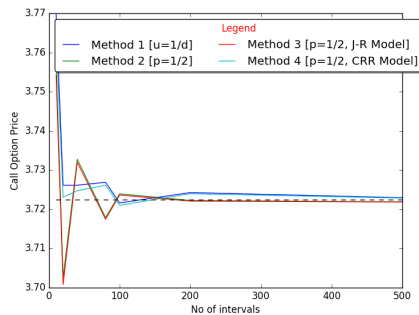


## Project -4

### Ashwin Kumar Ashok Kumar

Q1. From graph method 2 & 3 converge faster than method 1 & 2. The dashed line plot is the Black –Scholes Option Price



Q2.

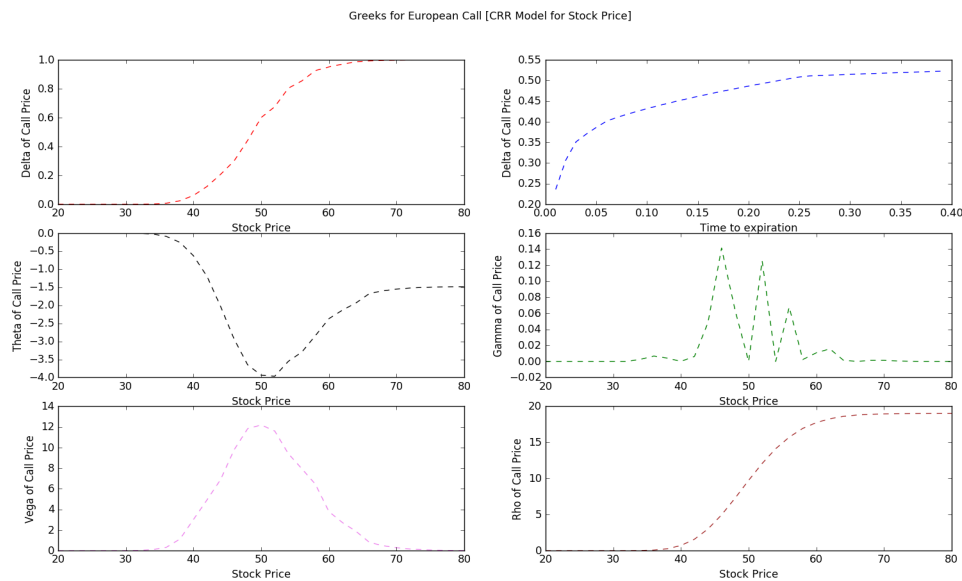
a) Using pandas in python, got the Adj-Close price of GOOG for the past 5 years. Historic vol = 25.4459%. ( return is calculated as  $S(t-1)/S(t) - 1$  )  
Last Close Price of GOOG (as on 4/25/16) = 708.140015 Strike = 770.  
Call = 41.04

I was not able to fetch the January 2017 expiry option using pandas (yahoo finance is the only api available). I used static value (Jan expiry from Bloomberg)  
Call actual = 29.30 ( as on 4/25/16).  
The values are different because of the assumptions of BS model (Binary is approximation).

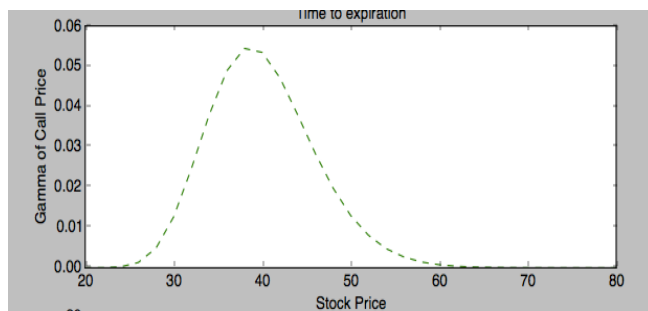
b) Market prices the option lower than the BS model. This implies the historic volatility is not good approximation for the future vol.  
Implied volatility using fsolve = 20.36 %

```
70users/akumar/anaconda/bin/python 70users/akumar/python/com/ashwin/computationalmethodsinfinance/Project4/q2.py
Q2. a) Using the Method-4 the call option price [S0,X,r,sigma,t] = [708.140015,770.000000,0.020000,0.254459,0.726027] = 41.047011
Q2. b) The implied volatility of the option price = 29.300000 = 20.362122 %
Process finished with exit code 0
```

Q3.

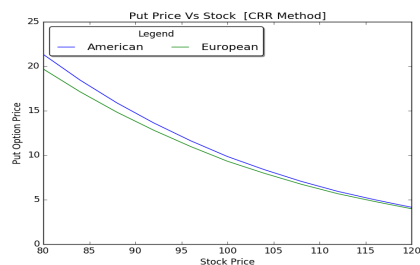


The graphs for the six plots are as expected. In case of gamma, since the shock to stock price is very small, the graph is not smooth. When epsilon = 0.25% of the stock value we get a smooth graph like below.



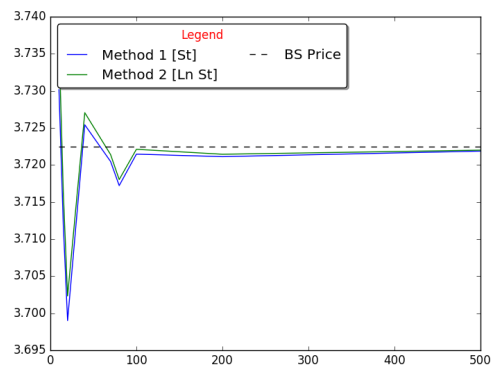
Q4.

From the graph, we can see the American Put option has higher value than European Put. This is as expected because, the value of option price at each node calculated for American  $\geq$  European (condition imposed in the code). Also, the value of American Put  $\gg$  European Put when the option is deep in the money.



Q5.

From the graph below, we can see that log St price model converges faster in the Trinomial model Option pricing.



Q6.

C (100,105,2,0.05,0.3,100000,2,7)

```
Q6. Price of European Call Option [MC using Halton seq] = 18.996778 with variance = 0.005653 for 100000 simulations ****[4.873386 sec]
Using BS Model %f 18.993677593705705
Process finished with exit code 0
```