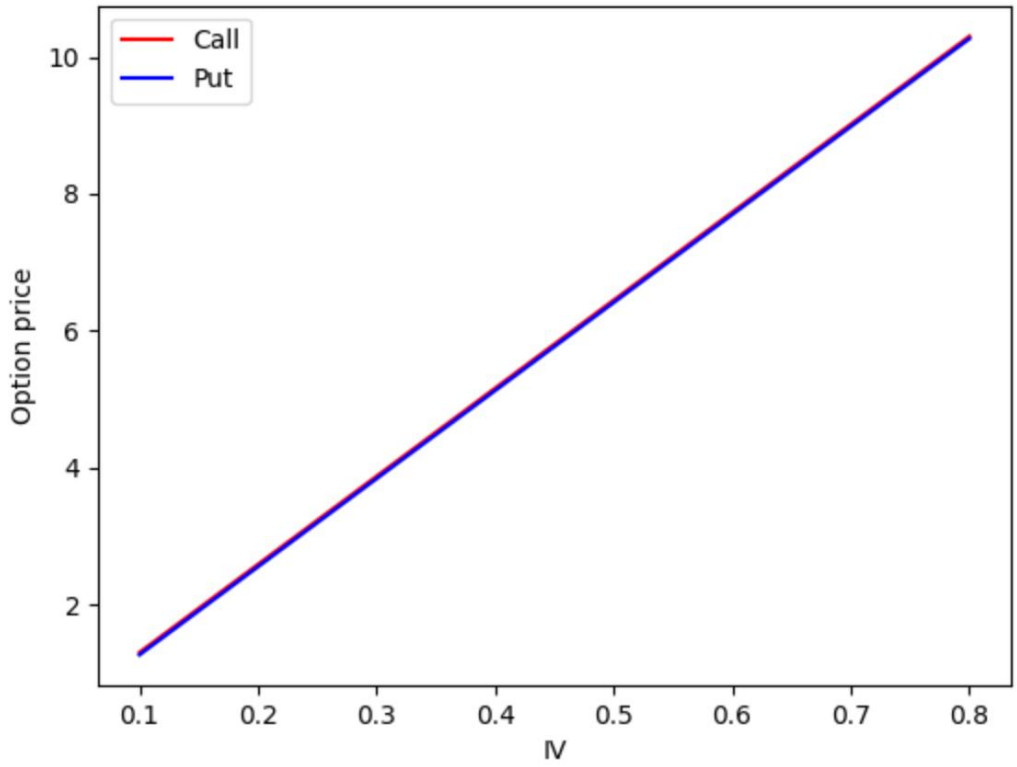
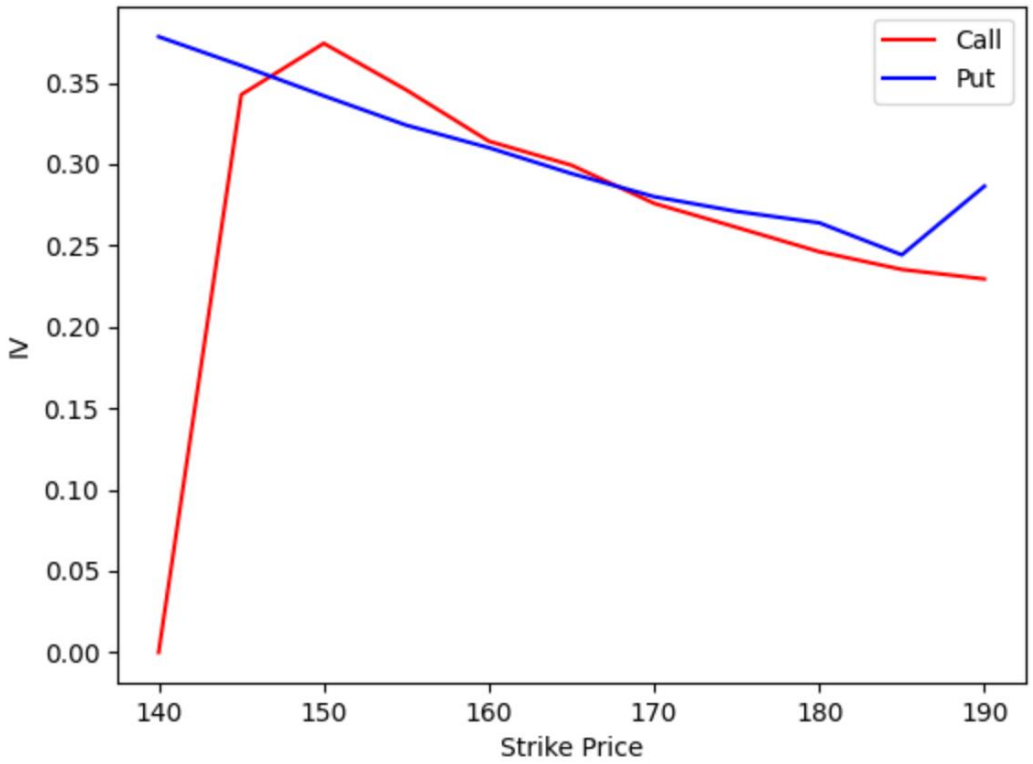
problem 1:



As we can see from graph, call and put both increase with IV increase, this is because volitility 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. Vise versa

Problem2:



As we can see from graph, we can see IV has some “volitility skew” in both call and put. For put option, the IV for OTM put is high because investor are worried about sudden tank of stock price due to some unexptected event, and they are more willing to pay higher price for that. For call option, IV for ITM is lower because it’s harder to make more money with high strike price. “volitility smile” is not obvious here due to lack of enough data and strike price range, in general when ITM call option will be slightly higher due to some investor tend to buy it with irrational price for unexpected heat event that may lead stock price rocket.

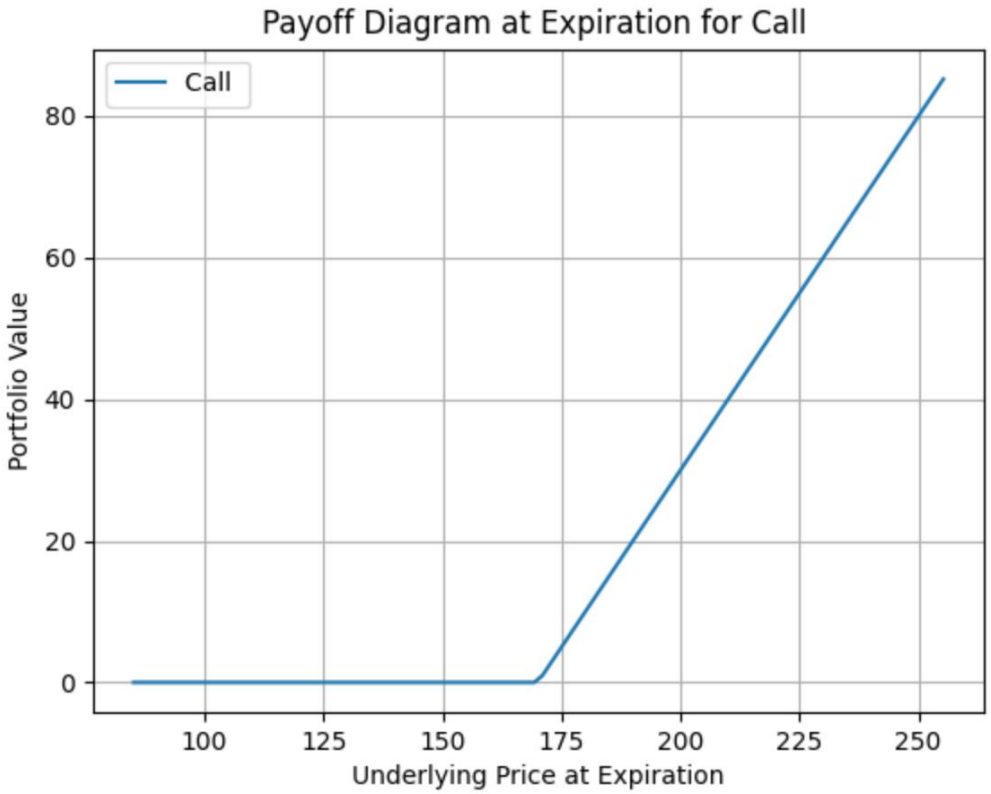
IV for those call in csv: [7.329680122169434e-13, 0.3427275106612758, 0.3742704881124152, 0.3456298350267712, 0.314111070812347, 0.29938335569889823, 0.27594351133425016, 0.26118314968879025, 0.24623598308692296, 0.23532738856535712, 0.22950006078563476]
IV for those put in csv: [0.378369494765029, 0.36064947832592303, 0.34203369685362073, 0.3239535919513756, 0.3101229516166319, 0.2942507743044481, 0.2800791971294717, 0.2709837028164774, 0.2639762799389453, 0.24429853927674072, 0.2865104419611764]

