

FINANCIAL LAB ASSIGNMENT-02

Name - Dev Sandip Shah

Roll Number - 200123074

Question 1-

$$S(0) = \text{Initial Stock Price} = 100$$

$$K = \text{Strike Price} = 100$$

$$T = \text{Time to maturity} = 1$$

$$r = \text{Risk-free rate} = 0.08$$

$$\sigma = \text{Volatility} = 0.2$$

At each time step, stock prices can go up by a factor of 'u' or down by a factor of 'd'.

The formula used for u and d are-

Set 1 -

$$u = e^{\sigma\sqrt{\Delta t}}$$

$$d = e^{-\sigma\sqrt{\Delta t}}$$

Set 2 -

$$u = e^{\sigma\sqrt{\Delta t} + (r - \sigma^2/2)\Delta t}$$

$$d = e^{-\sigma\sqrt{\Delta t} + (r - \sigma^2/2)\Delta t}$$

where $\Delta t = T/M$ with M being the number of subintervals in the time interval $[0, T]$. For sensitivity analysis of option price with $S(0)$, K, M, r, σ , various plots are made by varying one and two parameters.

Question 2-

The path-dependent derivative I chose is Asian Options.

For this question, I have taken M = 10 because the Algorithm for calculating the price is $O(2^M)$. For M = 100, this analysis would be computationally infeasible.

Price of the option can be calculated as –

$$\frac{1}{e^{rT}} \sum_{\text{over all paths}} q^{\text{counts of ups}} \times (1 - q)^{M - \text{counts of ups}} \times f(S_{avg})$$

where $f(S_{avg})$ is the final payoff calculated using the following formula –

for call option – $\max(S_{avg}(T) - K, 0)$

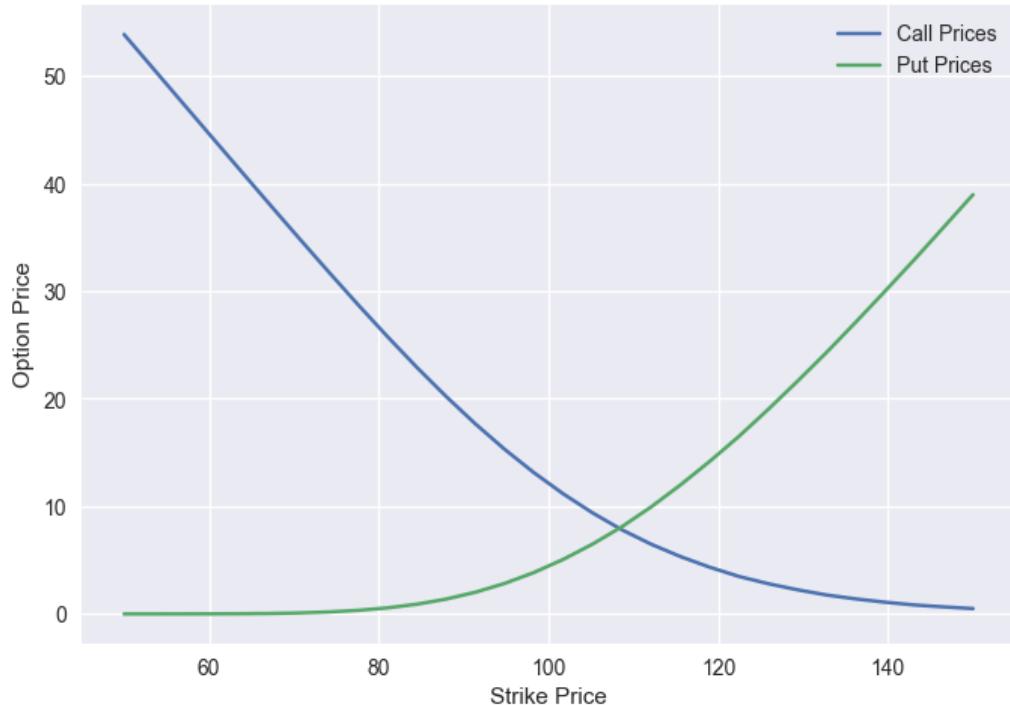
for put option – $\max(K - S_{avg}(T), 0)$

S_{avg} is the average stock price along any particular path.

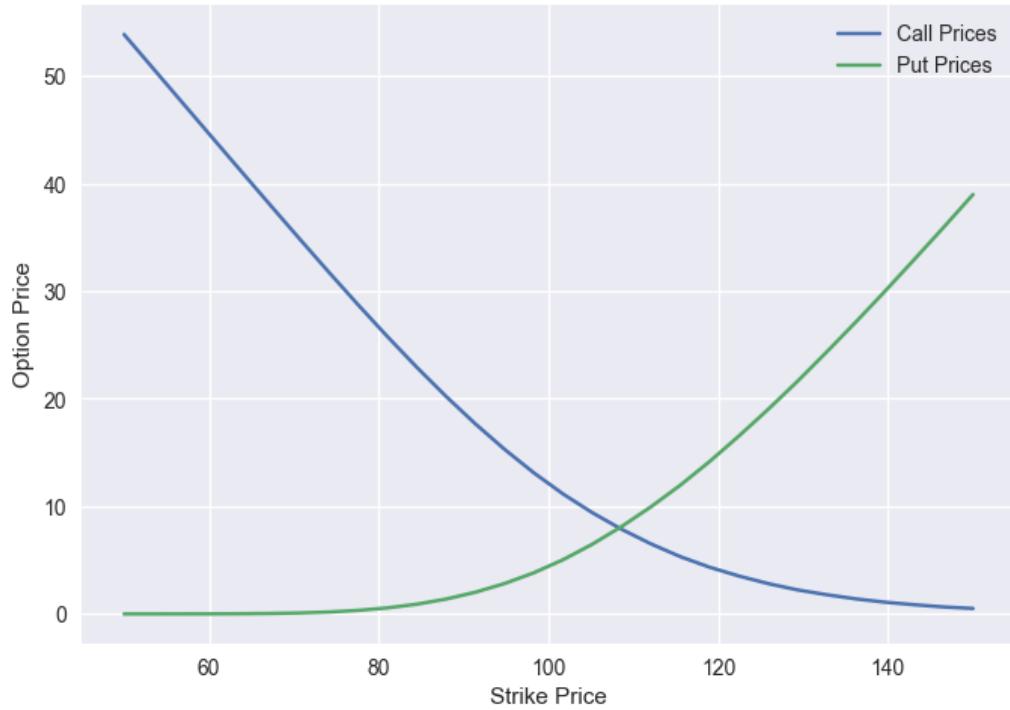
Question 1 2-d plots



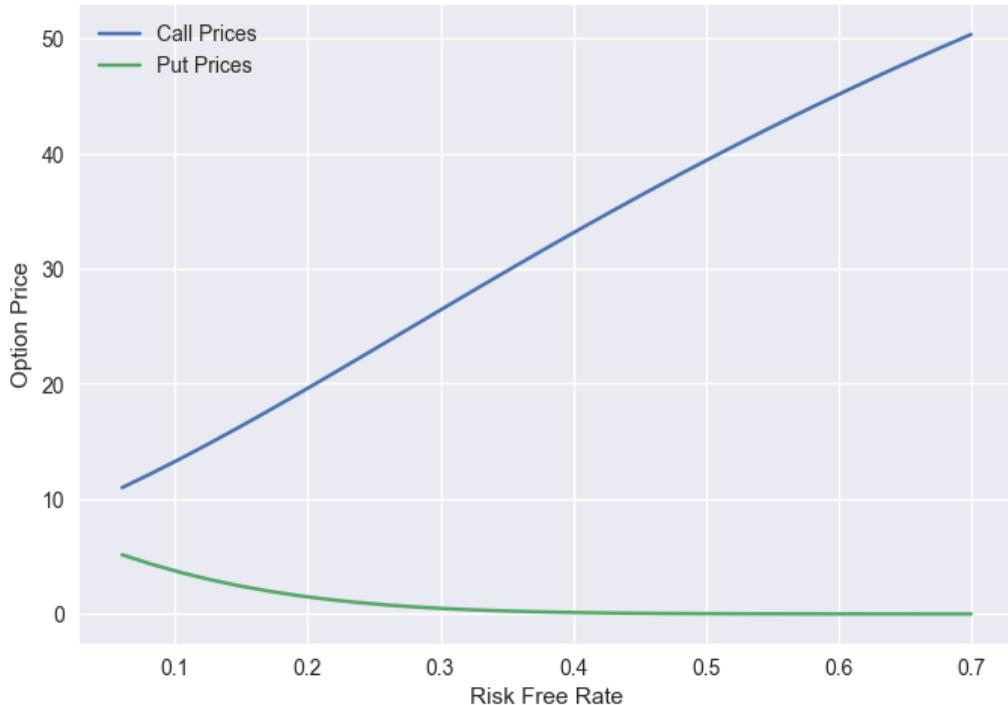
Option Price vs Strike Price (Set 1 of u,d)



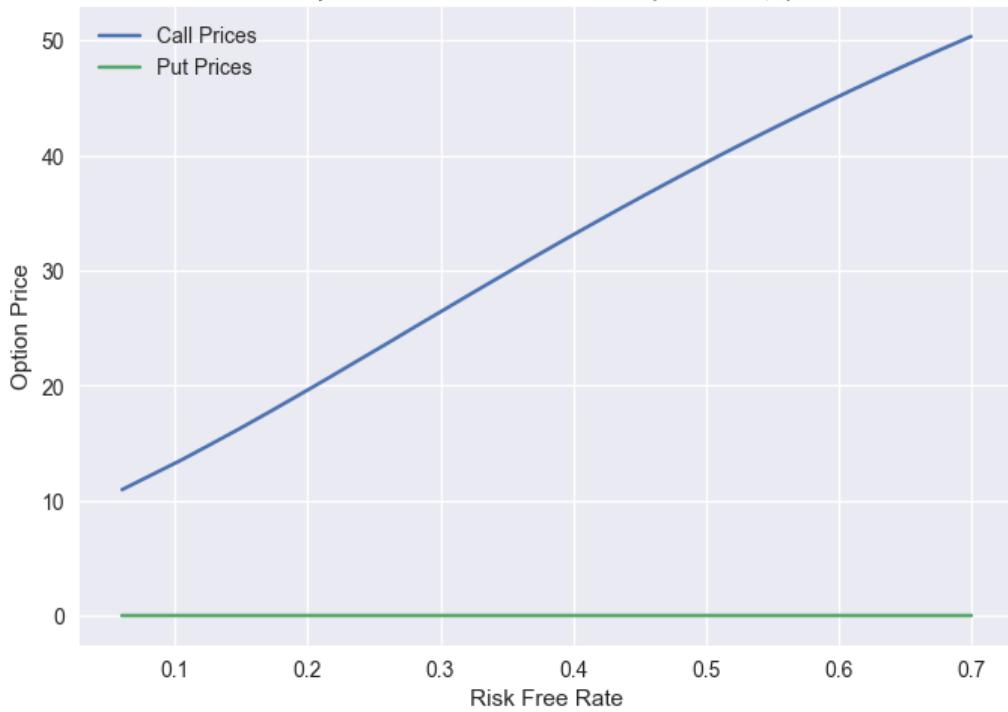
Option Price vs Strike Price (Set 2 of u,d)



