Coronavirus_Portfolio

September 29, 2021

1 Coronavirus Portfolio Risk and Returns

[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")

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

[2]:
```python
# input
# Coronavirus Stock
symbols = ['GE','F','GM','CAH','RMD','MDT','CVS','RAD','WBA']
start = '2019-12-01'
end = '2020-03-31'
```

[3]:
```python
df = pd.DataFrame()
for s in symbols:
    df[s] = yf.download(s,start,end)['Adj Close']
```

```
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```

[4]:
```python
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?
0 years
```

[5]:
```
number_of_years = delta.years
```

[6]:
```
days = (df.index[-1] - df.index[0]).days
days
```

[6]:
```
119
```

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

[7]:
```
                   GE         F         GM        CAH         RMD         MDT  \
Date
2019-12-02  11.138830  8.859331  35.071316  53.584694  148.676666  109.697014
2019-12-03  10.969152  8.741339  34.729202  53.476814  149.135651  109.776138
2019-12-04  10.879322  8.800335  34.993114  53.721989  149.814117  110.715752
2019-12-05  10.769532  8.780669  34.884445  53.202225  149.844055  110.972908
2019-12-06  11.078944  8.869164  35.111671  53.810249  150.253143  111.853165

                  CVS   RAD        WBA
Date
2019-12-02  75.043564  8.81  58.756363
2019-12-03  74.209198  8.61  58.478790
2019-12-04  74.497253  8.44  58.399483
2019-12-05  73.980743  8.04  58.587837
2019-12-06  74.854836  8.29  58.121910
```

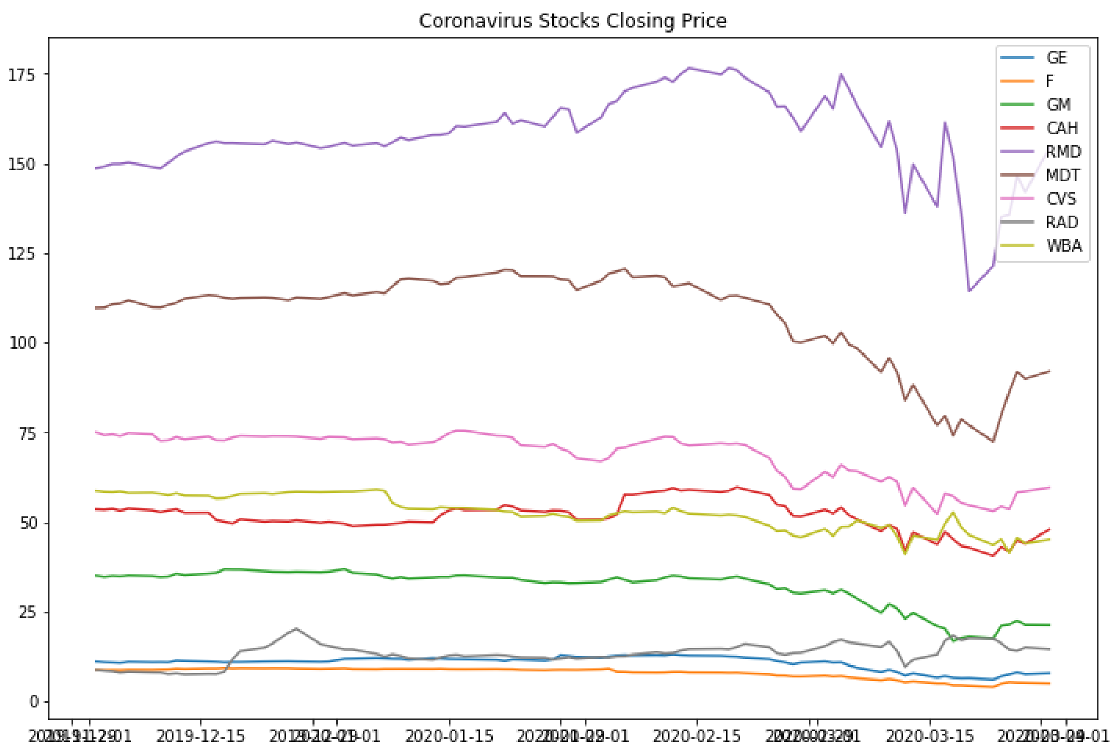
[8]:
```
df.tail()
```

[8]:
```
              GE     F         GM        CAH         RMD        MDT  \
Date
2020-03-24  7.01  4.95  21.110001  43.107567  135.059998  79.850243
2020-03-25  7.56  5.39  21.490000  41.830379  135.710007  86.279999
2020-03-26  8.12  5.25  22.559999  44.949097  146.520004  91.940002
2020-03-27  7.62  5.19  21.379999  43.939224  141.949997  89.889999
2020-03-30  7.89  5.03  21.320000  47.958900  154.210007  92.050003

