Tactical_Asset_Allocation

September 29, 2021

1 Tactical Asset Allocation

https://www.investopedia.com/terms/t/tacticalassetallocation.asp

1.0.1 Tactical Asset Allocation (TAA) Basics

Cash = 10%
Bonds = 35%
Stocks = 45%
Commodities = 10%

Cash = 5%
Bonds = 35%
Stocks = 45%
Commodities = 15%

[1]:
```
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]:
```
Cash = 100000.00
Cash_5 = Cash * 0.05
```

[3]:
```
print('How much cash left to invest?')
cash_to_invest = Cash - Cash_5
print(round(cash_to_invest, 2))
```

```
How much cash left to invest?
95000.0
```

[4]:
```
# input
symbols = ['ZROZ','AAPL','SB']
start = '2012-01-01'
end = '2019-01-01'
title = "Tactical Asset Allocation"
```

[5]:
```
df = pd.DataFrame()
for s in symbols:
    df[s] = yf.download(s,start,end)['Adj Close']
```

```
[**********************100%***********************]  1 of 1 completed
[**********************100%***********************]  1 of 1 completed
[**********************100%***********************]  1 of 1 completed
```

[6]:
```
from datetime import datetime
from dateutil import relativedelta

d1 = datetime.strptime(start, "%Y-%m-%d")
d2 = datetime.strptime(end, "%Y-%m-%d")
delta = relativedelta.relativedelta(d2,d1)
print('How many years of investing?')
print('%s years' % delta.years)
```

```
How many years of investing?
7 years
```

[7]:
```
df.head()
```

[7]:

Date	ZROZ	AAPL	SB
2012-01-03	86.308502	50.857235	5.310326
2012-01-04	85.031059	51.130558	5.412774
2012-01-05	84.007576	51.698215	5.634750
2012-01-06	85.086624	52.238651	5.566450
2012-01-09	84.777161	52.155792	5.592062

[8]:
```
df.tail()
```

[8]:

Date	ZROZ	AAPL	SB
2018-12-24	110.195335	143.924454	1.72
2018-12-26	108.613121	154.059814	1.79
2018-12-27	108.159683	153.059998	1.78
2018-12-28	108.685097	153.138428	1.74
2018-12-31	109.453789	154.618546	1.78

[9]:
```
print('Percentage of invest:')
percent_invest = [0.35, 0.45, 0.15]
names = ['Bonds', 'Stocks', 'Commodities']
for i, x in zip(names, percent_invest):
    cost = x * cash_to_invest
    print('{}: {}'.format(i, cost))
```

```
Percentage of invest:
Bonds: 33250.0
Stocks: 42750.0
Commodities: 14250.0
```

[10]:
```
df.iloc[0]
```

[10]:
```
ZROZ    86.308502
AAPL    50.857235
SB       5.310326
Name: 2012-01-03 00:00:00, dtype: float64
```

[11]:
```
df.ix[-1]
```

[11]:
```
ZROZ    109.453789
AAPL    154.618546
SB        1.780000
Name: 2018-12-31 00:00:00, dtype: float64
```

[12]:
```
print('Number of Shares:')
percent_invest = [0.35, 0.45, 0.15]
for i, x, y in zip(df.columns, percent_invest, df.iloc[0]):
    cost = x * cash_to_invest
    shares = int(cost/y)
    print('{}: {}'.format(i, shares))
```

```
Number of Shares:
ZROZ: 385
AAPL: 840
SB: 2683
```

[13]:
```
print('Beginning Value:')
percent_invest = [0.35, 0.45, 0.15]
for i, x, y in zip(df.columns, percent_invest, df.iloc[0]):
    cost = x * cash_to_invest
    shares = int(cost/y)
    Begin_Value = round(shares * y, 2)
    print('{}: ${}'.format(i, Begin_Value))
```

