MODEL CALIBRATION AND HEDGING

Abstract

In this document we compute the implied volatility (BS) with Newton's method, then we use the algorithm to plot the volatility smiles of sp-Index, google, and Cac40 Data. We proceed by introducing some Delta and Gamma Hedging modelization

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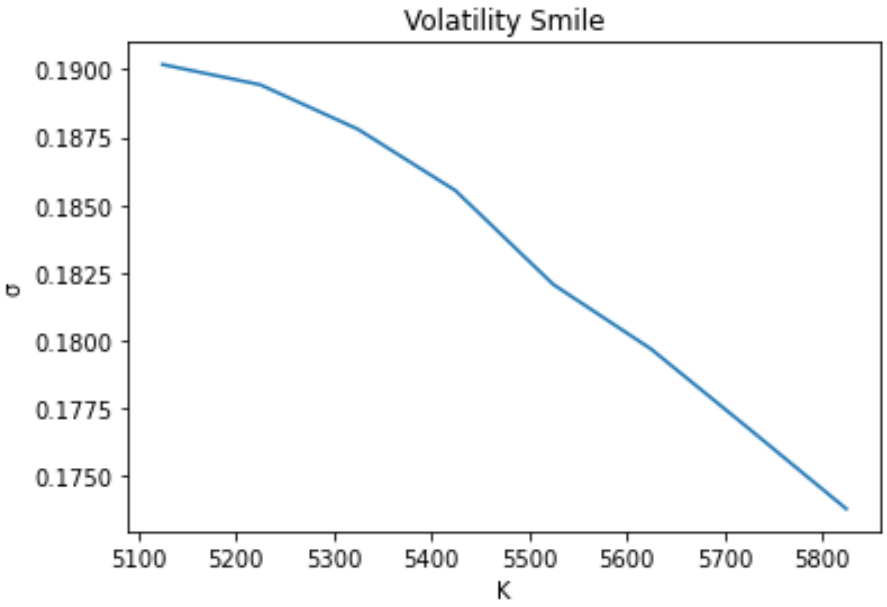
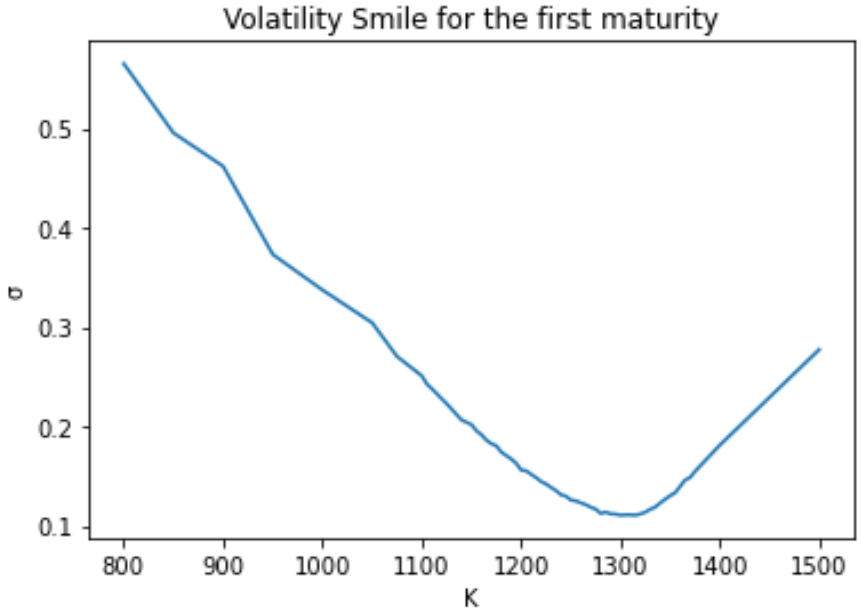
Part 1: Volatility smile of LIFFE data

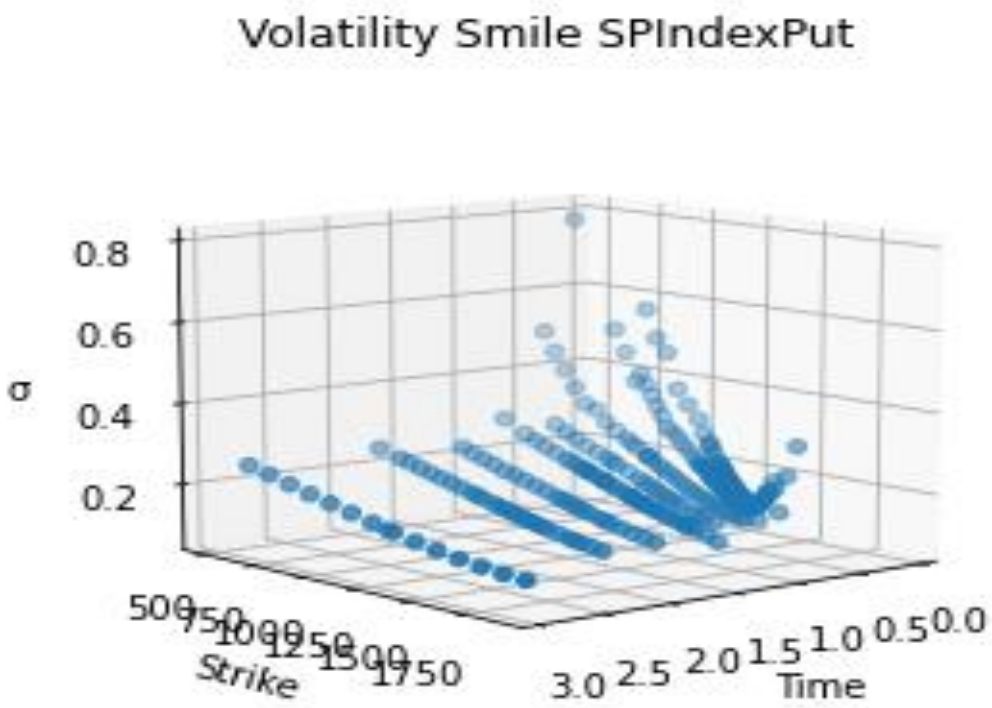


Change in the implied volatility of the underlying relative to a change in strike price K.

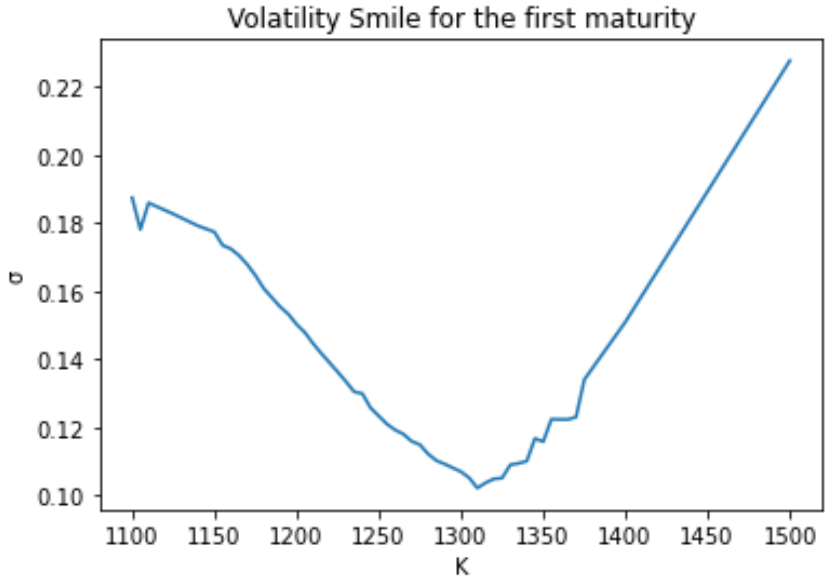
Part2: Volatility smiles of big databases



