# Mutual_Funds_Portfolio

September 29, 2021

## 1 Mutual Funds

https://www.nerdwallet.com/blog/investing/what-are-the-different-types-of-mutual-funds/

Equity funds
Bond funds
Money market funds
Balanced funds
Index funds

[1]:
```python
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import math

import warnings
warnings.filterwarnings("ignore")

# yfinance is used to fetch data
import yfinance as yf
yf.pdr_override()
```

[2]:
```python
# input
symbols = ['SPY','FIHBX','FBTAX','DBC']
start = '2014-01-01'
end = '2019-01-01'
title = "Mutual Funds"

# Read data
dataset = yf.download(symbols,start,end)['Adj Close']

# View Columns
dataset.head()
```

```
[*********************100%***********************]  4 of 4 completed
```

[2]:

| | DBC | FBTAX | FIHBX | SPY |
|---|---|---|---|---|
| Date | | | | |
| 2014-01-02 | 24.572100 | 16.094238 | 6.968676 | 160.925400 |
| 2014-01-03 | 24.416641 | 16.017763 | 6.975503 | 160.898972 |
| 2014-01-06 | 24.445789 | 15.813823 | 6.975503 | 160.432693 |
| 2014-01-07 | 24.426357 | 16.068747 | 6.989153 | 161.418060 |
| 2014-01-08 | 24.193171 | 16.374655 | 6.989153 | 161.453278 |

[3]:
```
dataset.tail()
```

[3]:

| | DBC | FBTAX | FIHBX | SPY |
|---|---|---|---|---|
| Date | | | | |
| 2018-12-24 | 14.163118 | 20.312393 | 8.344463 | 227.638824 |
| 2018-12-26 | 14.478073 | 21.567284 | 8.326165 | 239.140244 |
| 2018-12-27 | 14.340280 | 21.632837 | 8.335313 | 240.976212 |
| 2018-12-28 | 14.222172 | 21.632837 | 8.371911 | 240.665375 |
| 2018-12-31 | 14.261541 | 22.101082 | 8.426186 | 242.773315 |

### 1.1 Starting Cash with 100k to invest in Mutual Funds

[4]:
```
Cash = 100000
print('Percentage of invest:')
percent_invest = [0.25, 0.25, 0.25, 0.25]
for i, x in zip(dataset.columns, percent_invest):
    cost = x * Cash
    print('{}: {}'.format(i, cost))
```

```
Percentage of invest:
DBC: 25000.0
FBTAX: 25000.0
FIHBX: 25000.0
SPY: 25000.0
```

[5]:
```
print('Number of Shares:')
percent_invest = [0.25, 0.25, 0.25, 0.25]
for i, x, y in zip(dataset.columns, percent_invest, dataset.iloc[0]):
    cost = x * Cash
    shares = int(cost/y)
    print('{}: {}'.format(i, shares))
```

```
Number of Shares:
DBC: 1017
FBTAX: 1553
FIHBX: 3587
SPY: 155
```

[6]:
```python
print('Beginning Value:')
percent_invest = [0.25, 0.25, 0.25, 0.25]
for i, x, y in zip(dataset.columns, percent_invest, dataset.iloc[0]):
    cost = x * Cash
    shares = int(cost/y)
    Begin_Value = round(shares * y, 2)
    print('{}: ${}'.format(i, Begin_Value))
```

```
Beginning Value:
DBC: $24989.83
FBTAX: $24994.35
FIHBX: $24996.64
SPY: $24943.44
```

[7]:
```python
print('Current Value:')
percent_invest = [0.25, 0.25, 0.25, 0.25]
for i, x, y, z in zip(dataset.columns, percent_invest, dataset.iloc[0], dataset.
 ↪iloc[-1]):
    cost = x * Cash
    shares = int(cost/y)
    Current_Value = round(shares * z, 2)
    print('{}: ${}'.format(i, Current_Value))
```

```
Current Value:
DBC: $14503.99
FBTAX: $34322.98
FIHBX: $30224.73
SPY: $37629.86
```

[8]:
```python
result = []
for i, x, y, z in zip(dataset.columns, percent_invest, dataset.iloc[0], dataset.
 ↪iloc[-1]):
    cost = x * Cash
    shares = int(cost/y)
    Current_Value = round(shares * z, 2)
    result.append(Current_Value)
print('Total Value: $%s' % round(sum(result),2))
```

```
Total Value: $116681.56
```

