



भारतीय प्रौद्योगिकी संस्थान गुवाहाटी
INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI

MA 374: Financial Engineering Lab

Lab 09

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18th Mar 2021

Note: 

1. All plots are inside the **/Plots** folder.
2. Please run python programs using **python3**, i.e. `python3 <filename>.py`

Question 01.

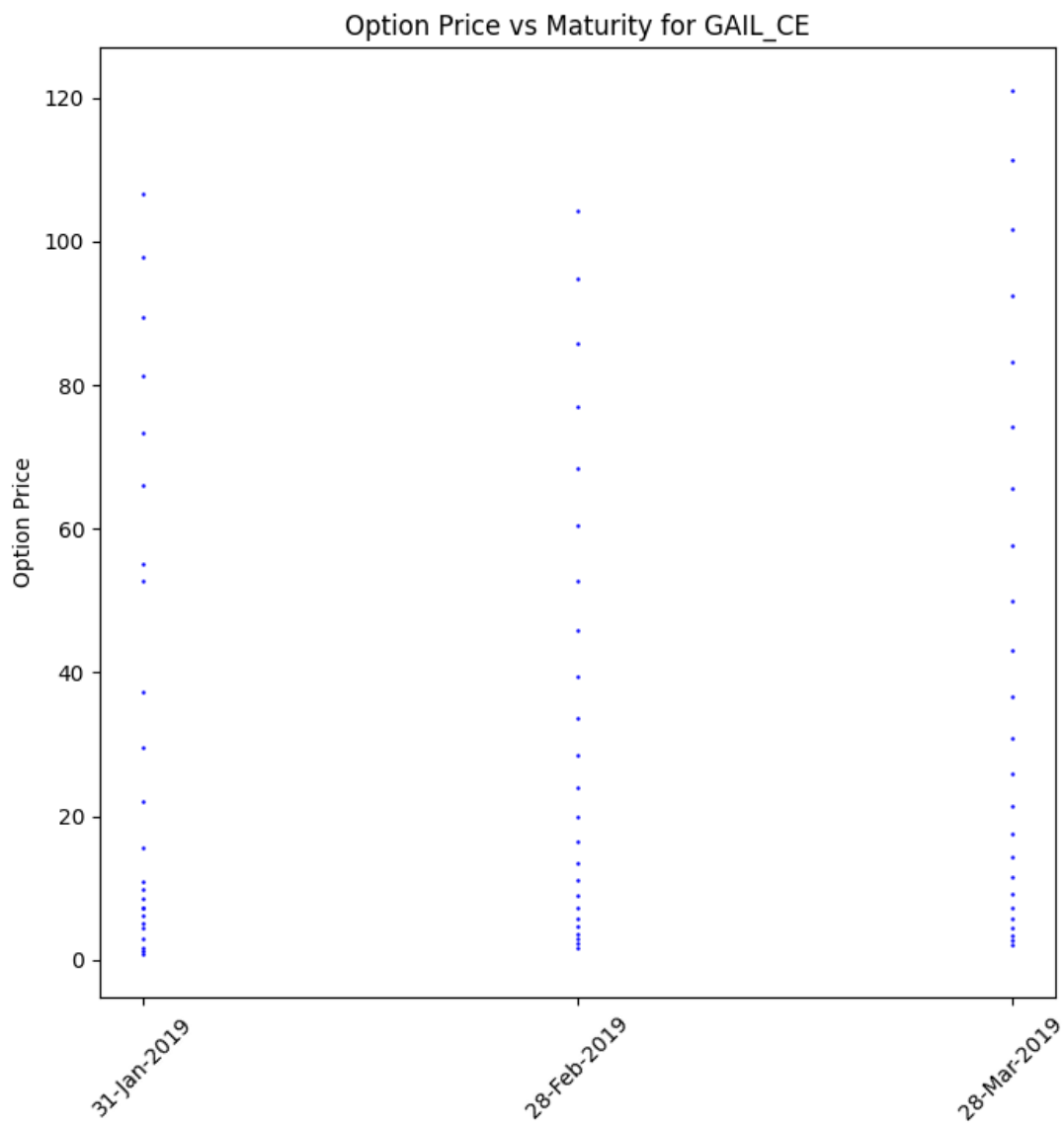
For this question, historical data was collected, from [National Stock Exchange of India Ltd.](#) website, for 4 different companies in NIFTY, i.e., **GAIL, IOC, ONGC,** and **TATAMOTORS**. The expiry time and strike prices were set to variable, and the rest of parameters were fixed. Data for PE and CE was obtained in different csv files and put in corresponding folders. (This was done for convenience in graph plotting. All the data was also finally put in a file called **stockoptiondata**.)

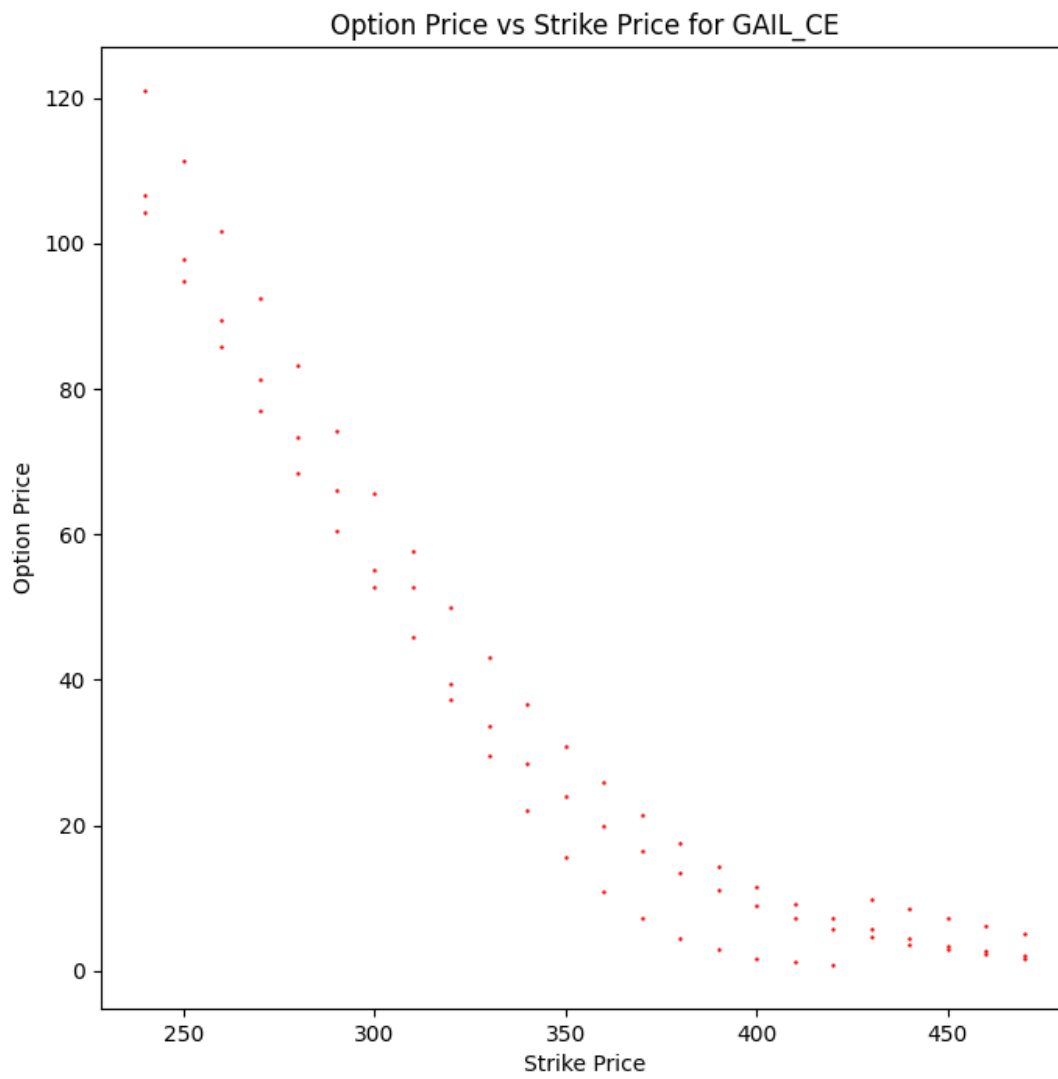
Question 02.

For this question, the option prices were plotted against range of maturities and strike prices in three dimensions and also against each of these 2 parameters in 2D. The plots are as shown below.

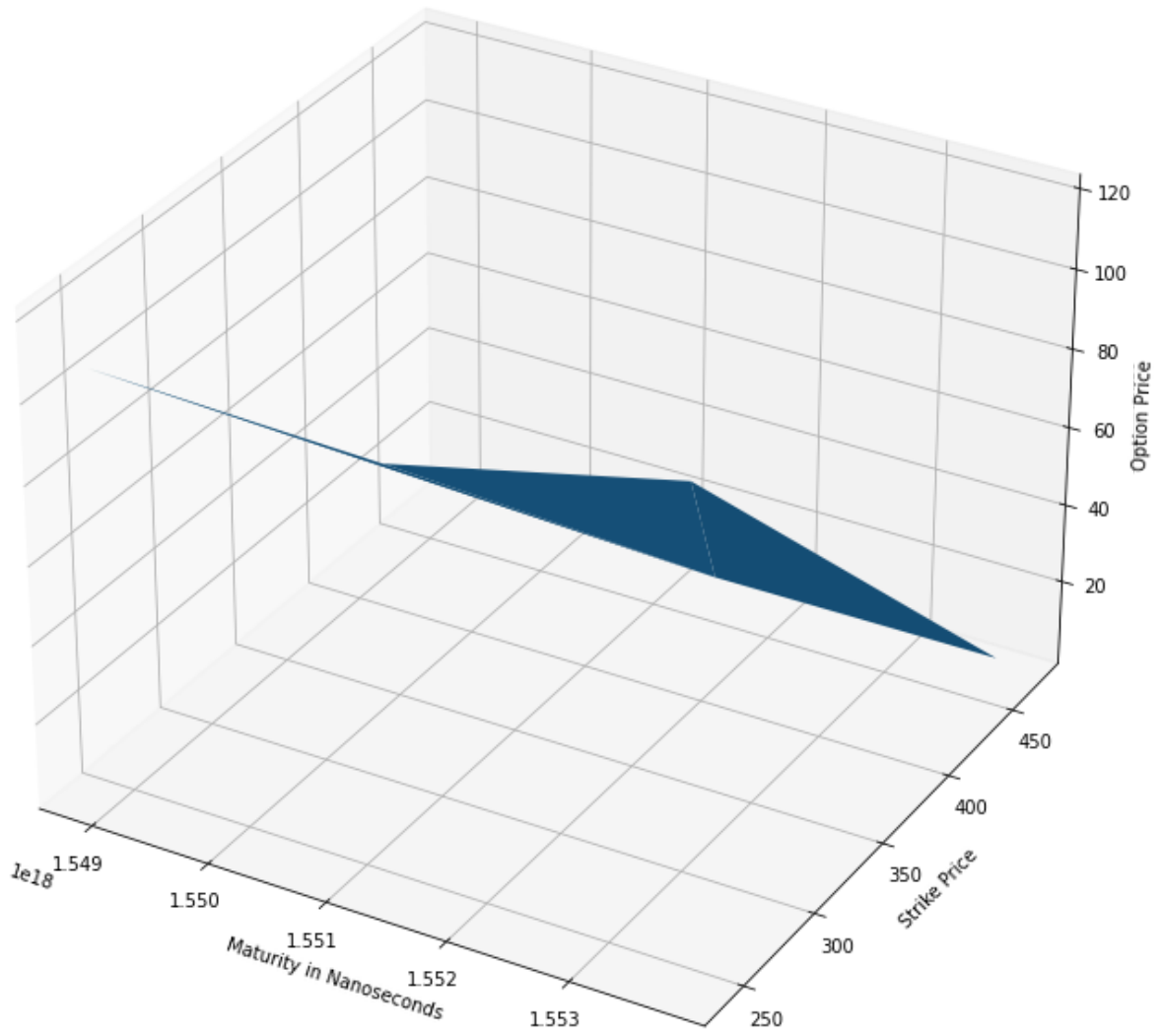
When we visualise the above plots in 2D, that is by considering the value of option price vs maturity and strike price, we observe that:

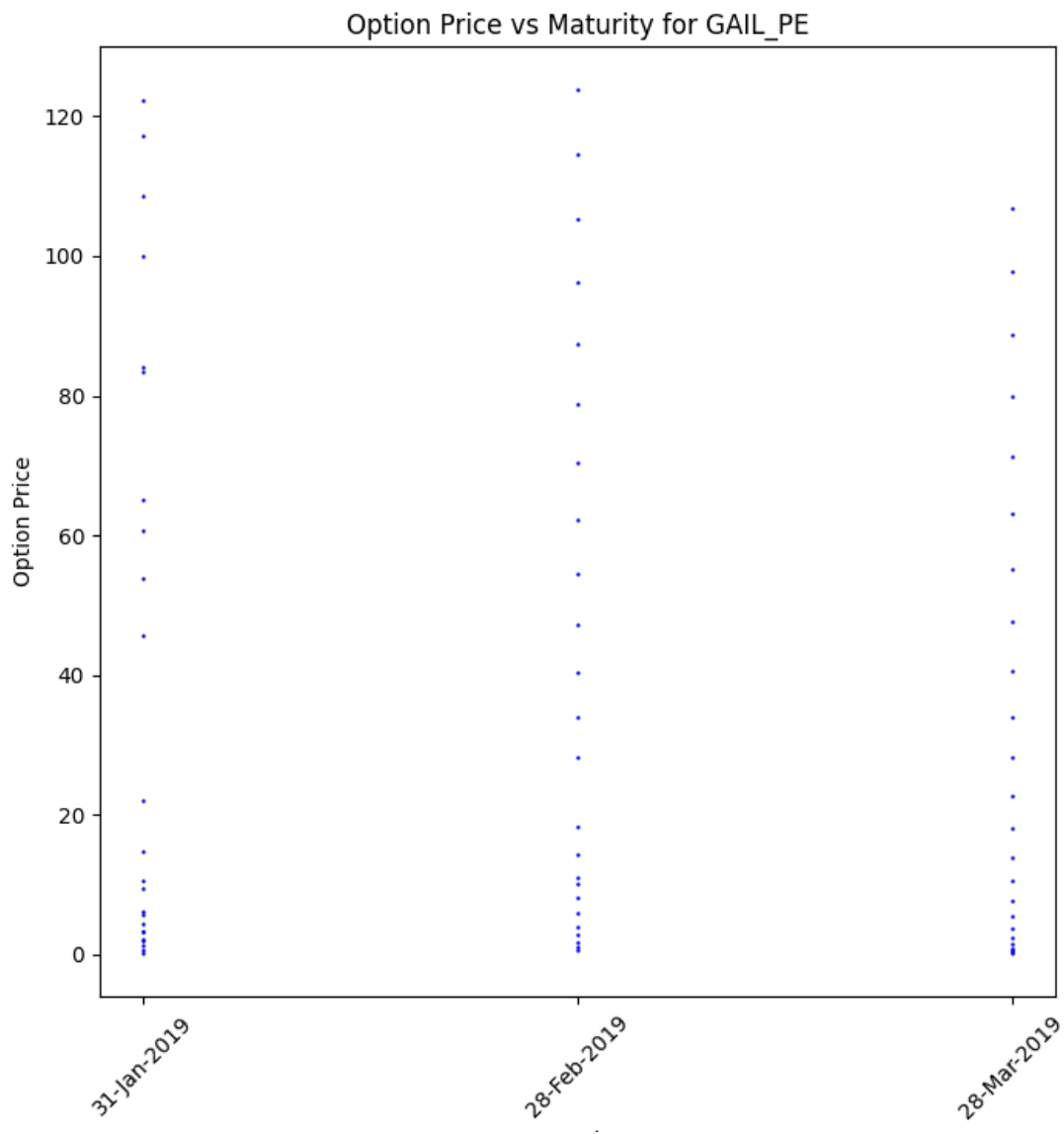
- The option prices (both call and put) are evenly distributed at the maturity time points.
- The option prices increase with strike price if it's a put option and decrease if it's a call option, which is the expected behavior.

