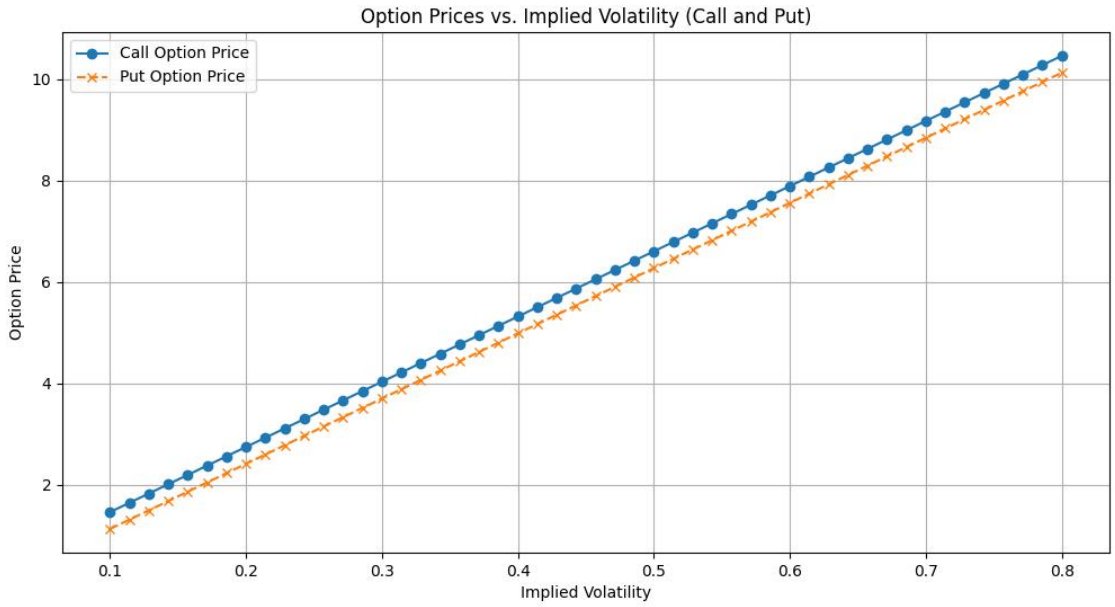
Week06
Problem1



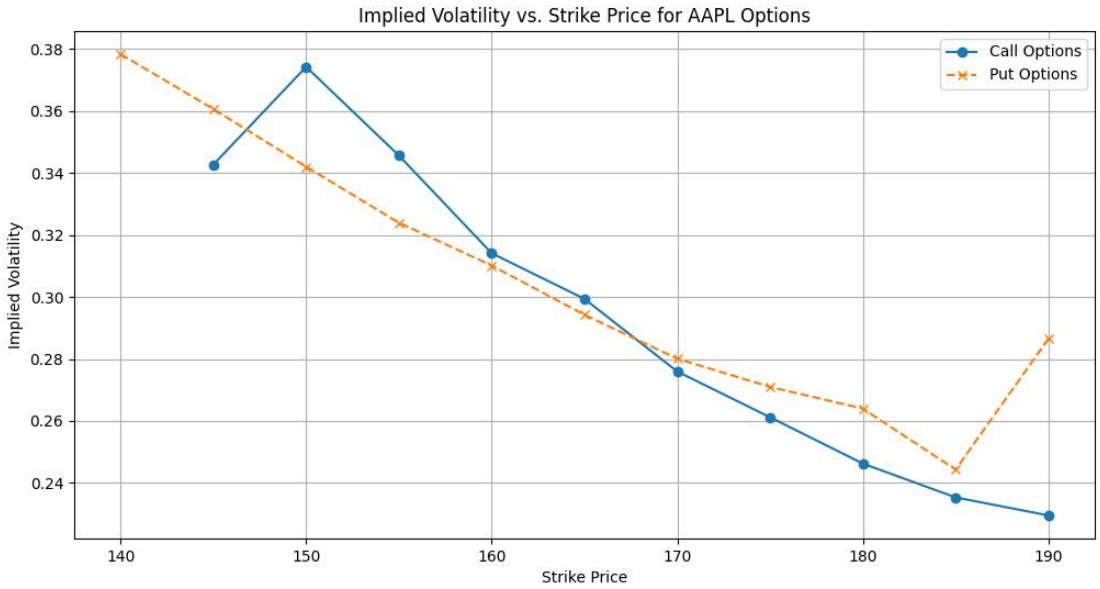
・Graph Discussion

The graph displays the relationship between implied volatility and option prices for both call and put options. As implied volatility increases, the prices of both call and put options also increase. This is because higher volatility indicates a greater range of potential future prices, which increases the probability of the option ending in-the-money, thus raising its value.

