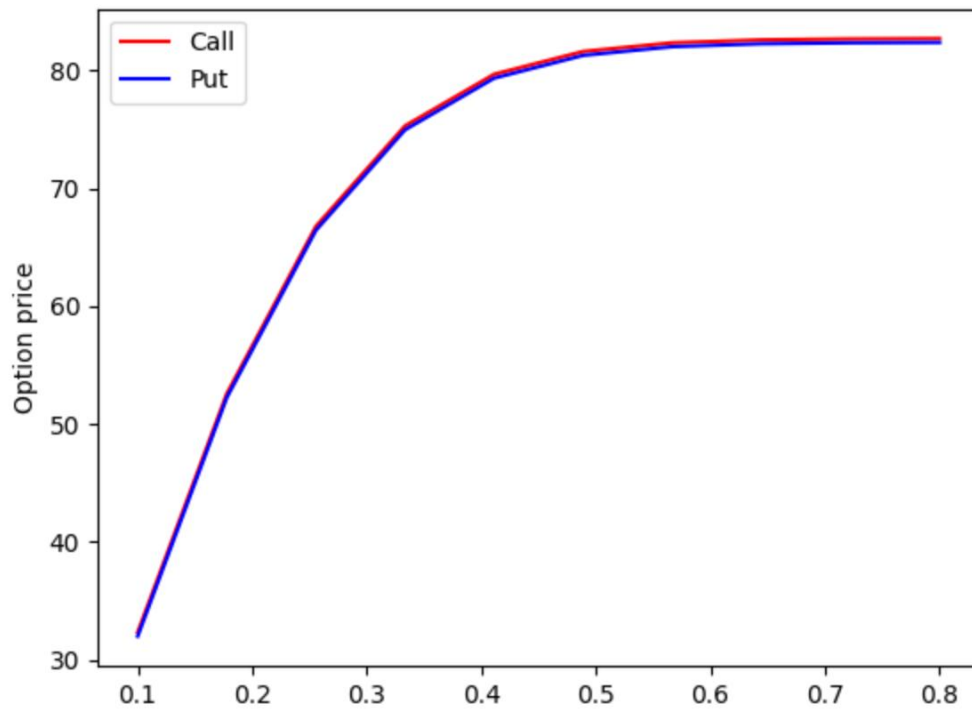


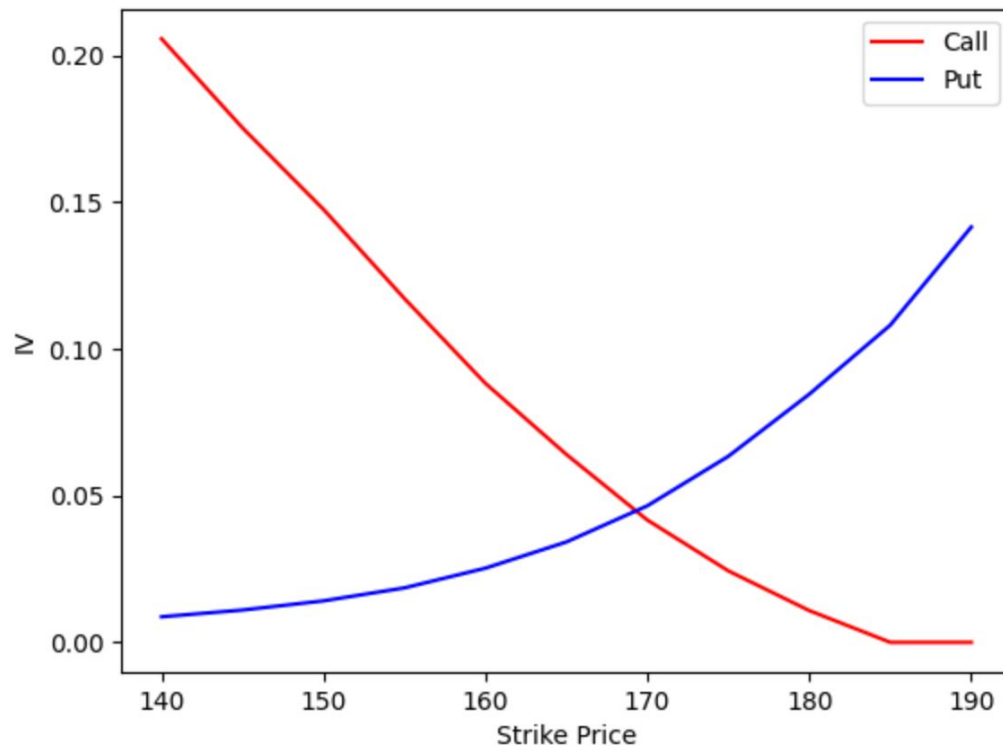
problem 1:



As we can see from graph, call and put both increase with IV increase, this is because volatility is market fluctuation, when fluctuation is high, investor tend to purchase option as insurance to hedge possible risk. We can also imply this relationship from BS option pricing formula

In other words, when demand is high, investor tend to buy more options, and the price will go up, we can calculate the new IV from new option price, which lead to higher IV. Vice versa

### Problem2:



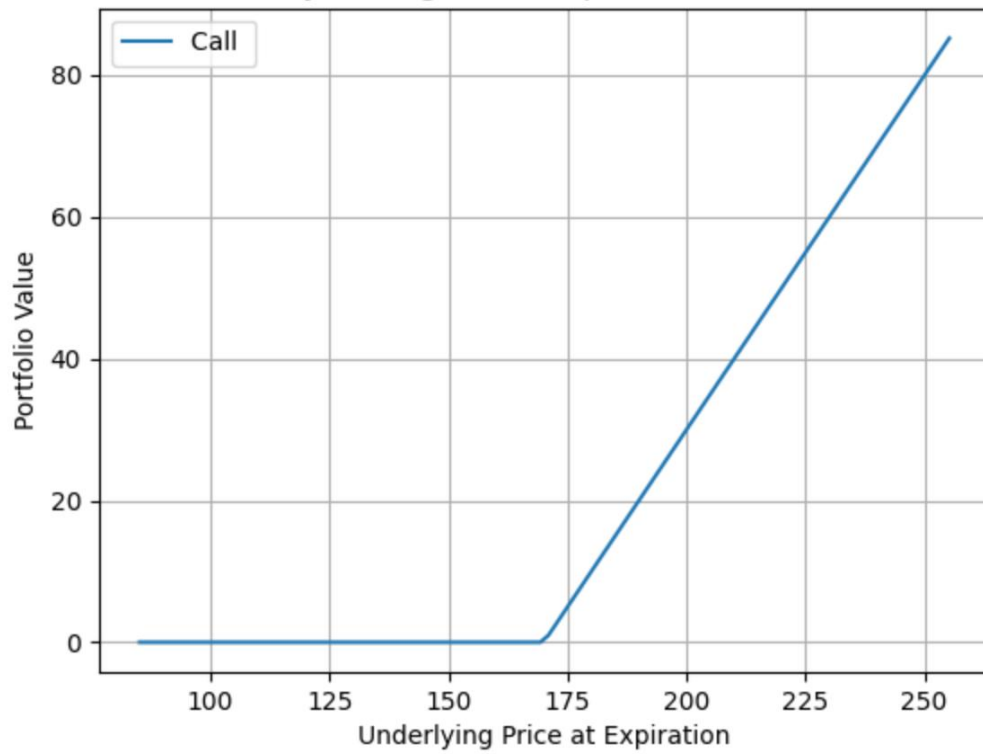
As we can see from plot, when current stock price stays the same, strike price go up lead to call option price go down (investor less likely to gain profit by purchasing this option) and put option go up. When thinking call option, less option price imply less market fluctuation, so IV will go down. When thinking put option, higher option price imply less market fluctuation, so IV will go up.