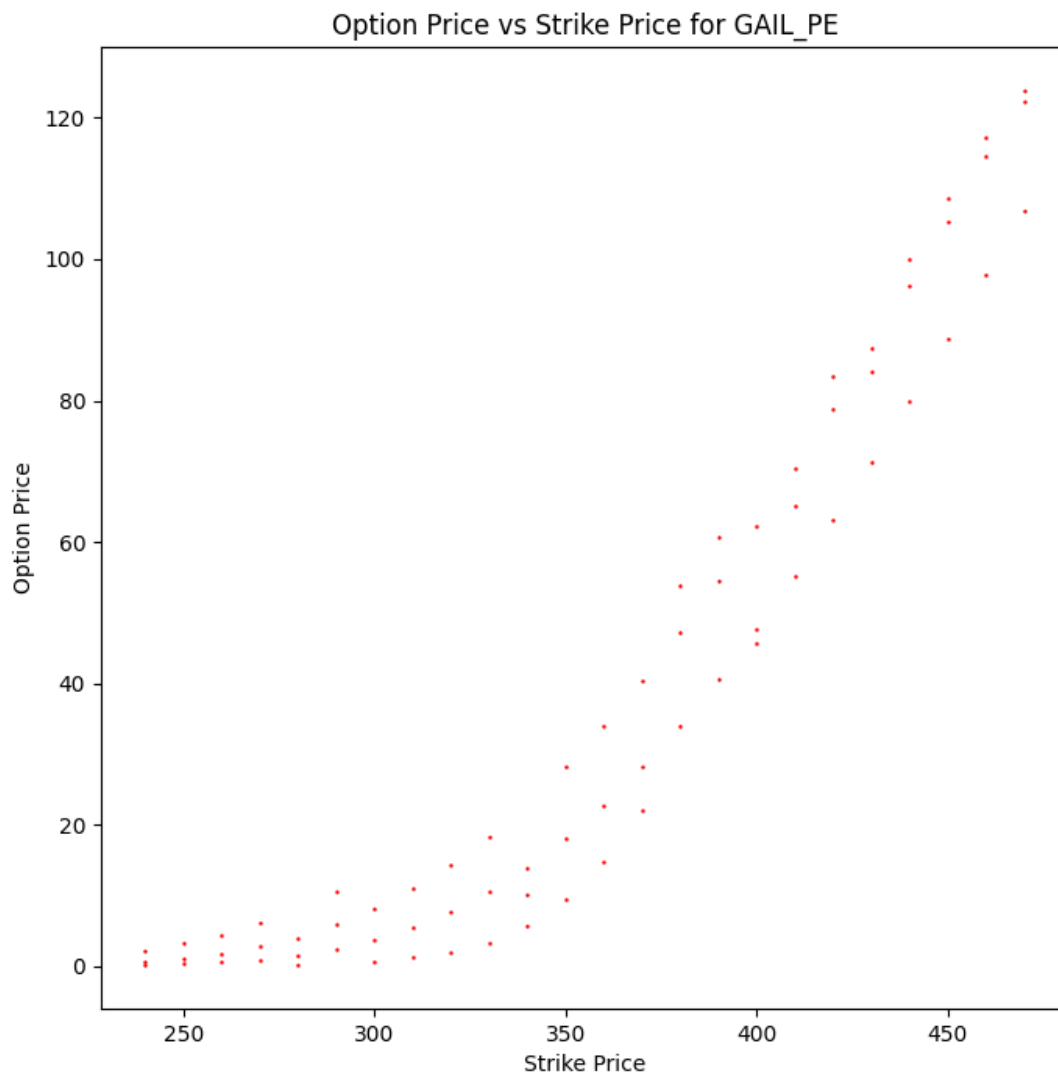




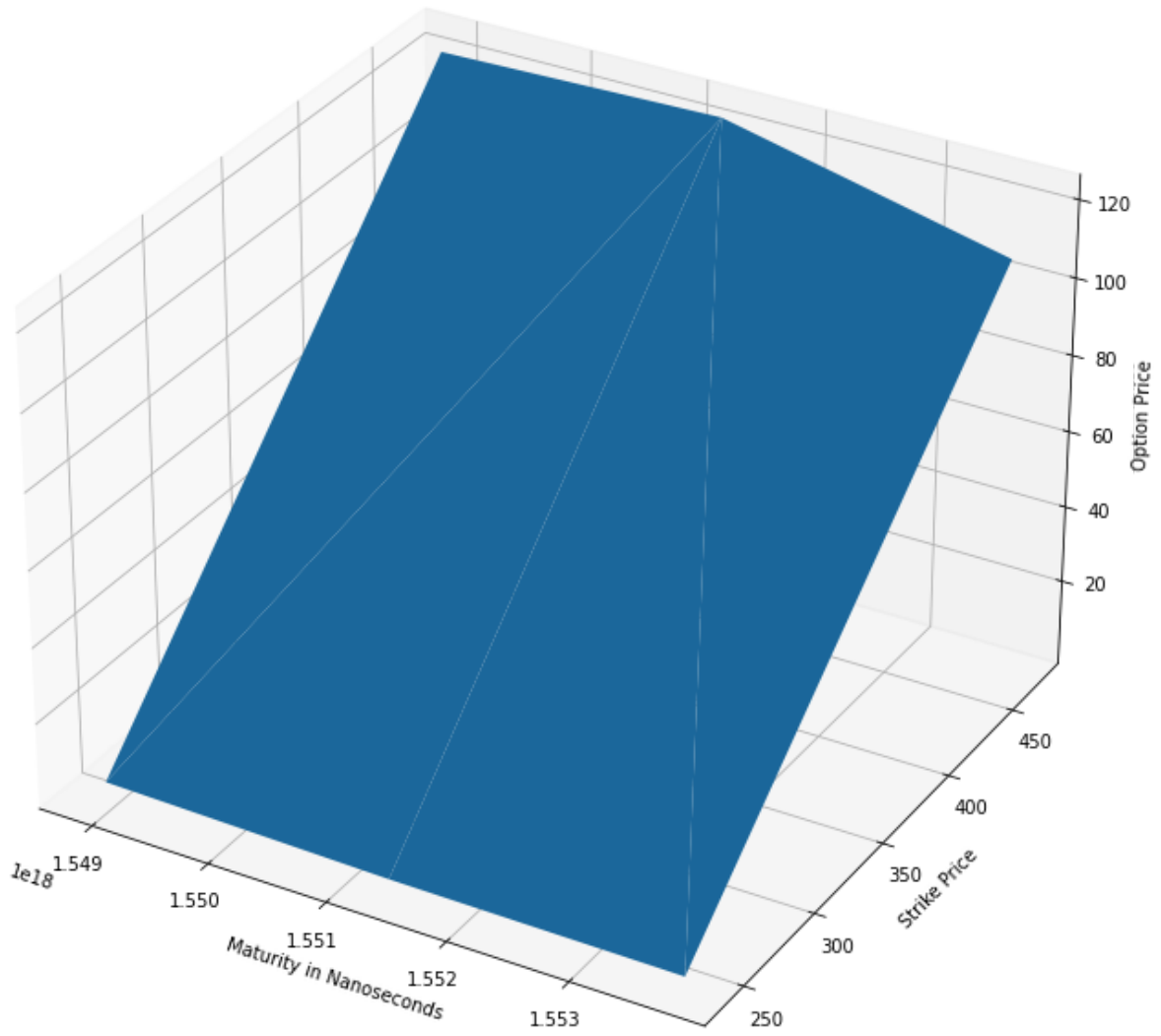
3D Plot for GAIL_CE

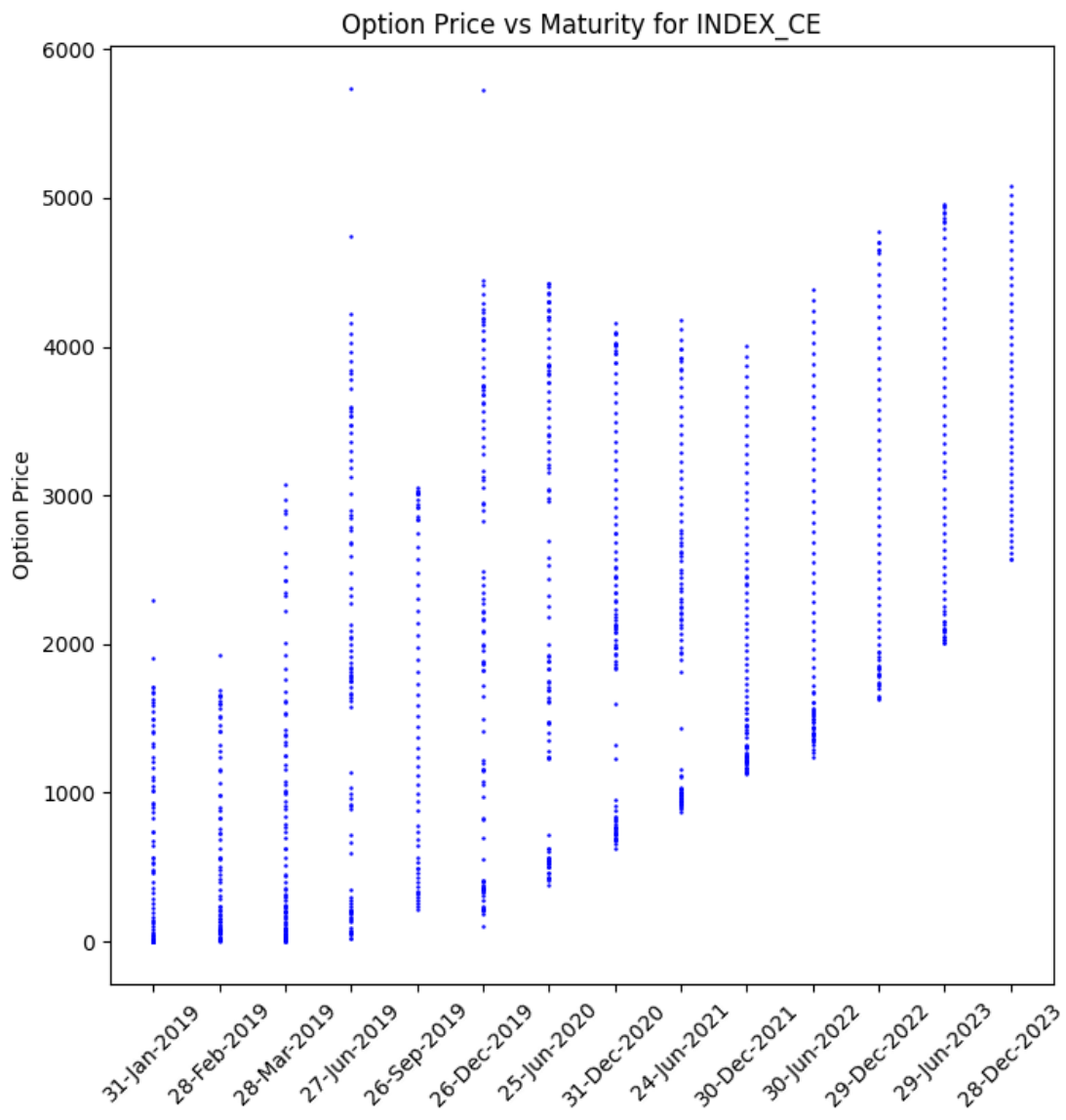


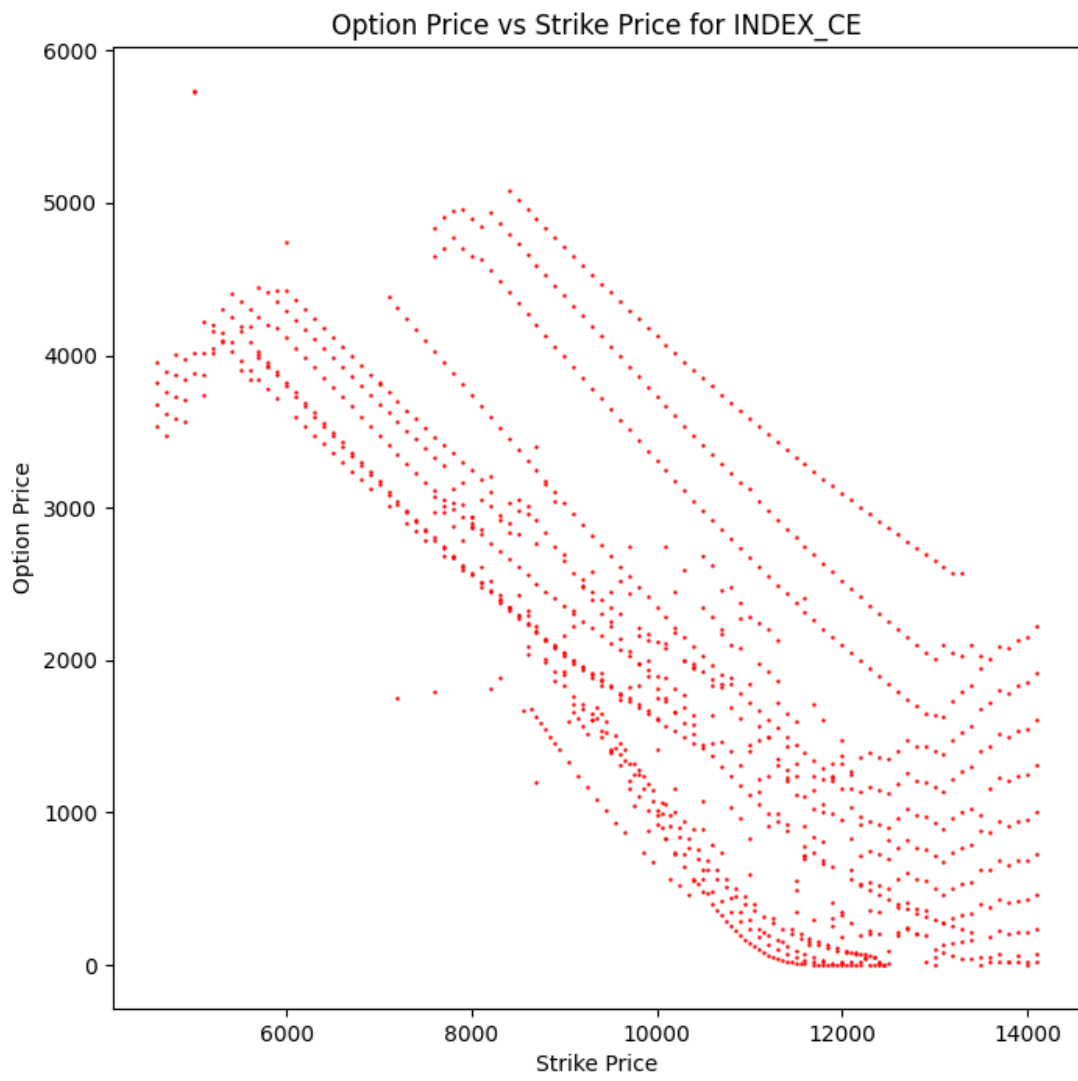




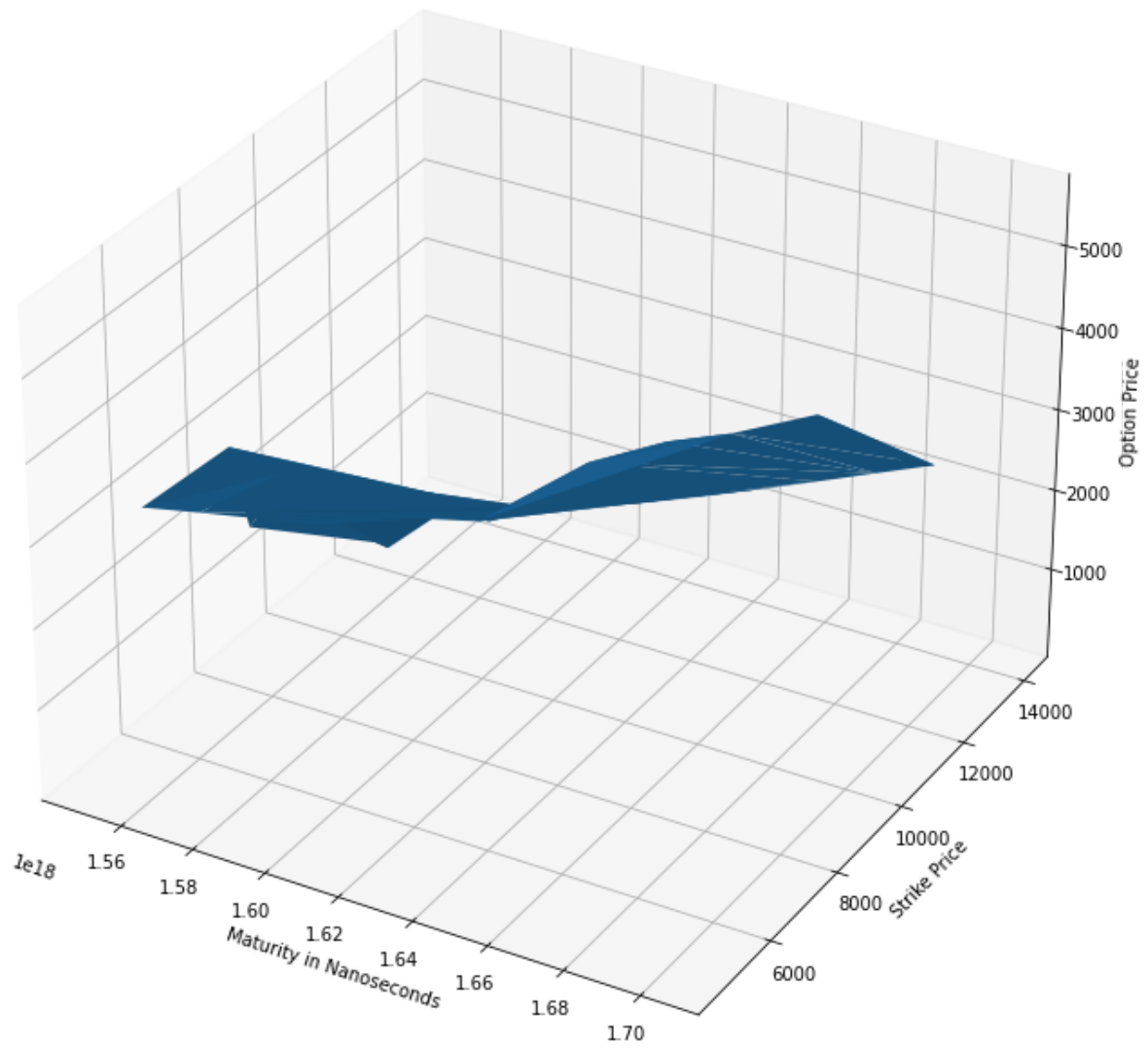
3D Plot for GAIL_PE

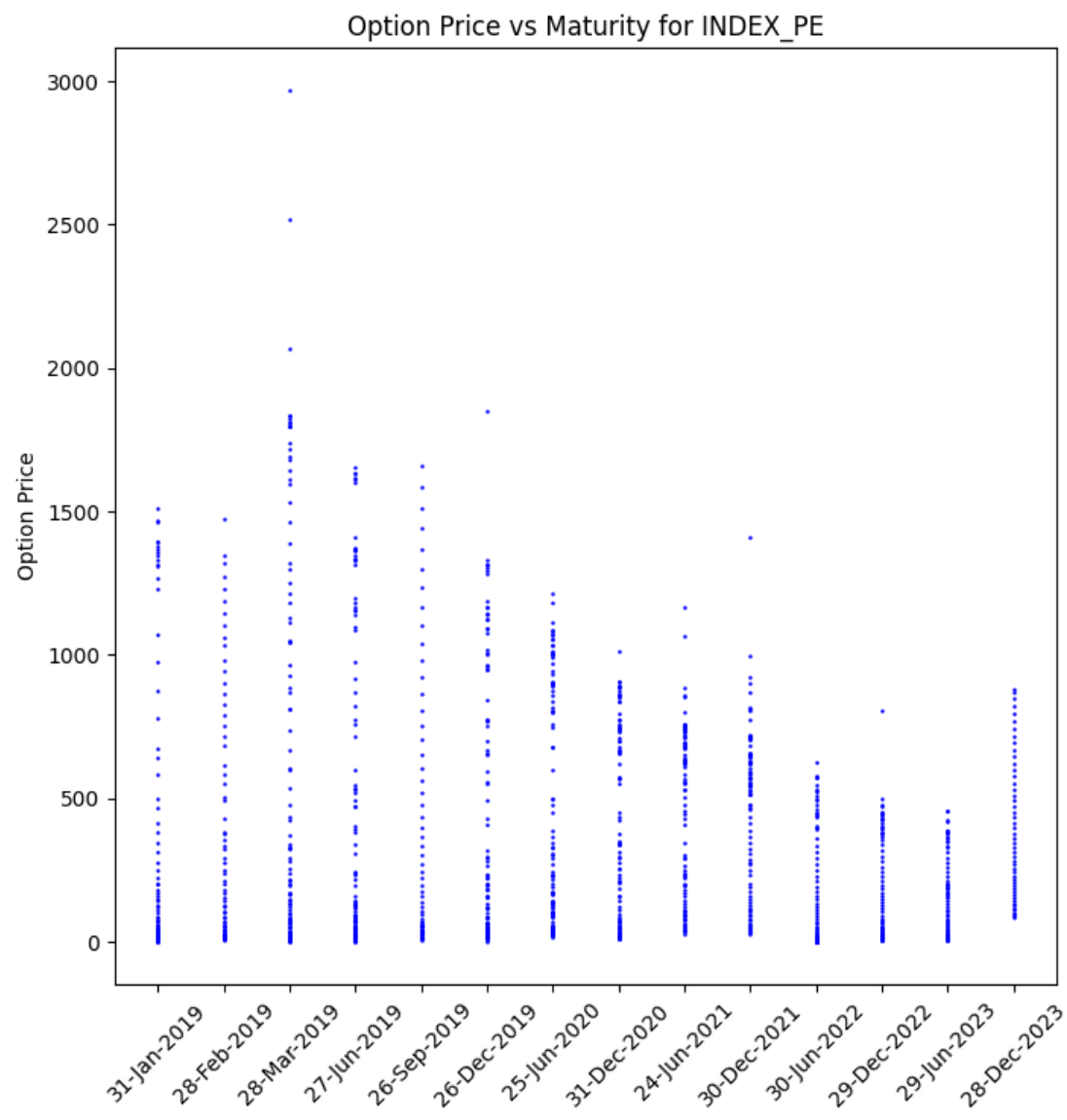






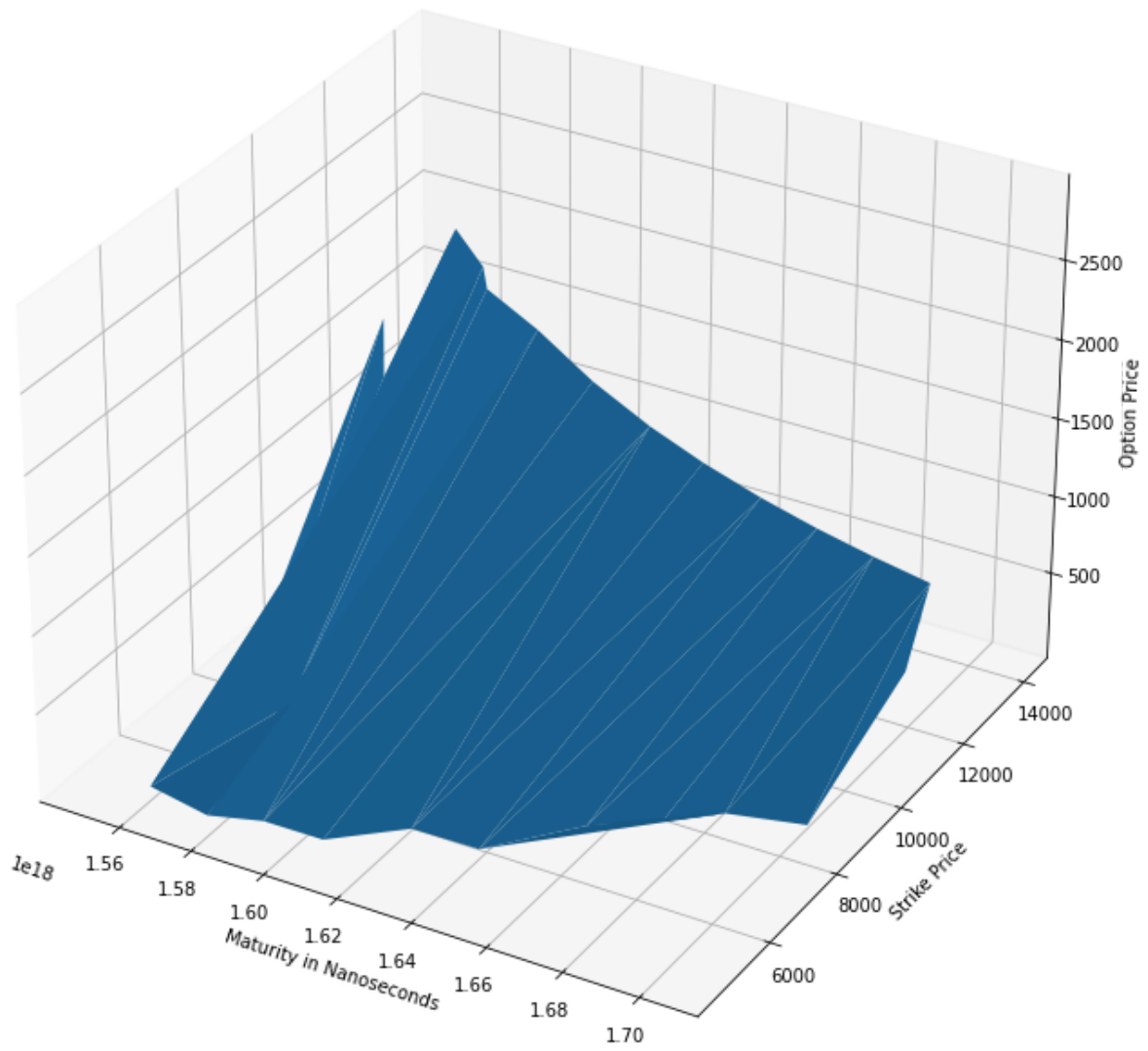
3D Plot for INDEX_CE

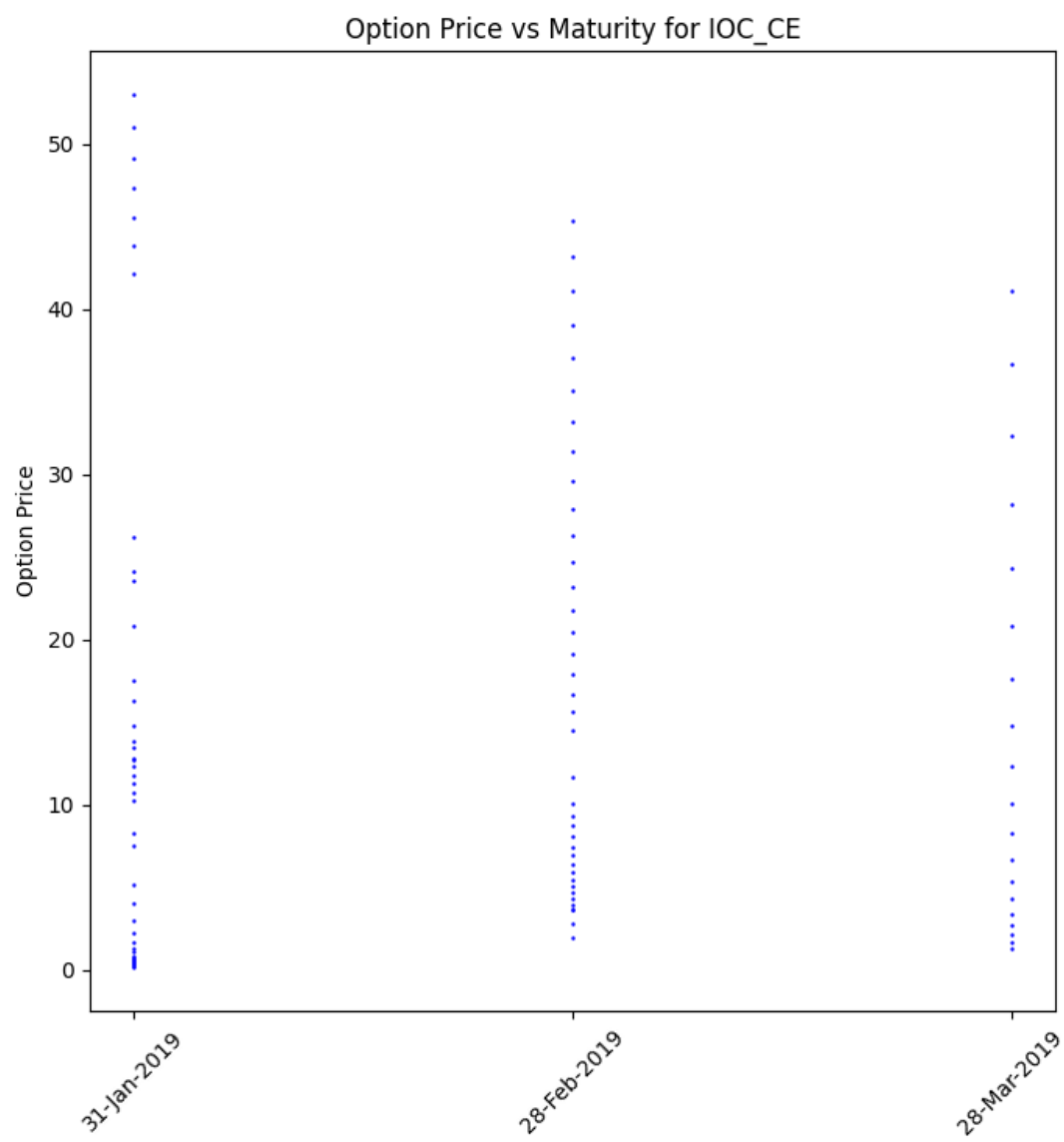


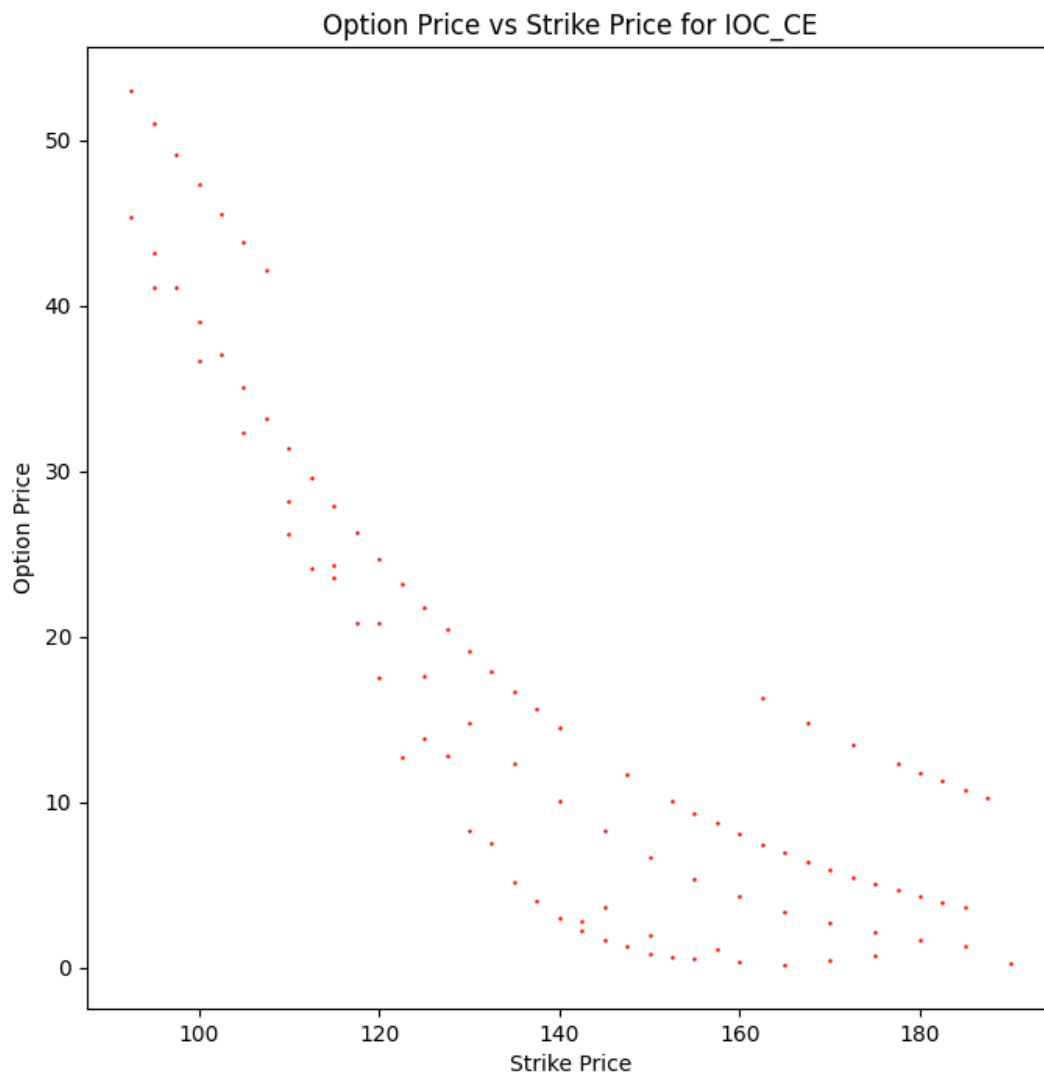




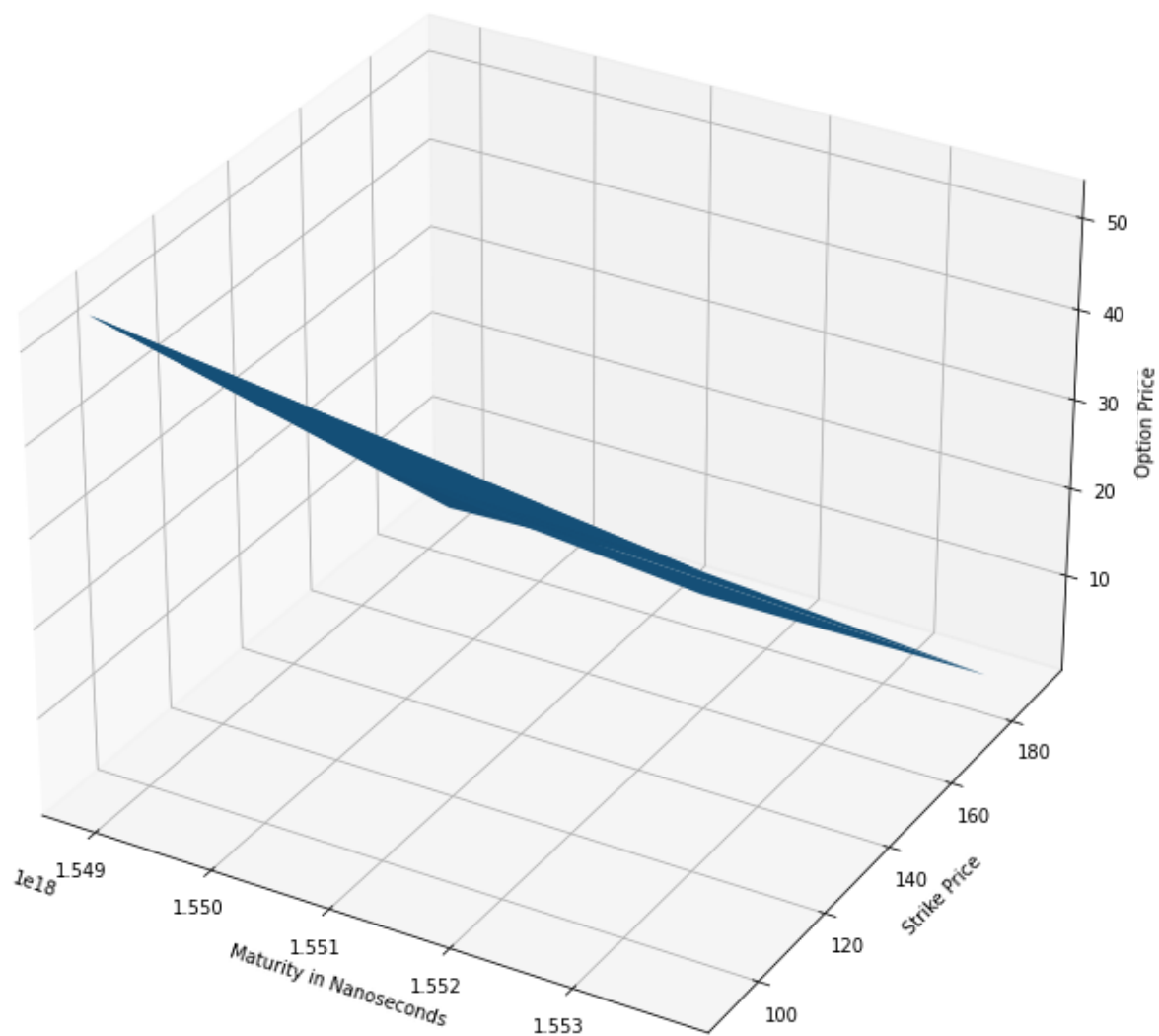
