**Problem 1:**

A number on a white background

Description automatically generated

A graph with a line

Description automatically generated

According to the graph, we can see that as implied volatility moves from 10% to 80%, both call and put option prices increase. This is because volatility can bring more value to the option, increasing the likelihood of in the money. The more demand for options, the higher the price of options since buyer would like to pay higher premium. On the contrary, the more the supply of options, the less the price since buyer only want to pay lower premium.

**Problem 2:**

A graph with a line

Description automatically generated

A graph with orange line

Description automatically generated

The first graph depicted call options. The implied volatility for the price at 140 is extremely low. The reason for that is probably because 140 is deep in the money. Thus, its volatility is closer to the underlying asset itself rather than a speculative derivative. The second graph shows that as put option become more in the money, the volatility gradually decreases. As the strike price get to around 185, the implied volatility rebounds to a higher level. There are multiple reason causing this. Those options sellers often hedge their positions. Sometimes, this action might cause higher volatility at some prices. Besides, some unexpected event such as covid might lead to abnormal demand for option at a specific strike price, causing higher volatility at that price.

**Problem 3 (1):**

A graph of different colored lines

Description automatically generated

The Straddle strategy shows a V-shape since it involves buying both a call and a put option at the same strike price. As a result, the maximum occurs at the strike price, creating a V-shape. Synlong strategy involves buying a call option and selling a put option. This strategy captures all upside potential but also incurs losses as the stock price falls. Call spread means buy a call option at a lower strike price and sell a call option at a higher strike price. This strategy limits the magnitude gain and loss. (Vice versa for Put spread). Covered call means holding the stock and selling a call option. It gets flat as the stock price approaches the strike price since the option buyer may exert their right and sell their holding. Protected put means holding stock with buying a put option. It gets flat as the stock price approaches the strike price since you might exert the right.

**Problem 3 (2):**

A number and a smiley face

Description automatically generated with medium confidence

According to the chart we can see that the mean return for simulated 10 values is approximately 0.33%. The VaR value is 3.67 and the ES value is 4.12 which follows our expectation since we expect ES is slightly higher than VaR.