

FINM3405 Derivatives and risk management

Tutorial Sheet 6: Options - Delta hedging, implied volatility, trading strategies

August 25, 2024

In the following questions let $S = \$50$, $r = 0.05$, $\sigma = 0.25$, $T = \frac{1}{2}$ and $q = 0$ unless otherwise stated.

Delta hedging

Question 1. Suppose you wrote 10 ATM call options.

1. How many assets Q should you short or long to be delta hedged? Show the outcomes of your hedging strategy in 1 week if the asset price went both up and down by \$1.5.
2. Consider an additional OTM put option with a strike of $K_1 = 47.5$. How many assets Q and puts k should you long and/or short to be delta and gamma hedged? Again, show the outcomes of your hedging strategy in 1 week if the asset price went both up and down by \$1.5.

Question 2. Suppose you wrote an ATM put but with 90 days to expiry. You can assume that there is 360 days in a year. Possibly using Excel, simulate 3 months of daily asset prices under geometric Brownian motion starting at $S = 50$ and calculate the mechanics of a daily dynamic delta hedging strategy. What was your final liquidation value? *Remark:* It should be as easy as writing formulas in only the top two rows of cells and then dragging them down.

Question 3. The delta of a portfolio of options is the sum of the delta of each option multiplied by the quantity of each option you hold in the portfolio. Suppose you implemented a bull spread with upper strike $K_2 = 55$, but are now unsure of your view of the market but don't want to close out the position. What is the delta of the position? How many assets Q should you short or long to be delta hedged? How many assets Q and OTM puts k with strike $K_1 = 47.5$ should you short and/or long in order to be delta-gamma hedged? What would be the outcome of each hedging position in 1 week if the asset fell by \$2?

Question 4. Now suppose you're a market maker and implemented a bear spread with lower strike $K_1 = 45$ and at very favourable bid-ask spreads (which you can make up) relative to the Black-Scholes prices. Calculate a dynamic delta hedging strategy possibly again in Excel. What was your final liquidation value and hence profit? Would you rather be a market maker or retail trader?

Trading strategies

- Question 5.**
1. Show how to create a bull spread out of puts.
 2. Show how to create a bear spread out of calls.
 3. Show how to create a short butterfly payoff out of calls alone and out of puts alone. Plot their profit diagrams.
 4. Show how to create a long butterfly payoff out of calls alone and out of puts alone. Plot their profit diagrams.
 5. Plot the payoffs (not profits) diagrams and premium curves on the same graphs for long and short butterflies.

Question 6. What are long and short strangles and condors? Show how they can be created out of calls alone or puts alone. Plot their profit diagrams. Also plot their payoff diagrams and premium curves on the same graphs. Under what market expectations would you consider using these strategies? Why would you consider them instead of straddles and butterflies? How are these strategies also impacted by implied vols and time decay?

Question 7. In the lecture notes we gave an example of a calendar spread constructed out of calls. The market expectations behind it are a stable underlying asset. How is this strategy impacted by implied vols? Construct and plot the profit diagram for a calendar spread created out of puts which also hopes for a stable asset price. Also construct and plot the profit diagrams of calendar spreads created out of calls alone and out of puts alone which expect market volatility. How does time decay and implied vols impact these "reverse" calendar spreads?