3D Plot for INDEX_PE

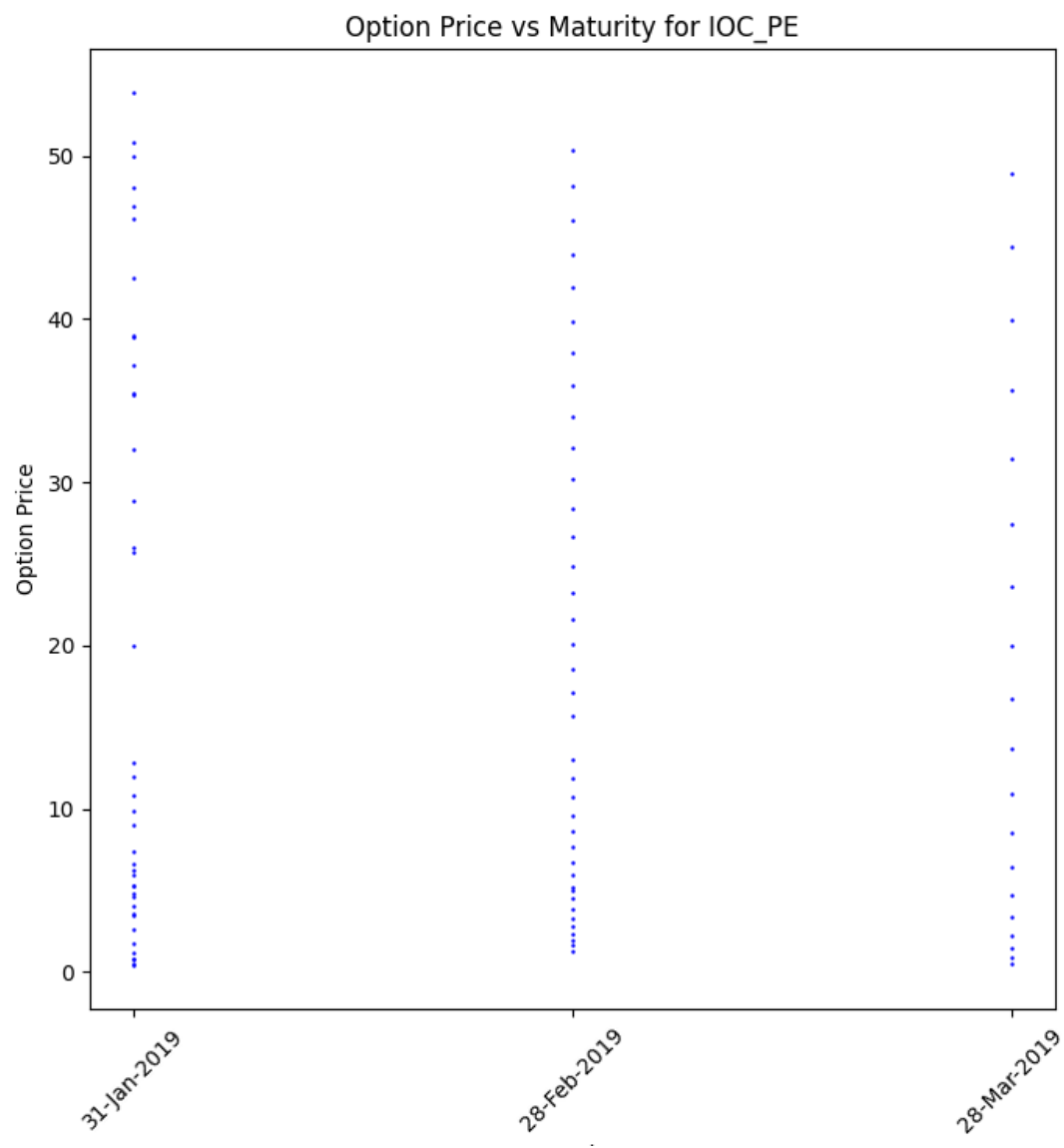


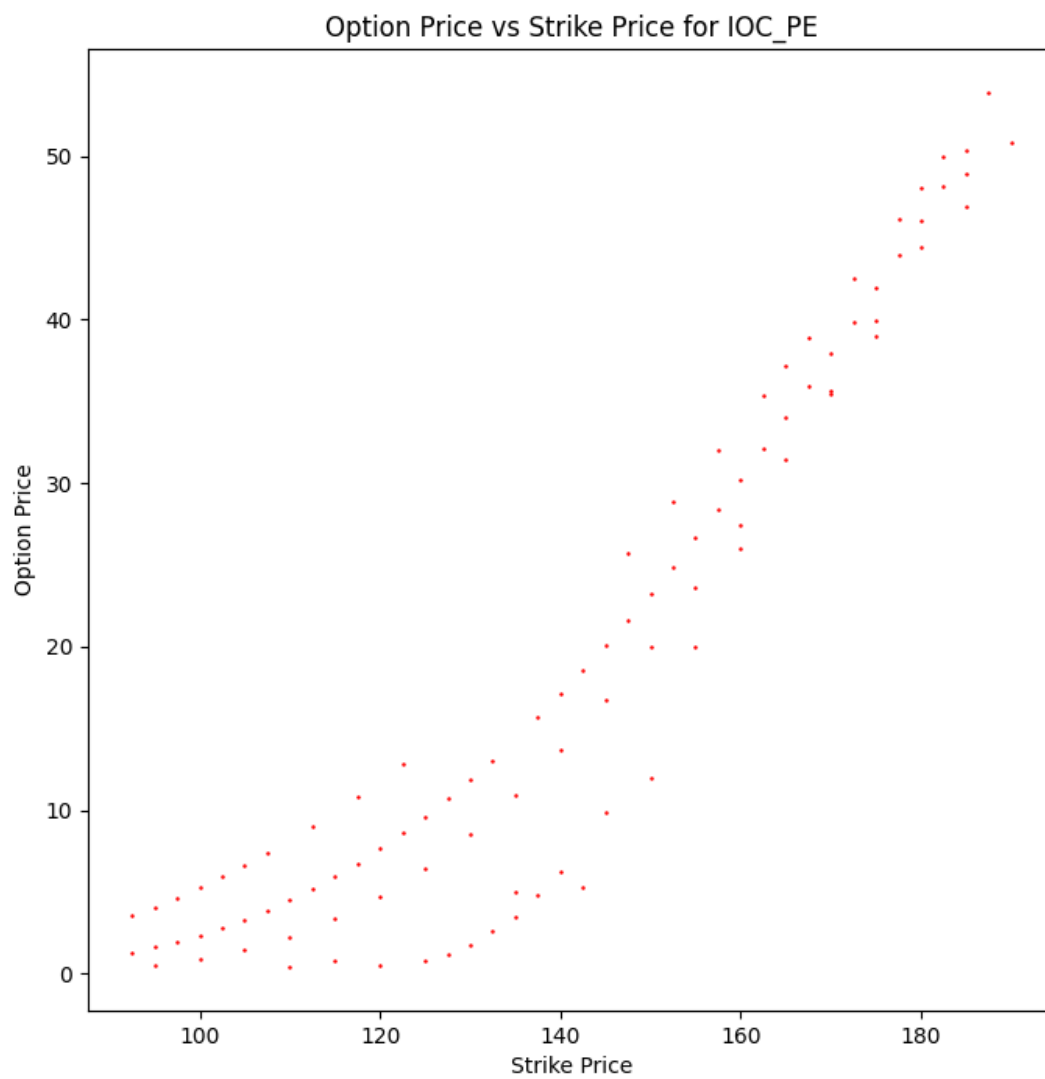




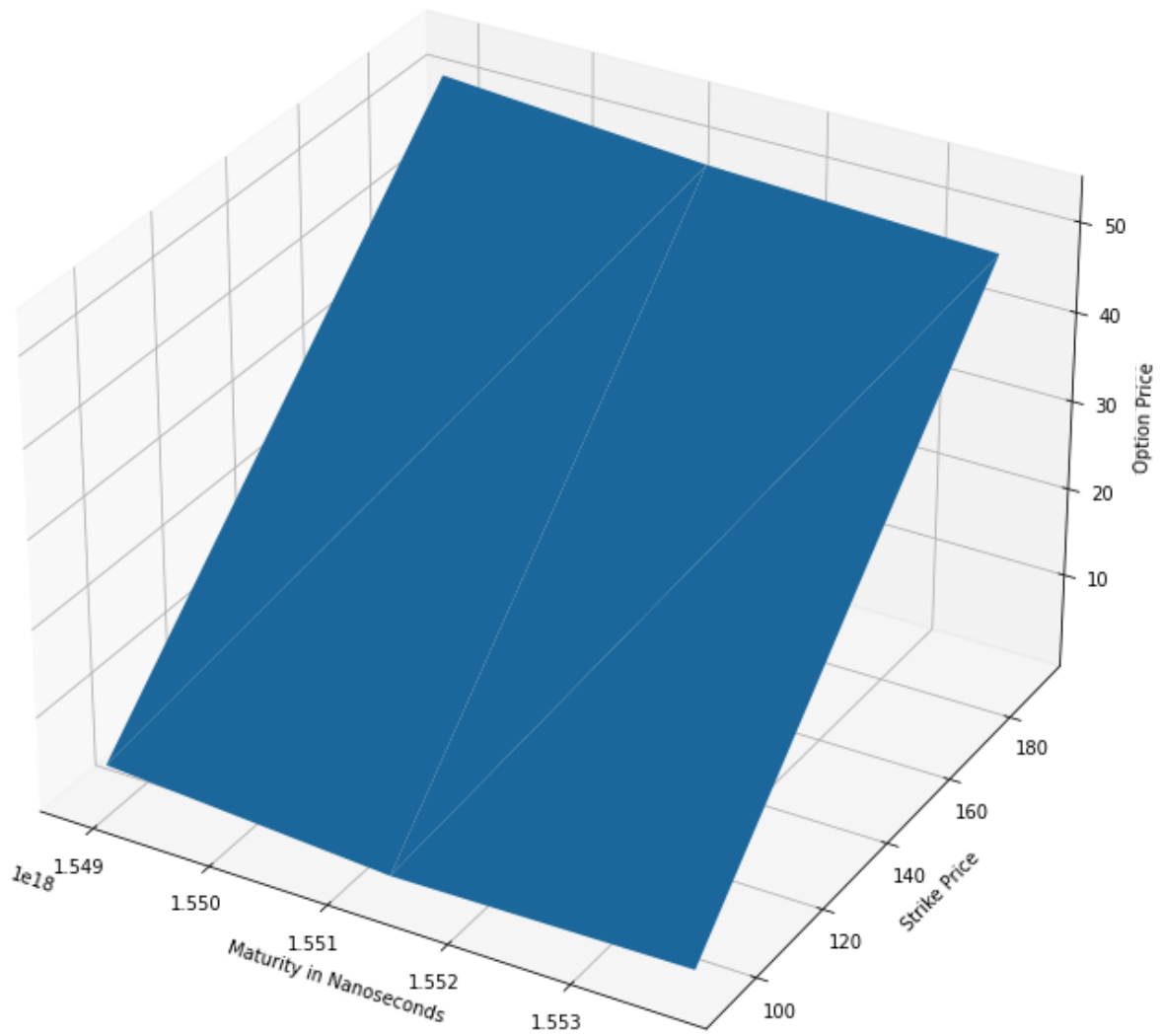
3D Plot for IOC_CE

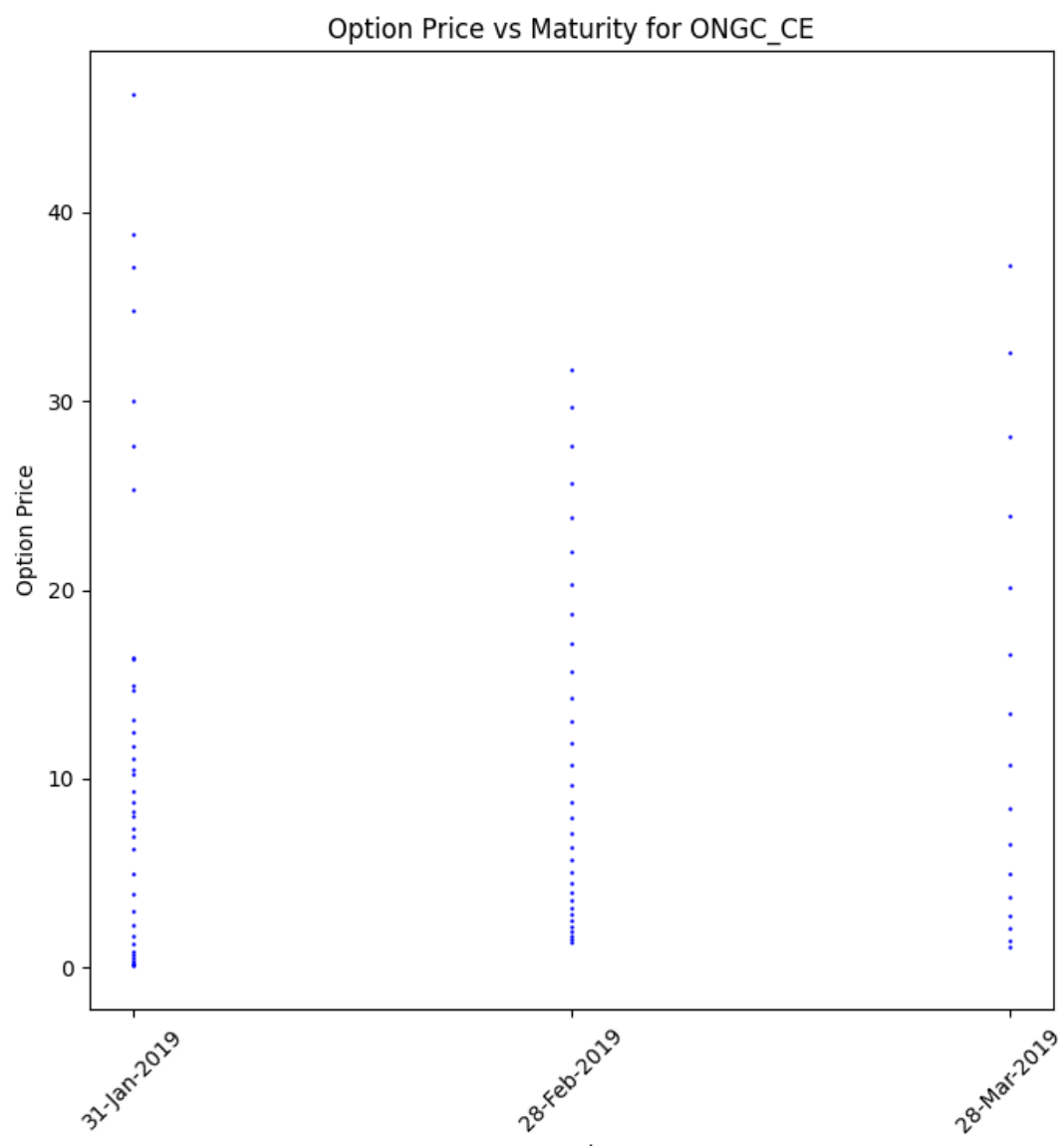


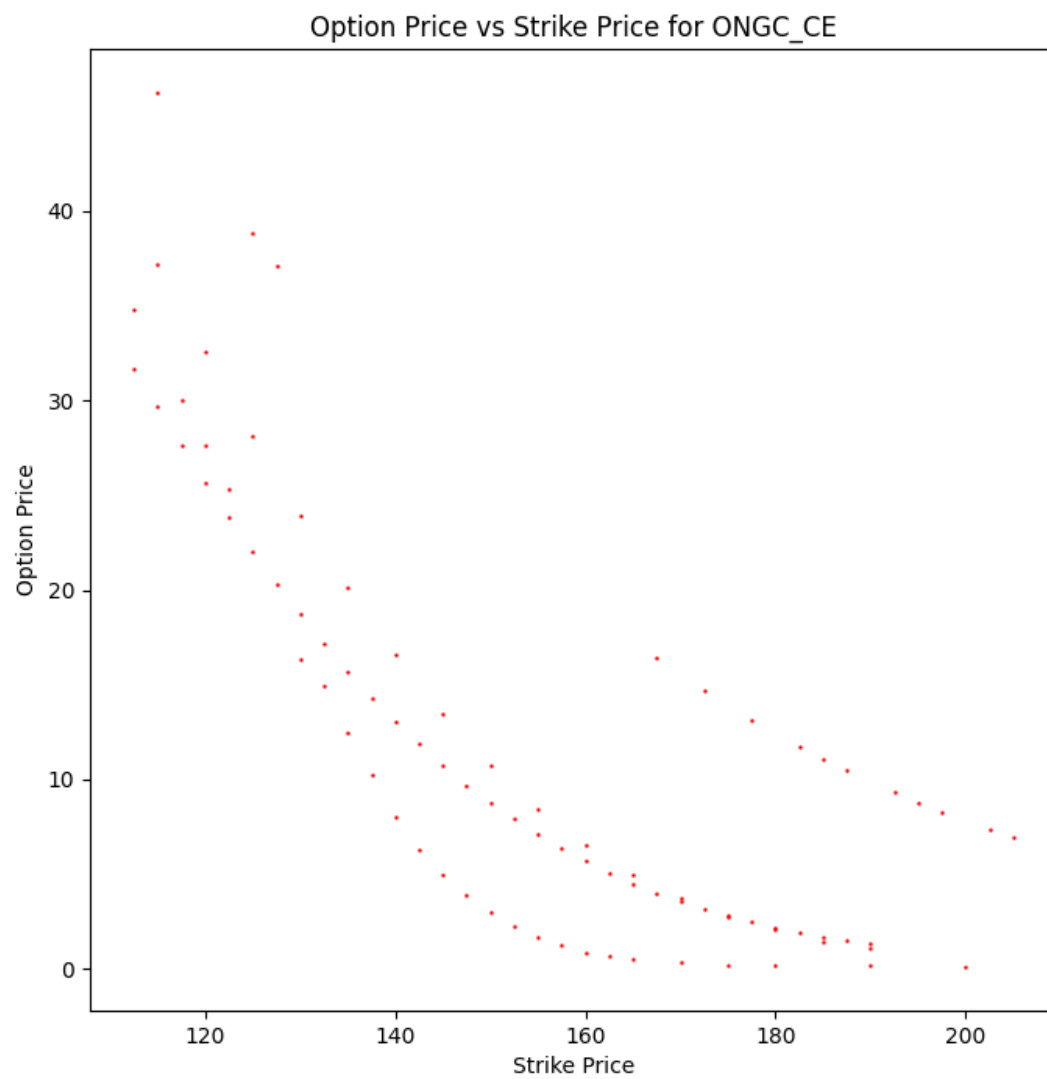




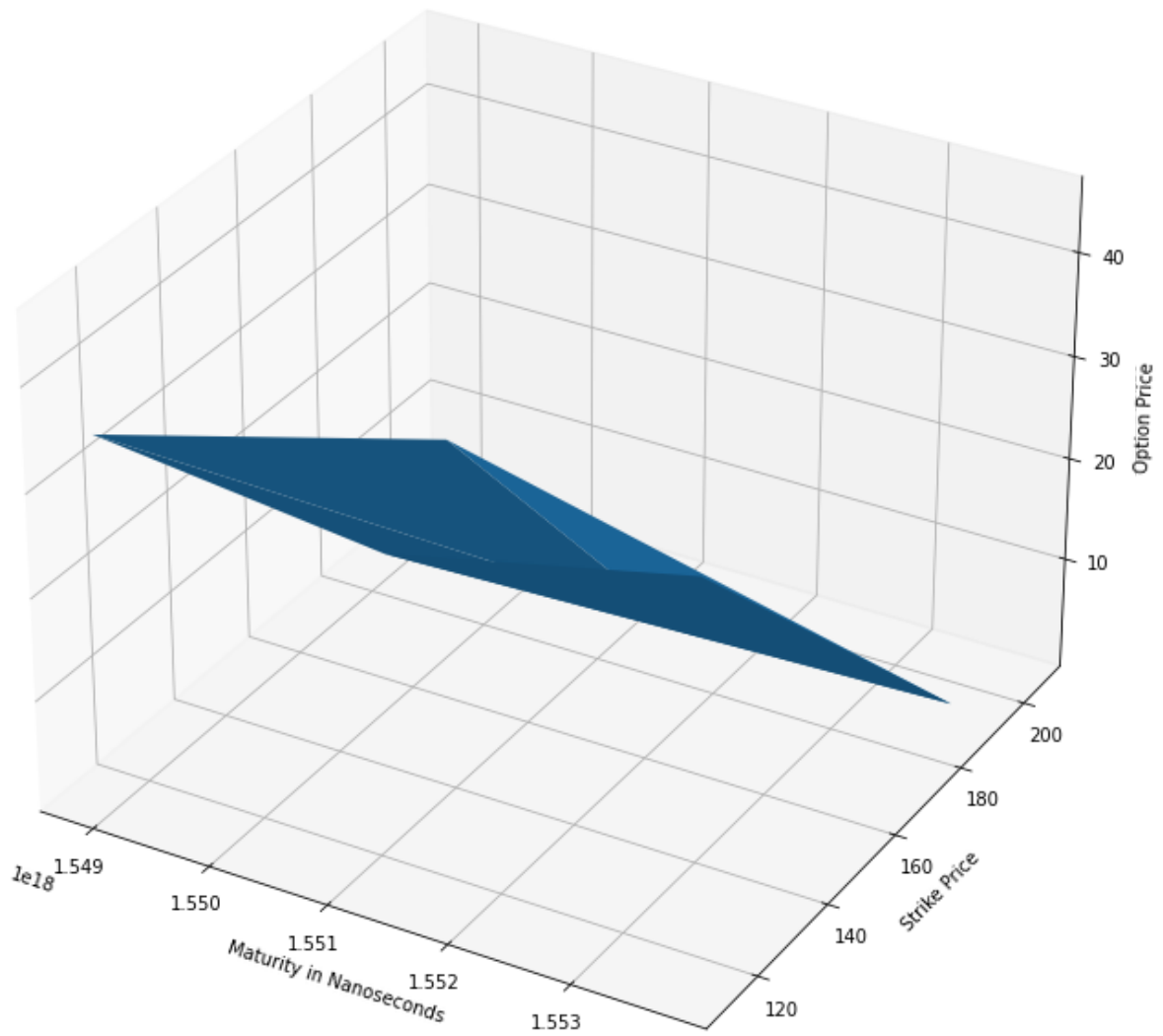
3D Plot for IOC_PE

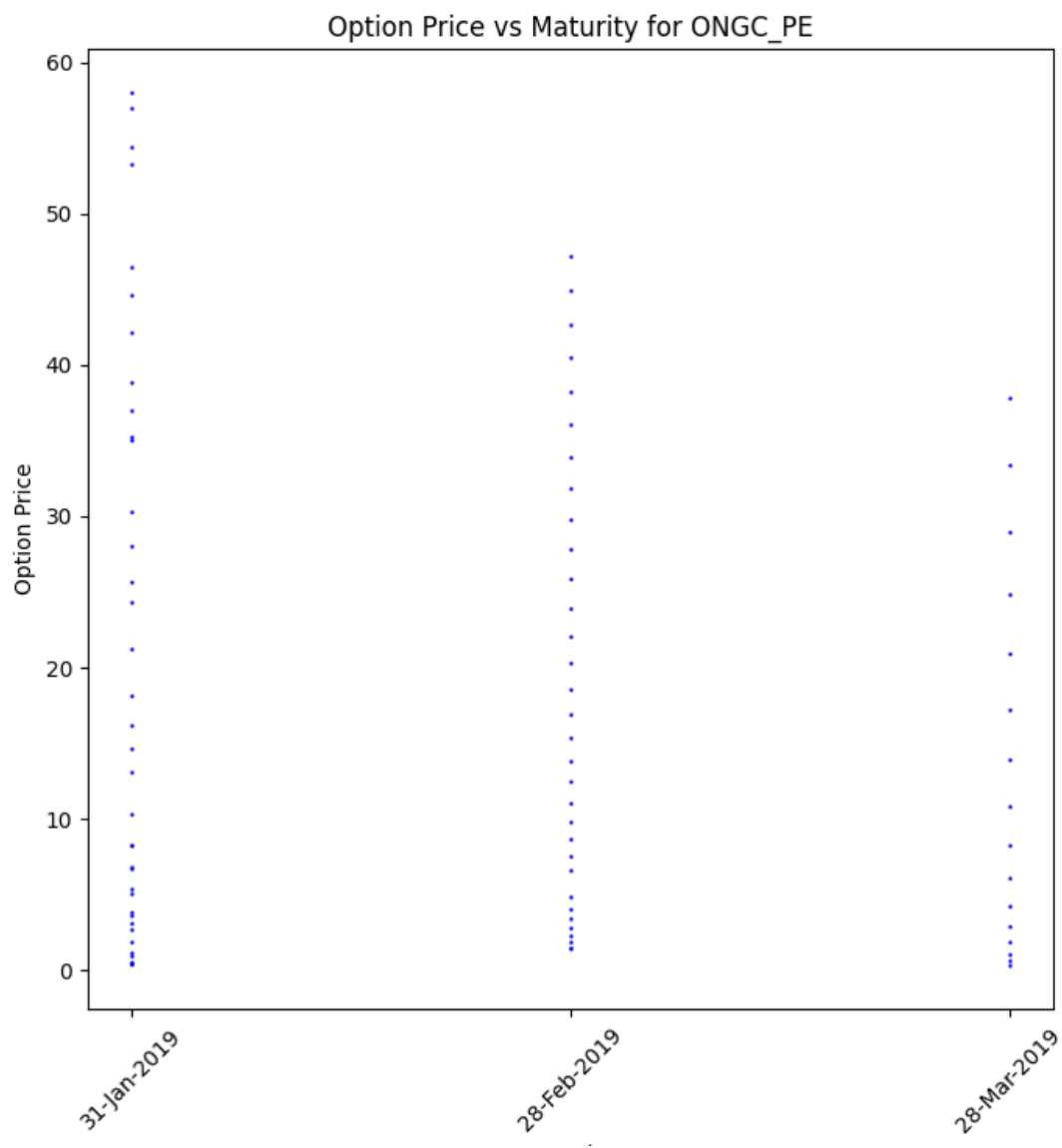


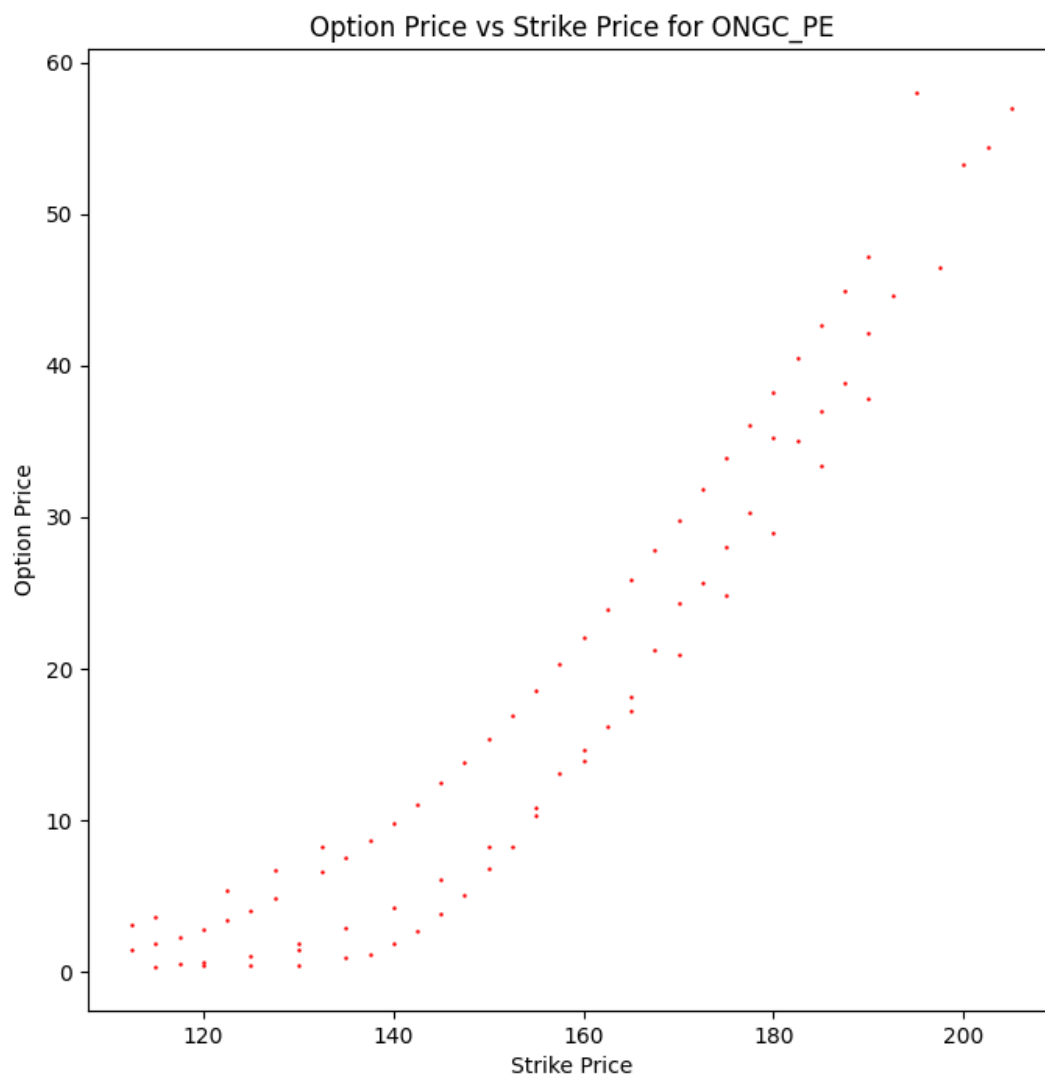




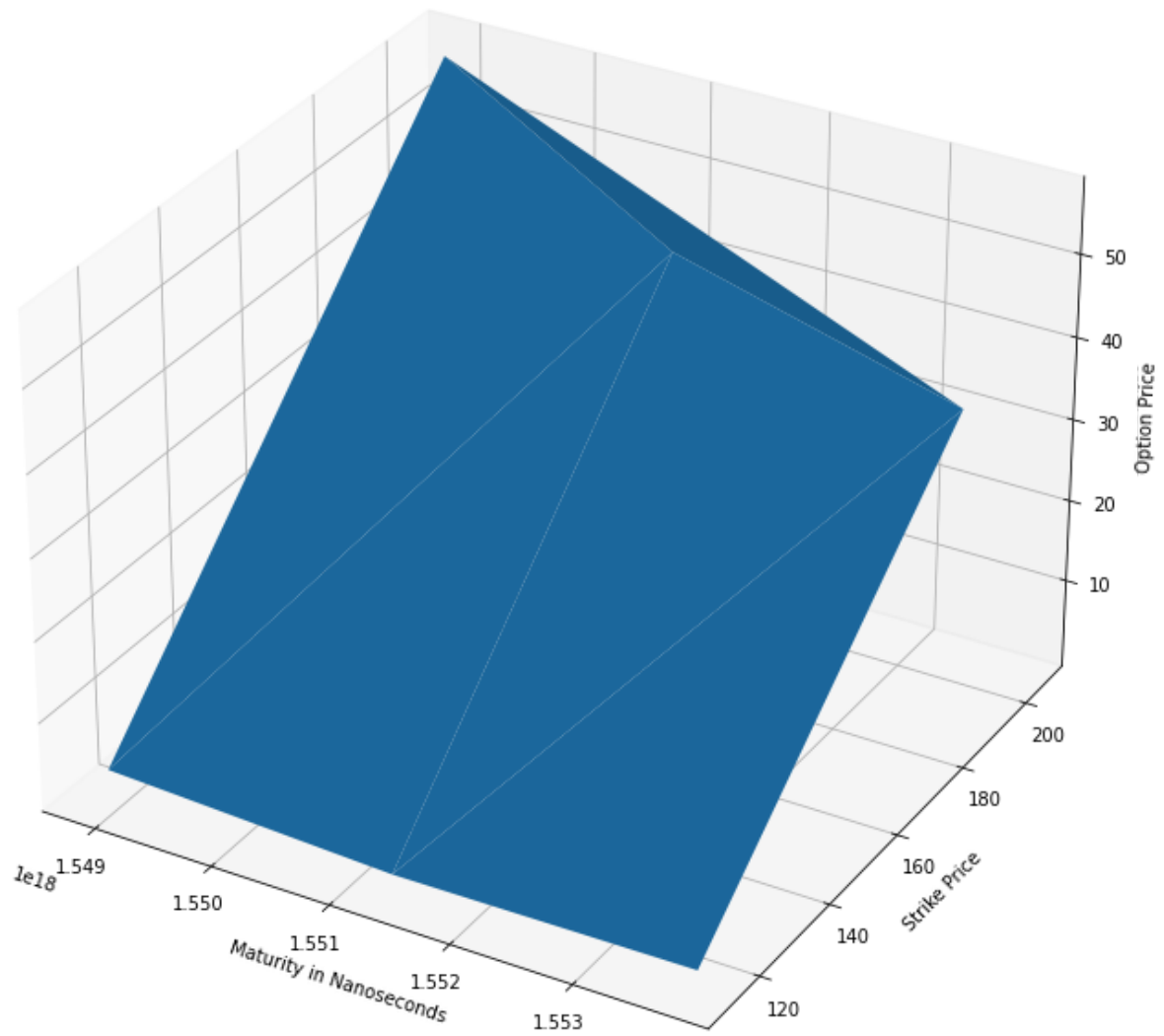