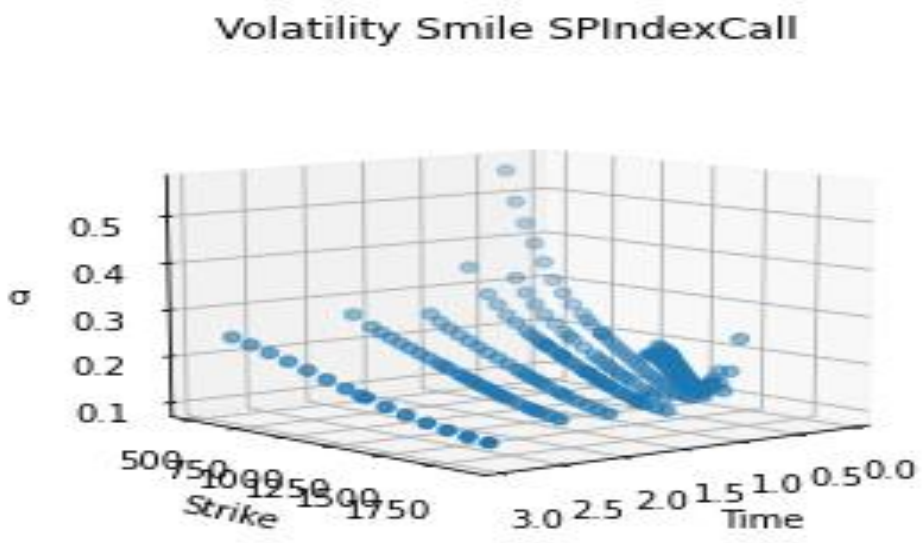
Put smile for SPIndex option data



3D volatility smiles for SPIndex put option data

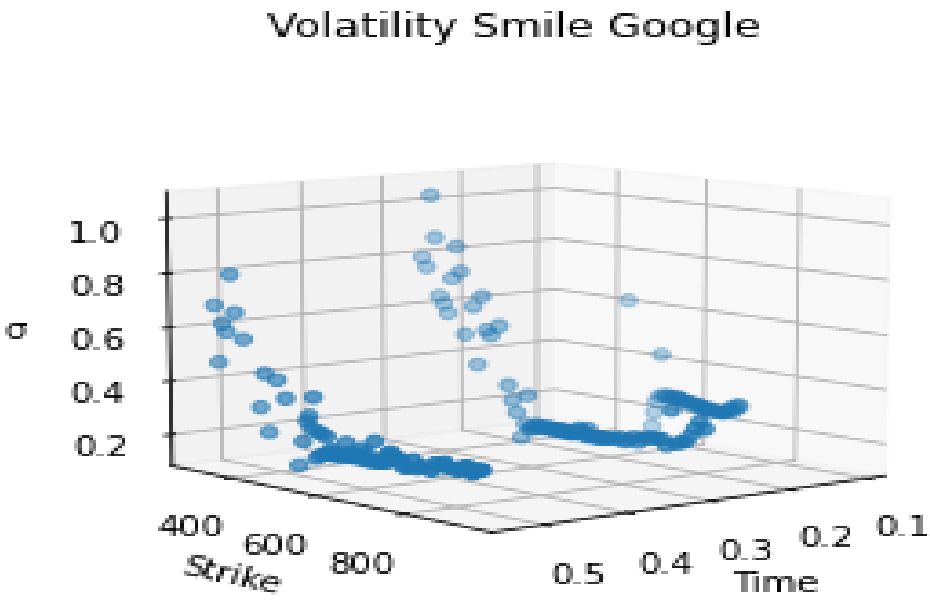


Call smile for SPIndex option data

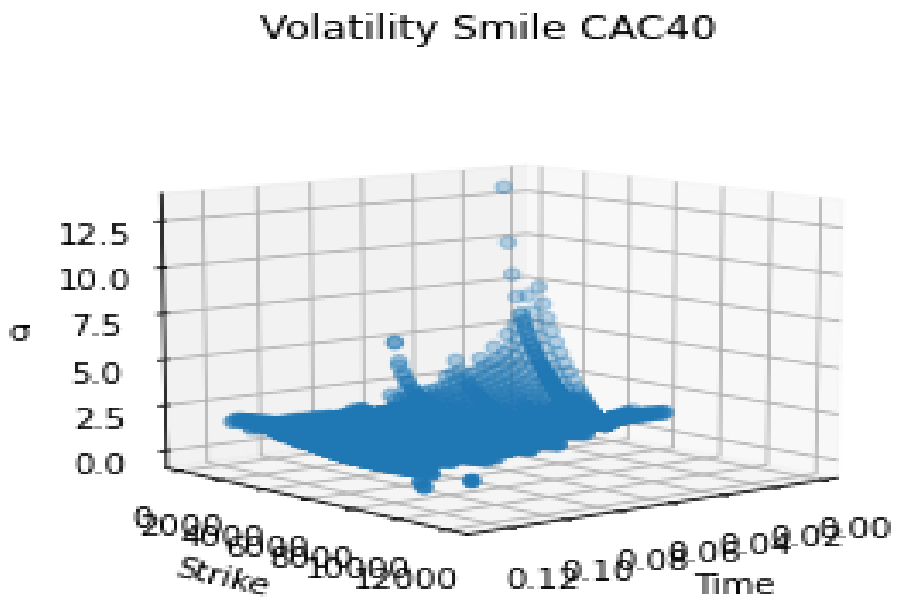


3D volatility smiles for SPIndex call option data

Part 3: Volatility smiles of CAC40 and Google



Volatility smiles for Google data

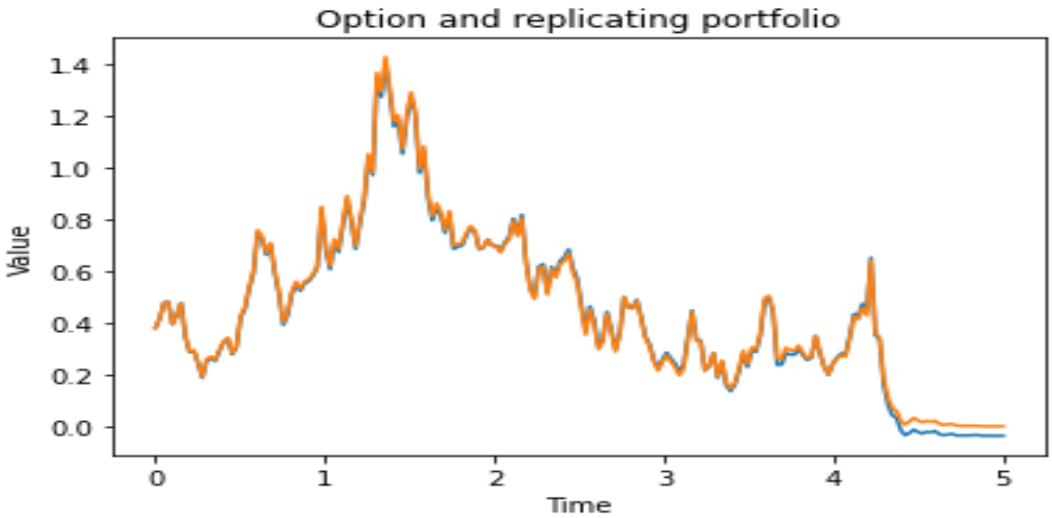


Volatility smiles for CAC40 Data

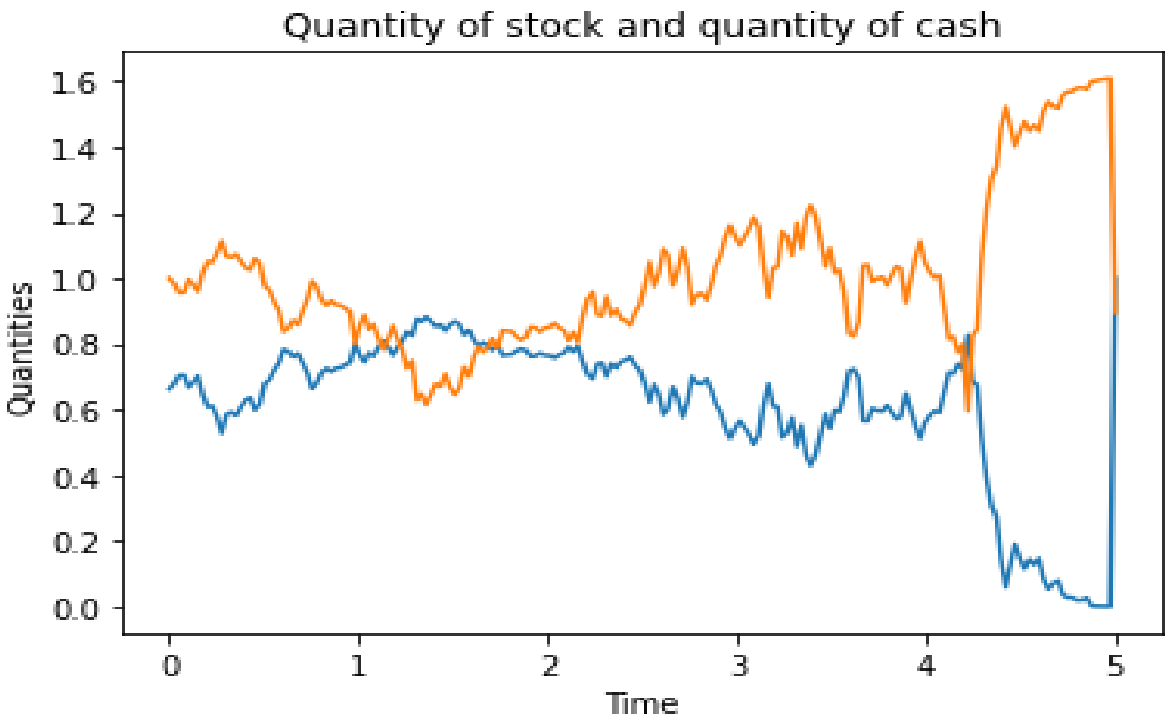
Part 4: Conclusion

The implied volatility of the underlying calculated using the BS equation seems to change with the strike price, which might be a bit counterintuitive since the implied volatility should only depend on the underlying instrument, but in practice, we do find a dependency on the strike price.

Part 5: Delta Hedging



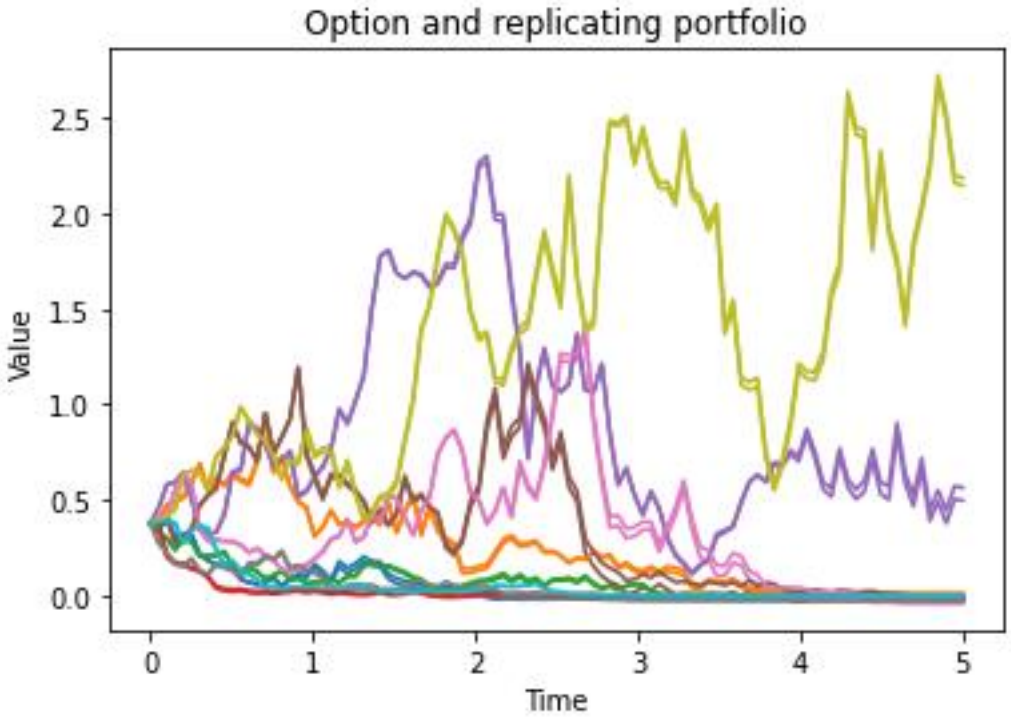
Plot of the option and hedging portfolio



