In [...]:
```python
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
```

In [...]:
```python
import os
os.chdir('/Users/divine/Documents/MBS /PGE 2 /S2/Finance appliquée avec Python /Rapport/2021:2022')
```

In [...]:
```python
df = pd.read_excel('NDAQ 2021.xlsx')
```

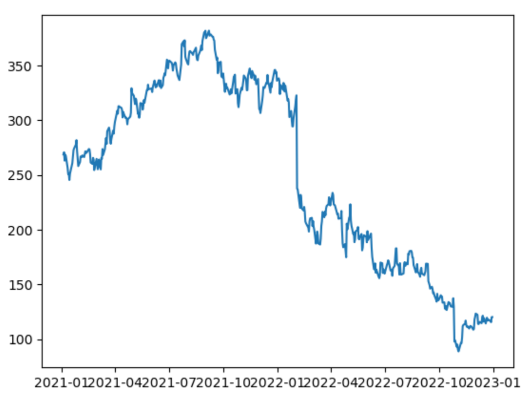
In [...]:
```python
print(df)
```

```
           Date        META     NASDAQ
0    2021-01-04  268.654968  42.049213
1    2021-01-05  270.682800  42.036465
2    2021-01-06  263.030914  43.129025
3    2021-01-07  268.455170  43.574966
4    2021-01-08  267.286407  44.215218
..          ...         ...        ...
498  2022-12-23  117.914894  60.059288
499  2022-12-27  116.756119  59.765259
500  2022-12-28  115.497459  59.490841
501  2022-12-29  120.132538  60.637527
502  2022-12-30  120.212448  60.127888

[503 rows x 3 columns]
```

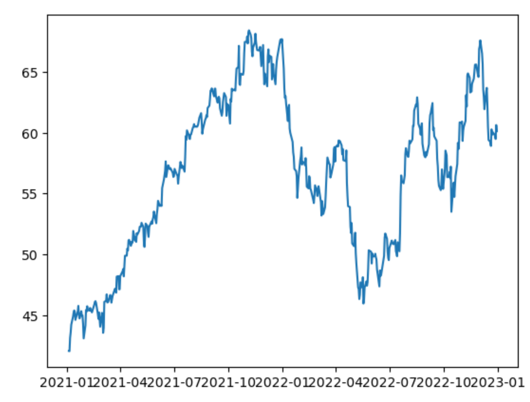
In [...]:
```python
plt.plot(df['Date'], df['META'])
```

Out[7]: `[<matplotlib.lines.Line2D at 0x12d707cd0>]`



In [...]:
```python
plt.plot(df['Date'], df['NASDAQ'])
```

Out[8]: `[<matplotlib.lines.Line2D at 0x12db57690>]`



In [...]:
```python
meta = df['META']
nasdaq = df['NASDAQ']
```

In [...]:
```python
meta_daily_returns = meta.pct_change()
```

In [...]:
```python
nasdaq_daily_returns = nasdaq.pct_change()
```

In [...]:
```python
meta_daily_returns.mean()*252
```

Out[12]: `-0.27203999231524006`

In [...]:
```python
nasdaq_daily_returns.mean()*252
```

Out[13]: `0.20821852746996086`

In [...]:
```python
meta_daily_returns.std()*252**0.5
```

Out[14]: `0.5008556318801559`

In [...]:
```python
nasdaq_daily_returns.std()*252**0.5
```

Out[15]: `0.23939344332419366`

In [...]:
```python
clean_meta_daily_returns = meta_daily_returns.dropna(axis=0)
clean_nasdaq_daily_returns = nasdaq_daily_returns.dropna(axis=0)
```

In [...]:
```python
data = np.array([clean_meta_daily_returns,clean_nasdaq_daily_returns])
```

In [...]:
```python
covMatrix = np.cov(data,bias=True)
print(covMatrix)
```

```
[[0.00099348 0.00020938]
 [0.00020938 0.00022696]]
```

In [...]:
```python
beta = covMatrix[0] [1] / covMatrix[1] [1]
print(beta)
```

```
0.9225097415184129
```

