MF 796 Assignment 3

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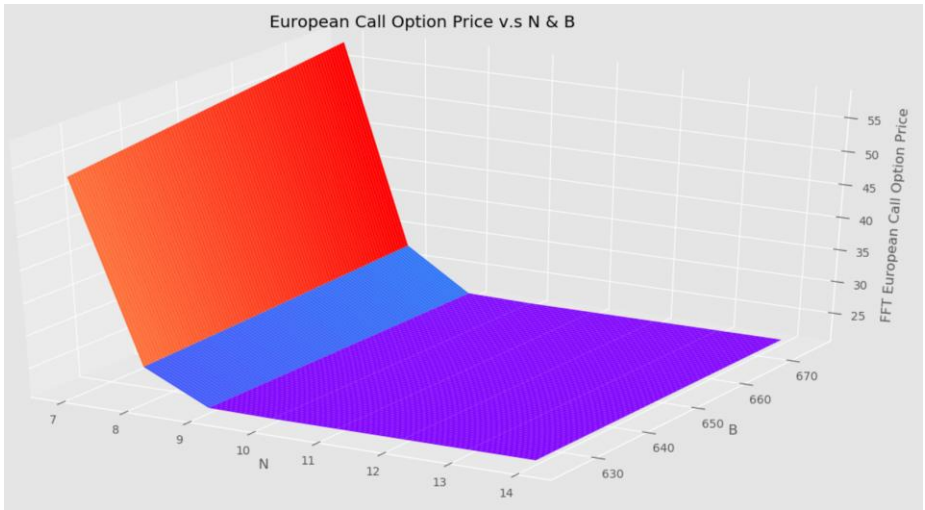
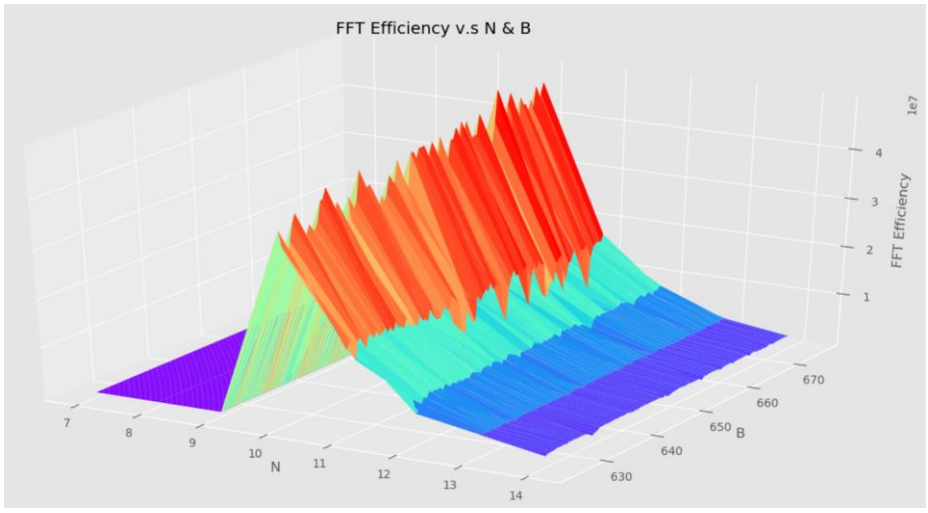
Problem 1 (a)

i. Prices of European Call with different damping factors are shown as follows:

As we could see, the price is stable when alpha is larger than 0.5. The stable price is roughly 21.27.

ii. Here we choose 1.5 as our alpha. And the range of n and B we chose are [7, 14] and [K*2.5, K*2.7] respectively. We could see the call price and efficiency of different values of N and B as follows:

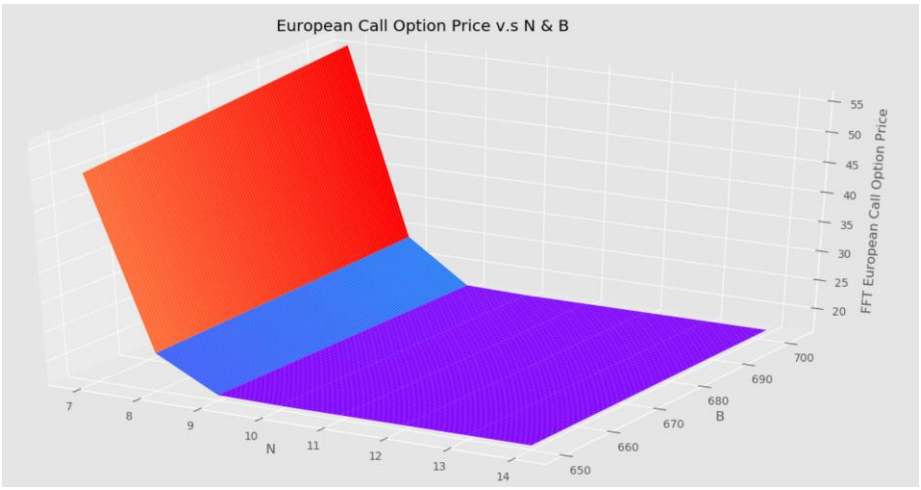


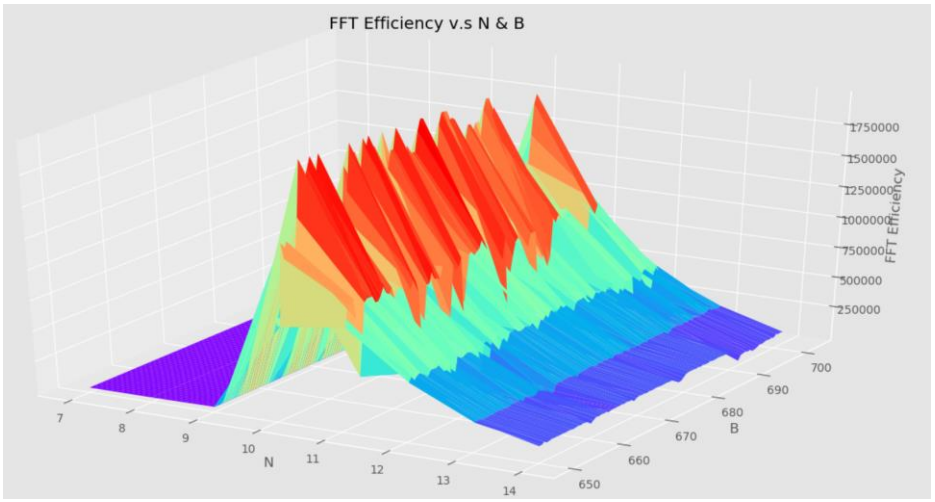


From first figure, we can see that the option price becomes stable when n is in range of [9, 14] and B is in range of [630, 670]. The second figure shows the efficiency of FFT algorithm varies with different n and B. And we got the result that the most optimal parameter pair for the efficiency of FFT algorithm when K is 250 is: n=10, B=665.

iii. By comparing different alphas, the price becomes stable when alpha is in range of [0.5, 30]. The price is 16.73.

Then we compare the impact of different values of parameter n and B. The results are shown as follows:

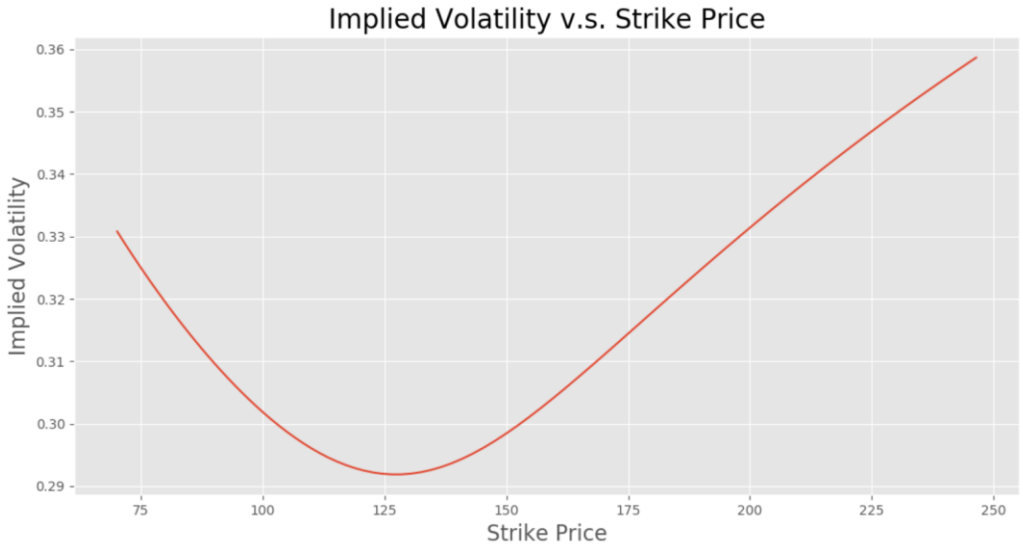




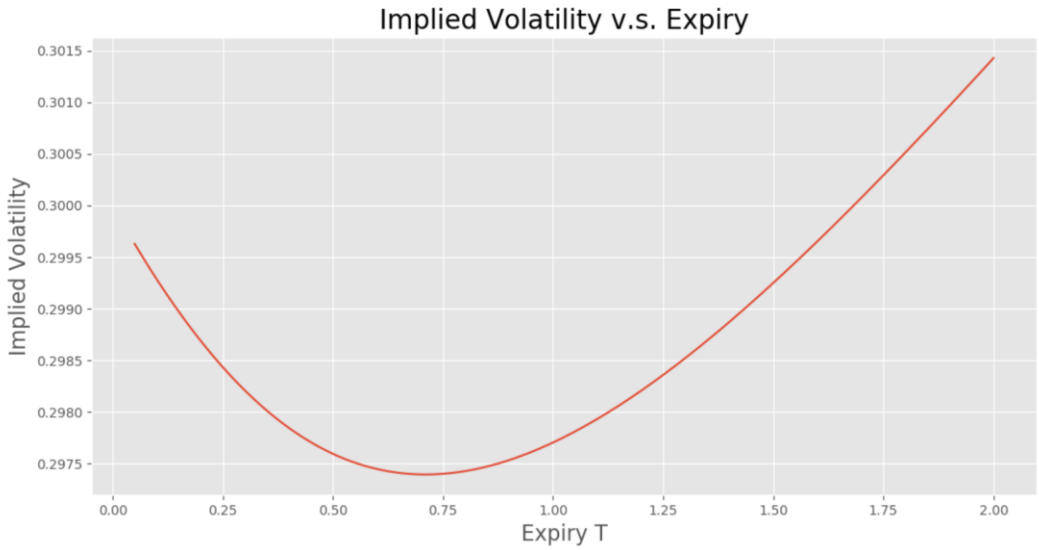
And we got the result that the most optimal parameter pair for the efficiency of FFT algorithm when K is 260 is: n=10, B=650. This combination is a slightly different from the previous one.

Problem 1 (b)

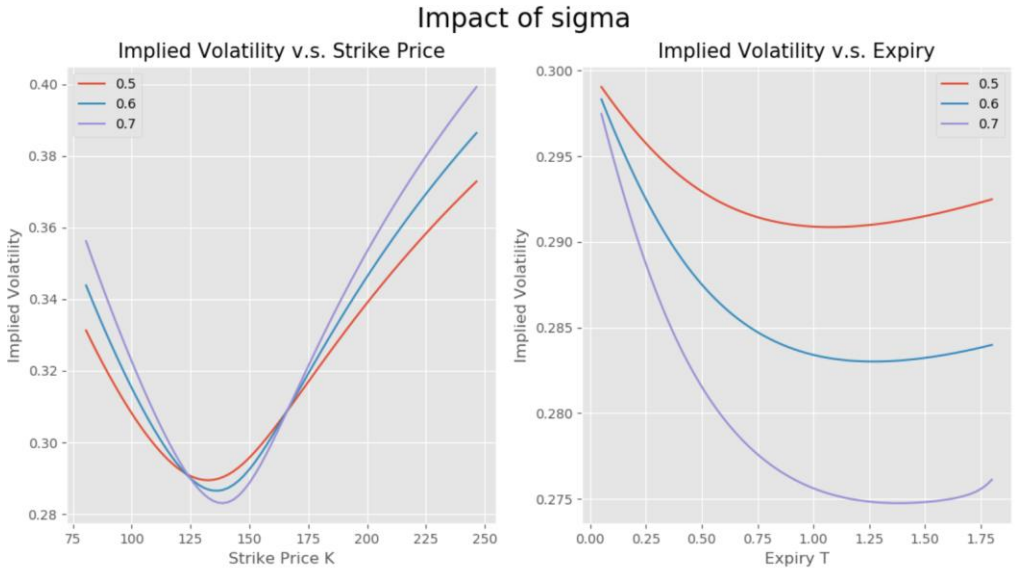
i. Using the new parameters, we have the following plot of implied volatility and strike price. We can see a volatility smile from this figure.



