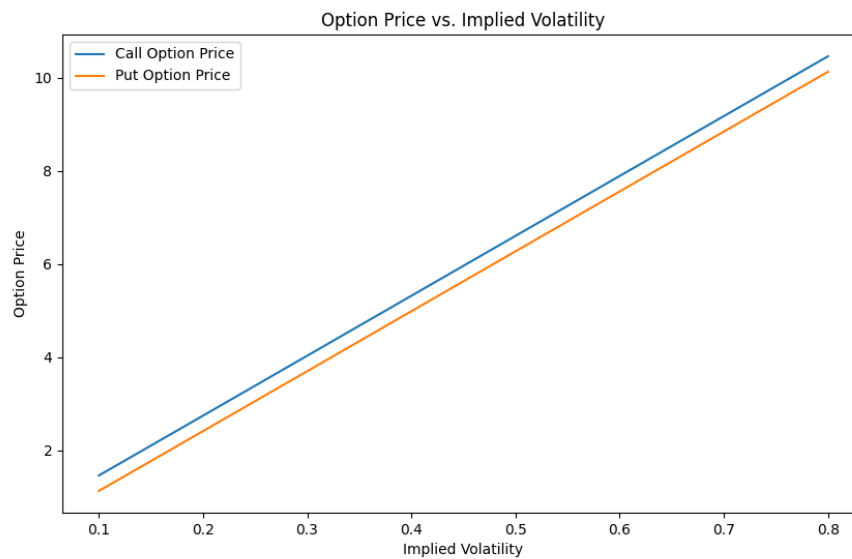
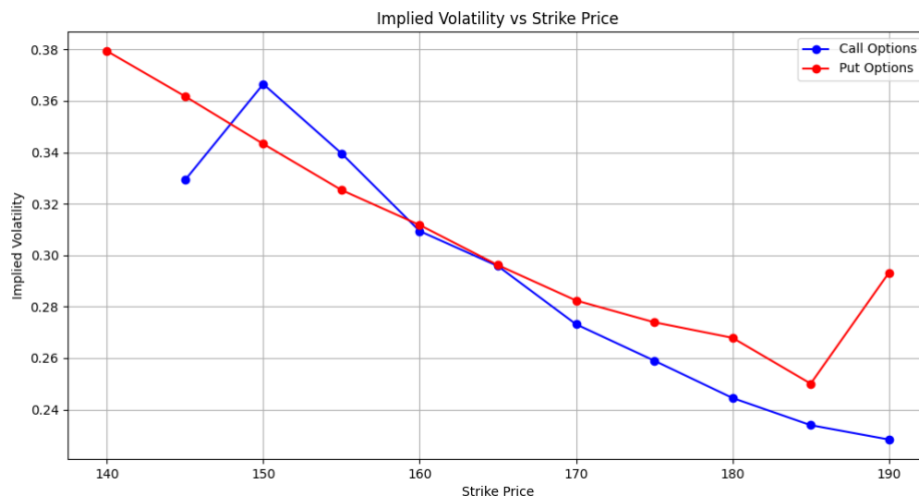


Problem 1:



1. Both put and call option prices increase as implied volatility increases, since option prices depend on the volatility of the underlying asset; so, higher volatility raises the probability of the option ending up in the money, which increases the option's price.
2. Theoretically, an increase in demand raises the price of the option and also increases implied volatility. A decrease in demand lowers the price of the option and decreases implied volatility. On the other hand, if market makers perceive that the risk of the underlying asset has increased, they will raise the price of the option, which will increase implied volatility. Conversely, if option buyers believe that the probability of the option ending up in the money has increased (or decreased), they will raise (or lower) the price of the option, resulting in an increase (or decrease) in implied volatility.

Problem 2:



1. **Downward Trend:** Implied volatility decreases as strike prices increase. This pattern is often seen in volatility smiles or skews.
2. **Higher Volatility for Lower Strikes:** Lower strike prices have higher implied volatility, suggesting more uncertainty for those options.

Possible reasons:

1. **Market Sentiment:**
 - a. Higher volatility for puts at lower strikes suggests investors are hedging against downside risk.
 - b. The decrease in volatility at higher strikes indicates less expectation of significant upward movement.
2. **Demand and Supply:**
 - a. High demand for put options at lower strikes leads to higher premiums and thus higher implied volatility.
 - b. Call options have less demand at higher strike prices, causing their implied volatility to decrease.
3. **Volatility Skew:**
 - a. The higher implied volatility for lower strikes reflects greater fear of downside risk than upside potential, which is common in equity markets.

Problem 3:

1. Put-Call Parity and Portfolio Graphs:

- **Put-Call Parity** shows the relationship between calls, puts, and the underlying stock, helping explain portfolio value changes.
- **Portfolio Shapes:**
 - **Protective Puts** provide a floor, limiting downside.
 - **Covered Calls** limit upside gains while generating extra income.
 - **Call and Put Options:** Calls gain value with price increases, while puts gain value as prices drop. Put-call parity explains the interaction of these effects.

2. Mean, VaR, and ES for AAPL Returns:

- **Mean:** Indicates expected return over 10 days; a positive mean implies a likely increase, and a negative mean suggests a decrease.
- **Value at Risk (VaR):** Measures the maximum expected loss within a confidence level (e.g., 95%) over 10 days.
- **Expected Shortfall (ES):** Estimates the average loss beyond VaR, capturing worst-case scenarios better than VaR alone.
- **VaR vs. ES:** VaR gives the limit on likely losses, while ES shows the average in extreme cases.

	simulatedValue	currentValue	pnl
Portfolio			
Call	[0.0, 8289295692218.267, 0.0, 18144694215.7308...	7.21	[-7.21, 8289295692211.057, -7.21, 18144694208....
CallSpread	[0.0, 9.9482421875, 0.0, 9.948352813720703, 9....	4.54	[-4.54, 5.408203125, -4.54, 5.408351898193359,...
CoveredCall	[0.0005161378071687377, 174.095703125, 1.01728...	165.52	[-165.51948386219283, 8.5751953125, -165.52, 8...
ProtectedPut	[164.14782465941477, 8289295692387.389, 164.14...	174.47	[-10.322175340585233, 8289295692212.918, -10.3...
Put	[169.12148502643834, 0.0, 169.12200116424552, ...	6.16	[162.96148502643834, -6.16, 162.96200116424552...
PutSpread	[9.948353009661503, 0.0, 9.948353009661503, 0....	3.17	[6.778353009661515, -3.17, 6.778353009661515, ...
Stock	[0.0005161378071687377, 8289295692387.389, 1.0...	170.15	[-170.14948386219282, 8289295692217.238, -170....
Straddle	[169.12148502643834, 8289295692218.267, 169.12...	13.37	[155.75148502643833, 8289295692204.896, 155.75...
SynLong	[-169.12148502643834, 8289295692218.267, -169....	1.05	[-170.17148502643835, 8289295692217.217, -170....

VaR and ES Percentages:

- **SynLong:** Highest risk, sensitive to adverse markets.
- **ProtectedPut:** Lowest risk, ideal for defense.

Volatility:

- High risk/volatility: **SynLong, Call, Put.**
- Lower volatility: **CallSpread, PutSpread** (hedging strategies).

Portfolio Risks:

- **Straddle:** Speculative, but smaller size.
- **SynLong:** Aggressive, highly volatile.
- **CoveredCall & ProtectedPut:** Conservative, suitable for low-risk investors.

Diversification:

- Mix low-risk (**ProtectedPut, CoveredCall**) with high-risk (**SynLong, Straddle**) for balanced portfolio risk.

