

## LAB-2

Name: Harsh

Roll Number: 200123022

### Question 1

Given Data -

$S(0)$  = Initial stock price = 100

$K$  = Strike price = 100

$T$  = Time to maturity = 1 year

$r$  = Risk free rate = 8%

$\sigma$  = Volatility of the stock = 20%

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

Formula used for  $u$  and  $d$  -

Set 1-

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

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

Set 2 -

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

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

where with  $M$  being the number of subintervals in the time interval  $[0, T]$ .

For sensitivity analysis of option price with  $S(0), K, M, r, \sigma$  various plots by varying one and two parameters are made.

## Question 2

The path dependent derivative I chose is Asian Options.

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

Price of the option can be calculated as -

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

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

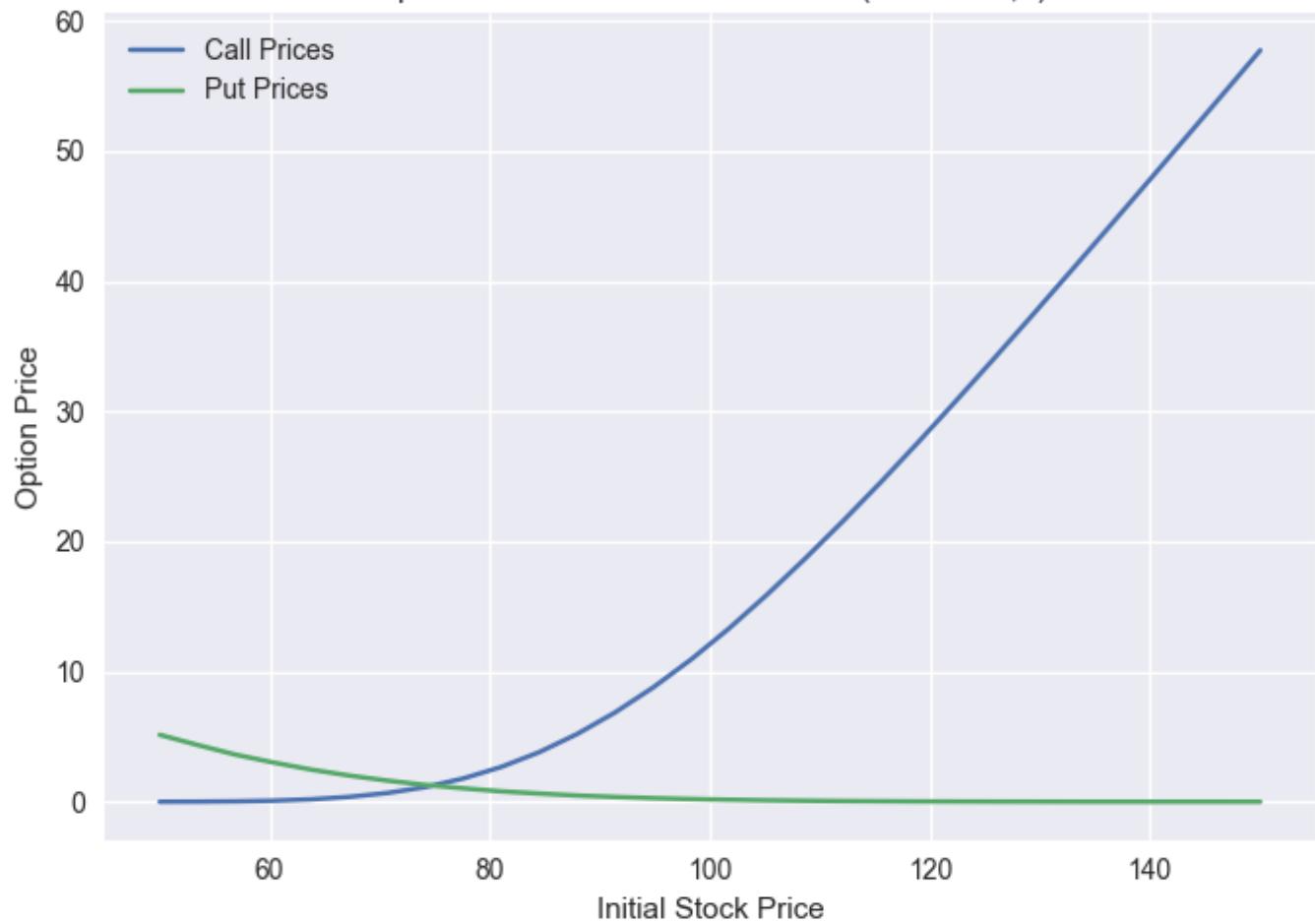
for put option -  $\max(K - S_{avg}(T), 0)$

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

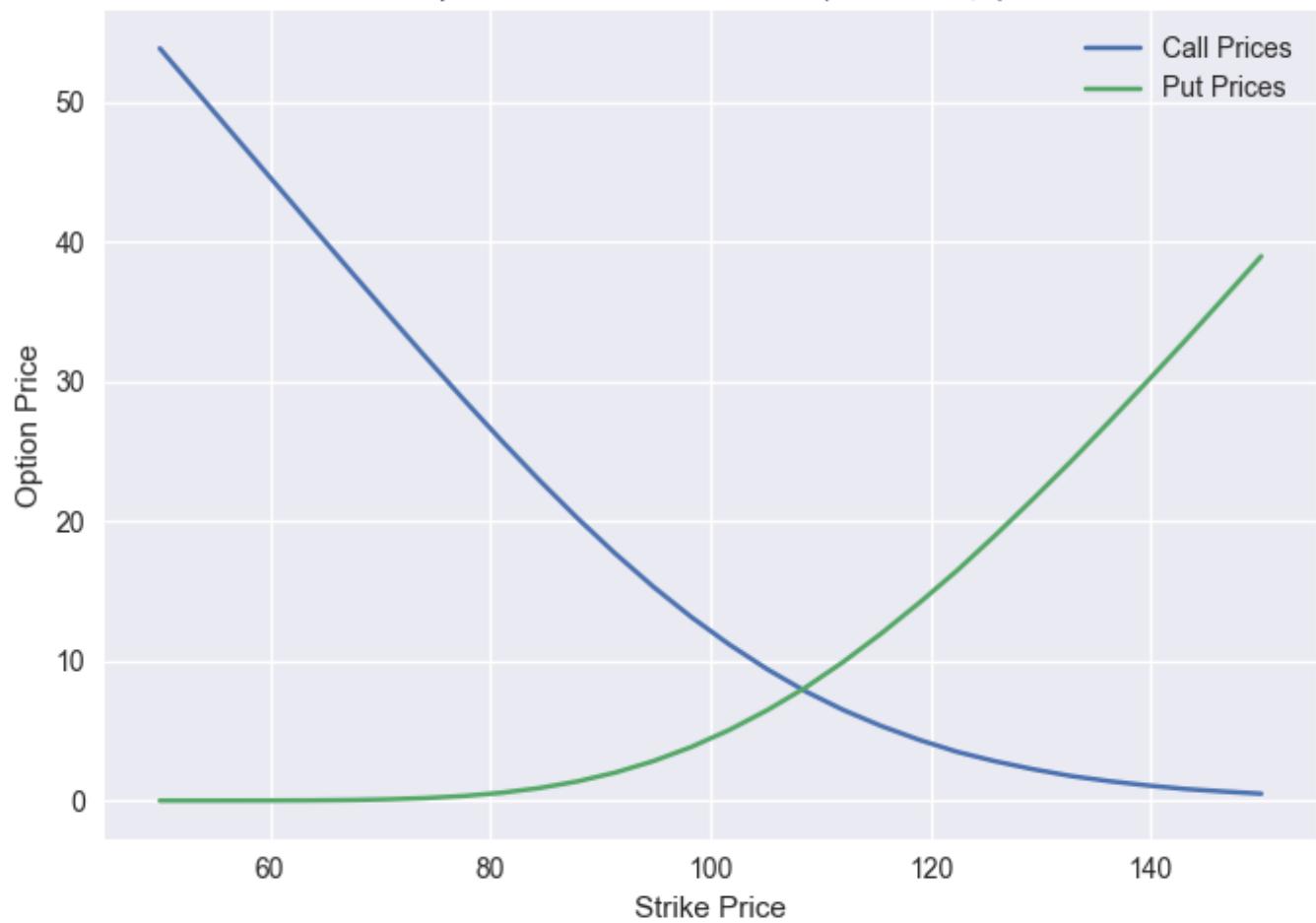
## Question 1 Plots



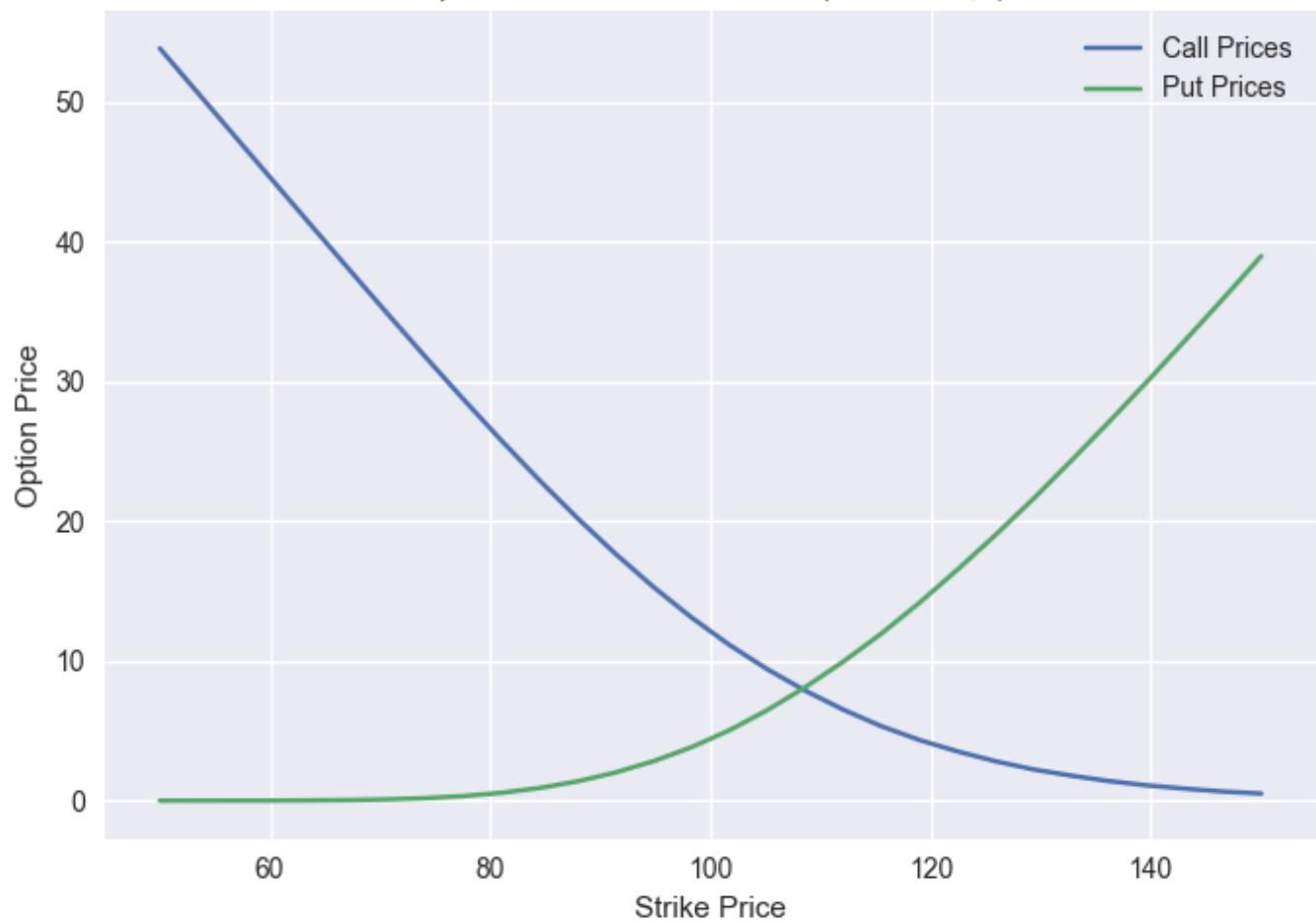
Option Price vs Initial Stock Price (Set 2 of u,d)



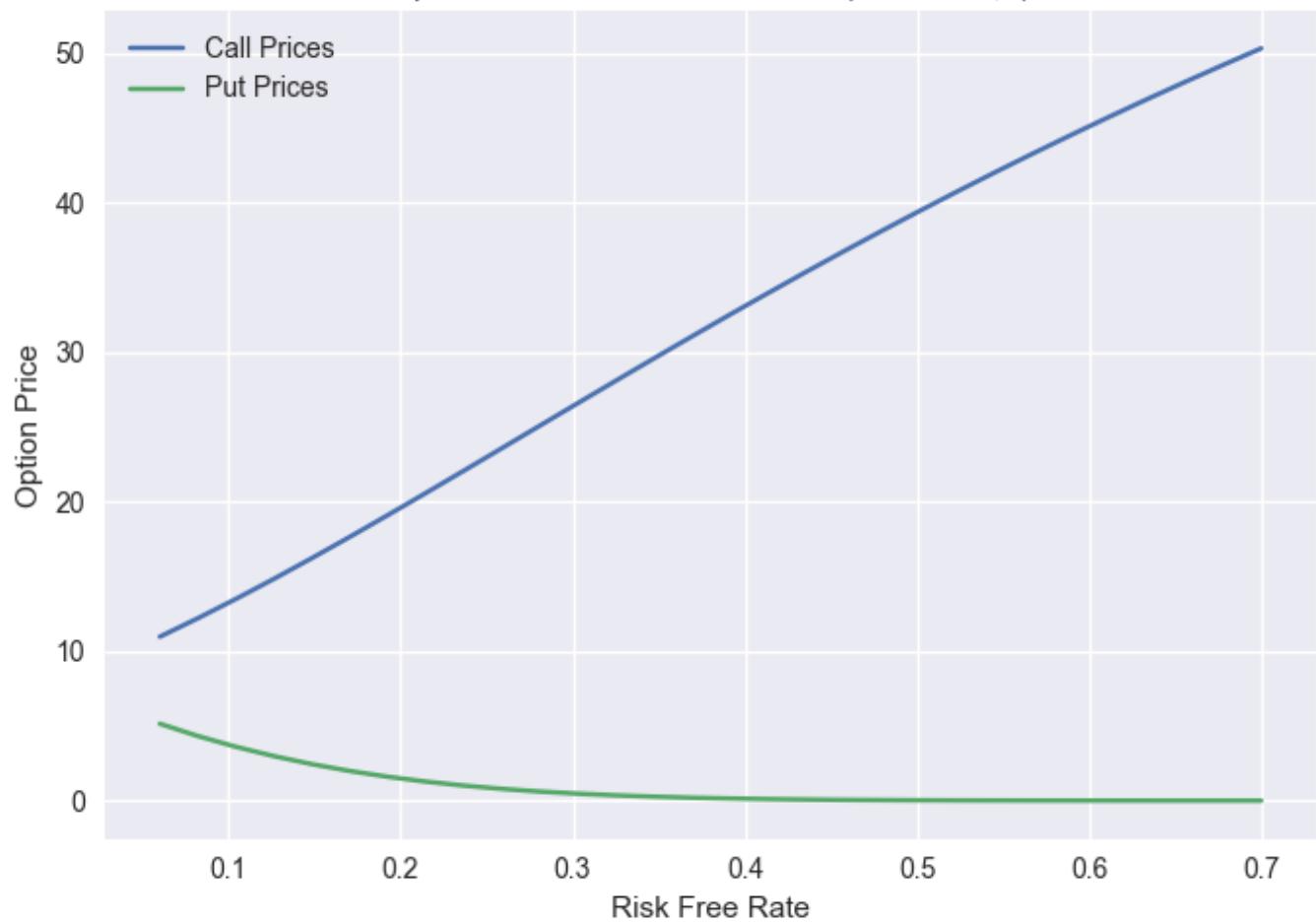
Option Price vs Strike Price (Set 1 of u,d)



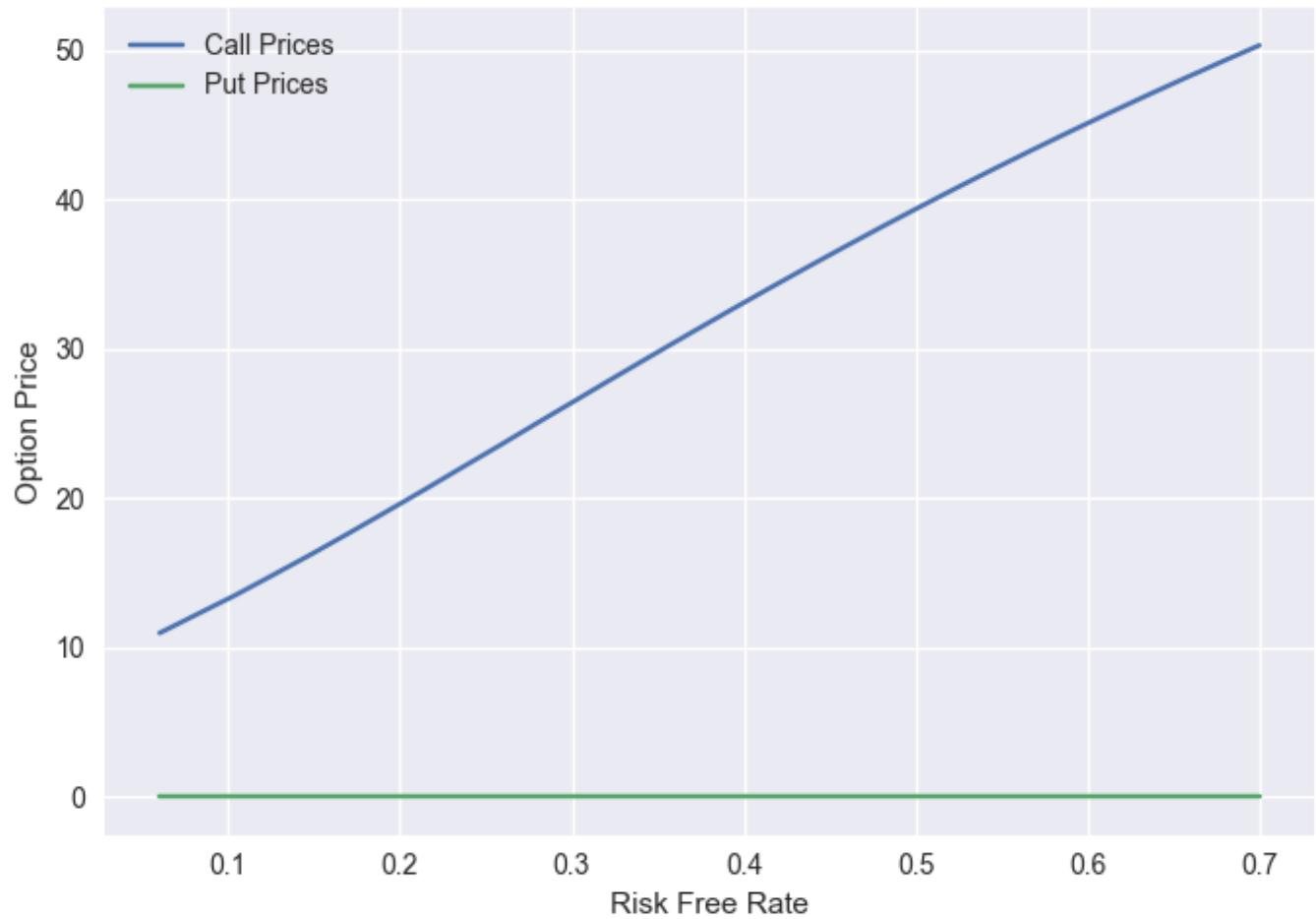
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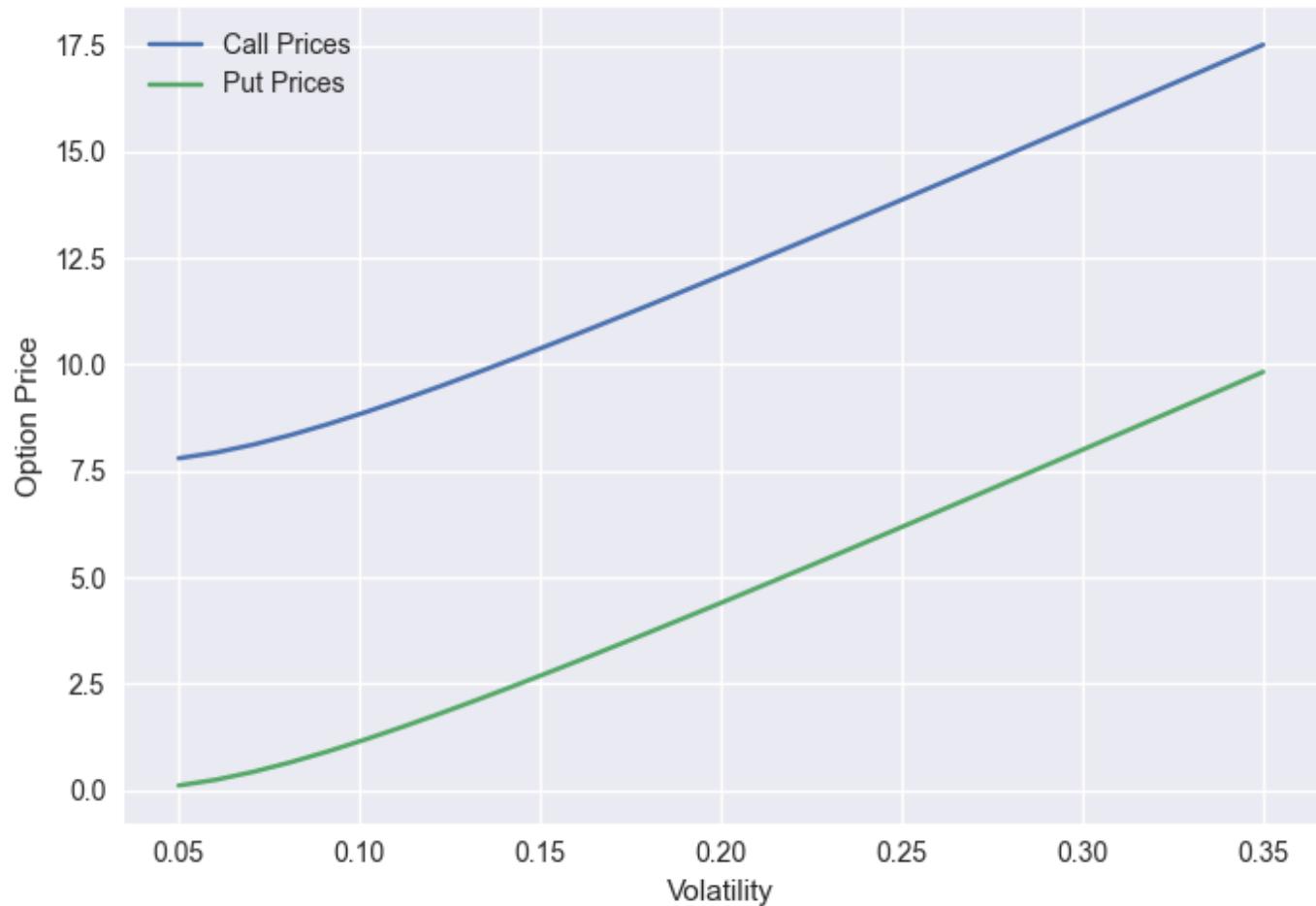
Option Price vs Risk Free Rate (Set 1 of u,d)



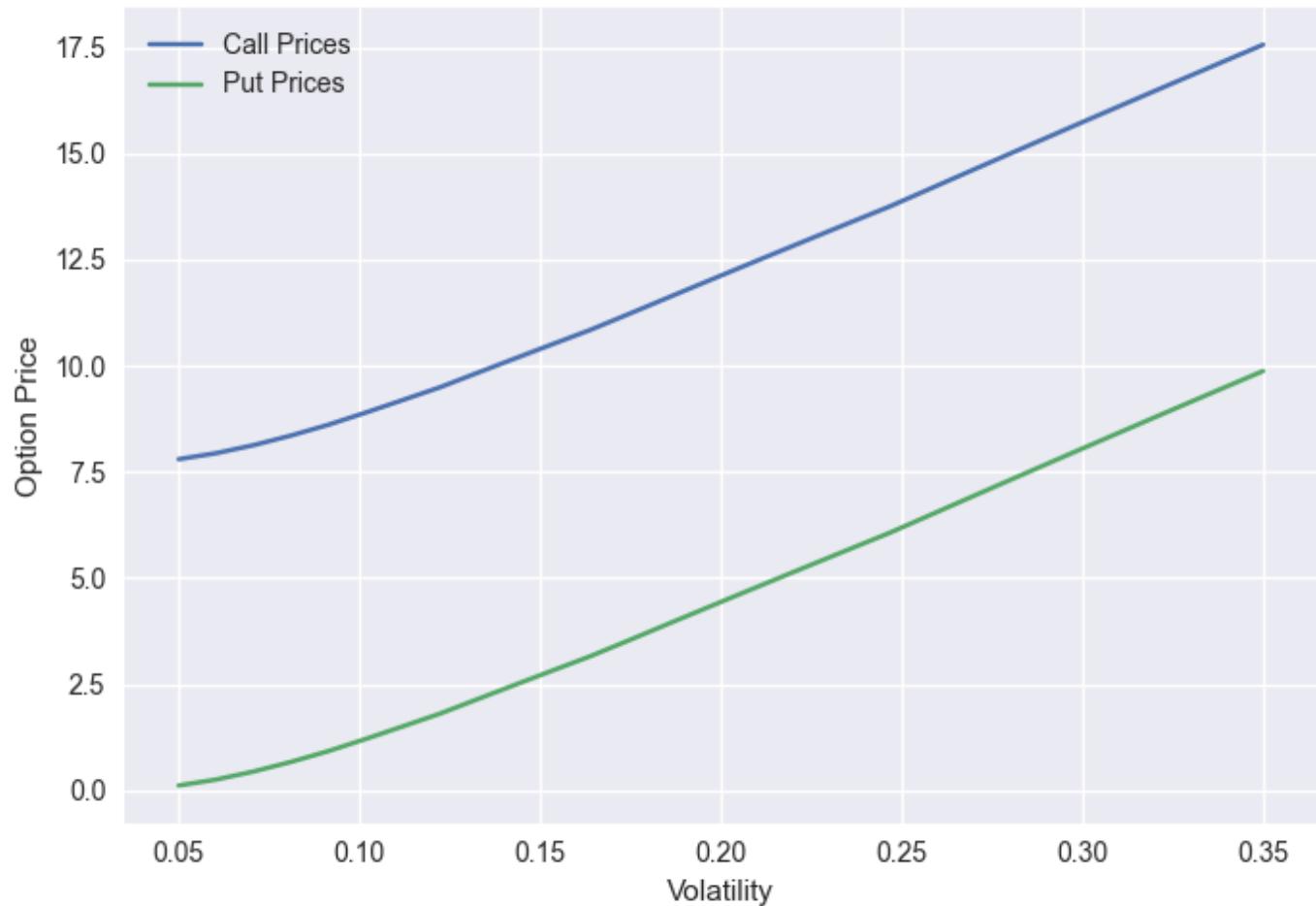
Option Price vs Risk Free Rate (Set 2 of u,d)



