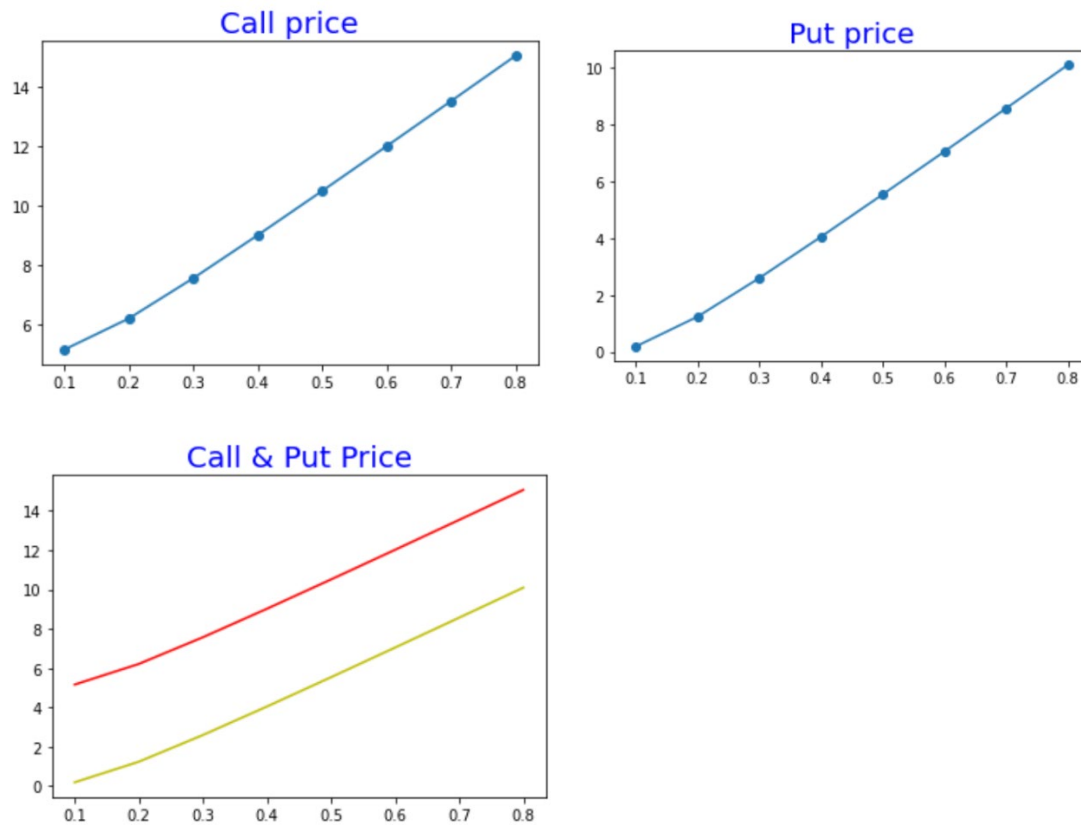# Week 6 Assignment

Problem 1:

For this question, I first write the GBSM function to calculate the option price. I set strike price to 160 and do the calculation. Here is the plots show the call and put price change by implied volatilities:


In the combined plot, the red line is call option price and the yellow line is put option price.

In this plot, I find when volatility increase, the price for both call and put options increase. This can be explained by the demand and supply relationship. When demand increases, the prices of the options will increase, and the implied volatility increase.

Problem 2:

For problem 2, we need to write the function to calculate the Implied Volatility. I split the option data with different types (Call, Put) and here is the result for Volatility with Strike price.

Volatility VS Strike Price
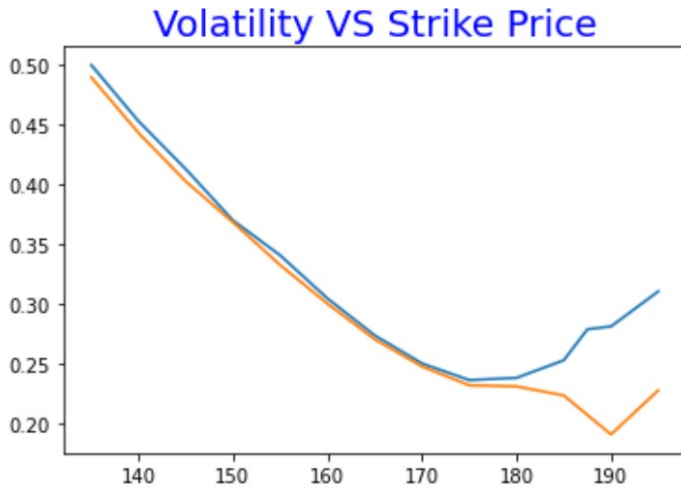
After do some research, I think this plot can be define as a Volatility smile. Volatility smiles can be seen when comparing various options with the same underlying asset and same expiration date but different strike prices. The smile shows that the options are furthest in the money or out of money with highest implied volatility. I also think the demand and supply relationship cause the smile plot either.

