PortfolioMPT1

May 2, 2021

1 Universidad Nacional de Ingeniería

1.1 Facultad de Ingeniería Económica, Estadística y CC.SS

1.1.1 Finanzas Corporativas II - 2021-I

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Trabajaremos portafolios de **5 activos**

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

[6]:
```
daily_returns = pd.read_csv("Returns.csv", index_col ="Date")
daily_returns
```

[6]:
```
                ABOT      ACPL      ADMM      AGIL    AGTL
Date
01/01/2015 -0.013902  0.050010  0.009142  0.001501 -0.0058
01/02/2015  0.033034  0.027779  0.011769  0.032827 -0.0046
01/05/2015 -0.009752  0.002904 -0.031203  0.044773 -0.0051
01/06/2015 -0.023324 -0.003494  0.006421  0.047703  0.0487
01/07/2015  0.001902  0.024085 -0.012817  0.001301  0.0487
…               …         …         …         …       …
22/12/2017  0.030248  0.049905  0.000000  0.050115  0.0298
26/12/2017  0.040499  0.043416  0.000000 -0.002397 -0.0114
27/12/2017 -0.048485  0.008435  0.000000 -0.029360  0.0125
28/12/2017  0.017451  0.032414  0.000000  0.000000  0.0208
29/12/2017 -0.002696 -0.021662  0.000000 -0.007174 -0.0136

[744 rows x 5 columns]
```

[9]:
```
mean_ret = daily_returns.mean()
mean_ret
```

[9]:
```
ABOT    0.000263
ACPL    0.000359
```

```
ADMM   -0.000338
AGIL    0.001378
AGTL    0.001262
dtype: float64
```

[13]:
```
#Generating a random matrix of 1000 rows and 4 Columns
matrix = np.random.rand(1000,5)
matrix
```

[13]:
```
array([[0.03793399, 0.23162727, 0.4241891 , 0.61955104, 0.83181821],
       [0.85811623, 0.14620567, 0.79904689, 0.07597934, 0.09784391],
       [0.34839287, 0.62540084, 0.38155596, 0.47263642, 0.18345699],
       …,
       [0.69845057, 0.31934102, 0.97262582, 0.11369351, 0.54769691],
       [0.73501671, 0.24603666, 0.69369365, 0.10872861, 0.11521956],
       [0.19196068, 0.05529799, 0.05339183, 0.12752771, 0.30489702]])
```

[15]:
```
#Converting to a data frame
matrix_df = pd.DataFrame(matrix, columns = daily_returns.columns)
matrix_df
```

[15]:

	ABOT	ACPL	ADMM	AGIL	AGTL
0	0.037934	0.231627	0.424189	0.619551	0.831818
1	0.858116	0.146206	0.799047	0.075979	0.097844
2	0.348393	0.625401	0.381556	0.472636	0.183457
3	0.621090	0.399250	0.101075	0.673702	0.214933
4	0.389246	0.011894	0.394807	0.639794	0.470837
..	…	…	…	…	…
995	0.389778	0.781210	0.297267	0.503297	0.822846
996	0.196934	0.083022	0.583718	0.026723	0.607528
997	0.698451	0.319341	0.972626	0.113694	0.547697
998	0.735017	0.246037	0.693694	0.108729	0.115220
999	0.191961	0.055298	0.053392	0.127528	0.304897

[1000 rows x 5 columns]

[23]:
```
matrix_sum = matrix_df.sum(axis = 1)
matrix_sum
```

[23]:
```
0      2.145120
1      1.977192
2      2.011443
3      2.010051
4      1.906579
         …
995    2.794397
996    1.497924
```

```
997    2.651808
998    1.898695
999    0.733075
Length: 1000, dtype: float64
```

[18]:
```
#Calculating portfolio weights
weights  = matrix_df.divide(matrix_sum , axis ="rows")
weights
```

[18]:

	ABOT	ACPL	ADMM	AGIL	AGTL
0	0.017684	0.107979	0.197746	0.288819	0.387772
1	0.434008	0.073946	0.404132	0.038428	0.049486
2	0.173205	0.310921	0.189693	0.234974	0.091207
3	0.308992	0.198627	0.050285	0.335167	0.106929
4	0.204159	0.006238	0.207076	0.335572	0.246954
..	…	…	…	…	…
995	0.139485	0.279563	0.106380	0.180109	0.294463
996	0.131471	0.055425	0.389685	0.017840	0.405580
997	0.263387	0.120424	0.366778	0.042874	0.206537
998	0.387117	0.129582	0.365353	0.057265	0.060684
999	0.261857	0.075433	0.072833	0.173963	0.415915

