Assignments

September 28, 2018

1 Assignments

Prj01 (L01)

A twin prime is a prime number that is either 2 less or 2 more than another prime number, see for details here: https://en.wikipedia.org/wiki/Twin_prime

- How many twin primes are bigger than one thousand but smaller than one million?
- What is the biggest twin prime you could find?

Prj02. (L04) This is an application of BSM evaluation to Geometric asian option price
Geometric asian call option with maturity T and strike K has its pay off as

$$C(T) = (A(T) - K)^+,$$

where $A(T)$ is geometric average of the stock price at times $0 \leq t_1 < t_2, \ldots, < t_n = T$, i.e.

$$A(T) = (S(t_1)S(t_2)\ldots S(t_n))^{1/n}.$$

The call price can be thus written by

$$C_0 = \mathbb{E}[e^{-rT}(A(T) - K)^+].$$

To do Use "BSM_option_valuation" module to find the BSM asian option value with the following parameters

```
In [2]: %reset -f
        import numpy as np
        #An example is given here
        S0 = 100.0 #initial stock price
        K = 110.0 #strike
        r=0.0475 #interest rate
        sigma = 0.20 #vol
        T = 1. #maturity
        Otype='C' #Call type
        n = 4 #number of periods
        t = np.linspace(0., T, n+1)[1:] #times to be used for geometric averaging stock price
```

Hint

Under the above BS model, one can show that the distribution of $A(T)$ is again a lognormal under EMM in the form of

$$A_T = S_0 \exp\{(\hat{r} - \frac{1}{2}\hat{\sigma}^2)T + \hat{\sigma}\sqrt{T}\hat{Z}\}.$$

In the above, $\hat{Z}$ is a standard normal random variable, $\hat{\sigma}$ is

$$\hat{\sigma} = \frac{\sigma}{n}\sqrt{\frac{(n+1)(2n+1)}{6}}$$

and $\hat{r}$ is

$$\hat{r} = \frac{1}{2}\hat{\sigma}^2 + \frac{n+1}{2n}(r - \frac{1}{2}\sigma^2).$$

Then, by fundamental asset pricing theory, we have GAC price by

$$\Pi_0^c = e^{(\hat{r}-r)T}\mathbb{E}[e^{-\hat{r}T}(A_T - K)^+].$$

Prj03

- From Yahoo Finance, download option chain for SPY of the date for the maturity of 1 month, 3 month, 12 month.
- Sort the data for the strikes within 2% of difference from the spot price.
- Calibrate BSM vol for three sets of data independently for each maturity.
- Merge three sets of data into one, and calibrate BSM vol for entire data sets.
- Comment on what you oberved.