Portfolio Management

January 28, 2020

1 Mutual Fund Creation

[1]:
```
#Importing Libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
```

[2]:
```
#Importing the dataset
stocks = pd.read_excel("Stock Data.xlsx", sheet_name="Returns")
stocks.head()
```

[2]:

	Date	HDFC Bank	Kotak Mahindra Bank	ICICI Bank	Bajaj Finance	Reliance	Avenue Supermarts	Housing Development Finance Corporation	Infosys	Asian Paints	…	Bandhan Bank	Bharti Airtel	Titan	Tech Mahindra	Larsen Toubro	Ultratech Cement
0	2019-12-31	-0.007066	-0.002192	-0.009560	-0.000649	-0.019492	-0.023818	-0.009867	-0.001433	-0.008627	…	0.007536	-0.010206	-0.005693	-0.025120	-0.002343	-0.001357
1	2019-12-30	0.004667	0.001869	-0.009920	-0.003492	0.001329	-0.021360	-0.002864	-0.005429	-0.005819	…	-0.005424	0.011421	0.002728	0.002178	0.001808	-0.001085
2	2019-12-27	0.002635	-0.005313	0.019295	0.015170	0.017283	0.002057	0.012509	0.010353	0.001574	…	0.012178	0.018227	-0.001174	0.012649	0.015947	-0.001071
3	2019-12-26	-0.013767	-0.010311	-0.003789	0.012275	-0.019406	0.007265	0.001286	-0.005455	0.003715	…	0.005520	-0.022302	-0.009510	-0.002330	-0.017209	-0.008908
4	2019-12-24	-0.009982	0.003930	-0.000739	-0.004941	-0.015945	-0.008065	-0.004603	-0.003533	-0.002241	…	-0.011313	0.005939				

```
4 -0.003641      -0.004189      -0.007321          0.003428

   Divis Laboratories  Pidilite Industries  Astral Polytech  Eicher Motors
0           -0.001352            -0.014004         0.006675      -0.011330
1            0.010937             0.006223         0.007544       0.023918
2            0.005250             0.006334         0.008083       0.008391
3            0.000770             0.009263         0.009565       0.007718
4            0.006033            -0.000617         0.002551      -0.012958

[5 rows x 25 columns]
```

[3]:
```
returns = stocks.iloc[:,1:]
returns.head()
```

[3]:
```
   HDFC Bank  Kotak Mahindra Bank  ICICI Bank  Bajaj Finance  Reliance  \
0  -0.007066            -0.002192   -0.009560      -0.000649 -0.019492
1   0.004667             0.001869   -0.009920      -0.003492  0.001329
2   0.002635            -0.005313    0.019295       0.015170  0.017283
3  -0.013767            -0.010311   -0.003789       0.012275 -0.019406
4  -0.009982             0.003930   -0.000739      -0.004941 -0.015945

   Avenue Supermarts  Housing Development Finance Corporation   Infosys  \
0          -0.023818                                -0.009867 -0.001433
1          -0.021360                                -0.002864 -0.005429
2           0.002057                                 0.012509  0.010353
3           0.007265                                 0.001286 -0.005455
4          -0.008065                                -0.004603 -0.003533

   Asian Paints  Bajaj Finserv      …        Bandhan Bank  Bharti Airtel  \
0     -0.008627      -0.004754      …            0.007536      -0.010206
1     -0.005819      -0.001366      …           -0.005424       0.011421
2      0.001574       0.010137      …            0.012178       0.018227
3      0.003715       0.005851      …            0.005520      -0.022302
4     -0.002241       0.000091      …           -0.011313       0.005939

      Titan  Tech Mahindra  Larsen Toubro  Ultratech Cement  \
0 -0.005693      -0.025120      -0.002343         -0.001357
1  0.002728       0.002178       0.001808         -0.001085
2 -0.001174       0.012649       0.015947         -0.001071
3 -0.009510      -0.002330      -0.017209         -0.008908
4 -0.003641      -0.004189      -0.007321          0.003428

   Divis Laboratories  Pidilite Industries  Astral Polytech  Eicher Motors
0           -0.001352            -0.014004         0.006675      -0.011330
1            0.010937             0.006223         0.007544       0.023918
2            0.005250             0.006334         0.008083       0.008391
3            0.000770             0.009263         0.009565       0.007718
```

```
4            0.006033            -0.000617          0.002551       -0.012958

[5 rows x 24 columns]
```