[9]:
```python
# Calculate Daily Returns
returns = dataset.pct_change()
returns = returns.dropna()
```

[10]:
```python
# Calculate mean returns
meanDailyReturns = returns.mean()
print(meanDailyReturns)
```

```
DBC     -0.000388
FBTAX    0.000403
FIHBX    0.000155
SPY      0.000362
dtype: float64
```

[11]:
```
# Calculate std returns
stdDailyReturns = returns.std()
print(stdDailyReturns)
```

```
DBC      0.009496
FBTAX    0.017337
FIHBX    0.002734
SPY      0.008306
dtype: float64
```

[12]:
```
# Define weights for the portfolio
weights = np.array([0.50, 0.10, 0.20, 0.20])
```

[13]:
```
# Calculate the covariance matrix on daily returns
cov_matrix = (returns.cov())*250
print (cov_matrix)
```

```
            DBC     FBTAX     FIHBX       SPY
DBC    0.022544  0.005441  0.001920  0.006348
FBTAX  0.005441  0.075140  0.003101  0.023501
FIHBX  0.001920  0.003101  0.001869  0.002384
SPY    0.006348  0.023501  0.002384  0.017247
```

[14]:
```
# Calculate expected portfolio performance
portReturn = np.sum(meanDailyReturns*weights)
```

[15]:
```
# Print the portfolio return
print(portReturn)
```

```
-5.022475164538252e-05
```

[16]:
```
# Create portfolio returns column
returns['Portfolio'] = returns.dot(weights)
```

[17]:
```
returns.head()
```

[17]:

| Date | DBC | FBTAX | FIHBX | SPY | Portfolio |
|---|---|---|---|---|---|
| 2014-01-03 | -0.006327 | -0.004752 | 0.000980 | -0.000164 | -0.003475 |
| 2014-01-06 | 0.001194 | -0.012732 | 0.000000 | -0.002898 | -0.001256 |
| 2014-01-07 | -0.000795 | 0.016120 | 0.001957 | 0.006142 | 0.002834 |
| 2014-01-08 | -0.009547 | 0.019037 | 0.000000 | 0.000218 | -0.002826 |

```
2014-01-09 -0.008032  0.047743  0.000000  0.000654   0.000889
```

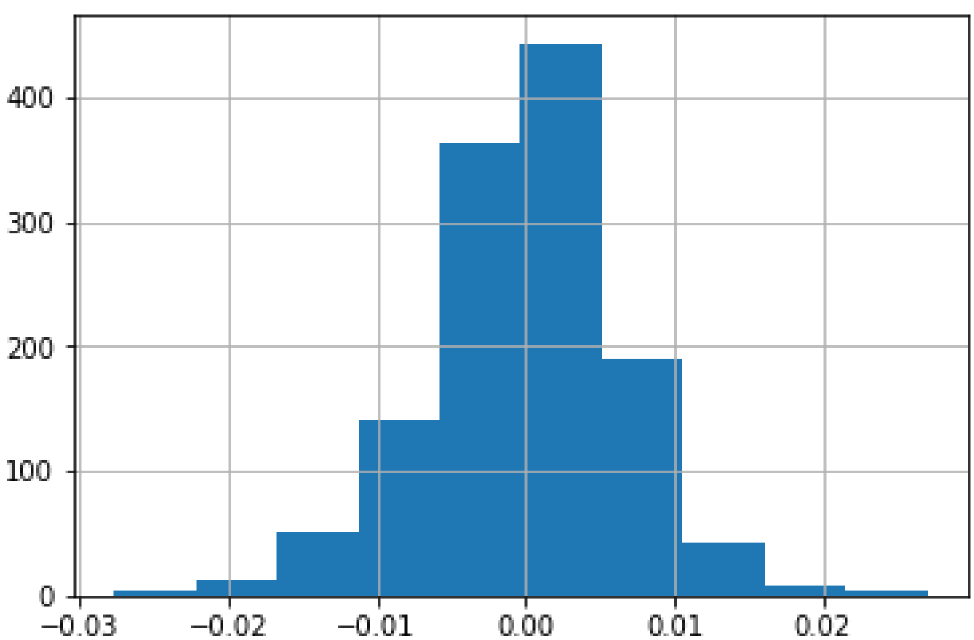
[18]:
```python
returns.tail()
```

[18]:
```
                 DBC     FBTAX     FIHBX       SPY  Portfolio
Date
2018-12-24 -0.011065 -0.010944 -0.003279 -0.026423  -0.012567
2018-12-26  0.022238  0.061780 -0.002193  0.050525   0.026963
2018-12-27 -0.009517  0.003039  0.001099  0.007677  -0.002700
2018-12-28 -0.008236  0.000000  0.004391 -0.001290  -0.003498
2018-12-31  0.002768  0.021645  0.006483  0.008759   0.006597
```