・Analysis of Supply and Demand Impact on Implied Volatility

Higher Demand: Increased demand for options generally pushes implied volatility higher, as market participants expect larger price swings. This results in higher option prices.
Higher Supply: When supply is high relative to demand, implied volatility may decrease, reflecting market expectations of lower price fluctuation, and thus reducing option prices.

Problem2



・Observations

1.Smile or Skew Pattern: There is a slight pattern where implied volatility changes with the strike price, which can often resemble a "volatility smile" or "volatility skew." This is common in options markets and indicates that options with strike prices far from the current stock price often have higher implied volatilities.

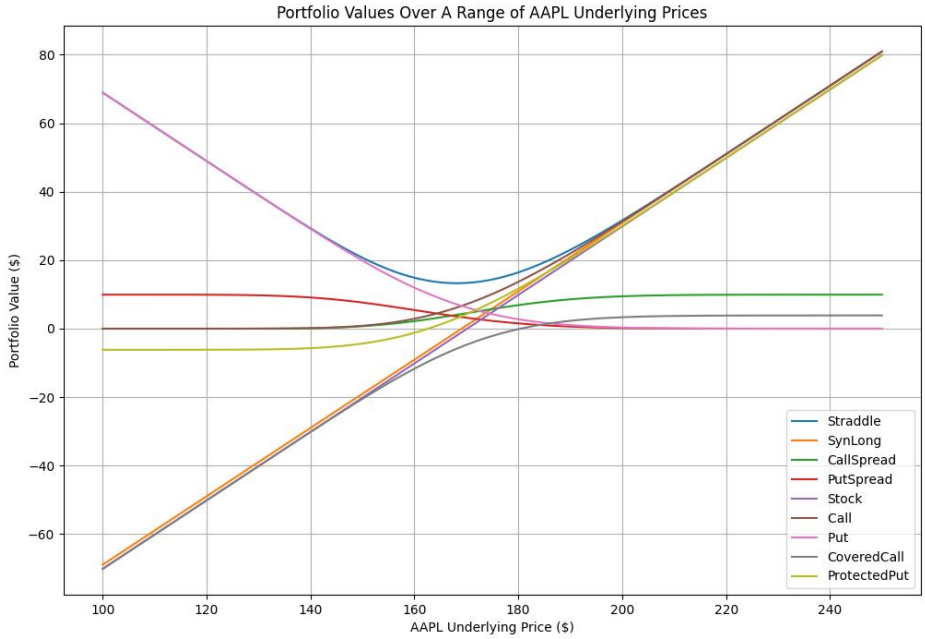
2.Higher Volatility at Lower Strikes for Puts: The implied volatility tends to be higher for put options at lower strike prices, likely due to increased demand for protective puts, which hedges against a significant drop in the stock's price.

・Market Dynamics

1.Demand for Out-of-the-Money Options: Higher demand for out-of-the-money puts (lower strikes) and out-of-the-money calls (higher strikes) may increase their implied volatilities.