[4]:
```
#Calculating average return
ave_return = returns.mean()
ave_return
```

[4]:
```
HDFC Bank                                    -0.000792
Kotak Mahindra Bank                           0.000738
ICICI Bank                                    0.001999
Bajaj Finance                                 0.001911
Reliance                                      0.001362
Avenue Supermarts                             0.000799
Housing Development Finance Corporation       0.000759
Infosys                                      -0.000939
Asian Paints                                  0.001054
Bajaj Finserv                                 0.001494
TCS                                           0.000538
Nestle India                                  0.001231
HUL                                           0.000515
Maruti Suzuki                                -0.000309
Bandhan Bank                                  0.000368
Bharti Airtel                                 0.000766
Titan                                         0.000991
Tech Mahindra                                 0.000538
Larsen Toubro                                 0.000174
Ultratech Cement                              0.000327
Divis Laboratories                            0.001748
Pidilite Industries                           0.000853
Astral Polytech                               0.000669
Eicher Motors                                -0.000372
dtype: float64
```

[5]:
```
#Calculates the risk matrix
var_covar = returns.cov()
var_covar
n = len(returns.columns)
```

[6]:
```
from quadprog import solve_qp
```

[7]:
```
#Making the constraint function (LHS of constraints)
cons1 = np.matrix([np.ones(n) ,ave_return])
cons2 = np.eye(n)
C = np.concatenate([cons1,cons2],axis =0)
C = C.T
C.shape
```

[7]: (24, 26)

[8]:
```
req_return = float(input("What is the daily rate of return required?")) #An␣
↪example
```

```
What is the daily rate of return required?0.0003
```

[9]:
```
req_return
```

[9]: 0.0003

[10]:
```
b1 = np.array([1,req_return])
b2 = [0]*n
b= np.concatenate([b1,b2],axis=0)
b
```

[10]:
```
array([1.e+00, 3.e-04, 0.e+00, 0.e+00, 0.e+00, 0.e+00, 0.e+00, 0.e+00,
       0.e+00, 0.e+00, 0.e+00, 0.e+00, 0.e+00, 0.e+00, 0.e+00, 0.e+00,
       0.e+00, 0.e+00, 0.e+00, 0.e+00, 0.e+00, 0.e+00, 0.e+00, 0.e+00,
       0.e+00, 0.e+00])
```

[11]:
```
#Model Solving
model = solve_qp(a=np.zeros(n),G=var_covar.values,C=C,b=b,meq=2)
```

[12]:
```
model
```

[12]:
```
(array([ 4.23715233e-02,  8.92662182e-02,  1.35075971e-17,  7.34437417e-18,
         5.37208001e-19,  3.55055205e-18,  1.02089512e-02,  6.52392698e-02,
        -4.95196796e-18,  9.39175209e-18,  2.18876292e-01,  0.00000000e+00,
         1.82555007e-01,  4.55844709e-02,  2.29959358e-18,  1.15109766e-02,
         1.32285788e-02,  1.06912425e-01,  1.42441555e-01,  1.02676426e-02,
        -4.38737628e-18, -8.69975486e-18,  3.73395290e-02,  2.41975608e-02]),
 3.64163253437568e-05,
 array([0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0.]),
 array([13,  0]),
 array([7.93774839e-05, 2.18161106e-02, 0.00000000e+00, 0.00000000e+00,
        2.89482302e-05, 4.67876523e-05, 4.58389246e-06, 1.03638030e-05,
        0.00000000e+00, 0.00000000e+00, 5.12711138e-06, 3.04379488e-05,
        0.00000000e+00, 1.74568758e-06, 0.00000000e+00, 0.00000000e+00,
        1.05897986e-05, 0.00000000e+00, 0.00000000e+00, 0.00000000e+00,
        0.00000000e+00, 0.00000000e+00, 1.48355148e-05, 5.08974661e-06,
        0.00000000e+00, 0.00000000e+00]),
 array([ 1,  2,  6, 12,  5, 23,  8, 11, 24, 17,  7, 14]))
```