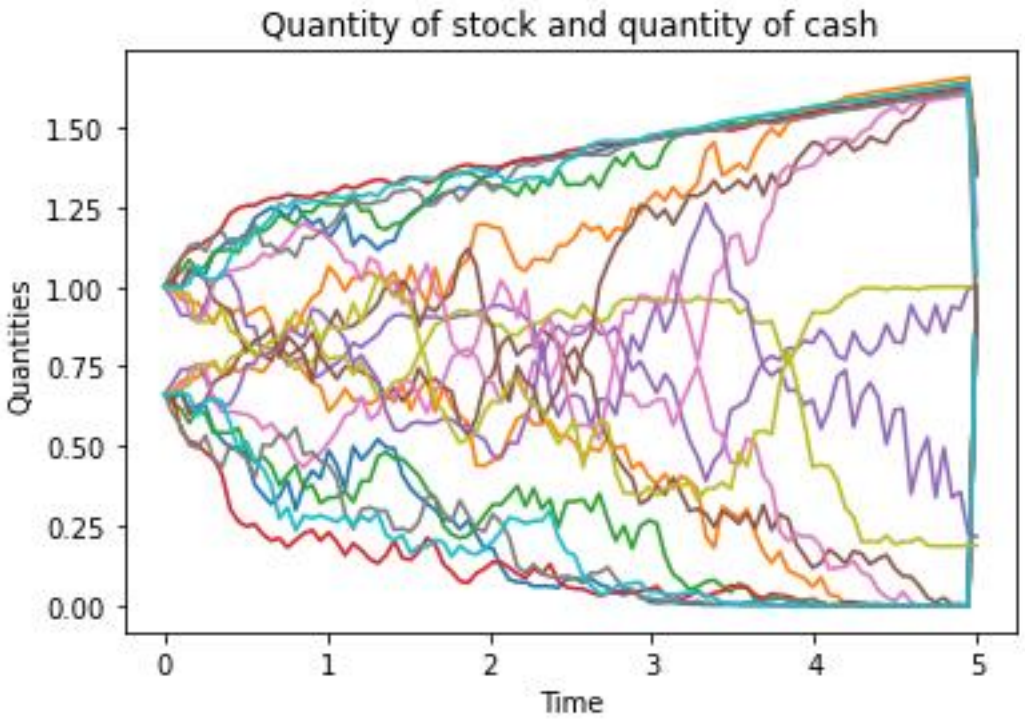
Plot of A and B

The difference between the hedging portfolio and the option

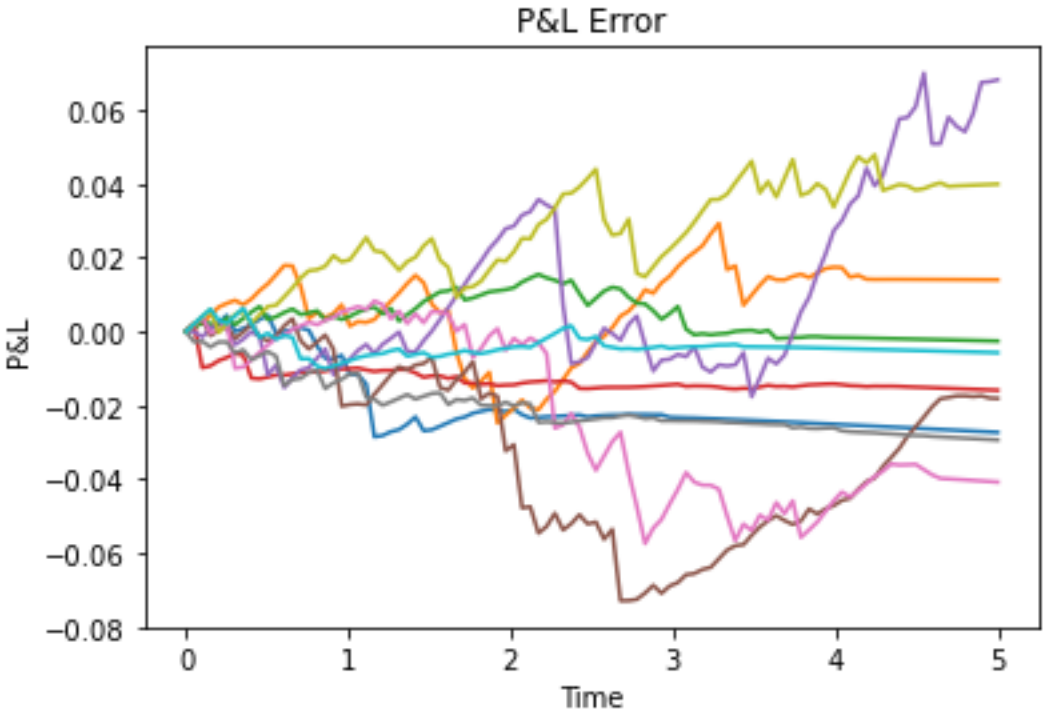
Part 6 : Many P&L Paths and distribution plots