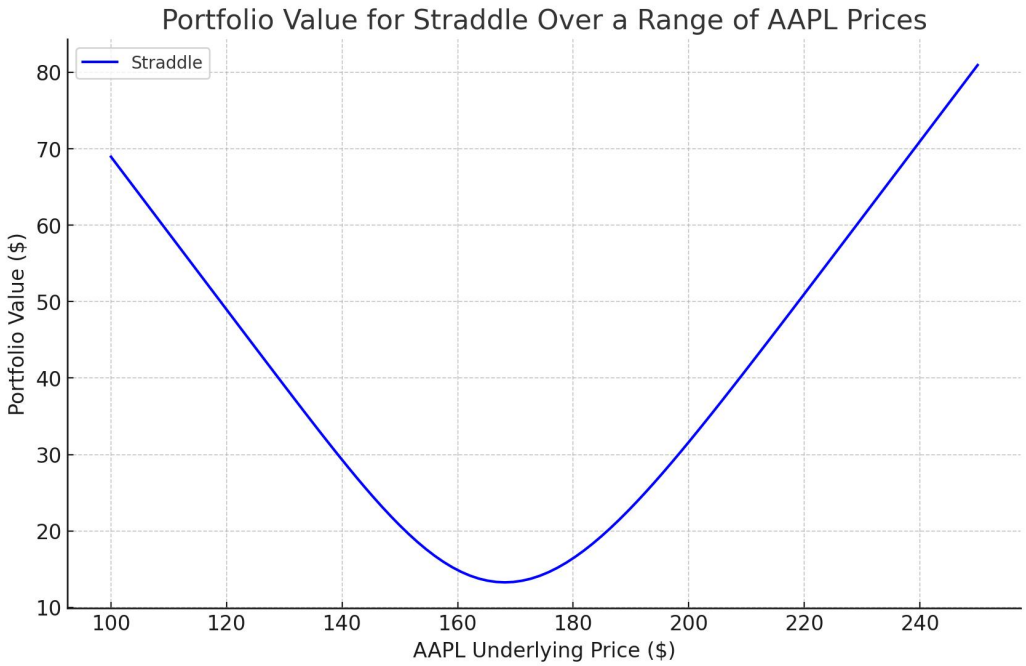
2.Risk Perceptions: Traders might perceive more risk at extreme price movements, hence the higher volatility at those strikes.