```
Beginning Value:
ZROZ: $33228.77
```

```
AAPL: $42720.08
SB: $14247.6
```

[14]:
```
print('Current Value:')
percent_invest = [0.35, 0.45, 0.15]
for i, x, y, z in zip(df.columns, percent_invest, df.iloc[0], df.iloc[-1]):
    shares = int(cost/x)
    Begin_Value = round(shares * y, 2)
    Current_Value = round(shares * z, 2)
    print('{}: ${}'.format(i, Current_Value))
```

```
Current Value:
ZROZ: $4456301.56
AAPL: $4896150.86
SB: $169100.0
```

[15]:
```
result = []
percent_invest = [0.35, 0.45, 0.15]
for i, x, y, z in zip(df.columns, percent_invest, df.iloc[0], df.iloc[-1]):
    shares = int(cost/x)
    Begin_Value = round(shares * y, 2)
    Current_Value = round(shares * z, 2)
    result.append(Current_Value)
print('Total Value: $%s' % round(sum(result),2))
```

```
Total Value: $9521552.42
```

[16]:
```
# Calculate Daily Returns
returns = df.pct_change()
returns = returns.dropna()
```

[17]:
```
# Calculate mean returns
meanDailyReturns = returns.mean()
print(meanDailyReturns)
```

```
ZROZ    0.000211
AAPL    0.000761
SB      0.000202
dtype: float64
```

[18]:
```
# Calculate std returns
stdDailyReturns = returns.std()
print(stdDailyReturns)
```

```
ZROZ    0.012353
AAPL    0.016042
SB      0.040456
dtype: float64
```

[19]:
```
# Define weights for the portfolio
weights = np.array([0.35, 0.45, 0.15])
```

[20]:
```
# Calculate the covariance matrix on daily returns
cov_matrix = (returns.cov())*250
print (cov_matrix)
```

```
          ZROZ      AAPL        SB
ZROZ  0.038151 -0.009752 -0.018241
AAPL -0.009752  0.064337  0.033587
SB   -0.018241  0.033587  0.409162
```

[21]:
```
# Calculate expected portfolio performance
portReturn = np.sum(meanDailyReturns*weights)
```

[22]:
```
# Print the portfolio return
print(portReturn)
```

