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Google Colab Link : https://colab.research.google.com/github/SmayanKulkarni/AI-and-ML-Course/blob/master/D100%20CMPM/exp-3.ipynb

[1]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
```

[2]:

```
def cal_d1(S,K,sigma,T,r):
    d1 = (np.log(S/K) + (r+ (0.5 * (sigma)**2) )*T) / (sigma * np.sqrt(T))
    return d1
```

[3]:

```
def cal_d2(d1, sigma,T):
    d2 = d1 - (sigma * (np.sqrt(T)))
    return d2
```

[4]:

```
from scipy.stats import norm
import math
def cal_C(S,K, d1,d2,r,T):
    """
    S = Current stock price
    K = Strike price
    T = Time to maturity (in years)
    r = Risk-free interest rate
      = Volatility of the stock
    N(d) = Cumulative distribution function (CDF) of the standard normal␣
  ↪distribution
    """
    c = S * norm.cdf(d1) - K * math.exp(- r  * T) * norm.cdf(d2)

    return c
```

[5]:

```
here_d1= cal_d1(60,56,0.3,0.5,0.14)
print(here_d1)
```

```
0.7612846969447399
```

[6]:

```
here_d2 = cal_d2(here_d1, 0.3,0.5)
here_d2
```

```
[6]: 0.5491526625887756
```

```
[7]: c_val = cal_C(60,56,here_d1,here_d2,0.14,0.5)
```

```
[8]: c_val
```

```
[8]: 9.60913887372783
```

```
[9]: def compute_Black_Scholes_Option_Pricing_Model(S,K,r,T,sigma):
         here_d1 = cal_d1(S,K,sigma,T,r)
         here_d2 = cal_d2(here_d1, sigma,T)
         c_val = cal_C(S,K, here_d1,here_d2,r,T)

         return c_val
```

```
[10]: c_val = compute_Black_Scholes_Option_Pricing_Model(60,56,0.14,0.5,0.3)
```

```
[11]: c_val
```

```
[11]: 9.60913887372783
```

```
[12]: variation_vol = np.arange(0.1, 0.6, 0.1)
```

```
[13]: variation_vol
```

```
[13]: array([0.1, 0.2, 0.3, 0.4, 0.5])
```

```
[14]: val_variations = []

      for var in variation_vol:
          temp_c_val = compute_Black_Scholes_Option_Pricing_Model(60,56,0.14,0.5,var)
          val_variations.append(temp_c_val)
```

```
[15]: val_variations
```

```
[15]: [7.822753913421124,
       8.46621414492224,
       9.60913887372783,
       10.94339920921135,
       12.35893254464969]
```

```
[16]: variation_T = np.arange(0.1,2.1, 0.1)
```

```
[17]: T_variations = []

      for T in variation_T:
          temp_c_val = compute_Black_Scholes_Option_Pricing_Model(60,56,0.14,T,0.3)
```

```
    T_variations.append(temp_c_val)

T_variations
```

[17]:

```
[5.3523436059603,
 6.598664019842751,
 7.689492527404234,
 8.6833079963654,
 9.60913887372783,
 10.48349259225845,
 11.316762465048804,
 12.115981207773139,
 12.886167219754533,
 13.631050468250208,
 14.353494249111762,
 15.05575504225795,
 15.73965034287766,
 16.406671335504086,
 17.058061024736624,
 17.694869919417933,
 18.317996664967378,
 18.928218305033543,
 19.526213226910166,
 20.11257883718394]
```

[18]:

```
int_variations = np.arange(0.01, 0.11, 0.01)
```

[19]:

```
int_variations
```

[19]:

```
array([0.01, 0.02, 0.03, 0.04, 0.05, 0.06, 0.07, 0.08, 0.09, 0.1 ])
```

[20]:

```
interest_variations = []

for inte in int_variations:
    temp_c_val = compute_Black_Scholes_Option_Pricing_Model(60,56,inte,0.5,0.3)
    interest_variations.append(temp_c_val)

interest_variations
```

[20]:

```
[7.3201864357995845,
 7.487056067932336,
 7.655602926067537,
 7.825789817382386,
 7.99757870389854,
 8.170930752066702,
 8.345806383176885,
 8.522165324473981,
 8.699966660858252,
 8.879168887049723]
```

```
[21]: df_interest = pd.DataFrame()
```

```
[22]: df_interest['Interest Variation'] = interest_variations
```

```
[23]: df_interest
```

```
[23]:    Interest Variation
      0            7.320186
      1            7.487056
      2            7.655603
      3            7.825790
      4            7.997579
      5            8.170931
      6            8.345806
      7            8.522165
      8            8.699967
      9            8.879169
```

```
[24]: df_interest['Interest rate'] = int_variations
```

```
[25]: df_interest
```

```
[25]:    Interest Variation  Interest rate
      0            7.320186           0.01
      1            7.487056           0.02
      2            7.655603           0.03
      3            7.825790           0.04
      4            7.997579           0.05
      5            8.170931           0.06
      6            8.345806           0.07
      7            8.522165           0.08
      8            8.699967           0.09
      9            8.879169           0.10
```

```
[26]: df_volatality = pd.DataFrame()
```

```
[27]: df_volatality['Volatility Variation'] = variation_vol
```

```
[28]: df_volatality['Variation with volatility'] = val_variations
```

```
[29]: df_volatality
```

```
[29]:    Volatility Variation  Variation with volatility
      0                   0.1                   7.822754
```

```
1                    0.2                    8.466214
2                    0.3                    9.609139
3                    0.4                   10.943399
4                    0.5                   12.358933
```

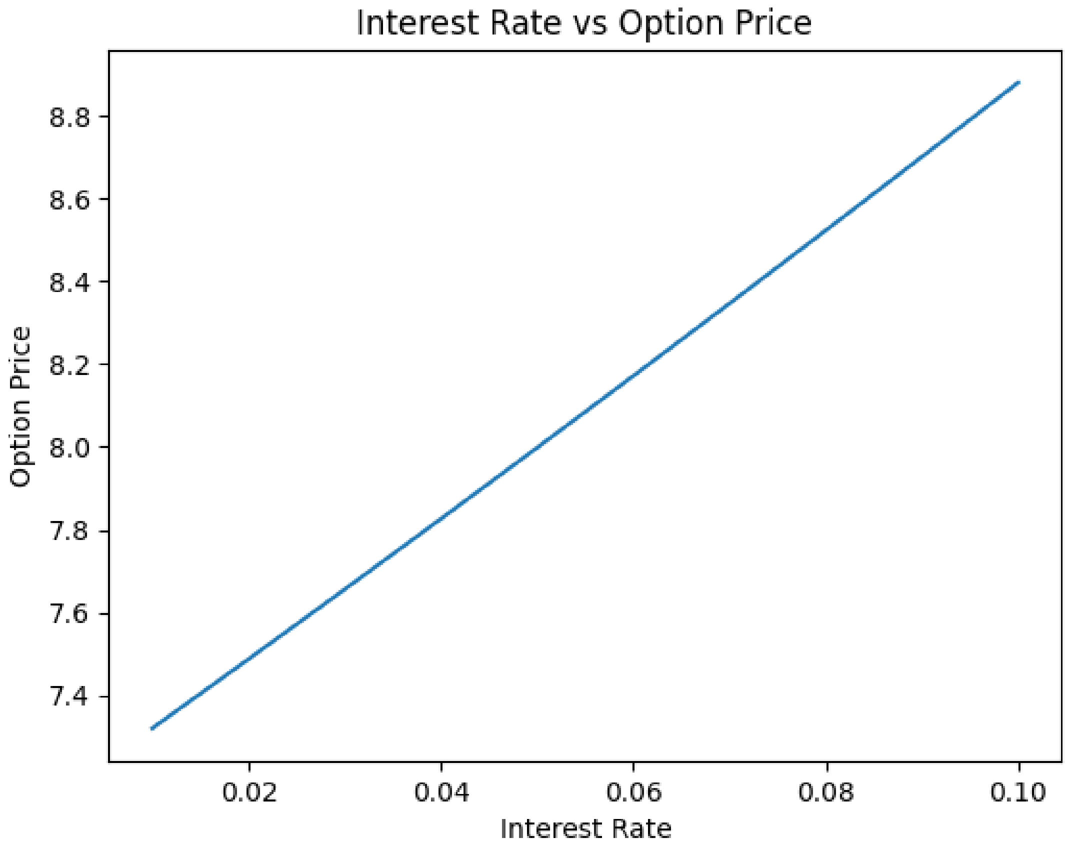
```
[30]: df_time = pd.DataFrame()
```