Problem3

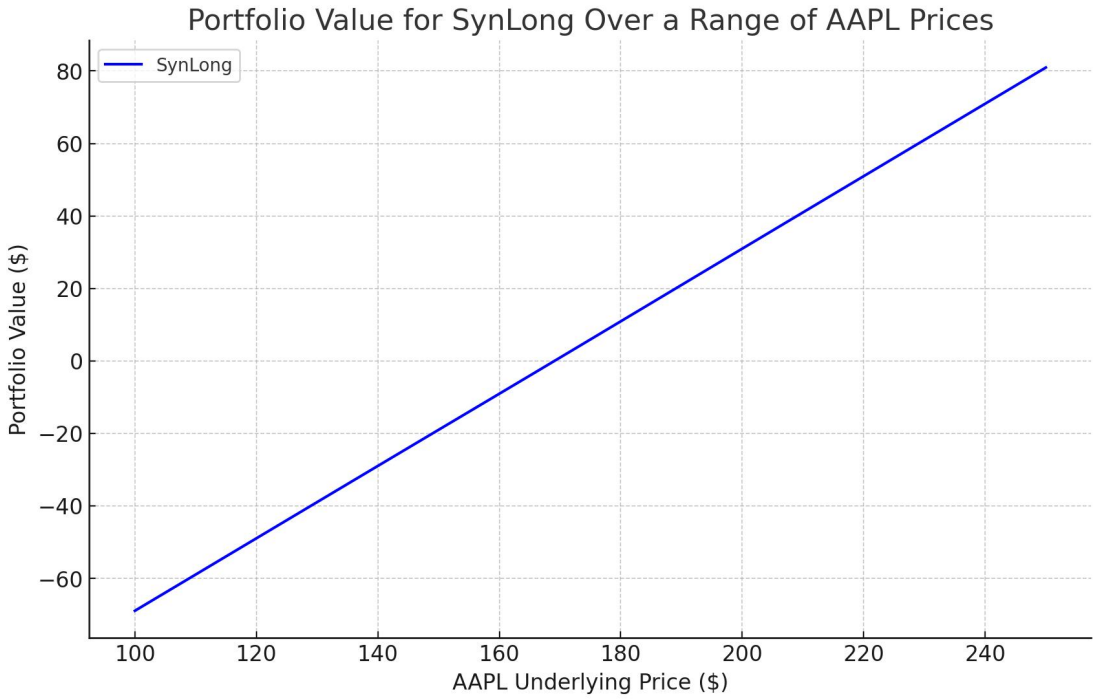


・Graph Analysis: Portfolio Values over AAPL Price Range

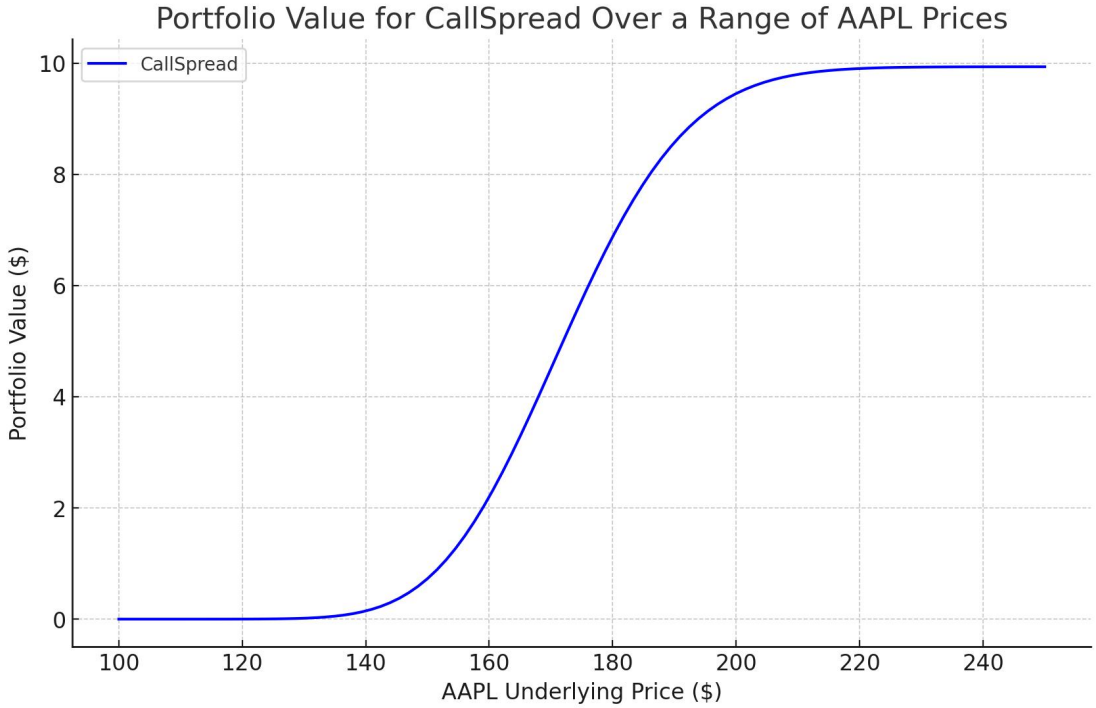
1.Straddle: The straddle portfolio, consisting of a long call and a long put with the same strike price, shows a symmetric "V" shape. This strategy profits from large price movements in either direction away from the strike, benefiting from volatility.



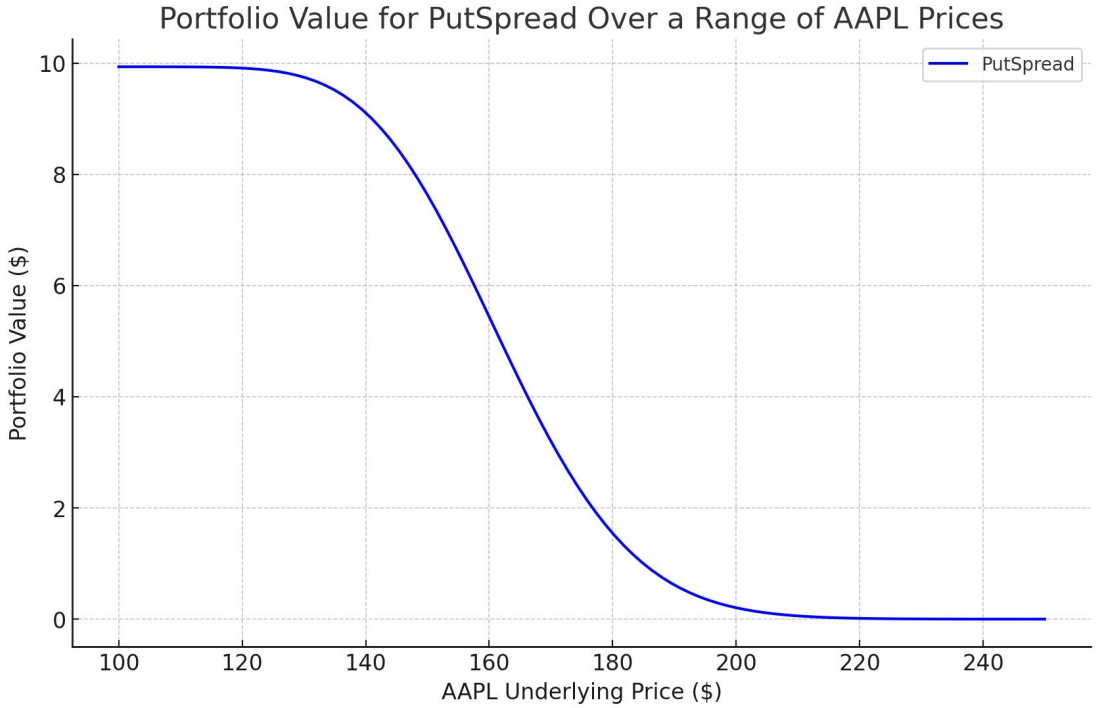
2. SynLong: The synthetic long position, created by a long call and a short put at the same strike, behaves similarly to holding stock. The linear upward trend mirrors a direct stock holding, consistent with put-call parity for a synthetic long position.