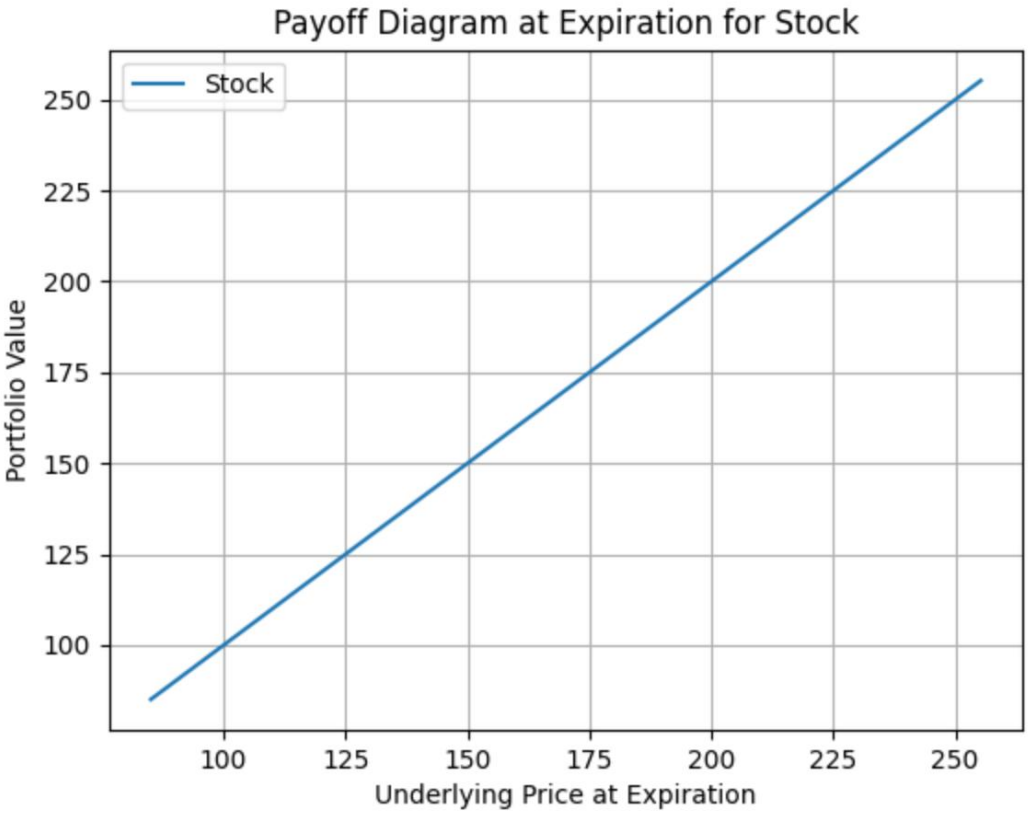
Problem3:

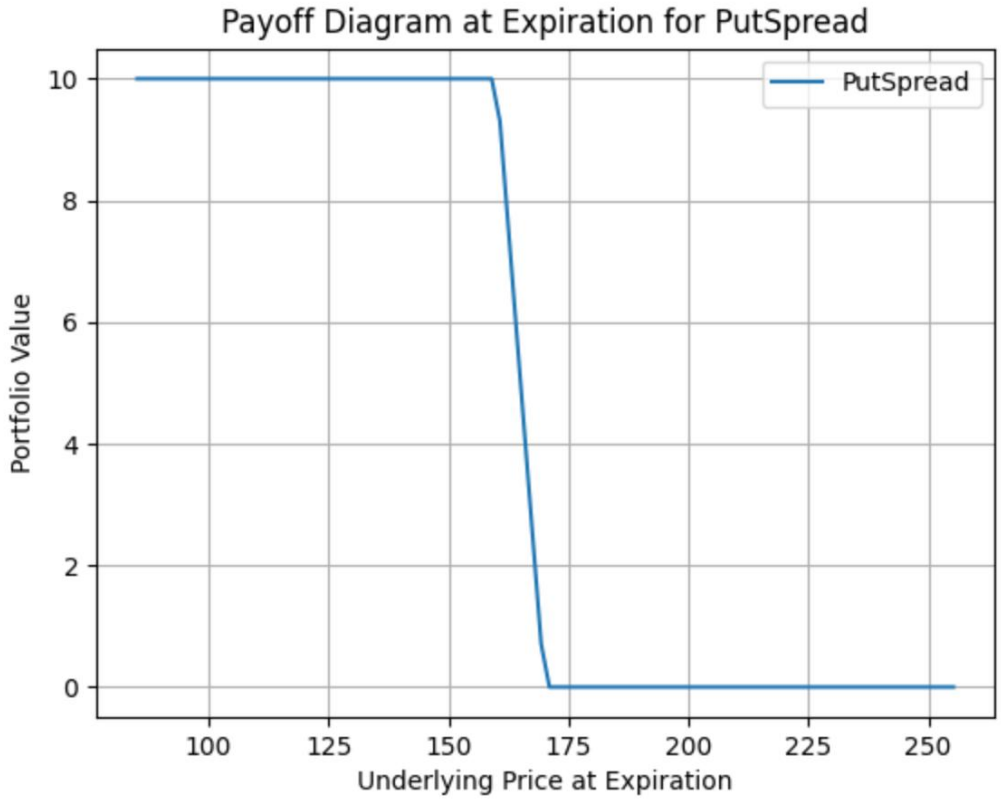
AAPL_Options.csvPortfolio	VaR95	ES95
0 Call	6.008008	6.629982

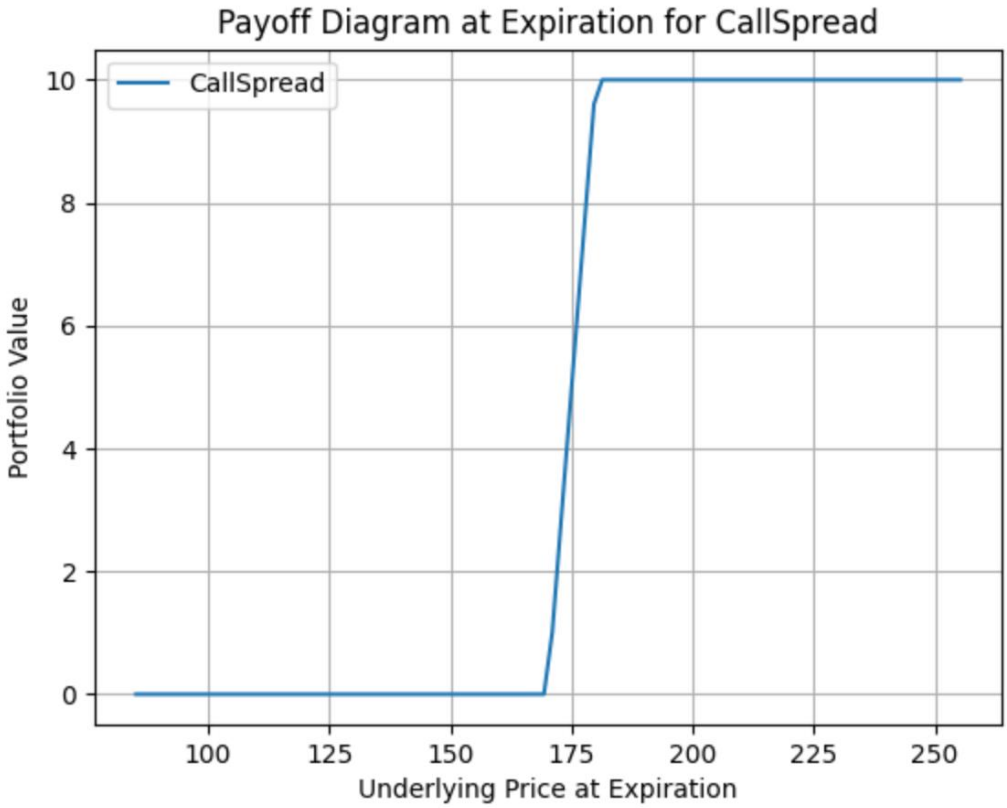
1	CallSpread	3.517474	3.823404
2	CoveredCall	10.223647	14.787138
3	ProtectedPut	17.774271	18.719636
4	Put	5.039225	5.617985
5	PutSpread	3.394191	2.543011
6	Stock	14.913777	18.243850
7	Straddle	1.559095	1.253675
8	SynLong	15.816744	18.811609