                  CVS    RAD        WBA
Date
2020-03-24  54.349998  16.26  45.250000
```

```
2020-03-25  53.639999  14.47  41.439999
2020-03-26  58.310001  14.11  45.669998
2020-03-27  58.599998  15.07  44.000000
2020-03-30  59.680000  14.61  45.160000
```

[9]:
```
plt.figure(figsize=(12,8))
plt.plot(df)
plt.title('Coronavirus Stocks Closing Price')
plt.legend(labels=df.columns)
```

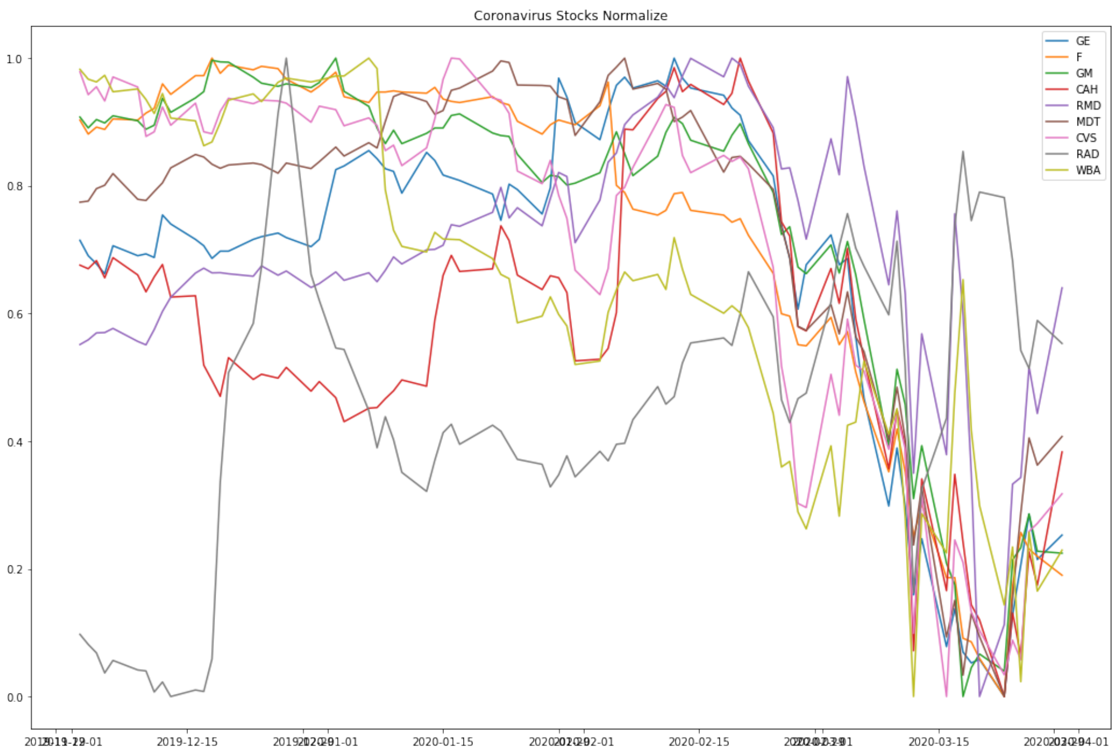
[9]:
```
<matplotlib.legend.Legend at 0x26650487320>
```



[10]:
```
# Normalize the data
normalize = (df - df.min())/ (df.max() - df.min())
```

[11]:
```
plt.figure(figsize=(18,12))
plt.plot(normalize)
plt.title('Coronavirus Stocks Normalize')
plt.legend(labels=normalize.columns)
```

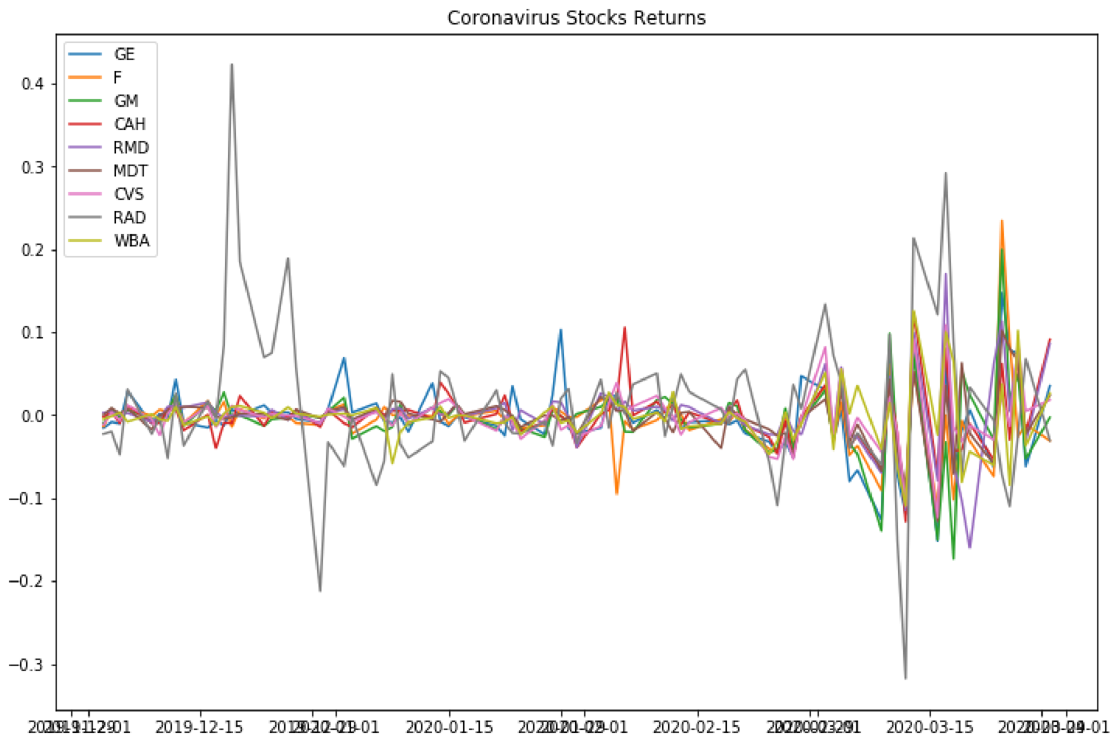
[11]:
```
<matplotlib.legend.Legend at 0x266504fb978>
```