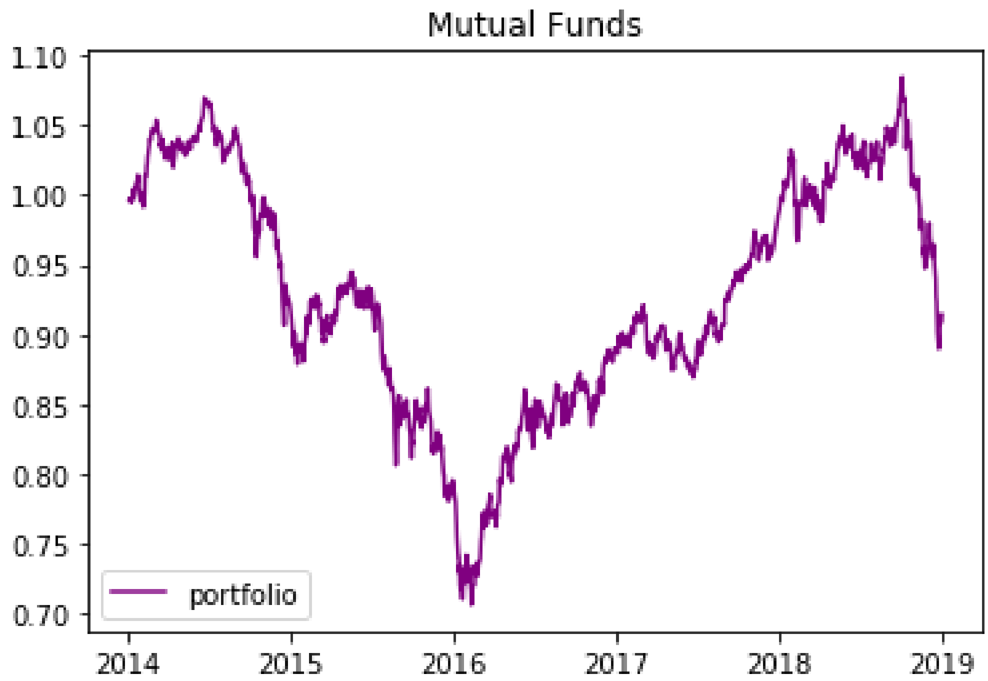
[19]:
```python
# Calculate cumulative returns
daily_cum_ret=(1+returns).cumprod()
print(daily_cum_ret.tail())
```

```
                 DBC     FBTAX     FIHBX       SPY  Portfolio
Date
2018-12-24  0.576390  1.262091  1.197425  1.414561   0.889783
2018-12-26  0.589208  1.340062  1.194799  1.486032   0.913774
2018-12-27  0.583600  1.344136  1.196111  1.497441   0.911307
2018-12-28  0.578794  1.344136  1.201363  1.495509   0.908120
2018-12-31  0.580396  1.373229  1.209152  1.508608   0.914110
```

[20]:
```python
returns['Portfolio'].hist()
plt.show()
```



[21]:
```python
import matplotlib.dates

# Plot the portfolio cumulative returns only
fig, ax = plt.subplots()
ax.plot(daily_cum_ret.index, daily_cum_ret.Portfolio, color='purple',␣
 ↪label="portfolio")
ax.xaxis.set_major_locator(matplotlib.dates.YearLocator())
plt.title(title)
plt.legend()
plt.show()
```




[22]:
```python
# Print the mean
print("mean : ", returns['Portfolio'].mean()*100)

# Print the standard deviation
print("Std. dev: ", returns['Portfolio'].std()*100)

# Print the skewness
print("skew: ", returns['Portfolio'].skew())

# Print the kurtosis
print("kurt: ", returns['Portfolio'].kurtosis())
```

```
mean :  -0.005022475164538249
Std. dev:  0.651291924442618
skew:  -0.2260558811935371
kurt:  1.2996237688067493
```