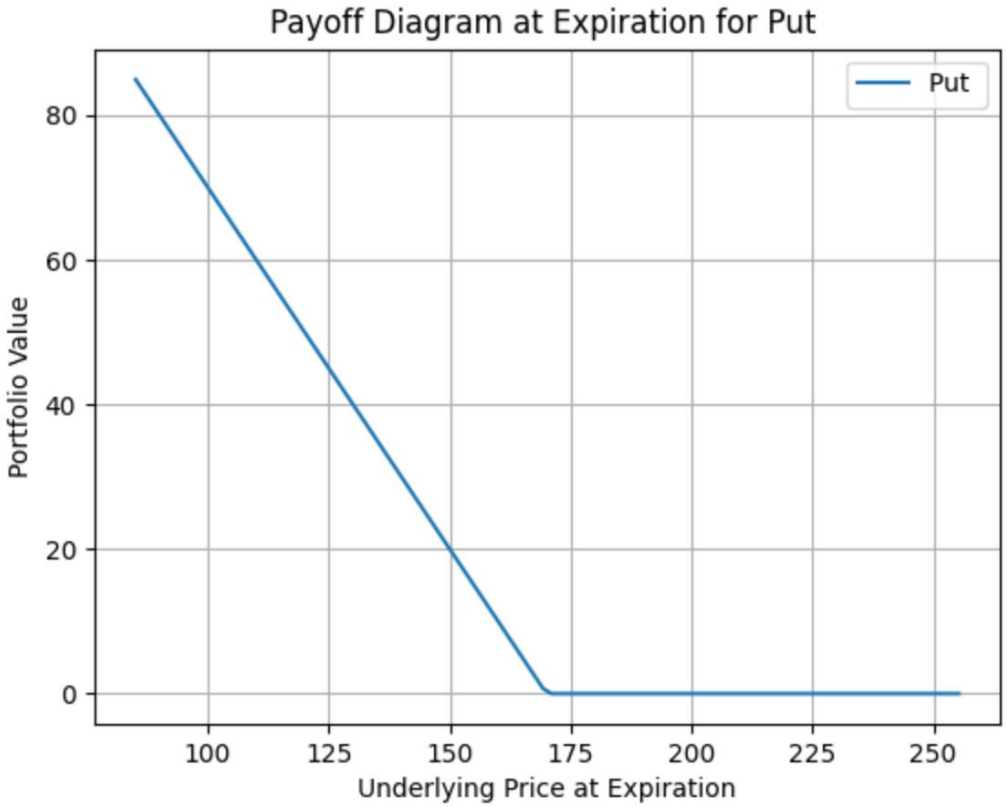
we can see when there is only 10 days remaining, safest way is straddle which owning both a call and put, so VaR of straddle is smallest, and owning a stock VaR is highest, which make sense because in this time you don't have "insurance" at all to prevent likely future loss.

