

Financial Engineering

Homework 7

Due at 07:00 pm (Korea Standard Time) on Saturday, May 13.

Submit one file: written solutions with executable Python code

Problem 1. Download the spreadsheet [EquityDerivsPractice\\_PSet3.xlsx](#) from the Course platform. It is also uploaded to the Notion. In the second worksheet, “*StockPricePaths*”, you will find four new price paths for the security. Now answer the following questions:

- (a) Compute the annualized realized volatility of the log-returns for price path #1,2,3,4.
- (b) Compute the total realized P&L when hedging using price path #1,2,3,4. (Note that the total realized P&L in the “*DemoSheet*” worksheet is in cell B11. It is the final value of the self-financing trading strategy minus the option payoff.)

Problem 2. Consider the following stock.

Time to expiration : 6 months  
Standard deviation : 50% per year  
Exercise price : \$50  
Stock price : \$50  
Annual interest rate : 3%  
Dividend : 0

- (a) Use the Black-Scholes formula to find the value of a call option and put option on the given stock.
- (b) Describe what would be the change in the price of the call option if each parameter was changed independently. (Substituting one parameter while keeping the other parameters. Don't consider about Dividend.)

Problem 3. Show that for a European call or put on a non-dividend-paying stock

$$\Gamma = \frac{N'(d_1)}{S\sigma\sqrt{T}}$$

$$\Theta = -\frac{SN'(d_1)\sigma}{2\sqrt{T}} - rKe^{-rT}N(d_2)$$

Problem 4. You have to price a European call option either with a constant volatility 30% or by drawing volatility from a random distribution with a mean of 30%. Which option would be more expensive? (Use Vega to solve the problem.)

Problem 5. Solve the corresponding leetcode problem below and register the solution on GitHub.

<https://leetcode.com/problems/3sum/>

<https://github.com/fbaquant/leetcode-challenge/issues>

Problem 6. Solve the corresponding leetcode problem below and register the solution on GitHub.

<https://leetcode.com/problems/happy-number/>

<https://github.com/fbaquant/leetcode-challenge/issues>