```
0.00044689842456079347
```

[23]:
```
# Create portfolio returns column
returns['Portfolio'] = returns.dot(weights)
```

[24]:
```
returns.head()
```

[24]:

Date	ZROZ	AAPL	SB	Portfolio
2012-01-04	-0.014801	0.005374	0.019292	0.000132
2012-01-05	-0.012037	0.011102	0.041010	0.006935
2012-01-06	0.012845	0.010454	-0.012121	0.007382
2012-01-09	-0.003637	-0.001586	0.004601	-0.001297
2012-01-10	-0.002807	0.003581	0.010687	0.002232

[25]:
```
returns.tail()
```

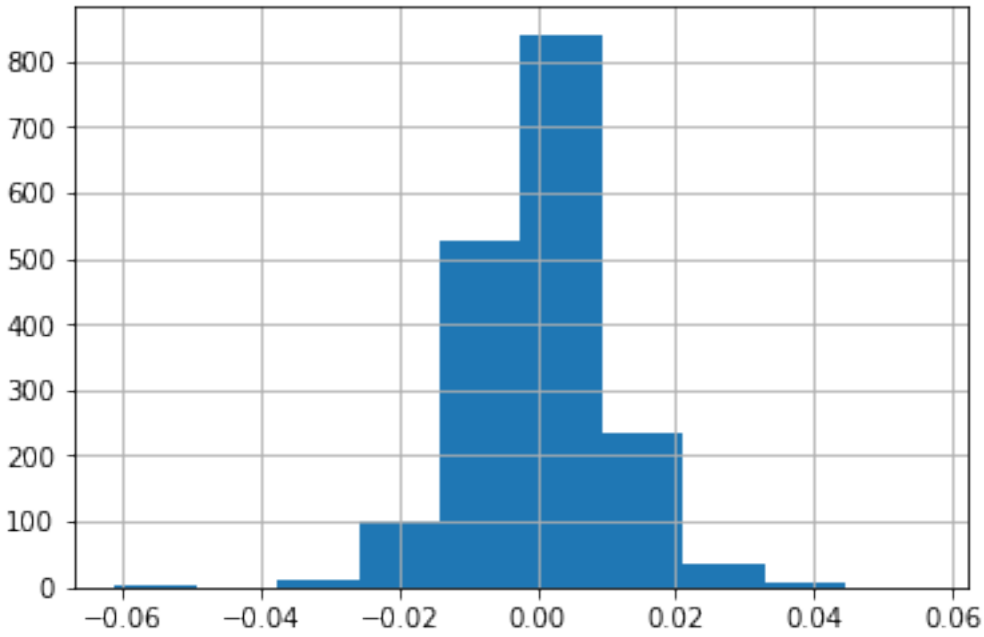
[25]:

Date	ZROZ	AAPL	SB	Portfolio
2018-12-24	0.006255	-0.025874	-0.011494	-0.011178
2018-12-26	-0.014358	0.070421	0.040698	0.032769
2018-12-27	-0.004175	-0.006490	-0.005587	-0.005220
2018-12-28	0.004858	0.000512	-0.022472	-0.001440
2018-12-31	0.007073	0.009665	0.022988	0.010273

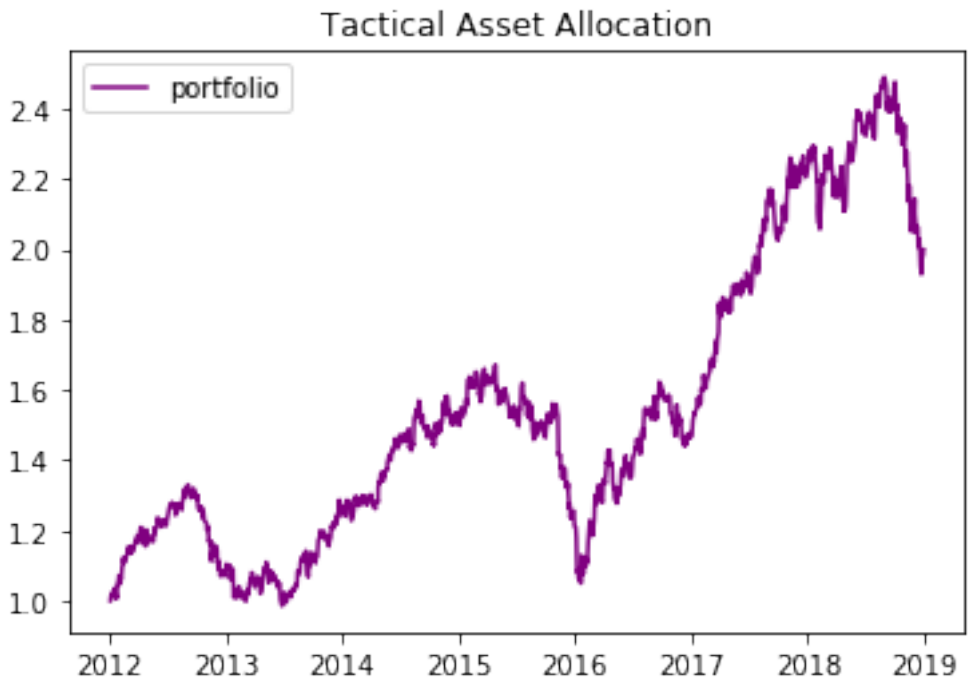
[26]:
```
# Calculate cumulative returns
daily_cum_ret=(1+returns).cumprod()
print(daily_cum_ret.tail())
```