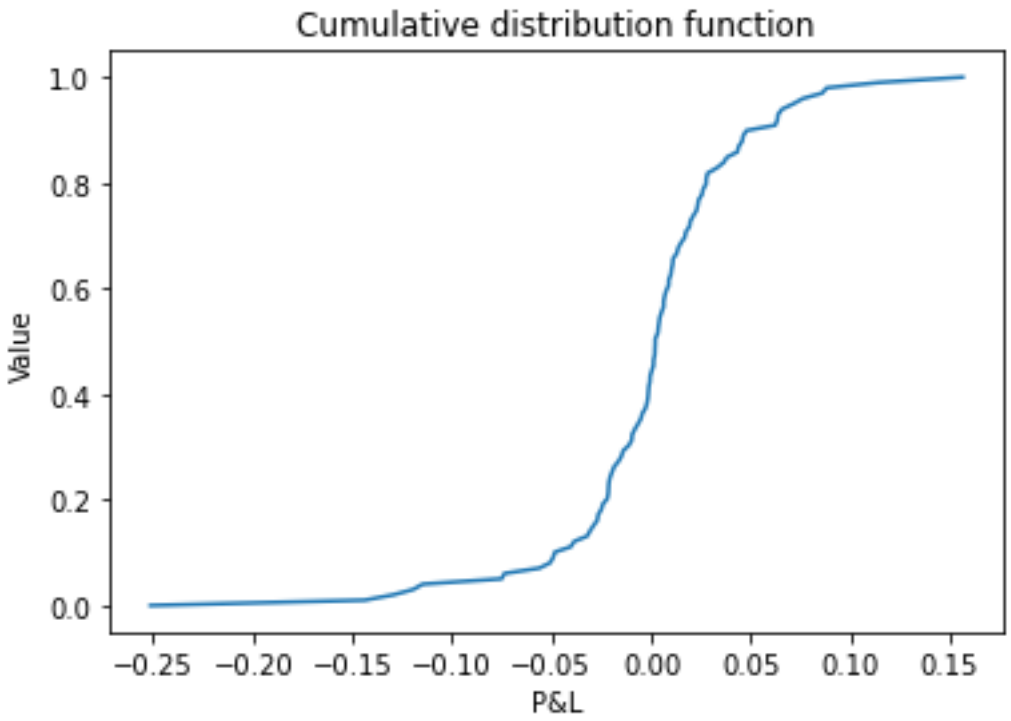
Multiple portfolios/options



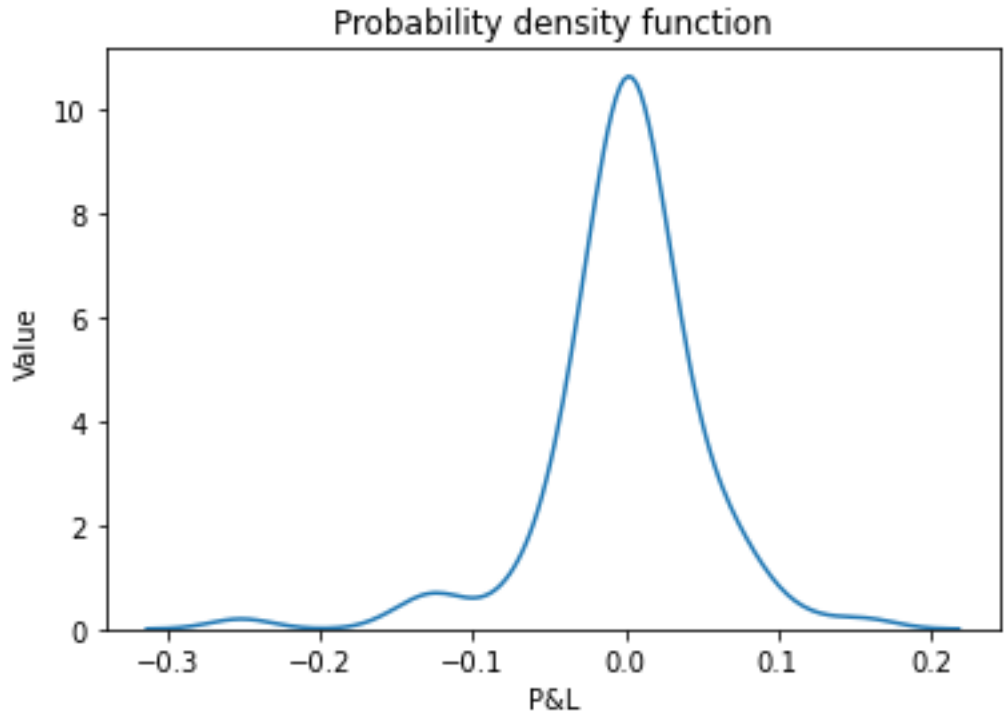
Multiples As and Bs



Multiple P&Ls

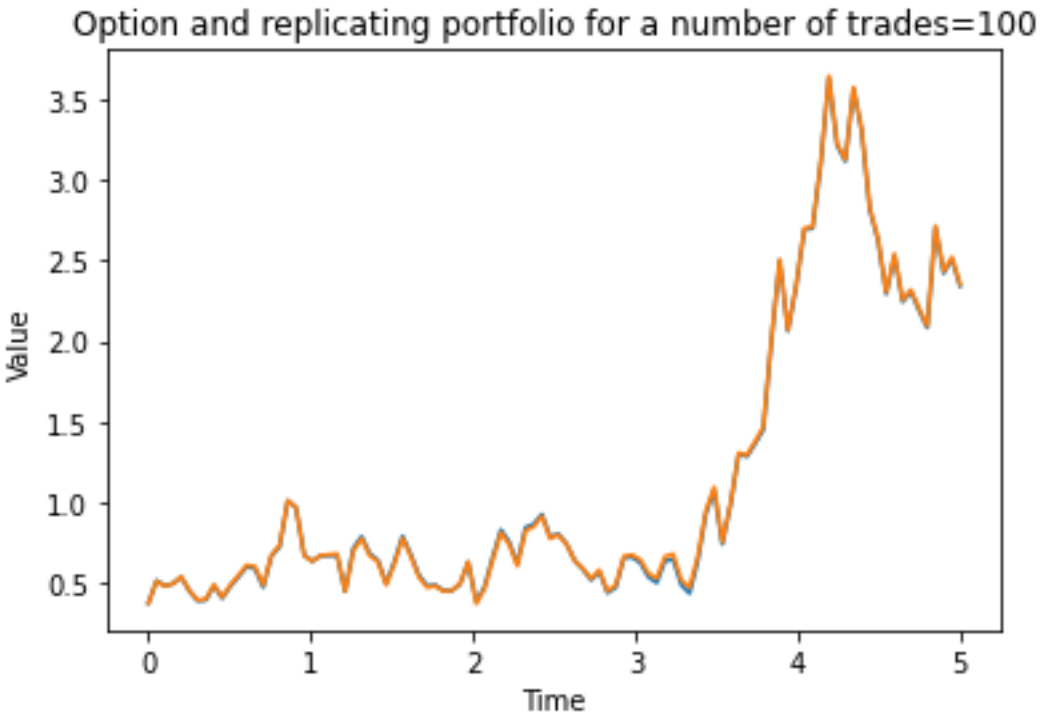


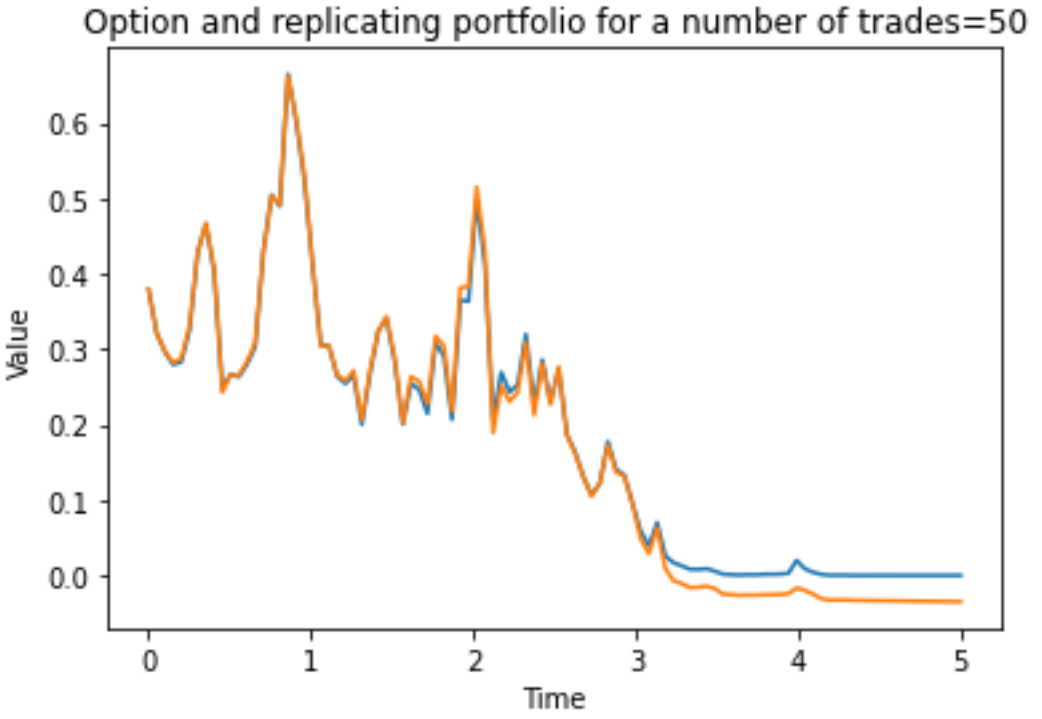
P&L CDF

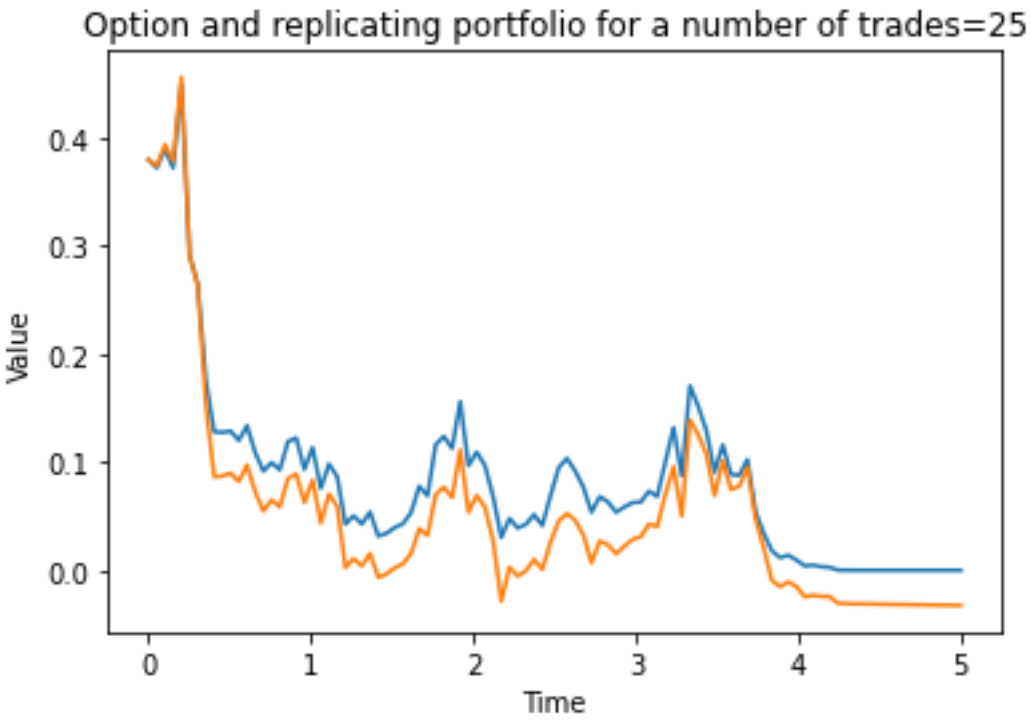