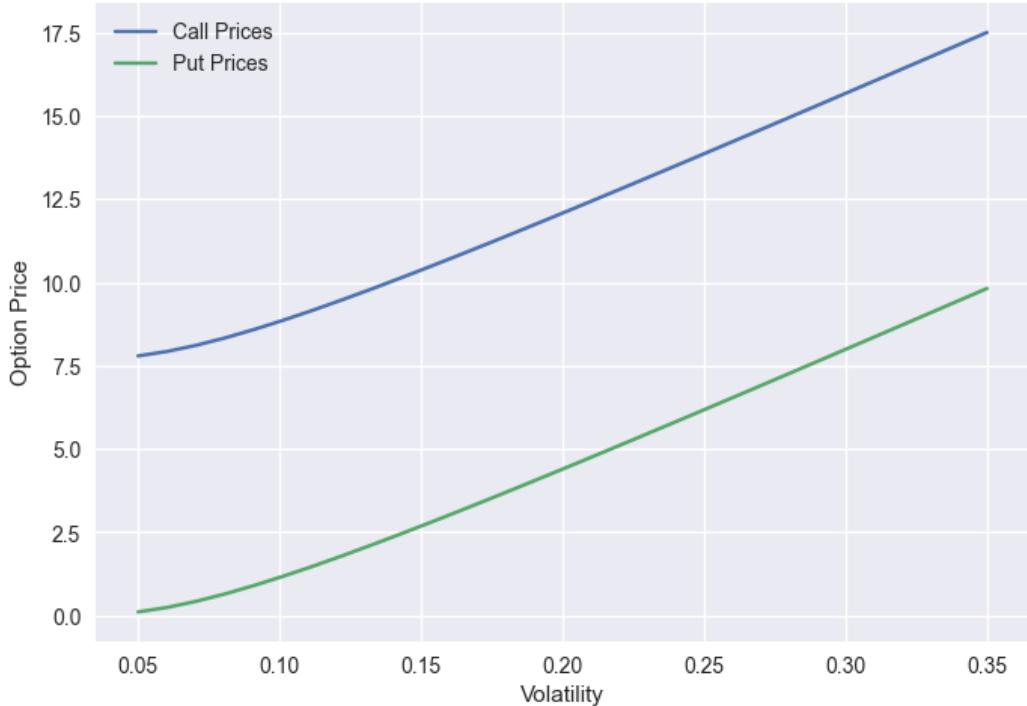
Option Price vs Risk Free Rate (Set 1 of u,d)



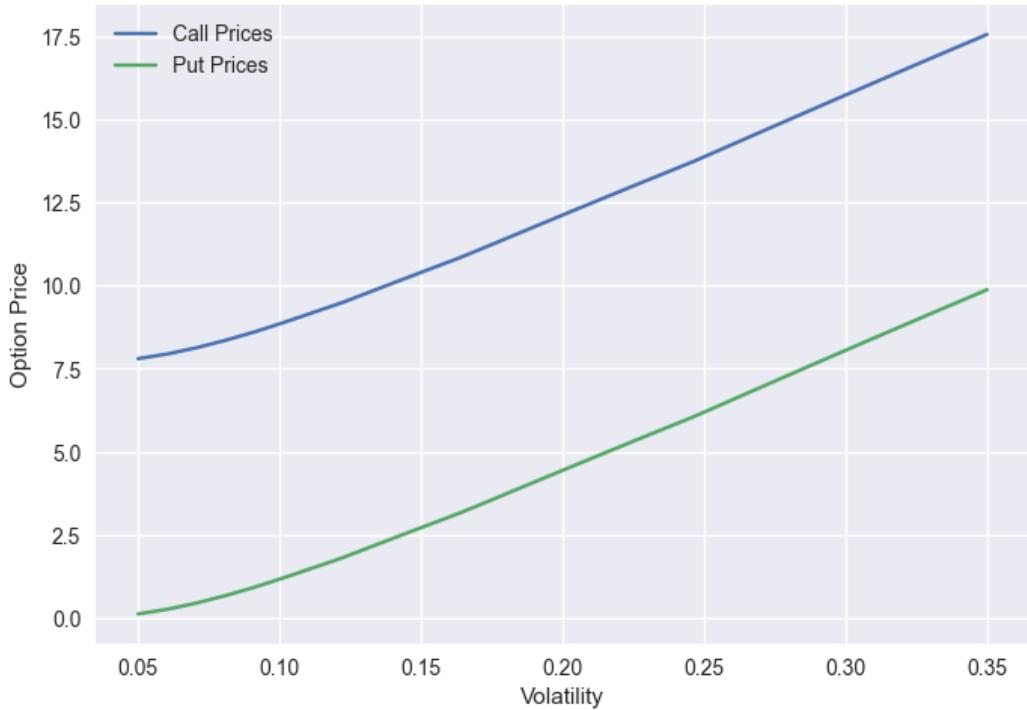
Option Price vs Risk Free Rate (Set 2 of u,d)

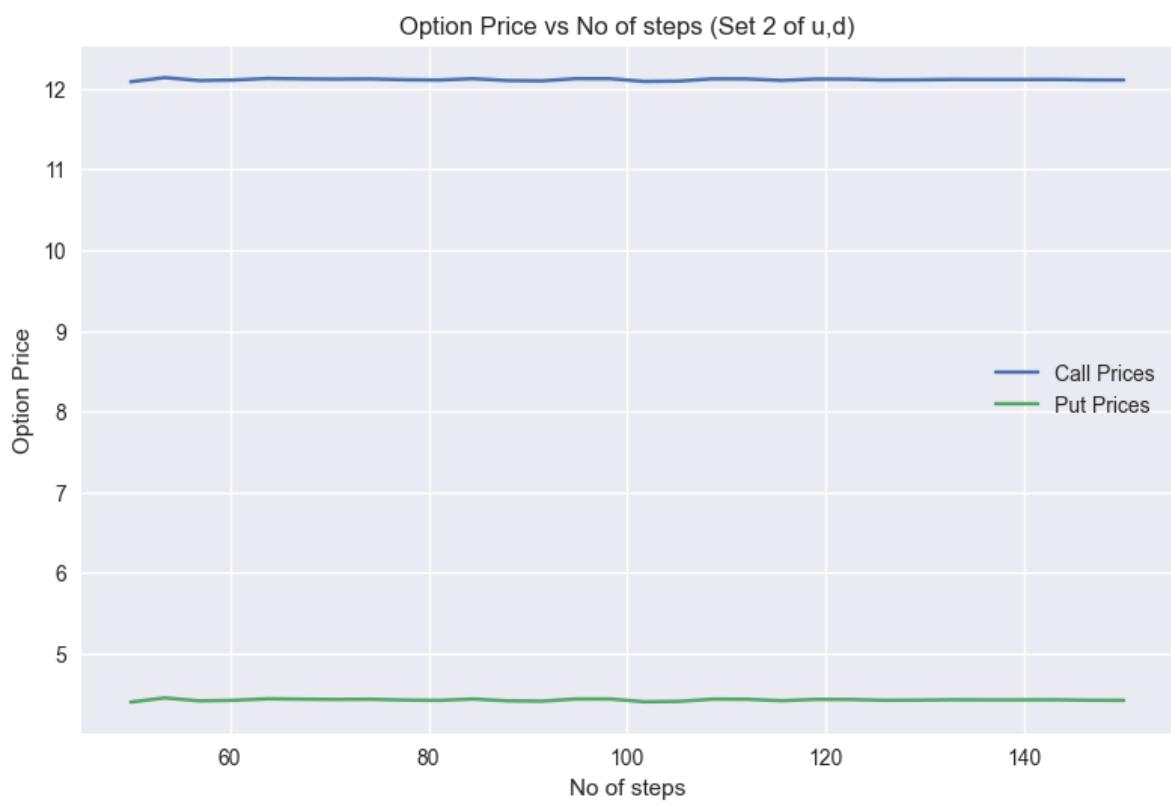
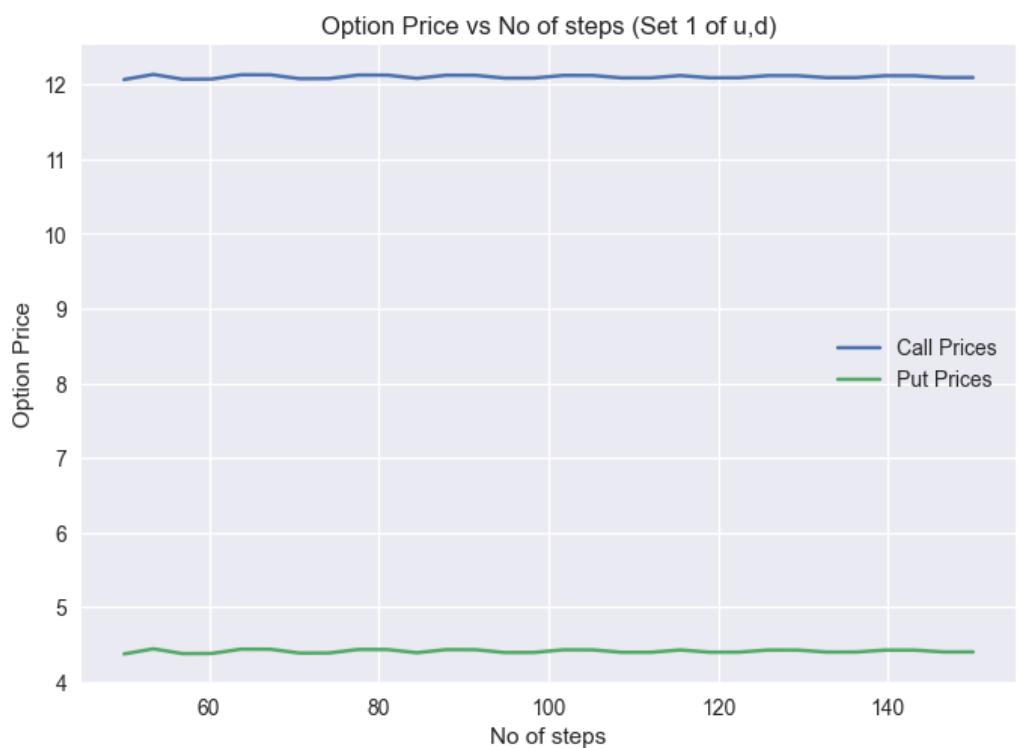


Option Price vs Volatility (Set 1 of u,d)

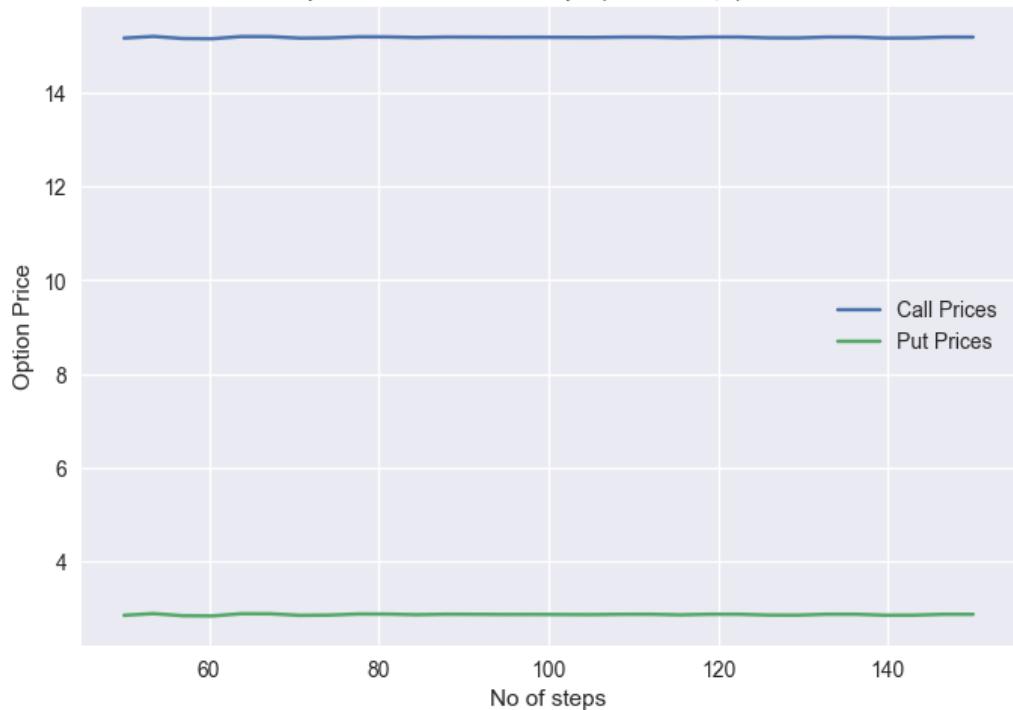


Option Price vs Volatility (Set 2 of u,d)