```
[12]: stock_rets = df.pct_change().dropna()
```

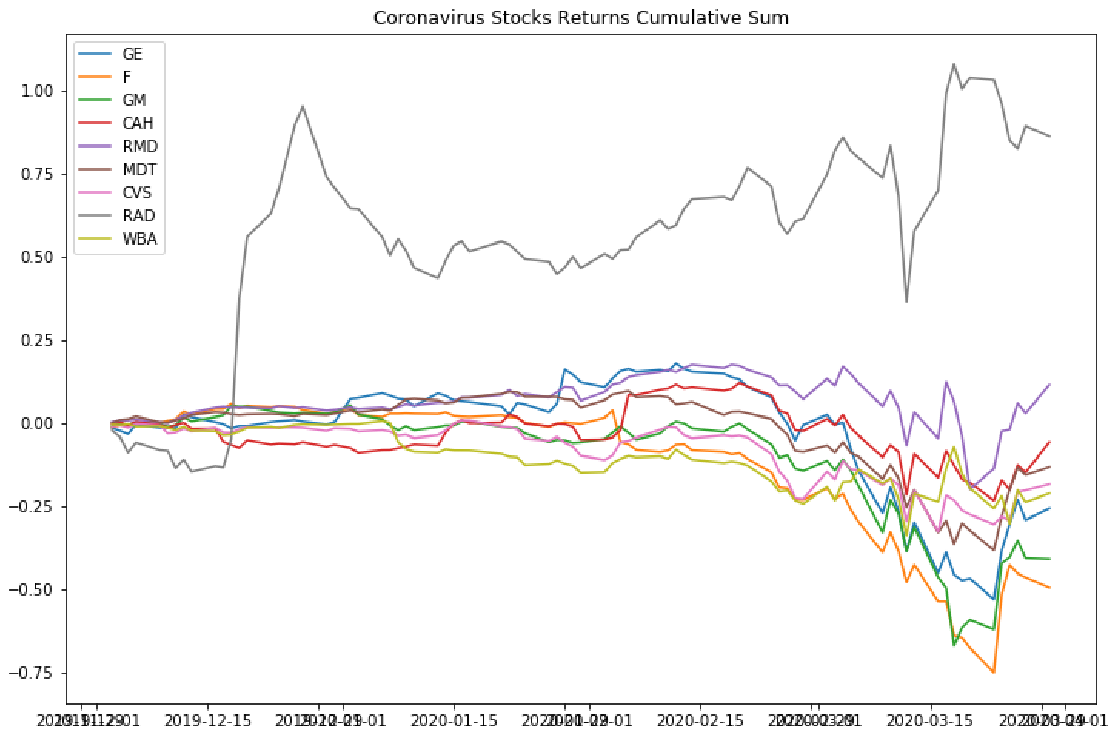
```
[13]: plt.figure(figsize=(12,8))
      plt.plot(stock_rets)
      plt.title('Coronavirus Stocks Returns')
      plt.legend(labels=stock_rets.columns)
```

