Problem 1

Closed Form Greeks For GBSM

	Greeks	Call Option	Put Option
0	Delta	0.082971	-0.916550
1	Gamma	0.016823	0.016823
2	Vega	6.938711	6.938711
3	Theta	-8.126522	-1.940991
4	Rho	1.102594	-13.758003
5	Carry Rho	1.132954	-12.515272

Greeks For Finite Difference Derivative Calculation

	Greeks	Call Option	Put Option
0	Delta	0.082971	-0.916550
1	Gamma	0.016823	0.016823
2	Vega	6.938711	6.938711
3	Theta	-8.126522	-1.940991
4	Rho	-0.030360	-1.242731
5	CarryRho	1.132954	-12.515272

Based on the results, we can find that the different methods give the same outcomes except for Rho.

American Call Option Price: 0.2986340478681555 American Put Option Price: 14.55932724012951

Greeks For BTAM

	Greeks	Call Option	Put Option
0	Delta	0 . 074842	-0.935932
1	Gamma	0.018483	0.015880
2	Vega	6.319465	5.667652
3	Theta	-7.425581	-0.416989
4	Rho	0.887512	-12.334293
5	CarryRho	NaN	NaN

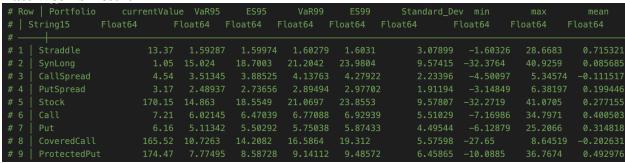
Dividend Sensitivity for Call Option: -0.021538913125285216 Dividend Sensitivity for Put Option: 0.9391384416801428

Problem 2

Delta-Normal

	Portfolio	PortfolioDelta	Mean	DN_VaR	DN_ES
0	Straddle	1.201974e+02	1.201974e+02	1.452452e+03	1.821434e+03
1	SynLong	2.098026e+02	2.098026e+02	2.535232e+03	3.179283e+03
2	CallSpread	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
3	PutSpread	-2.241398e+01	-2.241398e+01	2.708480e+02	3.396544e+02
4	Stock	1.650000e+02	1.650000e+02	1.993842e+03	2.500358e+03
5	Call	1.650000e+02	1.650000e+02	1.993842e+03	2.500358e+03
6	Put	-4.480259e+01	-4.480259e+01	5.413896e+02	6.789244e+02
7	CoveredCall	-5.237325e-08	-5.237325e-08	6.328727e-07	7.936478e-07
8	ProtectedPut	1.360388e+02	1.360388e+02	1.643878e+03	2.061489e+03

Last Week's Result



- The **Normal Distribution** and **Fitted AR(1) Model** provide similar and higher estimates of risk
- The VaR and ES calculated by the two methods are quite similar.

```
Weight
    Stock
                    Return
          0.0000 - 2.253823
     AAPL
0
1
    META
          0.0026
                   1.172346
2
          0.0000 - 0.114615
     UNH
3
      MA
          0.0000
                   1.773019
4
    MSFT
          0.0000 - 0.368813
5
          0.0000 - 3.702442
    NVDA
6
       HD
          0.1057 3.037572
7
          0.0000 - 5.385713
     PFE
8
    AMZN
          0.0000 - 0.014672
9
    BRK-B
          0.1501
                  2.170457
10
          0.4020 2.943831
       PG
11
     XOM
          0.0000 1.502708
12
    TSLA
          0.0000 - 4.043305
13
     JPM
          0.0000 0.183736
14
          0.0000
                  0.364972
        ٧
15
          0.0530 2.259346
     DIS
16
   G00GL 0.0000 -3.157294
17
      JNJ
          0.0653 1.943940
     BAC
          0.0000
                  0.016937
18
19
     CSC0
          0.2213
                   3.712624
Expected Return = 2.9016135536959844
Expected Volatility = 0.12554491218852082
Expected Sharpe Ratio = 22.713892061420275
```