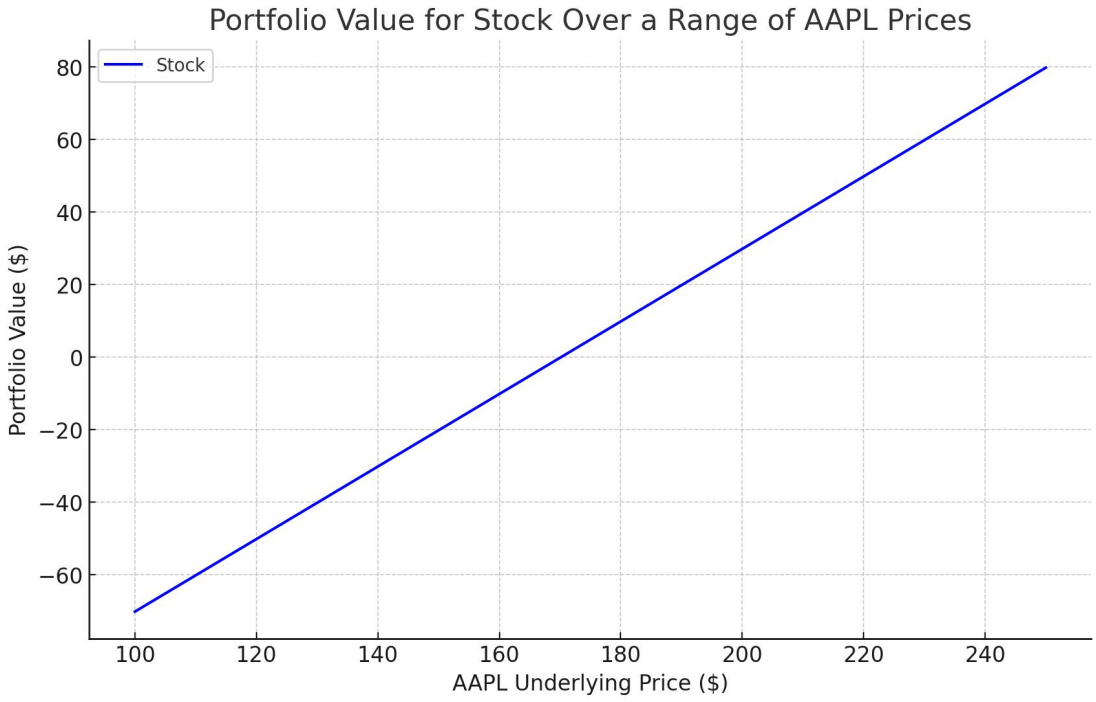
3. Call Spread: This spread involves buying a call at a lower strike and selling a call at a higher strike, creating a capped gain. The graph shows a plateau effect above the higher strike, limiting the profit potential.