```
[13]: <matplotlib.legend.Legend at 0x2665056af60>
```

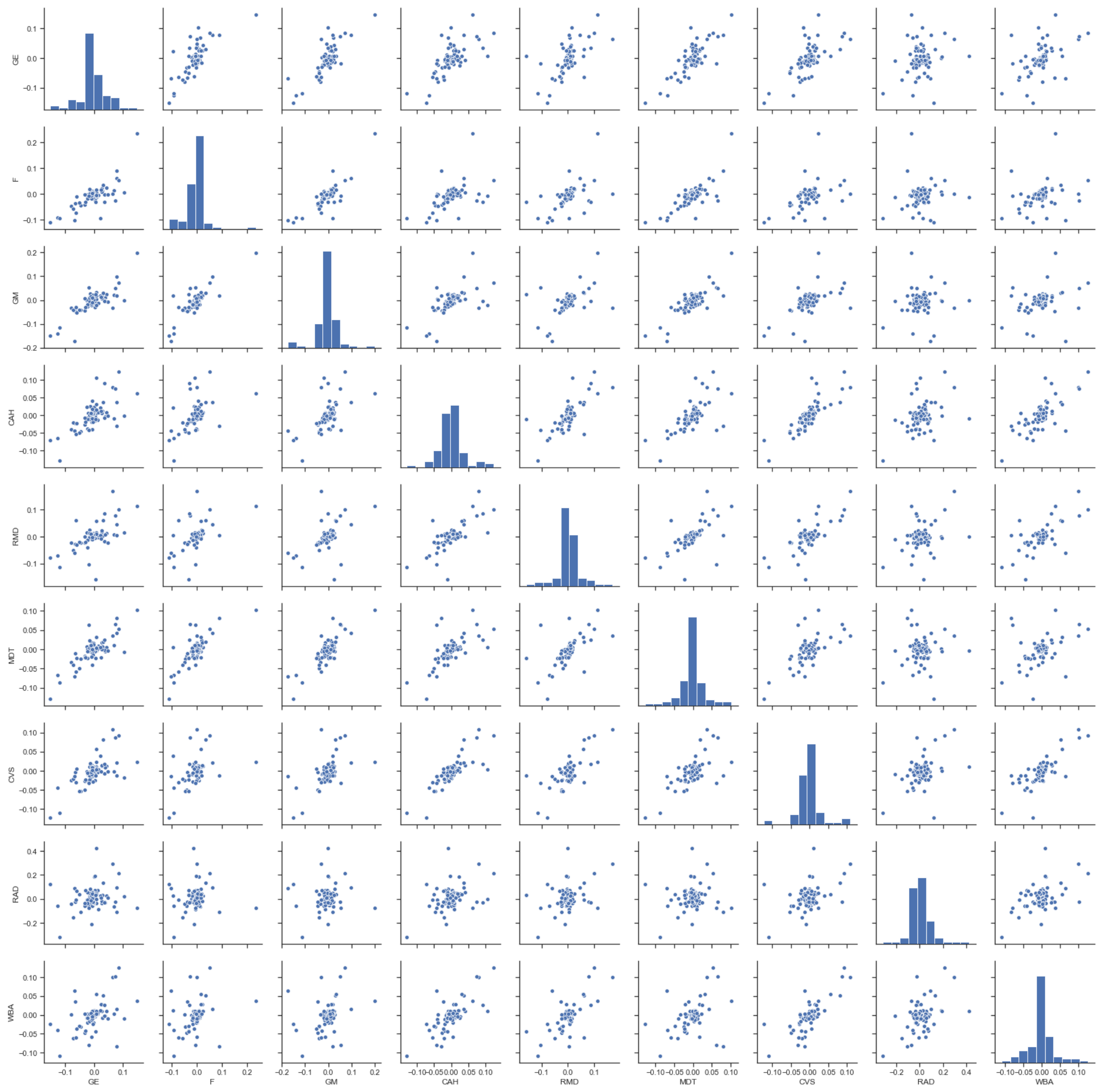