```
                ZROZ      AAPL        SB  Portfolio
Date
2018-12-24  1.276761  2.829970  0.323897   1.929088
2018-12-26  1.258429  3.029261  0.337079   1.992302
2018-12-27  1.253175  3.009601  0.335196   1.981903
2018-12-28  1.259263  3.011143  0.327664   1.979049
2018-12-31  1.268169  3.040247  0.335196   1.999380
```

[27]:
```
returns['Portfolio'].hist()
plt.show()
```



[28]:
```
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()
```



[29]:
```
# 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 :  0.044689842456079355
Std. dev:  1.0286902760363137
skew:  -0.18568585625514625
kurt:  3.1348800818141016
```

[30]:
```
# 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) + '%')
```

```
16.27%
```

[31]:
```
# 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) + '%')
```

```
2.65%
```

[32]:
```
# Calculate total return and annualized return from price data
total_return = (returns['Portfolio'][-1] - returns['Portfolio'][0]) /␣
↪returns['Portfolio'][0]

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

[33]:
```
# Calculate annualized volatility from the standard deviation
vol_port = returns['Portfolio'].std() * np.sqrt(250)
```

[34]:
```
# Calculate the Sharpe ratio
rf = 0.01
sharpe_ratio = ((annualized_return - rf) / vol_port)
print(sharpe_ratio)
```