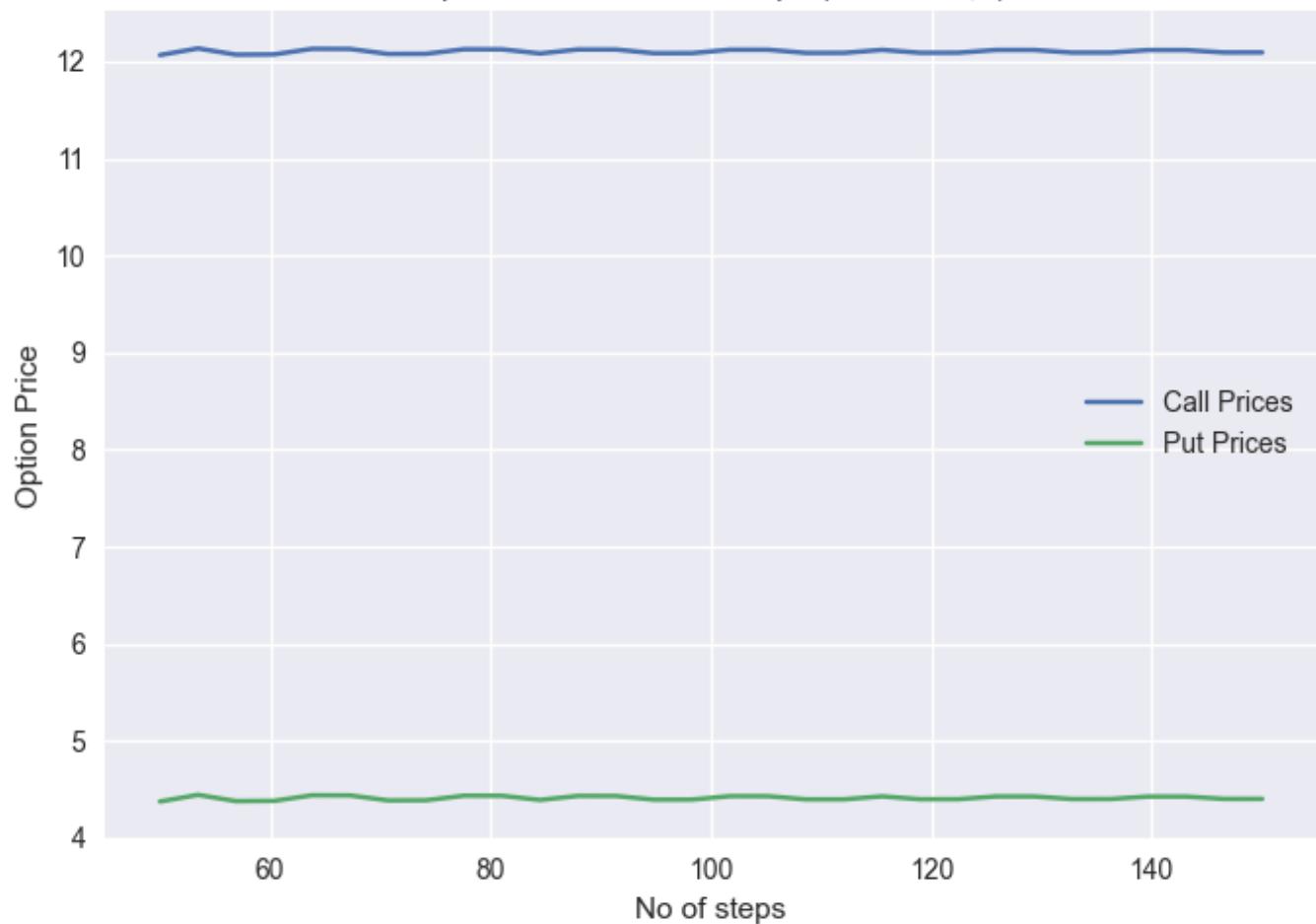
Option Price vs Volatility (Set 1 of u,d)



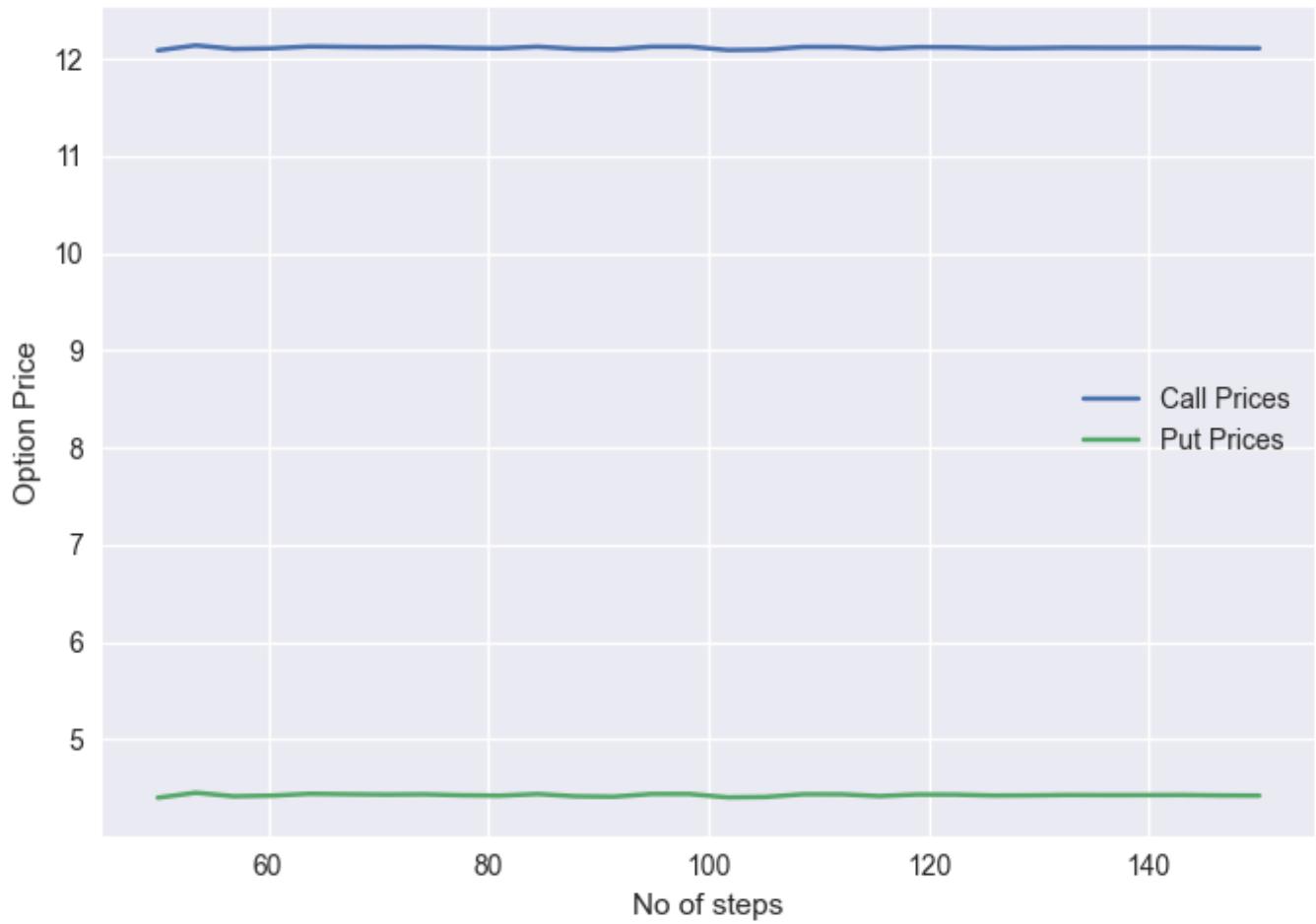
Option Price vs Volatility (Set 2 of u,d)



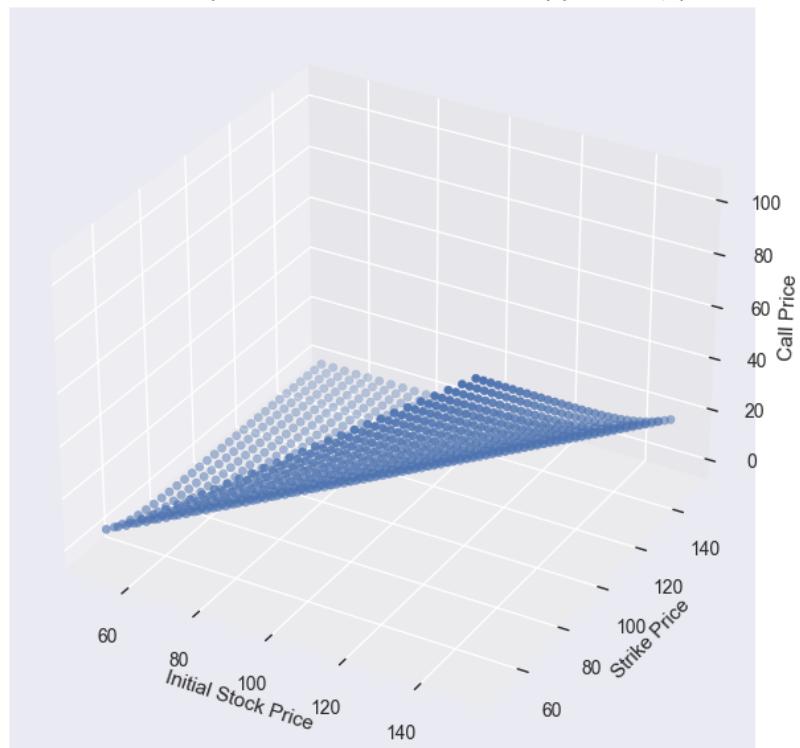
Option Price vs No of steps (Set 1 of u,d)



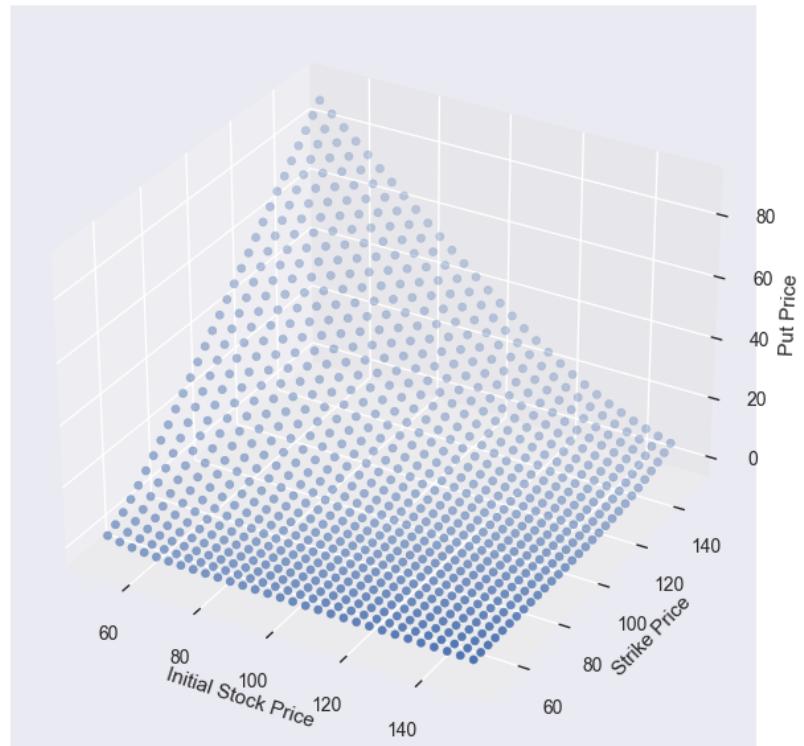
Option Price vs No of steps (Set 2 of u,d)



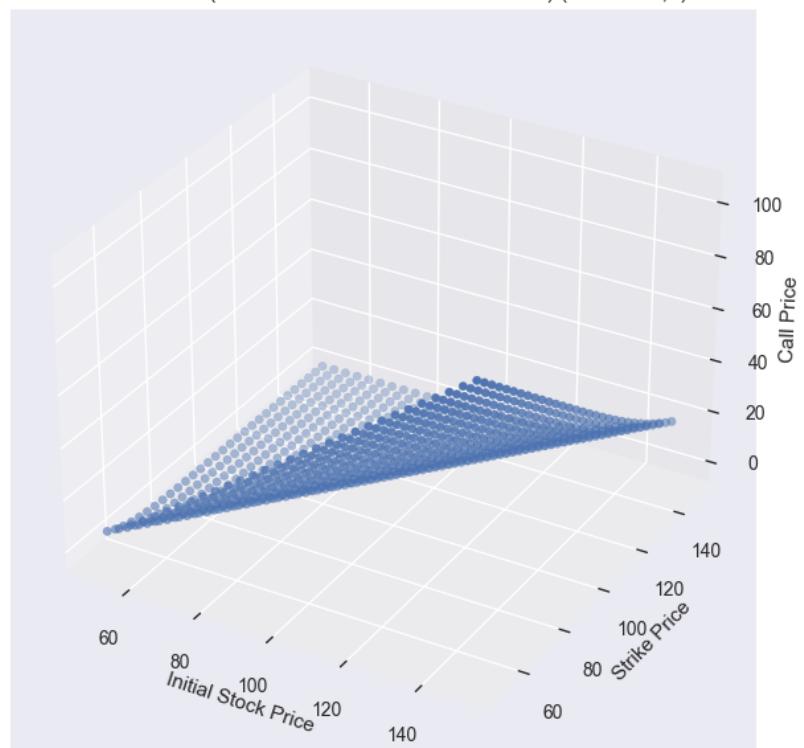
Call Price vs (Initial Stock Price and Strike Price) (Set 1 of u,d)



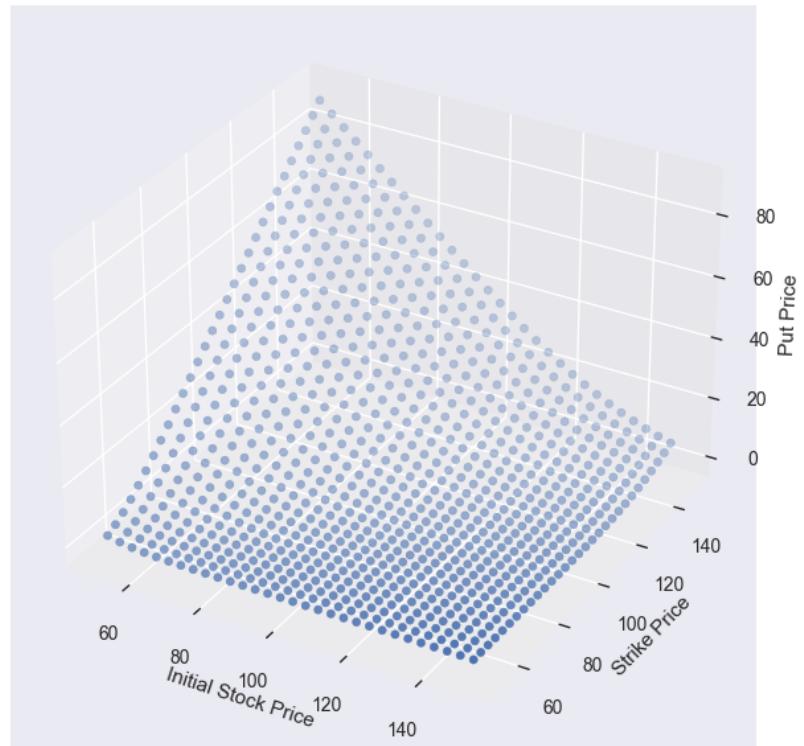
Put Price vs (Initial Stock Price and Strike Price) (Set 1 of u,d)



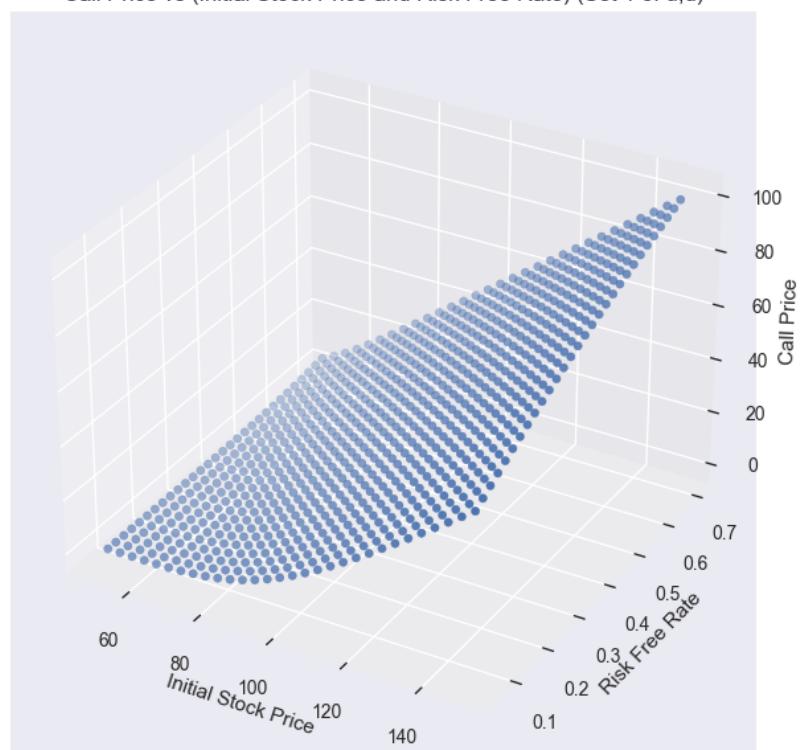
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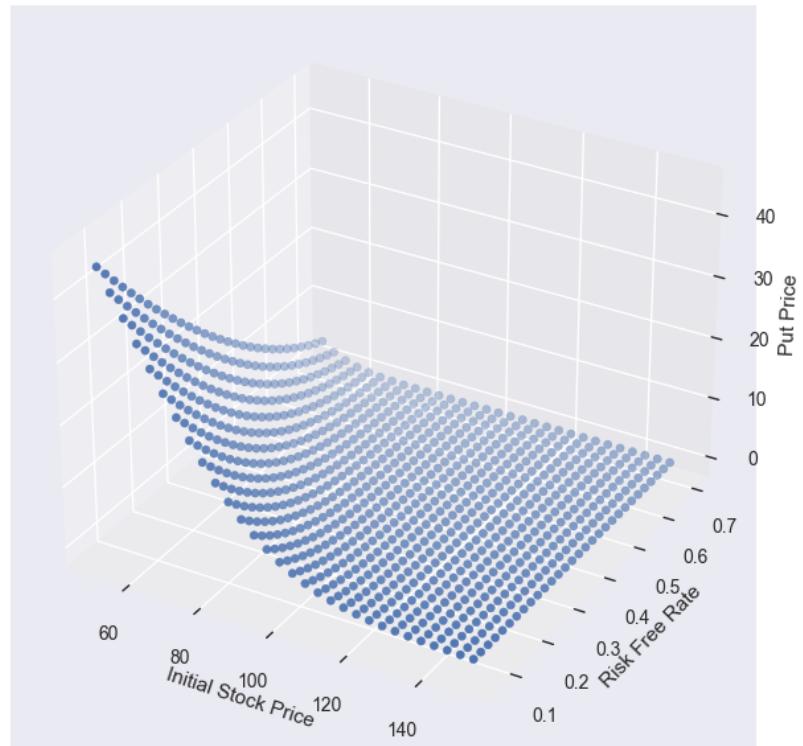
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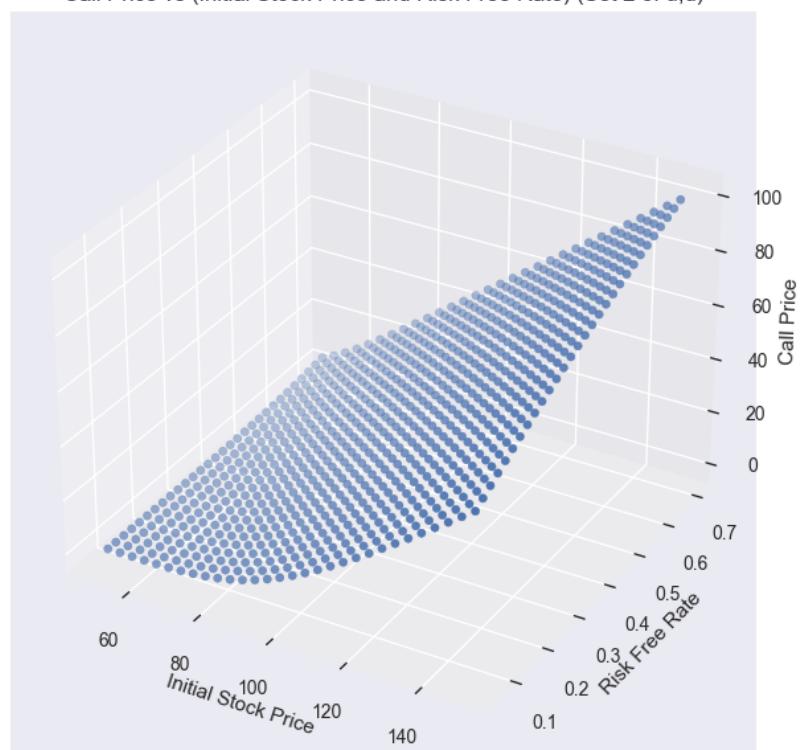
Call Price vs (Initial Stock Price and Risk Free Rate) (Set 1 of u,d)