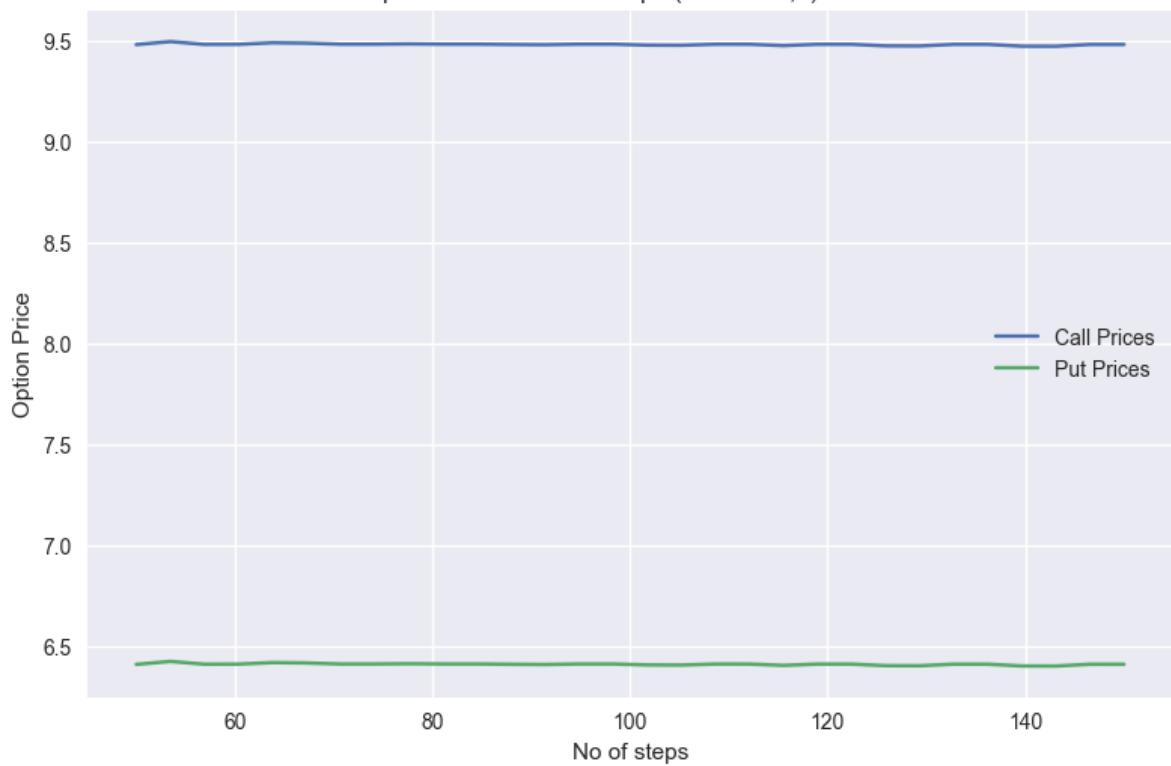




Option Price vs No of steps (Set 1 of u,d) K=95

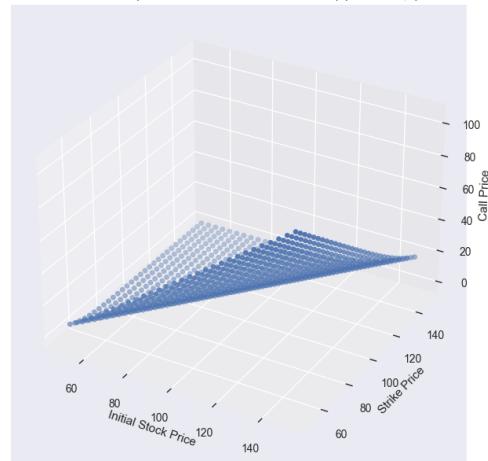


Option Price vs No of steps (Set 2 of u,d) K=105

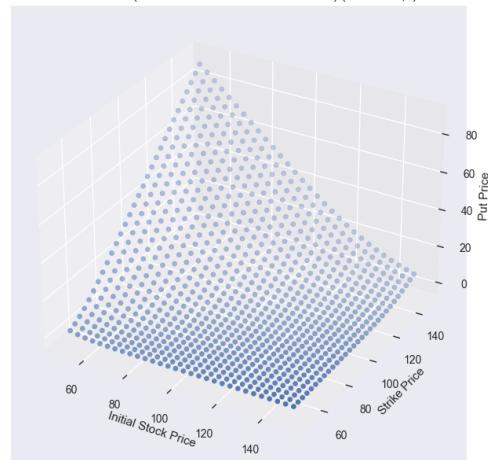


Question 1 3-d plots

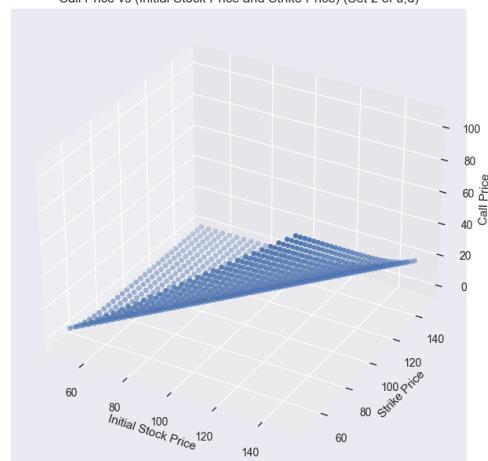
Call Price vs (Initial Stock Price and Strike Price) (Set 1 of u,d)



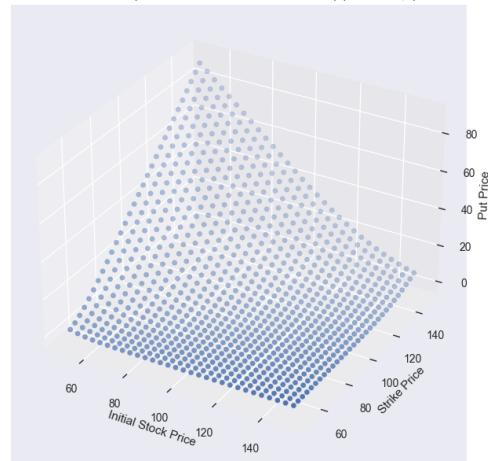
Put Price vs (Initial Stock Price and Strike Price) (Set 1 of u,d)