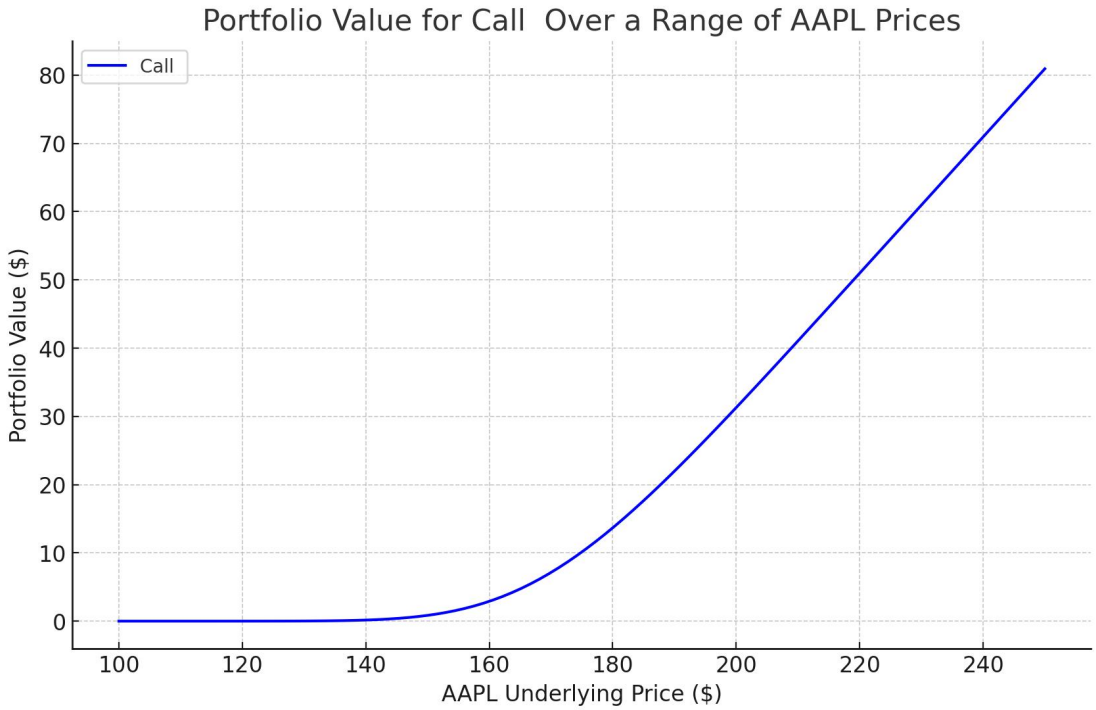
4.Put Spread: The put spread consists of buying a put at a higher strike and selling a put at a lower strike, limiting both upside and downside. The graph has a capped value below the lower strike price, where maximum profit is achieved.



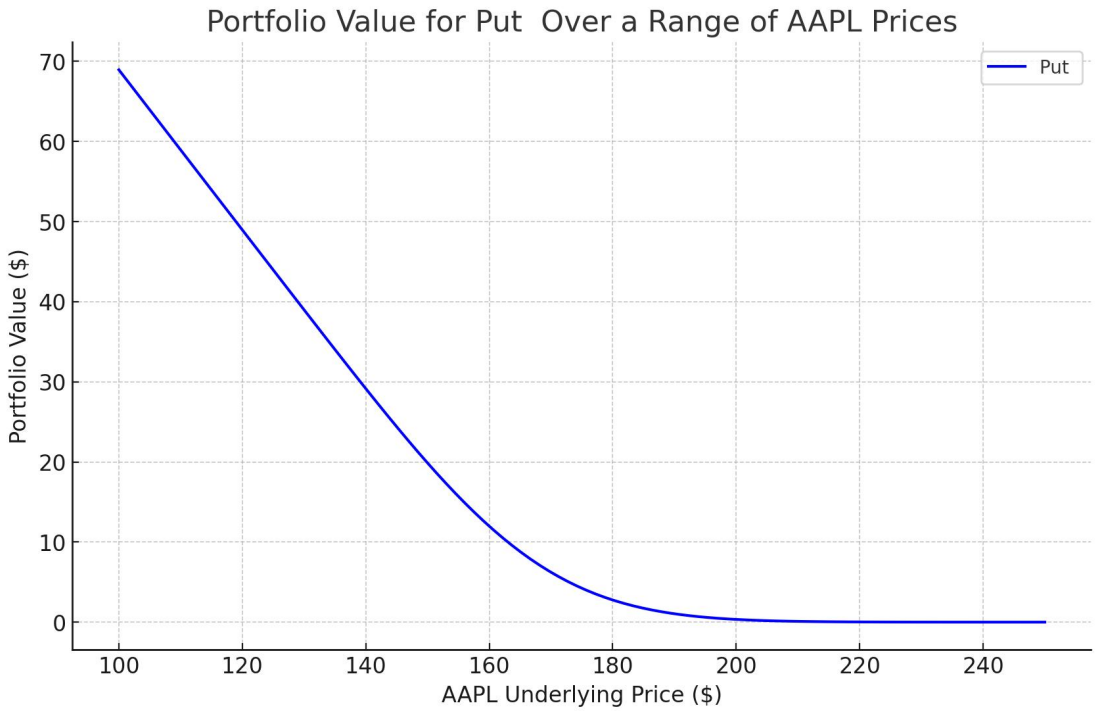
5.Stock: The stock holding reflects a straightforward linear relationship with the AAPL price. Profits increase as the price rises, and losses accumulate as it falls.