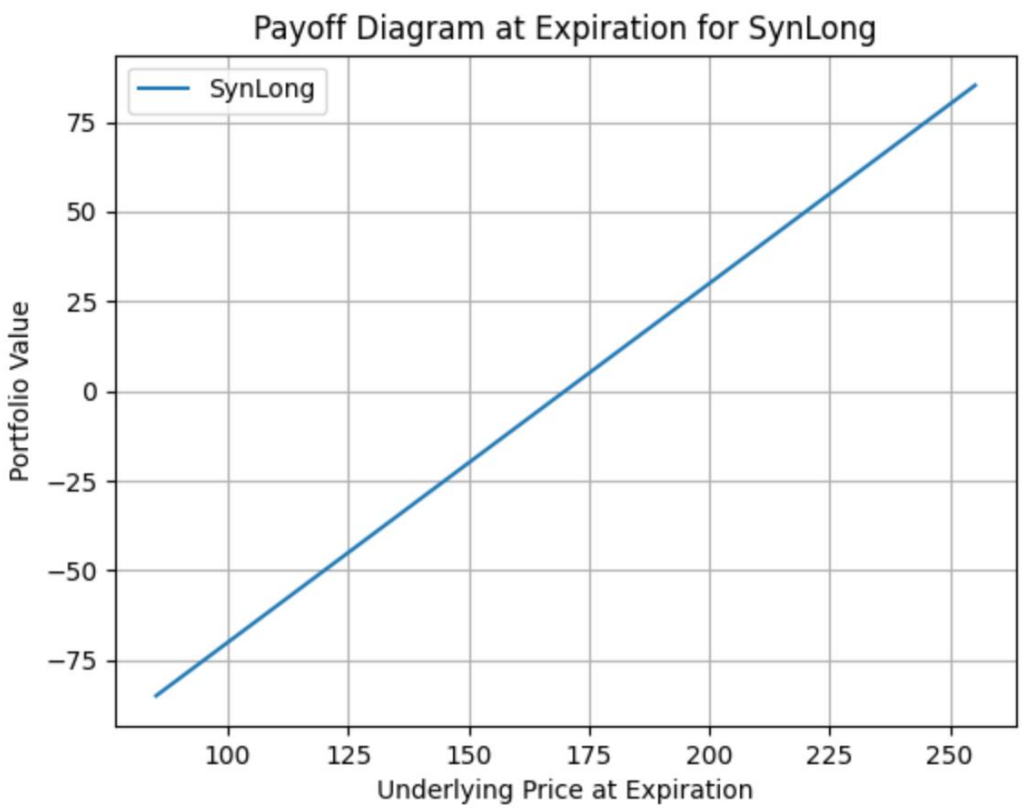


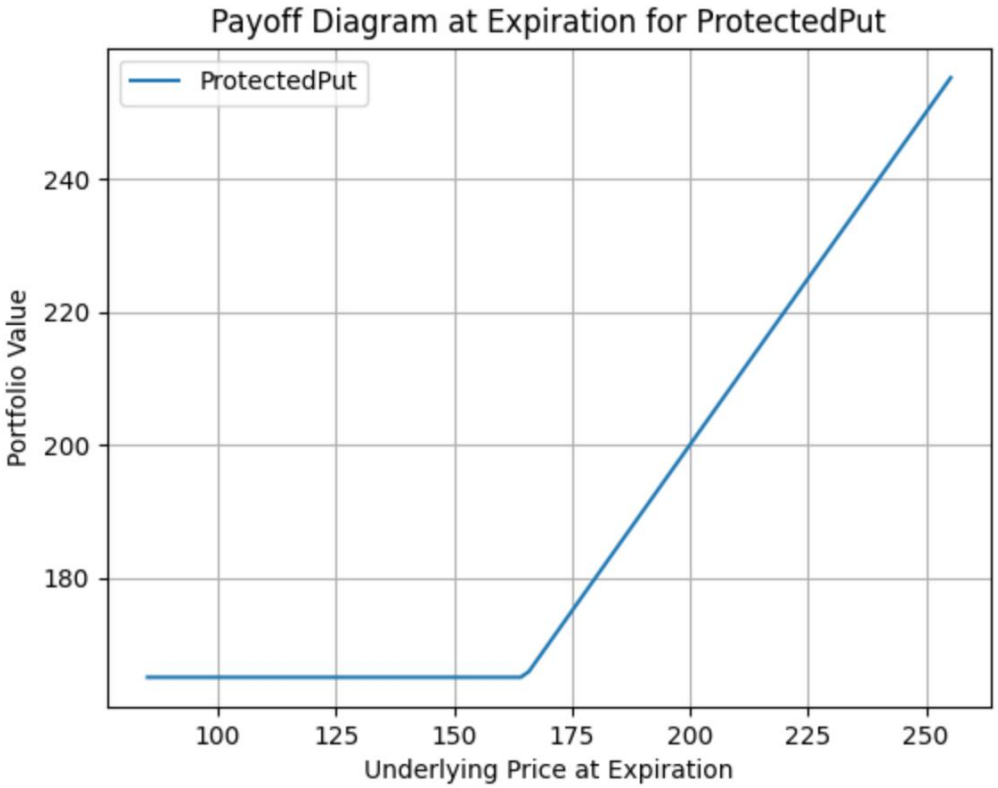

Payoff Diagram at Expiration for Stock
Stock
Portfolio Value
Underlying Price at Expiration
100
125
150
175