[23]:
```python
# Calculate the standard deviation by taking the square root
port_standard_dev = np.sqrt(np.dot(weights.T, np.dot(weights, cov_matrix)))

# Print the results
print(str(np.round(port_standard_dev, 4) * 100) + '%')
```

```
10.299999999999999%
```

[24]:
```python
# Calculate the portfolio variance
port_variance = np.dot(weights.T, np.dot(cov_matrix, weights))

# Print the result
print(str(np.round(port_variance, 4) * 100) + '%')
```

```
1.06%
```

[25]:
```python
# Calculate total return and annualized return from price data
total_return = returns['Portfolio'][-1] - returns['Portfolio'][0]

# Annualize the total return over 5 year
annualized_return = ((total_return + 1)**(1/5)) - 1
```

[26]:
```python
annualized_return
```

[26]:
```
0.0020063990122540787
```

[27]:
```python
# Calculate annualized volatility from the standard deviation
vol_port = returns['Portfolio'].std() * np.sqrt(252)
```

[28]:
```python
# Calculate the Sharpe ratio
rf = 0.01
sharpe_ratio = ((annualized_return - rf) / vol_port)
print(sharpe_ratio)
```

```
-0.07731548817030297
```

[29]:
```python
# Calculate the Sharpe ratio
# Different way
rf = 0.01
sharpe_ratio = (returns['Portfolio'].mean() - rf) / (returns['Portfolio'].
 ↪std()*np.sqrt(252))
print(round(sharpe_ratio,4))
```

-0.0972

[30]:

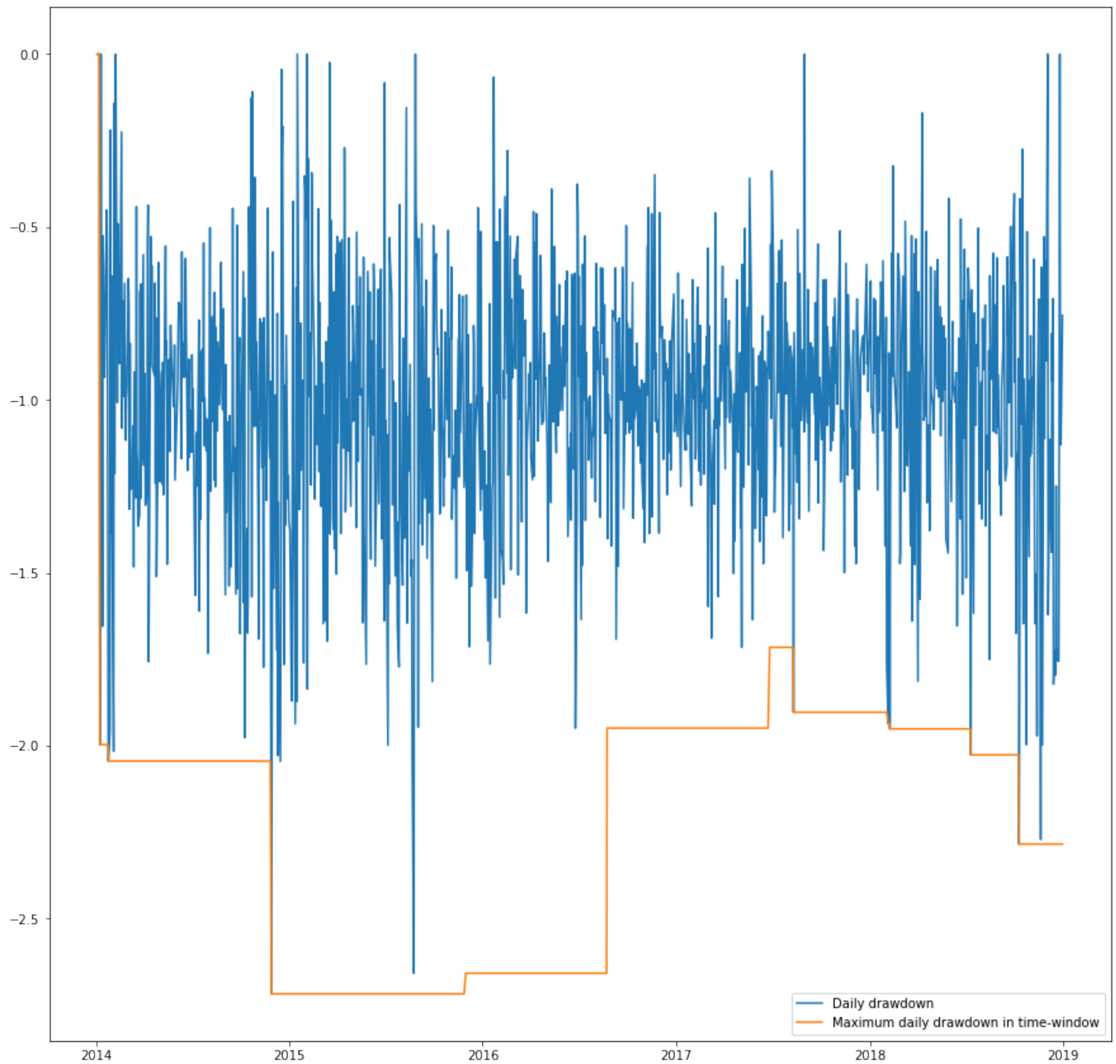
```
# Create a downside return column with the negative returns only
target = 0
downside_returns = returns.loc[returns['Portfolio'] < target]

# Calculate expected return and std dev of downside
expected_return = returns['Portfolio'].mean()
down_stdev = downside_returns.std()

# Calculate the sortino ratio
rf = 0.01
sortino_ratio = (expected_return - rf)/down_stdev

# Print the results
print("Expected return: ", expected_return*100)
print('-' * 50)
print("Downside risk:")
print(down_stdev*100)
print('-' * 50)
print("Sortino ratio:")
print(sortino_ratio)
```

```
Expected return:  -0.005022475164538249
--------------------------------------------------
Downside risk:
DBC          0.717214
FBTAX        1.608918
FIHBX        0.269959
SPY          0.779532
Portfolio    0.459835
dtype: float64
--------------------------------------------------
Sortino ratio:
DBC         -1.401287
FBTAX       -0.624657
FIHBX       -3.722866
SPY         -1.289263
Portfolio   -2.185616
dtype: float64
```

