are two kinds of options, so I build two classes for each of them. For each class, I build the functions, such as computation of option and Greek (with single or multiple parameter input), for the requirement of the assignment.

Also, owing to the requirement of mesh array, I build two global functions for each of class.