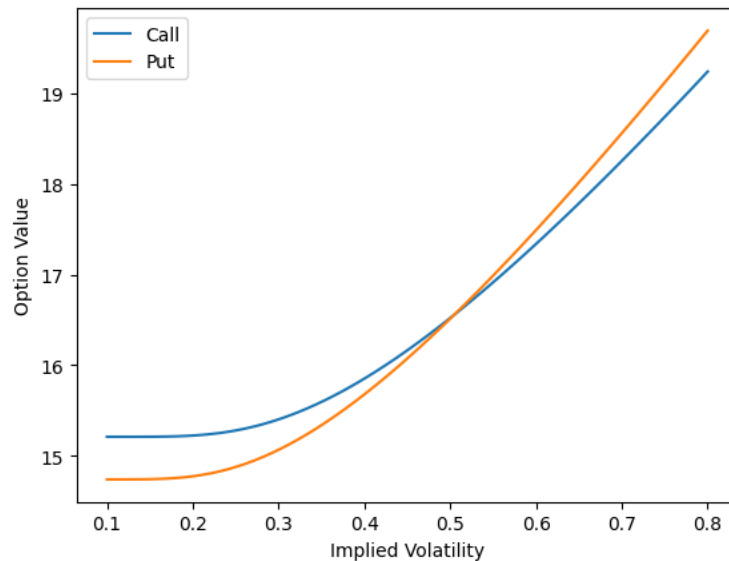


## Problem 1

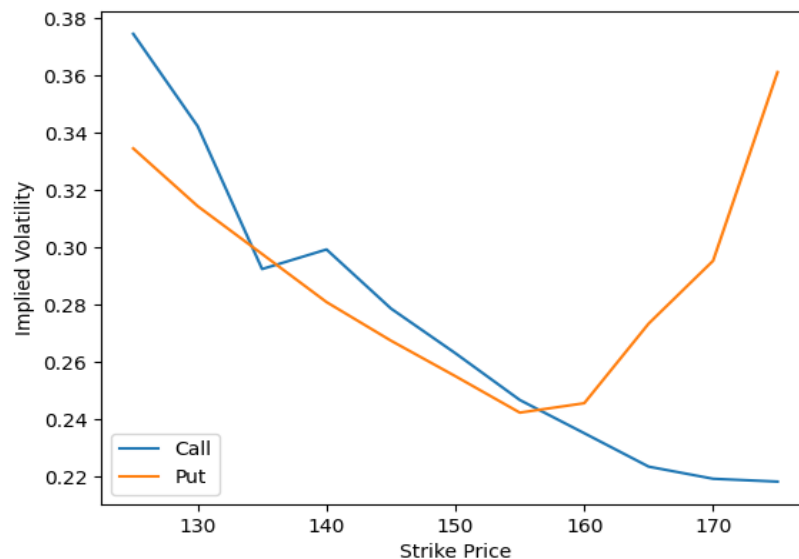
Time to Maturity is 0.0384 (3/3/23 to 3/17/23)

I assumed the strike price is 165.



Based on the graph, calculated by Black Sholes Merton model, the Option values for both Call and Put option will both increase accordingly with the implied volatility increases. Higher implied volatility leads to a high option value. When the implied volatility is high, the market expects the price of the asset to be more volatile in the future. This higher expected volatility increases the probability of the option, which increases its value. Considering about the supply and demand, an increase in demand will lead the price of option going up, since people are willing to pay more for the option. Simultaneously, the implied volatility will increase with the high demand and possible price increase. In the contrary, if the supply is more than demand, the price will decrease with the implied volatility, because less demand means people are less willing to pay for the option.