[31]:

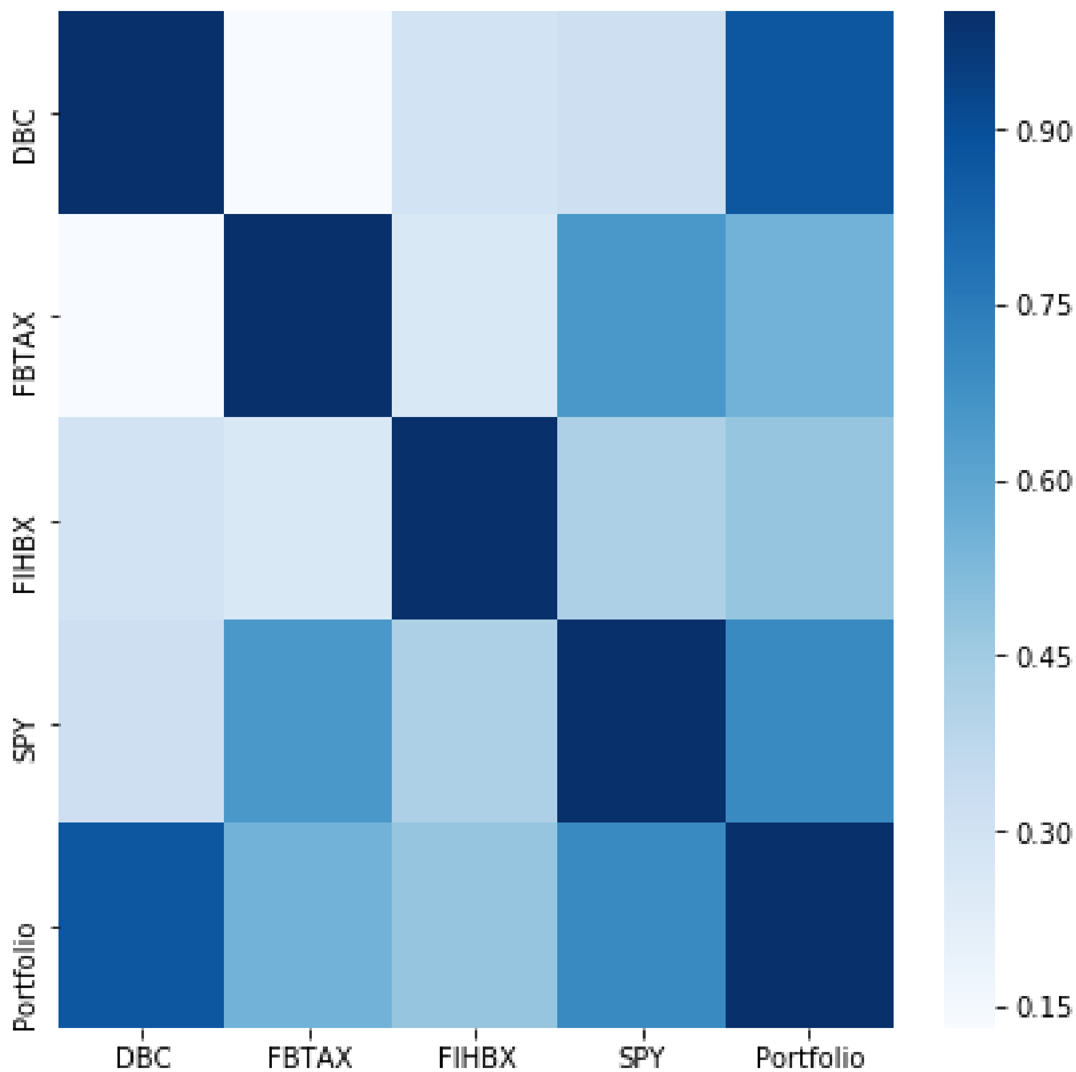
```
# Calculate the max value
roll_max = returns['Portfolio'].rolling(center=False,min_periods=1,window=252).
 ↪max()

# Calculate the daily draw-down relative to the max
daily_draw_down = returns['Portfolio']/roll_max - 1.0
```

```
# Calculate the minimum (negative) daily draw-down
max_daily_draw_down = daily_draw_down.
 ↪rolling(center=False,min_periods=1,window=252).min()

# Plot the results
plt.figure(figsize=(15,15))
plt.plot(returns.index, daily_draw_down, label='Daily drawdown')
plt.plot(returns.index, max_daily_draw_down, label='Maximum daily drawdown in␣
 ↪time-window')
plt.legend()
plt.show()
```