Problem 3:

For this problem, I first calculate the implied Volatility, then I calculate the portfolio value for 9 holding. Here are the plots:
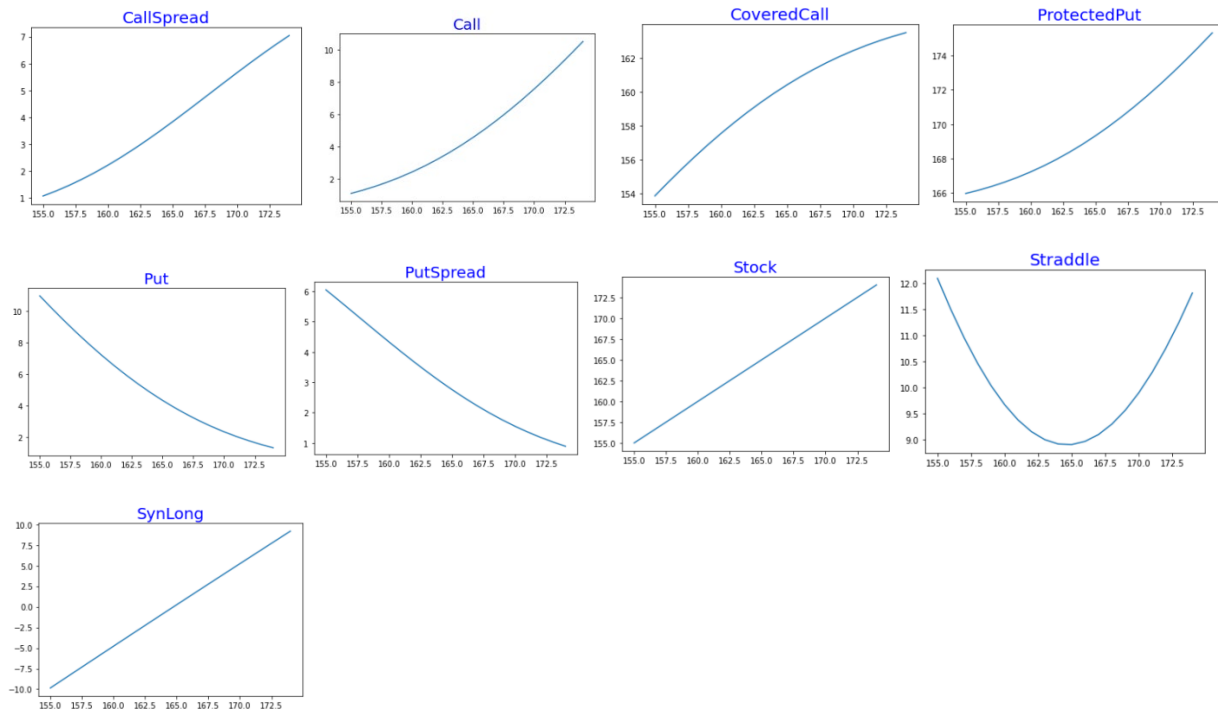
After calculate the holding value, I did the simulation and calculate the pnl mean, VaR and ES for each portfolio.

Here is the result:

	PnL Mean	5% VaR	5% ES
Portfolio			
Call	2.681833	-0.593863	-0.265604
CallSpread	5.136356	-2.201233	-1.765483
CoveredCall	16.313986	-10.908861	-9.987594
ProtectedPut	2.710068	-0.600388	-0.270919
Put	-1.922085	2.627516	2.702048
PutSpread	0.493284	0.467263	0.567195
Stock	4.632152	-1.314998	-0.721990
Straddle	0.759749	0.120747	0.185467
SynLong	9.559749	-8.679253	-8.614533