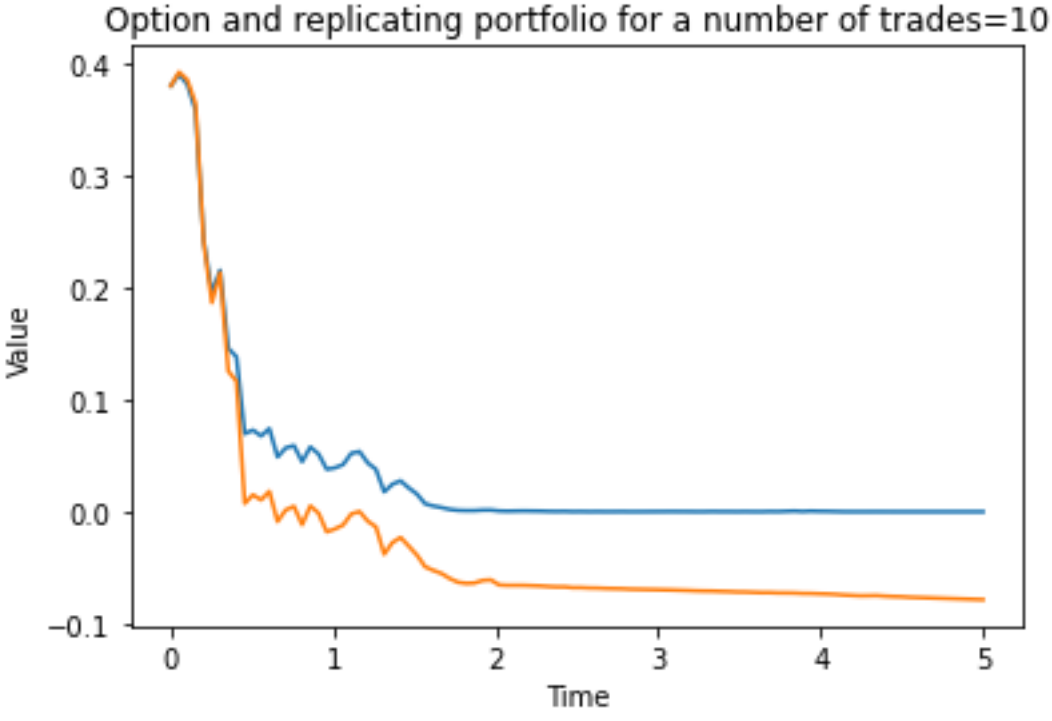
P&L Density function

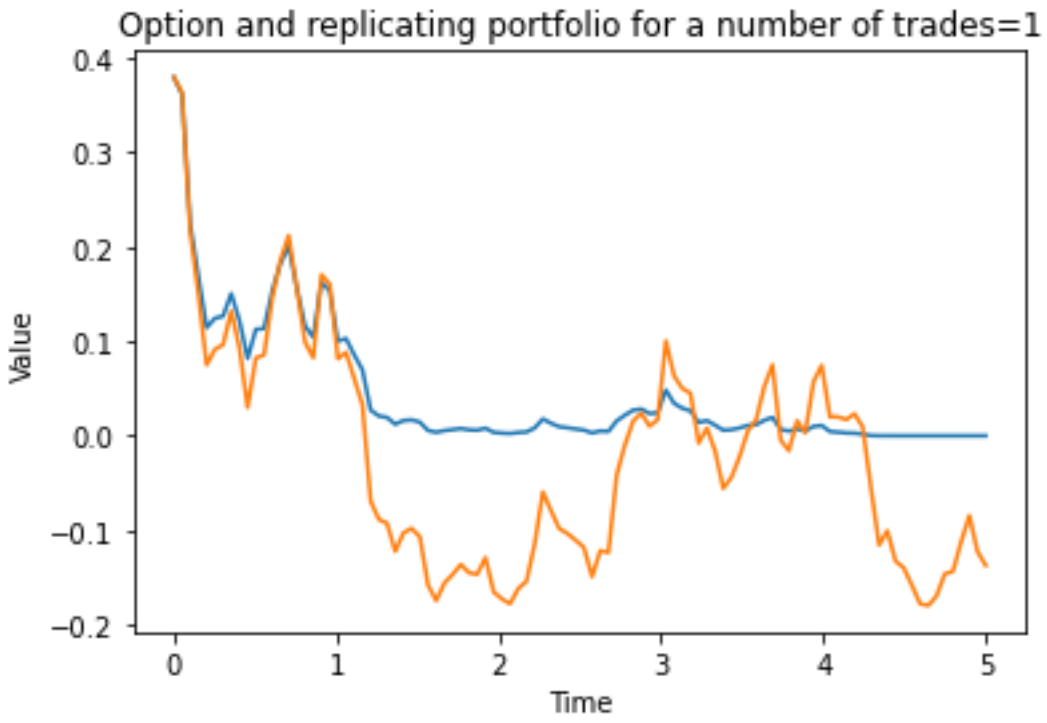
Part 7: Trading frequency






Option and replicating portfolio for a number of trades=25
Value
Time
0.4
0.3
0.2
0.1
0.0
0
1
2
3
4
5