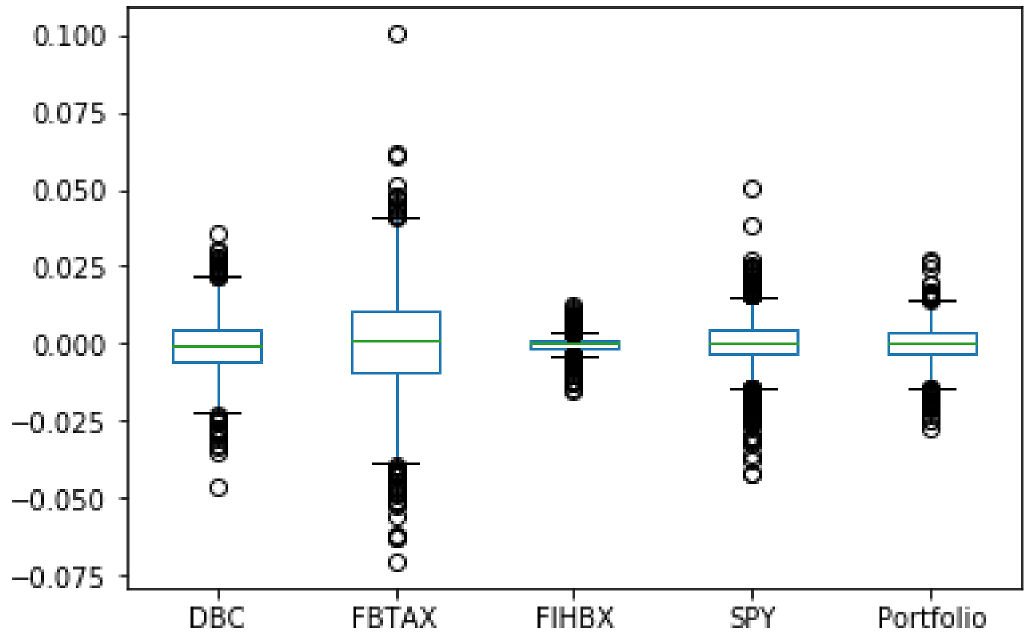
[32]:
```python
plt.figure(figsize=(7,7))
corr = returns.corr()

# plot the heatmap
sns.heatmap(corr,
        xticklabels=corr.columns,
        yticklabels=corr.columns,
            cmap="Blues")
```