[13]:
```
ret_seq = np.linspace(min(ave_return),max(ave_return),num=50)
ret_seq
```

[13]:
```
array([-9.39468483e-04, -8.79495221e-04, -8.19521959e-04, -7.59548697e-04,
       -6.99575435e-04, -6.39602173e-04, -5.79628911e-04, -5.19655649e-04,
       -4.59682388e-04, -3.99709126e-04, -3.39735864e-04, -2.79762602e-04,
       -2.19789340e-04, -1.59816078e-04, -9.98428161e-05, -3.98695542e-05,
        2.01037078e-05,  8.00769697e-05,  1.40050232e-04,  2.00023494e-04,
        2.59996755e-04,  3.19970017e-04,  3.79943279e-04,  4.39916541e-04,
        4.99889803e-04,  5.59863065e-04,  6.19836327e-04,  6.79809589e-04,
        7.39782851e-04,  7.99756113e-04,  8.59729375e-04,  9.19702636e-04,
        9.79675898e-04,  1.03964916e-03,  1.09962242e-03,  1.15959568e-03,
        1.21956895e-03,  1.27954221e-03,  1.33951547e-03,  1.39948873e-03,
        1.45946199e-03,  1.51943526e-03,  1.57940852e-03,  1.63938178e-03,
        1.69935504e-03,  1.75932830e-03,  1.81930157e-03,  1.87927483e-03,
        1.93924809e-03,  1.99922135e-03])
```

[15]:
```
#Calculating risk free rate
sigma_seq = []
max_sr = 0
rf = (1.065)**(1/252)-1
rf
```