### Problem3:

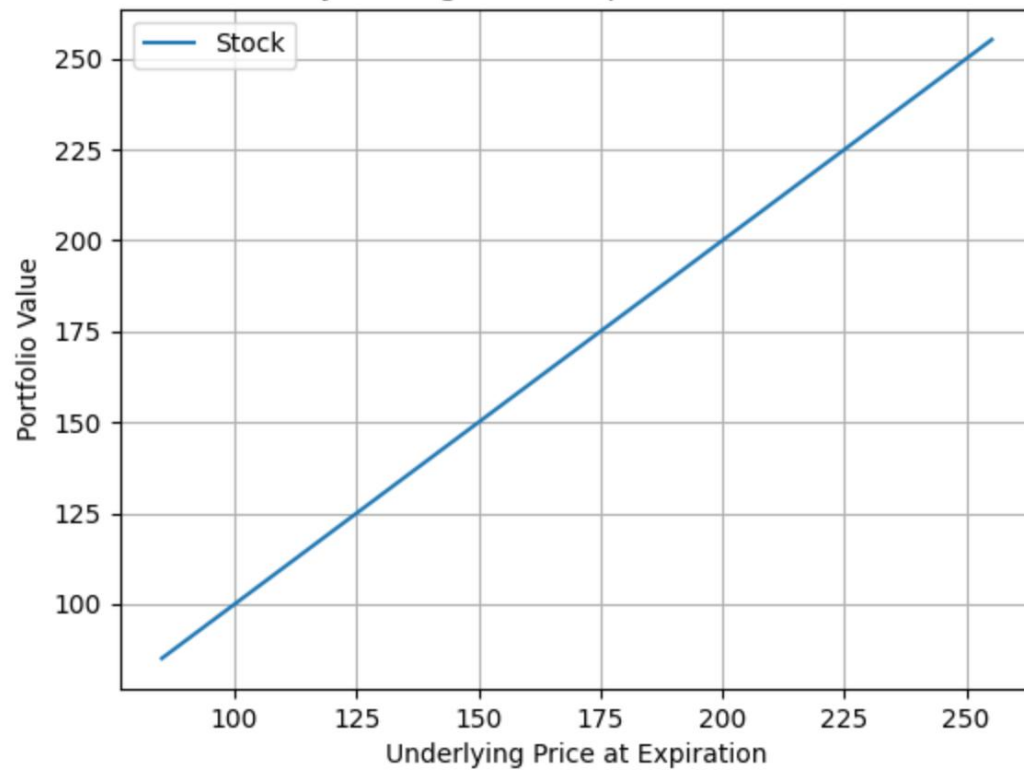
AAPL_Options.csvPortfolio	VaR95	ES95
0 Call	6.008008	6.629982
1 CallSpread	3.517474	3.823404
2 CoveredCall	10.223647	14.787138
3 ProtectedPut	17.774271	18.719636
4 Put	5.039225	5.617985
5 PutSpread	3.394191	2.543011
6 Stock	14.913777	18.243850
7 Straddle	1.559095	1.253675
8 SynLong	15.816744	18.811609