[1000 rows x 5 columns]

[25]:
```
#transpose
weights_t= np.transpose(weights)
weights_t
```

[25]:

	0	1	2	3	4	5	6	\
ABOT	0.017684	0.434008	0.173205	0.308992	0.204159	0.141918	0.285772	
ACPL	0.107979	0.073946	0.310921	0.198627	0.006238	0.131903	0.235093	
ADMM	0.197746	0.404132	0.189693	0.050285	0.207076	0.183922	0.142948	
AGIL	0.288819	0.038428	0.234974	0.335167	0.335572	0.371883	0.183002	
AGTL	0.387772	0.049486	0.091207	0.106929	0.246954	0.170374	0.153185	

	7	8	9	…	990	991	992	\
ABOT	0.218730	0.308817	0.343410	…	0.244592	0.329424	0.173324	
ACPL	0.217361	0.291821	0.135711	…	0.113687	0.342680	0.128191	
ADMM	0.016227	0.142498	0.089641	…	0.386211	0.011063	0.184259	
AGIL	0.278007	0.075738	0.307294	…	0.199886	0.208108	0.153529	
AGTL	0.269676	0.181127	0.123944	…	0.055625	0.108726	0.360697	

	993	994	995	996	997	998	999
ABOT	0.051238	0.105073	0.139485	0.131471	0.263387	0.387117	0.261857
ACPL	0.265209	0.229748	0.279563	0.055425	0.120424	0.129582	0.075433
ADMM	0.488065	0.261550	0.106380	0.389685	0.366778	0.365353	0.072833
AGIL	0.189359	0.297586	0.180109	0.017840	0.042874	0.057265	0.173963

```
AGTL  0.006128  0.106044  0.294463  0.405580  0.206537  0.060684  0.415915

[5 rows x 1000 columns]
```

[26]:
```
#Using the portfolio return formula
portfolio_return = np.dot(weights, mean_ret)
portfolio_return
```

[26]:
```
array([8.63880688e-04, 1.19453957e-04, 5.31992618e-04, 7.32266955e-04,
       7.59890036e-04, 7.49932154e-04, 5.56674424e-04, 8.53373102e-04,
       4.70716921e-04, 6.88470182e-04, 5.88203929e-04, 7.80654322e-04,
       6.82019906e-04, 7.04351205e-04, 5.53708287e-04, 4.34050210e-04,
       4.52063472e-04, 4.43736914e-04, 5.85272269e-04, 5.08766290e-04,
       4.29732280e-04, 7.79856455e-04, 7.19400624e-04, 7.30839079e-04,
       7.40880586e-04, 6.62073555e-04, 8.66044558e-04, 7.38499317e-04,
       6.31584074e-04, 3.39144881e-04, 3.32401573e-04, 4.31993908e-04,
       5.20041217e-04, 8.60848504e-04, 6.12869911e-04, 5.73190669e-04,
       6.26439412e-04, 8.59594497e-04, 9.04807633e-04, 5.94324582e-04,
       8.45147568e-04, 6.02653859e-04, 2.50824043e-04, 3.56854404e-04,
       4.61382186e-04, 4.07963855e-04, 5.60276824e-04, 4.36613026e-04,
       4.58456022e-04, 8.28907488e-04, 5.24799204e-04, 6.87350730e-04,
       4.47925114e-04, 1.00857612e-03, 3.07552083e-04, 5.10932214e-04,
       5.31758913e-04, 7.23375656e-04, 4.26362130e-04, 5.75490181e-04,
       5.59703492e-04, 2.06944268e-04, 5.02650409e-04, 4.52267000e-04,
       2.66381286e-04, 4.33776246e-04, 7.79845854e-04, 4.61369180e-04,
       4.51265701e-04, 5.23390109e-04, 4.11157139e-04, 6.04812994e-04,
       5.70565721e-04, 6.38227089e-04, 7.33025439e-04, 6.73524296e-04,
       4.55450358e-04, 7.07234119e-04, 9.79874833e-04, 4.28666843e-04,
       5.29973009e-04, 5.73434212e-04, 6.87478151e-04, 5.05005614e-04,
       5.67760416e-04, 4.43710578e-04, 7.75619360e-04, 6.60183226e-04,
       5.85842014e-04, 6.85181807e-04, 4.02936950e-04, 5.48304734e-04,
       8.64351737e-04, 5.59249772e-04, 8.82852696e-04, 8.66344990e-04,
       6.27243383e-04, 6.48377661e-04, 1.03570882e-03, 7.20123575e-04,
       5.84716843e-04, 4.19314971e-04, 5.02744091e-04, 7.45361559e-04,
       4.65568997e-04, 9.25489638e-04, 6.02884449e-04, 6.01620883e-04,
       4.76433663e-04, 7.60637810e-04, 6.20431540e-04, 7.23544415e-04,
       4.01469983e-04, 6.00056140e-04, 5.40018373e-04, 7.99857632e-04,
       6.49626419e-04, 4.98557744e-04, 6.24383513e-04, 6.70982230e-04,
       5.36825698e-04, 6.05156536e-04, 6.41724871e-04, 3.10640491e-04,
       4.31226127e-04, 6.72590856e-04, 5.08987770e-04, 4.47890496e-04,
       6.24439315e-04, 6.94513940e-04, 4.48430613e-04, 4.77056264e-04,
       7.63863314e-04, 4.55572157e-04, 1.77563675e-04, 8.02726378e-04,
       4.24666942e-04, 4.88384267e-04, 5.45330818e-04, 7.43948587e-04,
       5.62447426e-04, 4.78736594e-04, 5.18525972e-04, 3.47748225e-04,
       8.17429197e-04, 5.38554424e-04, 6.15395678e-04, 4.86197506e-04,
       6.02142610e-04, 3.11768780e-04, 5.86339393e-04, 5.08013258e-04,
       2.52513223e-04, 6.76927302e-04, 6.48021820e-04, 7.89568116e-04,
```