[15]:
```
0.00024993122427763304
```

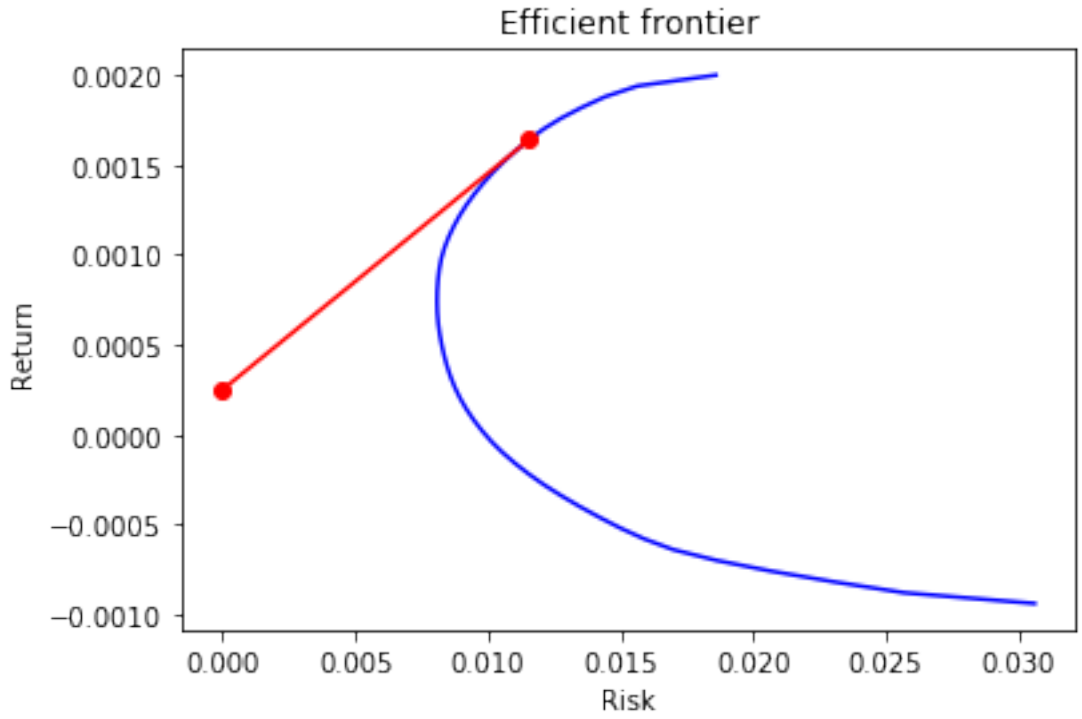
[16]:
```
for i in range(0,len(ret_seq)):

    cons1 = np.matrix([np.ones(n) ,ave_return])
    cons2 = np.eye(n)
    C = np.concatenate([cons1,cons2],axis =0)
    cons3 = np.zeros((5,n))
    cons3[0][0]=-1     #Imposing restrictions on maximum weights on some stocks
    cons3[1][5]=-1
    cons3[2][14]=-1
    cons3[3][17]=-1
    cons3[4][23]=-1
    cons3 = cons3.reshape((5,-1))
    C = np.concatenate([C,cons3])
    C = C.T


    #Limiting exposure of HDFC Bank to less than 10%
    #Limiting exposure of Avenue Supermarts to less than 5%
    #Limiting exposure of Bandhan Bank to less than 2%
    #Limiting exposure of Tech Mahindra to less than 1.5%
    #Limiting exposure of Eicher Motors to less than 0.5%

    b1 = np.array([1,ret_seq[i]])
    b2 = [0]*n
    b= np.concatenate([b1,b2],axis=0)
```

```
    b= np.concatenate([b,[-0.10,-0.05,-0.02,-0.015,-0.005]],axis=0)
    model = solve_qp(a=np.zeros(n),G=var_covar.values,C=C,b=b,meq=2)
    sigma = np.sqrt(2*model[1])
    sigma_seq.append(sigma)


    sr = (ret_seq[i]-rf)/(sigma)

    if sr>max_sr:
        max_sr = sr
        weights_opt = model[0]
```

[17]:
```
r_p = np.sqrt(np.dot(np.dot(weights_opt.T,var_covar),weights_opt))
ret_p = np.dot(ave_return,weights_opt)
```

[18]:
```
#Plotting
plt.plot(sigma_seq,ret_seq,color='blue')
plt.title('Efficient frontier')
plt.xlabel('Risk')
plt.ylabel('Return')

plt.plot([0,r_p],[rf,ret_p],color='red',marker='o')
```

[18]: [<matplotlib.lines.Line2D at 0x1fc21ef12b0>]



[19]:
```
#Optimum weights
weights_opt
```

[19]:
```
array([-2.24915349e-17, -1.72546645e-18,  2.78665347e-01,  1.07582321e-01,
        1.42274886e-01, -8.69908642e-18, -1.16572242e-17, -6.39425133e-18,
        0.00000000e+00,  3.77631675e-17,  2.80759679e-02,  2.07271687e-01,
        1.15998585e-16,  1.15816389e-16, -2.21502697e-17,  2.77458225e-17,
        8.21125895e-19, -3.17130401e-18, -8.89884646e-17, -1.09306953e-16,
        2.36129792e-01, -6.42809553e-17,  9.30763141e-19, -6.84351493e-17])
```

[20]:
```
#Optimum portfolio risk
r_p
```

[20]:
```
0.011551595041886875
```

[21]:
```
#Optimum Portfolio return
ret_p
```

[21]:
```
0.0016393817794543419
```

[ ]:
```

```