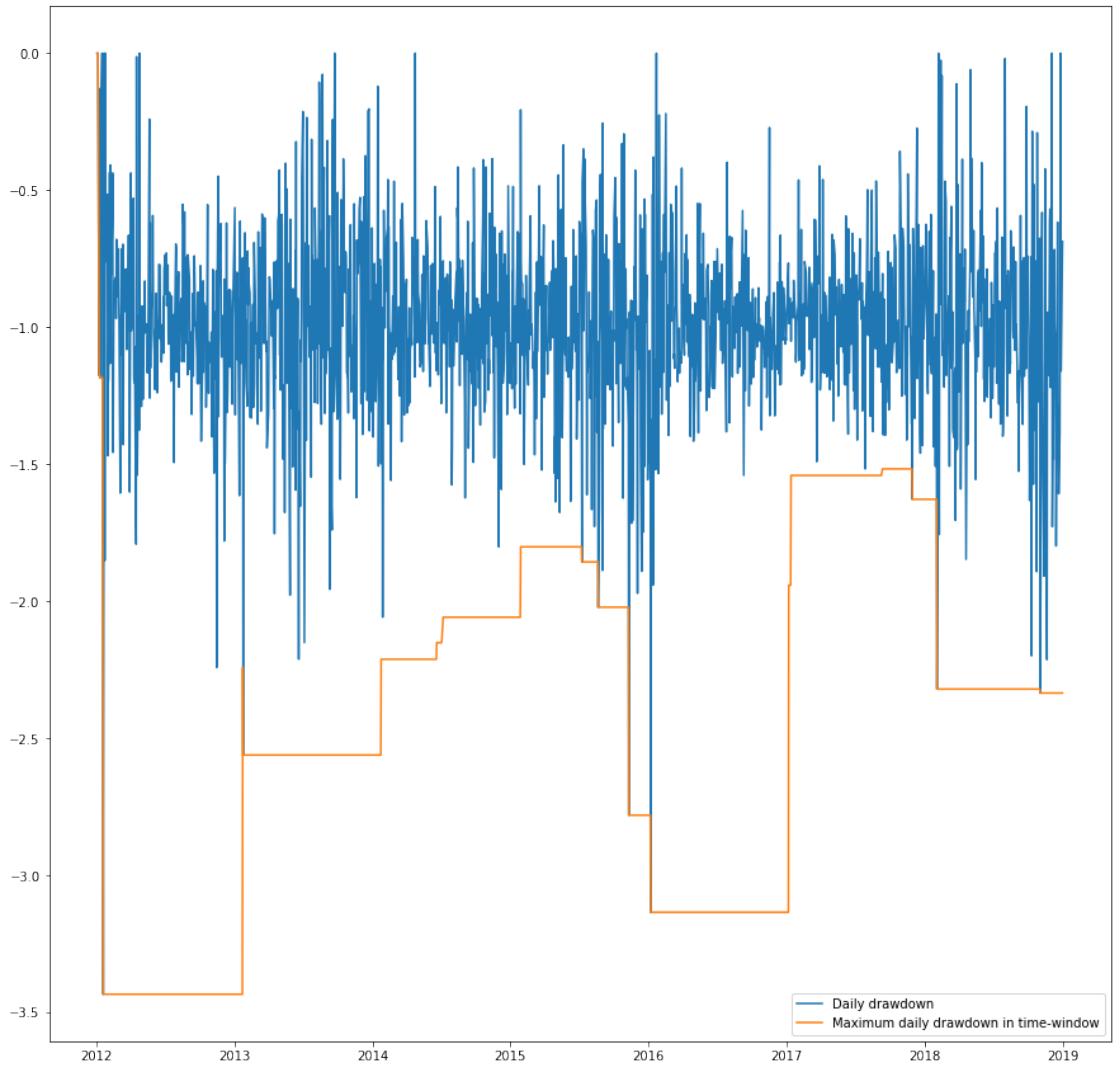
```
8.479402639933092
```

[35]:
```
# 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:  0.044689842456079355
--------------------------------------------------
```

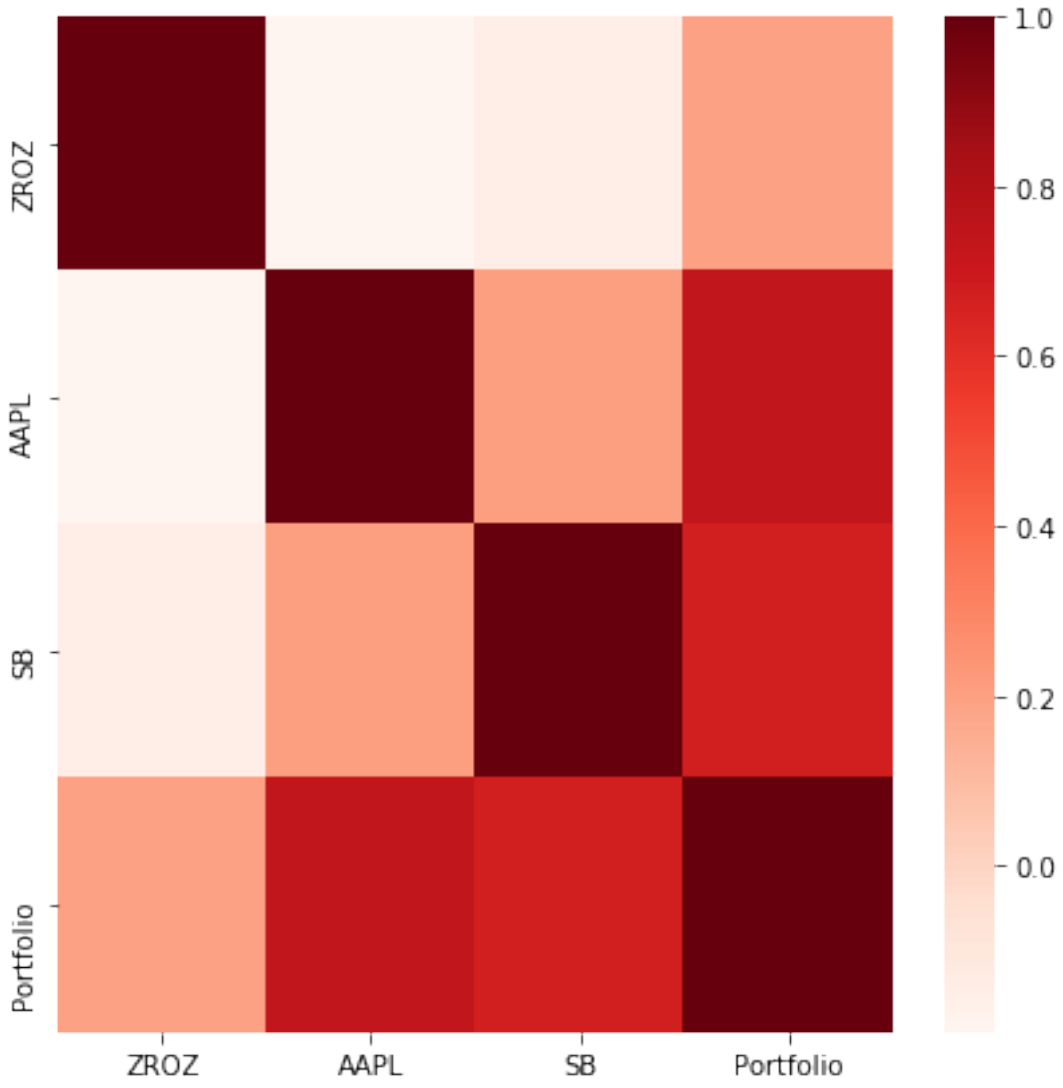
```
Downside risk:
ZROZ         1.330979
AAPL         1.392202
SB           3.547902
Portfolio    0.711117
dtype: float64
--------------------------------------------------
Sortino ratio:
ZROZ        -0.717750
AAPL        -0.686186
SB          -0.269261
Portfolio   -1.343393
dtype: float64
```