3D Plot for ONGC_CE

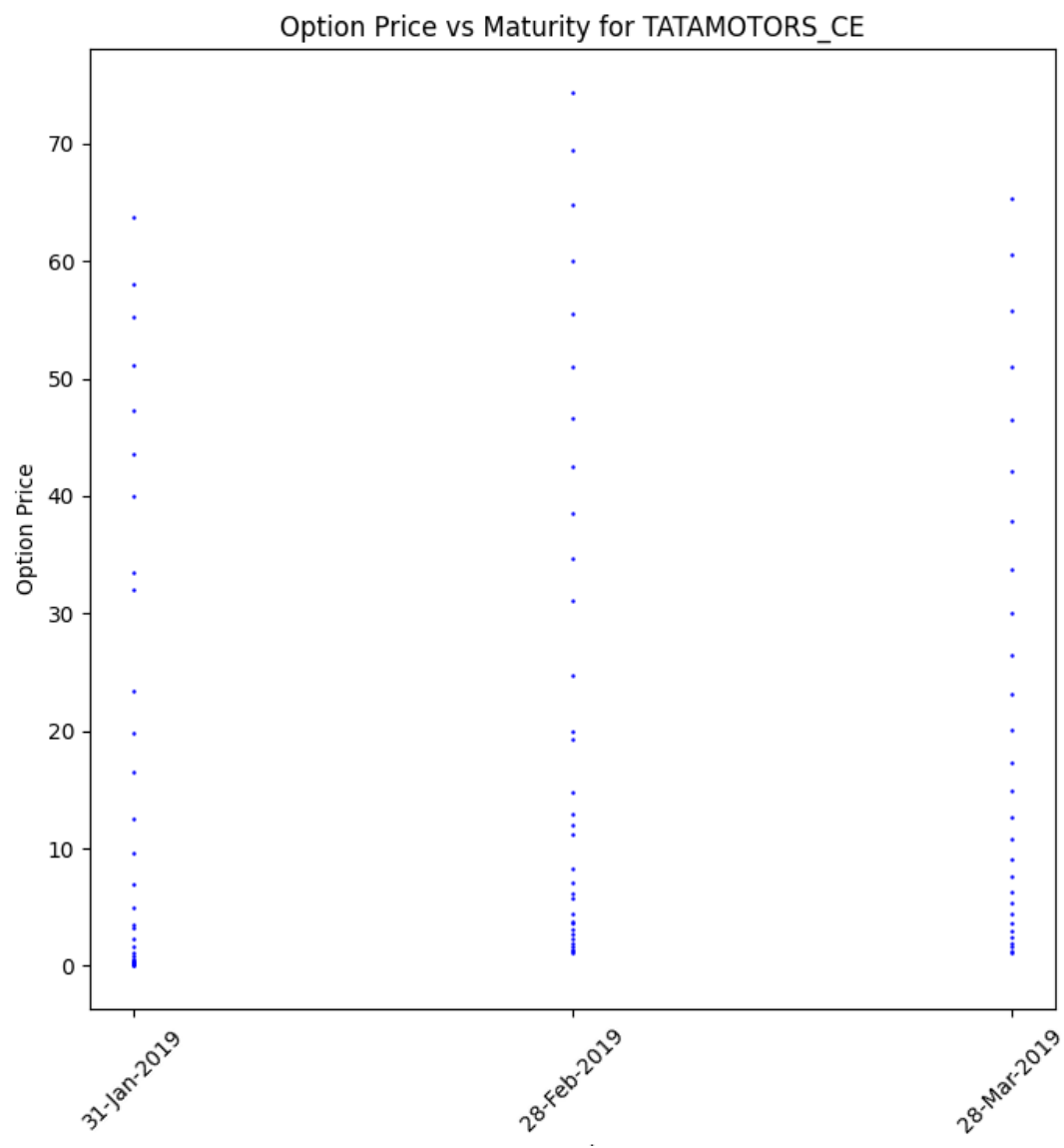


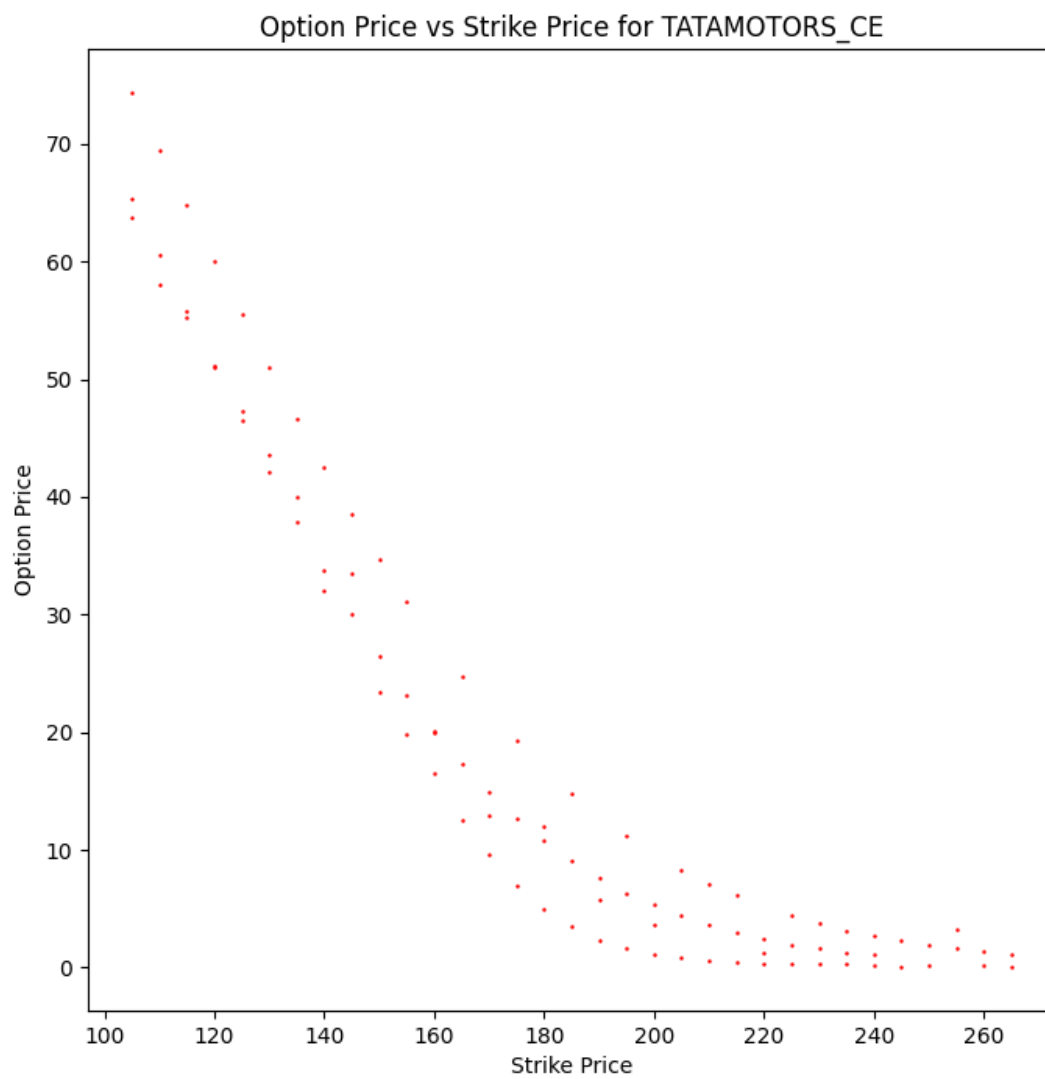




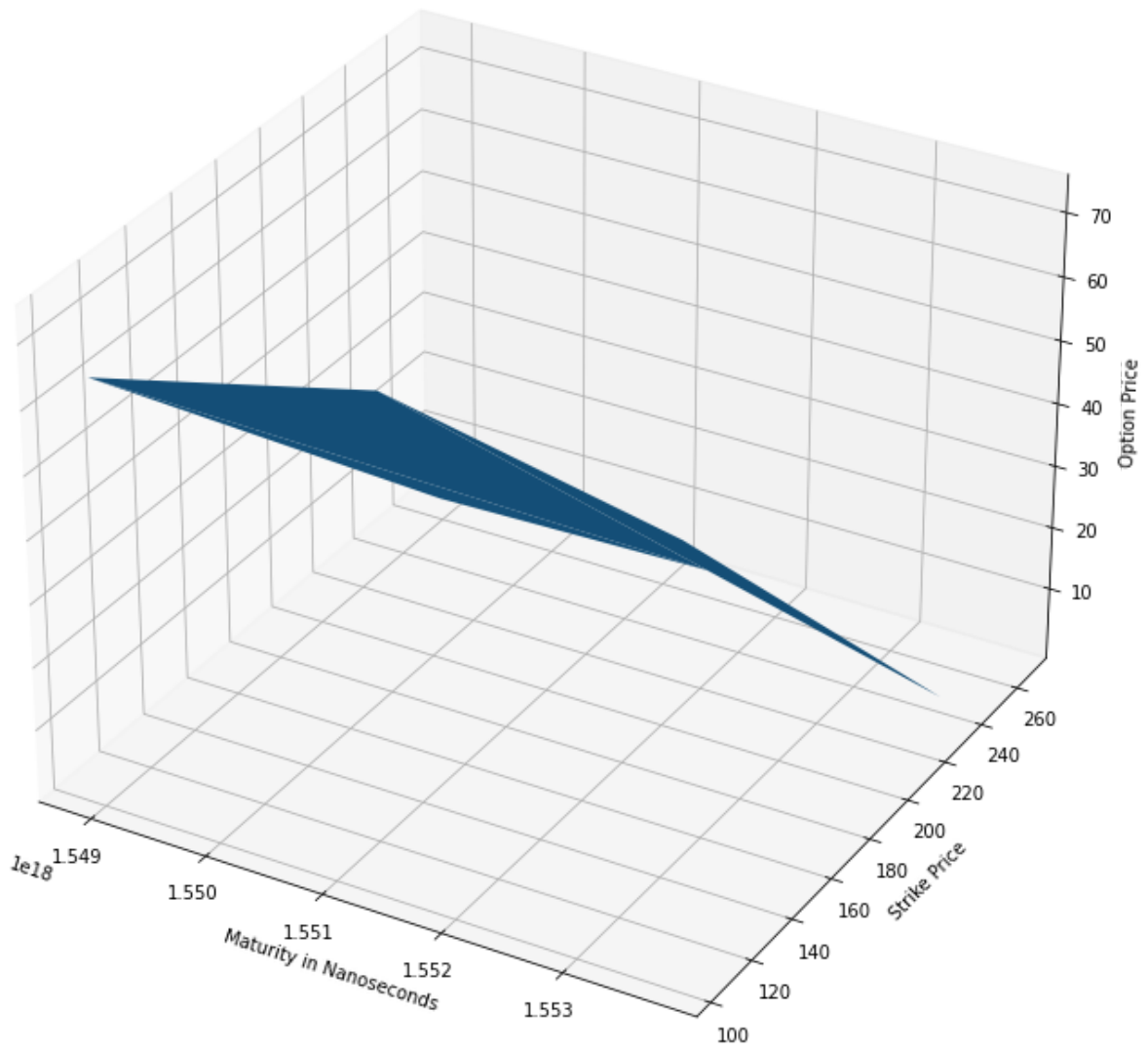
3D Plot for ONGC_PE

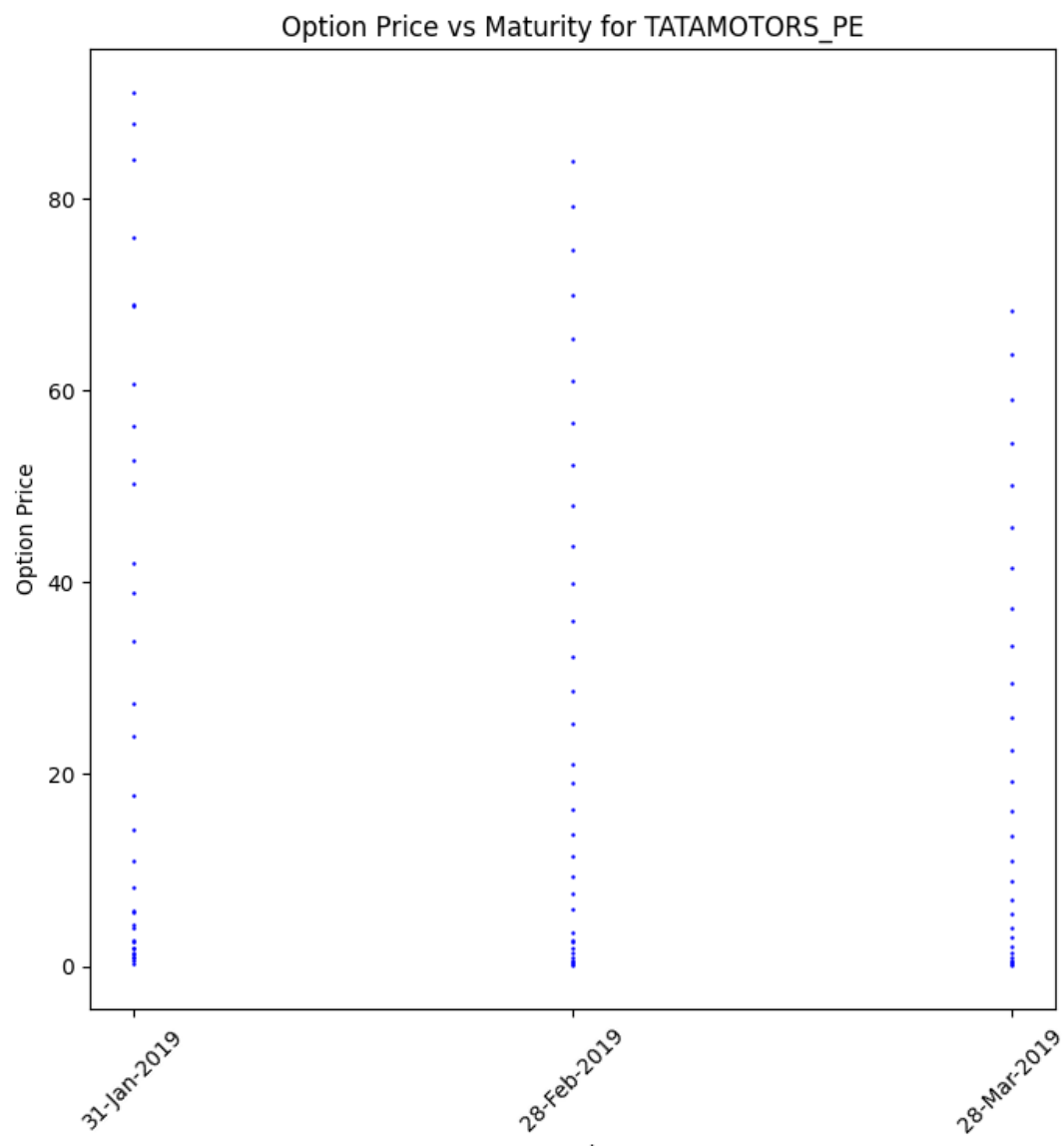


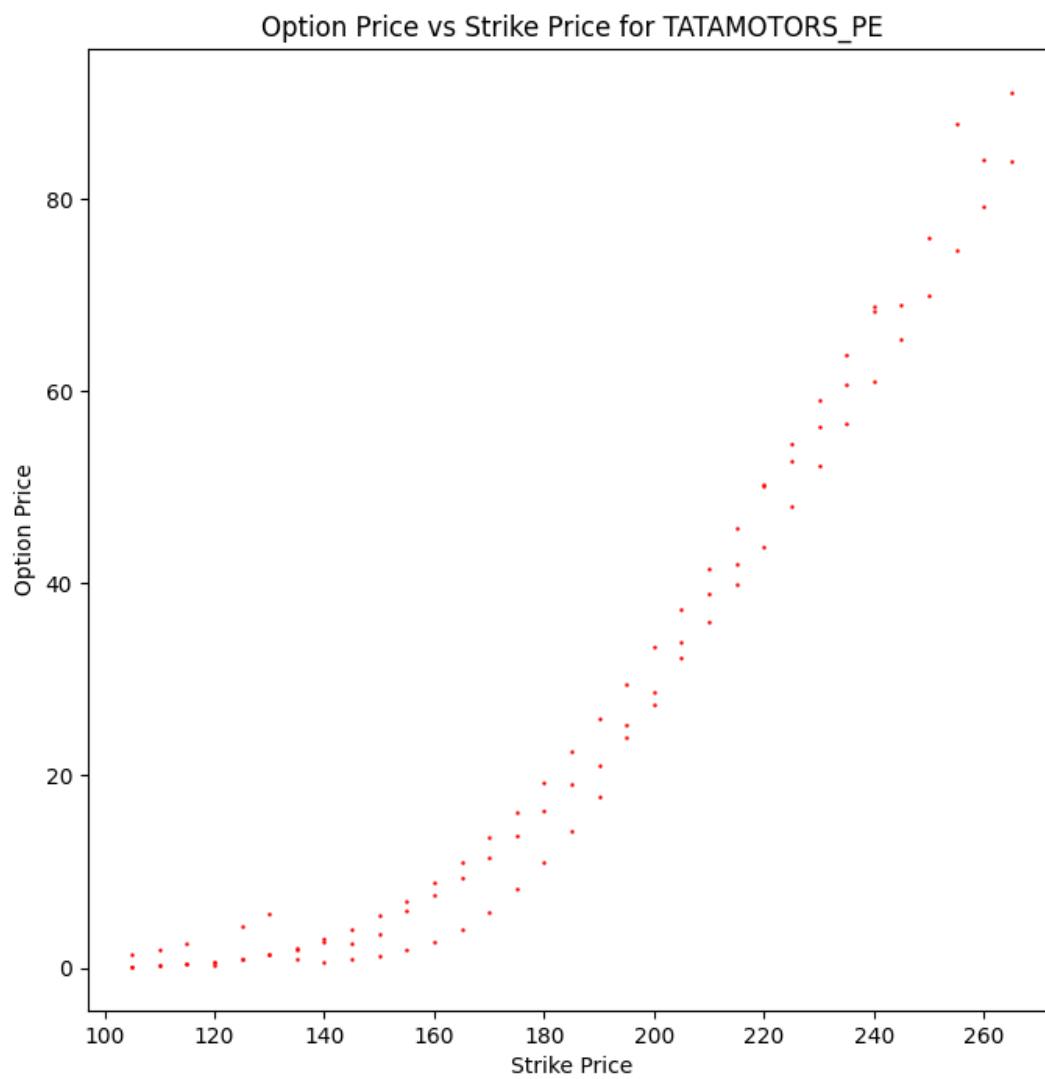




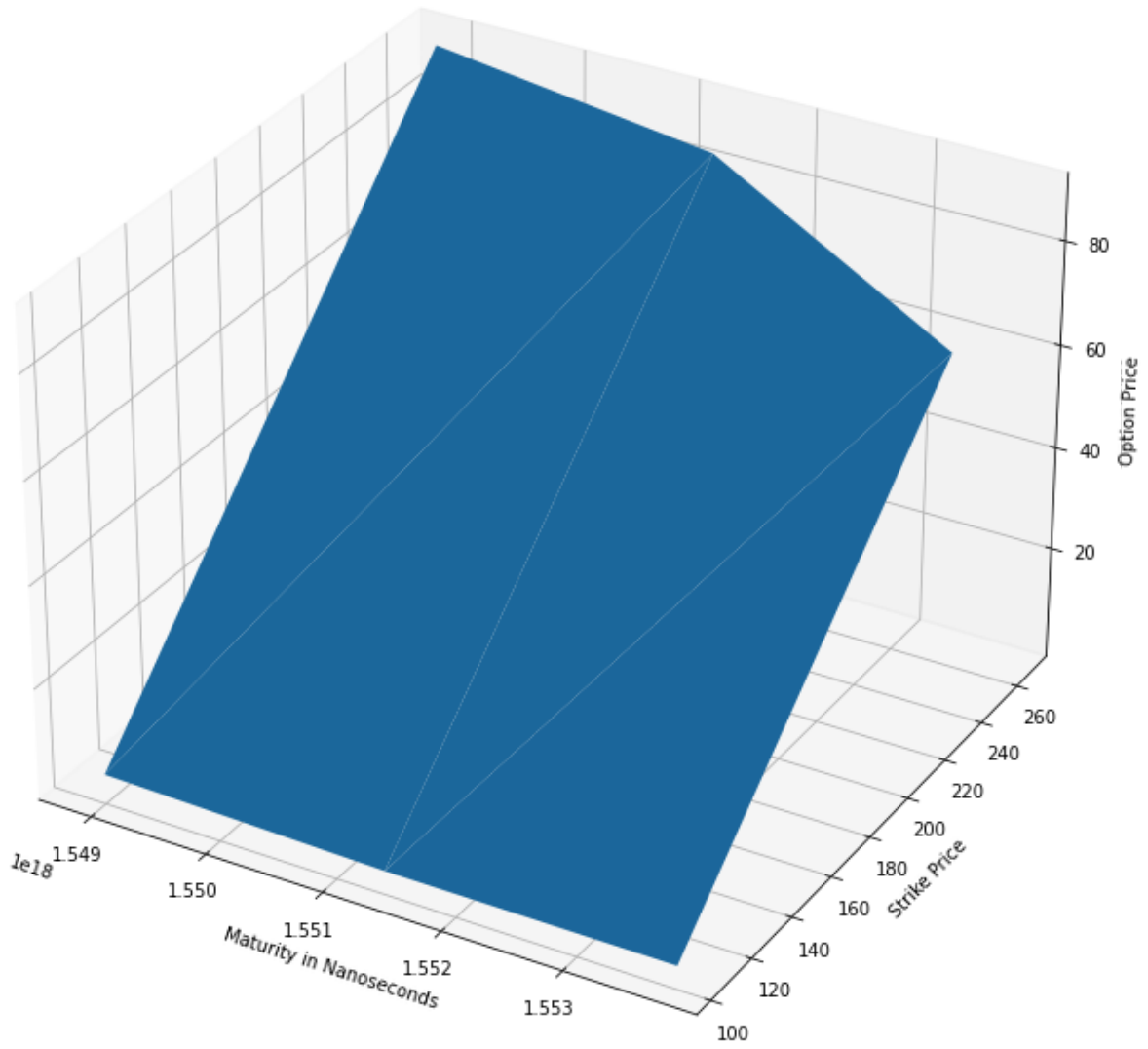
3D Plot for TATAMOTORS_CE







3D Plot for TATAMOTORS_PE



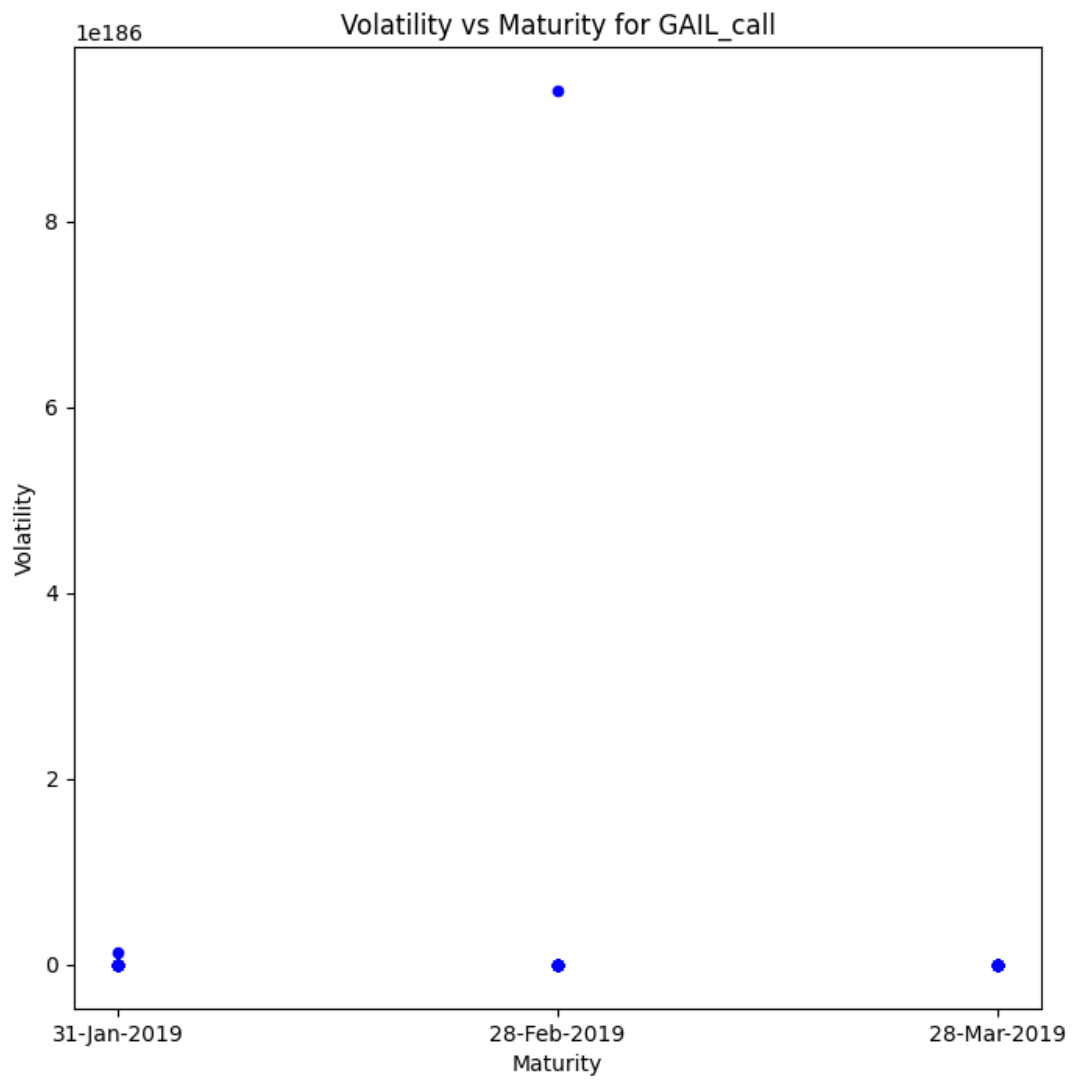
Question 03.

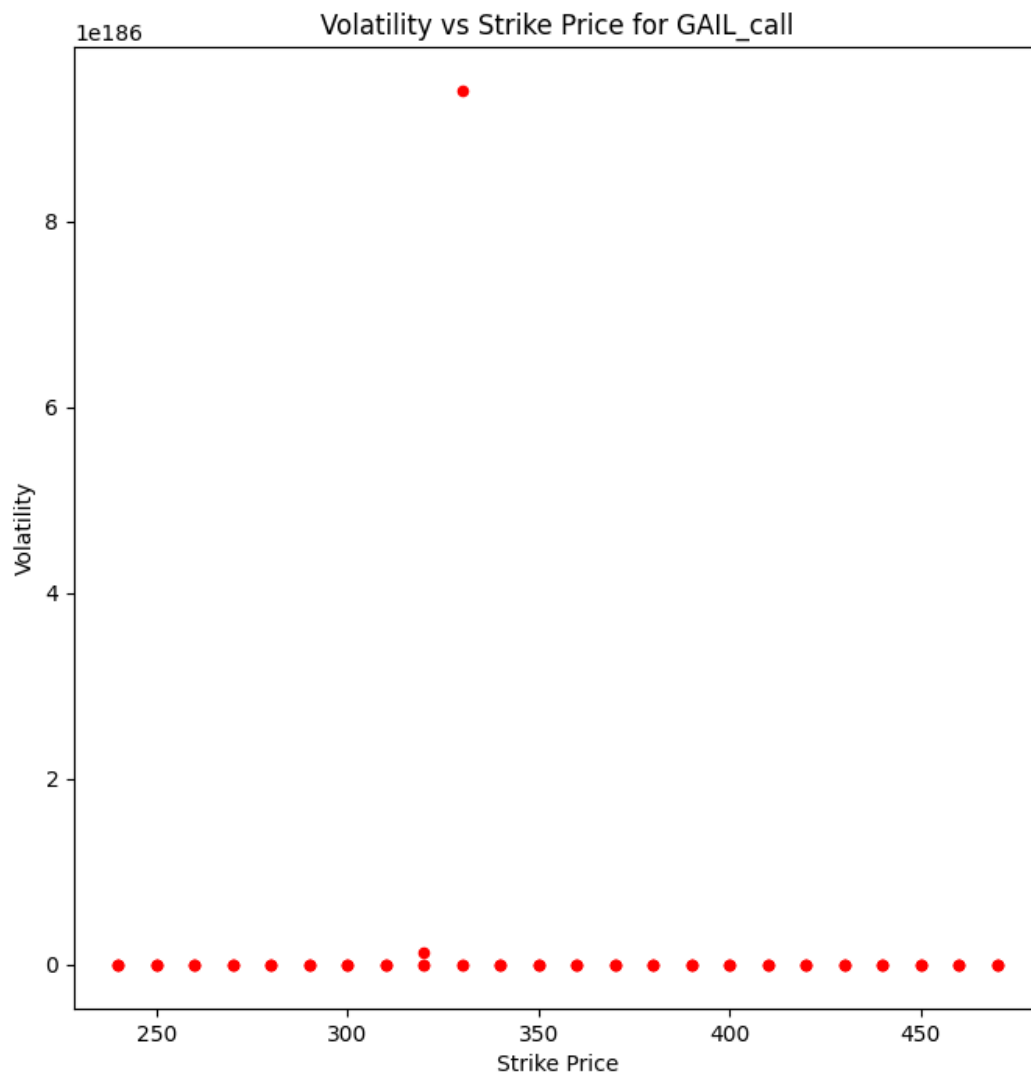