[32]: <matplotlib.axes._subplots.AxesSubplot at 0x1f6656f6f98>

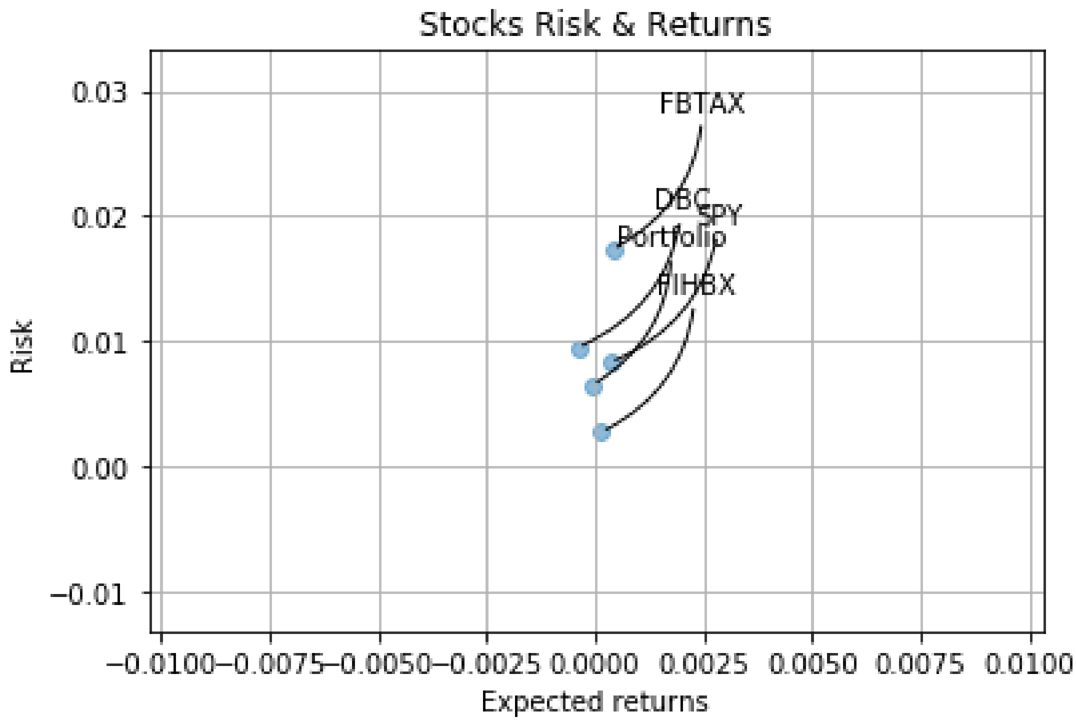



[33]:
```python
# Box plot
returns.plot(kind='box')
```

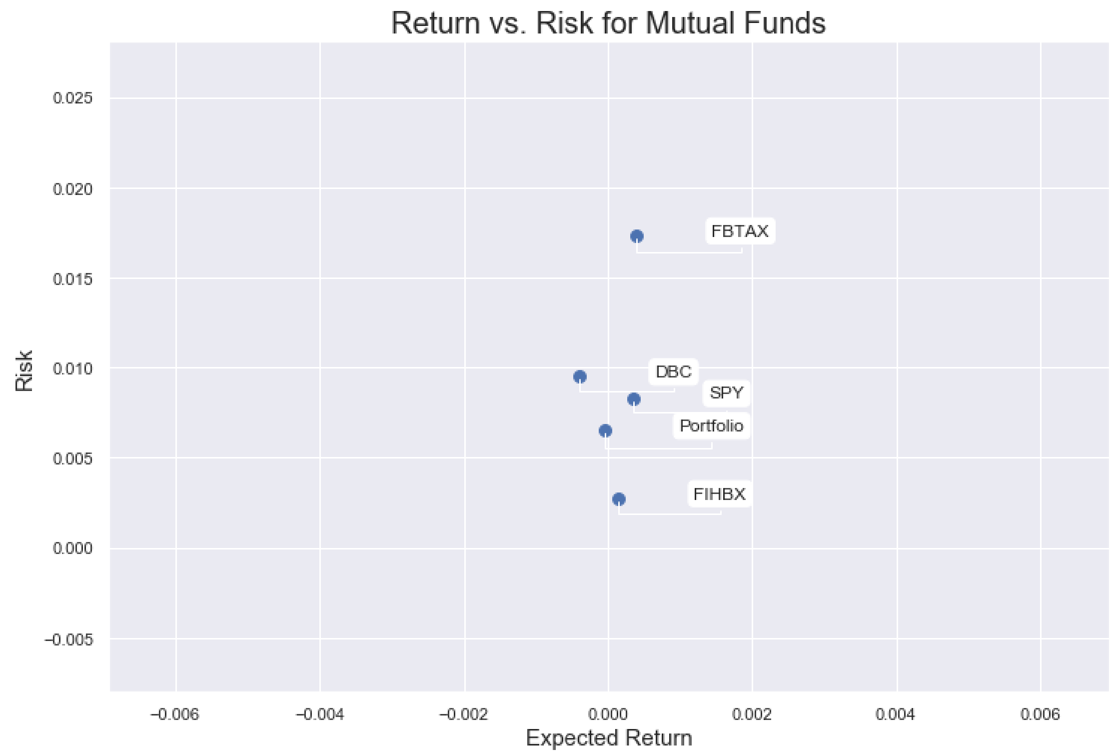
[33]: <matplotlib.axes._subplots.AxesSubplot at 0x1f6656a2be0>