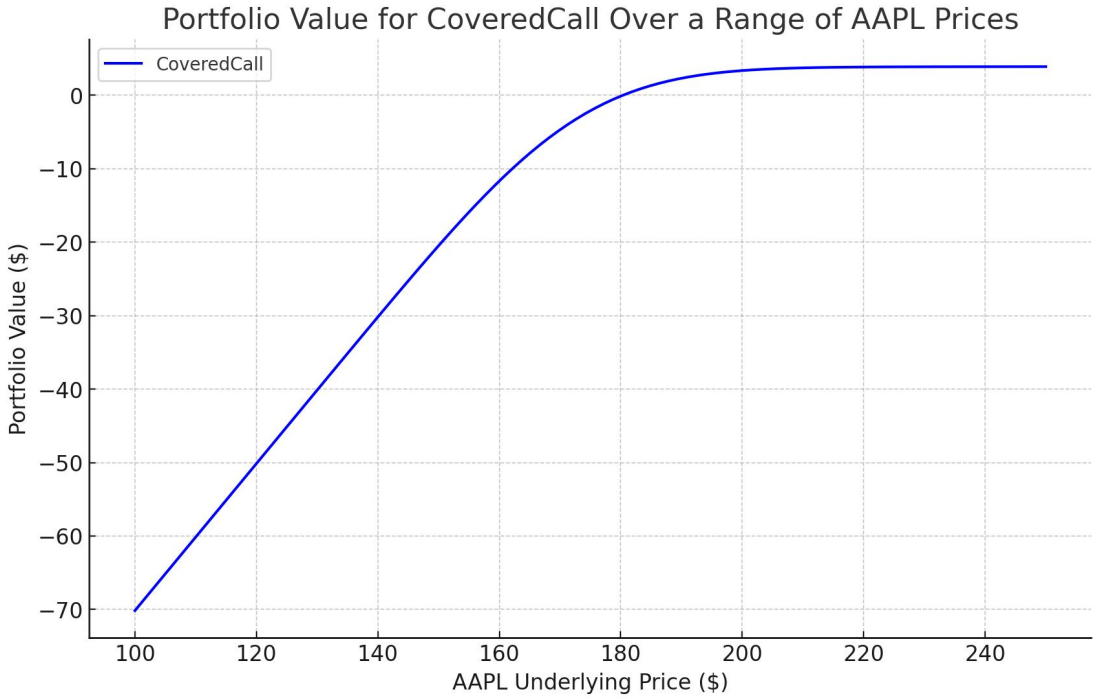
6.Call: The call option portfolio value increases as the AAPL price rises. This graph has a convex shape, with the option value growing exponentially as the price moves higher.