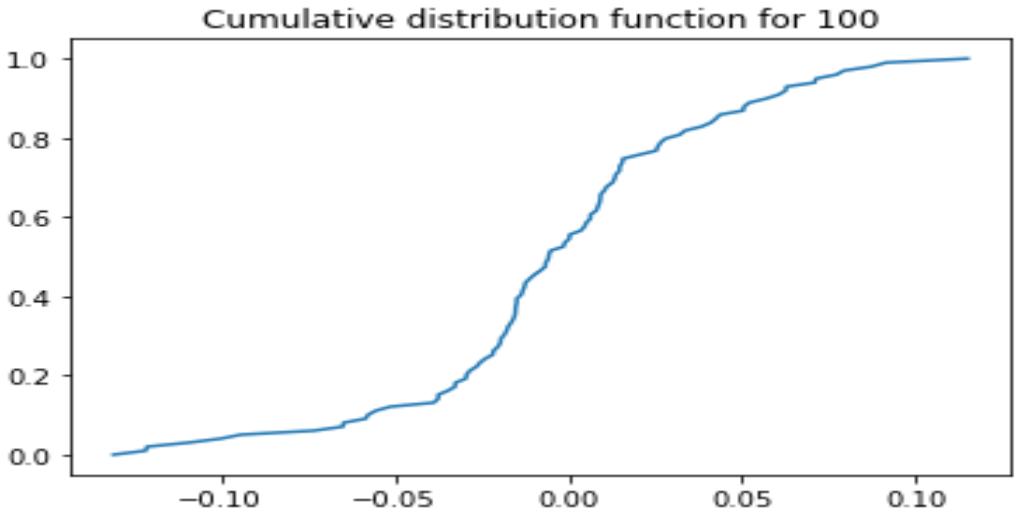

Option and replicating portfolio for a number of trades=10
Value
Time
0.4
0.3
0.2
0.1
0.0
−0.1
0
1
2
3
4
5

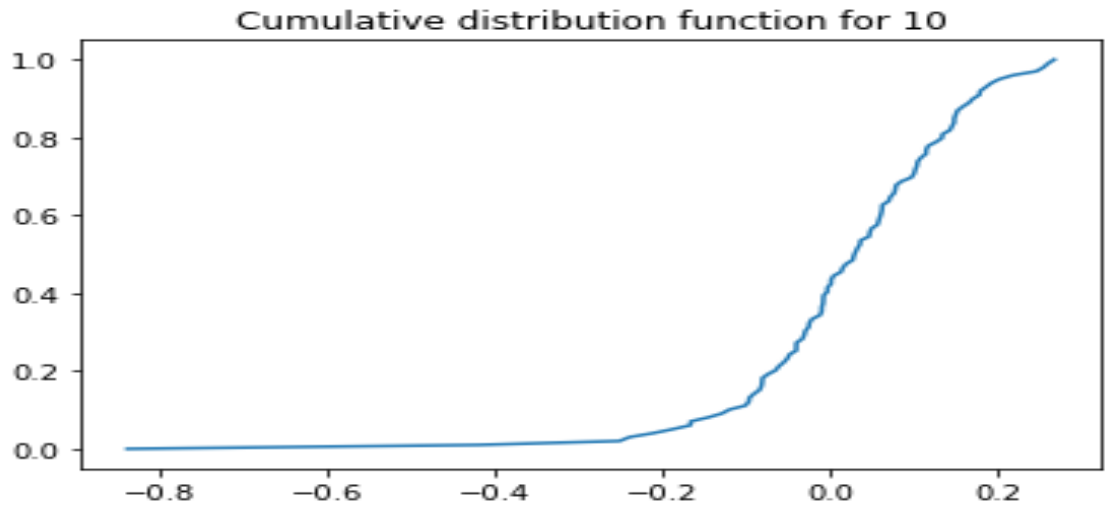


The hedging portfolio and option error goes up as we diminish the trading frequency.