The implied volatility for each stock has been calculated and stored in .csv files inside the Volatility folder. The plots (both 3D and 2D) are as shown below.

The bisection method is used to find the implied volatility.

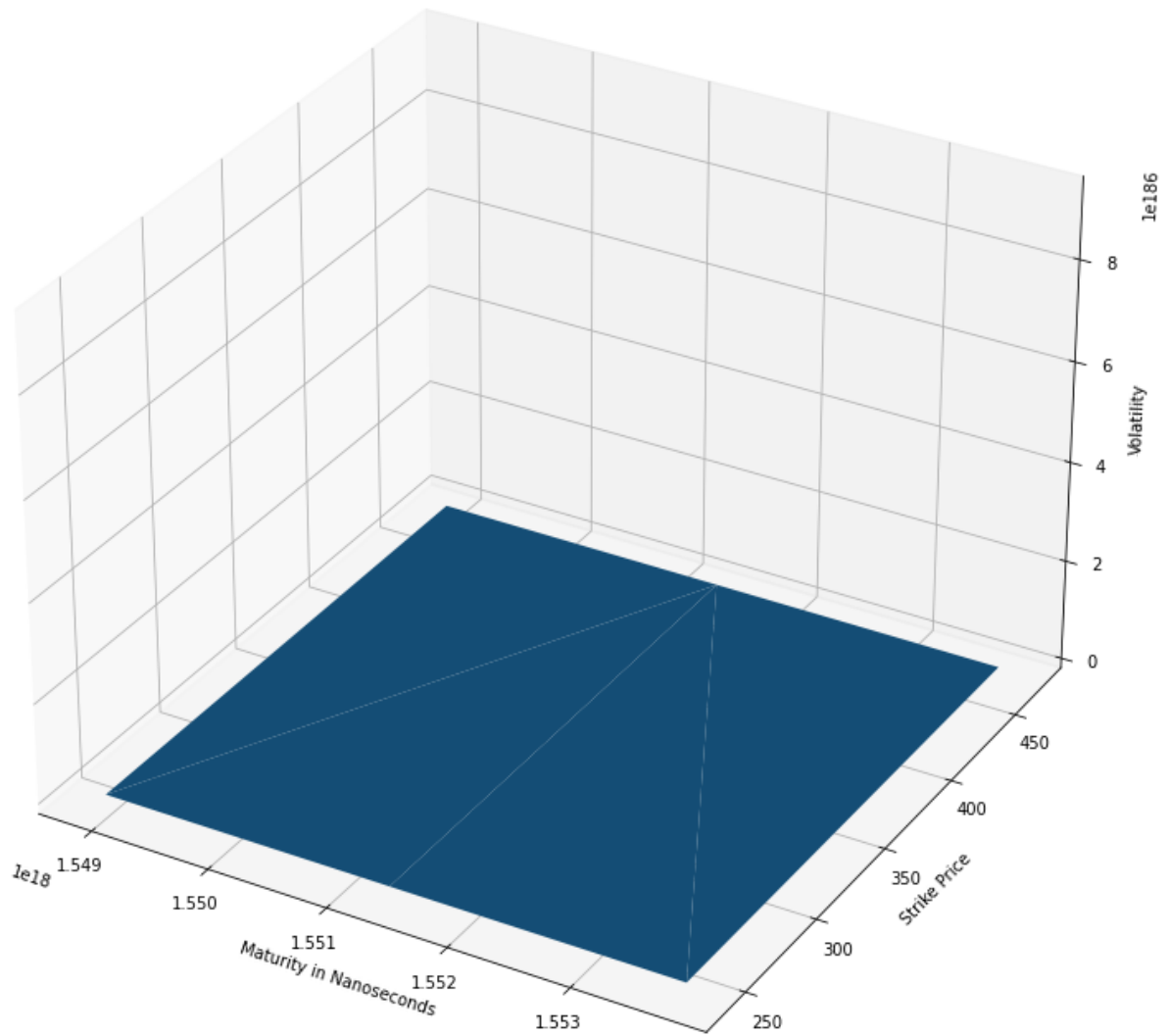
From the 2D plots we observe that:

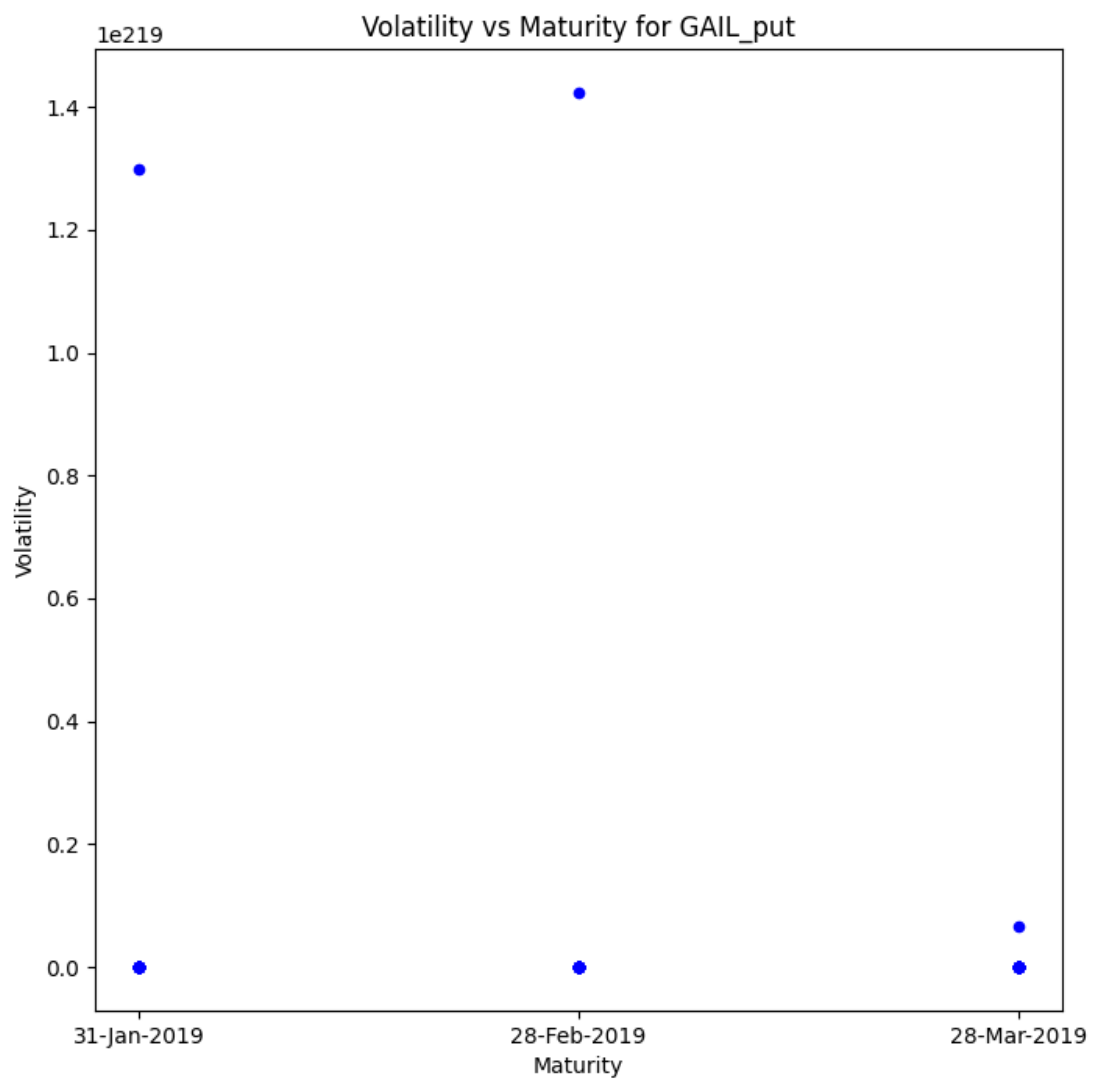
- Volatility is small for all the stock prices and thus the plots of volatility vs maturity / strike price is mostly a dotted line near the origin in most cases.