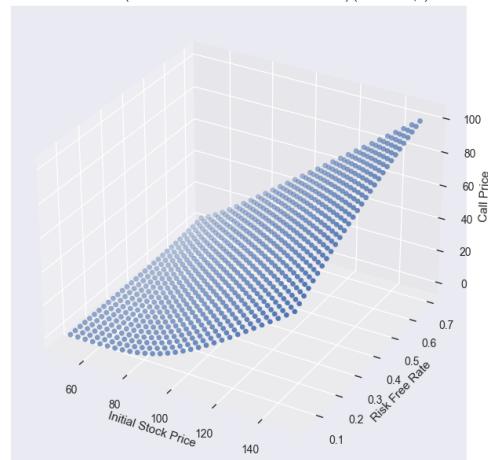
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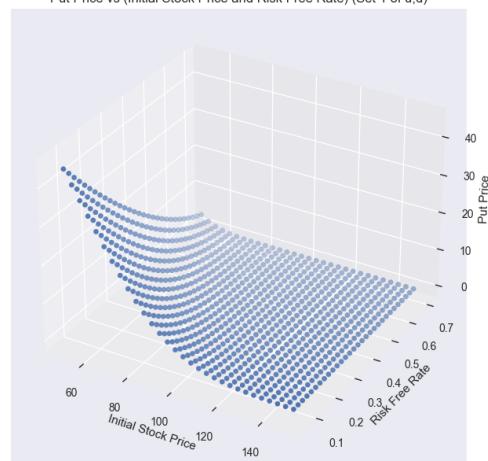
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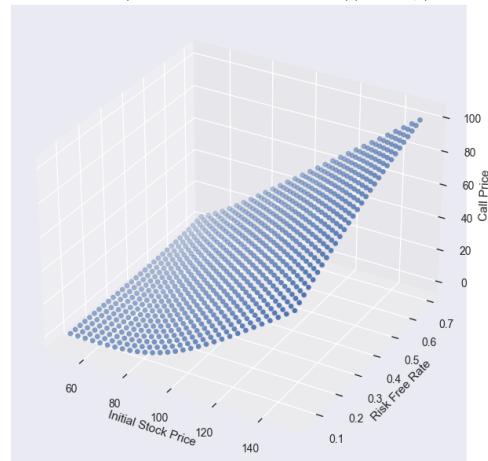
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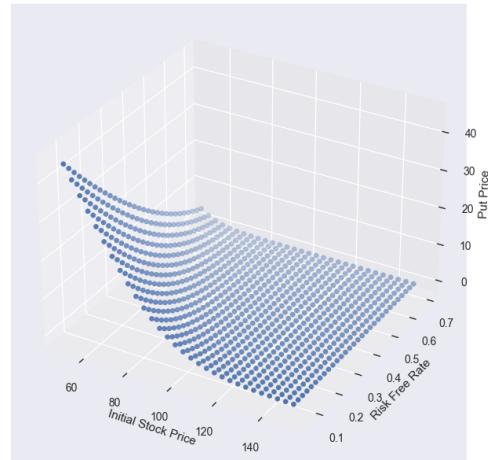
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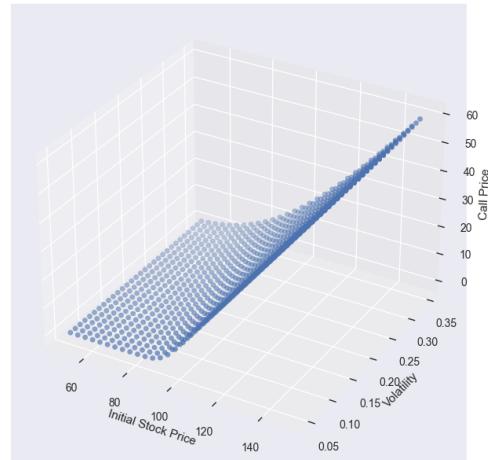
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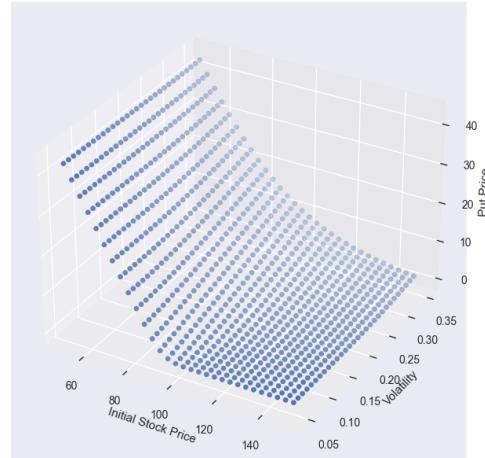
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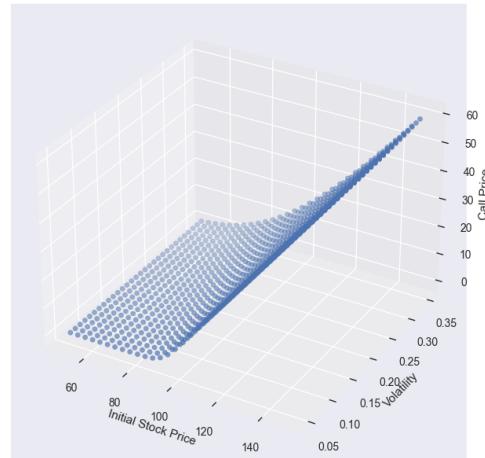
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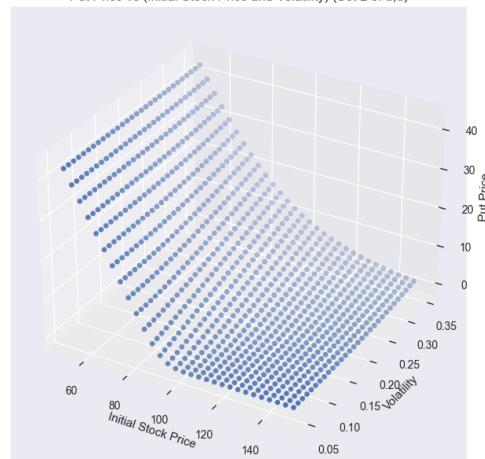
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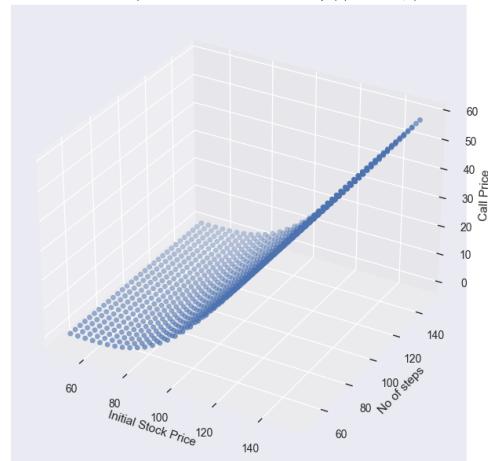
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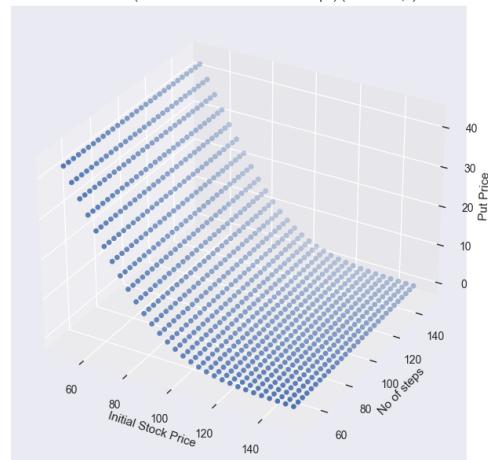
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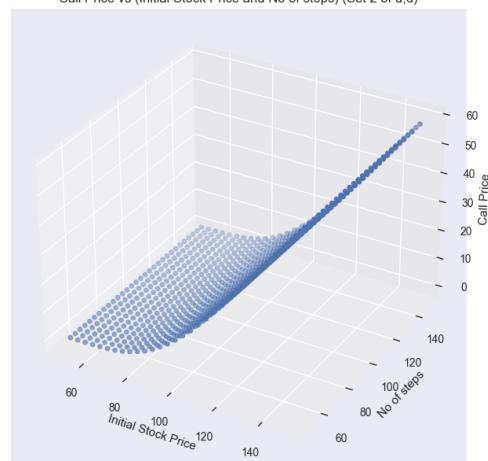
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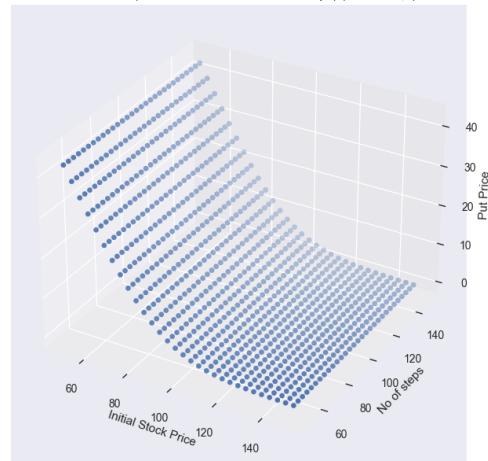
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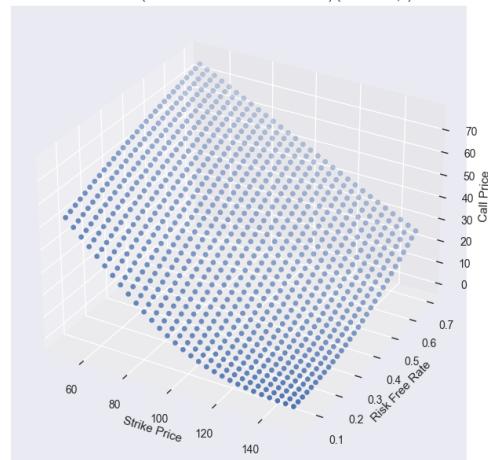
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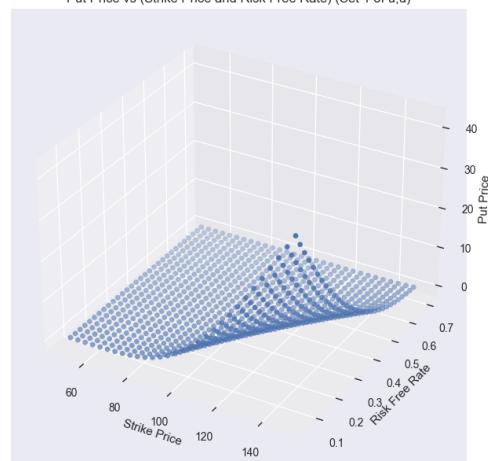
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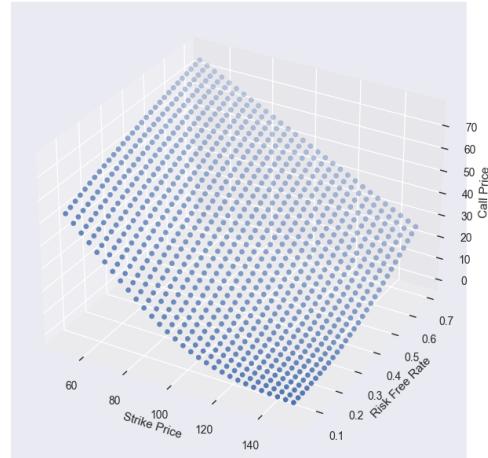
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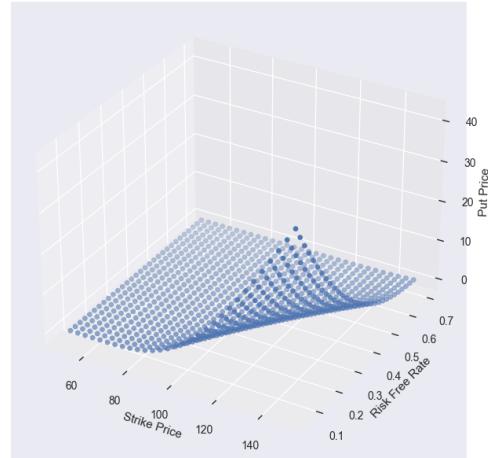
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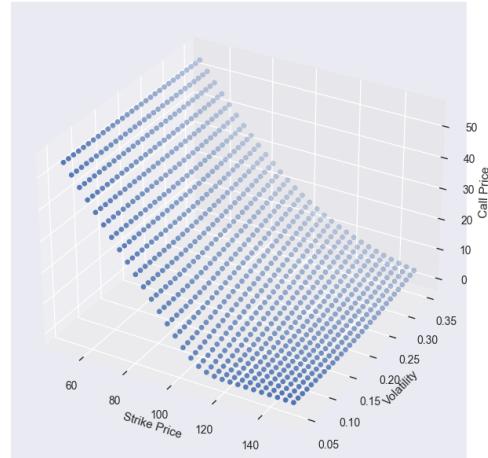
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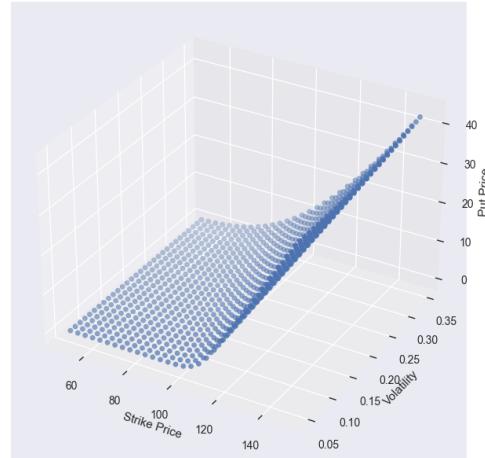
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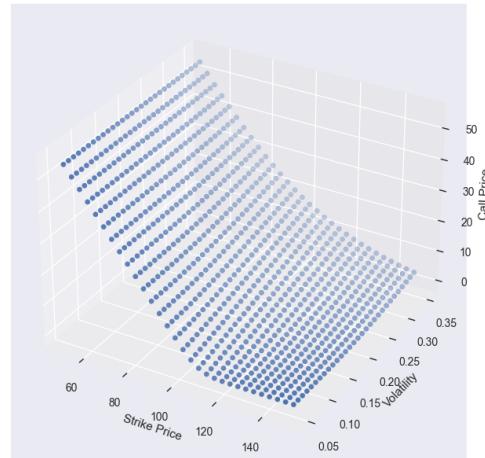
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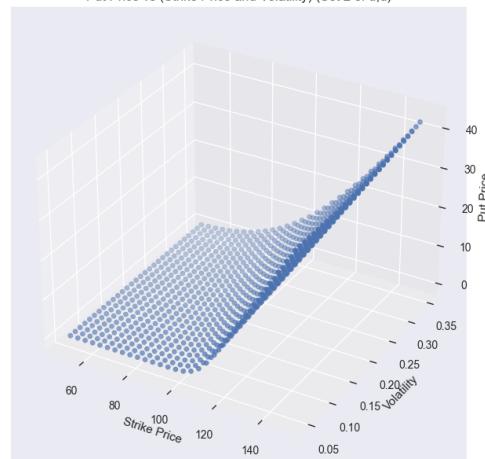
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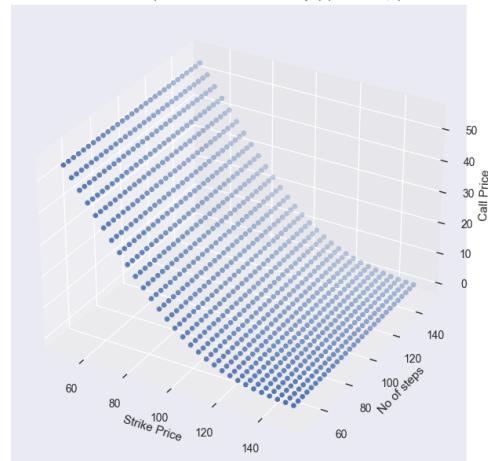
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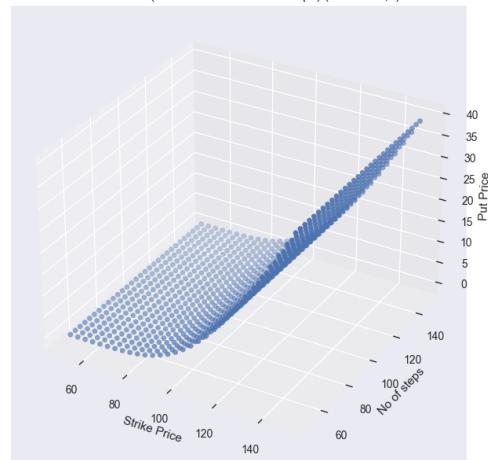
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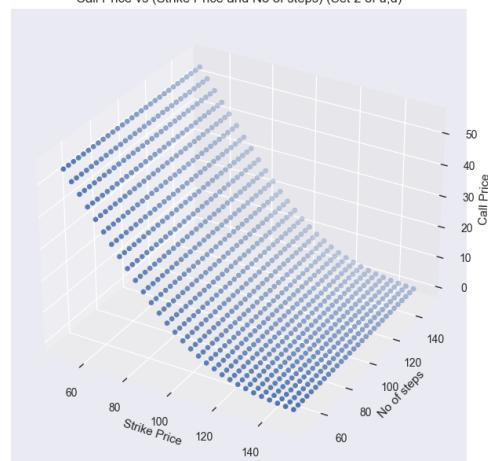
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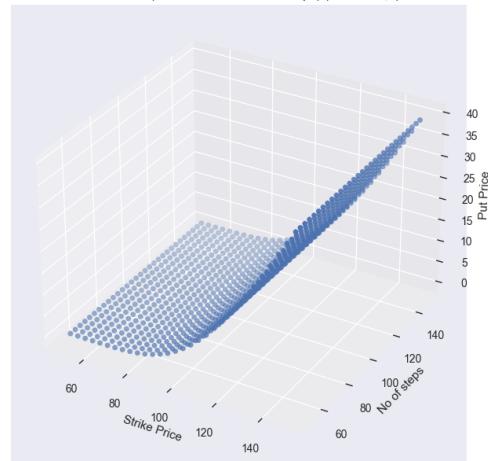
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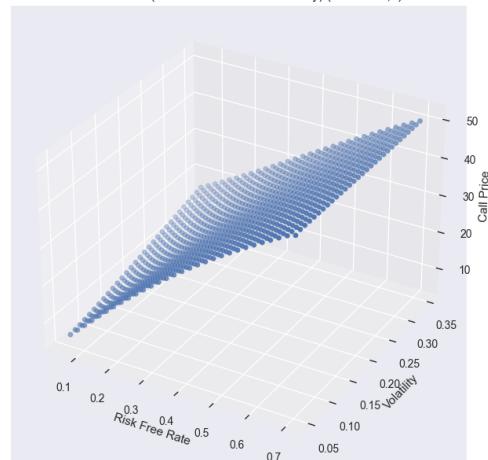
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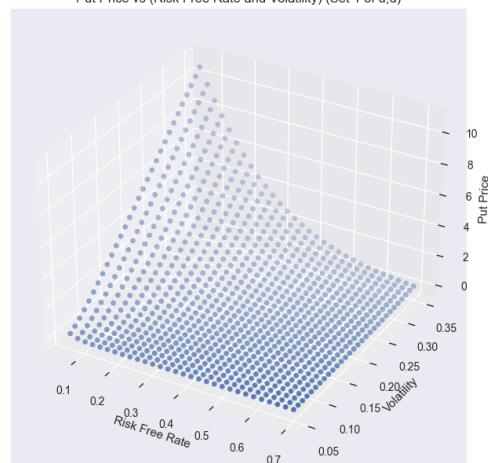
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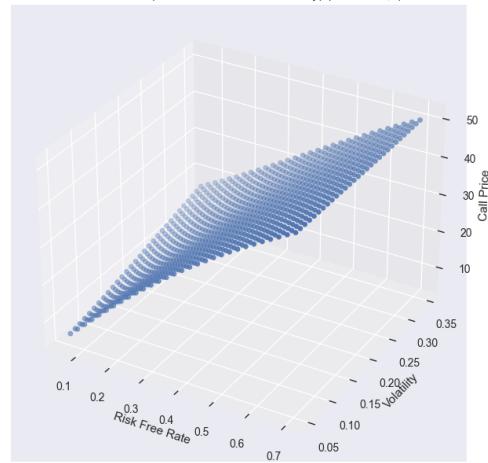
Call Price vs (Risk Free Rate and Volatility) (Set 1 of u,d)