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5.60222954e-04, 2.50253879e-04, 8.96644377e-04, 7.98513281e-04,
3.79731959e-04, 4.38121296e-04, 4.82856293e-04, 5.79351614e-04,
6.65848614e-04, 3.78731863e-04, 4.84499030e-04, 4.28128306e-04,
4.49808906e-04, 2.90416198e-04, 5.67473984e-04, 6.42030455e-04,
5.96389818e-04, 6.31984207e-04, 4.91933412e-04, 9.79105289e-04,
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7.58977480e-04, 4.96466740e-04, 7.60866891e-04, 2.68956156e-04,
7.16298599e-04, 3.78506767e-05, 5.79240029e-04, 3.88141749e-04,
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5.94092564e-04, 7.59623194e-04, 5.54834090e-04, 5.62871614e-04,
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7.44291528e-04, 6.33266974e-04, 4.62794039e-04, 6.79926324e-04,
6.04625179e-04, 4.93350752e-04, 5.48652373e-04, 5.26840258e-04,
6.22710949e-04, 6.54682961e-04, 5.52629303e-04, 4.23743086e-04,
3.85015304e-04, 6.26771323e-04, 3.54381599e-04, 4.84144712e-04,
7.87491285e-04, 4.46171688e-04, 5.71555394e-04, 7.68225066e-04,
8.24665699e-04, 6.42878473e-04, 4.68273815e-04, 6.71488774e-04,
8.01597128e-04, 6.66920729e-04, 6.23216504e-04, 5.13649858e-04,
7.04526420e-04, 6.96251986e-04, 4.06065018e-04, 5.52125714e-04,
6.82408504e-04, 6.23637331e-04, 3.92028468e-04, 5.27924007e-04,
4.88002275e-04, 5.41855623e-04, 5.05489944e-04, 4.82457892e-04,
6.63443283e-04, 2.34877759e-04, 6.50555054e-04, 6.19815070e-04,

7.40340957e-04, 6.32465411e-04, 8.40412420e-04, 8.47417038e-04,
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```

[24]:
```
#Variance covariance
cov_mat = daily_returns.cov()
cov_mat
```

[24]:

	ABOT	ACPL	ADMM	AGIL	AGTL
ABOT	0.000298	0.000076	0.000031	0.000059	0.000072
ACPL	0.000076	0.000353	0.000020	0.000070	0.000068
ADMM	0.000031	0.000020	0.000423	-0.000006	0.000062
AGIL	0.000059	0.000070	-0.000006	0.000435	0.000105
AGTL	0.000072	0.000068	0.000062	0.000105	0.000488

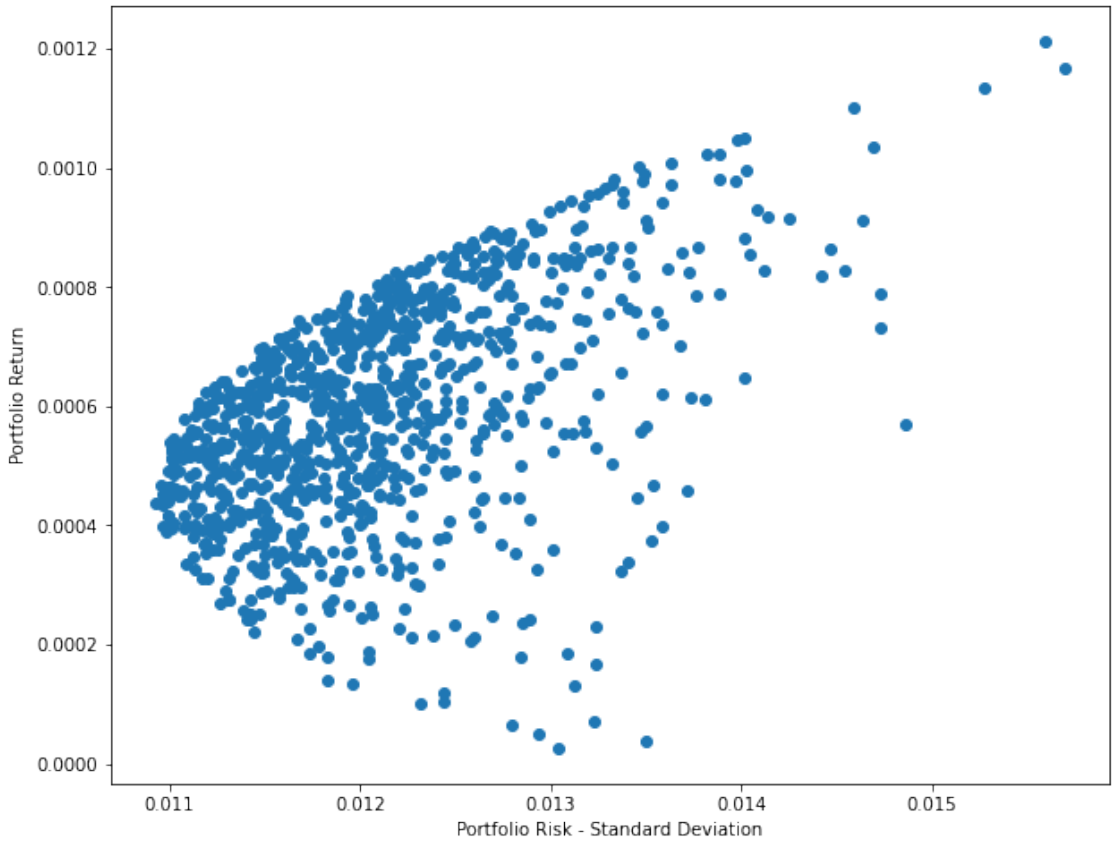
[ ]:
```
portfolio_risk = []
for one_port in range(weights.shape[0]):

    risk = np.sqrt(np.dot(weights.iloc[one_port,:],np.dot(cov_mat,weights_t.
 ↪iloc[:,one_port])))

    portfolio_risk.append(risk)
```

[21]:
```
plt.figure(figsize = (10,8))
plt.scatter(portfolio_risk, portfolio_return)
plt.xlabel("Portfolio Risk - Standard Deviation")
plt.ylabel("Portfolio Return")
```

```
plt.show()
```



[22]:
```
#converting to a csv file
portfolio_risk = pd.DataFrame(portfolio_risk, columns = ["portfolio risk"])
portfolio_return = pd.DataFrame(portfolio_return, columns = ["portfolio␣
↪return"])
random_portfolio = pd.concat([portfolio_return, portfolio_risk, weights], axis␣
↪=1)
random_portfolio.to_csv("Random_Portfolios.csv")
```