Part 8: Value at Risk and stochastic volatility

Var=-0.05683674505321945





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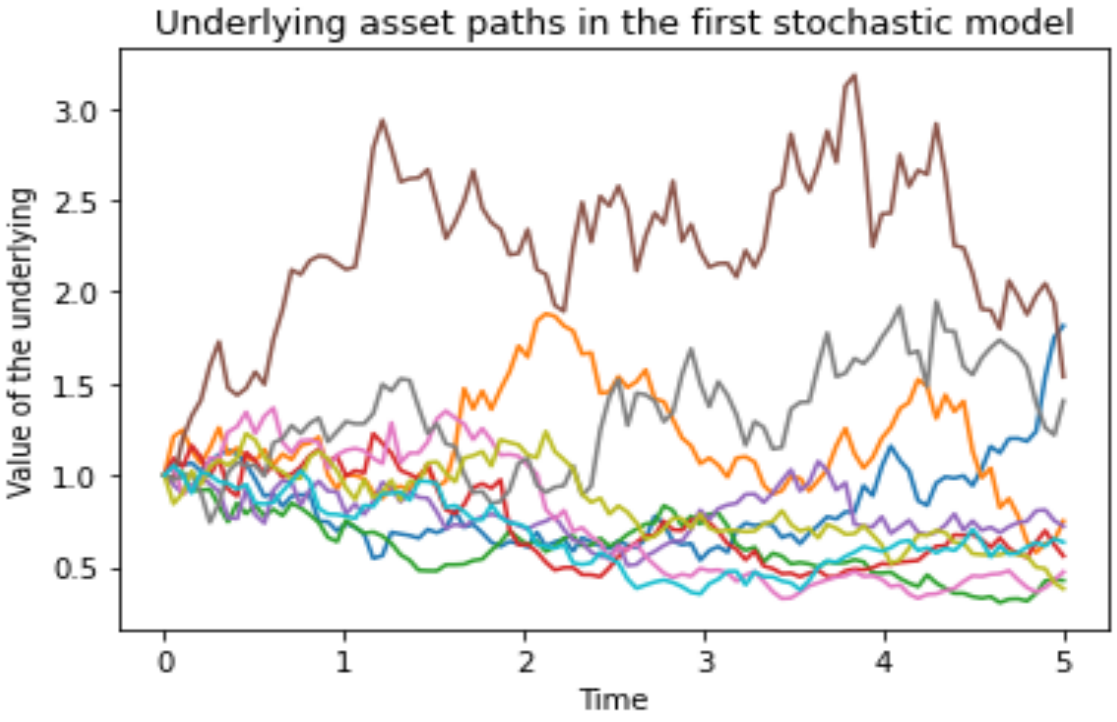
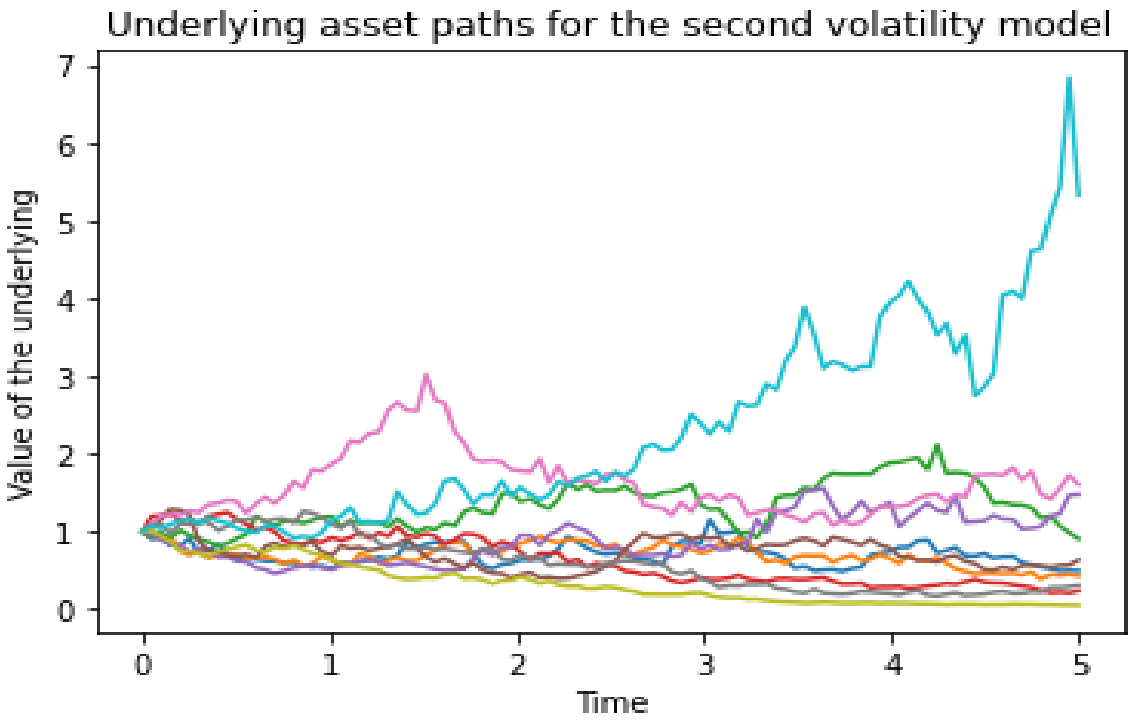
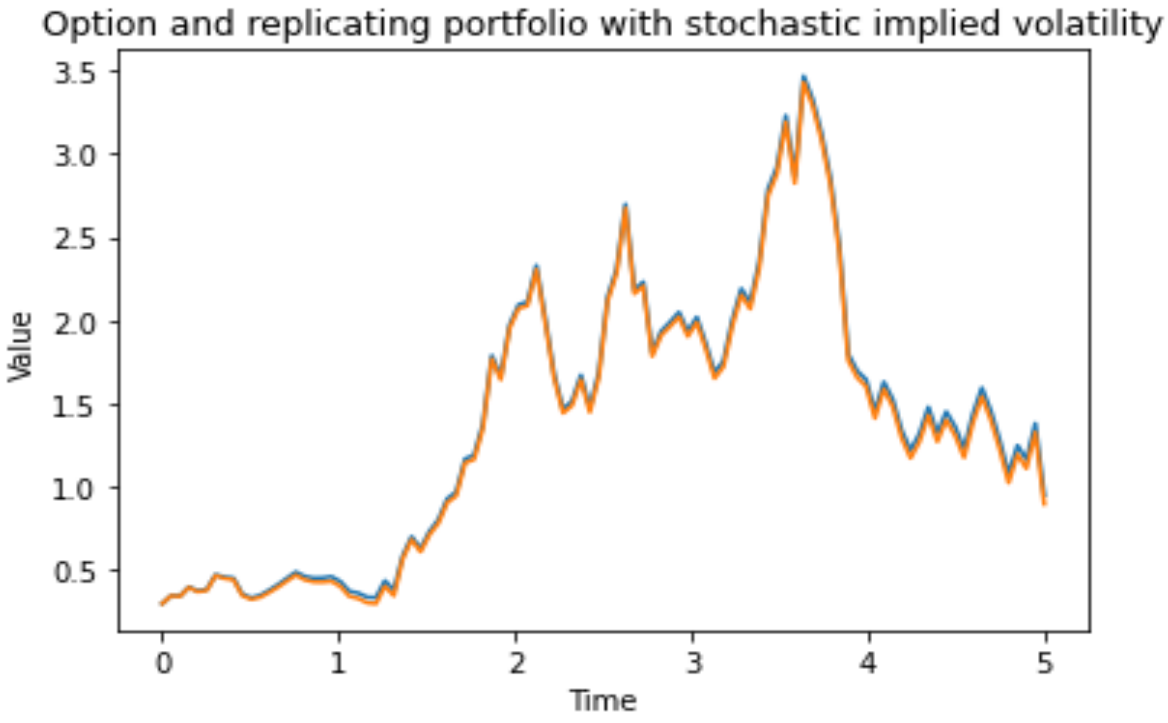


