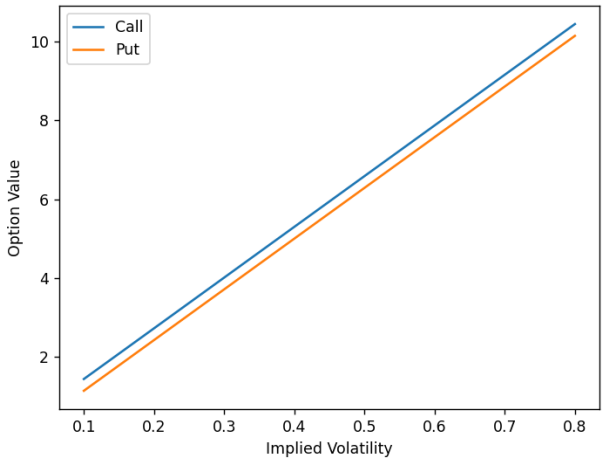
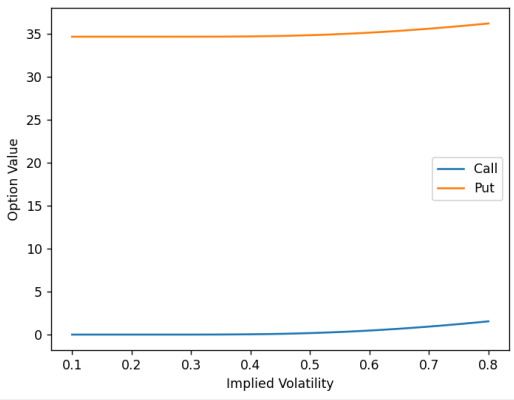
Problem 1.

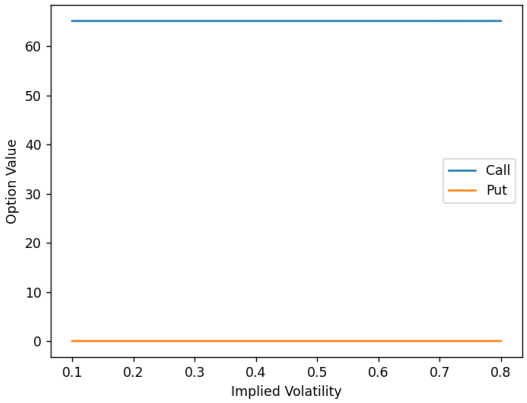
Time to Maturity is 14 days.

When X=165, the option is at the money. Calls and puts are positively and linearly related to implied volatility, and the reason for this is that if the current market is efficient, then greater volatility implies greater potential option returns. In addition, the value of put options is lower compared to that of call options due to the problem of paying interest for the lender.



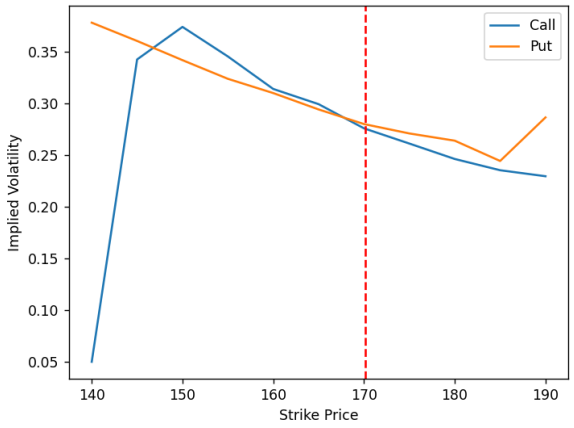
When X = 200, call options -> out-of-the-money options; put options -> in-the-money options. Obviously, the call option will not be executed, so its value is equal to zero. On the contrary, the put option will be executed and its value should be 200 - 165 = 35, which often was taken as time value. In the other case, when X = 100, call option -> in-the-money option; put option -> out-of-the-money option and vice versa.





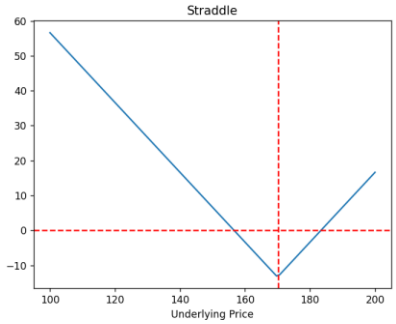
Typically, for options, the larger the market supply and demand, the more efficient the market tends to be, i.e., its implied volatility is relatively low. When an option has a low trading volume, i.e., is inactive (low market supply and low demand), its implied volatility is higher.