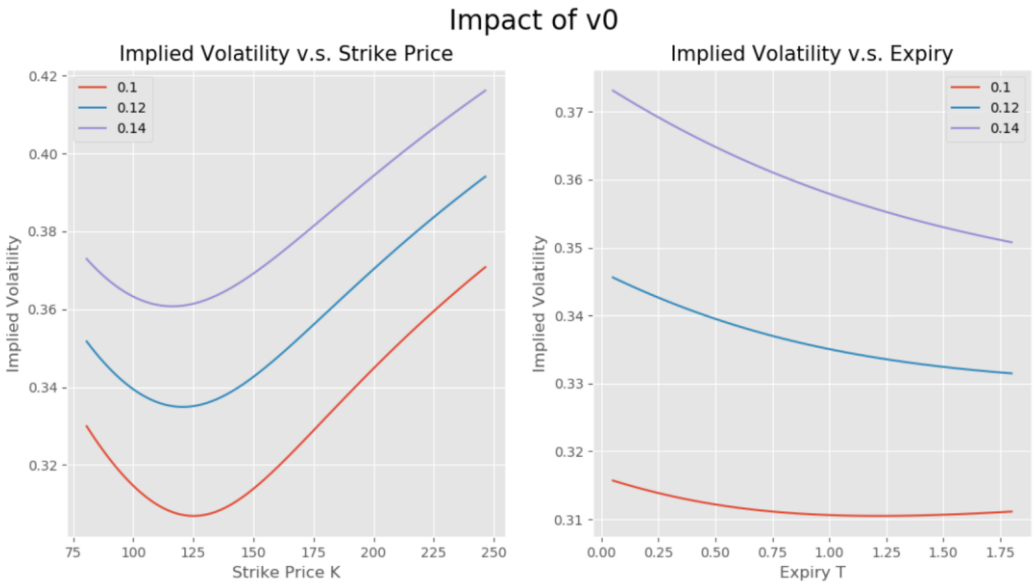
ii. Using the new parameters, we have the following plot of implied volatility and expiry.



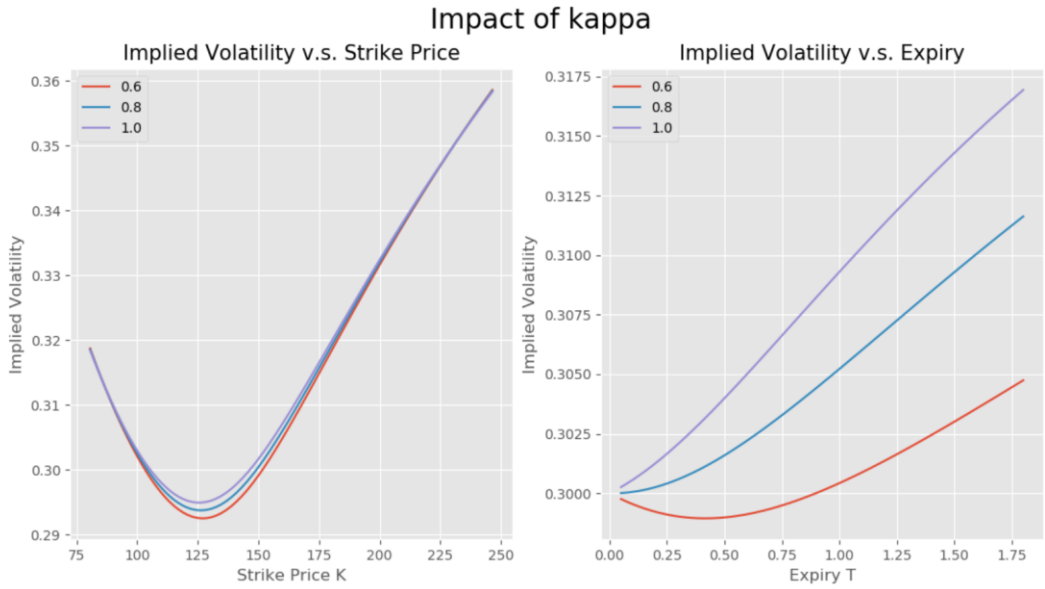
iii. By varying the parameters separately while holding others constant, we get the following figures:



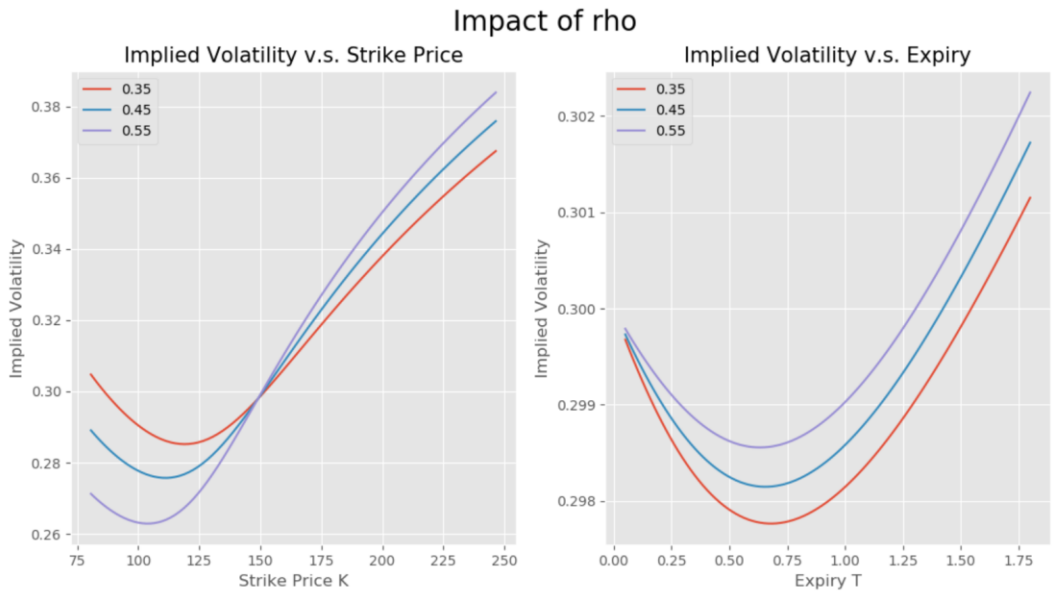
By increasing sigma, we find that the two curves shift up and the ranges of volatility become wider.



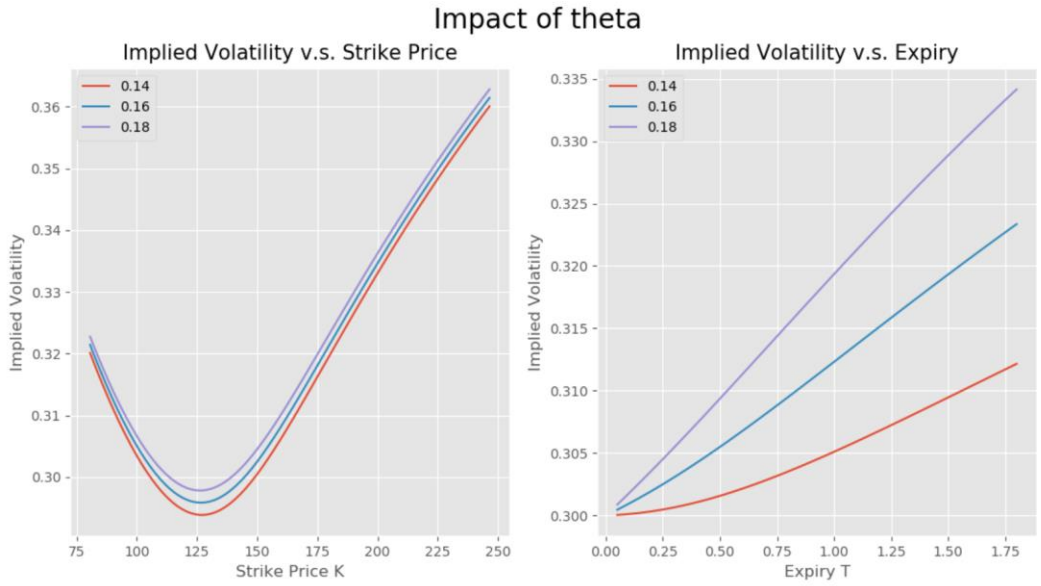
By increasing v0, we find that the two curves shift up and the term structure presents decreasing trend.



By increasing kappa, we find that the skew structure has slight change and the term structure presents increasing trend.



By increasing rho, we find that the skew structure shifts downwards and the term structure only has slight change



By increasing theta, we find that both the skew structure and the term structure shift upwards.