[36]:
```
# 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()
```



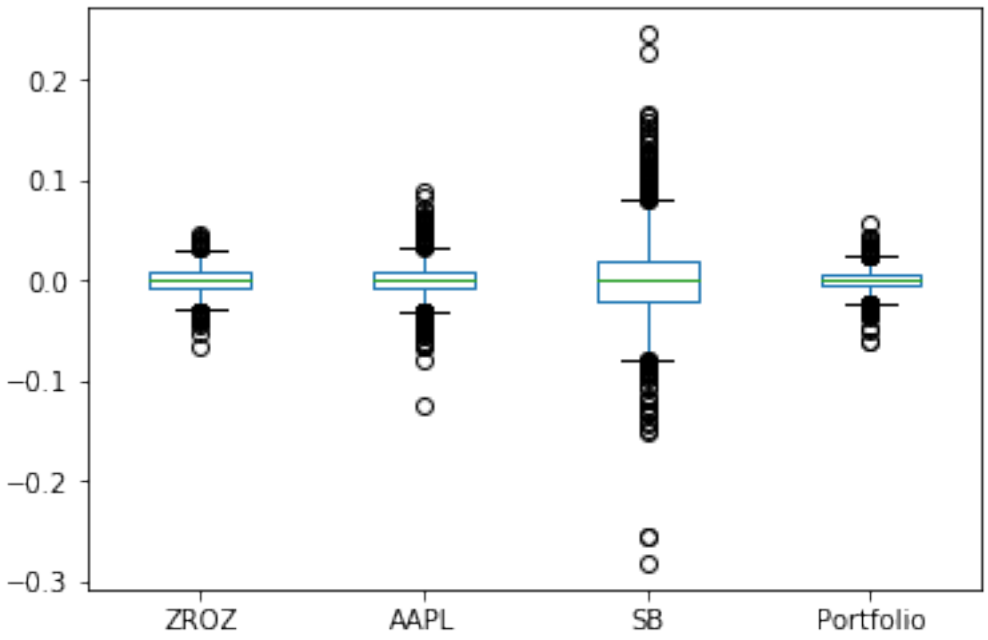
[37]:
```
plt.figure(figsize=(7,7))
corr = returns.corr()

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

[37]: <matplotlib.axes._subplots.AxesSubplot at 0x18dce5999e8>

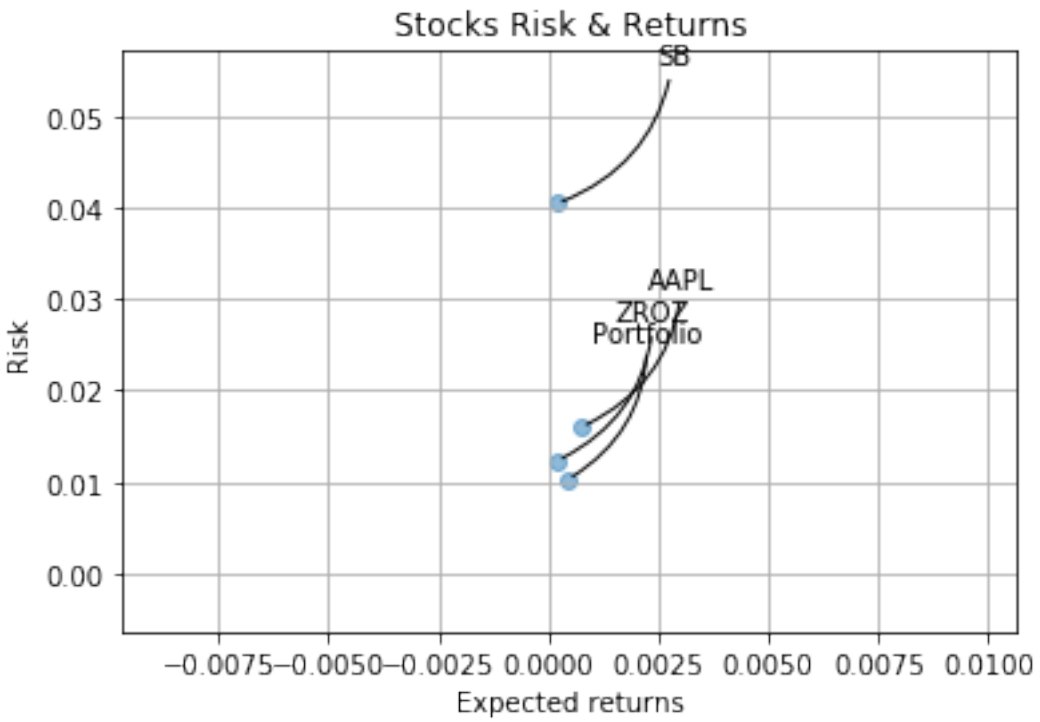


[38]:
```
# Box plot
returns.plot(kind='box')
```

[38]: <matplotlib.axes._subplots.AxesSubplot at 0x18dce5a8cc0>



[39]:
```
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'))
```



[40]:
```
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"))
```

[41]:
```
print("Stock returns: ")
print(rets.mean())
print('-' * 50)
print("Stock risk:")
print(rets.std())
```

```
Stock returns:
ZROZ         0.000211
AAPL         0.000761
SB           0.000202
Portfolio    0.000447
dtype: float64
--------------------------------------------------
Stock risk:
ZROZ         0.012353
AAPL         0.016042
SB           0.040456
Portfolio    0.010287
dtype: float64
```

[42]:
```
table = pd.DataFrame()
table['Returns'] = rets.mean()
table['Risk'] = rets.std()
```

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

[42]:

	Returns	Risk
SB	0.000202	0.040456
ZROZ	0.000211	0.012353
Portfolio	0.000447	0.010287
AAPL	0.000761	0.016042

[43]:
```
table.sort_values(by='Risk')
```

[43]:

	Returns	Risk
Portfolio	0.000447	0.010287
ZROZ	0.000211	0.012353
AAPL	0.000761	0.016042
SB	0.000202	0.040456

[44]:
```
rf = 0.01
table['Sharpe_Ratio'] = (table['Returns'] - rf) / table['Risk']
table
```

[44]:

	Returns	Risk	Sharpe_Ratio
ZROZ	0.000211	0.012353	-0.792385
AAPL	0.000761	0.016042	-0.575910
SB	0.000202	0.040456	-0.242185
Portfolio	0.000447	0.010287	-0.928666