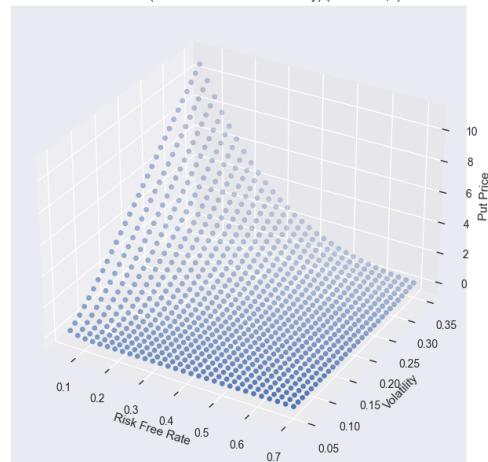
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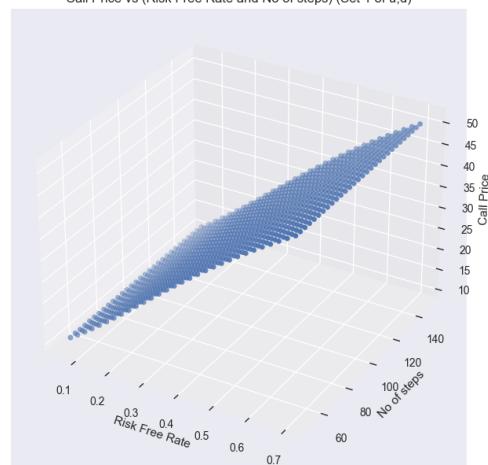
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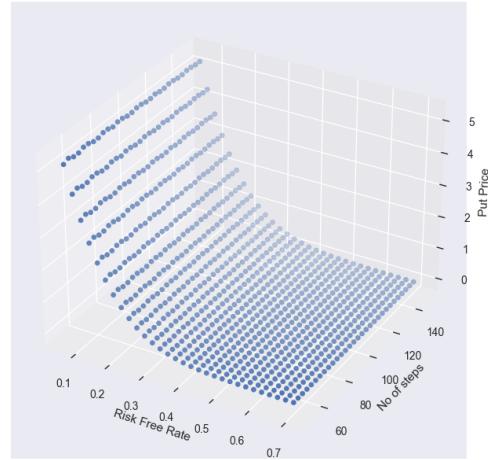
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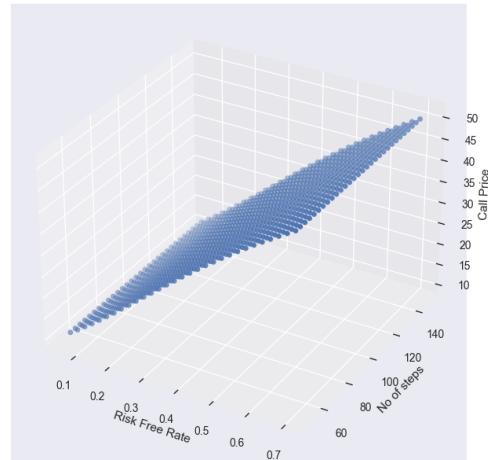
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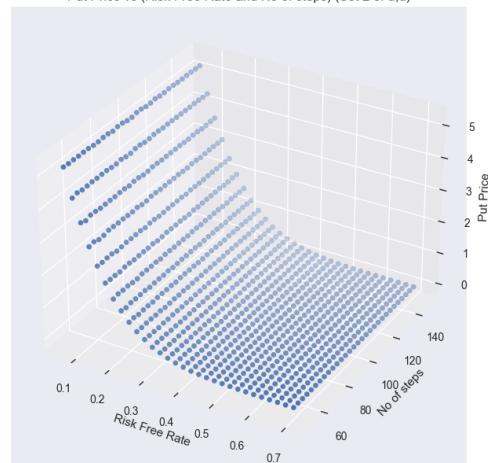
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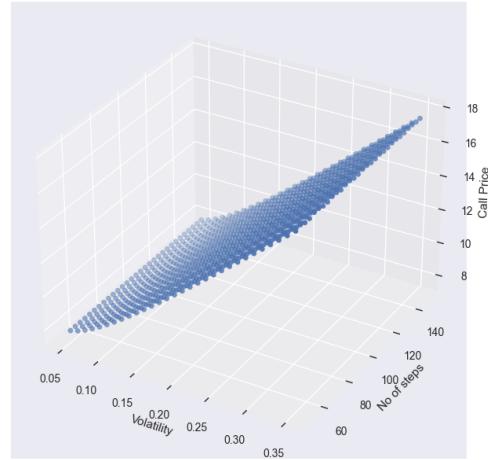
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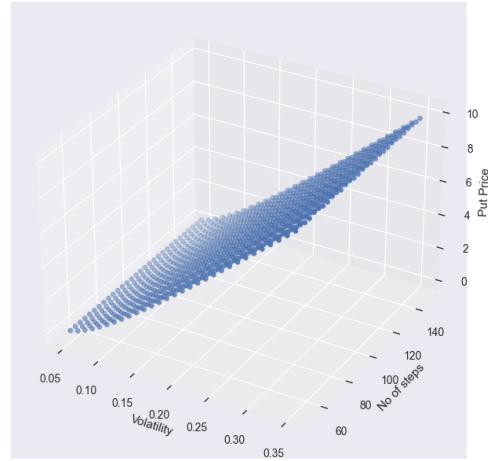
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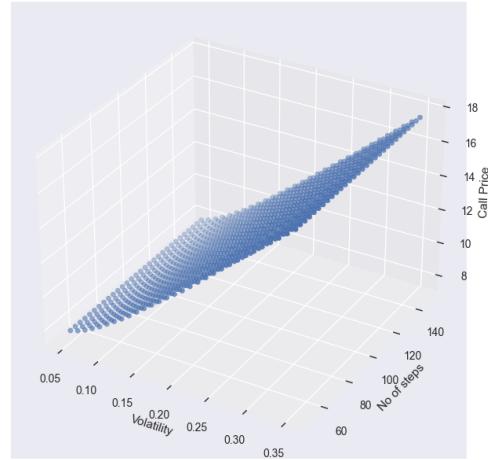
Call Price vs (Volatility and No of steps) (Set 1 of u,d)