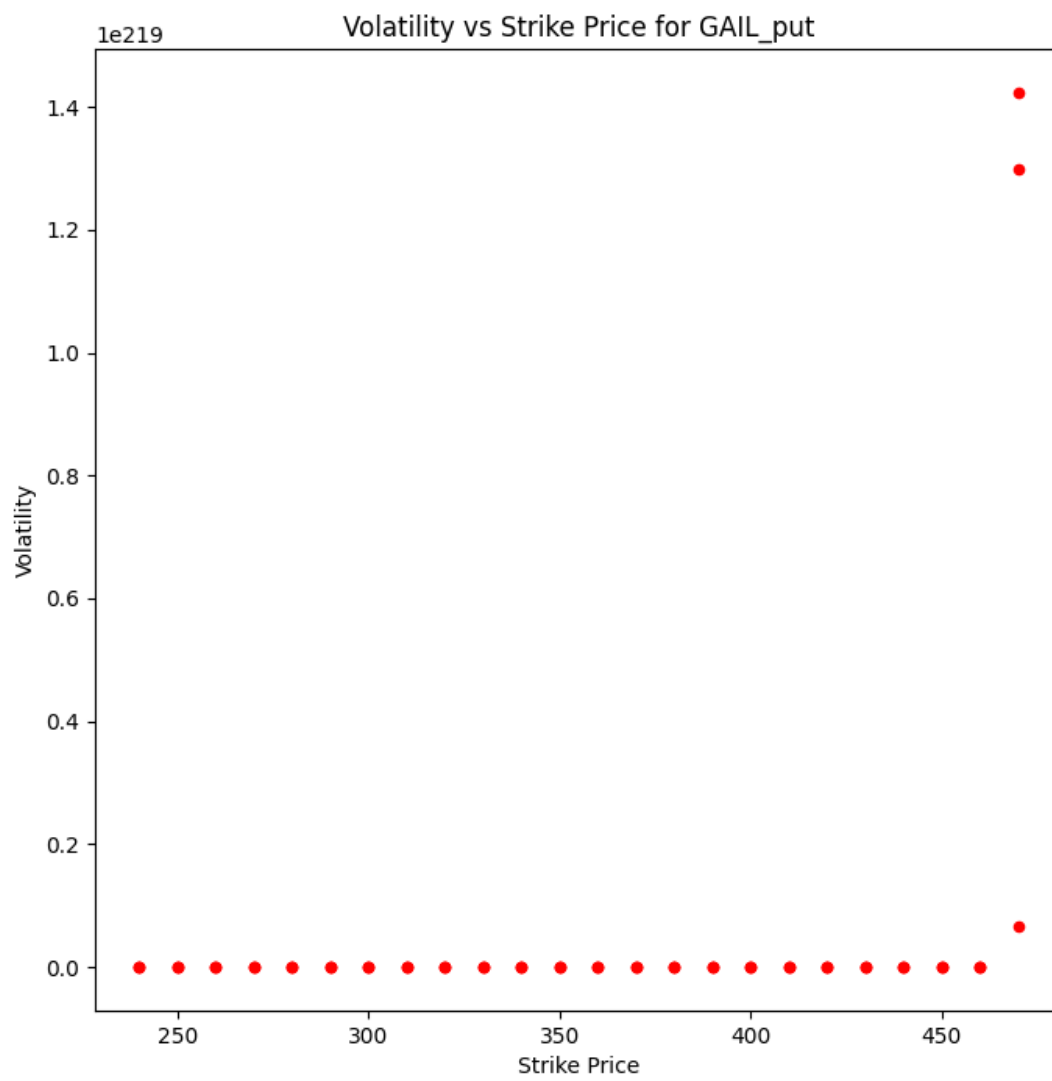




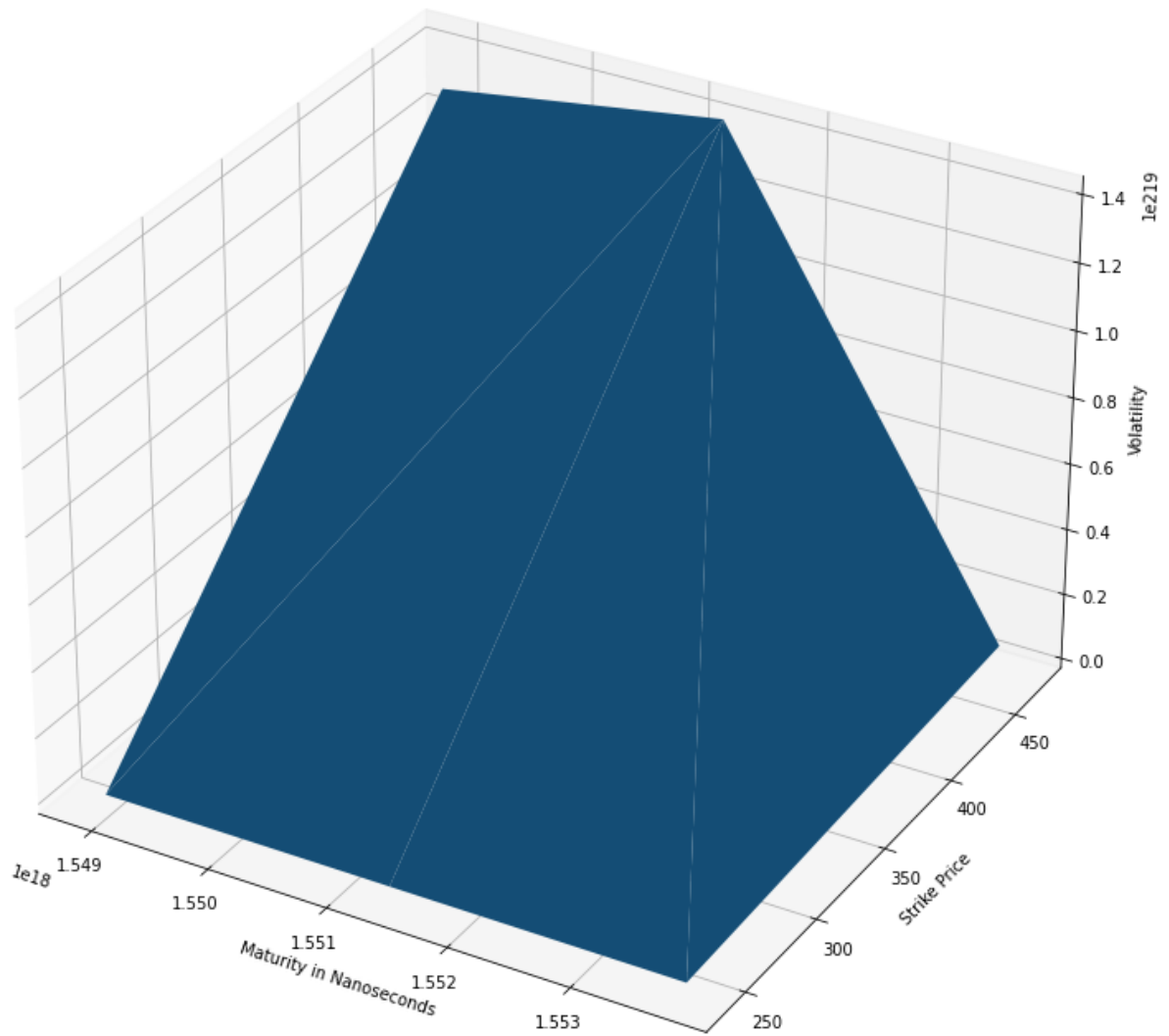
3D Plot for GAIL_call

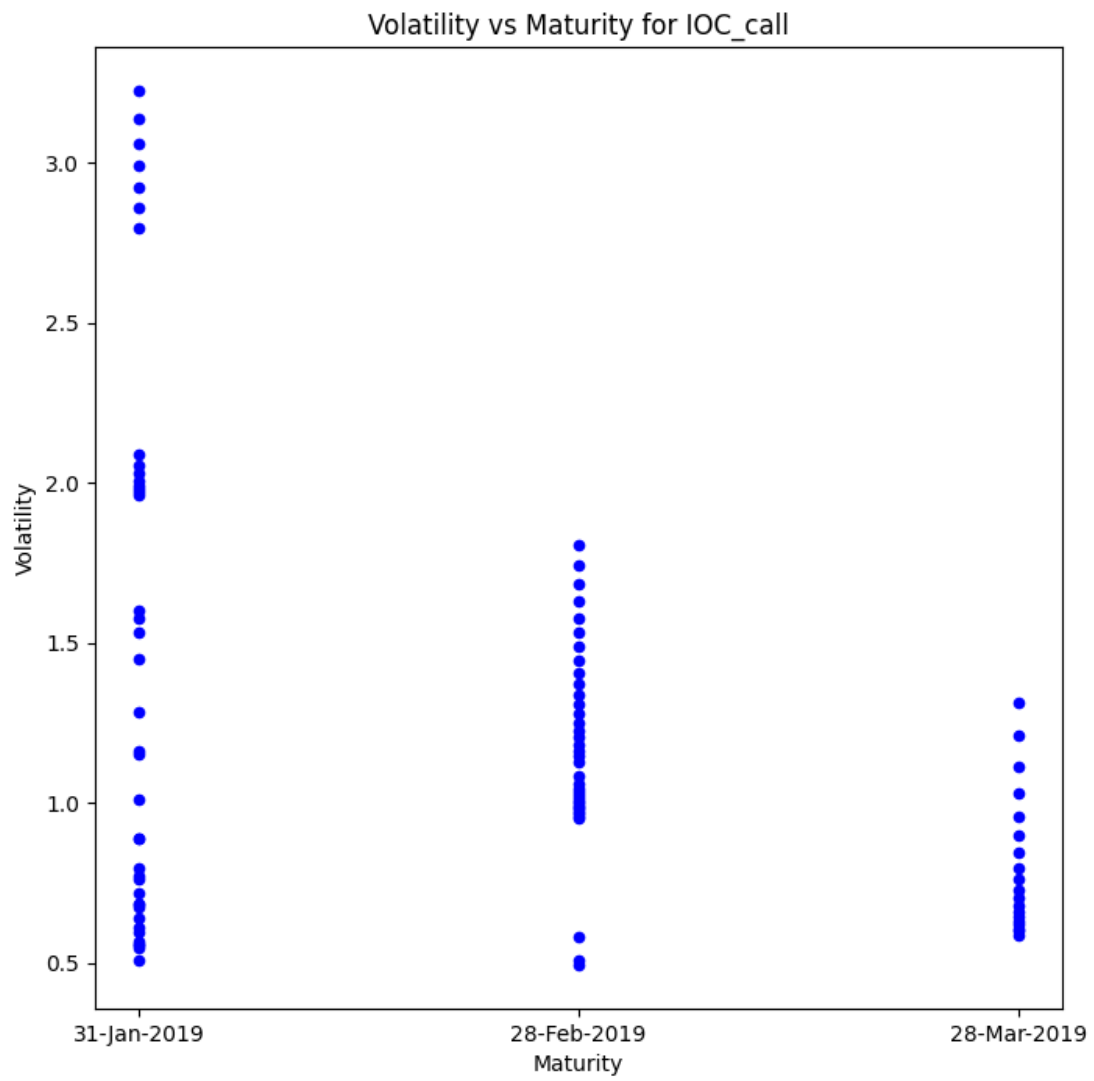


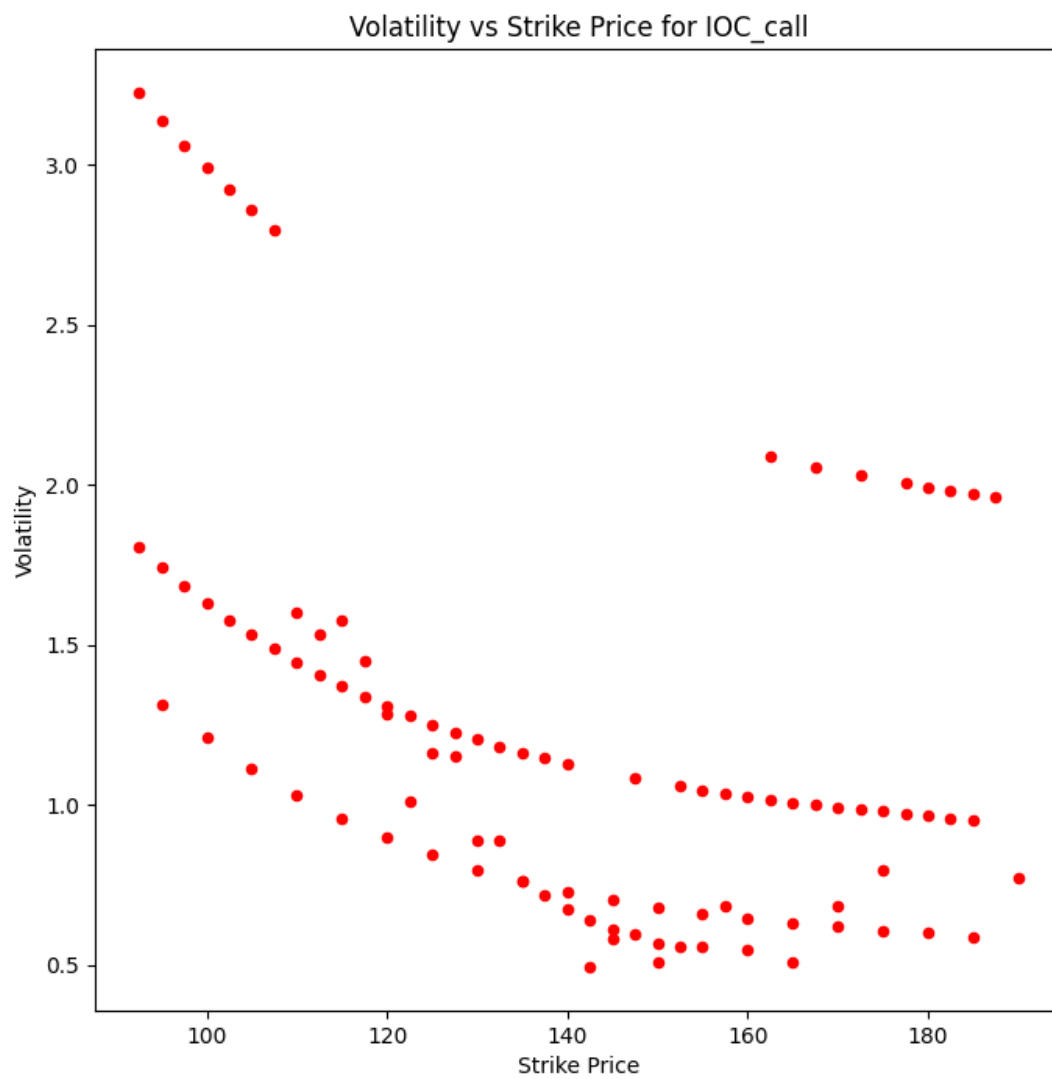




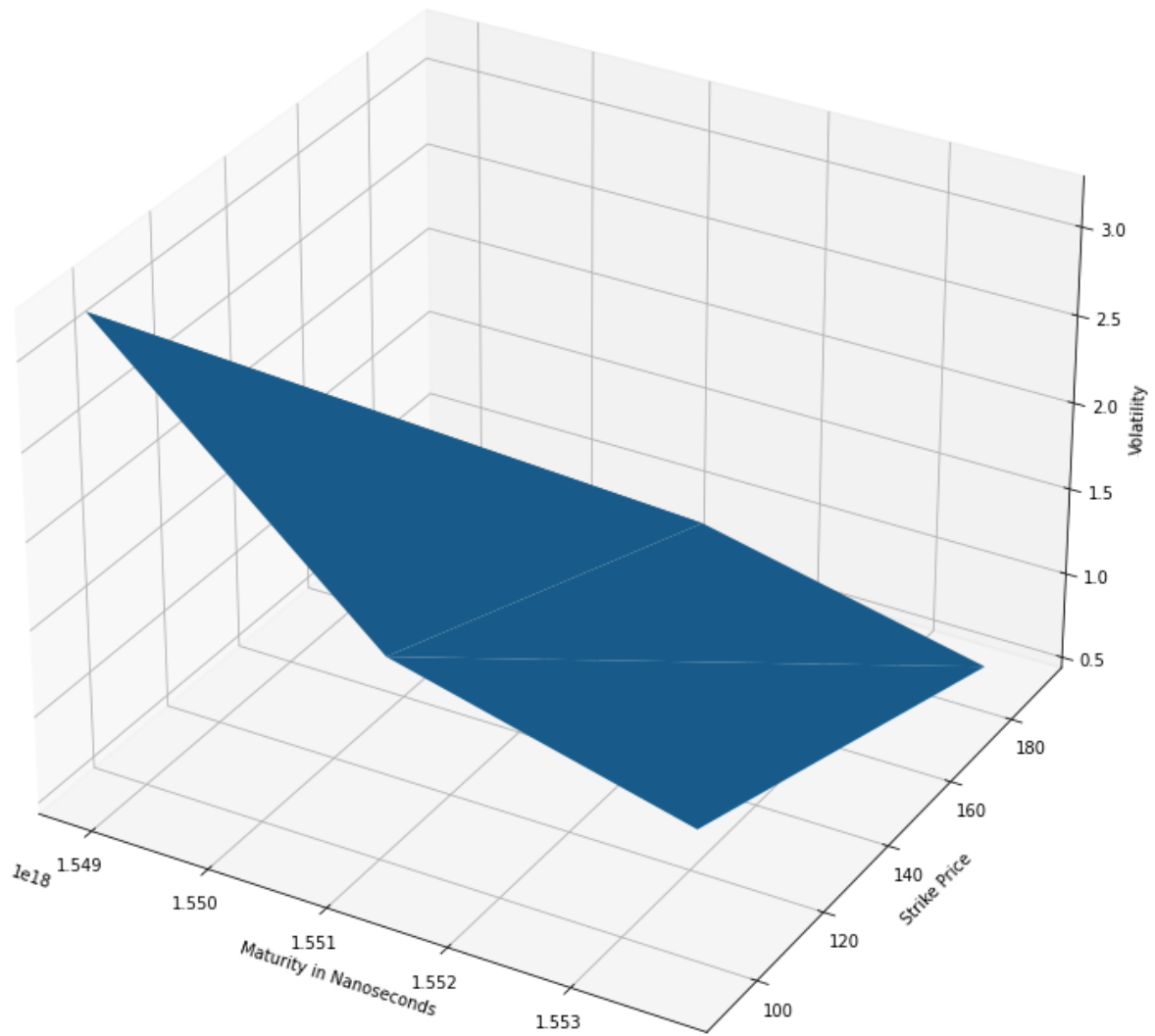
3D Plot for GAIL_put

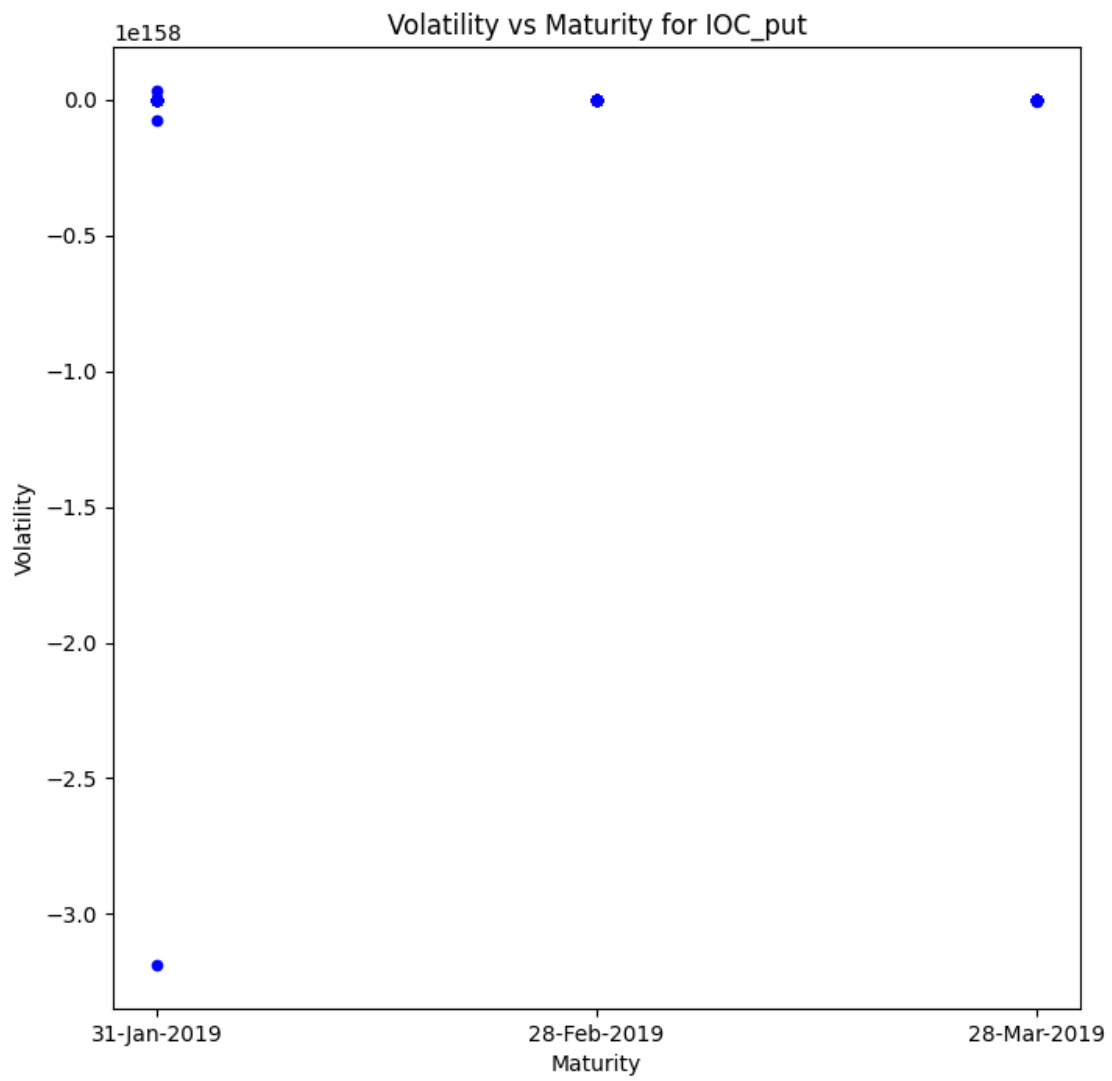


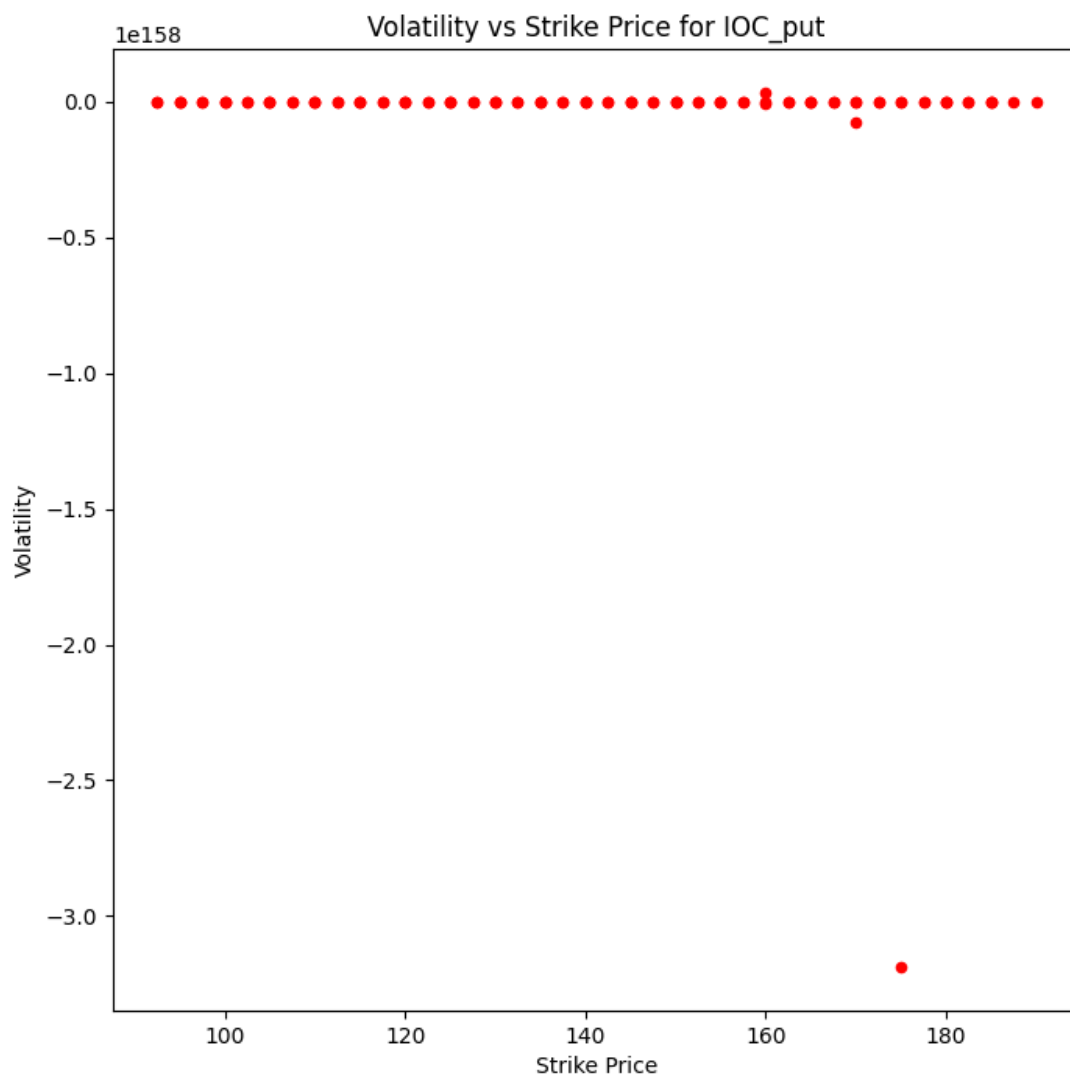




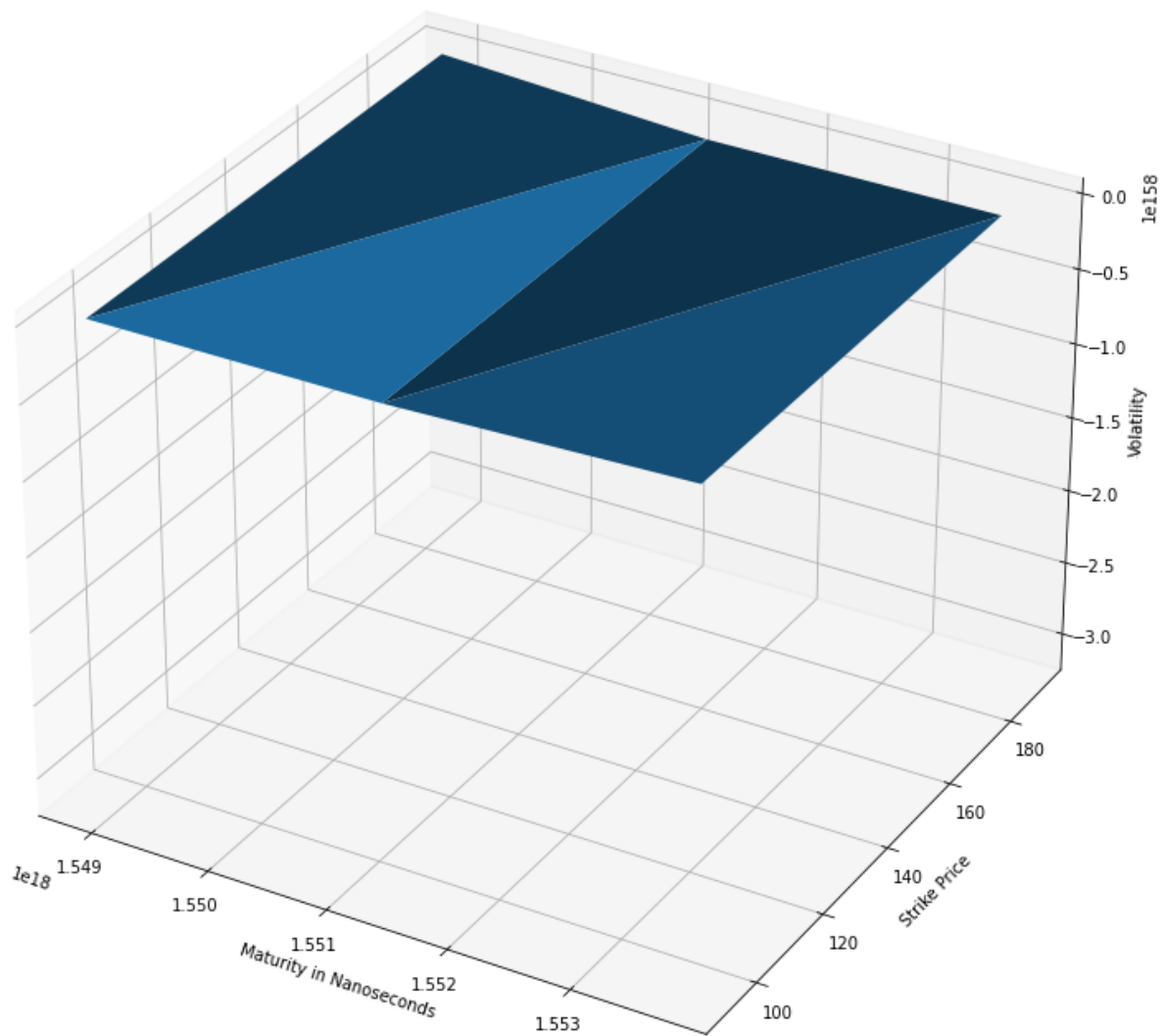
3D Plot for IOC_call

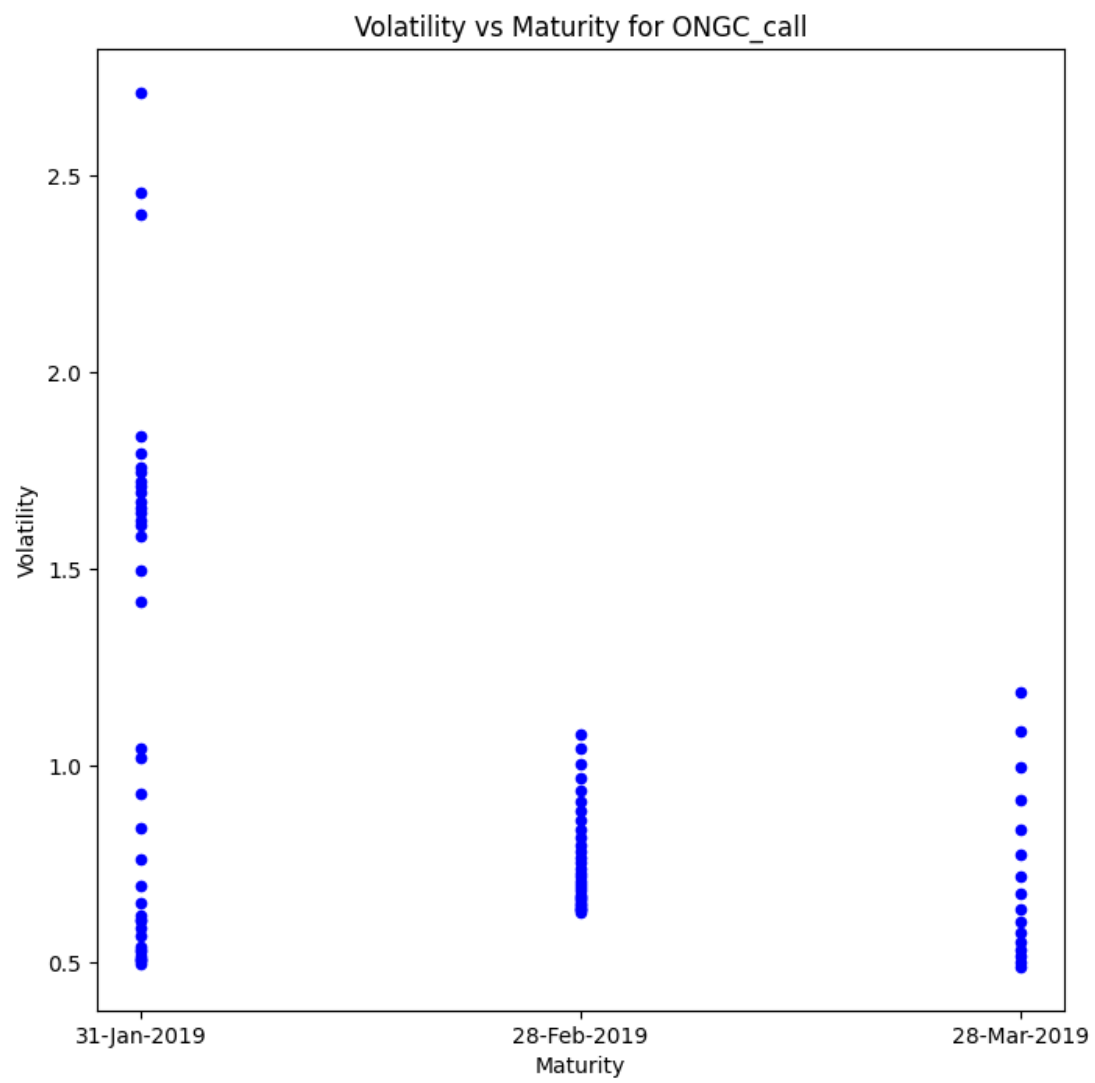


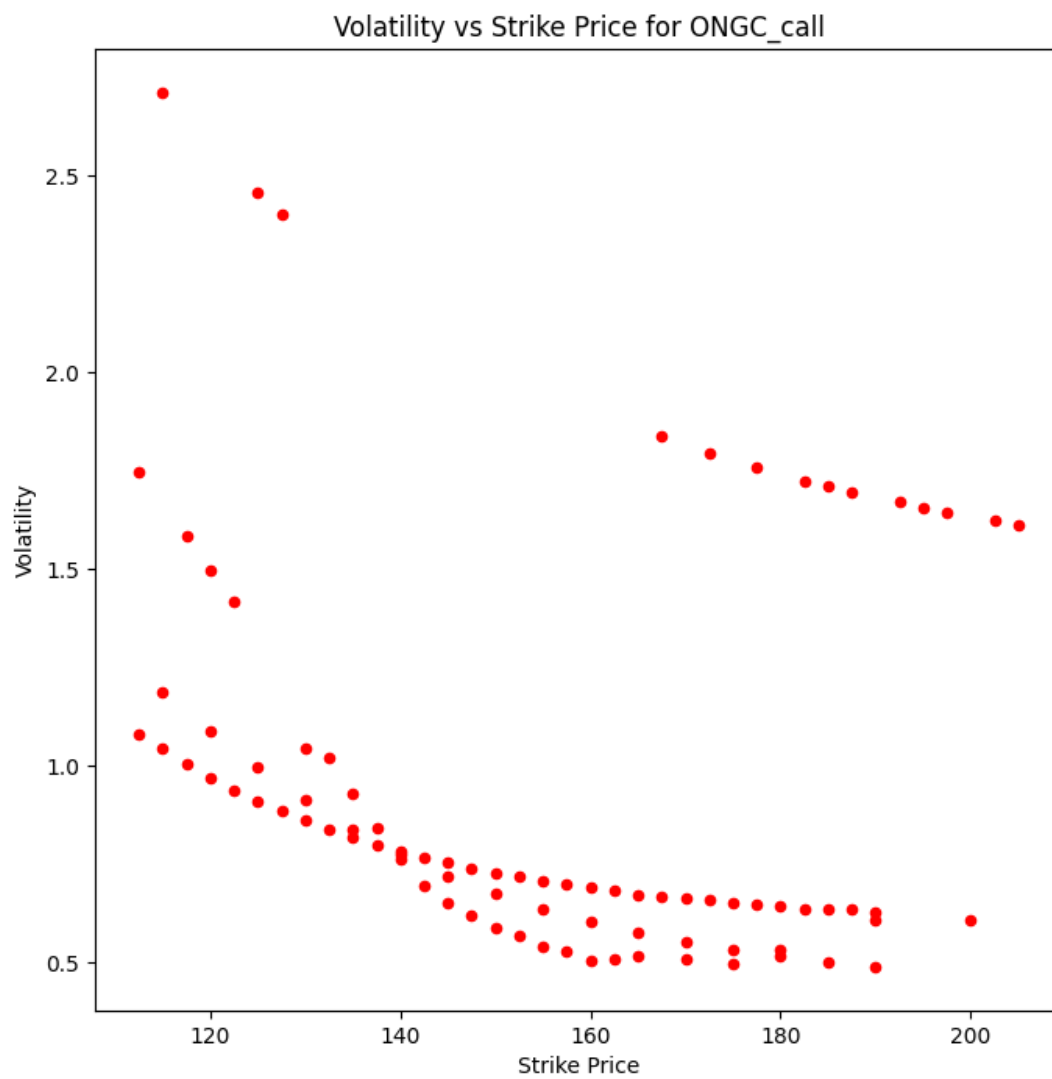




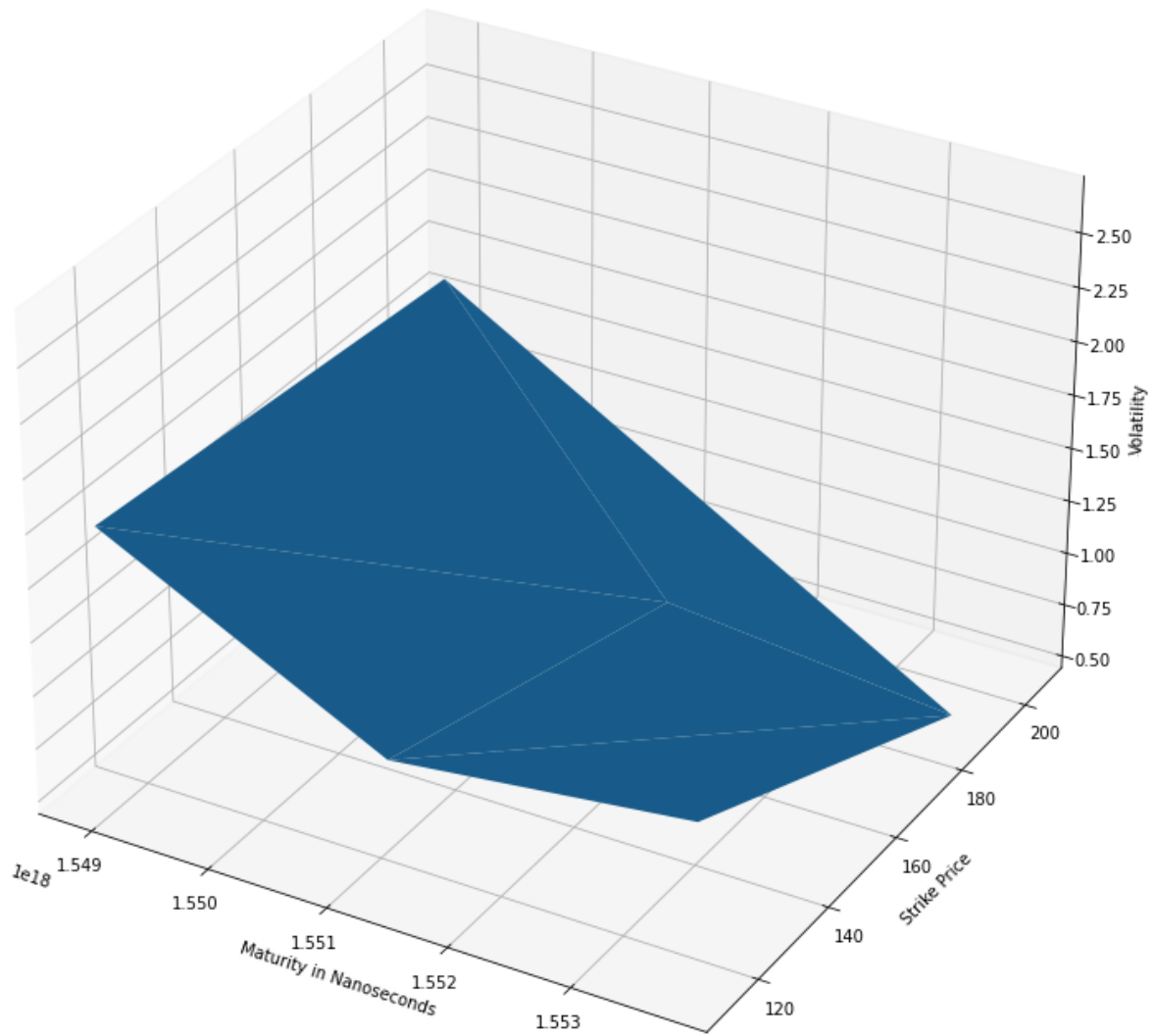
3D Plot for IOC_put

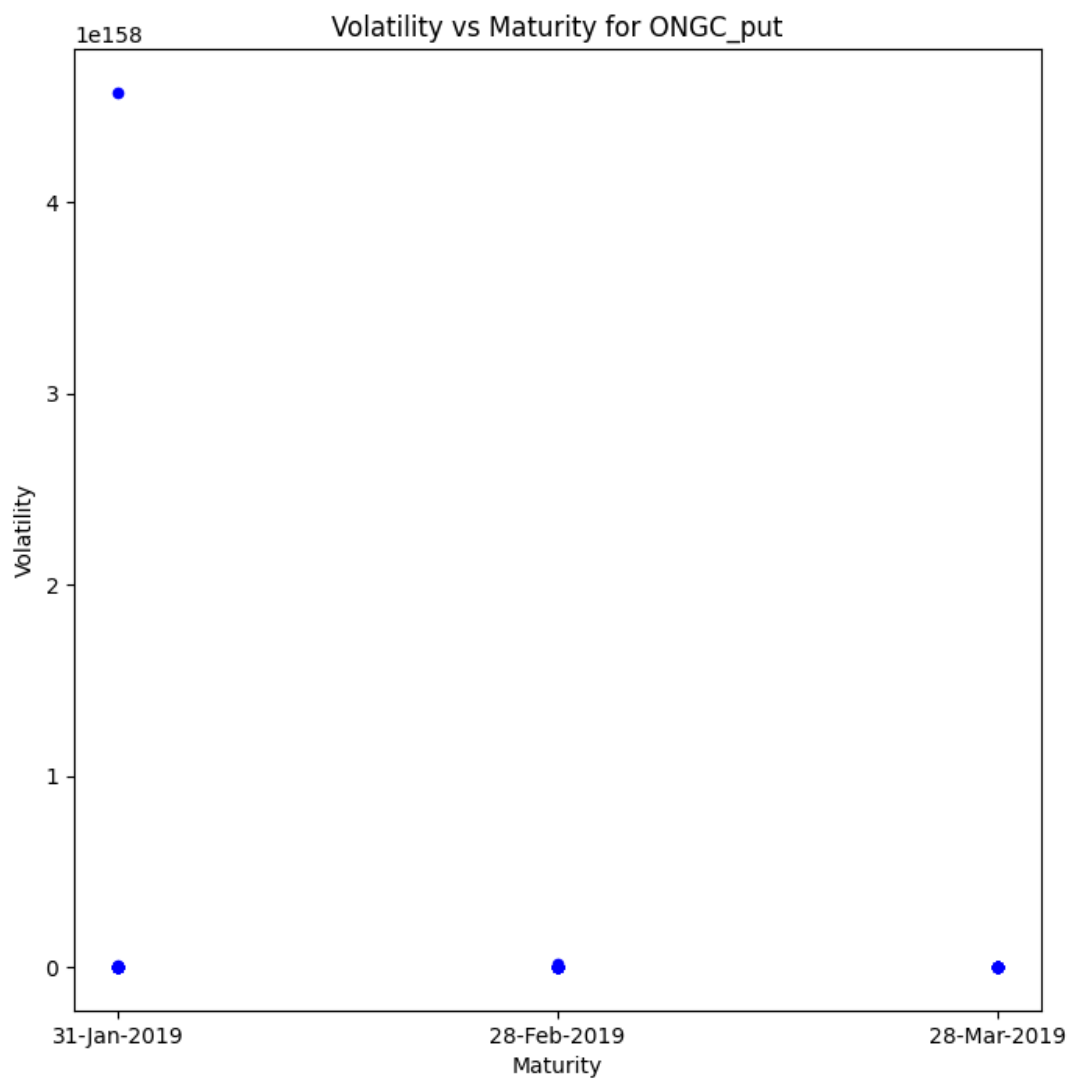


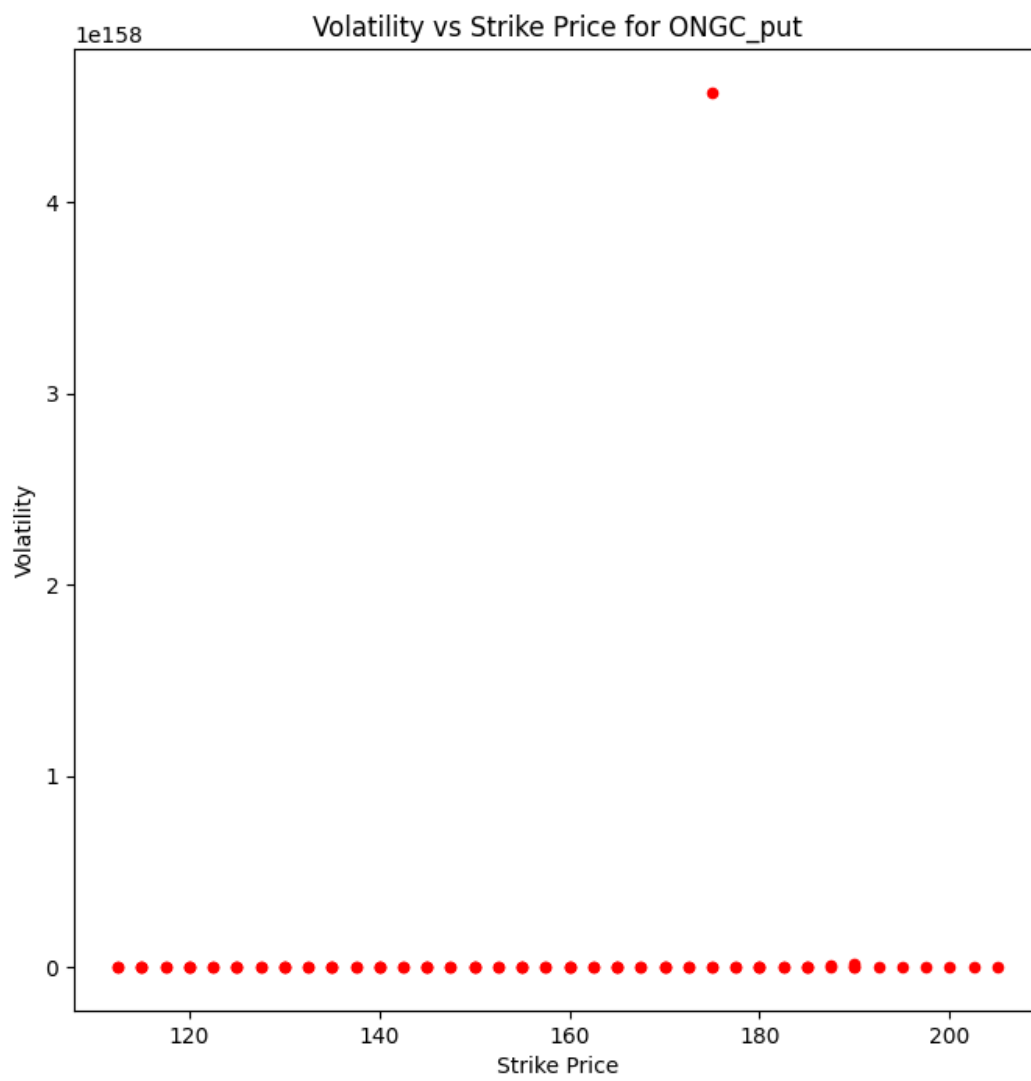




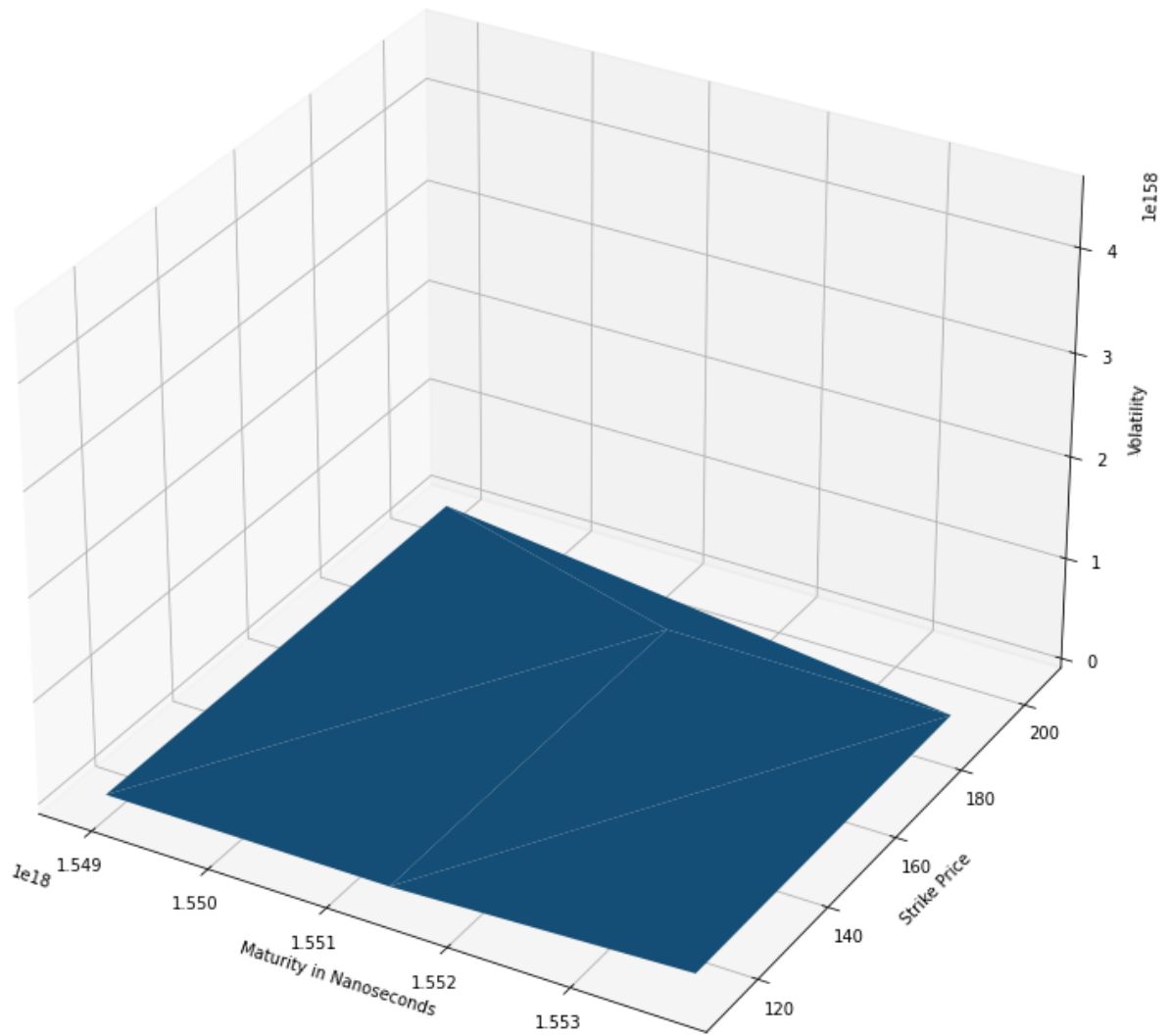