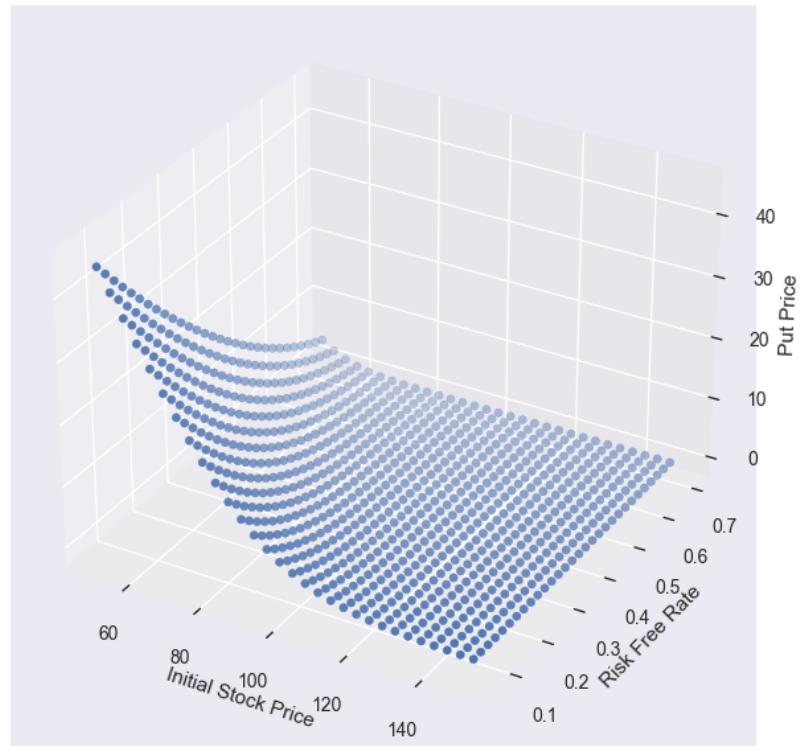
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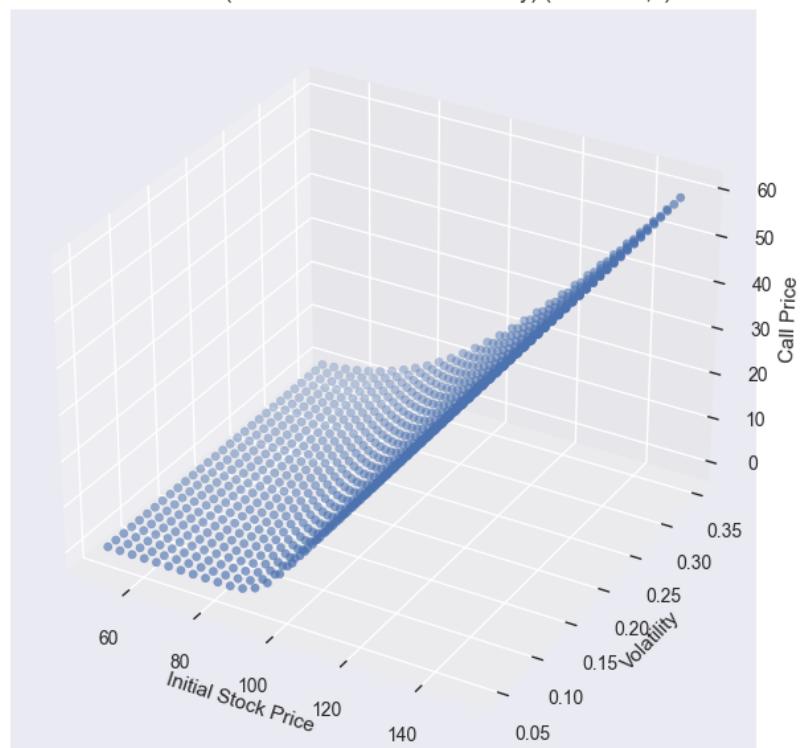
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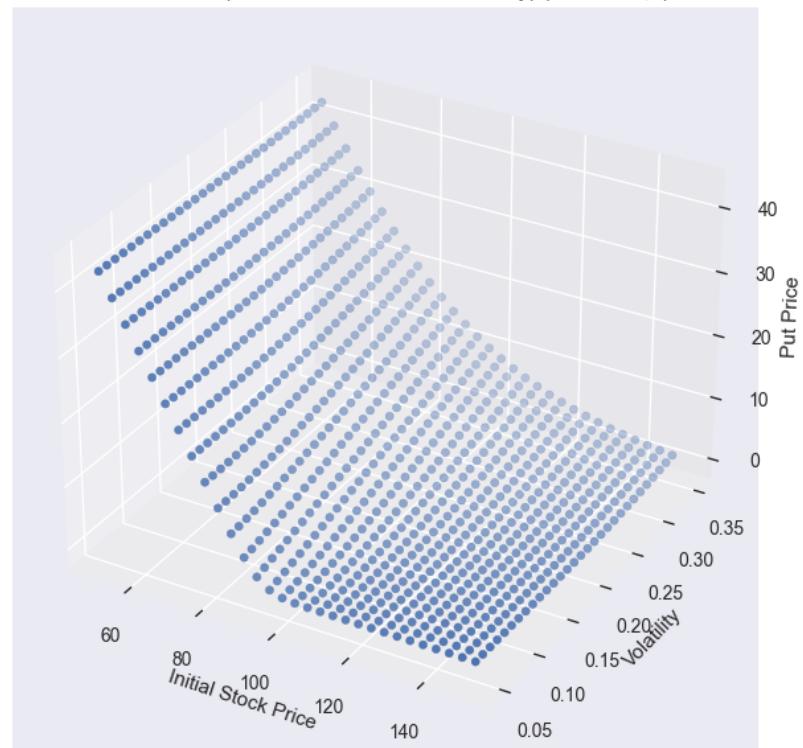
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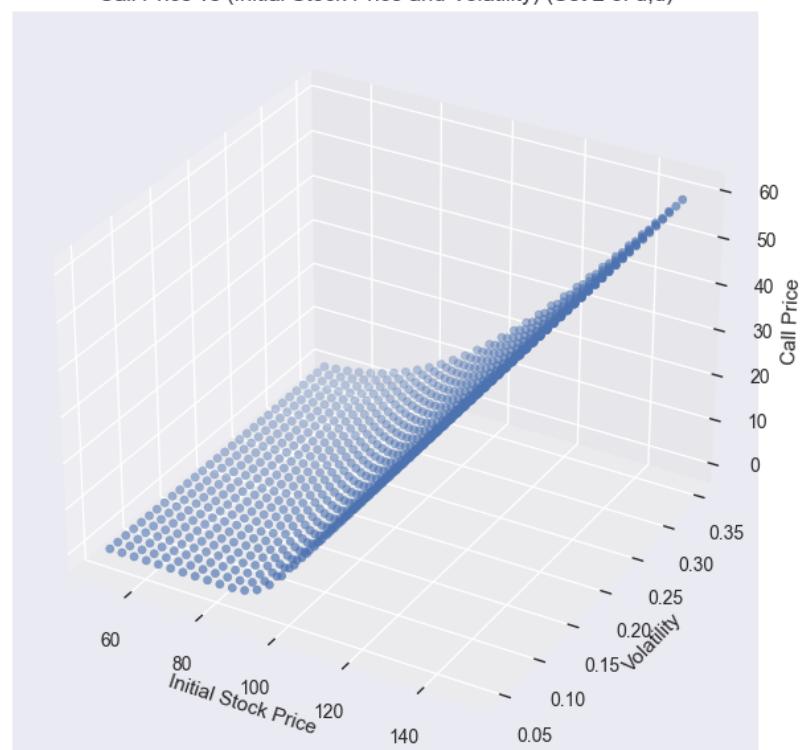
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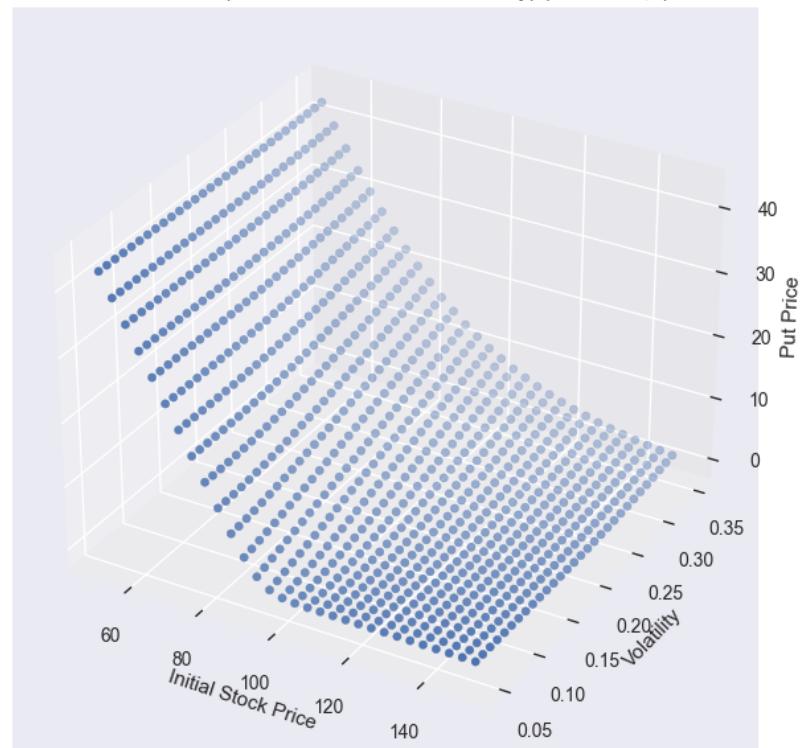
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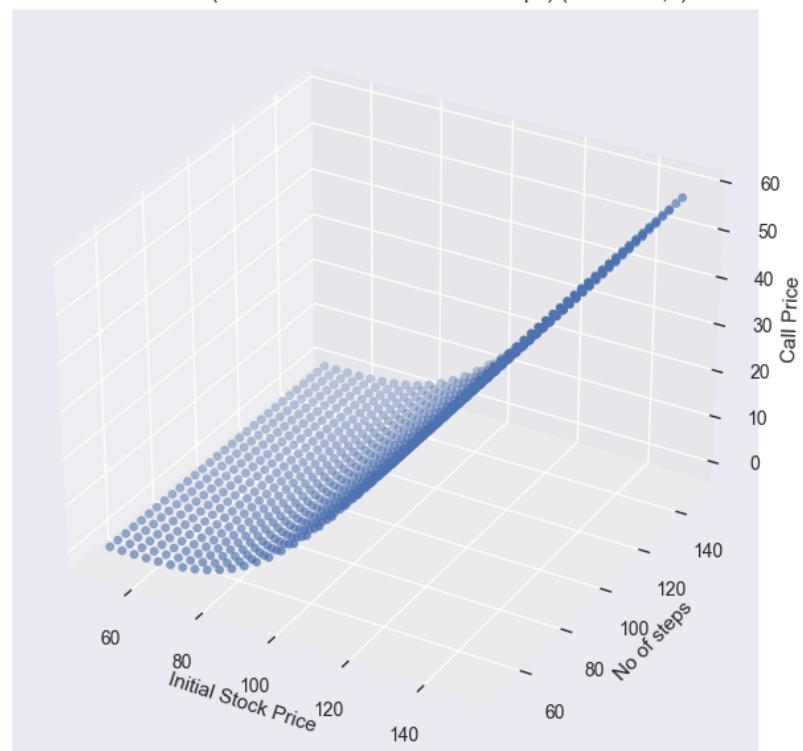
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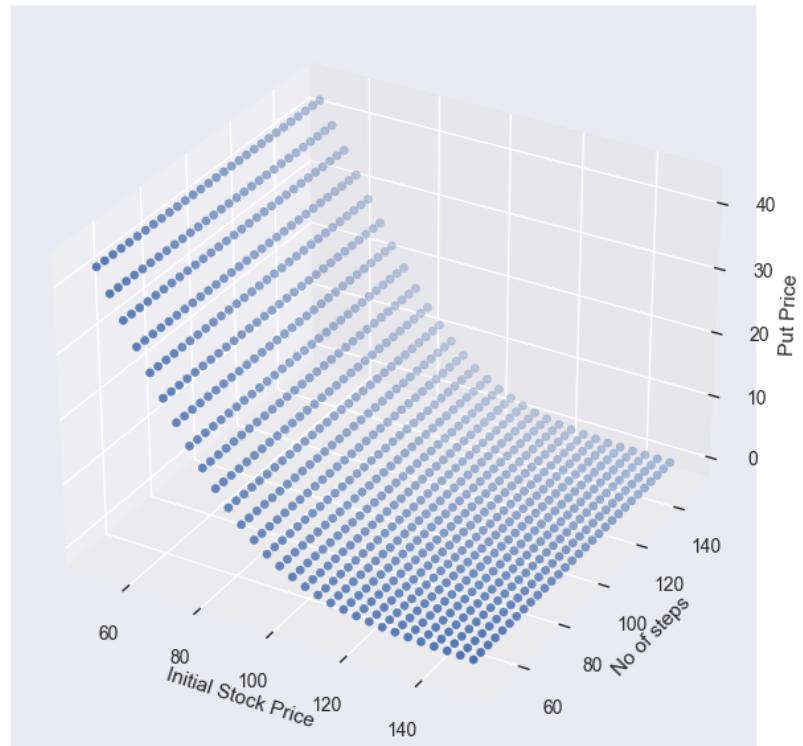
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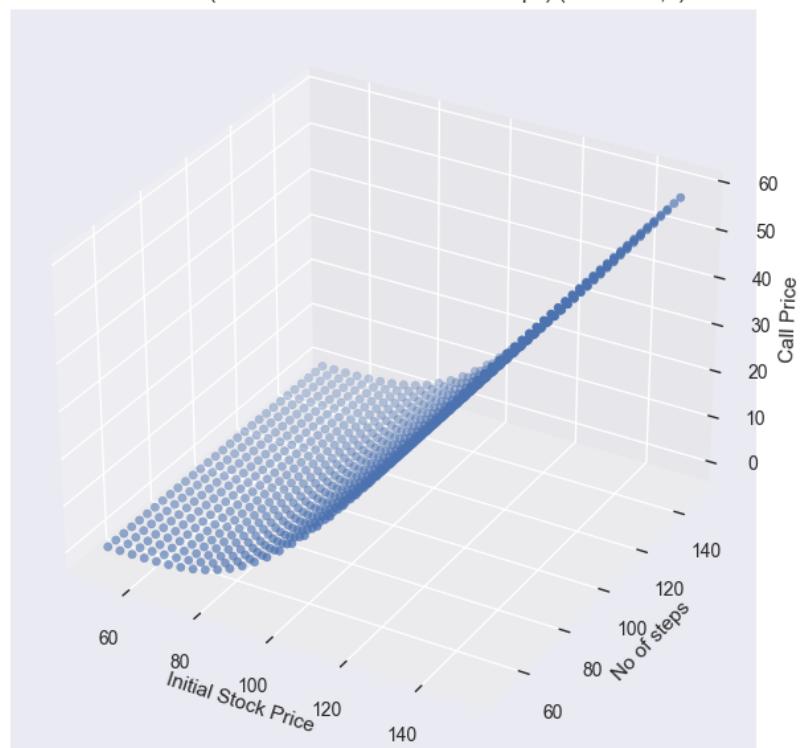
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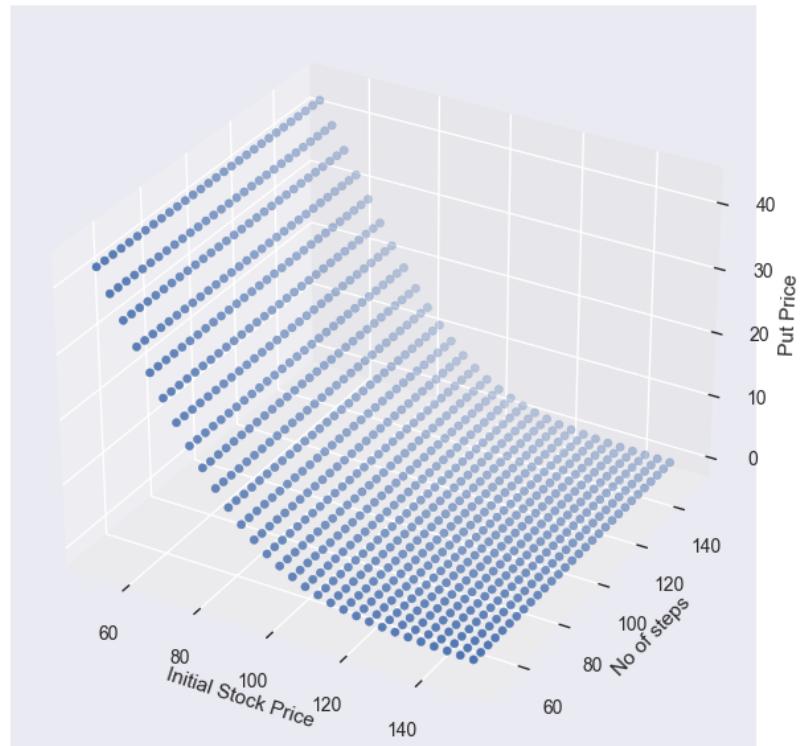
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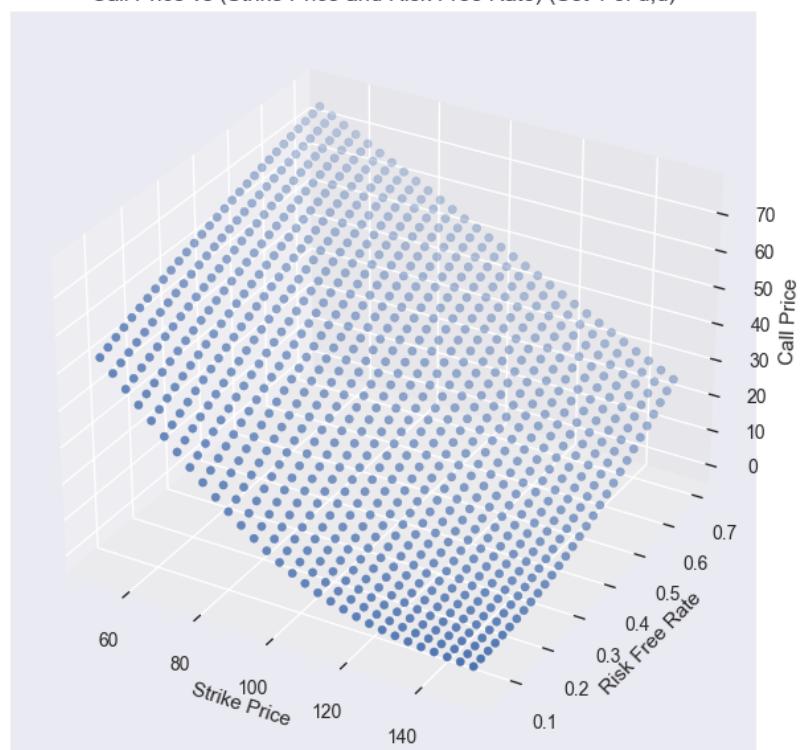
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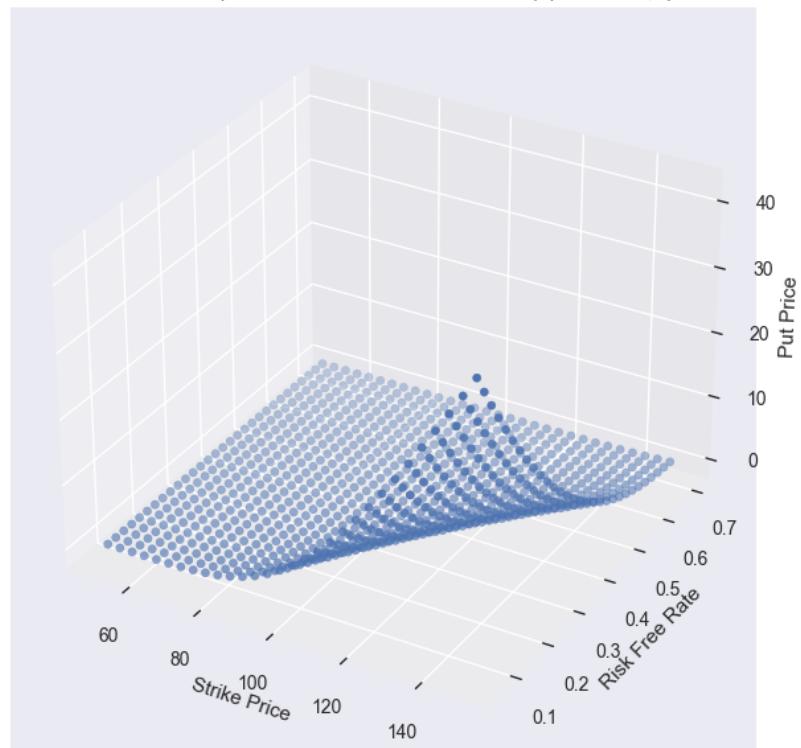
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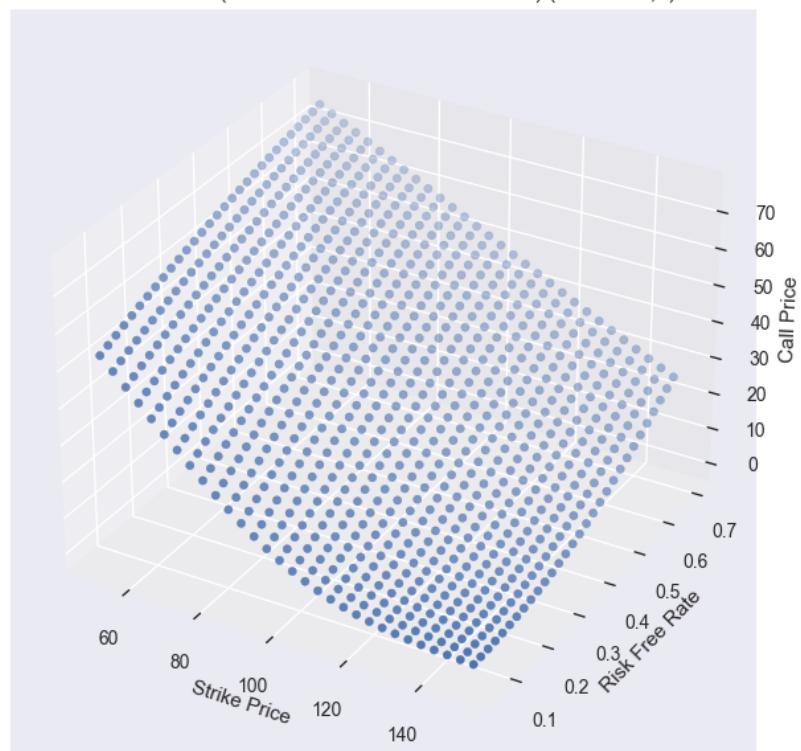
Call Price vs (Strike Price and Risk Free Rate) (Set 1 of u,d)