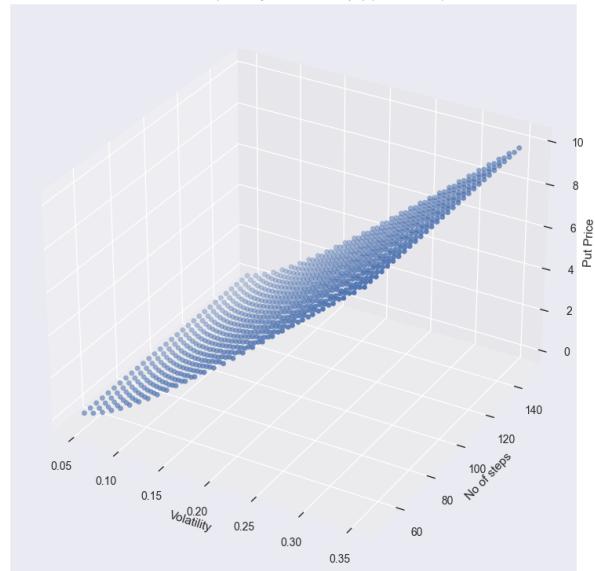
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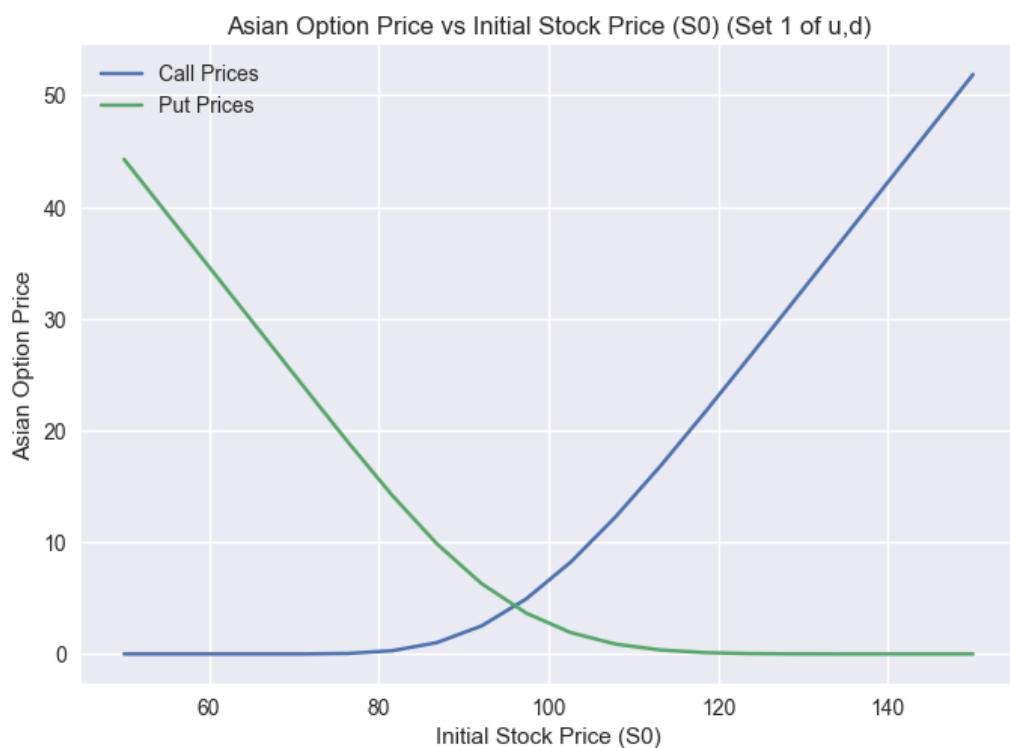
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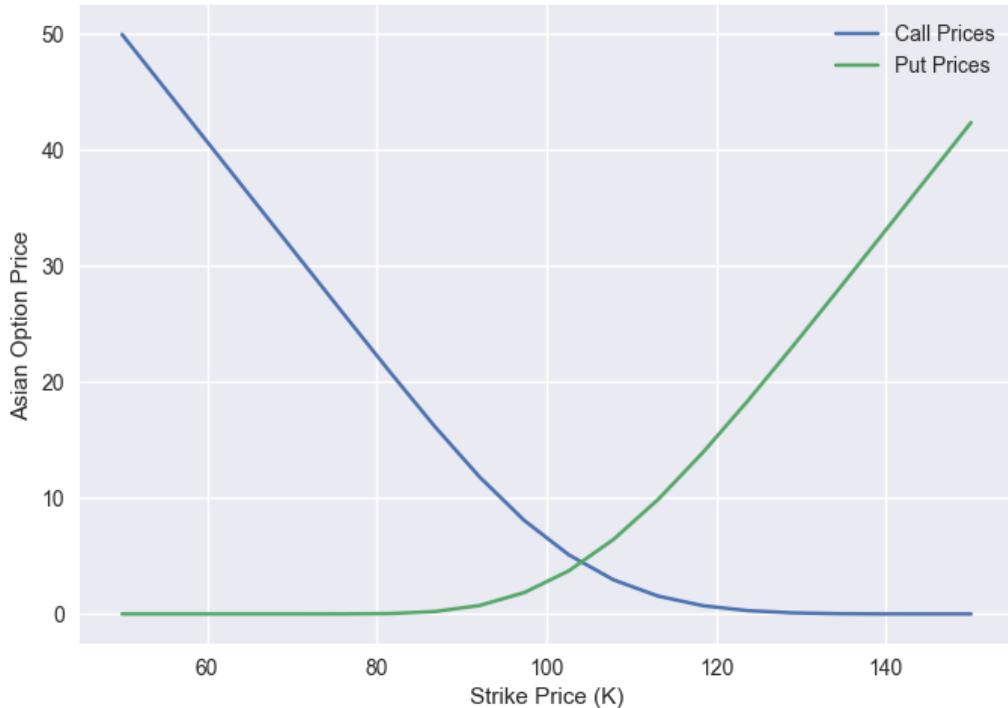
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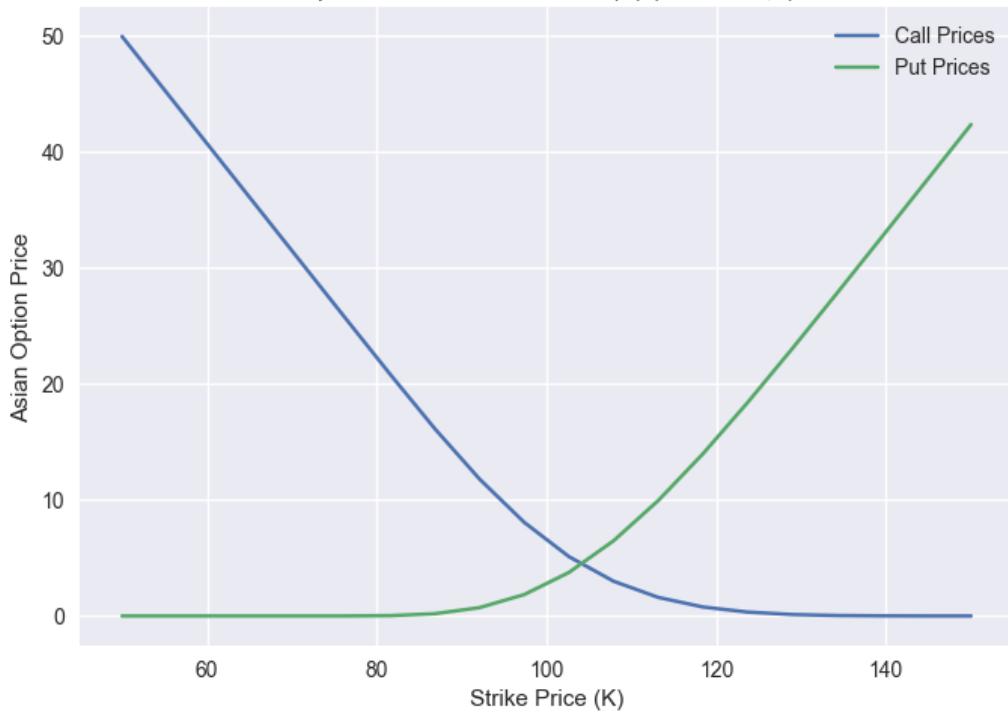
Question 2 2-d plots