200
225
250

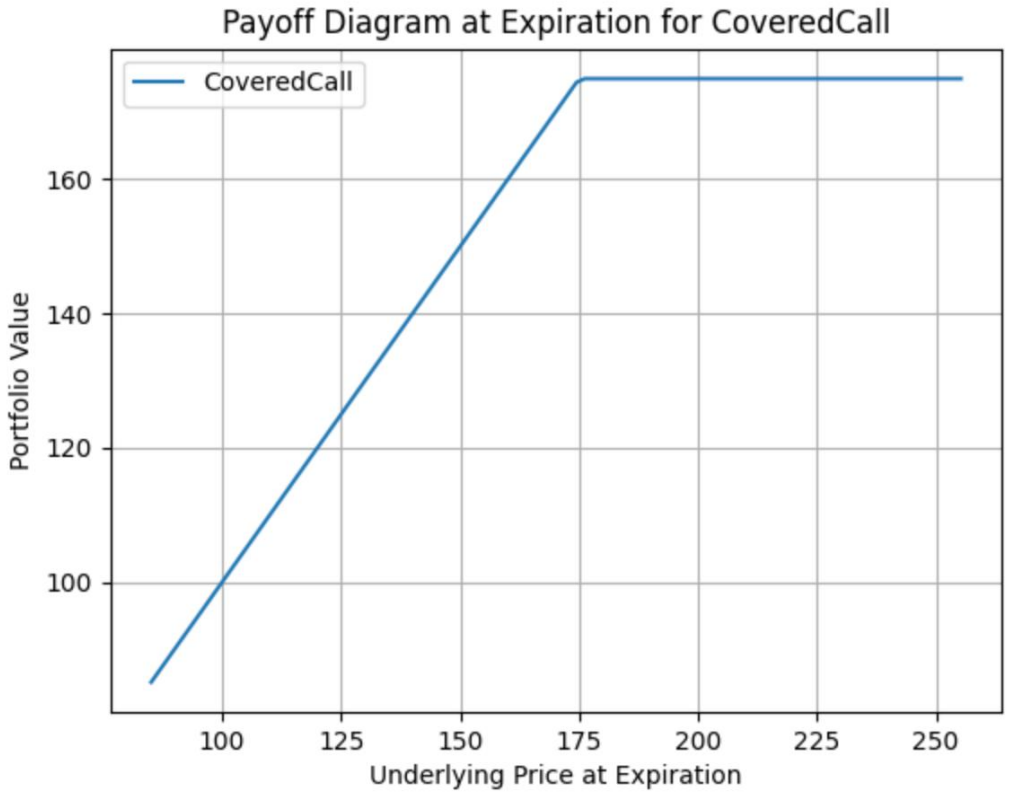

Payoff Diagram at Expiration for PutSpread
PutSpread
Portfolio Value
Underlying Price at Expiration
0
2
4
6
8
10
100
125
150
175
200
225
250