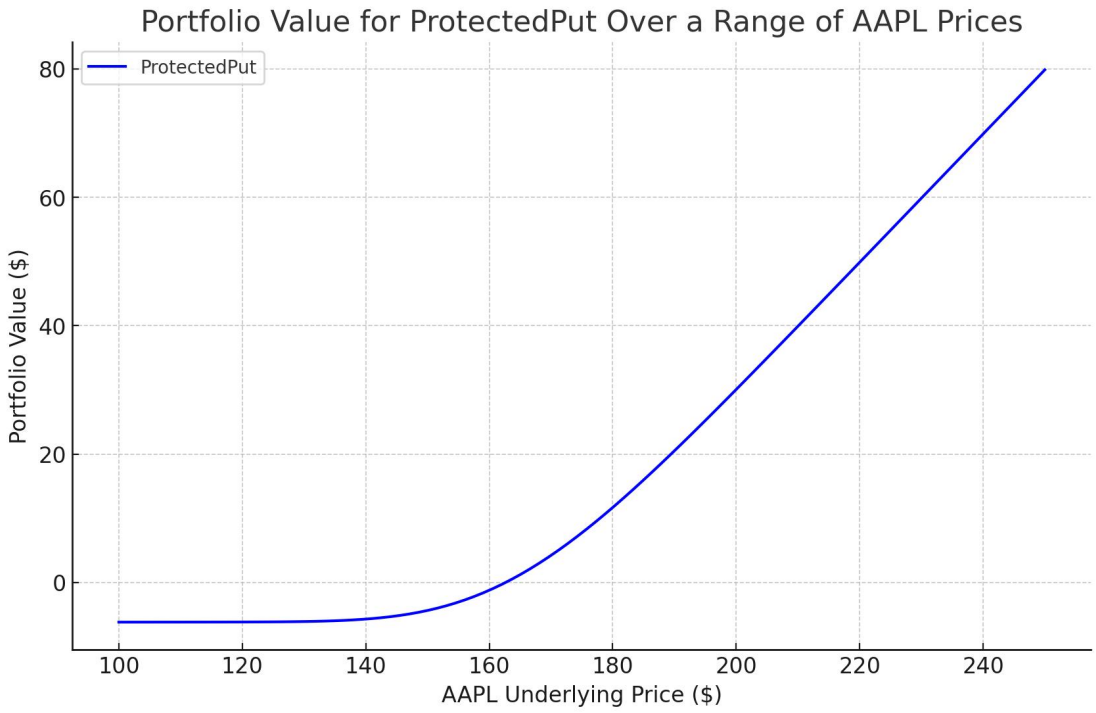
7.Put: The put option portfolio increases in value as the AAPL price drops. This graph has a concave shape, with the put value decreasing as the underlying price rises.



8.Covered Call: Combining stock with a sold call option limits upside gains. The graph shows a capped effect above the strike price, reflecting the offsetting impact of the short call on the stock gains.



9.Protected Put: This portfolio combines stock with a protective put option. The downside is limited by the put, while the stock allows for unlimited upside, creating a payoff profile with limited losses as prices fall and gains as they rise.



・Risk Analysis Results （AAPL mean var es)

1.Mean of Simulated Prices: 170.61

Although the forecast period is short, the mean value being slightly higher than the current price of 170.15 suggests a modest expected increase in AAPL's price.

2.Value at Risk (VaR) at 5% Confidence Level: 156.05

This metric helps measure potential extreme risk, which is useful for investors to understand and prepare for possible substantial downside within a short timeframe.

3.Expected Shortfall (ES) at 5% Confidence Level: 152.23

In this case, if AAPL's price drops below 156.05, the average price level is expected to be around 152.23. This is lower than the VaR level, indicating a potential for further decline in extreme scenarios.

Mean Price: 170.61120602698526
Var (95%): 156.05418464627516
Expected Shortfall (95%): 152.22691911671922

・Risk Analysis Results （Portfolio mean var es)

	Mean	VaR	ES
Straddle	13.468777	13.296756	13.277944
SynLong	1.028781	-2.299106	-3.573932
CallSpread	4.536437	3.715407	3.405553
PutSpread	3.187500	2.656175	2.487240
Stock	-0.021976	-3.353479	-4.630532
Call	7.248779	5.536084	4.936851
Put	6.219998	5.032782	4.669464
CoveredCall	-4.695267	-6.726180	-7.562674
ProtectedPut	4.350134	2.259610	1.509448

・Options-Based Portfolios (Straddle, Call Spread, Put Spread...):

These portfolios show controlled risk with VaR and ES values indicating limited downside, especially the spreads, which cap risk effectively.

Positive means for the straddle and spreads align with strategies designed to capture gains from moderate price movements or volatility.

・Directional Exposure Portfolios (SynLong and Stock...):

Both portfolios show a higher downside risk, with negative means and VaR/ES, reflecting their vulnerability to price declines.

The synthetic long position has a less negative ES than the stock position, reflecting some downside protection, while the stock position is fully exposed to tail risk.

In summary, the option strategies effectively manage risk with limited downside, while the direct stock and synthetic long portfolios show sensitivity to market downturns, typical of their structures.