MF 796 Assignment 7

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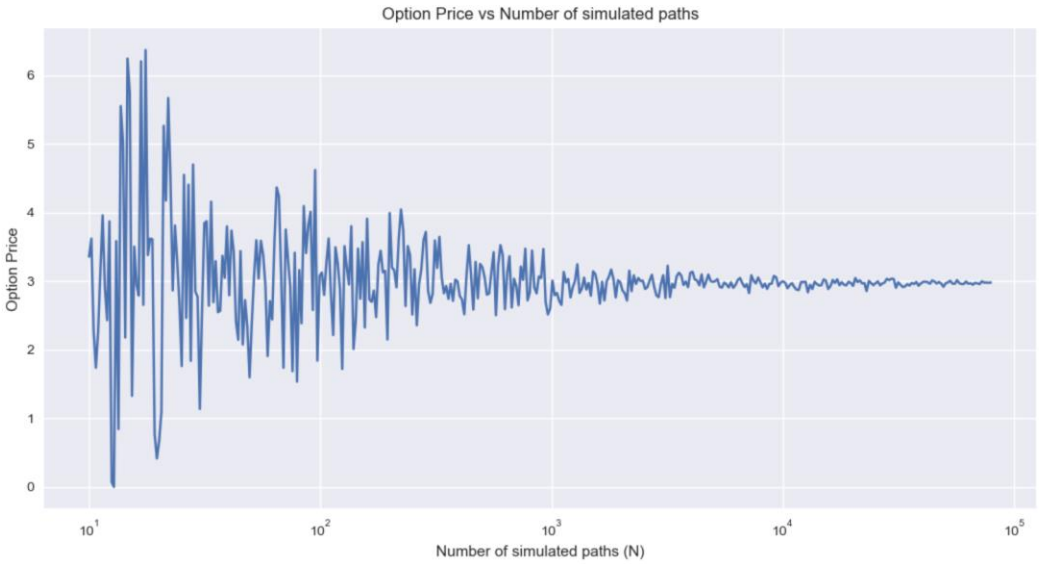
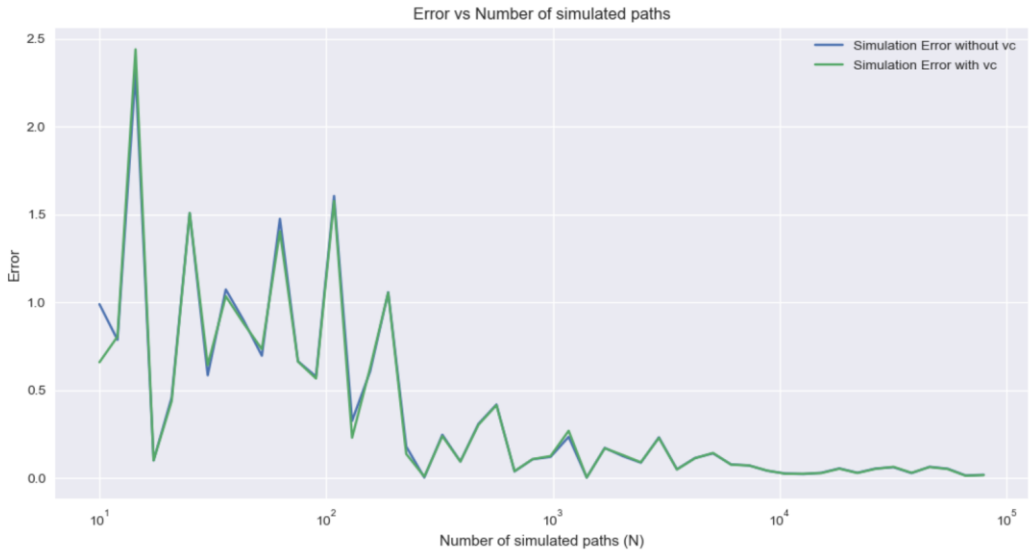
Problem 1

1. I used the parameters we calibrated from Homework 5. I used these parameters because these parameters can explain the SPY very well, and they should not change within a short period.
   Kappa = 3.52; theta = 0.052; sigma = 1.18; rho = -0.77; v0 = 0.034
2. I choose dt = 1/250, N = 20000. This dt is a very small step that make sure dt is small enough for simulation. Since simulation converge in the speed of 1/sqrt(N), we need a large number like 20000.
3. European Call price through Simulation is: 17.21
   European Call price through FFT is: 17.49
   We can see the difference is quite small.
4. The Up-And-Out Call option price is 2.97. From the figure below, we could see that the price converges after roughly N = 10000.



5. From the figure below, we could see that there is no clear difference of the decreasing speed of the error between the method with and without control variate. I think this is mainly because the correlation between European option and Up-And-Out Option is too low to make a difference on the converge rate, since the impact of variance reduction brought by variate control requires a high covariance between two estimators.


Error vs Number of simulated paths
Simulation Error without vc
Simulation Error with vc
Error
2.5
2.0
1.5
1.0
0.5
0.0
10^1
10^2
10^3
10^4
10^5
Number of simulated paths (N)