**Homework 3 - Fall 2024**

**Problem #1**  
Calculate the daily delta, gamma, vega and theta for three put options and three call options over a 3-month time period (63 days). The three options are in-the-money, at-the-money and out-of-the-money. Graph the results as the options approach maturity and compare your results to those developed in the class slides. For the problem, use an option where the strike is $10, the away-from the money strike prices are $2 from $10 ($8 and $12), the risk-free rate is 7% and the volatility is 70%. Perform the same as if you had written the options. Assume 252 trading days in a year.

**Problem #2**   
Use the option inputs from problem #1. Instead of moving time and holding all else constant, we will be holding time constant and moving the spot price. Calculate and graph the delta and gamma as you change the asset price from in-the-money to out-of-the-money. Start at $5 and end at $15 ($0.10 increments). Perform the analysis for options having a one-day, 30 days and 60 days from maturity. Graph the results. Create the same graph if you were short the options. Assume a strike of $10, volatility of 70% and a risk-free rate of 7%

**Problem #3**   
Compare the Delta and Gamma based graphs from problem #1. Analyze & explain the behavior of the two Greeks in relation to each other as the option approaches maturity. Are they consistent with the notes?

**Problem #4**  
Assume you have the following set of options in a portfolio. Calculate the portfolio Greeks and analyze the portfolio Greeks. Assume the risk - free rate is 7.0%.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Quantity | Bought/Sold | Volatility | Maturity (days) | Strike Price | Current Price |
| 15,000 | Bought Call | 36% | 7 | $10.90 | $11 |
| 12,000 | Bought Call | 28% | 6 | $12.50 | $11 |
| 7,500 | Bought Put | 37% | 4 | $9.20 | $11 |
| 5,340 | Bought Put | 49% | 1 | $8.50 | $11 |
| 11,110 | Sold Put | 70% | 2 | $10.20 | $11 |
| 3,000 | Sold Call | 32% | 2 | $11.10 | $11 |

**Problem #5**

Please use HW 2 prices for April 2024 spot prices for WTI Crude. Using these prices, you will create a breakdown of the cost of dynamic hedging the month of April 2024. You will assume that you have bought calls on 600,000 barrels of oil on March 30th 2024. You will be using futures to make yourself delta neutral at the end of each day. In order to do this, you must calculate your delta every trading day of April. Then, determine how many futures you would need to hedge (round your delta to the nearest whole number). After that you can use the brokerage fee to determine how much it would cost you in fees to get back to delta neutral. Aggregate the fees to see what the total cost would be for the month of April.

Key notes:

Option Expiry: 4/30/2024

Position to hedge: 600,000 barrels

Commission Fee: 1.5% of every transaction

Strike: $70

Risk Free: 7.0%

Vol: 40%

Note: Time changes every day.