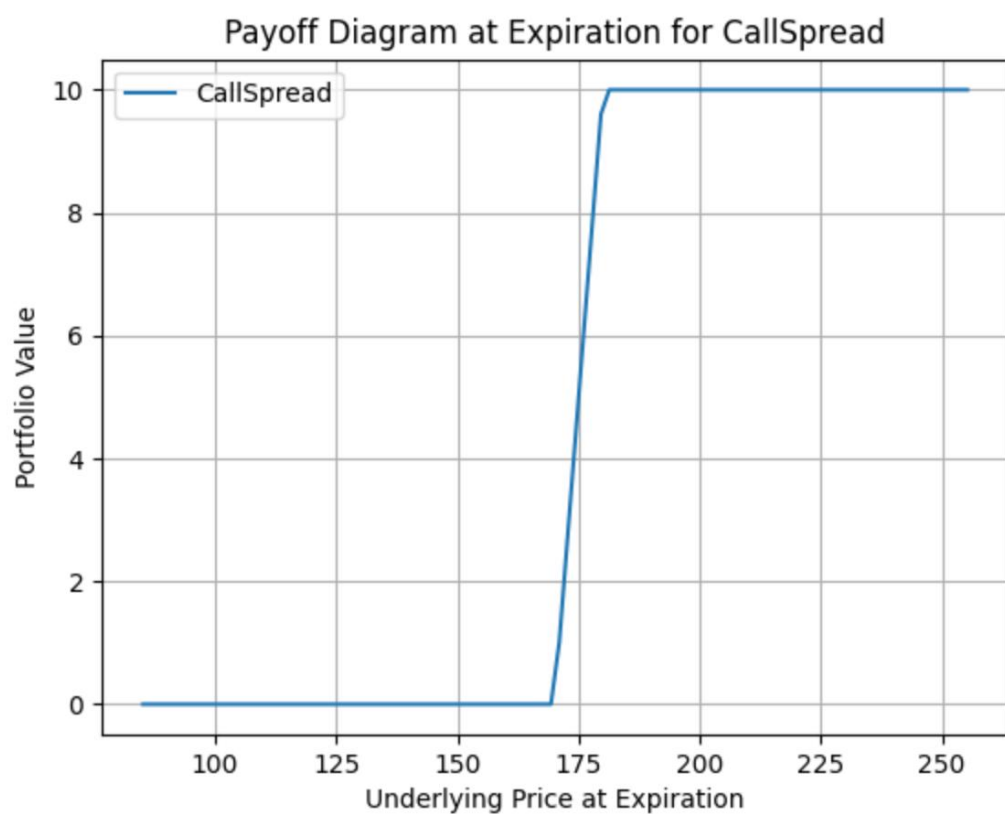
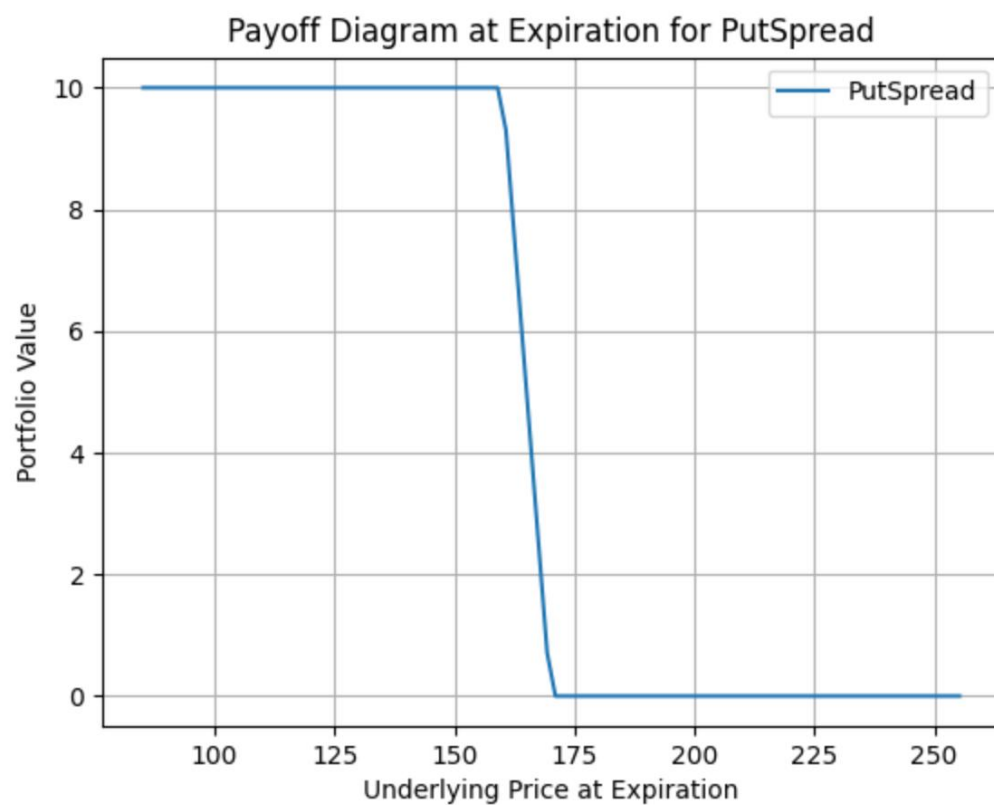
we can see when there is only 10 days remaining, safest way is straddle which owning both a call and put, so VaR of straddle is smallest, and owning a stock VaR is highest, which make sense because in this time you don't have "insurance" at all to prevent likely future loss.