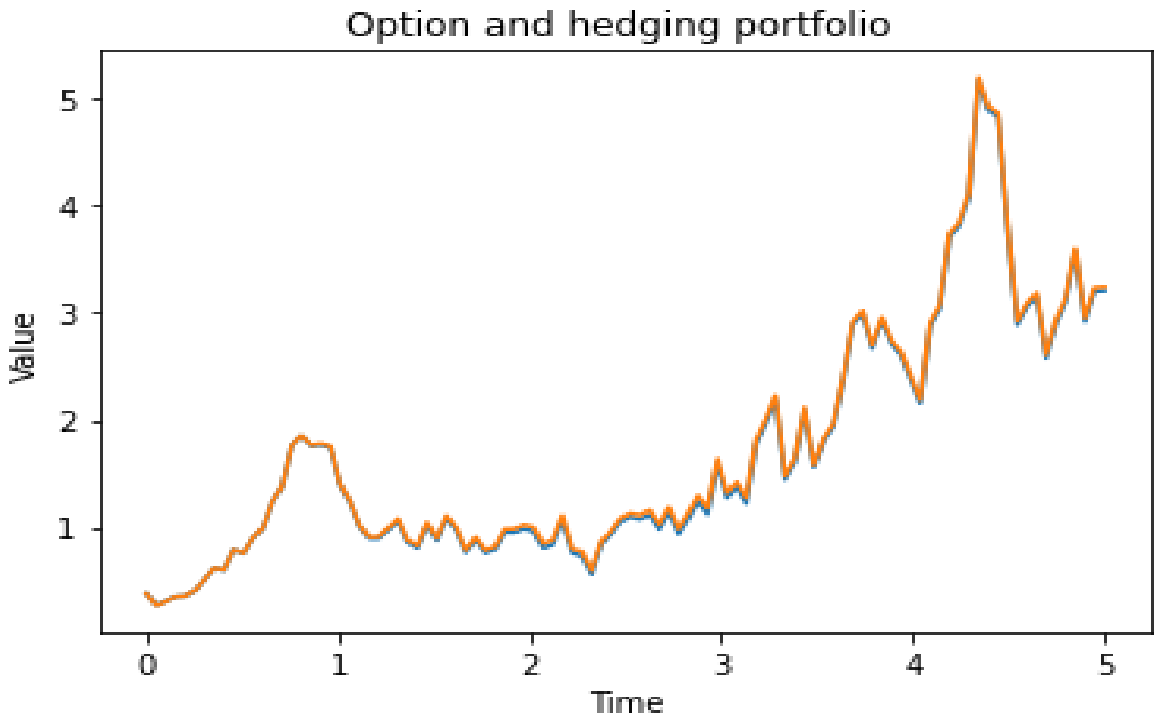
Asset paths with stochastic volatility model 1



Part 9: Delta hedging with implied volatility and replicating portfolio

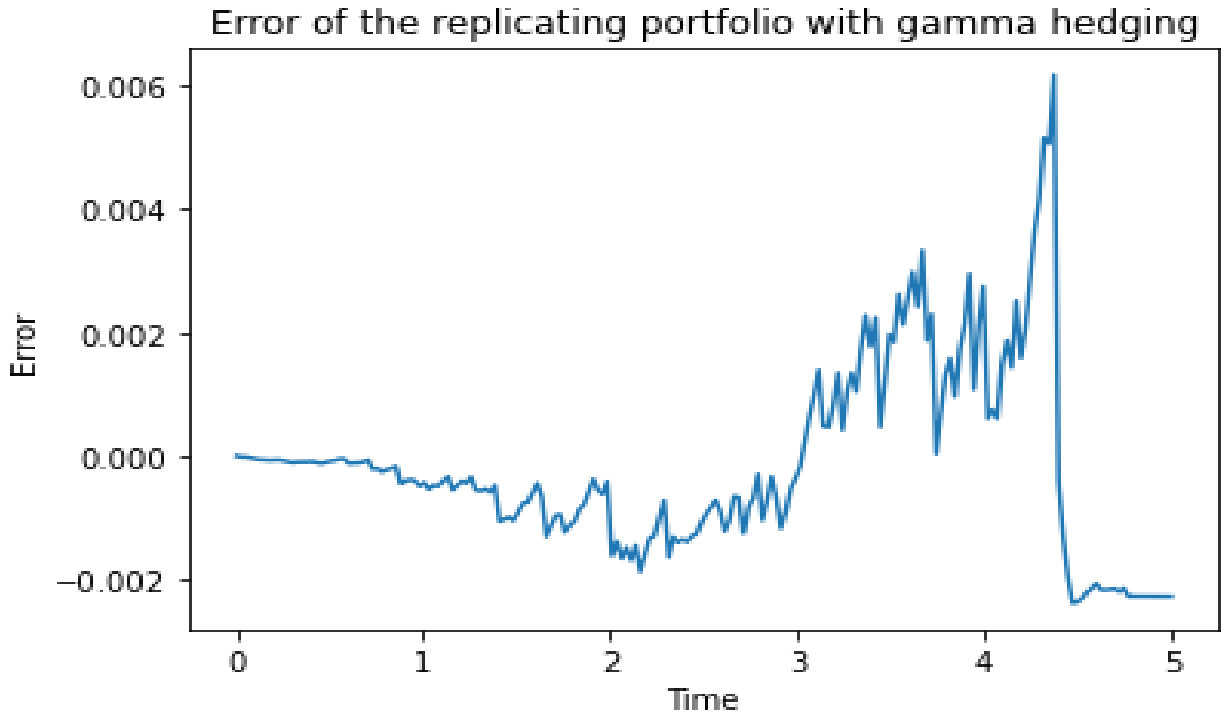


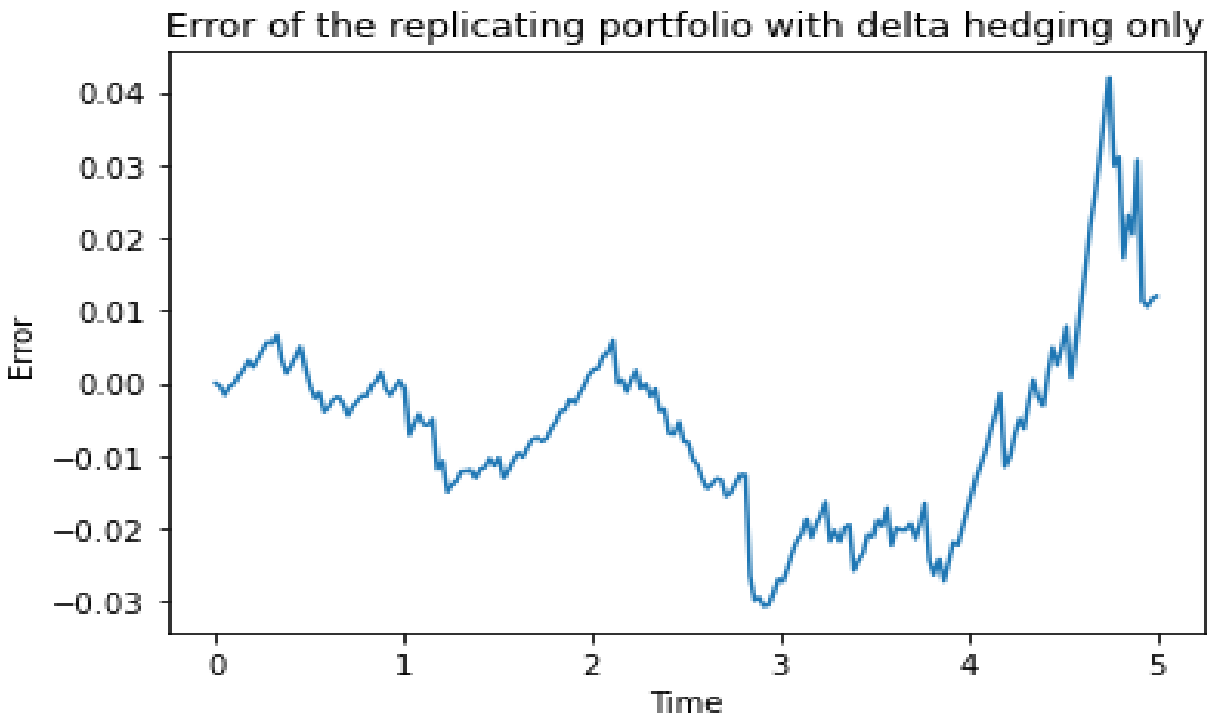
Hedging using stochastic implied volatility and historical volatility



Hedging in the case B[0]=V[0]-A[0]*S[0]

Part 10: Gamma Hedging





There is less error if we gamma hedge, mainly because delta hedging is linear, and as shown in the paper the error is proportional to the gamma, so adding an option, adds convexity to the overall approximation, and hence offers better results.