```
[31]: df_time['Year Variation'] = variation_T
      df_time['Value Variations'] = T_variations
```

```
[32]: df_time
```

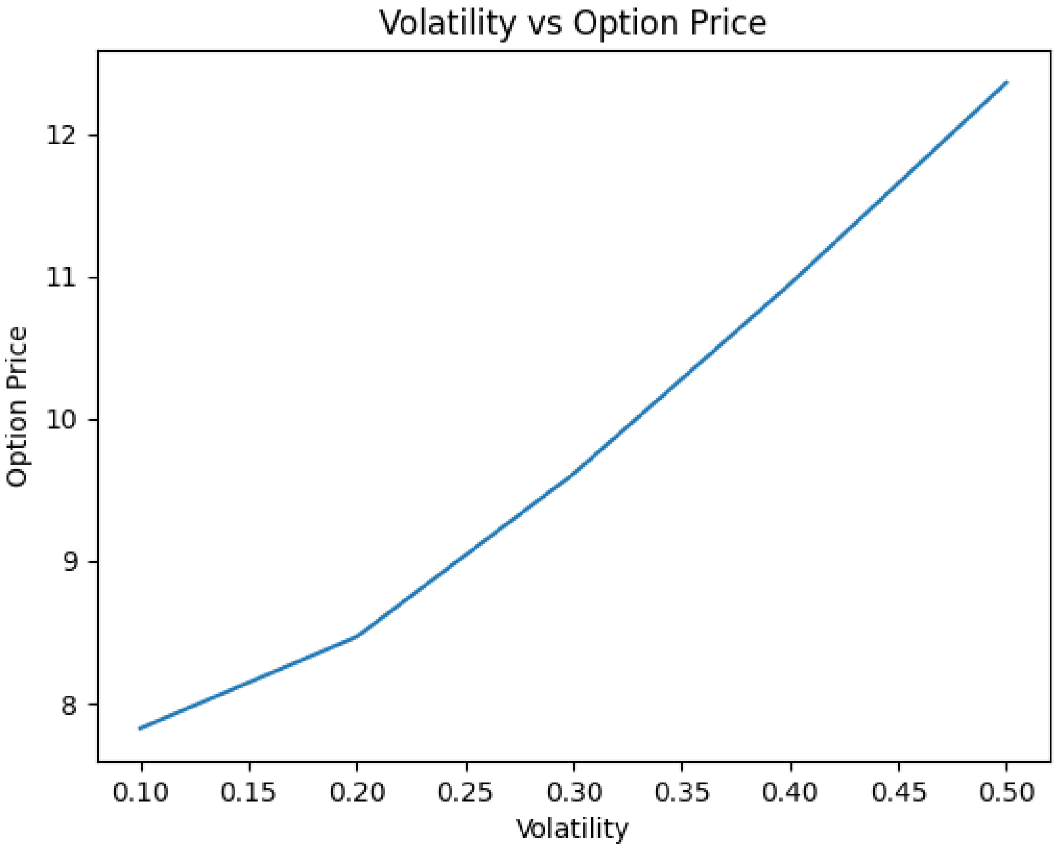
```
[32]:     Year Variation  Value Variations
      0              0.1          5.352344
      1              0.2          6.598664
      2              0.3          7.689493
      3              0.4          8.683308
      4              0.5          9.609139
      5              0.6         10.483493
      6              0.7         11.316762
      7              0.8         12.115981
      8              0.9         12.886167
      9              1.0         13.631050
      10             1.1         14.353494
      11             1.2         15.055755
      12             1.3         15.739650
      13             1.4         16.406671
      14             1.5         17.058061
      15             1.6         17.694870
      16             1.7         18.317997
      17             1.8         18.928218
      18             1.9         19.526213
      19             2.0         20.112579
```