Payoff Diagram at Expiration for Call

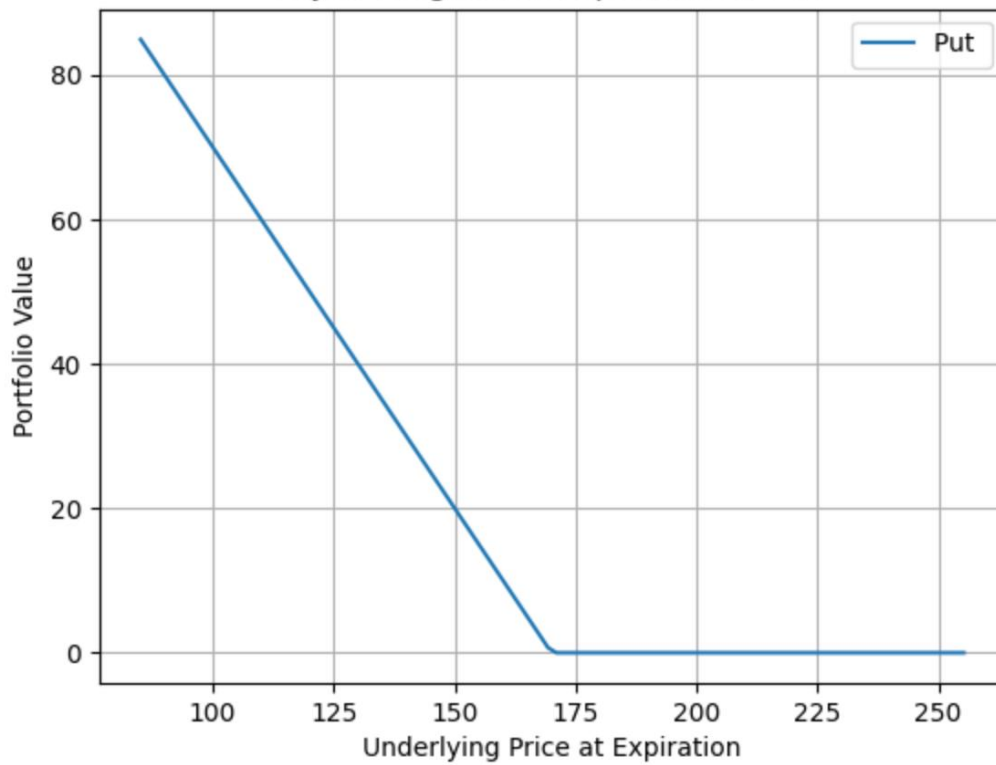


Payoff Diagram at Expiration for Stock

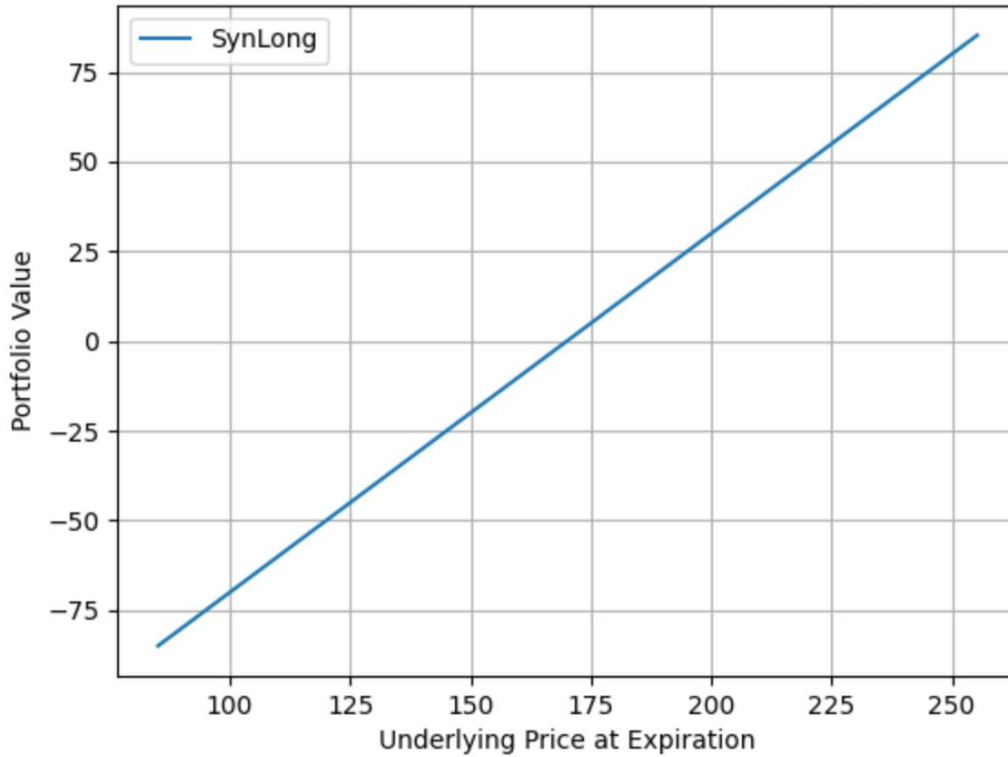