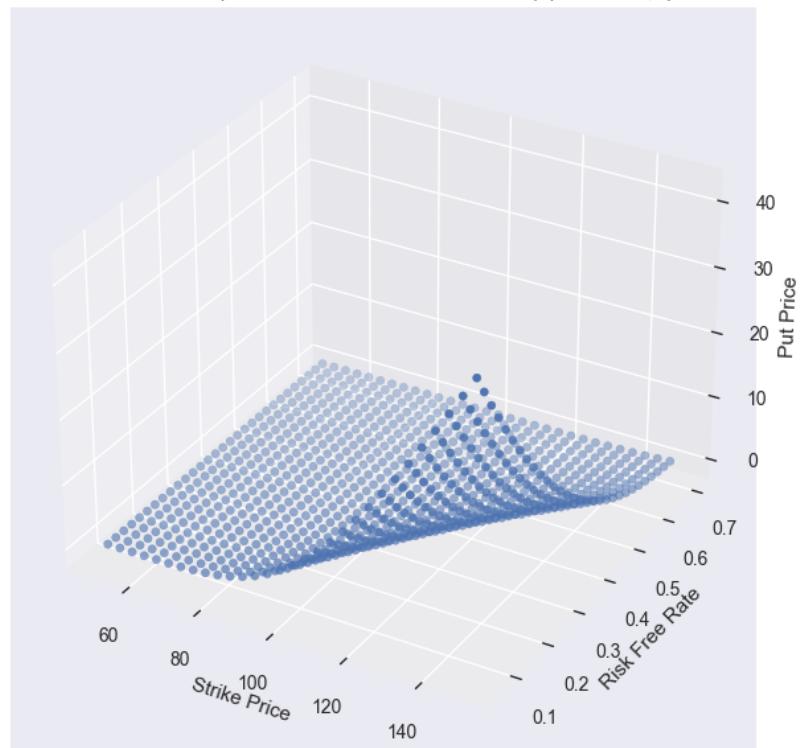
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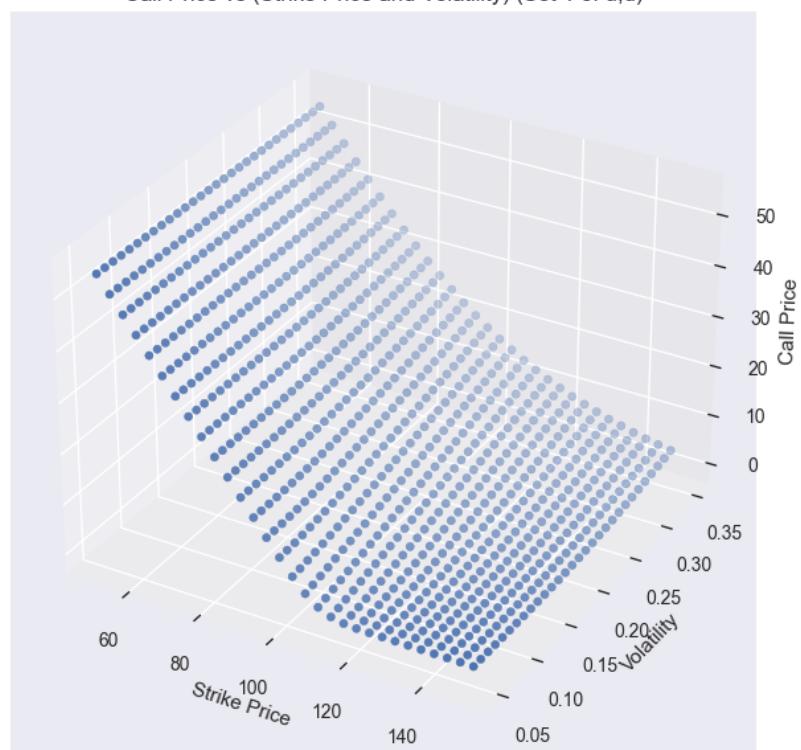
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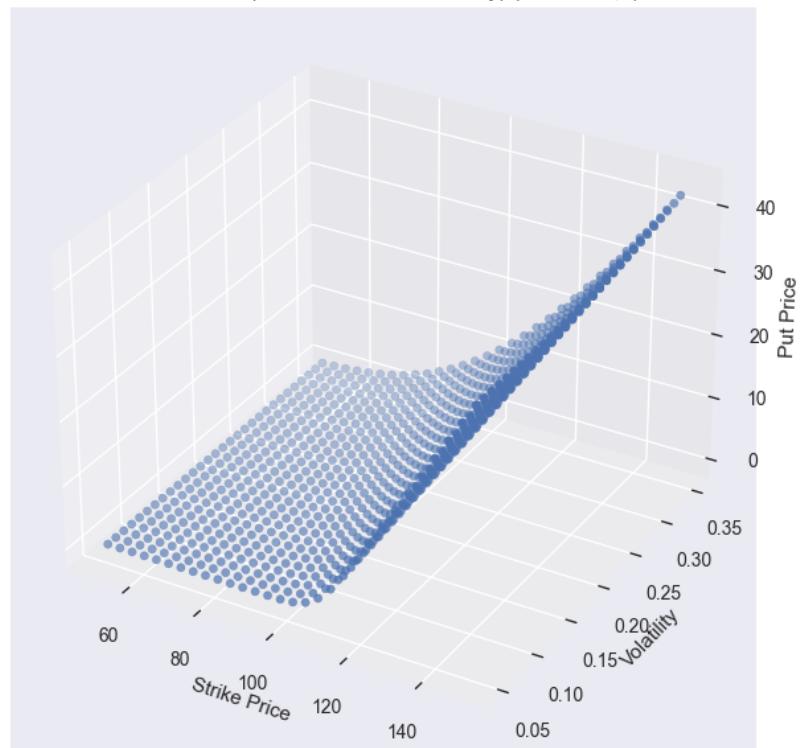
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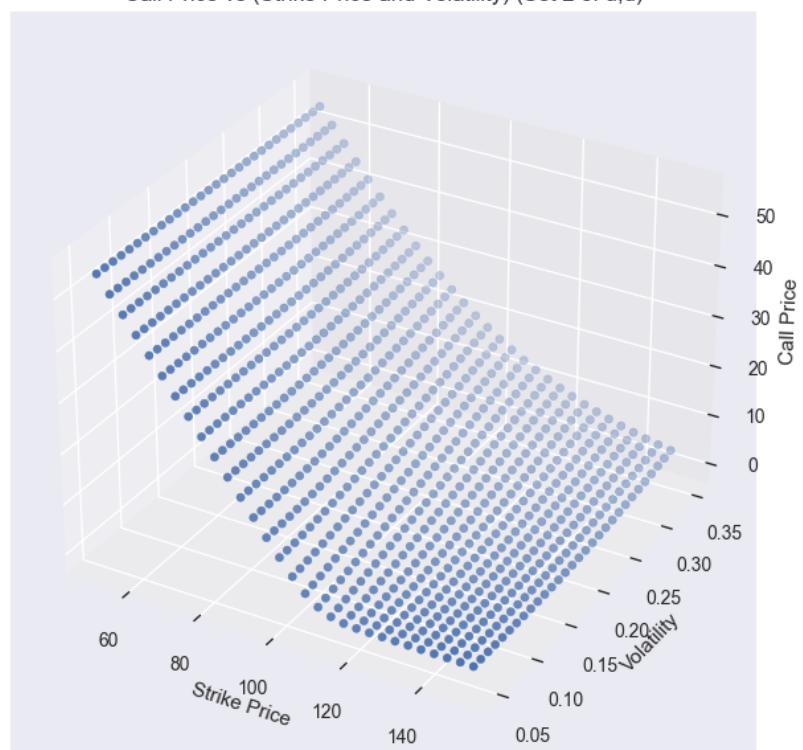
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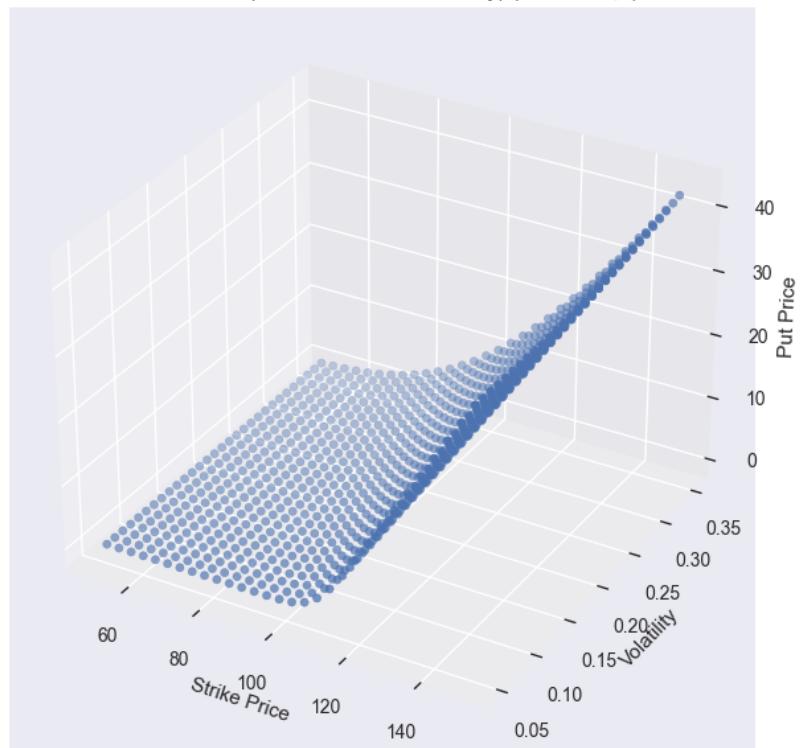
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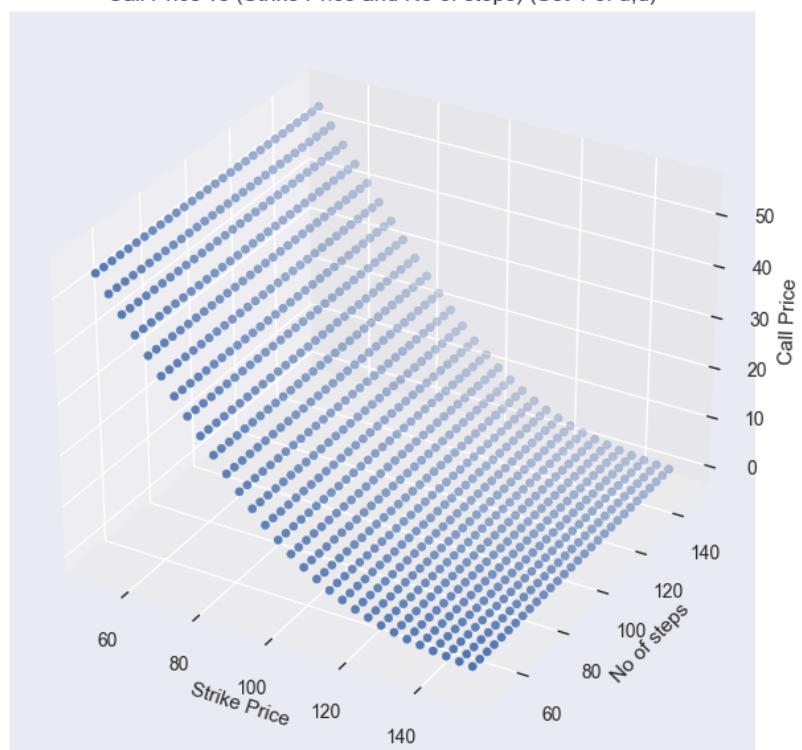
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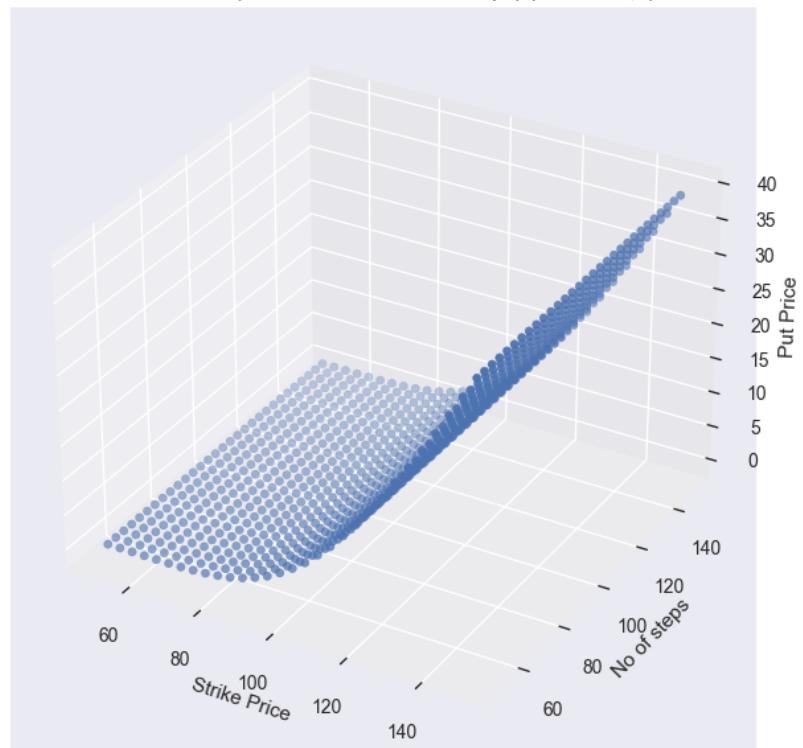
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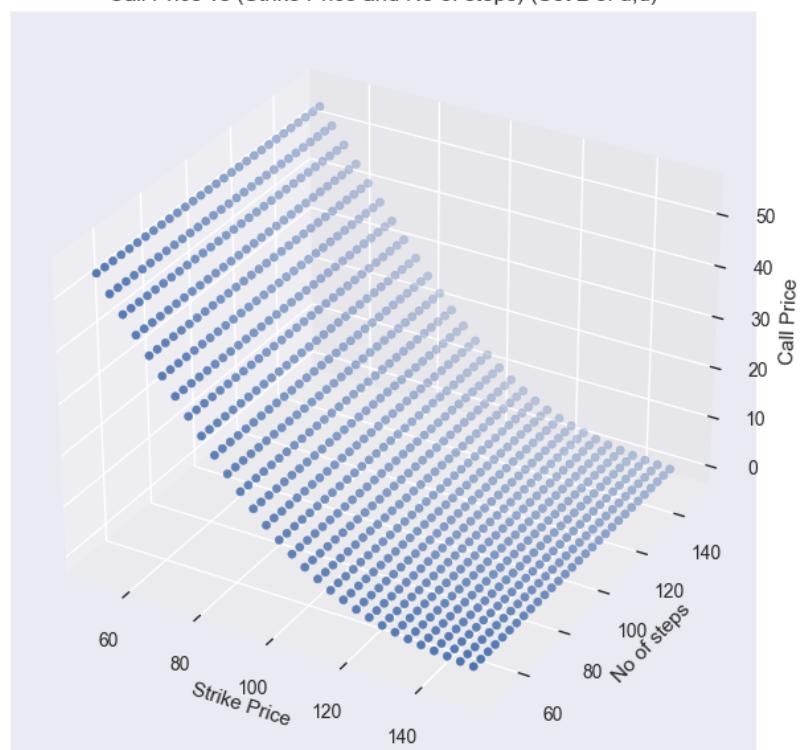
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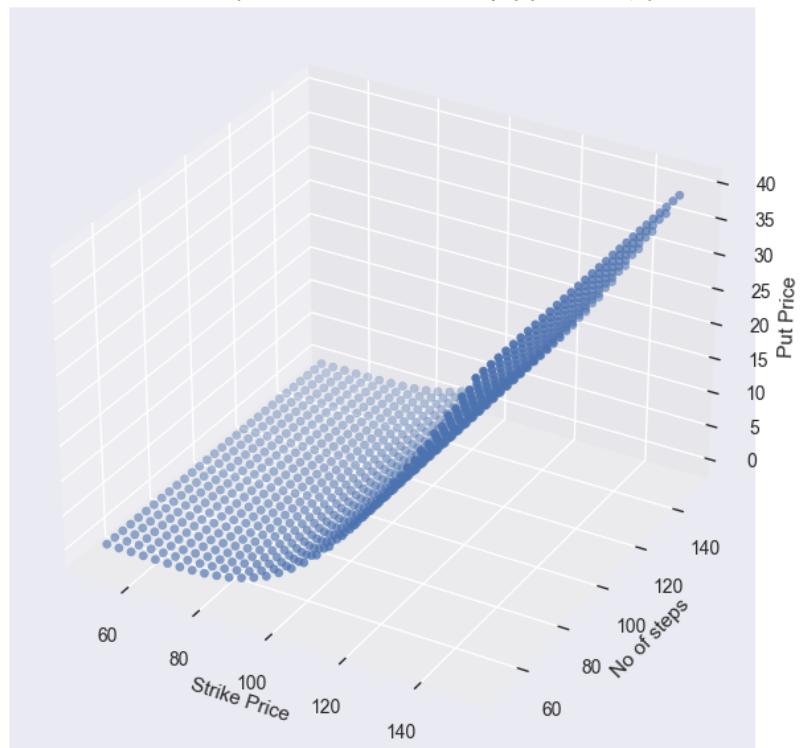
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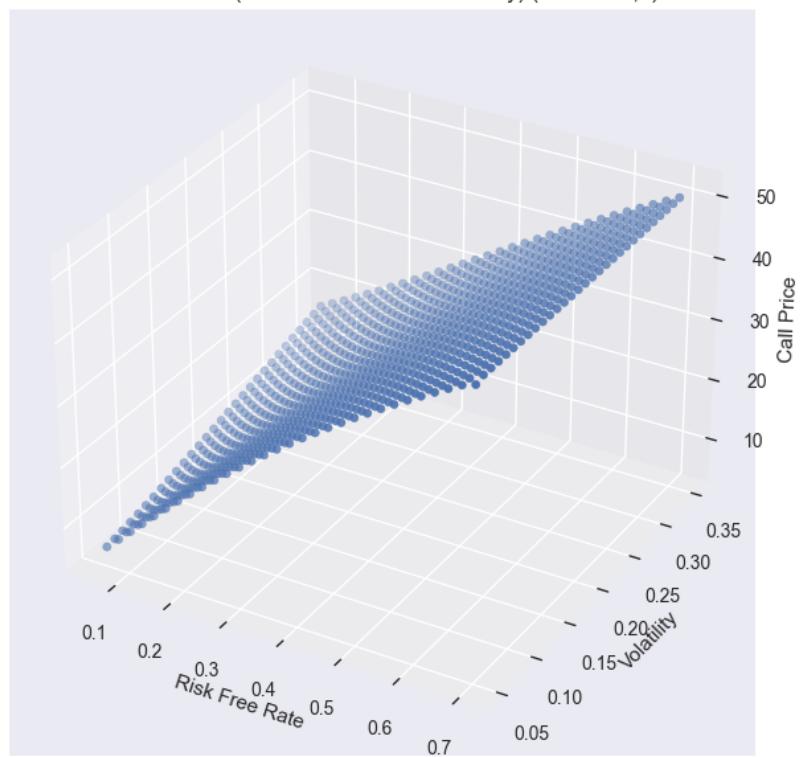
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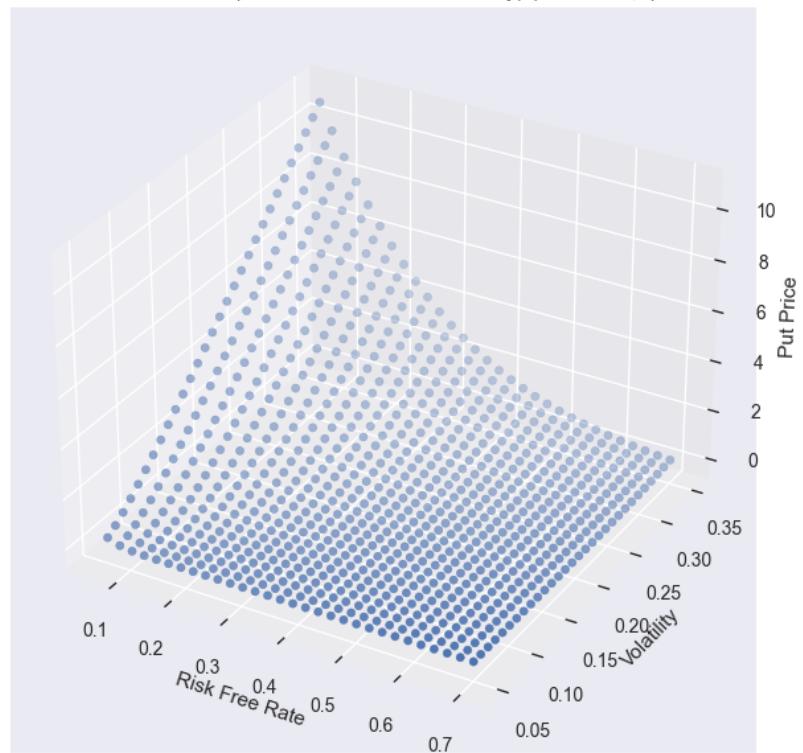
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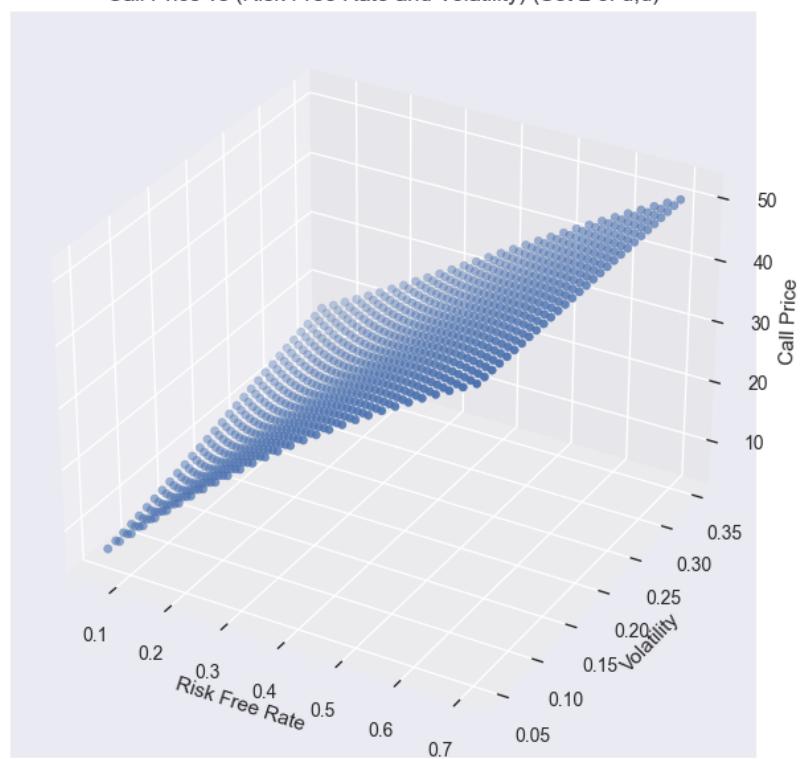
Call Price vs (Risk Free Rate and Volatility) (Set 1 of u,d)



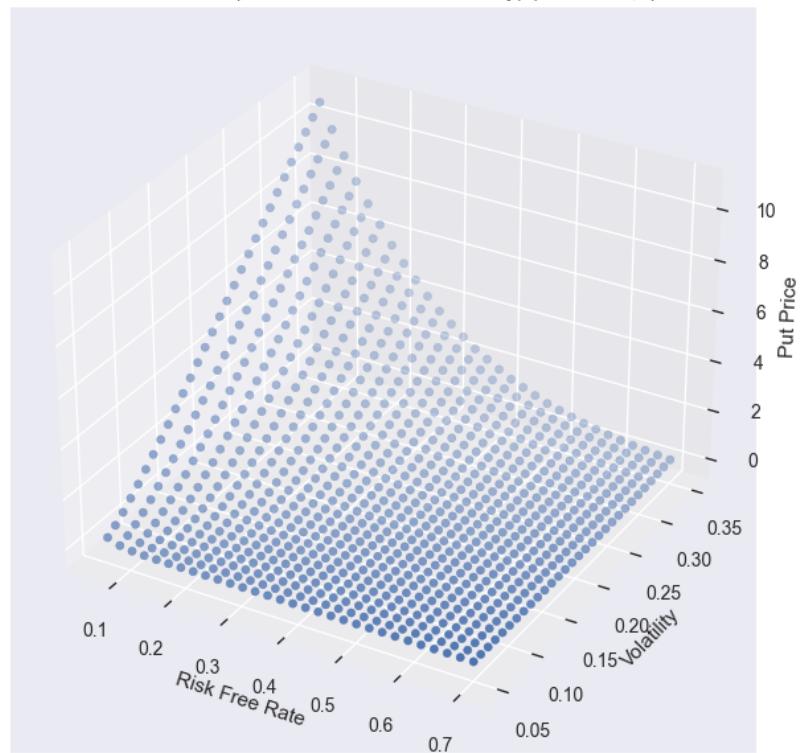
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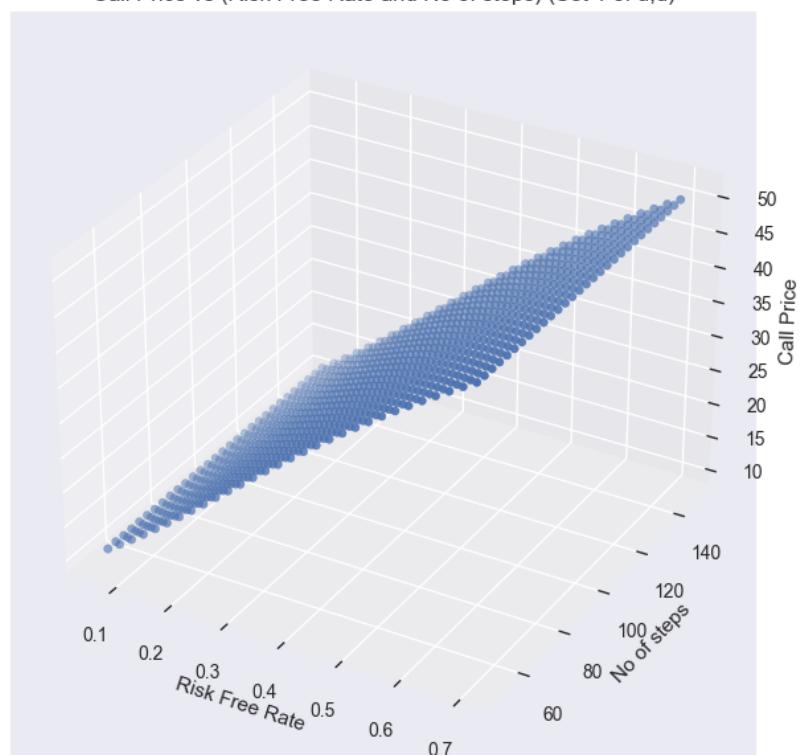
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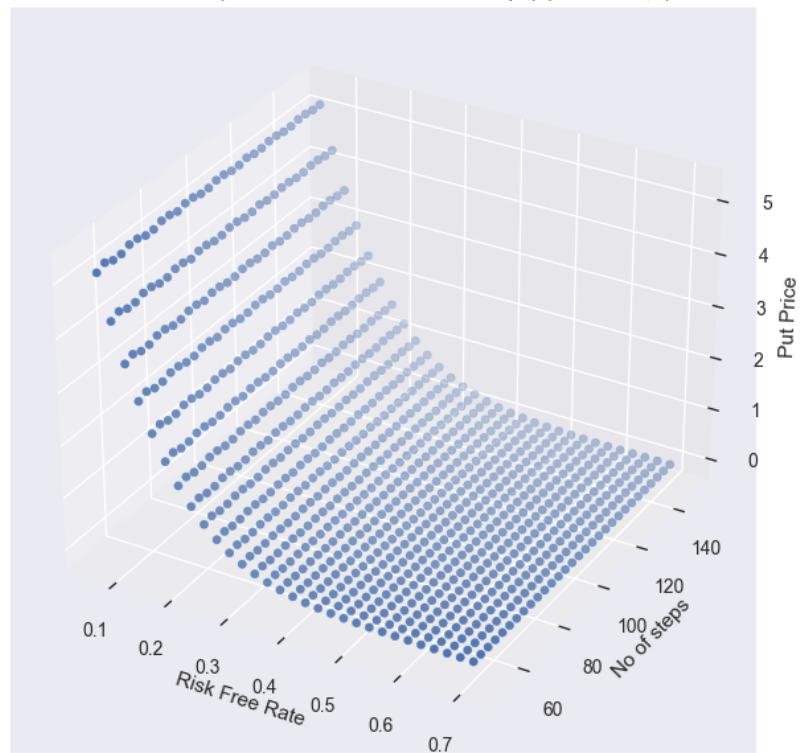
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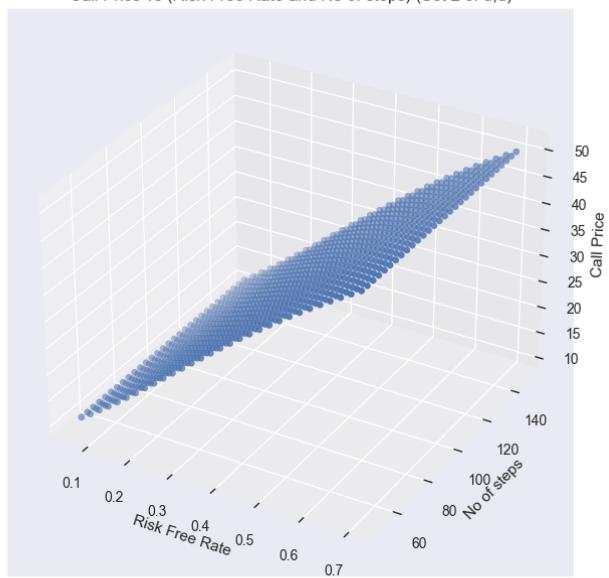
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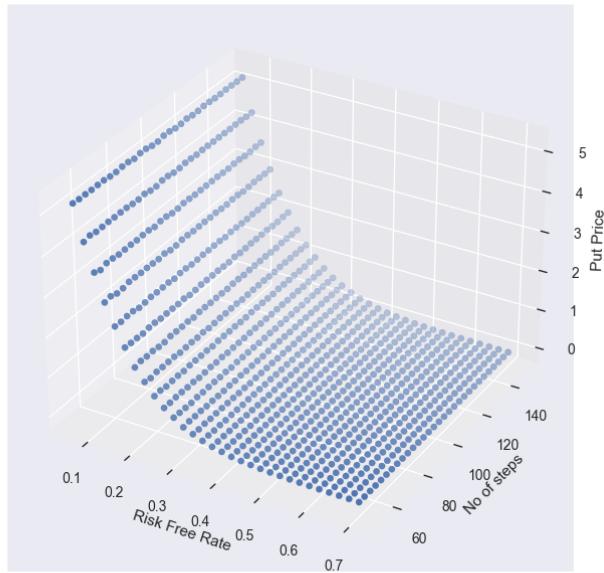
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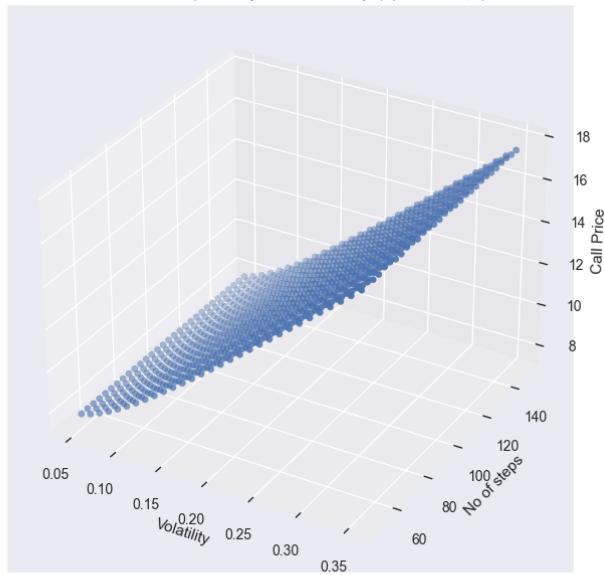
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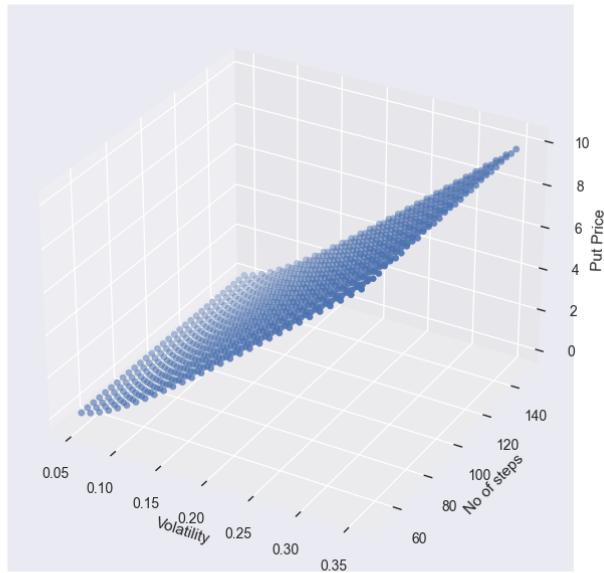
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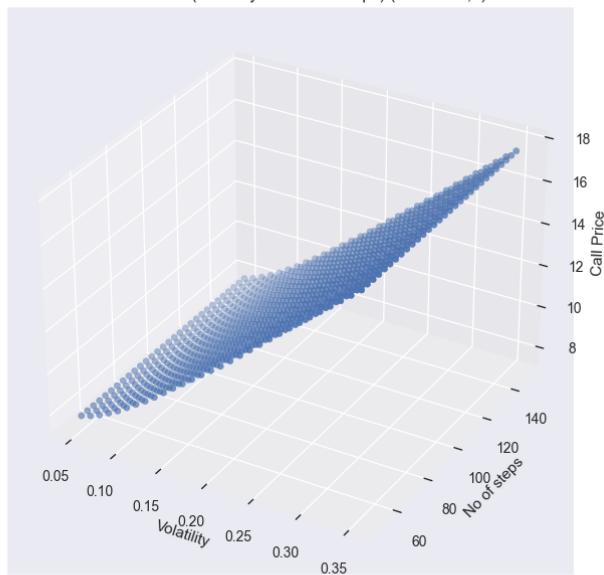
Call Price vs (Volatility and No of steps) (Set 1 of u,d)

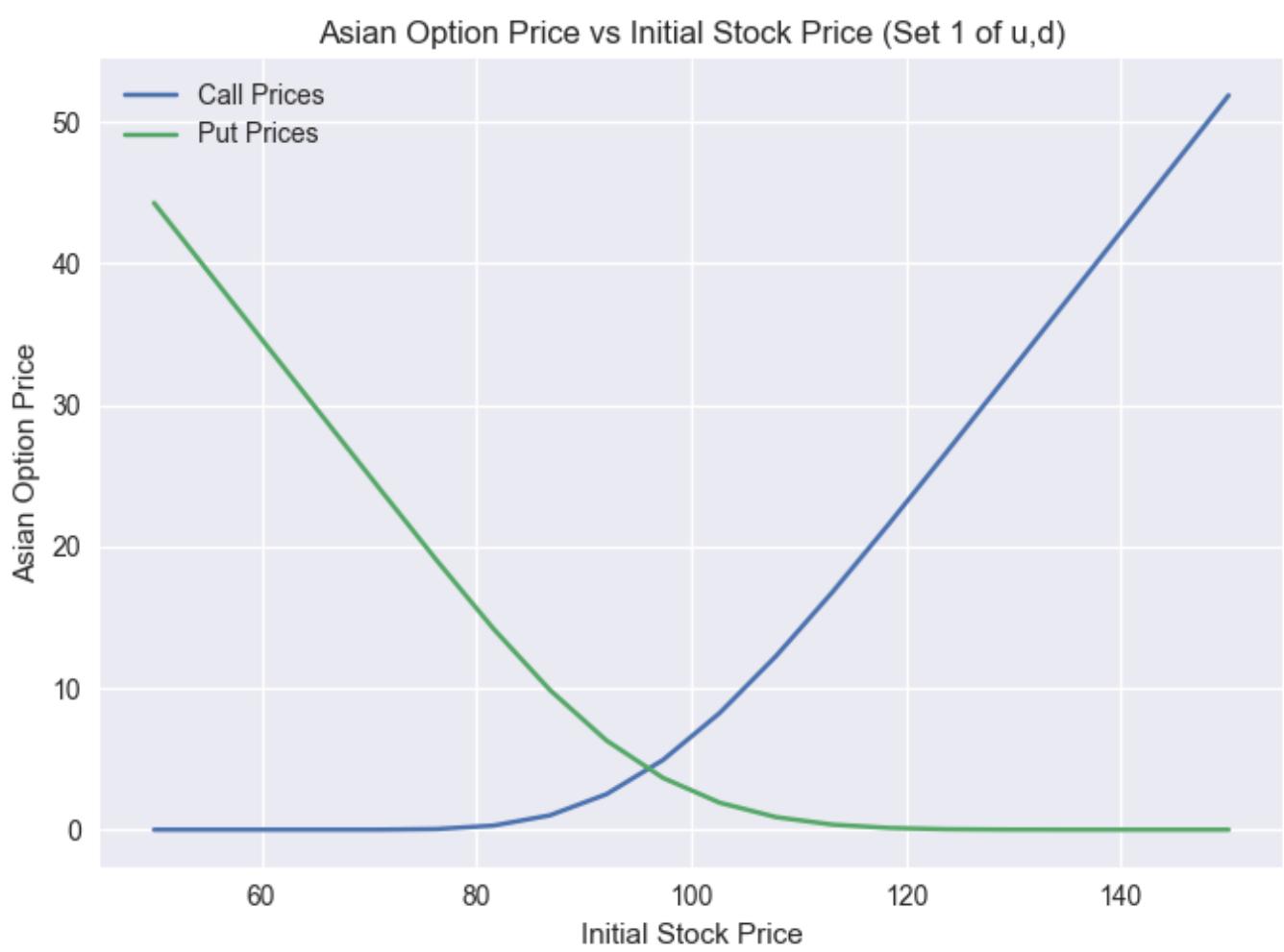
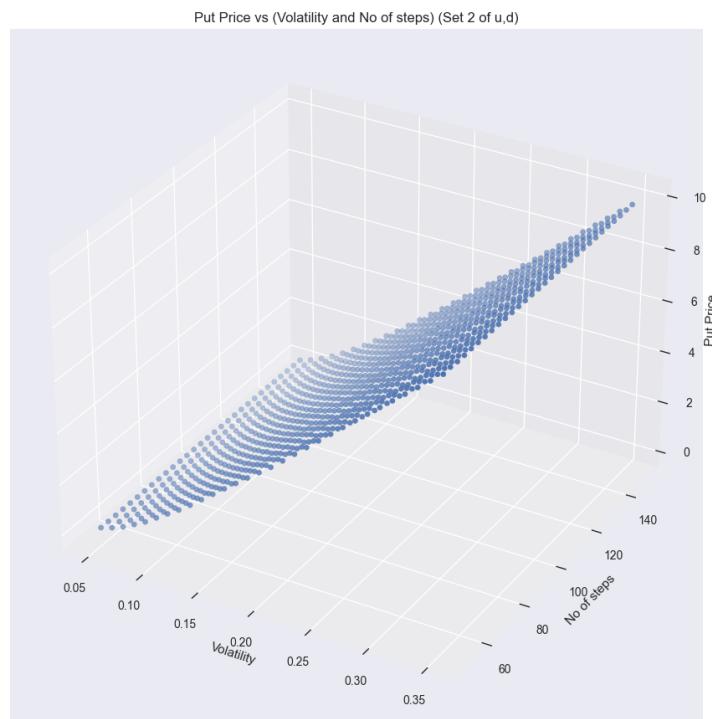