In [...]:
```python
import os
os.chdir('/Users/divine/Documents/MBS /PGE 2 /S2/Finance appliquée avec Python /Rapport/2021:2022')
```

In [...]:
```python
data = pd.read_excel('META2021.xlsx')
```

In [...]:
```python
data.head()
```

Out[22]:

	Date	META	NVIDIA	ALPHABET INC.	MICROSOFT	BAIDU
0	2021-01-04	268.654968	130.833954	86.412003	211.605286	176.399994
1	2021-01-05	270.682800	133.739792	87.045998	211.809448	174.800003
2	2021-01-06	263.030914	125.855415	86.764503	206.317368	171.800003
3	2021-01-07	268.455170	133.133682	89.362503	212.188538	170.000000
4	2021-01-08	267.286407	132.462723	90.360497	213.481369	191.000000

In [...]:
```python
stocks = data.drop(columns=["Date"])
stocks.head()
```

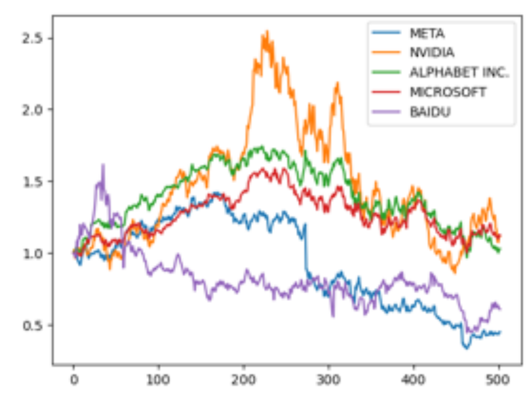
Out[23]:

	META	NVIDIA	ALPHABET INC.	MICROSOFT	BAIDU
0	268.654968	130.833954	86.412003	211.605286	176.399994
1	270.682800	133.739792	87.045998	211.809448	174.800003
2	263.030914	125.855415	86.764503	206.317368	171.800003
3	268.455170	133.133682	89.362503	212.188538	170.000000
4	267.286407	132.462723	90.360497	213.481369	191.000000

In [...]:
```python
stock_normed = stocks/stocks.iloc[0]
```

In [...]:
```python
stock_normed.plot()
```

Out[25]: `<Axes: >`



In [...]:
```python
log_ret = np.log(stocks/stocks.shift(1))
```

In [...]:
```python
log_ret.mean() * 252
```

Out[27]:
```
META            -0.403686
NVIDIA           0.055292
ALPHABET INC.    0.013288
MICROSOFT        0.057473
BAIDU           -0.250959
dtype: float64
```

In [...]:
```python
log_ret.describe().transpose()
```

Out[28]:

	count	mean	std	min	25%	50%	75%	max
META	502.0	-0.001602	0.032776	-0.306391	-0.013486	-0.000310	0.014581	0.162064
NVIDIA	502.0	0.000219	0.034583	-0.099518	-0.020369	0.001376	0.020590	0.133913
ALPHABET INC.	502.0	0.000053	0.020306	-0.101313	-0.009954	0.000720	0.010154	0.074606
MICROSOFT	502.0	0.000228	0.018335	-0.080295	-0.009206	-0.000084	0.011290	0.079059
BAIDU	502.0	-0.000996	0.039350	-0.165775	-0.022895	0.000000	0.018669	0.333690

In [...]:
```python
log_ret.cov()
```

Out[29]:

	META	NVIDIA	ALPHABET INC.	MICROSOFT	BAIDU
META	0.001074	0.000611	0.000425	0.000352	0.000051
NVIDIA	0.000611	0.001196	0.000479	0.000462	0.000027
ALPHABET INC.	0.000425	0.000479	0.000412	0.000302	0.000021
MICROSOFT	0.000352	0.000462	0.000302	0.000336	-0.000002
BAIDU	0.000051	0.000027	0.000021	-0.000002	0.001548