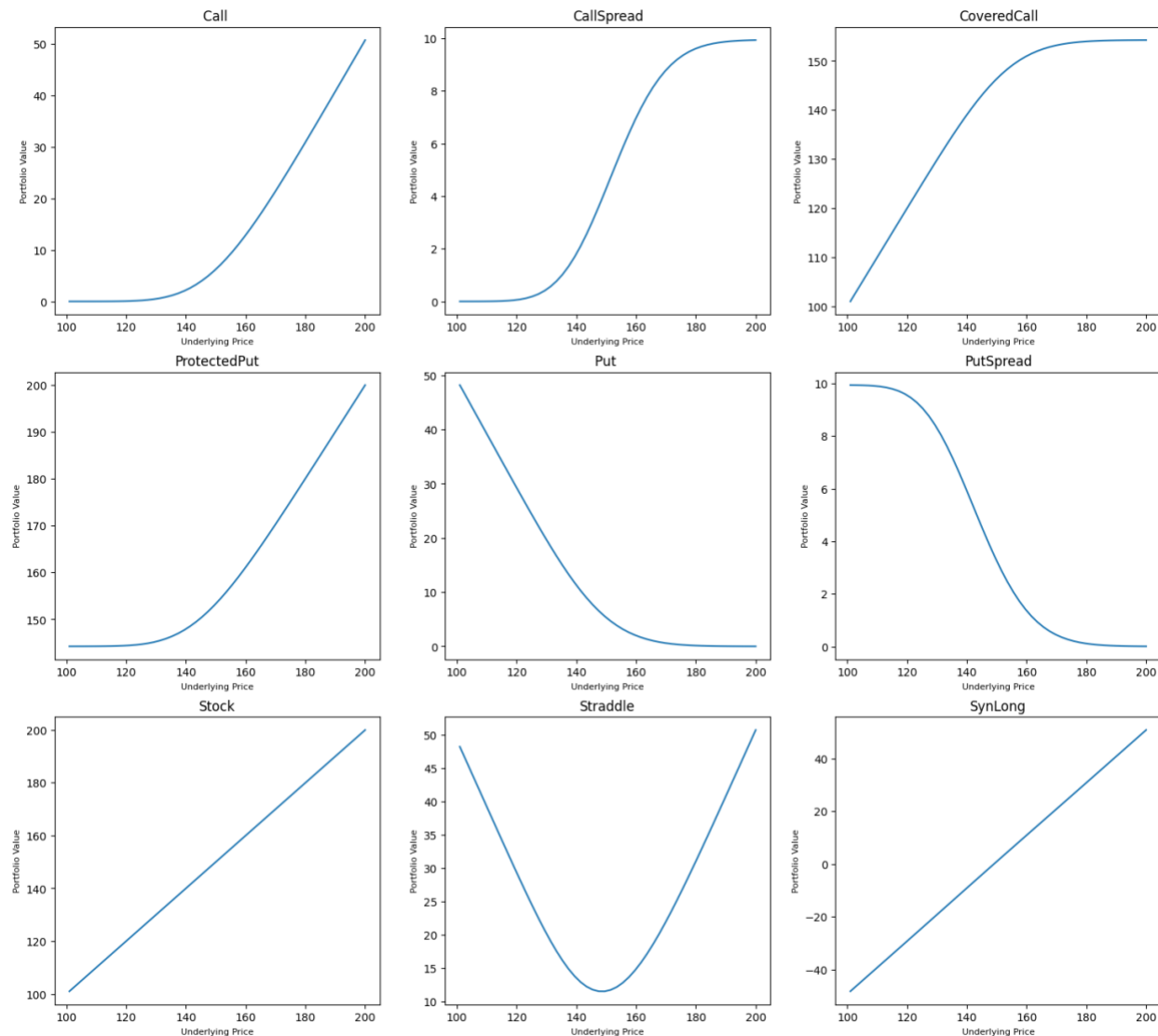
## Problem 2



As we can see from the graph, for Call option, its implied volatility tends to decrease as the strike price increases. This is because call options become less valuable as the asset price increases, so the demand will decrease, which makes the implied volatility decrease. As for the put options, we can see the implied volatility is high when the current price is higher than and lower than the strike price. So, when the current price is lower than strike price, the potential gain from the put option is high, so the implied volatility will be higher. And when the current price is higher than strike price, it's often when investors seek to hedge against large market declines. For Put option, when the current price is at the strike price, the implied volatility is the lowest.

There are several market dynamics that could make these graphs. In a market where there is high demand for put options, the implied volatility curve for puts may have a smile shape, with higher implied volatilities for both lower than strike price and higher than strike price options. This is because investors are willing to pay more for these options to protect against large market declines. On the other hand, in a market where there is low demand for call options, the implied volatility curve for calls may be downward sloping, as investors are less willing to pay a premium for these options as the underlying asset price increases. Other than that, market expectations of future volatility, change of risk preference etc. can also impact on the graph.

### Problem 3



1. Call: It's a upward sloping line, and it's portfolio values increase with the value of Underlying price, and the increase rate become bigger after underlying asset price above the strike price of the call option.
2. Call Spread: it's buying a call option at a lower strike price and selling a call option at a higher strike price, both with the same expiration date. The graph of a call spread shows the potential profit or loss at expiration for different underlying asset prices, and has a limited profit potential and limited loss potential
3. Covered Call: Happened When an investor holds a long position in an asset, such as a stock, and sells a call option, It can be used to potentially earn income while also protecting against downside risk. If the price of the underlying asset rises, the investor may miss out on potential gains beyond the strike price of the call option, like showing in the graph.

4. Protected Put: The graph of Protected Put shows the maximum loss and maximum gain. It often used in purchasing a put option to protect against a potential decline in the price of an underlying asset.
5. Put: It's typically downward sloping, and the graph shows the maximum profit when the underlying asset price decreases below the strike price.
6. Put Spread: The graph shows the profit and loss potential, involving buying a put option with a higher strike price and selling a put option with a lower strike price. The maximum profit occurs when the underlying asset's price is below the lower strike price. The maximum loss occurs when the underlying asset's price is above the higher strike price.
7. Stock: The graph is very direct, it's a straight upward linear line. The value increase with the stock price increases.
8. Straddle: The graph of a straddle is a V-shape, with the maximum profit occurring at the near strike price. A straddle involves buying both a call option and a put option with the same strike price and expiration date. The strategy profits if the underlying asset's price moves significantly in either direction, while limited losses are incurred if the price remains relatively stable.
9. Syn Long: The graph is just a straight line, but it combines a long call option and a short put option, which simulates owning the underlying asset. The profit/loss diagram for a synthetic long position looks like the profit/loss diagram for owning the underlying asset directly. It has unlimited profit potential and limited downside risk.

After that, I simulated 10 days ahead, and I found that the Call and put option makes money with stock prices goes up and down. They are normal option, so the risk is moderate. For Call Spread and Put Spread, both have maximum and minimum bond, so their risks are under controlled. For Covered Call and Protected Put, they have a mix of stocks and options, and just like the Call and put options, therefore their risk are in the middle of stocks and options. For SynLong and Stock, they don't have a profit or loss bound, so the risks are very high. The Straddle strategies can be used for hedging, since it can make money no matter how the stock price goes. The risk is relatively low than others.