Put Price vs (Volatility and No of steps) (Set 1 of u,d)

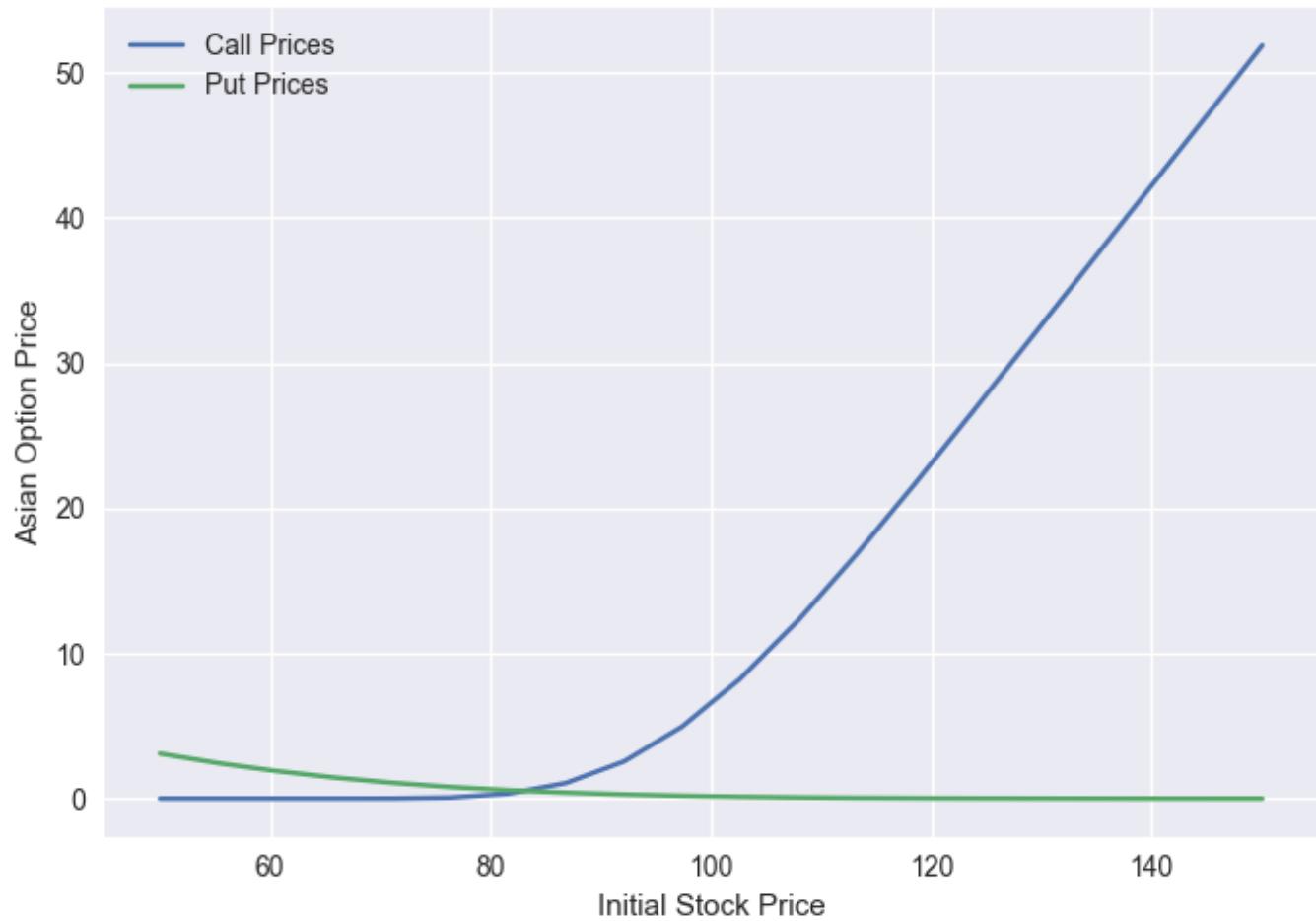


Call Price vs (Volatility and No of steps) (Set 2 of u,d)

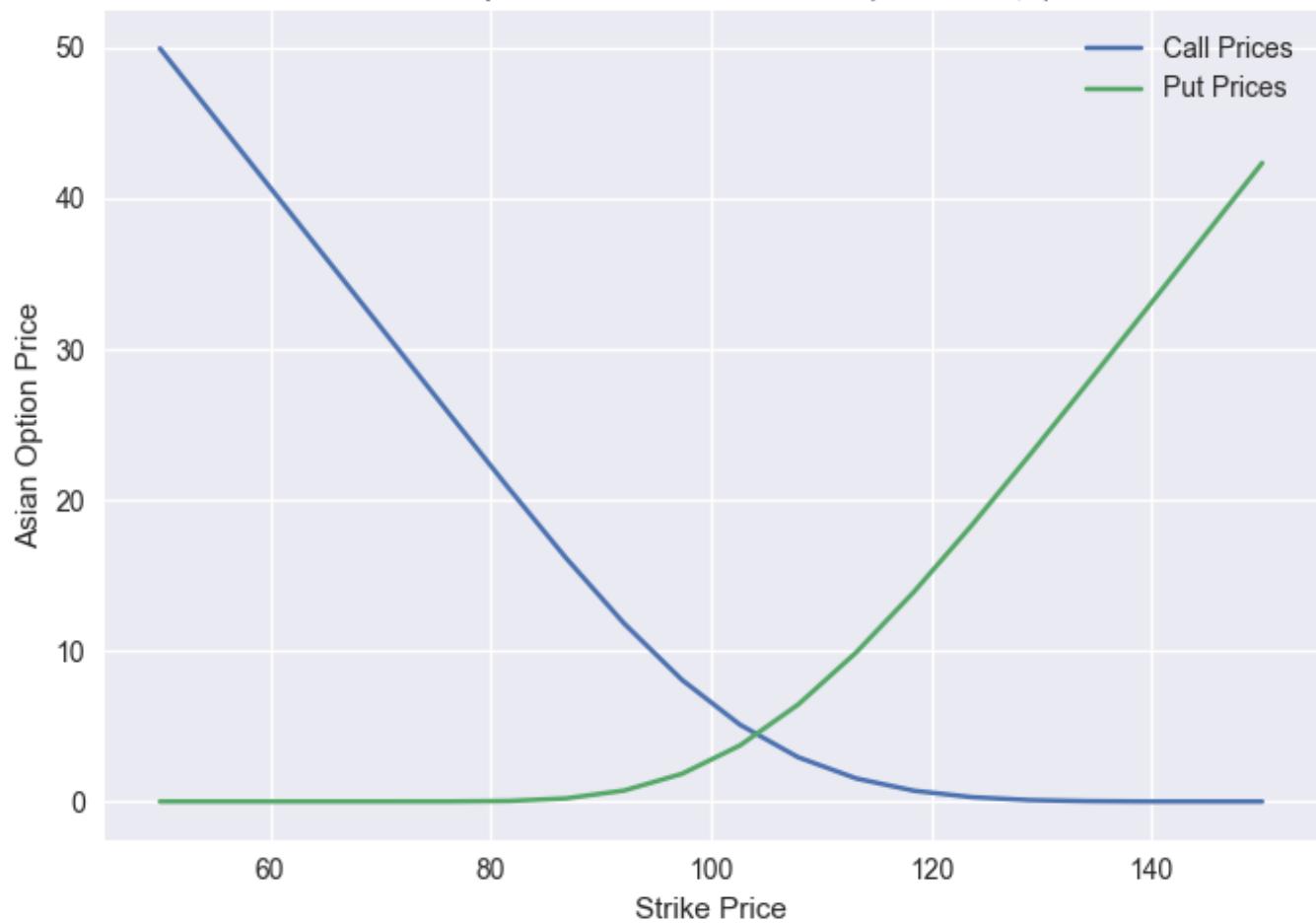




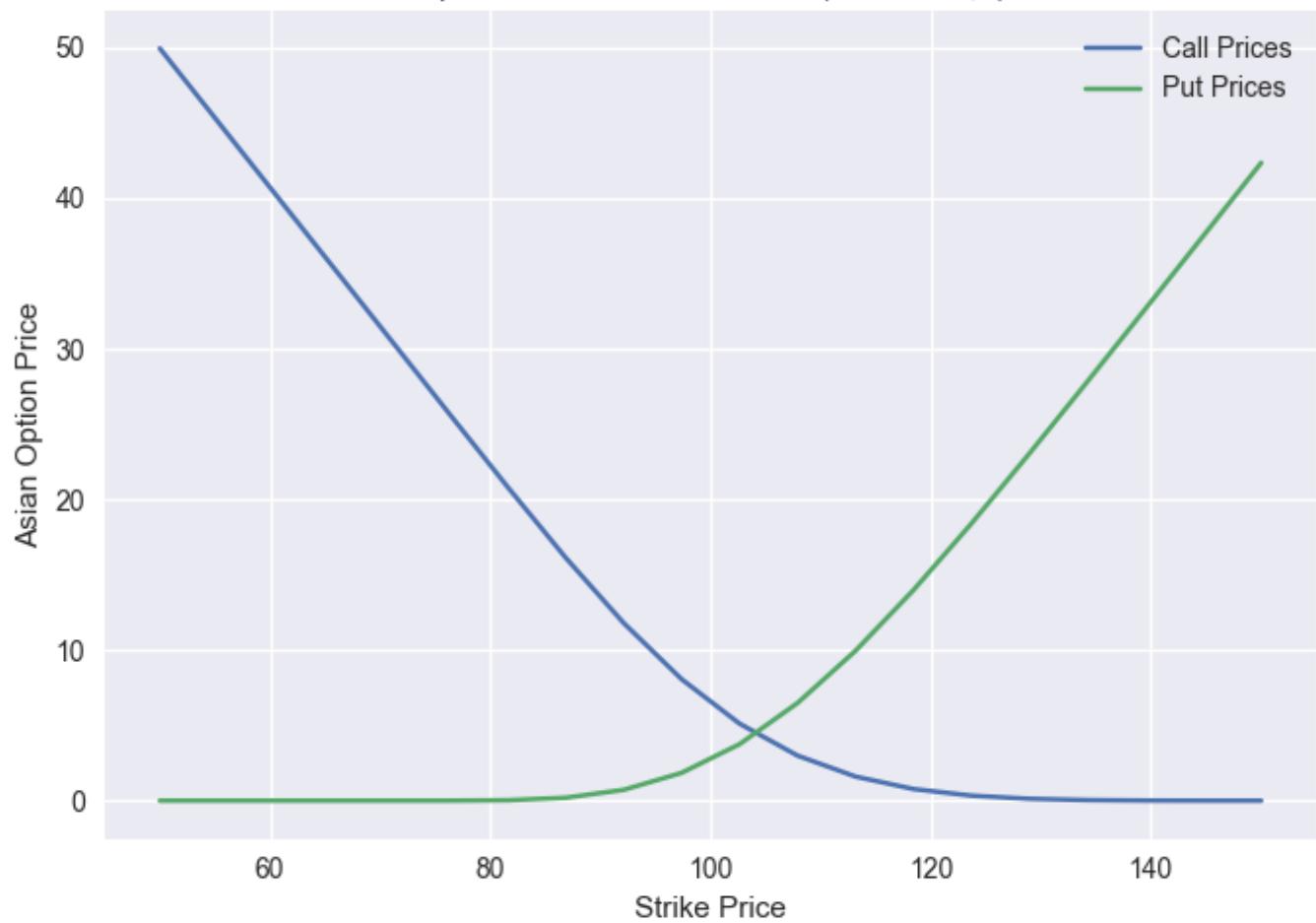
Option Price vs Initial Stock Price (Set 2 of u,d)



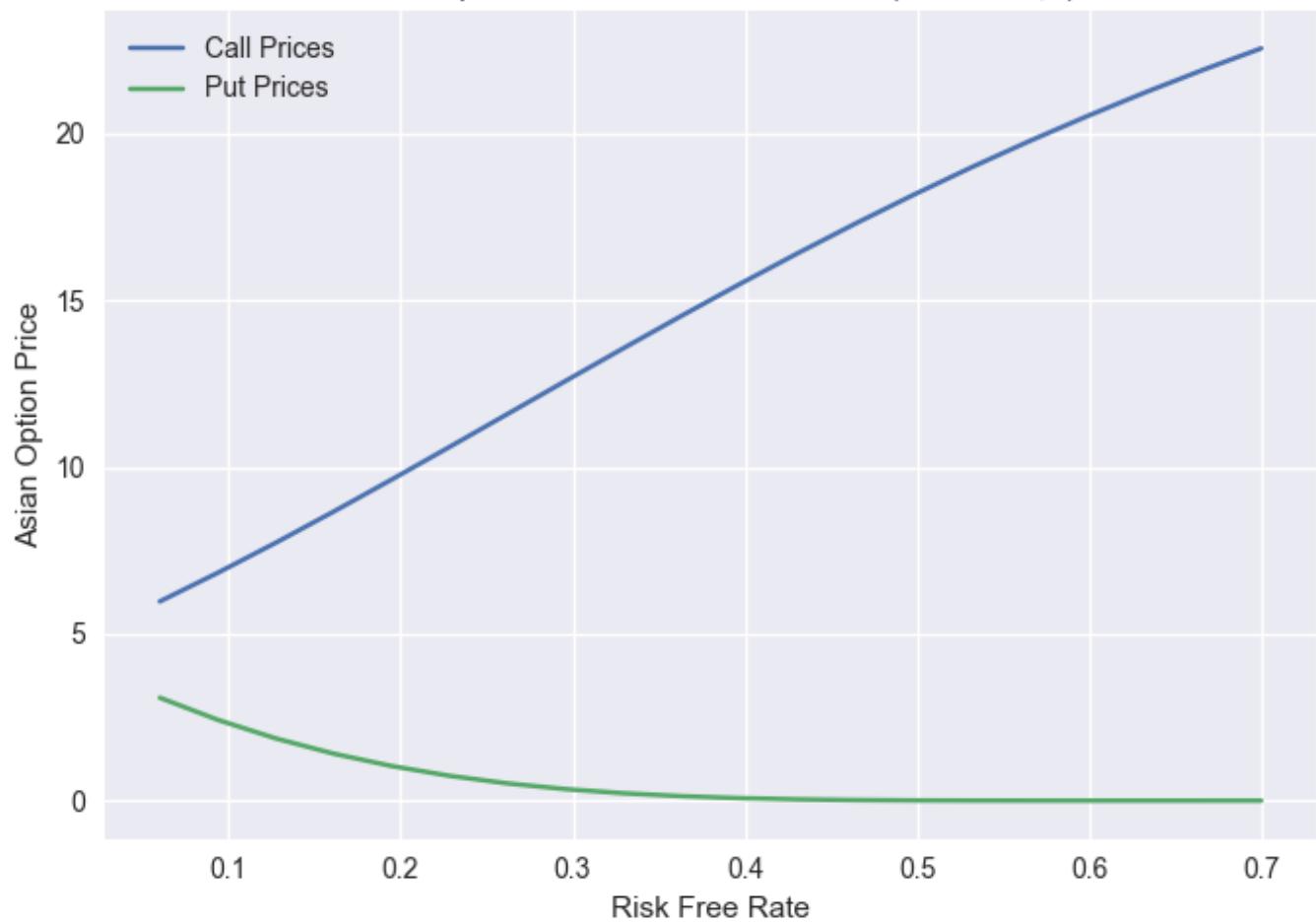
Asian Option Price vs Strike Price (Set 1 of u,d)



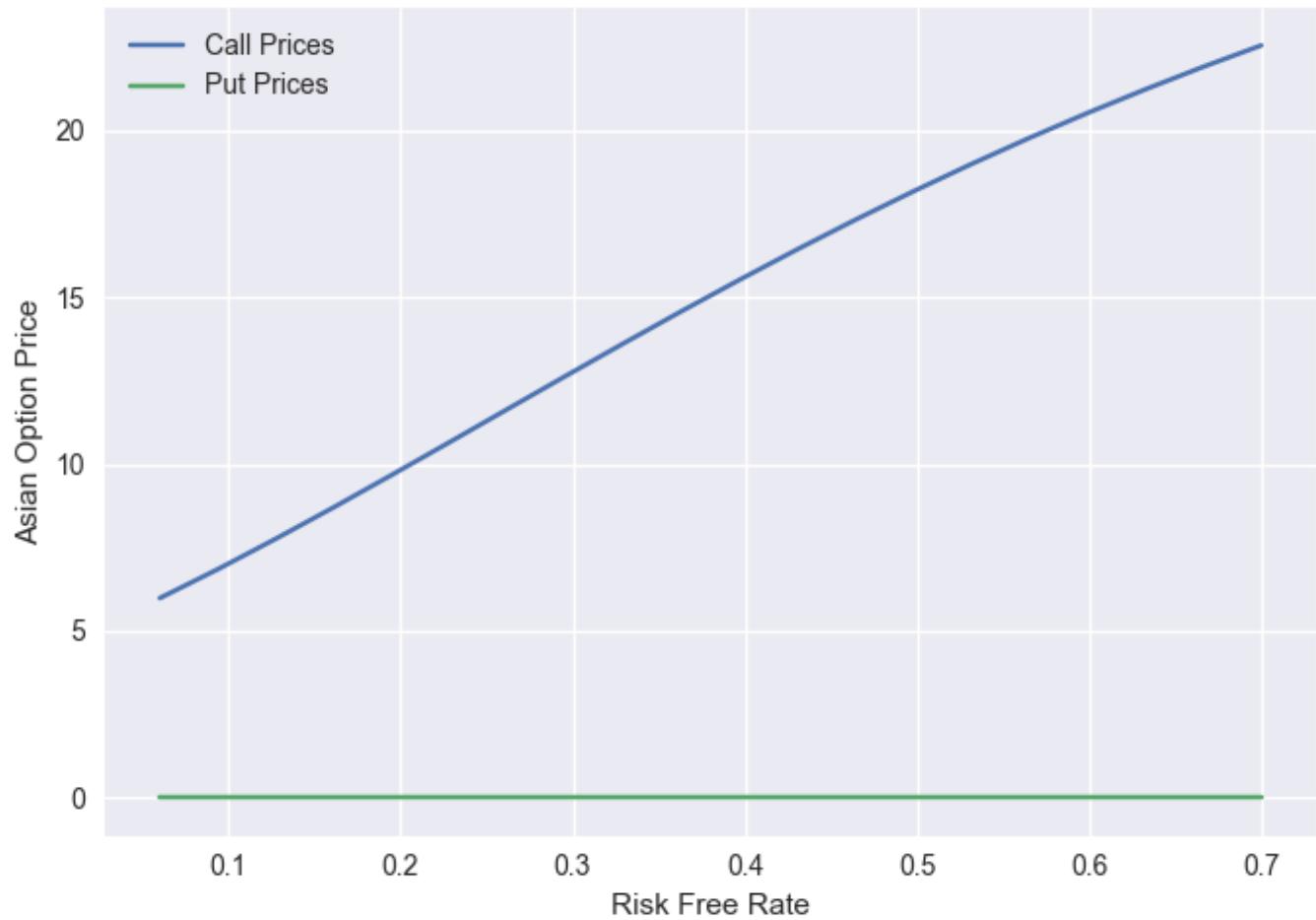
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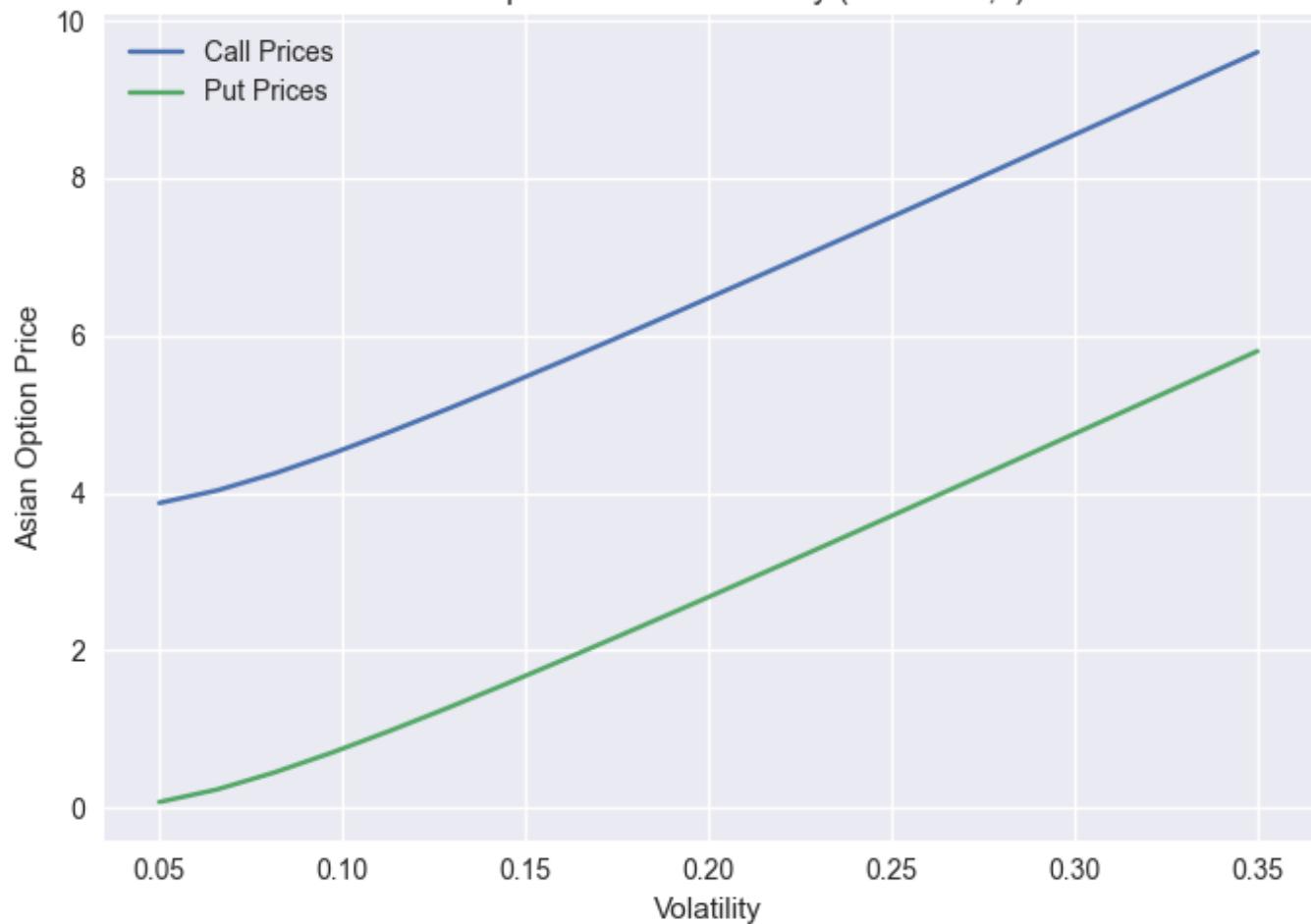
Asian Option Price vs Risk Free Rate (Set 1 of u,d)