In [...]:
```python
log_ret.corr()
print(log_ret.corr())
```

```
                   META    NVIDIA  ALPHABET INC.  MICROSOFT     BAIDU
META           1.000000  0.538802       0.638188   0.585666  0.039530
NVIDIA         0.538802  1.000000       0.681950   0.728488  0.020084
ALPHABET INC.  0.638188  0.681950       1.000000   0.811912  0.026548
MICROSOFT      0.585666  0.728488       0.811912   1.000000 -0.003158
BAIDU          0.039530  0.020084       0.026548  -0.003158  1.000000
```

In [...]:
```python
num_ports = 15000
all_weights = np.zeros((num_ports,len(stocks.columns)))
ret_arr = np.zeros(num_ports)
vol_arr = np.zeros(num_ports)
sharpe_arr = np.zeros(num_ports)
nb_assets = stocks.shape[1]
```

In [...]:
```python
for ind in range(num_ports):
    weights = np.array(np.random.random(nb_assets))
    weights = weights / np.sum(weights)
    all_weights[ind,:] = weights
    ret_arr[ind] = np.sum((log_ret.mean() * weights) *252)
    vol_arr[ind] = np.sqrt(np.dot(weights.T, np.dot(log_ret.cov() * 252, weights)))
    sharpe_arr[ind] = ret_arr[ind]/vol_arr[ind]
```

In [...]:
```python
sharpe_arr.max()
optimal = sharpe_arr.argmax()
print(optimal)
```

```
4636
```

In [...]:
```python
optimal_pf = all_weights[optimal,:]
o_w = optimal_pf.tolist()
weights_sim = dict(zip(stocks, o_w))
```

In [...]:
```python
optimal_weights = pd.DataFrame.from_dict(weights_sim, orient='index', columns=['Weight in %'])
optimal_weights = optimal_weights*100
optimal_weights = optimal_weights.round(decimals = 2)
optimal_weights = optimal_weights.sort_values(by=['Weight in %'], ascending = False)
optimal_weights
```

Out[35]:

	Weight in %
MICROSOFT	65.45
NVIDIA	19.06
ALPHABET INC.	13.01
BAIDU	2.38
META	0.10

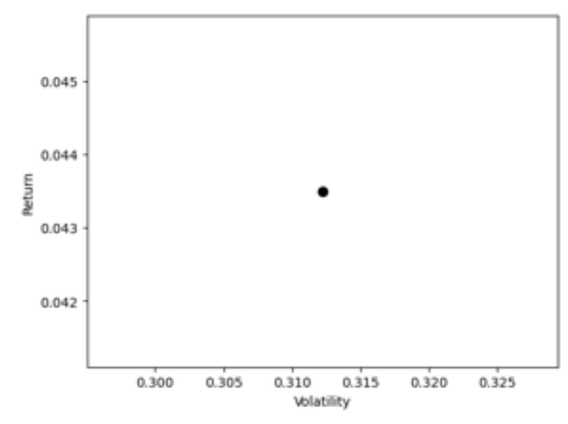
In [...]:
```python
max_sr_ret = ret_arr[optimal]
max_sr_vol = vol_arr[optimal]
max_sr = sharpe_arr[optimal]
```

In [...]:
```python
print('La rentabilité du portefeuille optimal est',max_sr_ret*100,'%')
print('La volatilité du portefeuille optimal est',max_sr_vol*100,'%')
print('Le ratio de Sharpe du portefeuille optimal est',max_sr)
```

```
La rentabilité du portefeuille optimal est 4.349397649445135 %
La volatilité du portefeuille optimal est 31.22392546629376 %
Le ratio de Sharpe du portefeuille optimal est 0.13929695208055473
```

In [...]:
```python
plt.scatter(max_sr_vol,max_sr_ret,c='black',s=50,edgecolors='black')
plt.xlabel('Volatility')
plt.ylabel('Return')
```

Out[38]: `Text(0, 0.5, 'Return')`



In [...]:
```python
plt.figure(figsize=(12,8))
plt.scatter(vol_arr,ret_arr,c=sharpe_arr,cmap='plasma')
plt.scatter(max_sr_vol,max_sr_ret,c='black',s=50,edgecolors='black')
plt.colorbar(label='Sharpe Ratio')
plt.xlabel('Volatility')
plt.ylabel('Return')
```

Out[39]: `Text(0, 0.5, 'Return')`