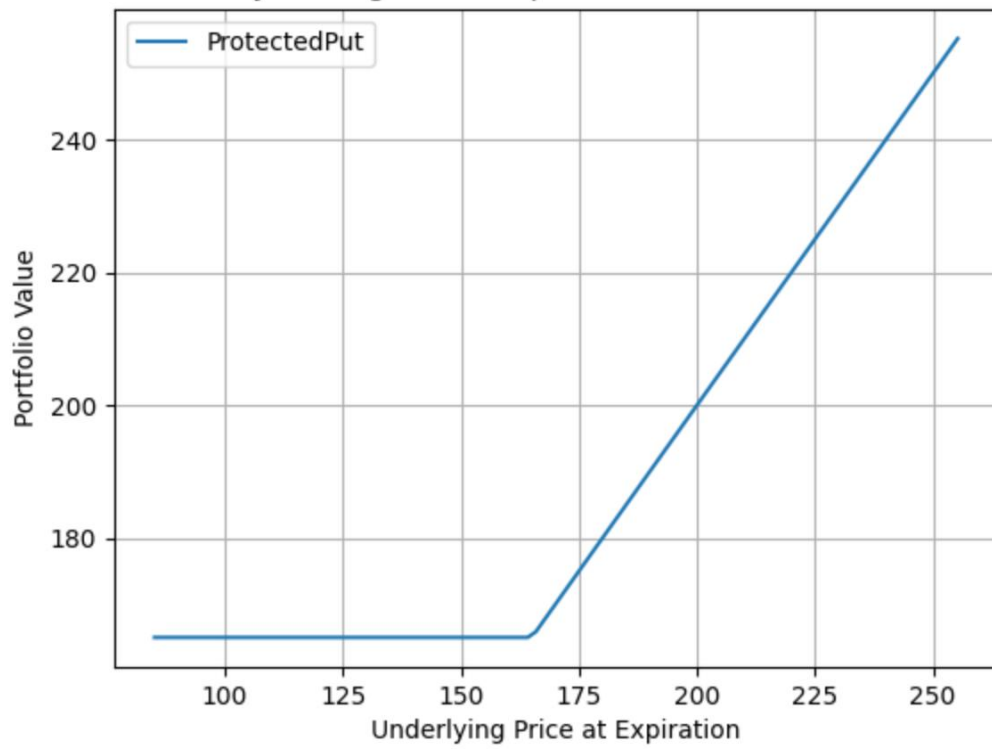
Payoff Diagram at Expiration for Put



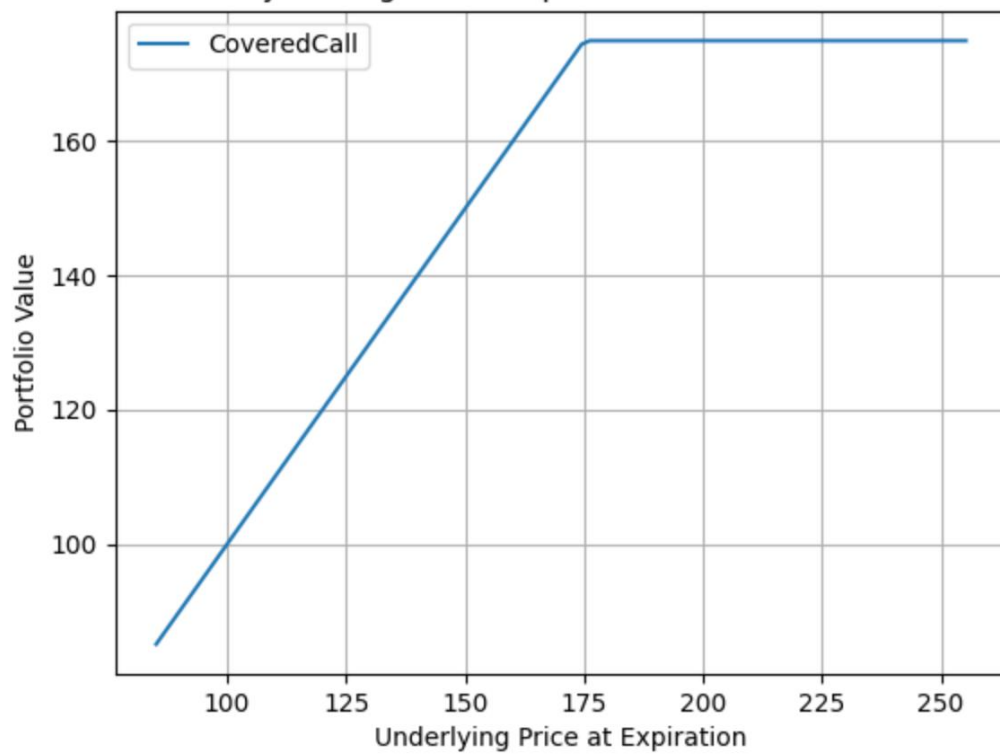
Payoff Diagram at Expiration for SynLong