```
[33]: #Plotting the graph for interest rate
      plt.plot(df_interest['Interest rate'], df_interest['Interest Variation'])
      plt.xlabel('Interest Rate')
      plt.ylabel('Option Price')
      plt.title('Interest Rate vs Option Price')
      plt.show()
```



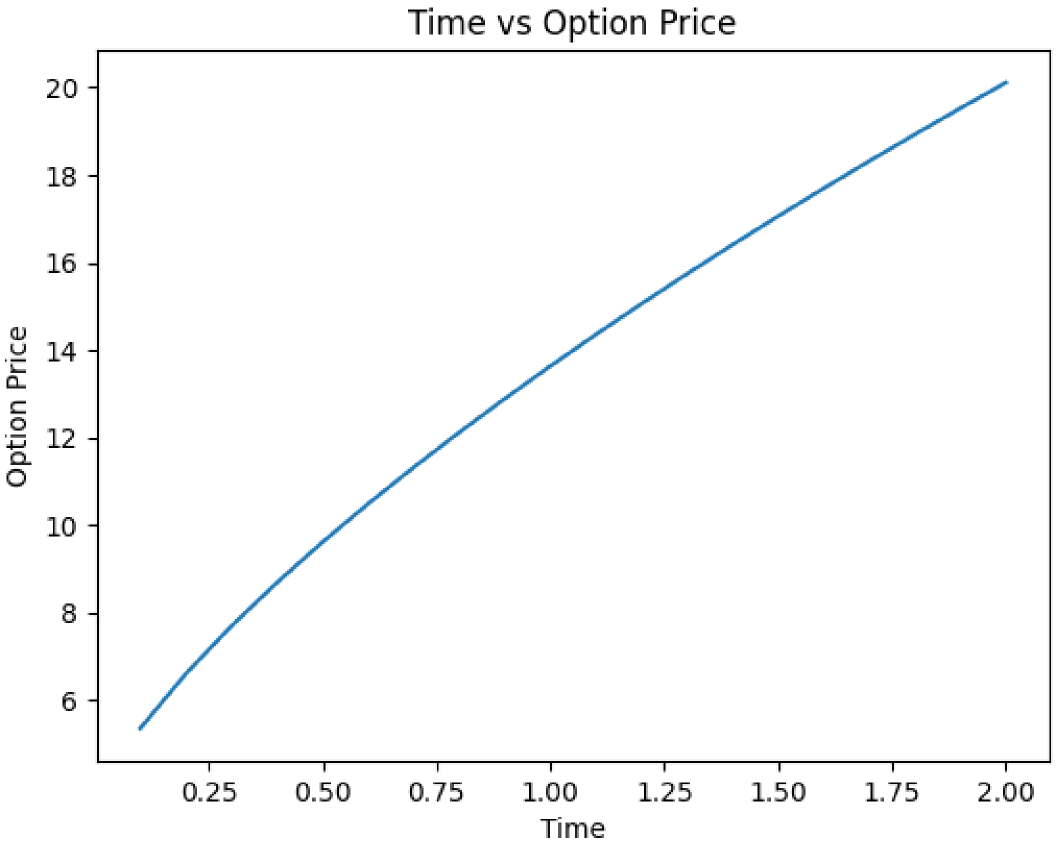
[34]:

```
#Plotting the graph for volatility
plt.plot(df_volatality['Volatility Variation'], df_volatality['Variation with␣
  ↪volatility'])
plt.xlabel('Volatility')
plt.ylabel('Option Price')
plt.title('Volatility vs Option Price')
plt.show()
```



[35]:

```
#plotting the graph for time
plt.plot(df_time['Year Variation'], df_time['Value Variations'])
plt.xlabel('Time')
plt.ylabel('Option Price')
plt.title('Time vs Option Price')
plt.show()
```


Time vs Option Price
Option Price
20
18
16
14
12
10
8
6
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
Time