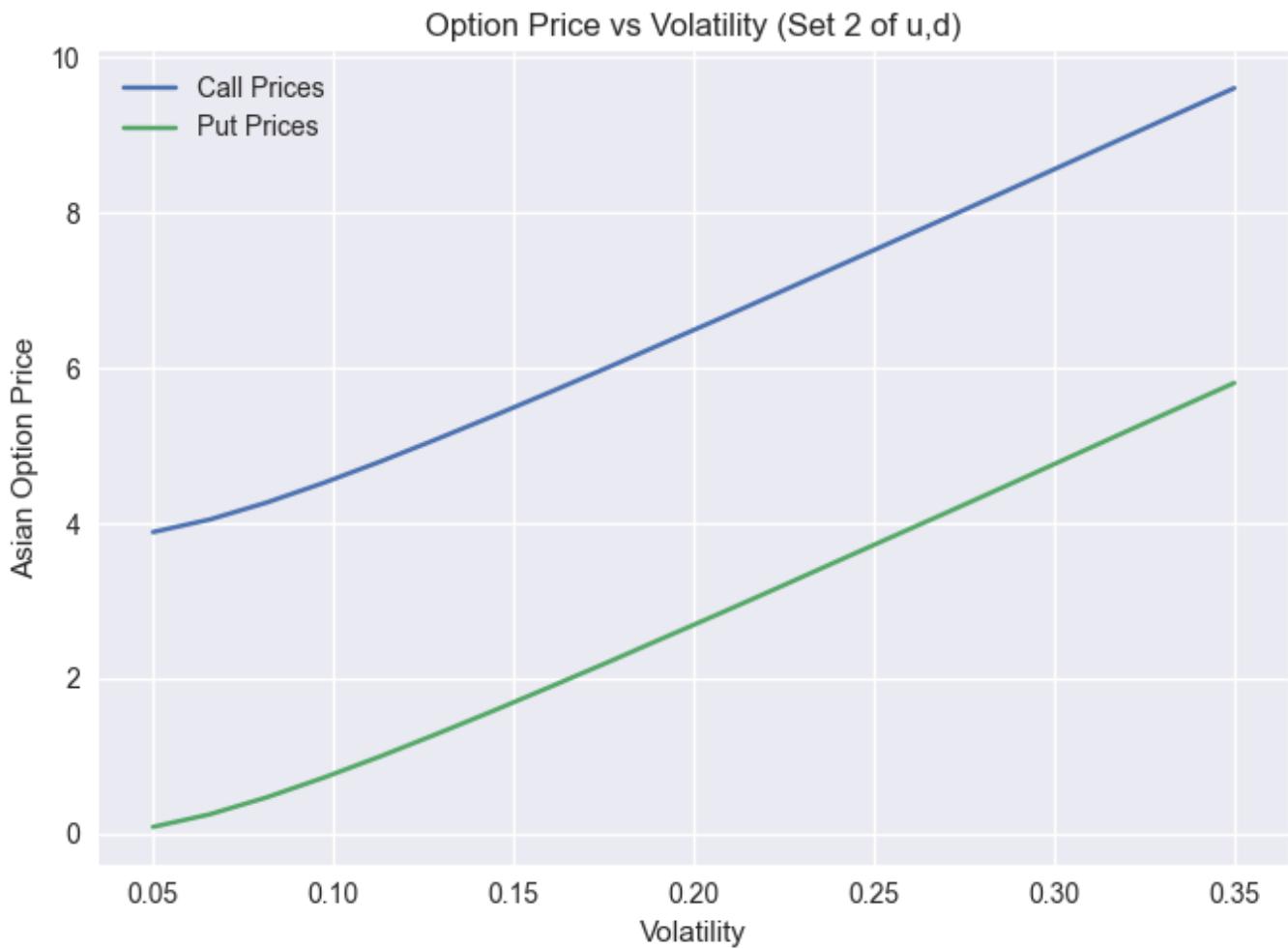


Option Price vs Risk Free Rate (Set 2 of u,d)

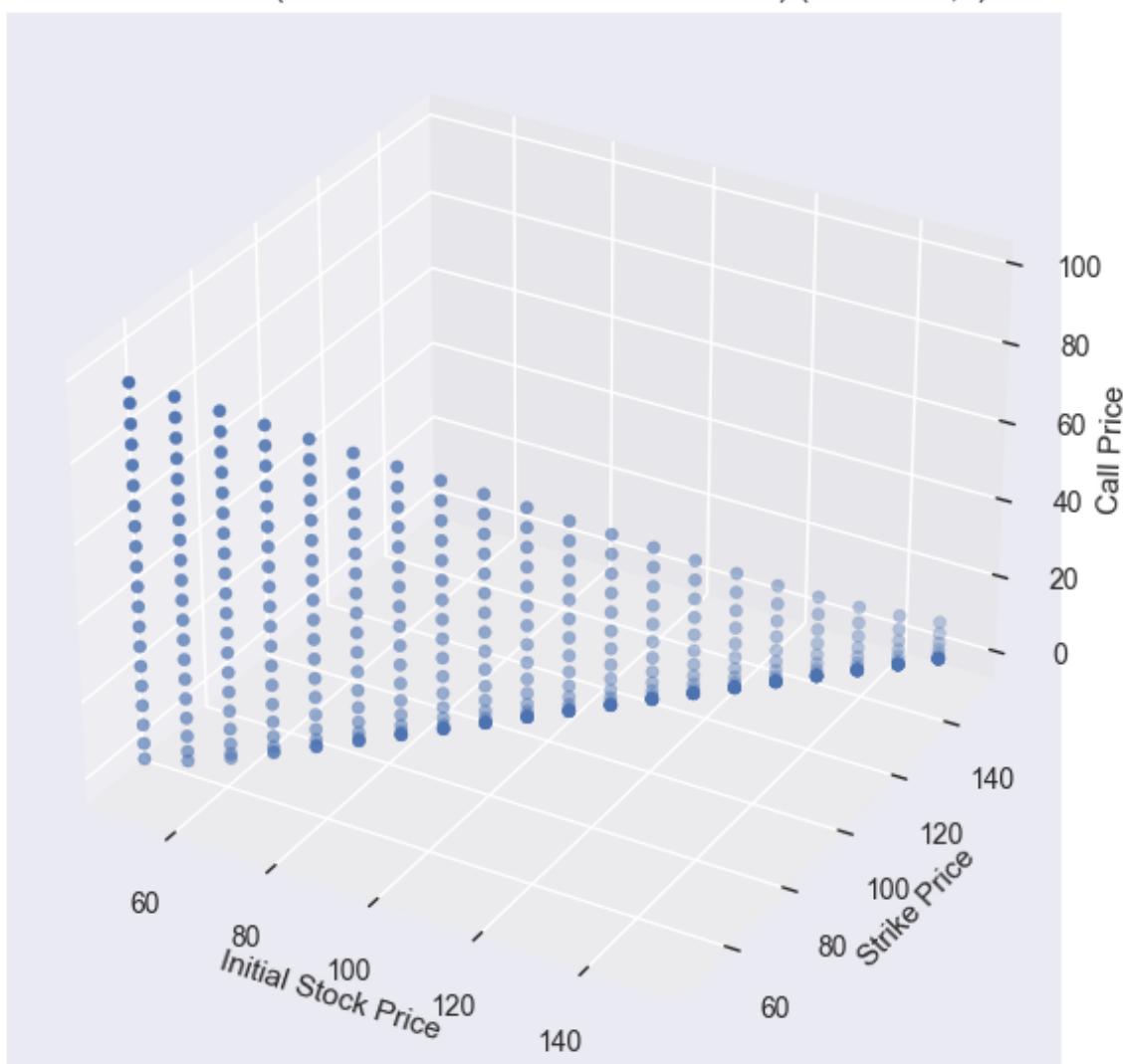


Asian Option Price vs Volatility (Set 1 of u,d)

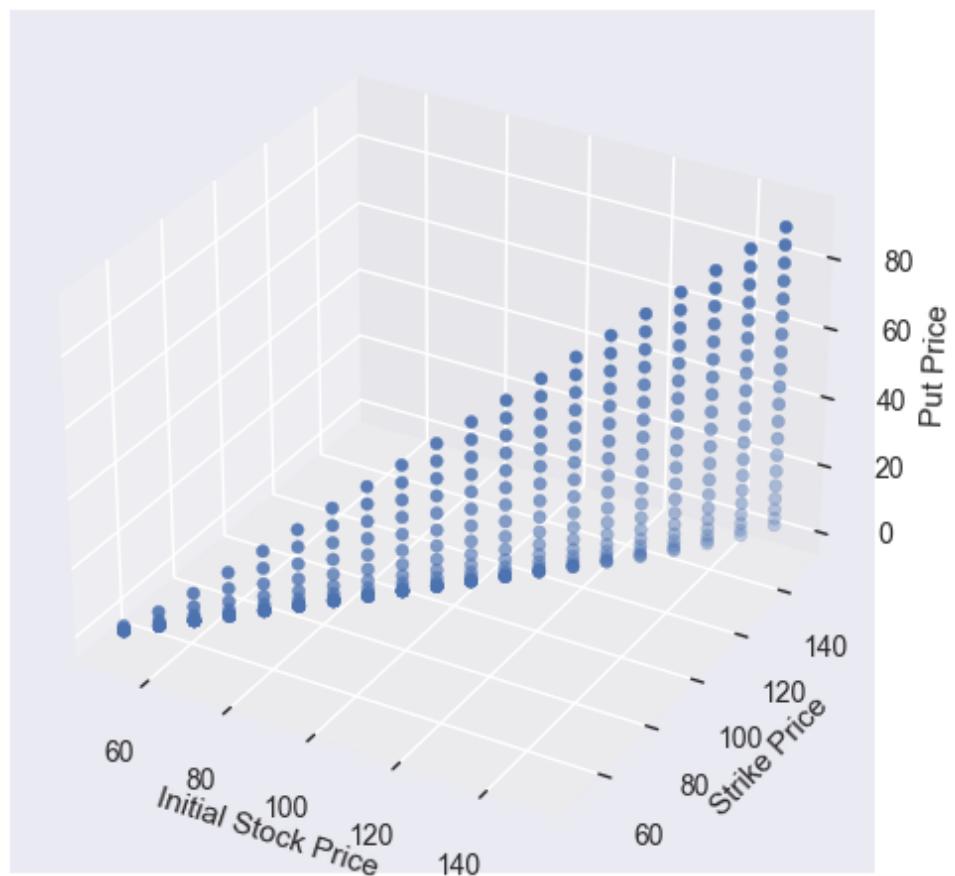




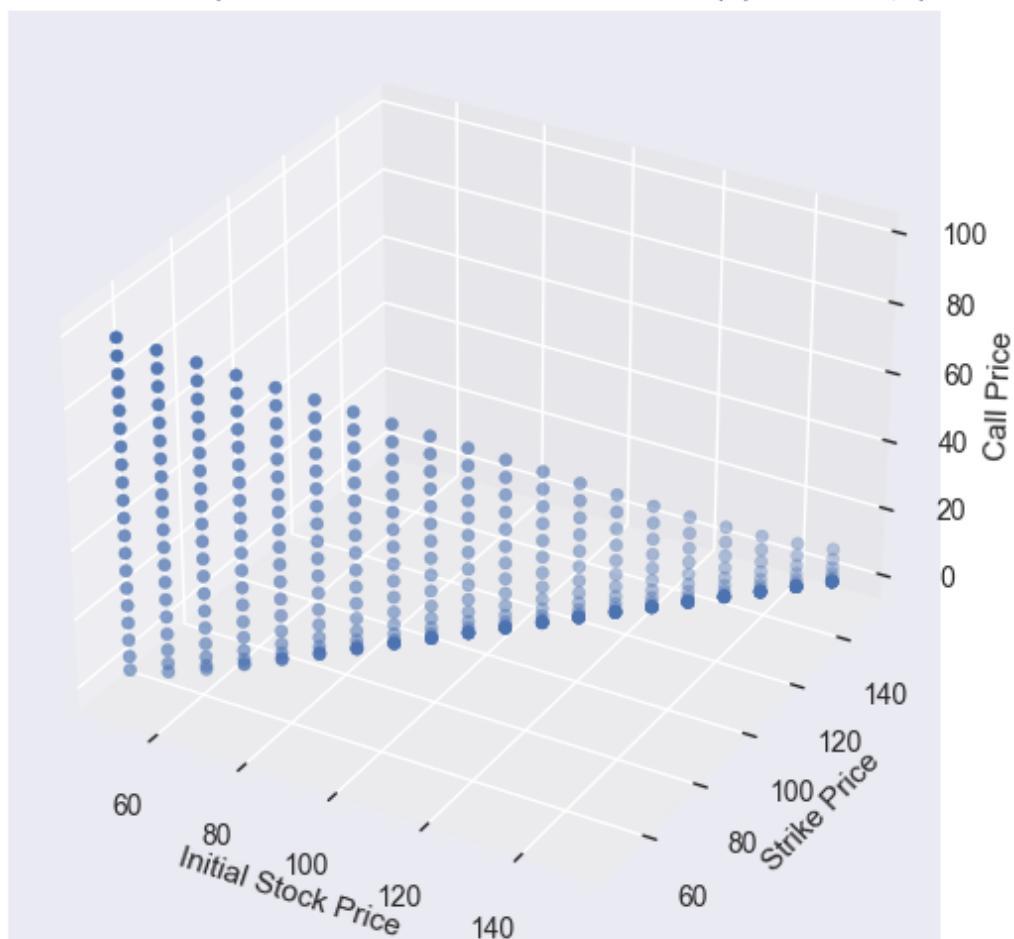
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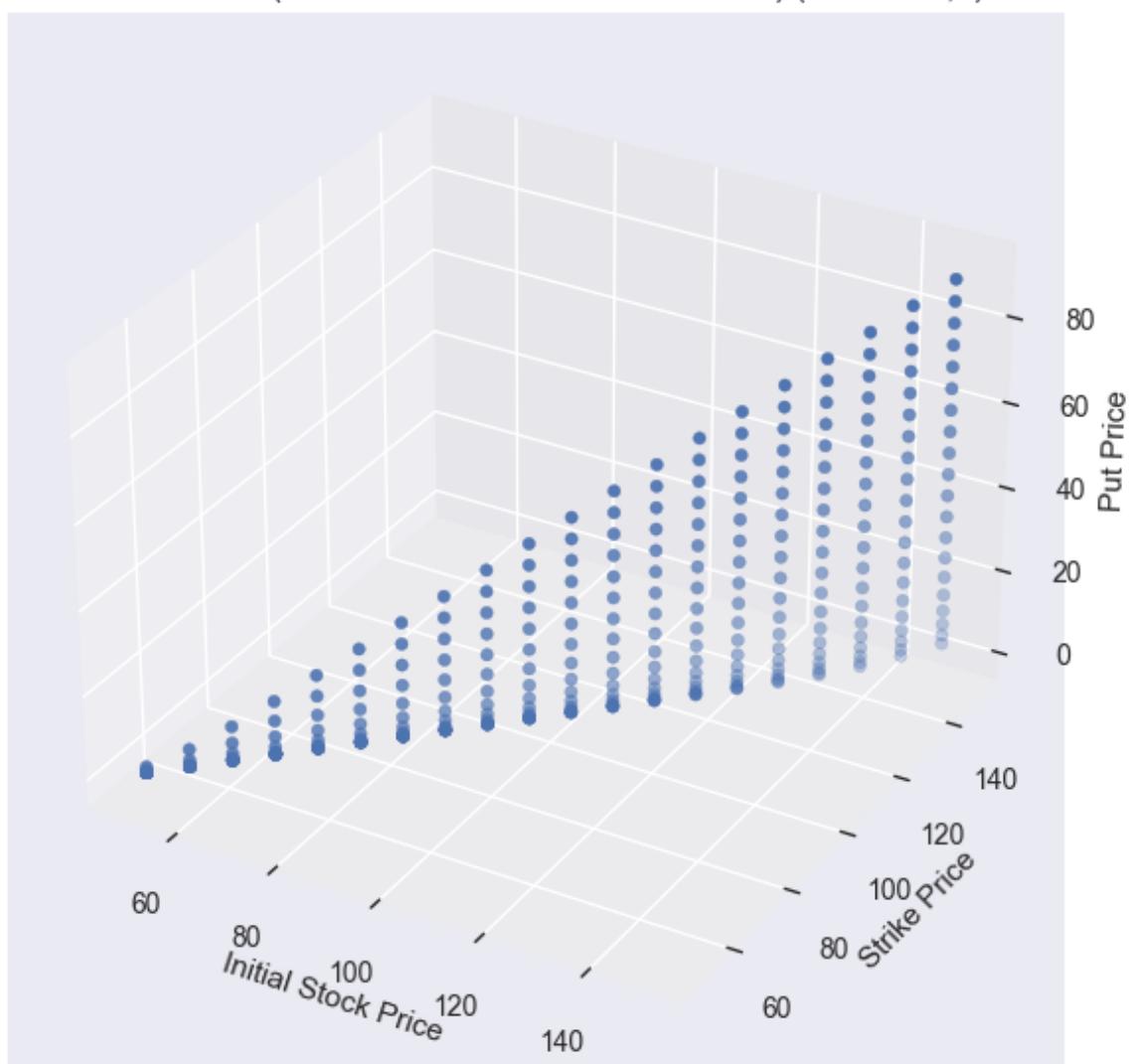
Put Price vs (Initial Stock Price and Strike Price) (Set 1 of u,d)