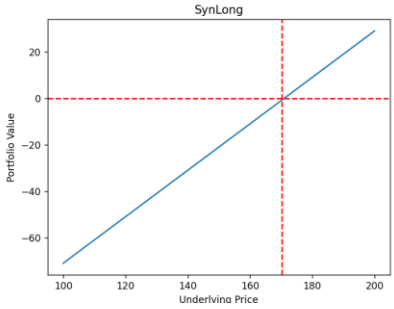
Problem 2.

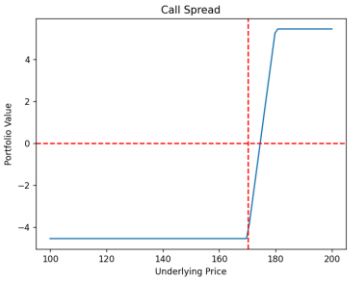


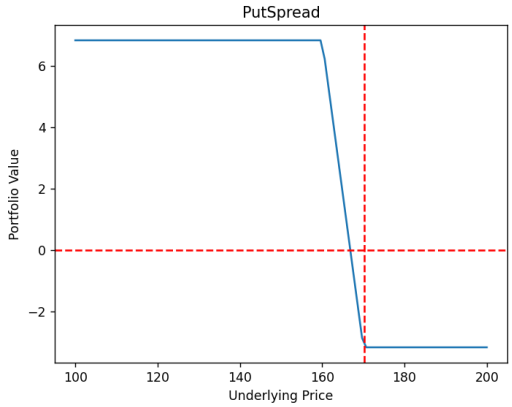
With this graph we can see that there are two turning points in AAPL containing call options and AAPL containing put options. First, the pricing for investments containing options is usually determined by intrinsic value and time value. In the case of call-containing options, I believe that until about the price level of 145, the time value is more influential because the intrinsic value of the asset is undervalued (meaning, assuming the market is efficient, the true value of the stock will not fall to 145, i.e., the call option cannot be bought at that price), thus leading to a positive relationship between the price and the implicit volatility, but after exceeding the price level of 145, the intrinsic value of the asset becomes dominant and the correct estimation of the intrinsic value will reduce the implicit risk, so the price becomes somewhat inversely related to it. Conversely, the impact of the intrinsic value of the asset containing put options is higher up to about 186, but once it exceeds 186, we believe that the intrinsic value of the asset is grossly overestimated (by this I mean that it is unlikely that the stock price will rise beyond 186, and therefore it is almost impossible for the put option to be sold at that price). Therefore, we believe that 145~186 is a reasonable valuation range for AAPL, and around 168, where the price of the asset with put and call options is equal, we can consider that the asset at that price can be equivalent to risk free fixed income.

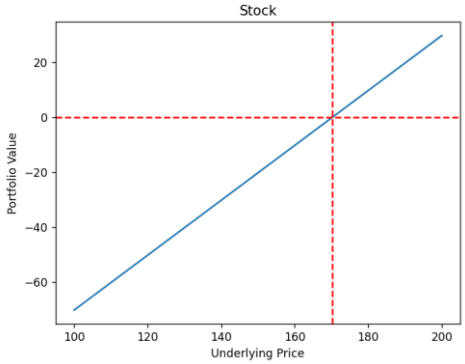
Problem 3.

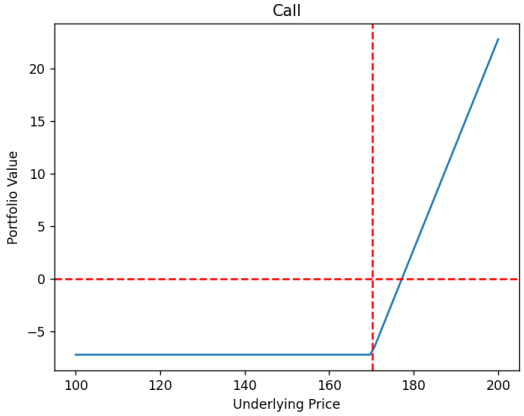

Straddle
60
50
40
30
20
10
0
−10
100
120
140
160
180
200
Underlying Price

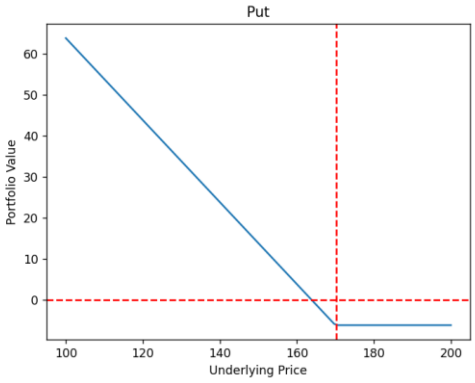

SynLong
20
0
−20
−40
−60
Portfolio Value
100
120
140
160
180
200
Underlying Price