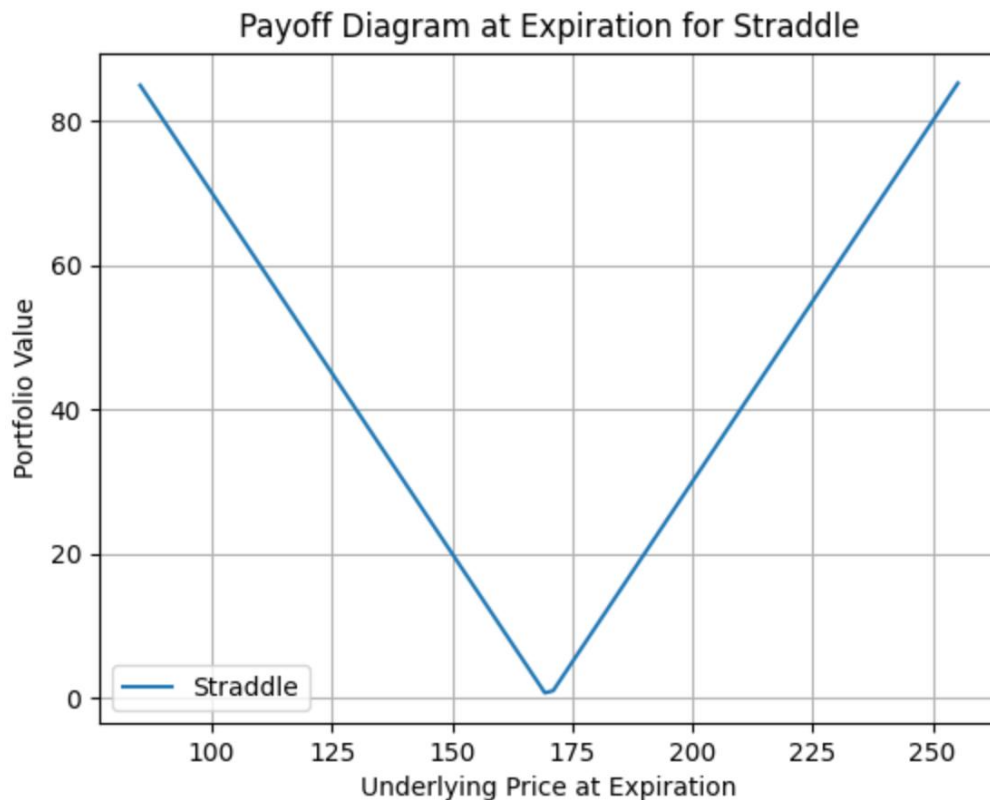


Payoff Diagram at Expiration for ProtectedPut



Payoff Diagram at Expiration for CoveredCall





first we can see plot for Stock which is make sense as stock price go up our profit go up. And then we see call and put graph, we know if  $S > K$ , owning a C's value =  $S - K$ , and from Put-Call Parity, if this time  $-P$  can still make profit, the arbitrage opportunity come up, which will be quickly fixed by market. It's same as for put. Now looking at straddle above, if we have  $C + P$ , the value should be same as a call graph plus put graph, which =  $C + P = S - K_e - 2P$ , which means when  $S > K$ , the profit will be  $S - K_e$  since  $P$  don't have value this time, and when  $S < K$ , the payoff will be  $P$  since one  $-P$  cancel with loss from  $S - K_e$ .