3D Plot for ONGC_call

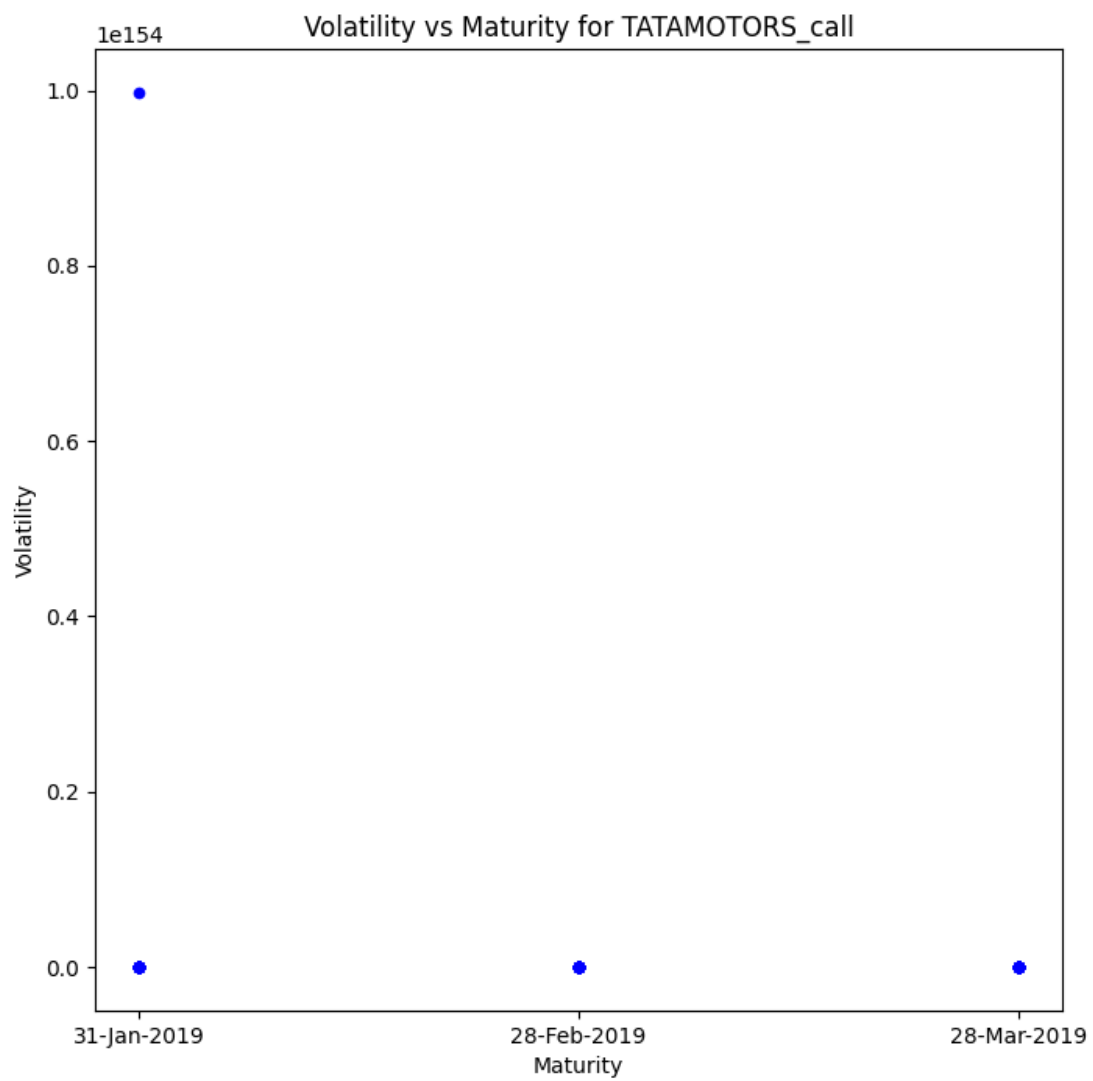


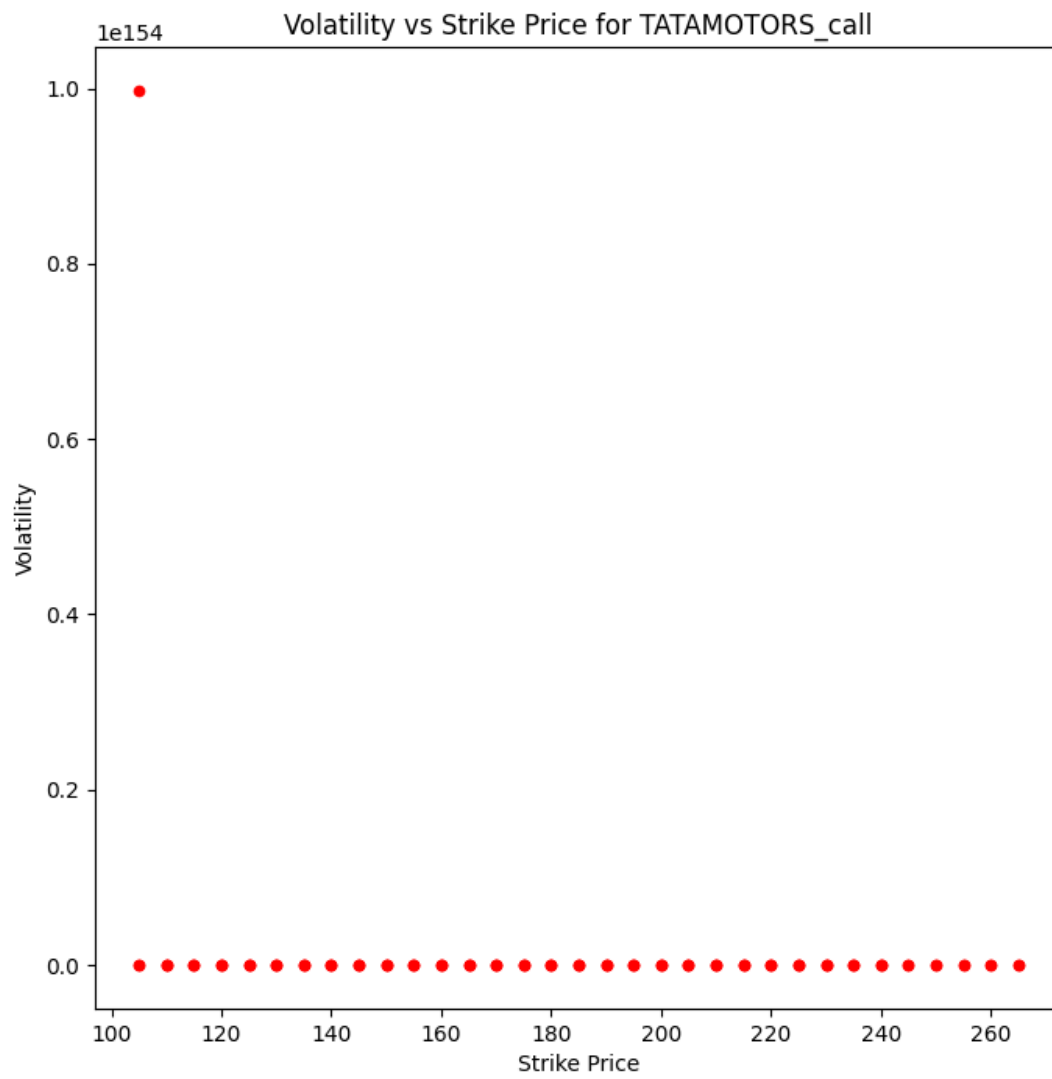




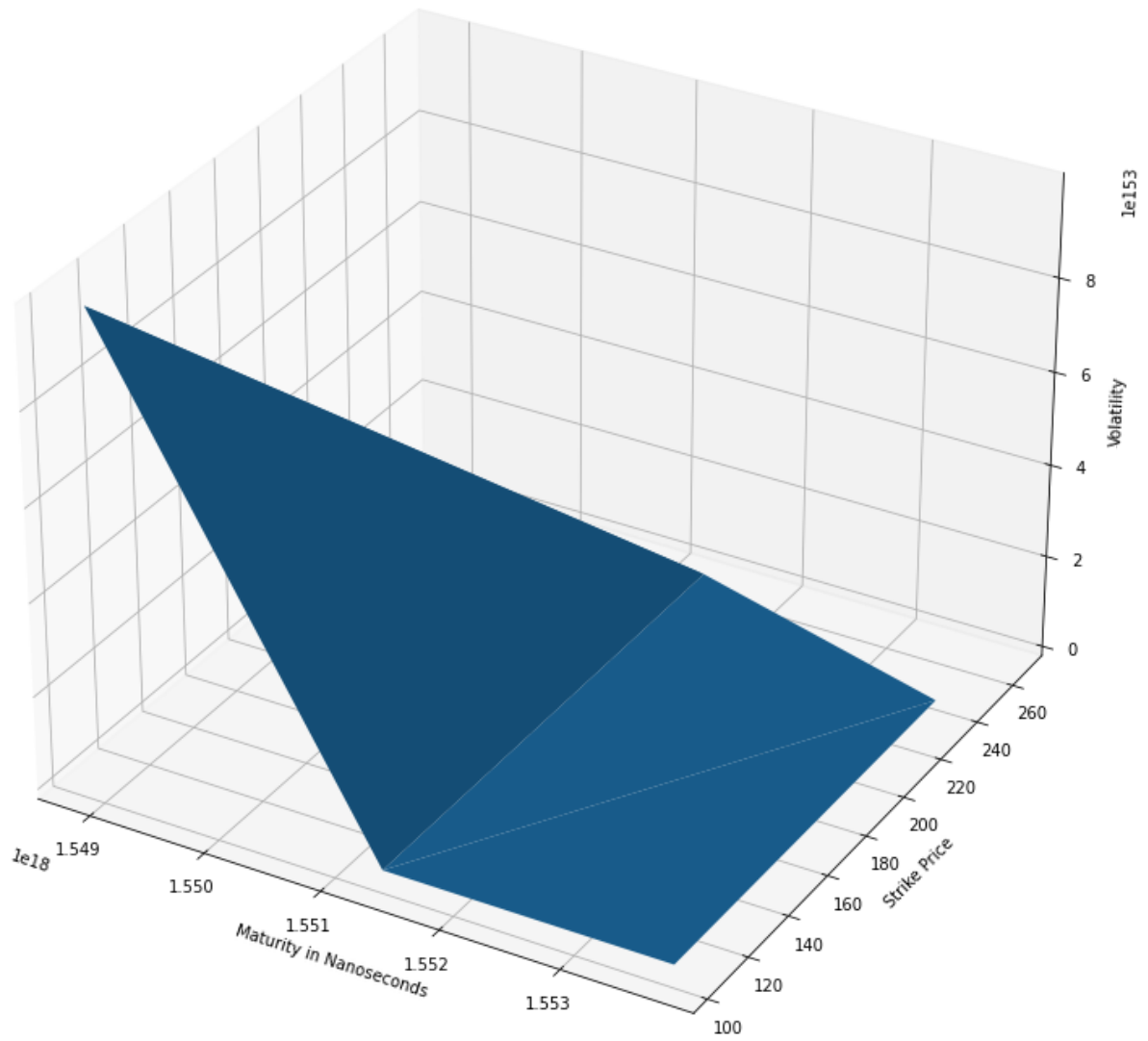
3D Plot for ONGC_put

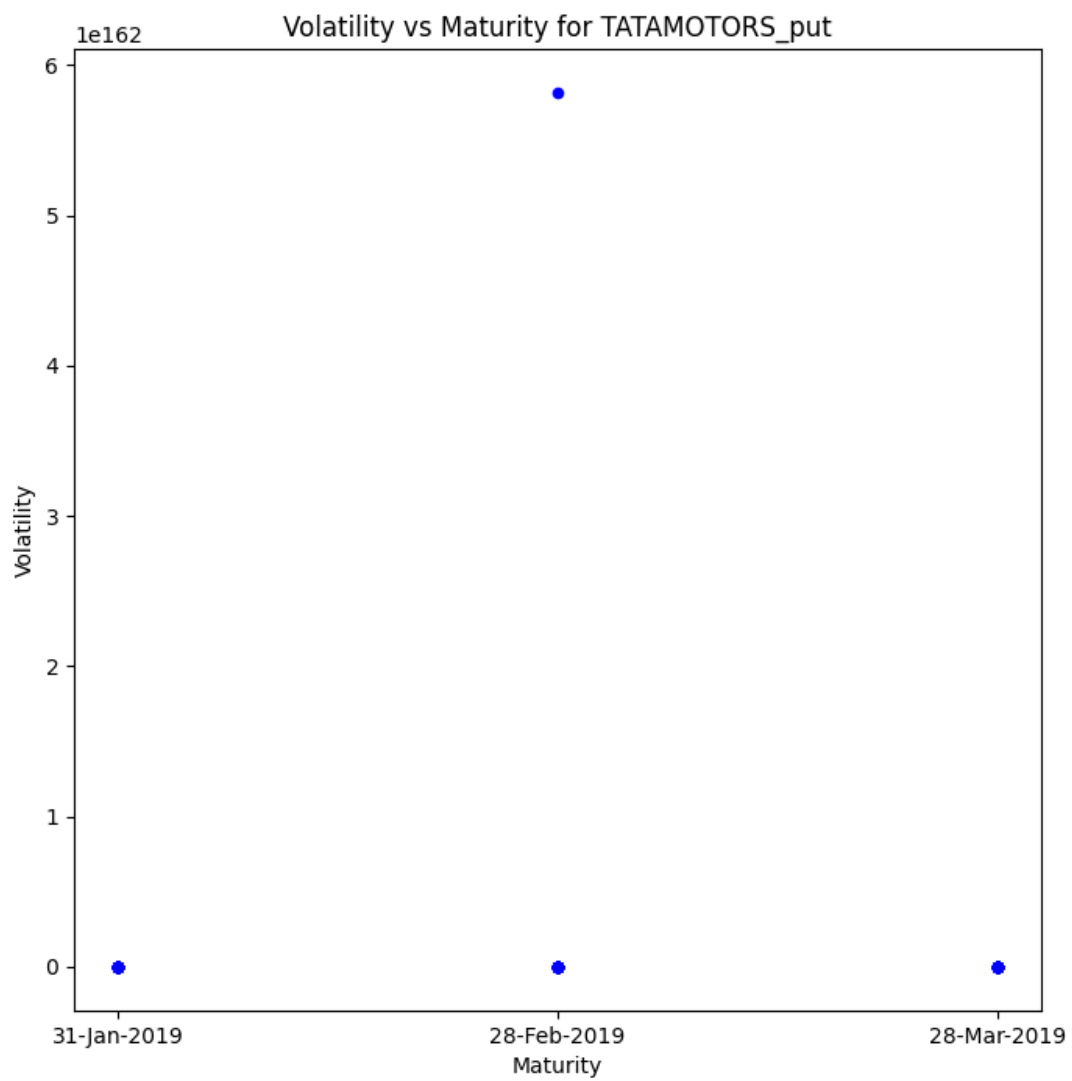


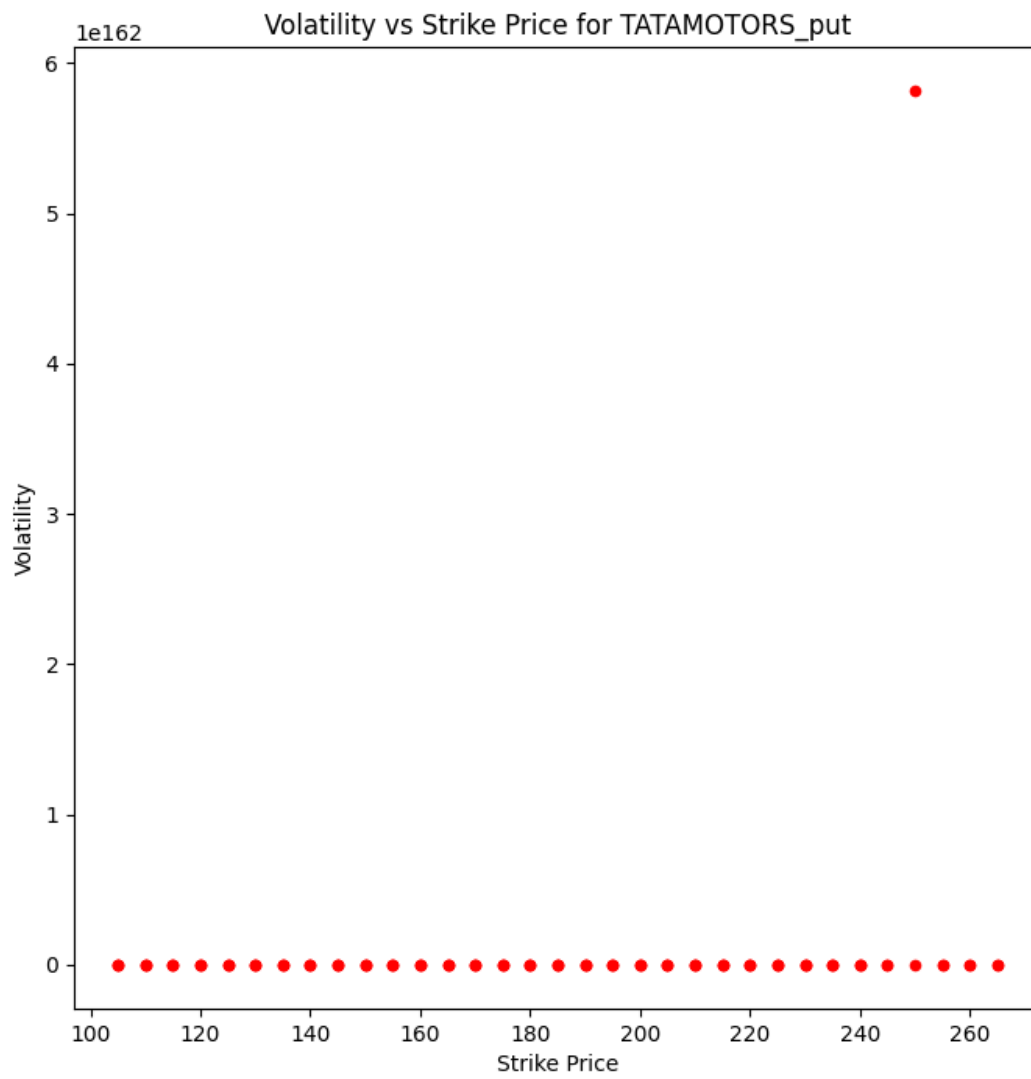




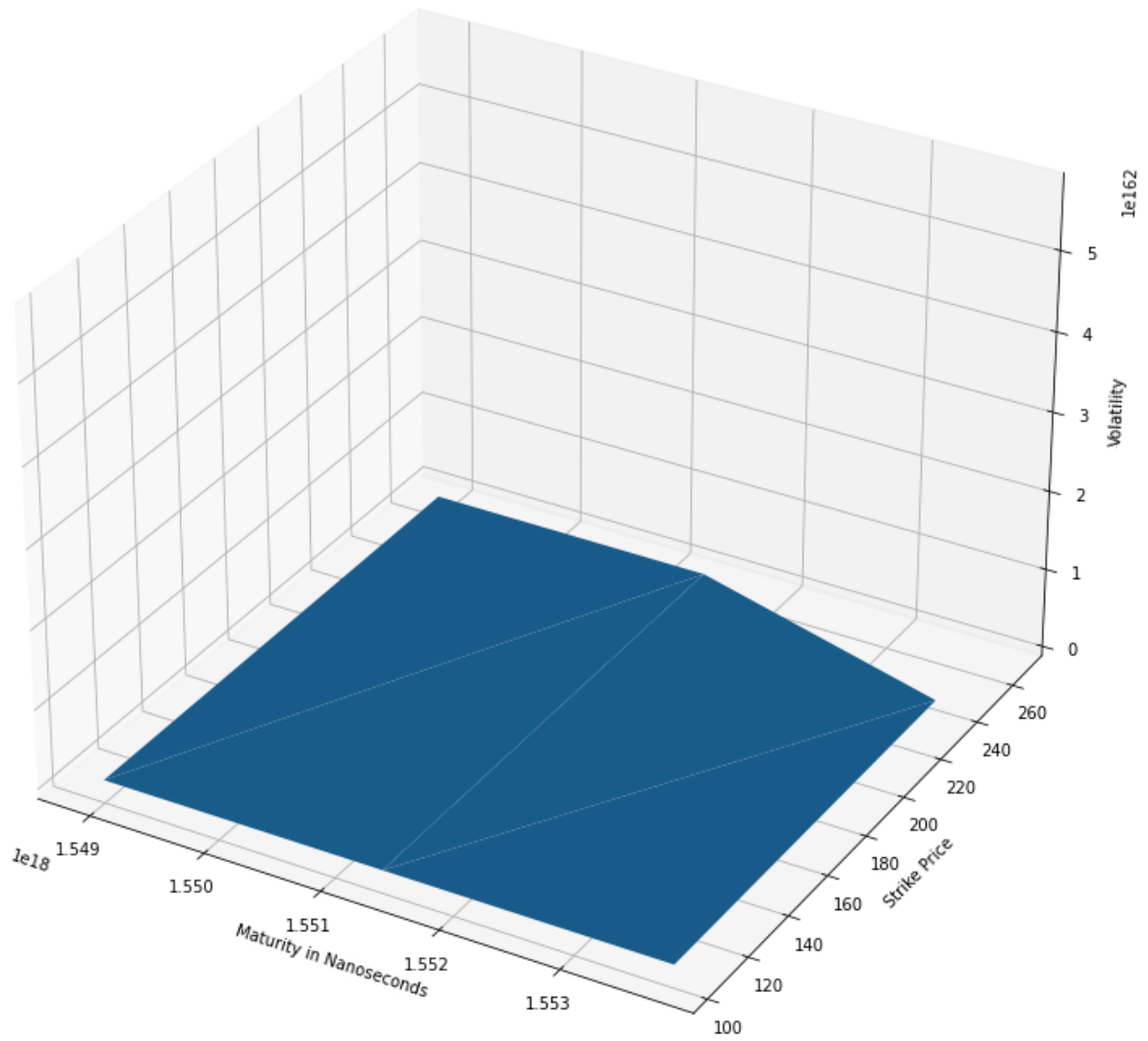
3D Plot for TATAMOTORS_call







3D Plot for TATAMOTORS_put



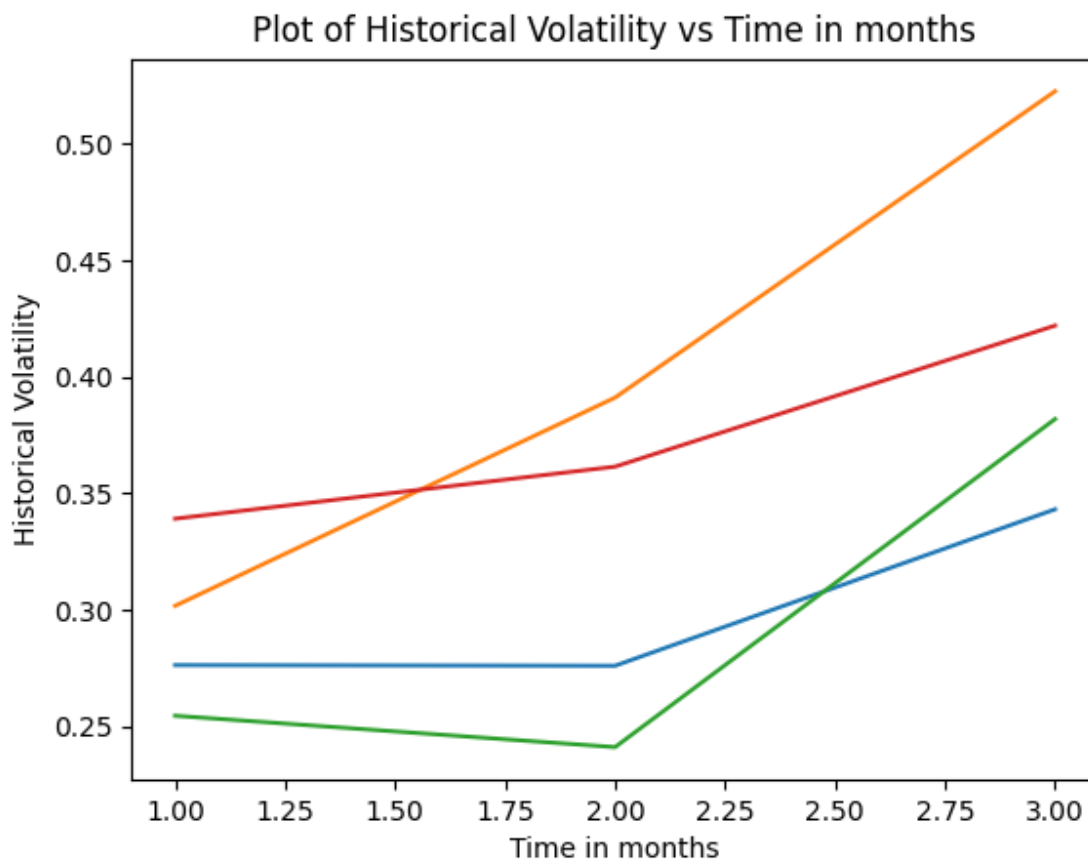
Question 04.

The historical volatility is estimated for a period of 3 months (the same period for which implied volatility is measured). The data for 4 stocks are tabulated inside the **HistoricalVolatility.csv** file.

- The historical volatility has no direct correlation with the implied volatility, but by combining these metrics, we can judge the option premiums. For example when implied volatility is significantly higher than the average historical levels, option premiums are assumed to be overvalued.

TIME	GAIL	IOC	ONGC	TATAMOTORS
1 months	0.276213	0.301657	0.254460	0.339085
2 months	0.275928	0.391108	0.240973	0.361448
3 months	0.343134	0.522698	0.381893	0.422017

The plots are as shown below.



Extras...

The following packages need to be installed for this lab.

Kindly use `pip3` since the code must be run in python 3 as mentioned previously.

```
Numpy - pip3 install numpy  
Pandas - pip3 install pandas  
Matplotlib - pip3 install matplotlib  
Scipy - pip3 install scipy
```