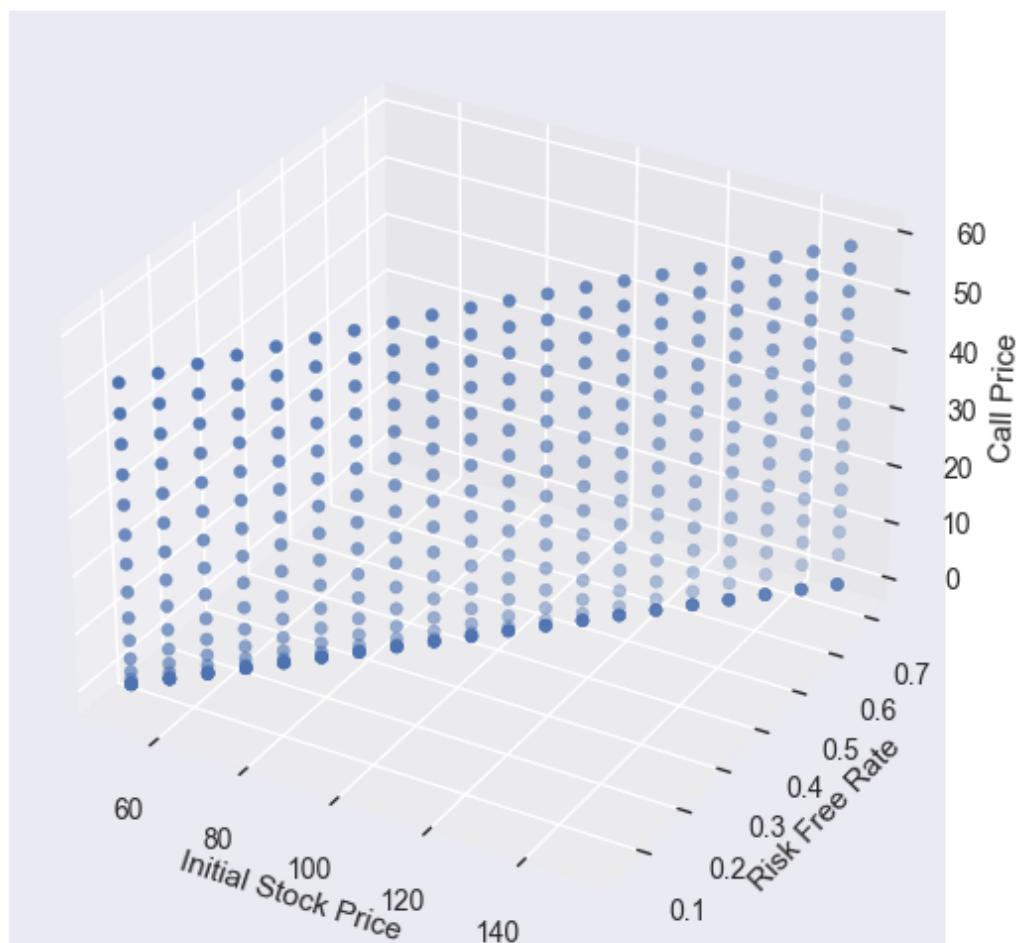
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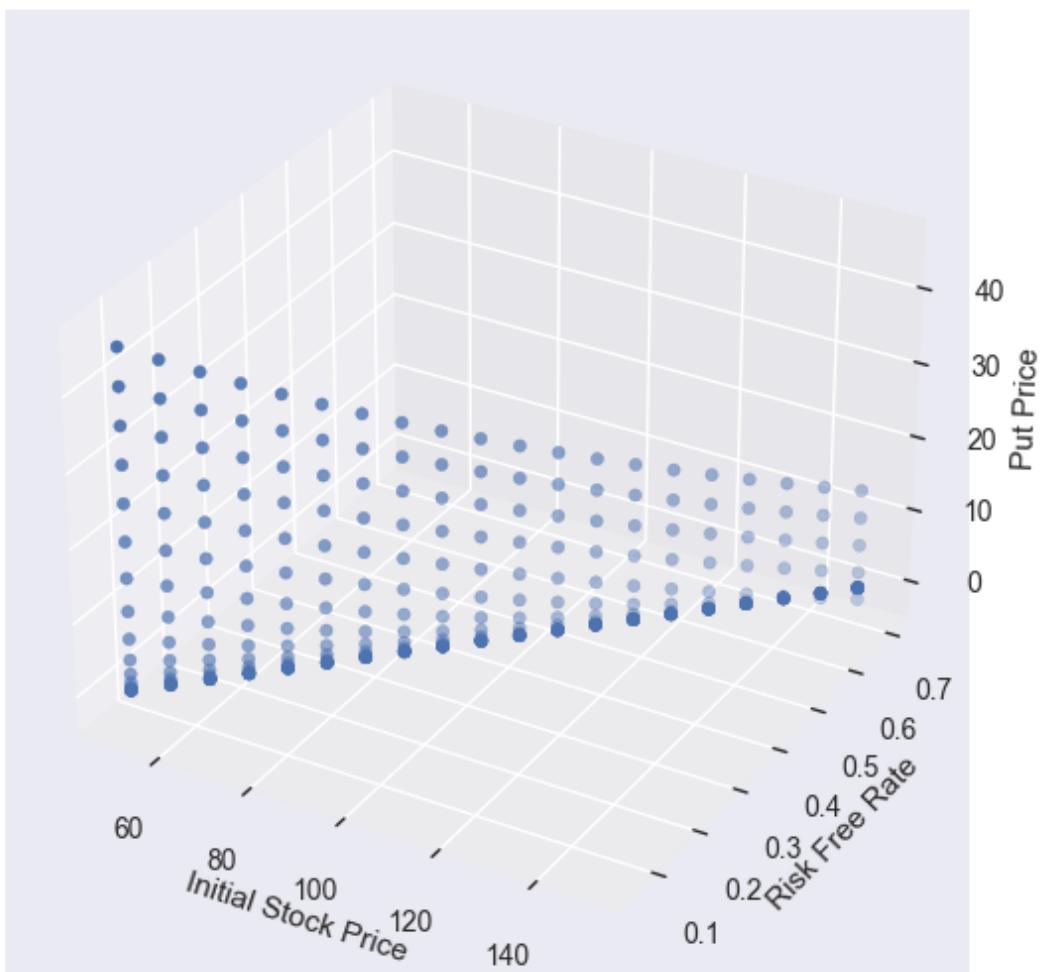
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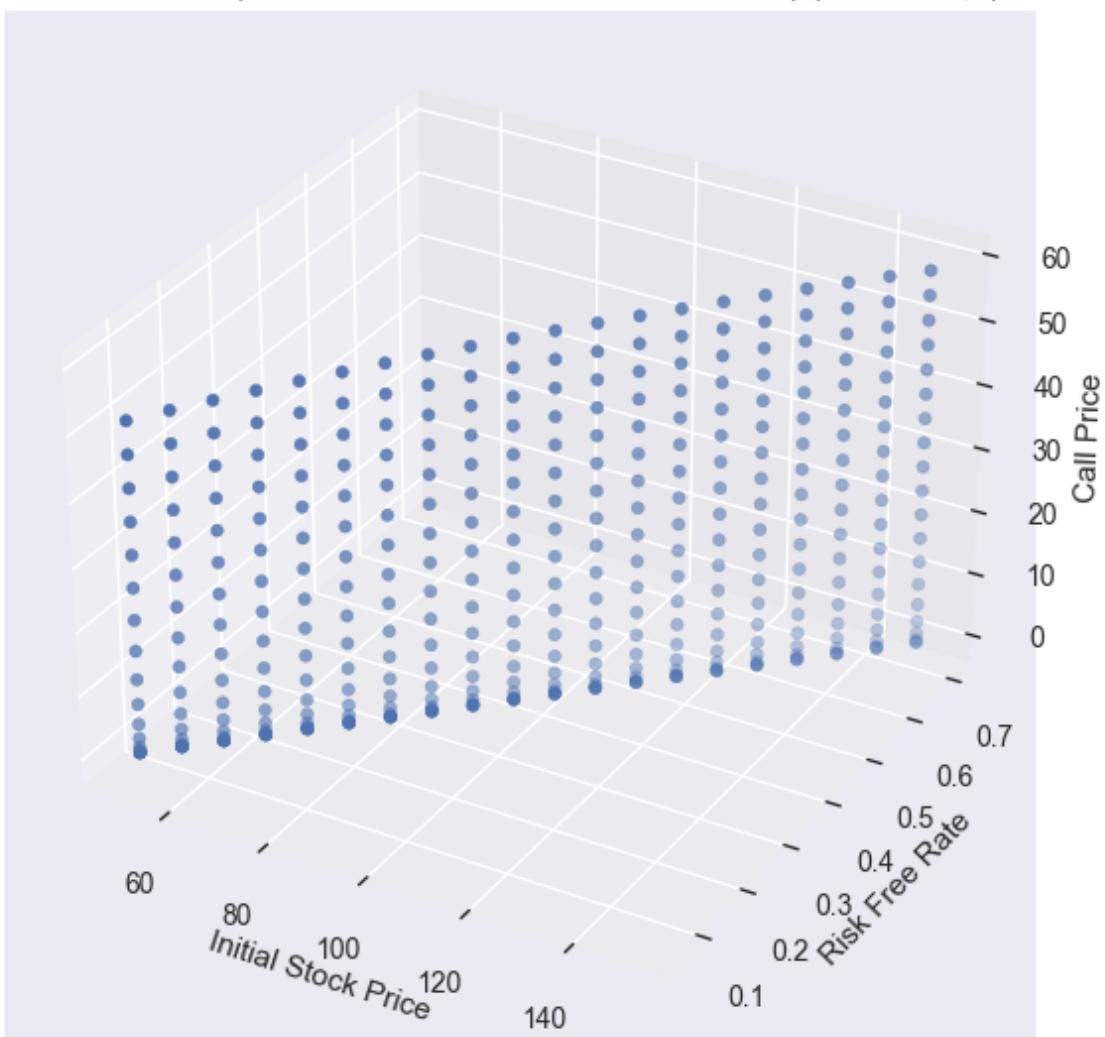
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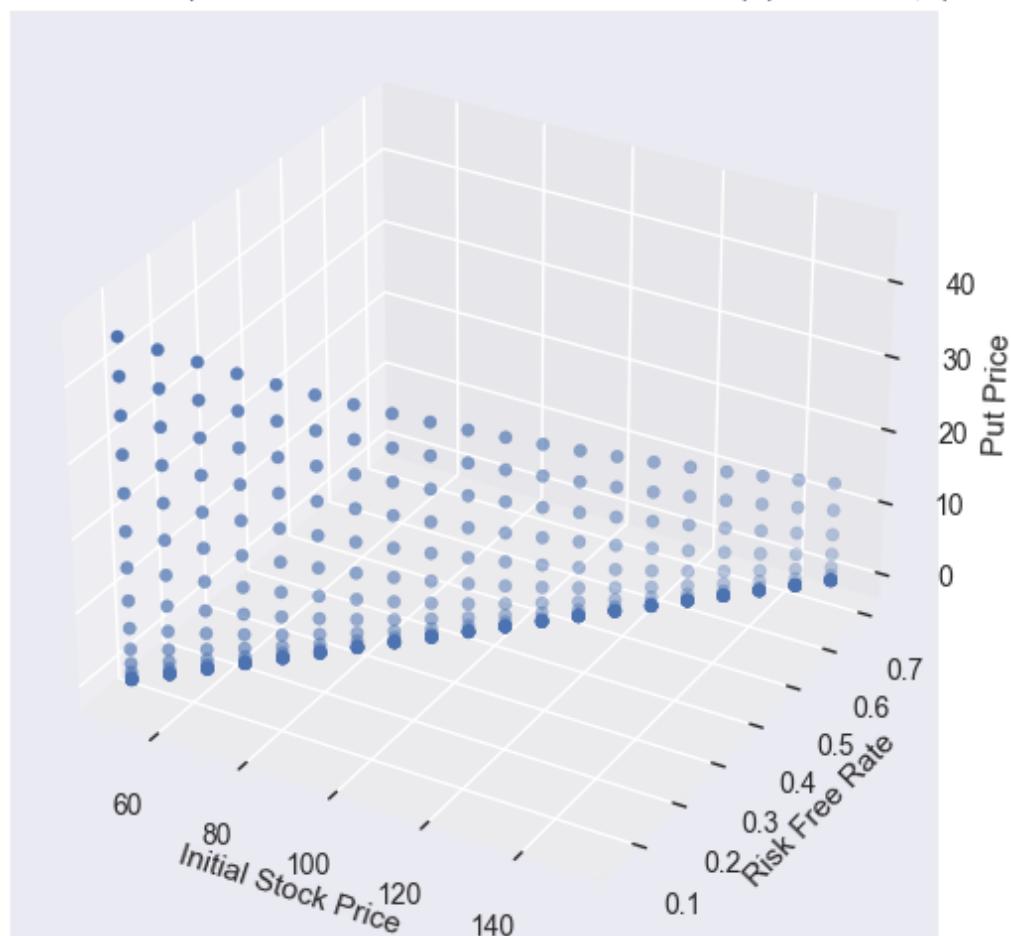
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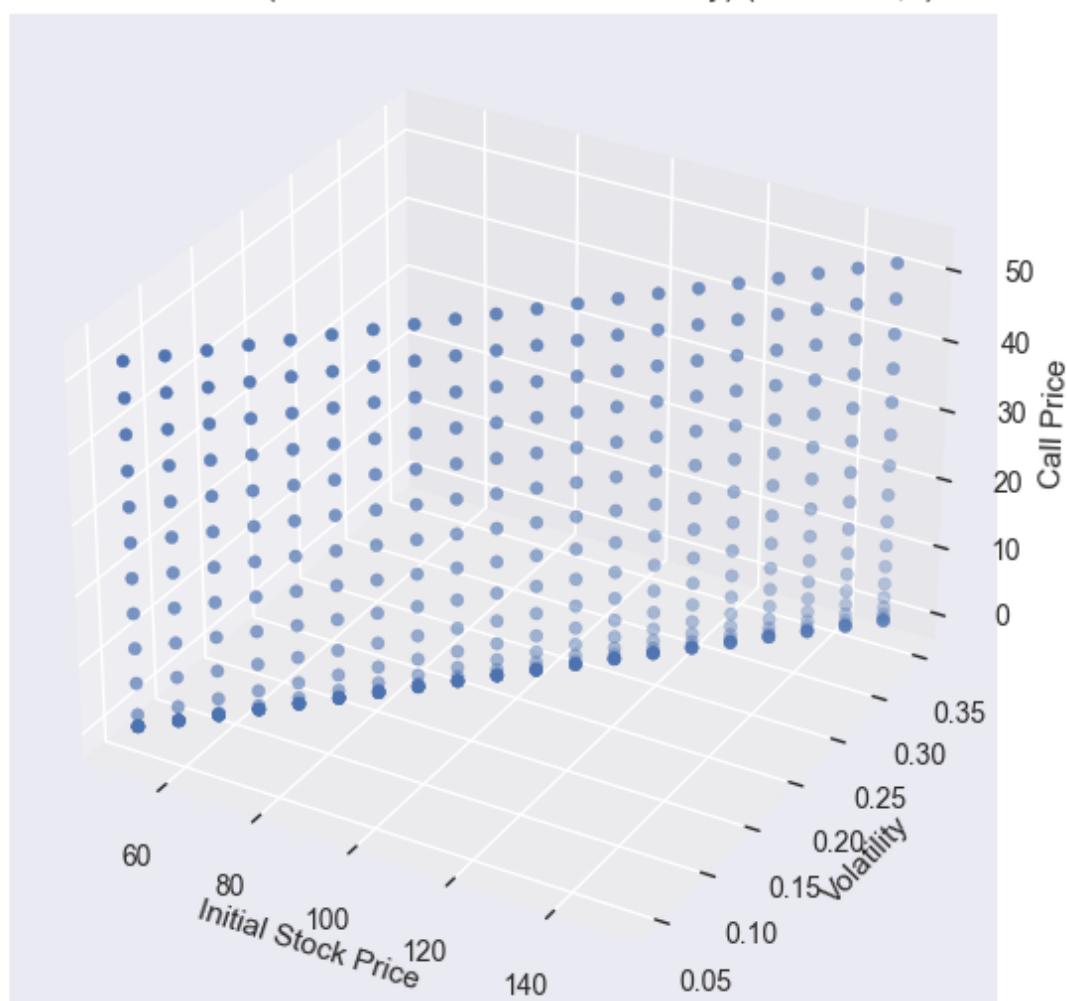
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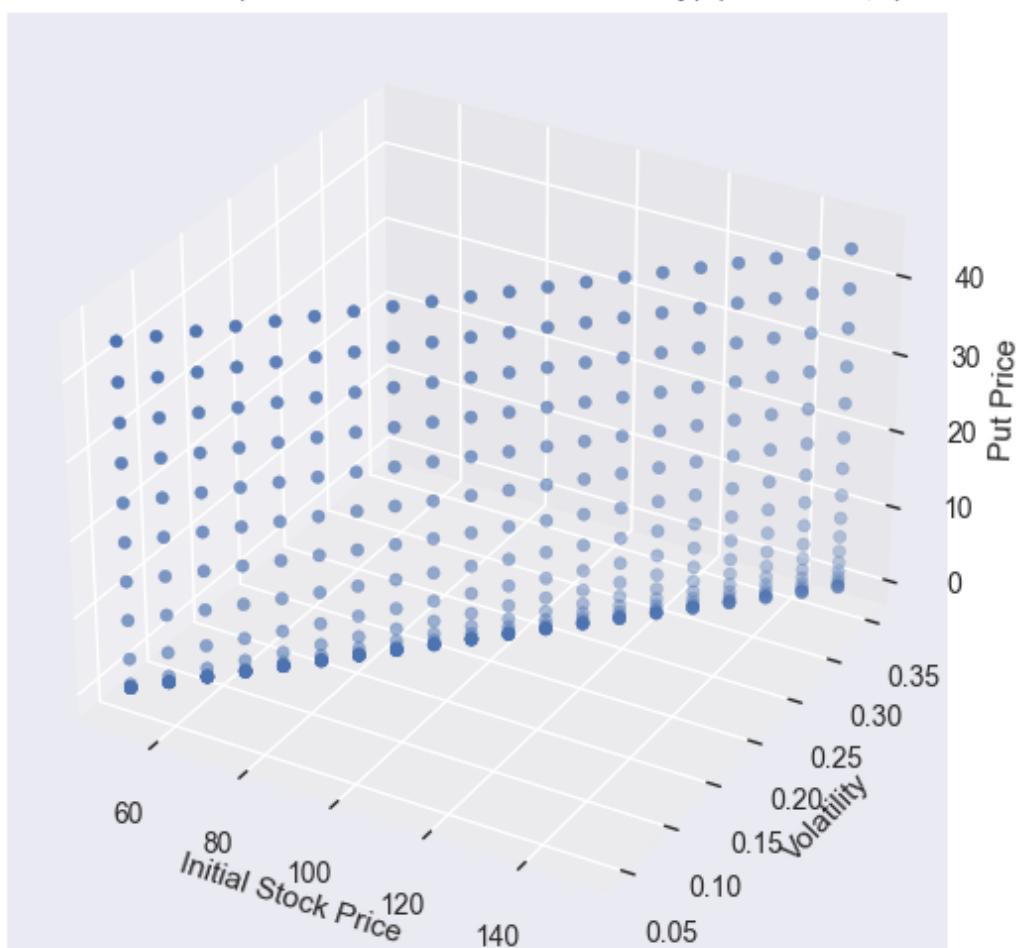
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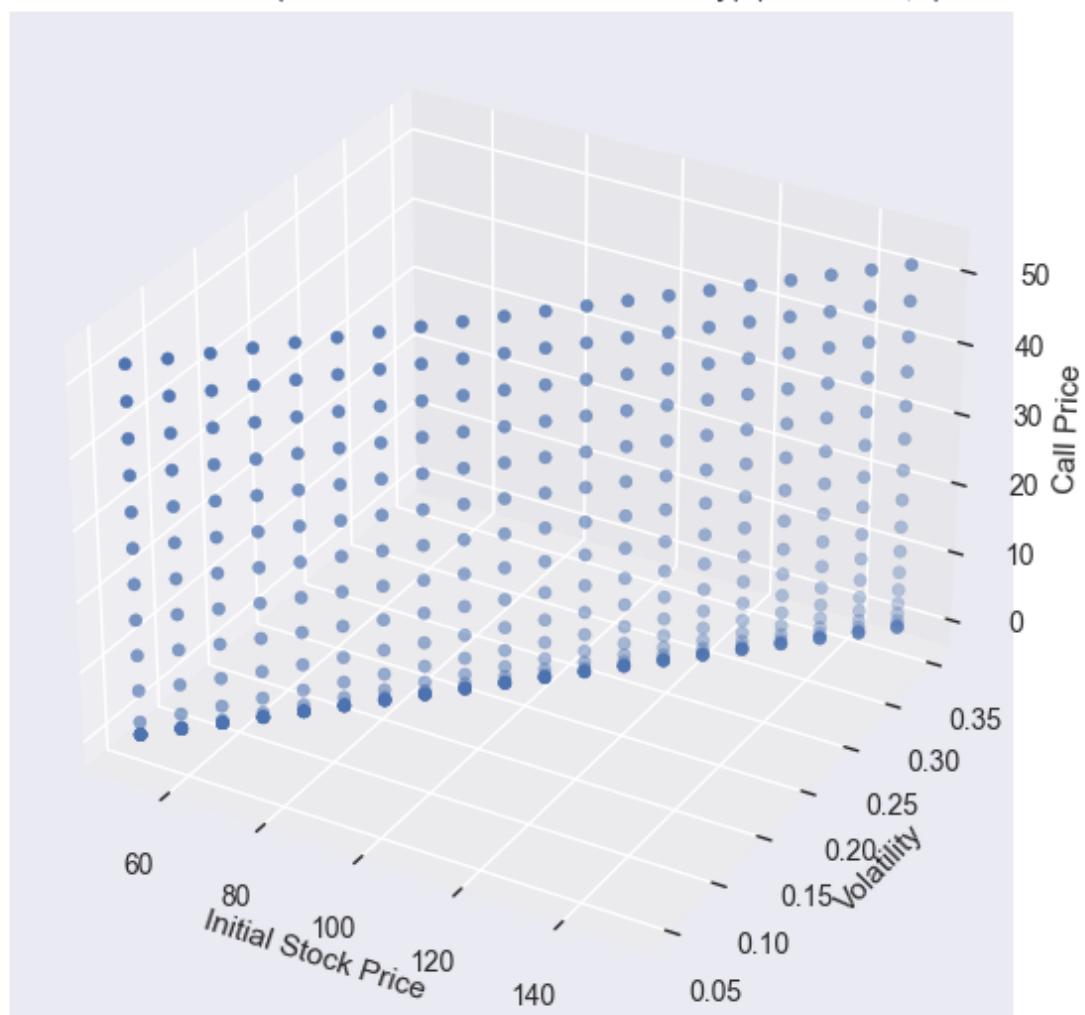
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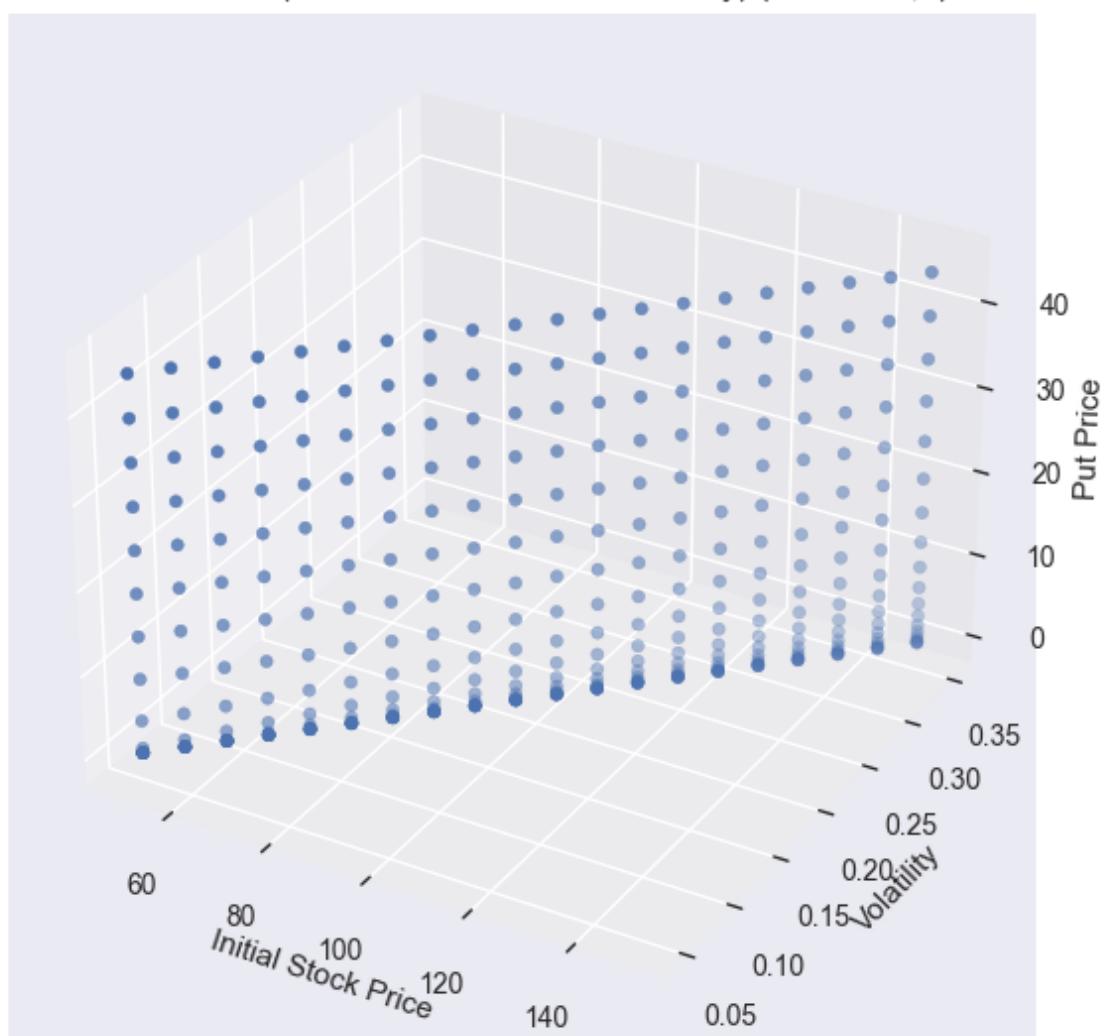
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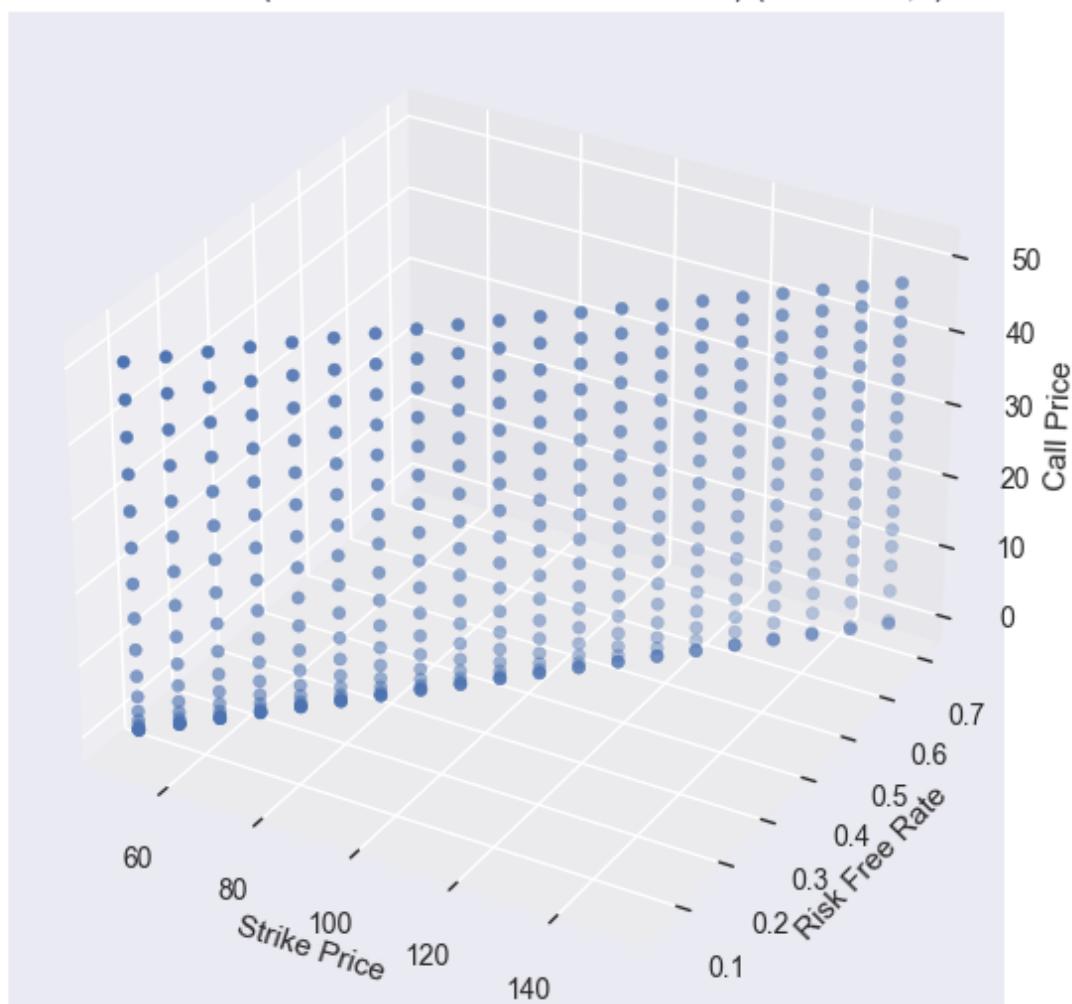
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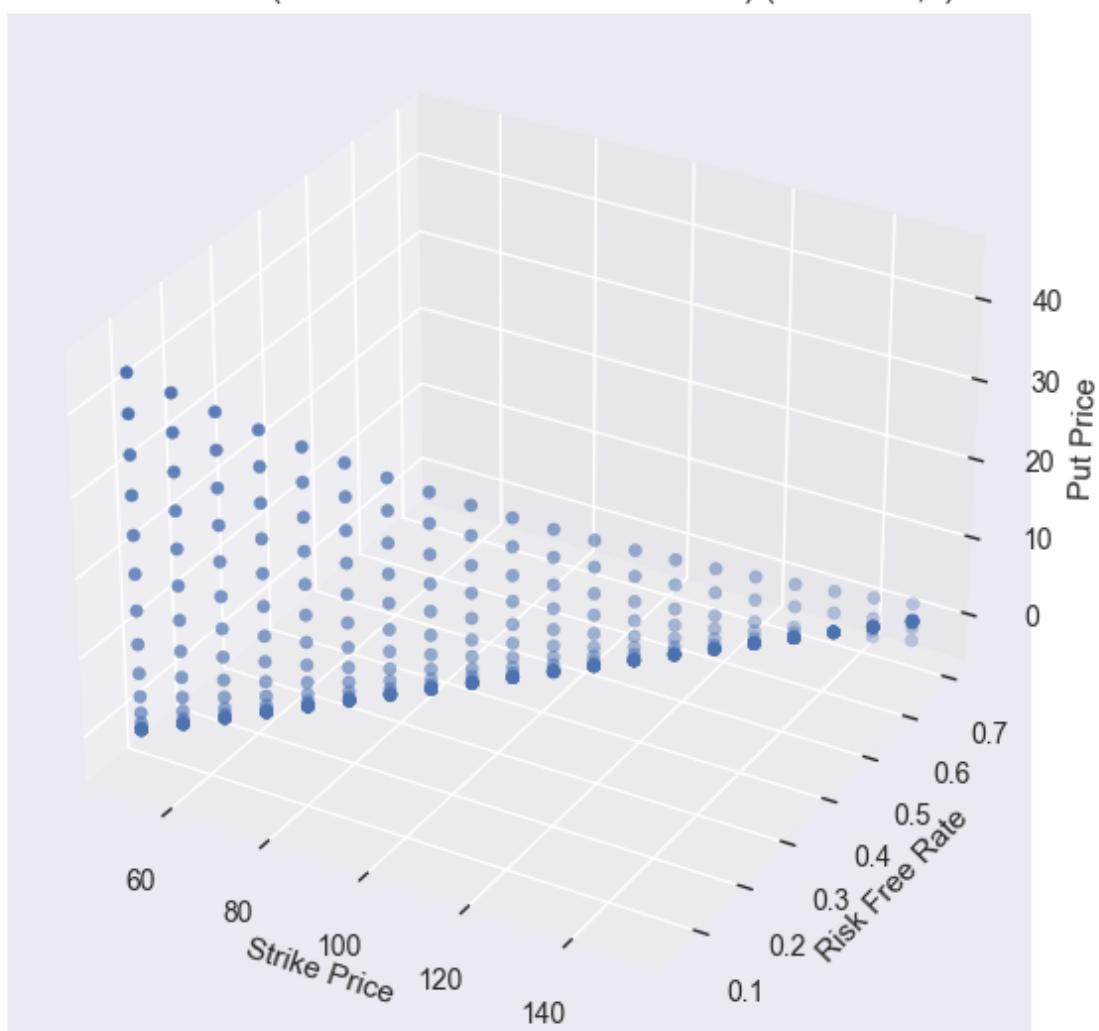
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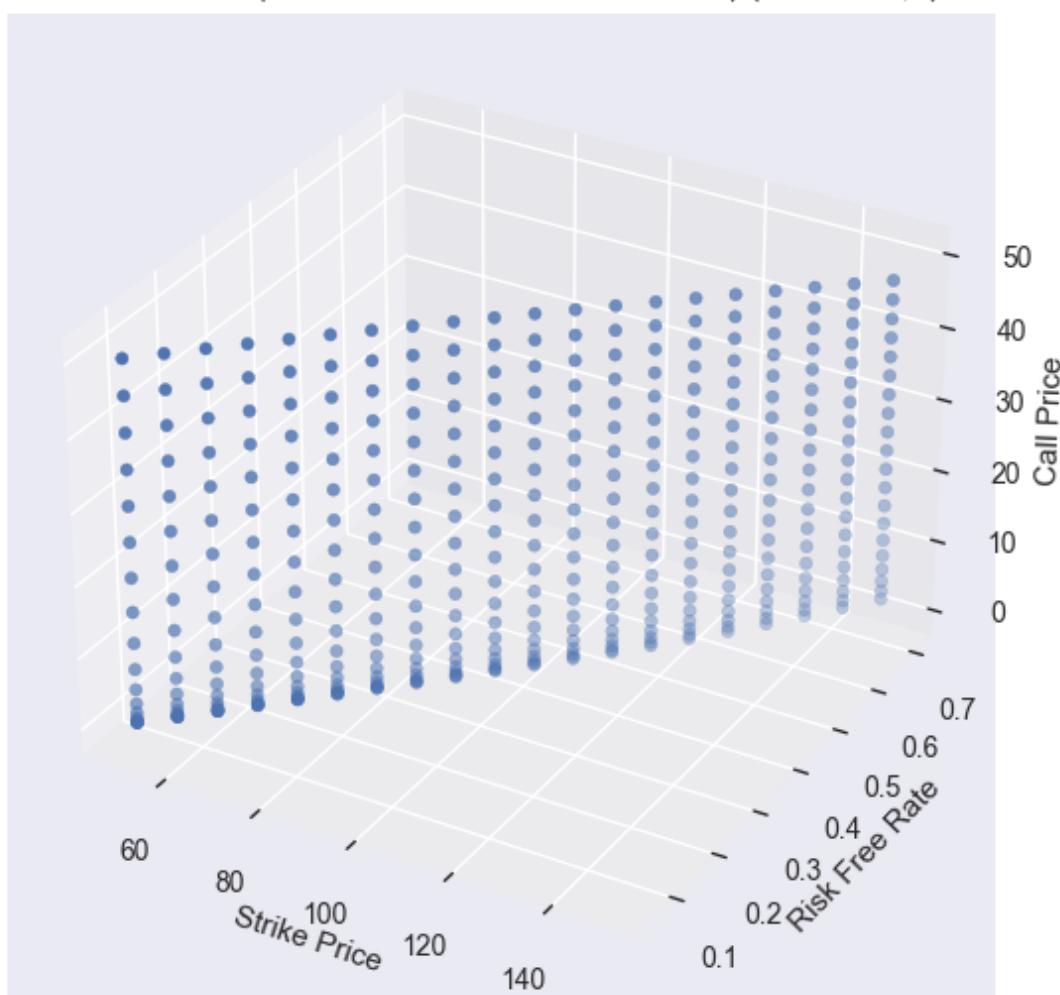
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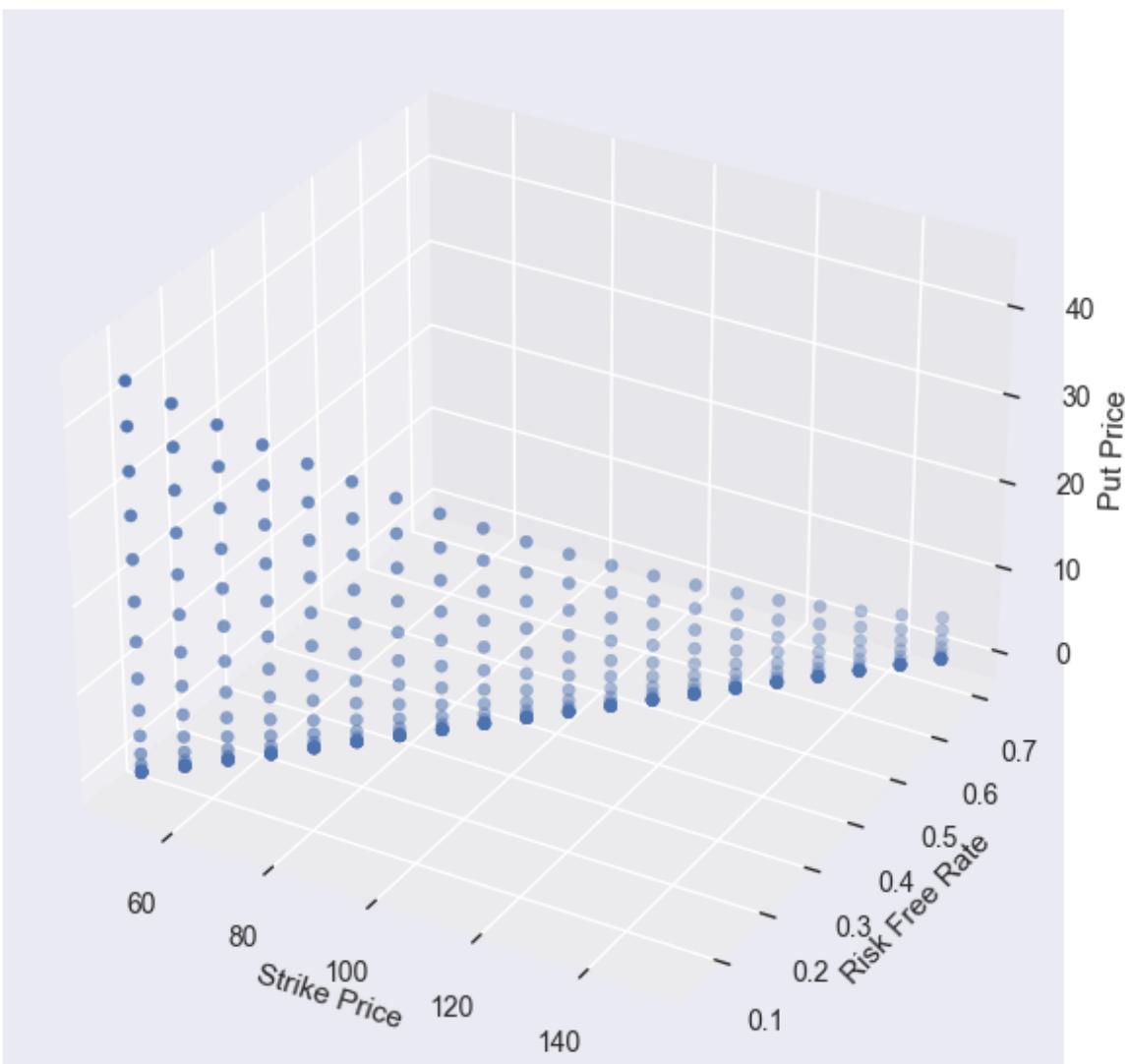
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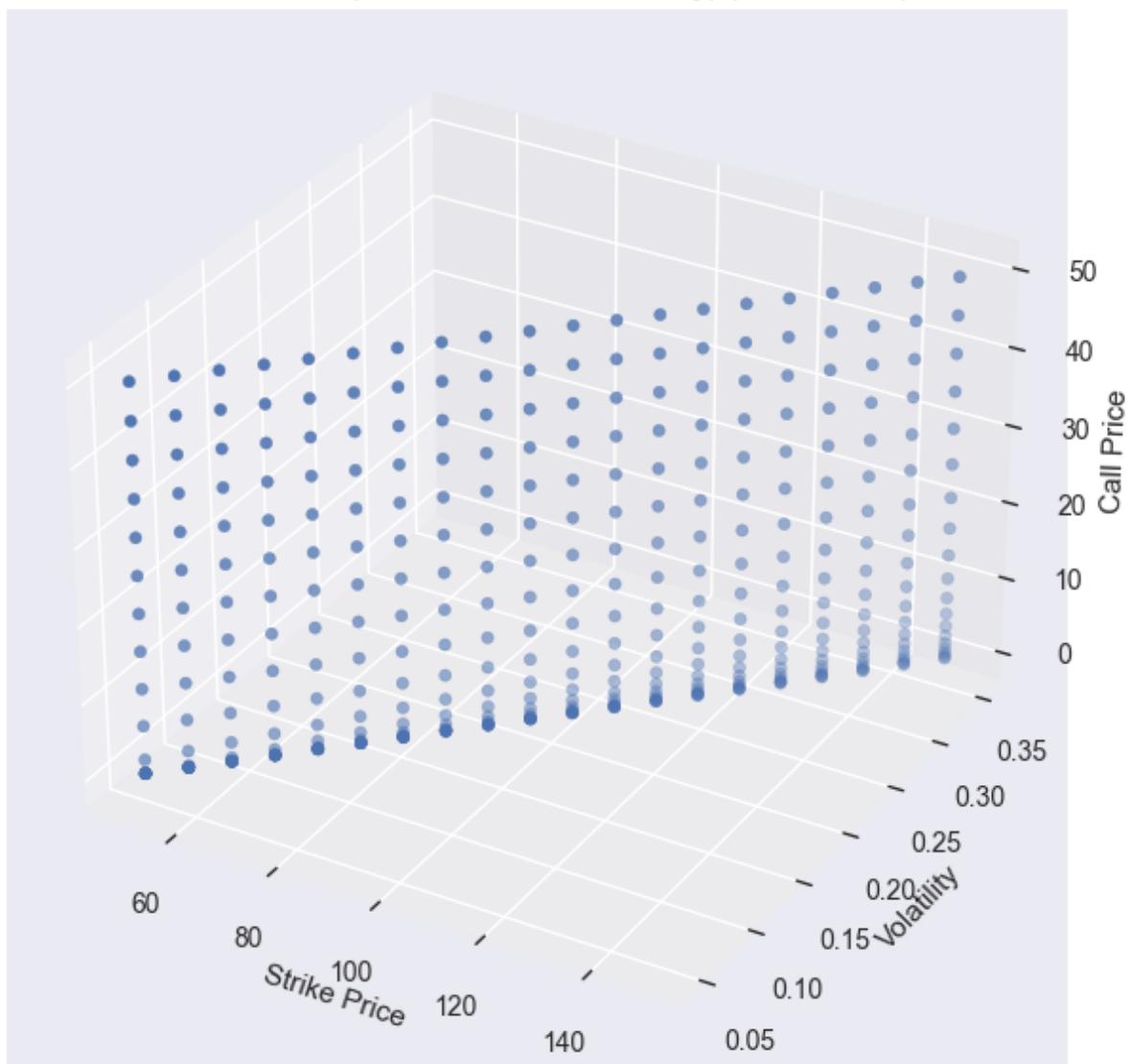
Call Price vs (Strike Price and Risk Free Rate) (Set 2 of u,d)