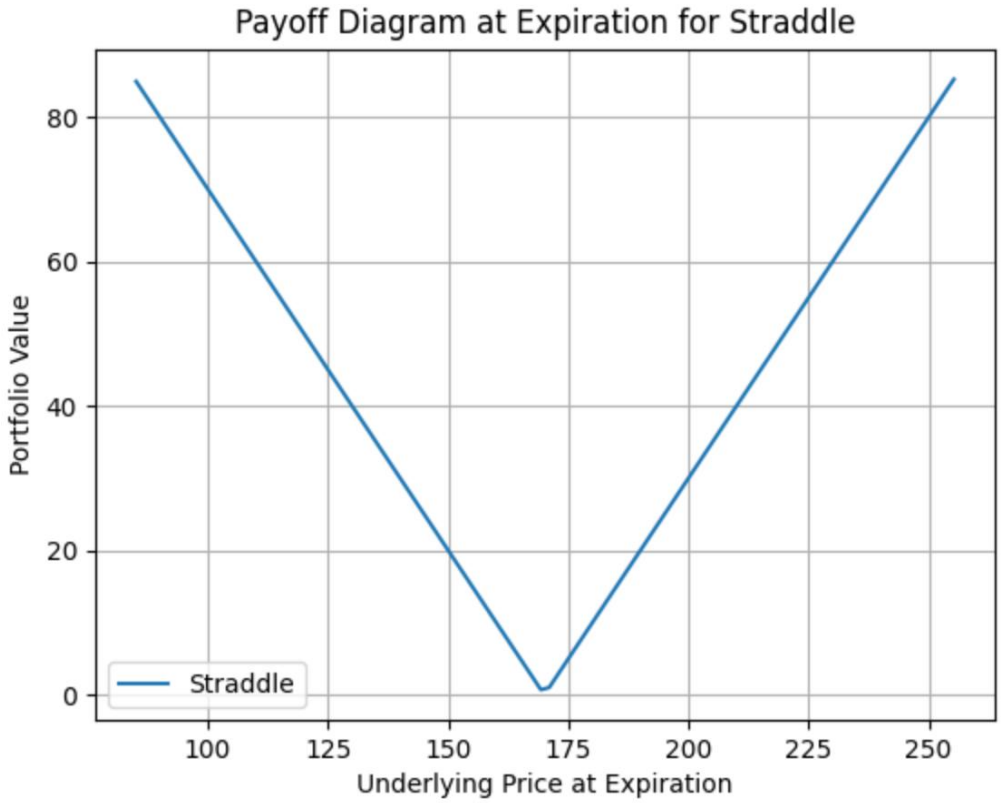

Payoff Diagram at Expiration for CallSpread
CallSpread
Portfolio Value
Underlying Price at Expiration
0
2
4
6
8
10
100
125
150
175
200
225
250


Payoff Diagram at Expiration for Put
Put
Portfolio Value
Underlying Price at Expiration
0
20
40
60
80
100
125
150
175
200
225
250


Payoff Diagram at Expiration for SynLong
SynLong
75
50
25
0
−25
−50
−75
Portfolio Value
100
125
150
175
200
225
250
Underlying Price at Expiration


Payoff Diagram at Expiration for ProtectedPut
ProtectedPut
240
220
200
180
Portfolio Value
100
125
150
175
200
225
250
Underlying Price at Expiration





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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 - Ke - 2P, which means when S > K, the profit will be S - Ke since P don't have value this time, and when S < K, the payofff will be P since one -P cancel with loss from S-Ke.