[34]:
```
rets = returns.dropna()

plt.scatter(rets.mean(), rets.std(),alpha = 0.5)

plt.title('Stocks Risk & Returns')
plt.xlabel('Expected returns')
plt.ylabel('Risk')
plt.grid(which='major')

for label, x, y in zip(rets.columns, rets.mean(), rets.std()):
    plt.annotate(
        label,
        xy = (x, y), xytext = (50, 50),
        textcoords = 'offset points', ha = 'right', va = 'bottom',
        arrowprops = dict(arrowstyle = '-', connectionstyle = 'arc3,rad=-0.3'))
```




[35]:
```
area = np.pi*20.0

sns.set(style='darkgrid')
plt.figure(figsize=(12,8))
plt.scatter(rets.mean(), rets.std(), s=area)
plt.xlabel("Expected Return", fontsize=15)
plt.ylabel("Risk", fontsize=15)
plt.title("Return vs. Risk for " + title, fontsize=20)

for label, x, y in zip(rets.columns, rets.mean(), rets.std()) :
    plt.annotate(label, xy=(x,y), xytext=(50, 0), textcoords='offset points',
                arrowprops=dict(arrowstyle='-',␣
 ↪connectionstyle='bar,angle=180,fraction=-0.2'),
                bbox=dict(boxstyle="round", fc="w"))
```




[36]:
```python
print("Stock returns: ")
print(rets.mean())
print('-' * 50)
print("Stock risk:")
print(rets.std())
```

```
Stock returns:
DBC         -0.000388
FBTAX        0.000403
FIHBX        0.000155
SPY          0.000362
Portfolio   -0.000050
dtype: float64
--------------------------------------------------
Stock risk:
DBC          0.009496
FBTAX        0.017337
FIHBX        0.002734
SPY          0.008306
Portfolio    0.006513
dtype: float64
```

[37]:

```
table = pd.DataFrame()
table['Returns'] = rets.mean()
table['Risk'] = rets.std()
table.sort_values(by='Returns')
```

[37]:

| | Returns | Risk |
|---|---|---|
| DBC | -0.000388 | 0.009496 |
| Portfolio | -0.000050 | 0.006513 |
| FIHBX | 0.000155 | 0.002734 |
| SPY | 0.000362 | 0.008306 |
| FBTAX | 0.000403 | 0.017337 |

[38]:

```
table.sort_values(by='Risk')
```

[38]:

| | Returns | Risk |
|---|---|---|
| FIHBX | 0.000155 | 0.002734 |
| Portfolio | -0.000050 | 0.006513 |
| SPY | 0.000362 | 0.008306 |
| DBC | -0.000388 | 0.009496 |
| FBTAX | 0.000403 | 0.017337 |

[39]:

```
rf = 0.001
table['Sharpe_Ratio'] = ((table['Returns'] - rf) / table['Risk']) * np.sqrt(252)
table
```

[39]:

| | Returns | Risk | Sharpe_Ratio |
|---|---|---|---|
| DBC | -0.000388 | 0.009496 | -2.319664 |
| FBTAX | 0.000403 | 0.017337 | -0.546904 |
| FIHBX | 0.000155 | 0.002734 | -4.907362 |
| SPY | 0.000362 | 0.008306 | -1.219900 |
| Portfolio | -0.000050 | 0.006513 | -2.559805 |