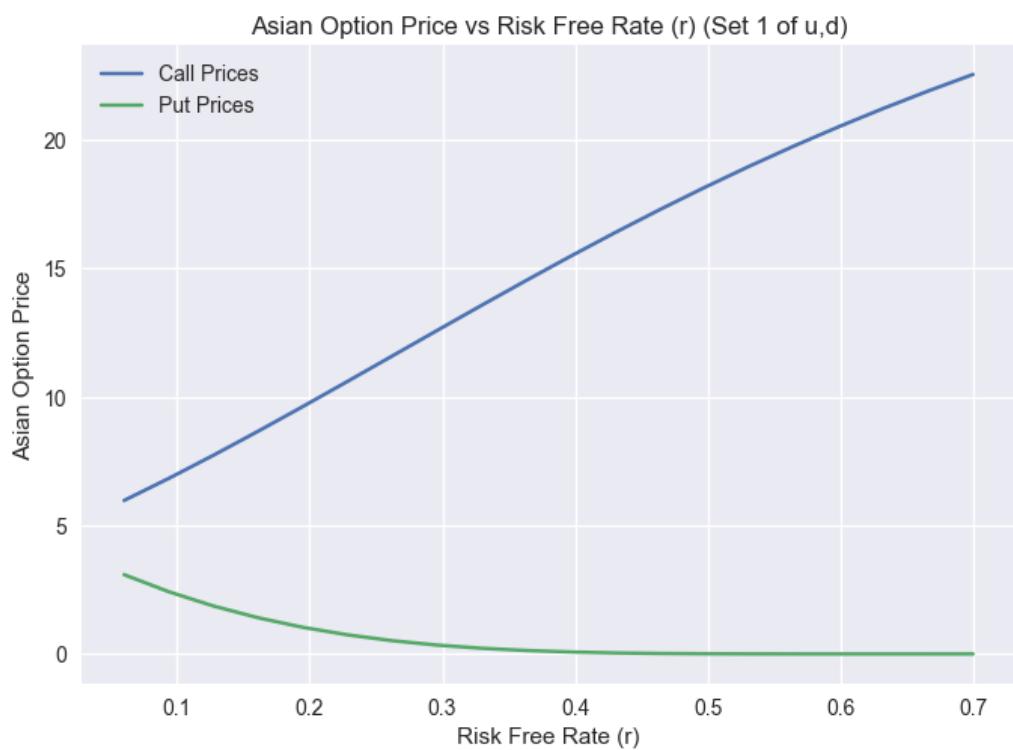


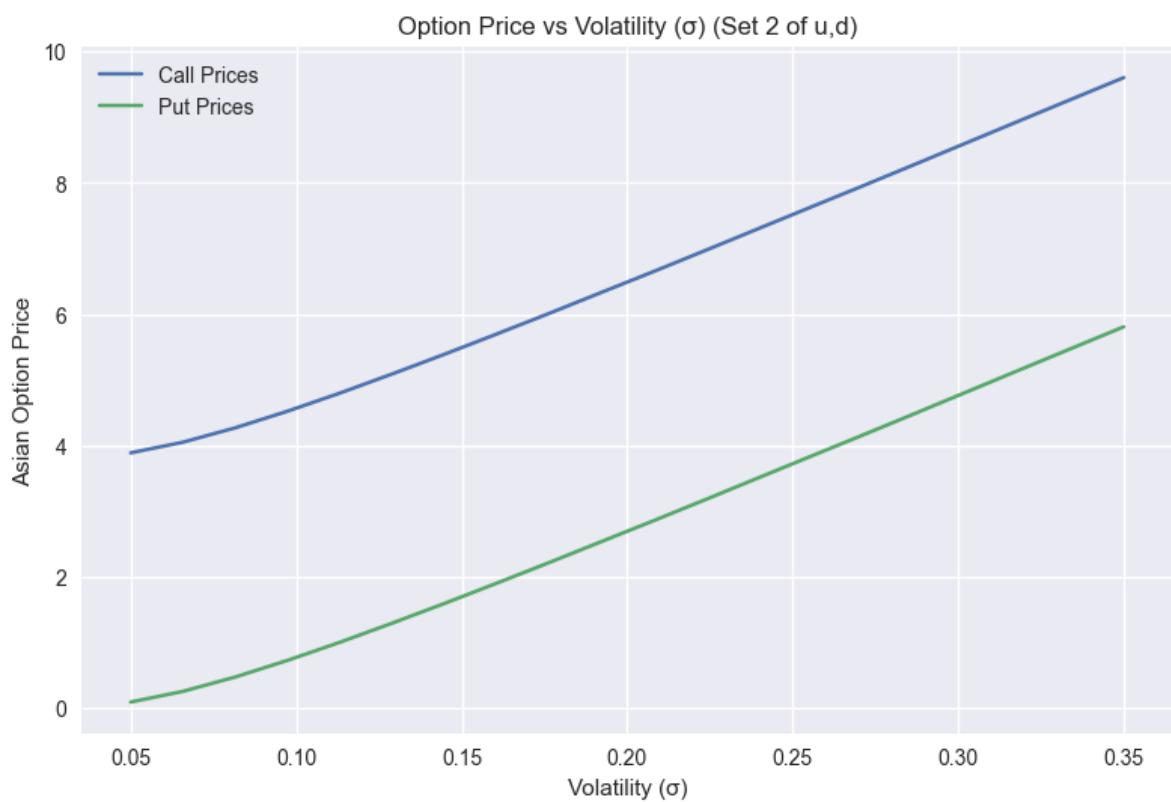
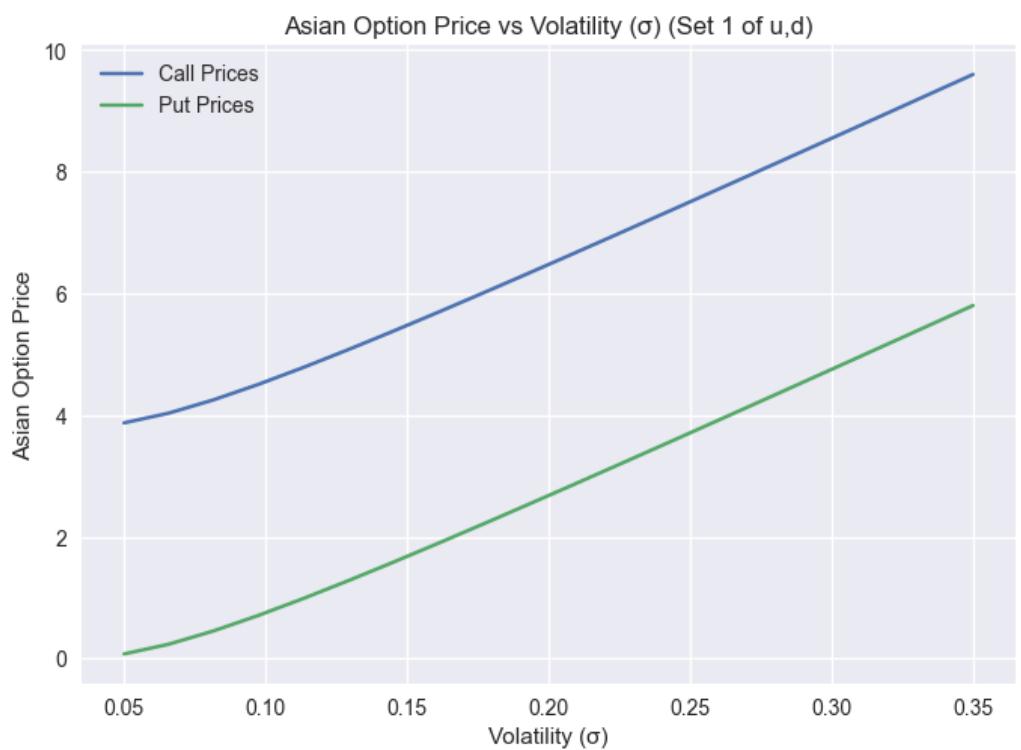
Asian Option Price vs Strike Price (K) (Set 1 of u,d)



Option Price vs Strike Price (K) (Set 2 of u,d)

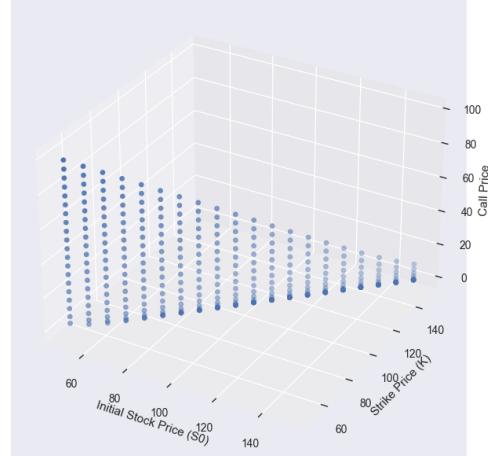




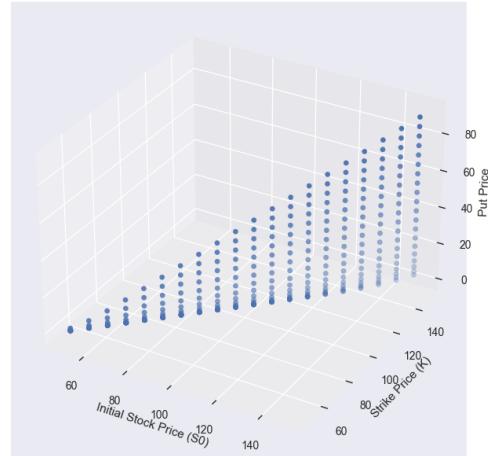


Question 2 3-d plots

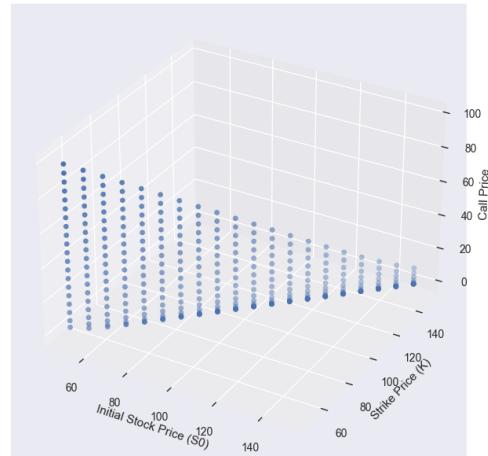
Call Price vs (Initial Stock Price (S_0) and Strike Price (K)) (Set 1 of u,d)



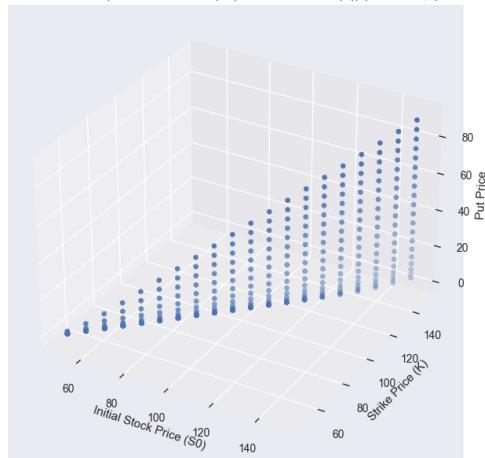
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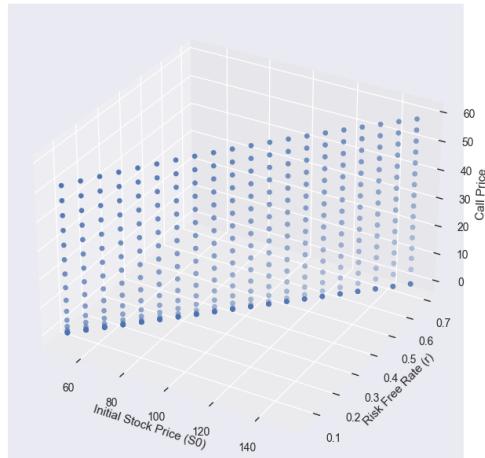
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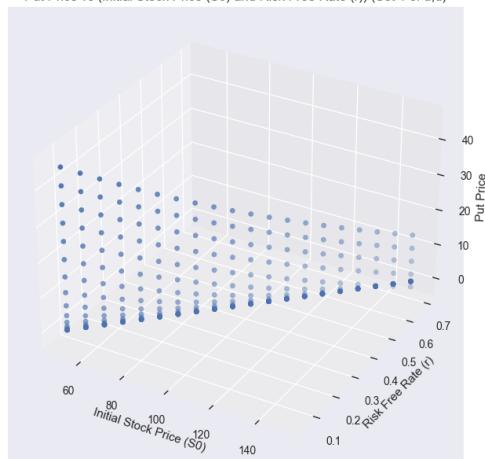
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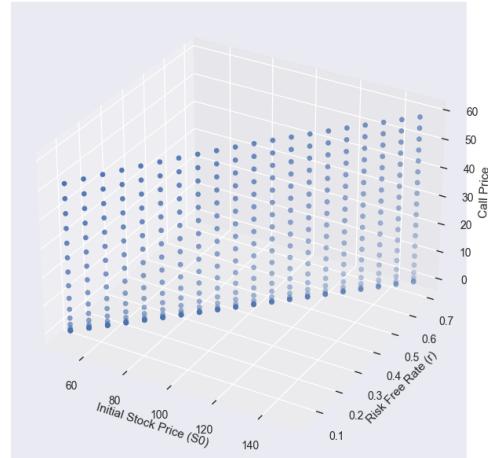
Call Price vs (Initial Stock Price (S_0) and Risk Free Rate (r)) (Set 1 of u,d)



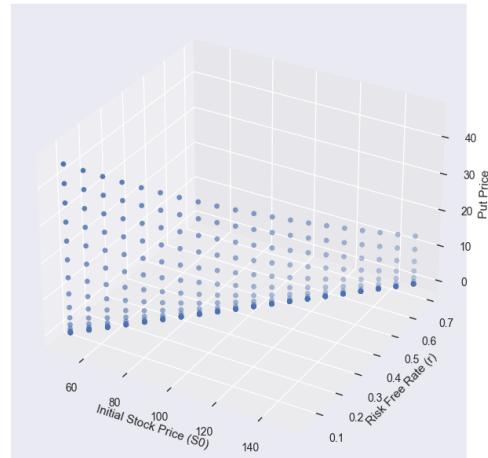
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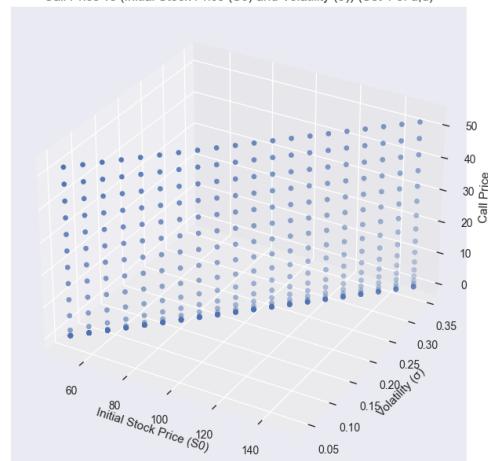
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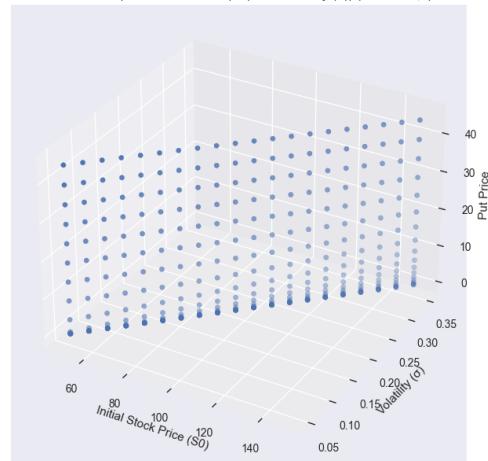
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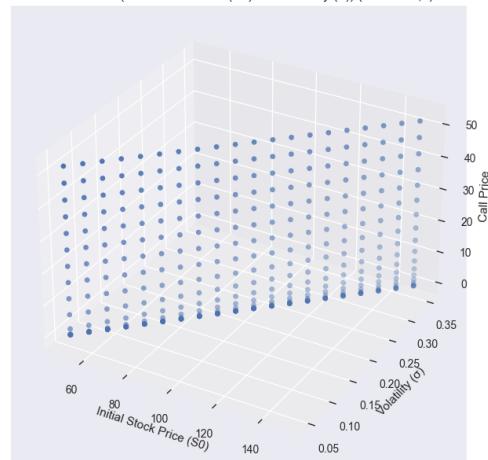
Call Price vs (Initial Stock Price (S_0) and Volatility (σ)) (Set 1 of u,d)