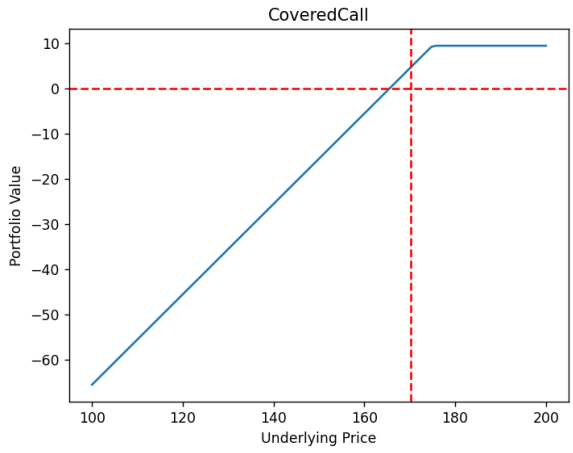

Call Spread
4
2
0
−2
−4
Portfolio Value
100
120
140
160
180
200
Underlying Price

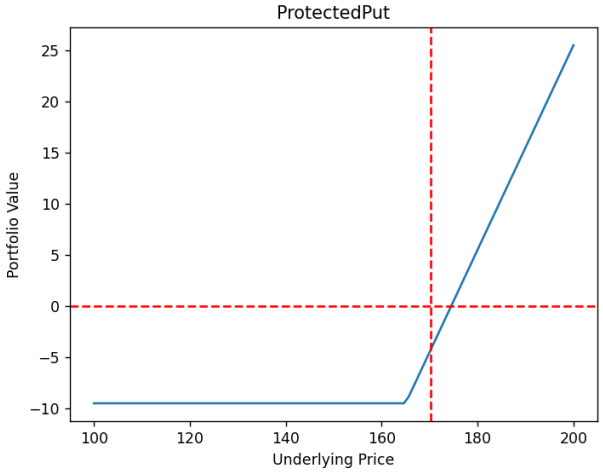












Straddle: Capitalizing on Price Volatility

Benefit from significant price movements away from the current level, potentially yielding substantial profits.

Risk arises when the price remains stable around its current point, leading to potential losses.

SynLong Position: Amplify Gains with Leverage

Efficiently replicate a long stock position while utilizing less capital.

Designed to magnify both potential profits and losses through leverage.

Call Spread: Controlled Risk with Upside Potential

Profit from price increases exceeding the difference between the two options.

Defined risk and reward, providing a limited-risk trading strategy.

Put Spread: Managing Downside Risk

A mirror-image of the Call Spread, aiming to profit from price declines.

Offers risk management by defining the maximum loss potential.

Stock: Direct Price Movement Profits

A straightforward strategy where gains occur with price appreciation and losses with price depreciation.

The risk is tied to the initial capital invested.

Call Option: Leveraging Upside with Limited Risk

Generate profits when the price rises beyond the option's purchase price, with well-defined risk.

Offers a controlled way to benefit from price increases.

Put Option: Managing Downside Exposure

Functions as the opposite of a call option, with limited profit potential and defined losses.

Provides risk management when expecting price declines.

Covered Call: Enhanced Gains with Stock Ownership

Earn additional income without intending to sell your stock or in anticipation of modest price fluctuations.

Provides profits in stable markets but caps gains if prices surge while limiting losses in case of price drops.

Protective Put: Safeguarding Long Positions

Functions similar to a call option but primarily serves as a protective measure.

Designed to mitigate losses when holding a long position, ensuring unlimited profit potential without the obligation to buy.

Simulation:

Portfolio	Mean	VaR	ES
Call	12.394907	-3.810171	-2.253088
CallSpread	1.612888	0.036266	0.476669
CoveredCall	-11.728124	19.342310	21.747085
ProtectedPut	7.965643	1.409260	3.195261
Put	7.544713	-1.859523	-0.809570
PutSpread	-0.427778	1.630515	1.859967
Stock	0.073391	15.334396	19.079445
Straddle	19.93962	-17.903916	-17.895551
SynLong	4.850194	10.482587	14.201826

The data aligns seamlessly with the visual representation and the discussion provided earlier. Furthermore, it's noteworthy that the Covered Call, SynLong, and Stock strategies exhibit a similar performance profile. However, it's important to highlight that the Covered Call strategy, owing to its option-selling component, tends to incur comparatively lower losses.