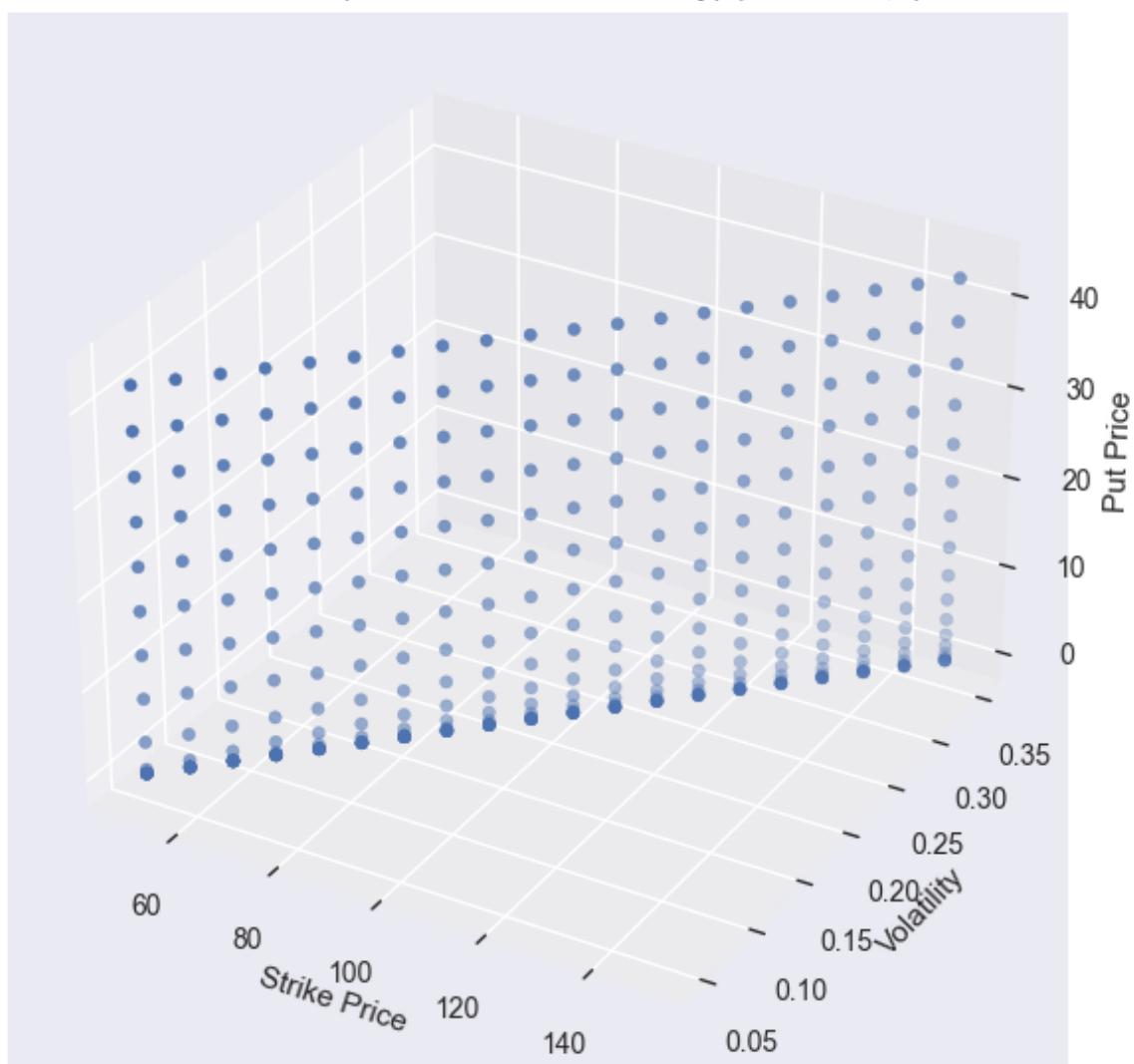
Put Price vs (Strike Price and Risk Free Rate) (Set 2 of u,d)



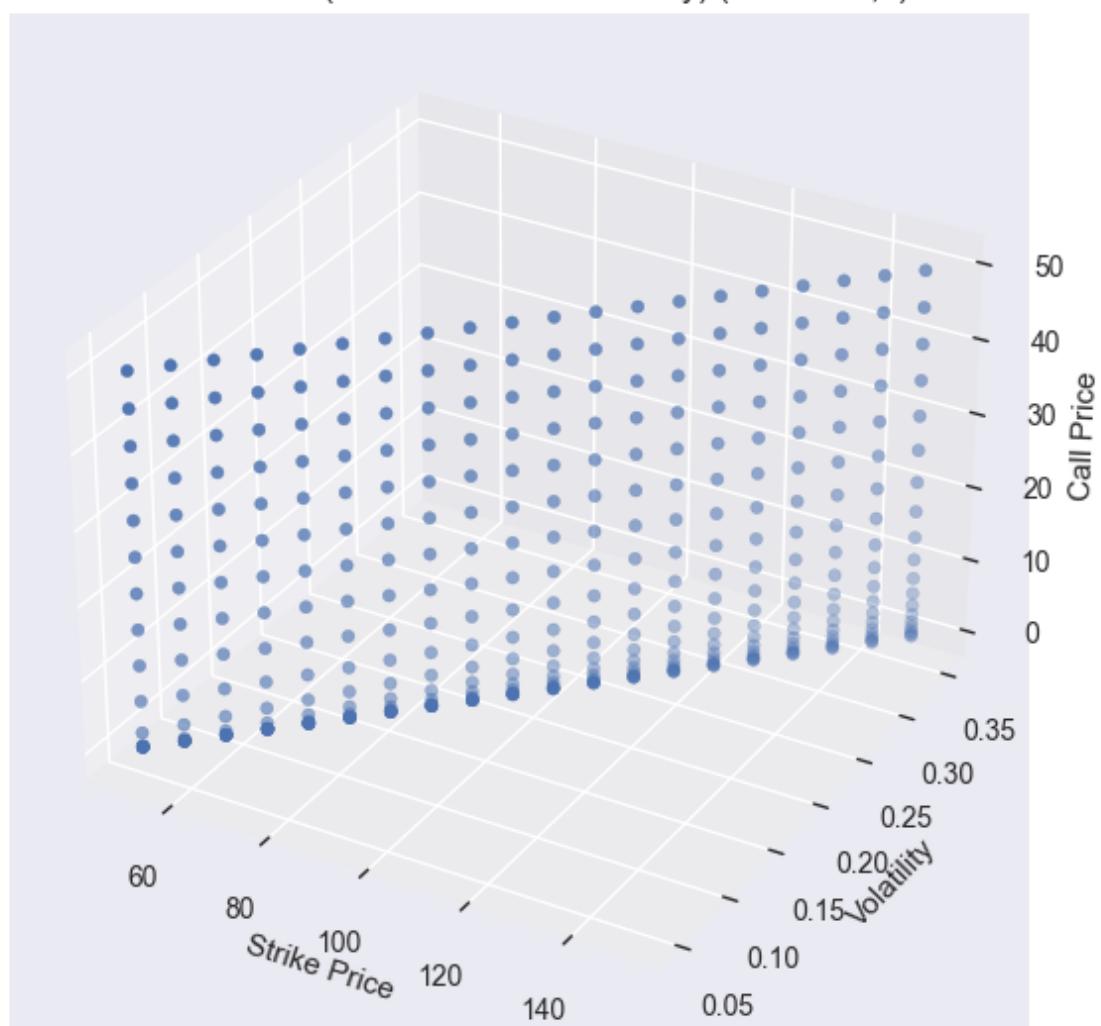
Call Price vs (Strike Price and Volatility) (Set 1 of u,d)



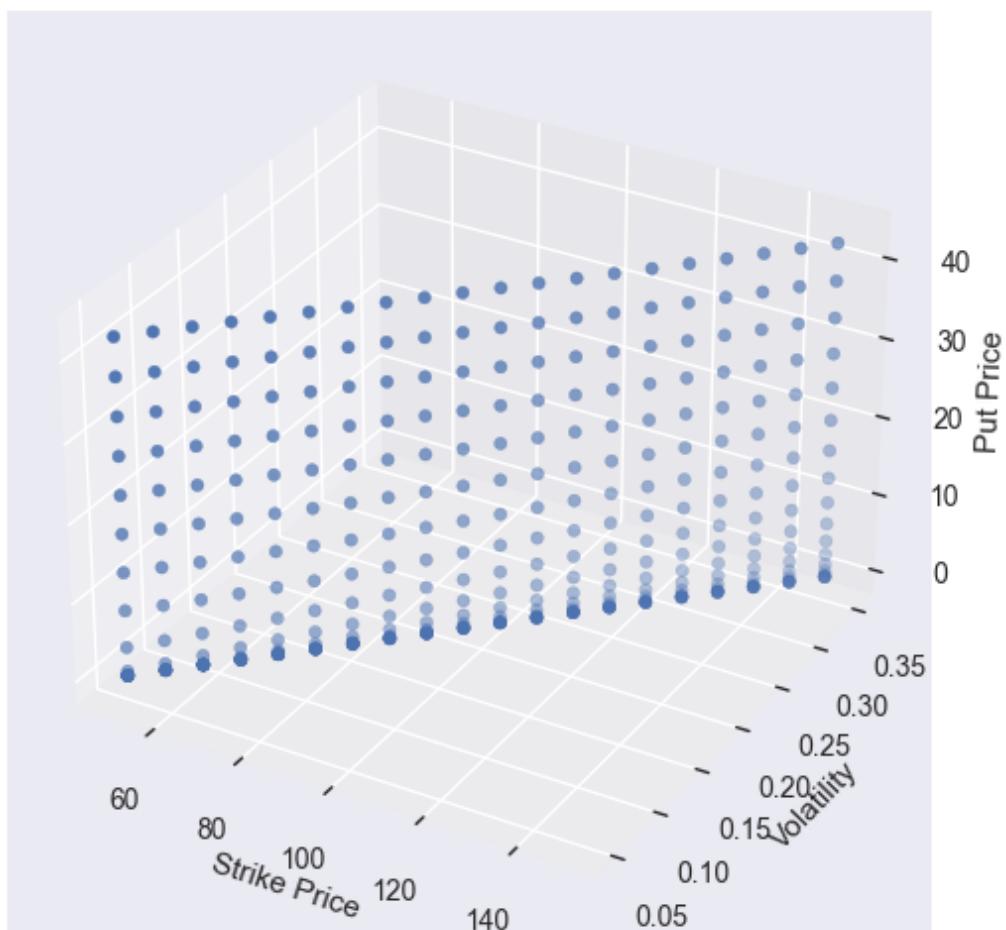
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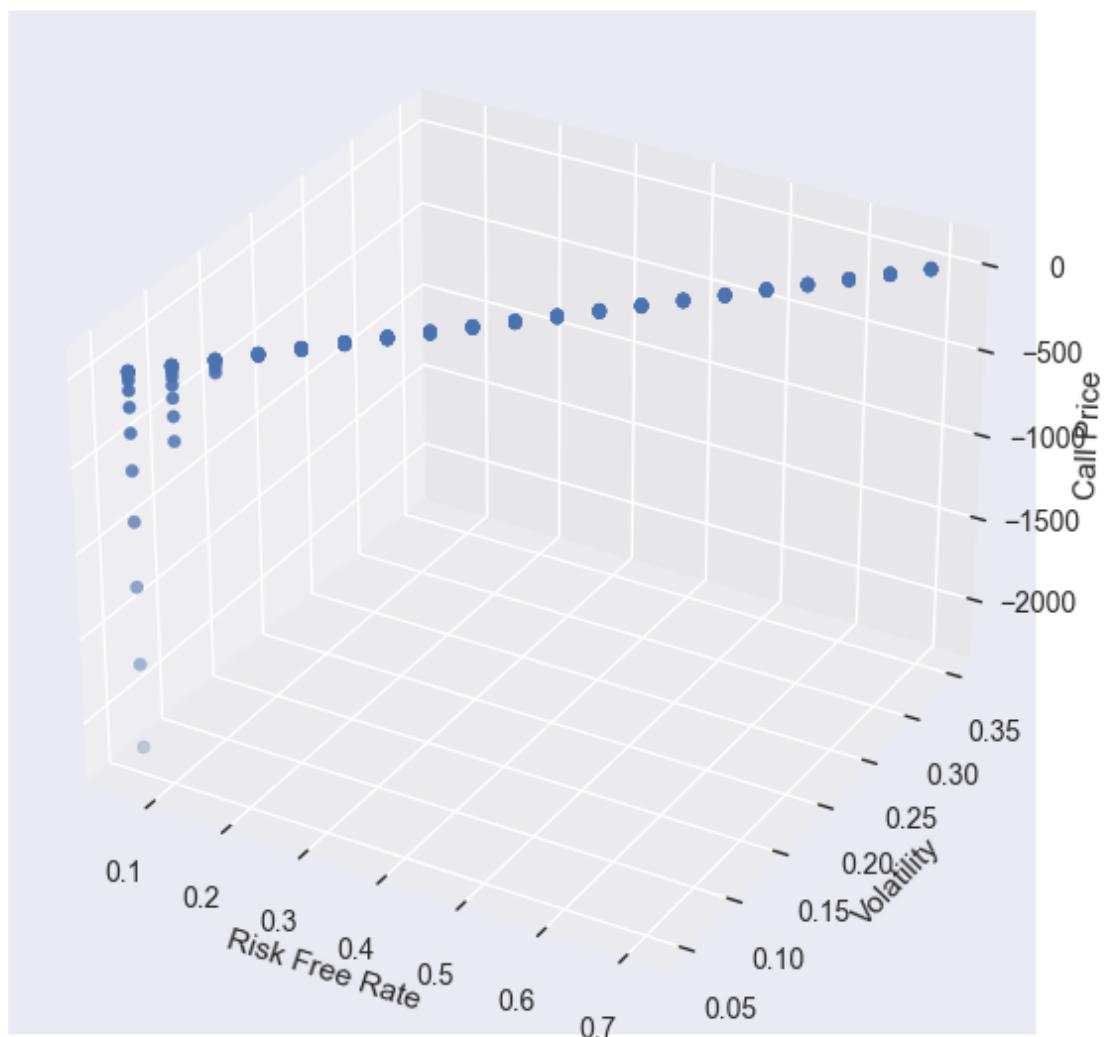
Call Price vs (Strike Price and Volatility) (Set 2 of u,d)



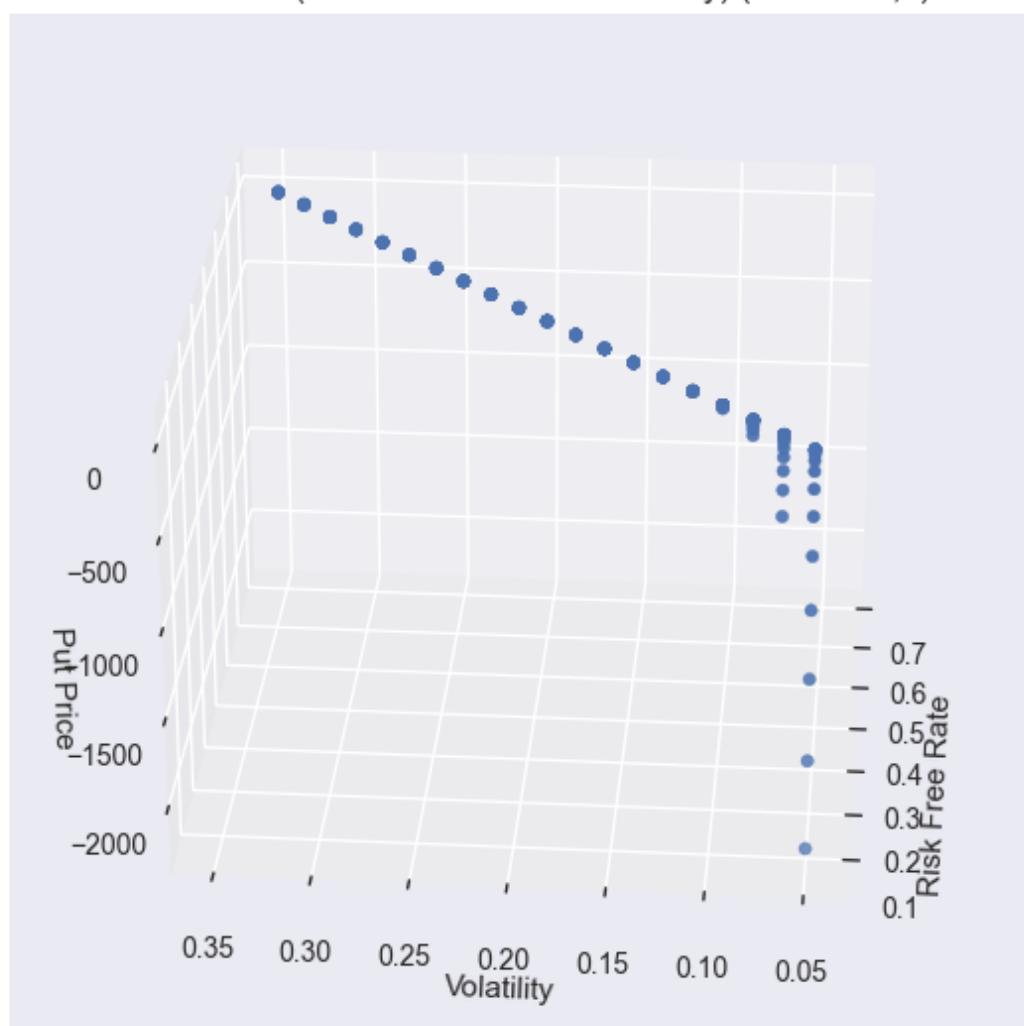
Put Price vs (Strike Price and Volatility) (Set 2 of u,d)



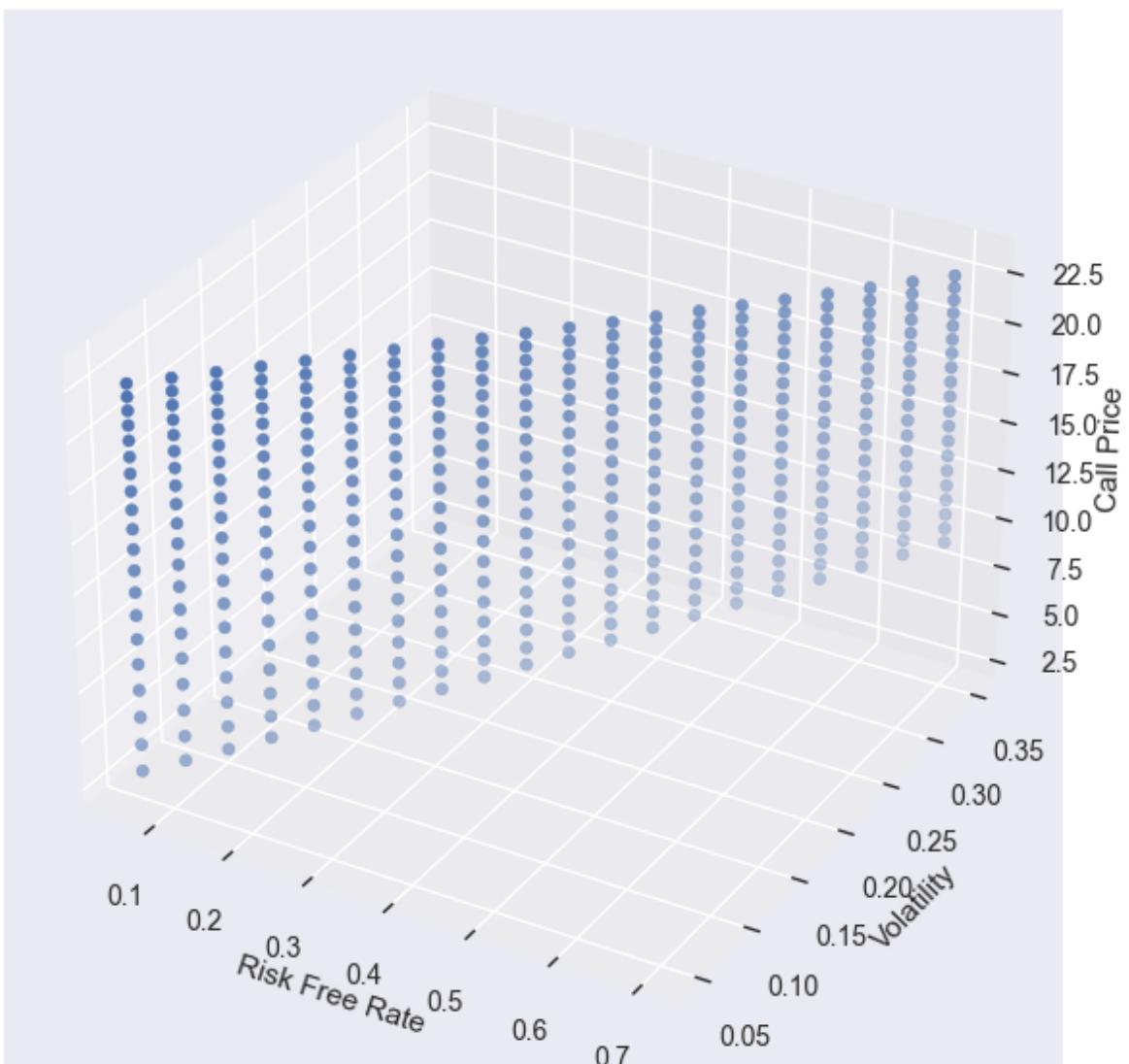
Call Price vs (Risk Free Rate and Volatility) (Set 1 of u,d)



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



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



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