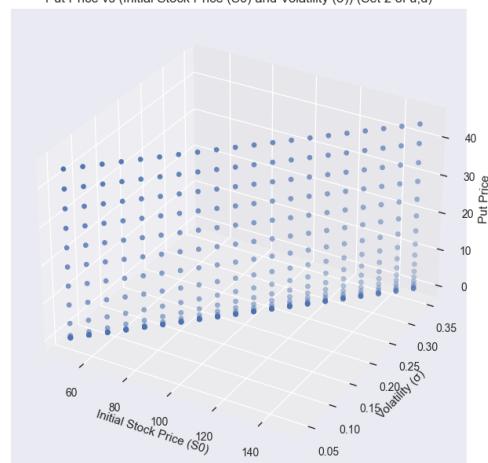
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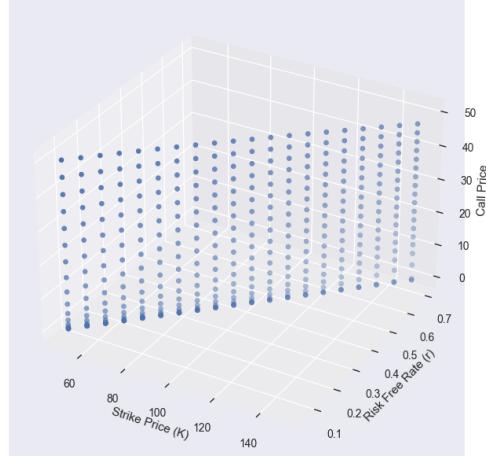
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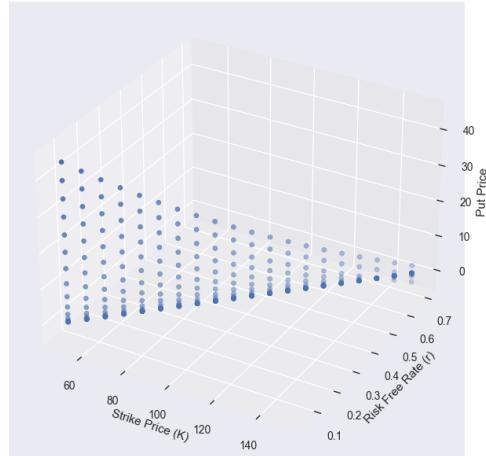
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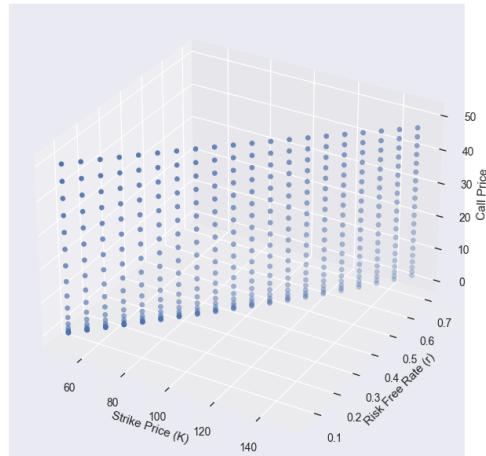
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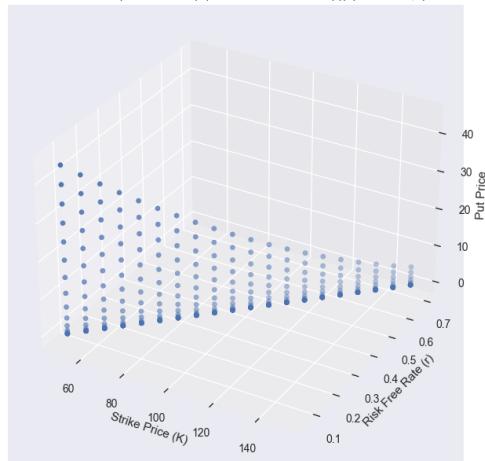
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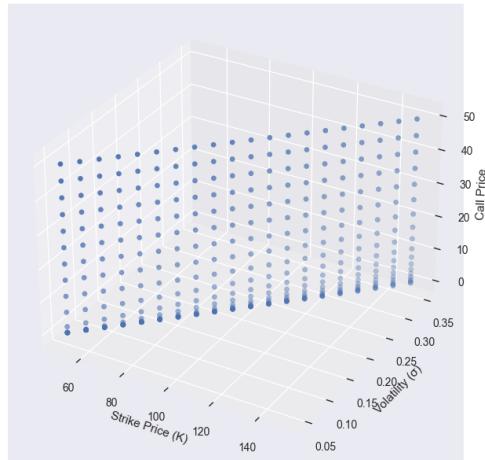
Call Price vs (Strike Price (K) and Risk Free Rate (r)) (Set 2 of u,d)



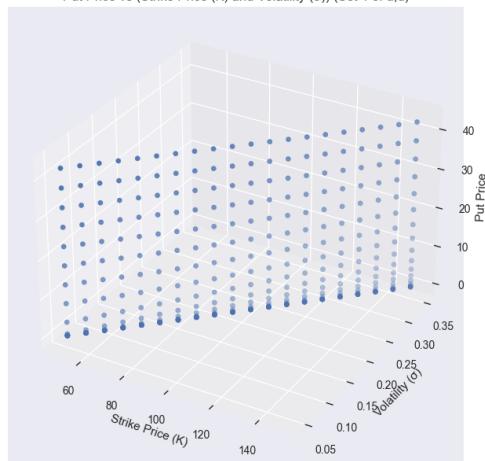
Put Price vs (Strike Price (K) and Risk Free Rate (r)) (Set 2 of u,d)



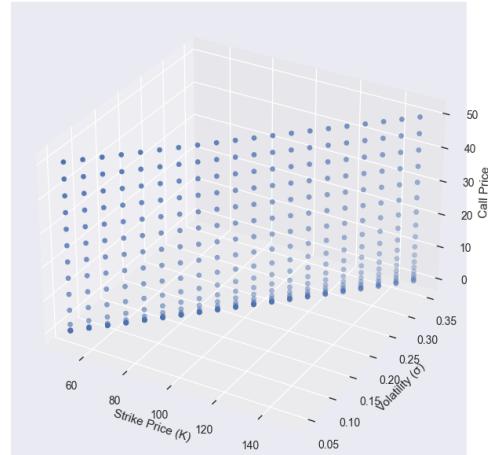
Call Price vs (Strike Price (K) and Volatility (σ)) (Set 1 of u,d)



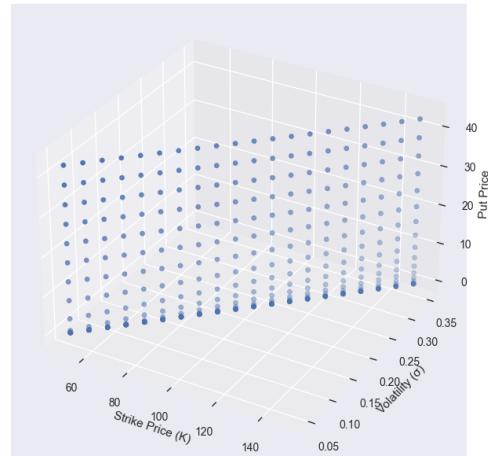
Put Price vs (Strike Price (K) and Volatility (σ)) (Set 1 of u,d)



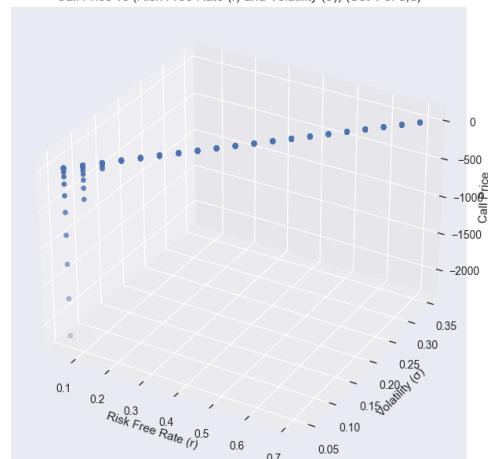
Call Price vs (Strike Price (K) and Volatility (σ)) (Set 2 of u,d)



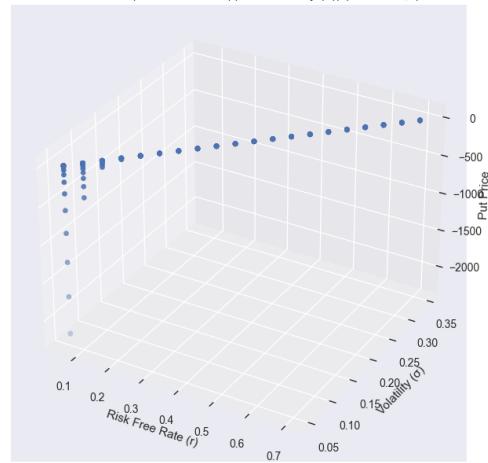
Put Price vs (Strike Price (K) and Volatility (σ)) (Set 2 of u,d)



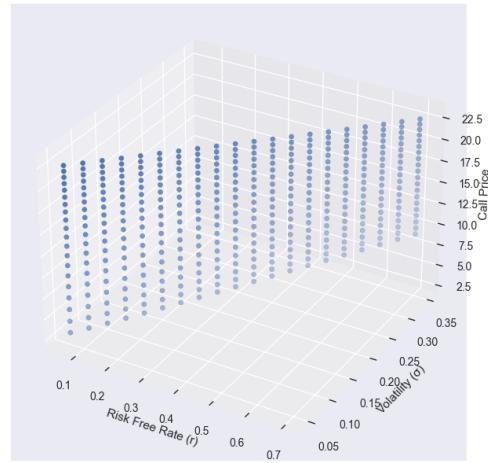
Call Price vs (Risk Free Rate (r) and Volatility (σ)) (Set 1 of u,d)



Put Price vs (Risk Free Rate (r) and Volatility (σ)) (Set 1 of u,d)



Call Price vs (Risk Free Rate (r) and Volatility (σ)) (Set 2 of u,d)



Put Price vs (Risk Free Rate (r) and Volatility (σ)) (Set 2 of u,d)