```
[14]: plt.figure(figsize=(12,8))
      plt.plot(stock_rets.cumsum())
      plt.title('Coronavirus Stocks Returns Cumulative Sum')
      plt.legend(labels=stock_rets.columns)
```

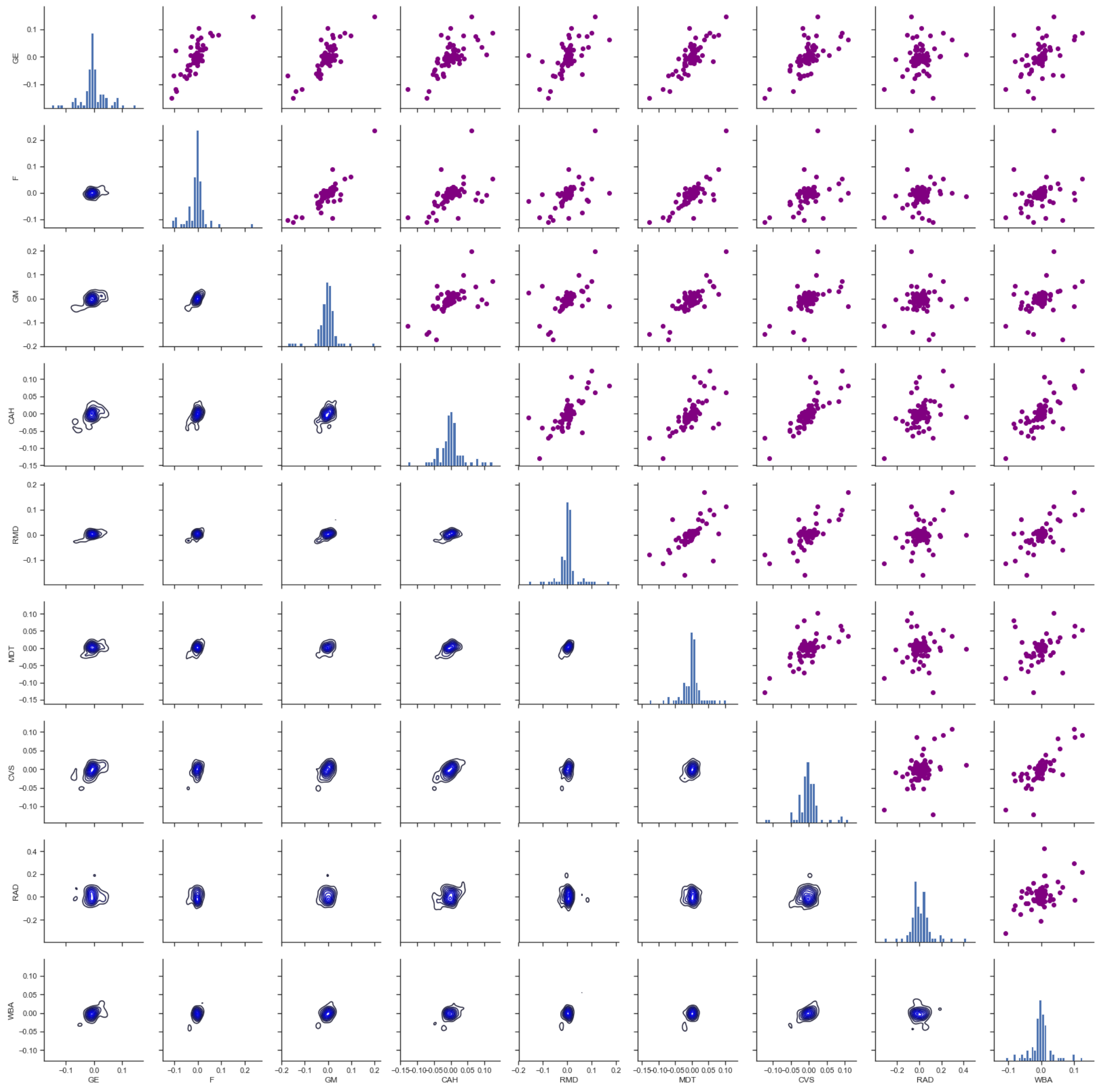
```
[14]: <matplotlib.legend.Legend at 0x266505df080>
```



[15]:
```
sns.set(style='ticks')
ax = sns.pairplot(stock_rets, diag_kind='hist')

nplot = len(stock_rets.columns)
for i in range(nplot) :
    for j in range(nplot) :
        ax.axes[i, j].locator_params(axis='x', nbins=6, tight=True)
```

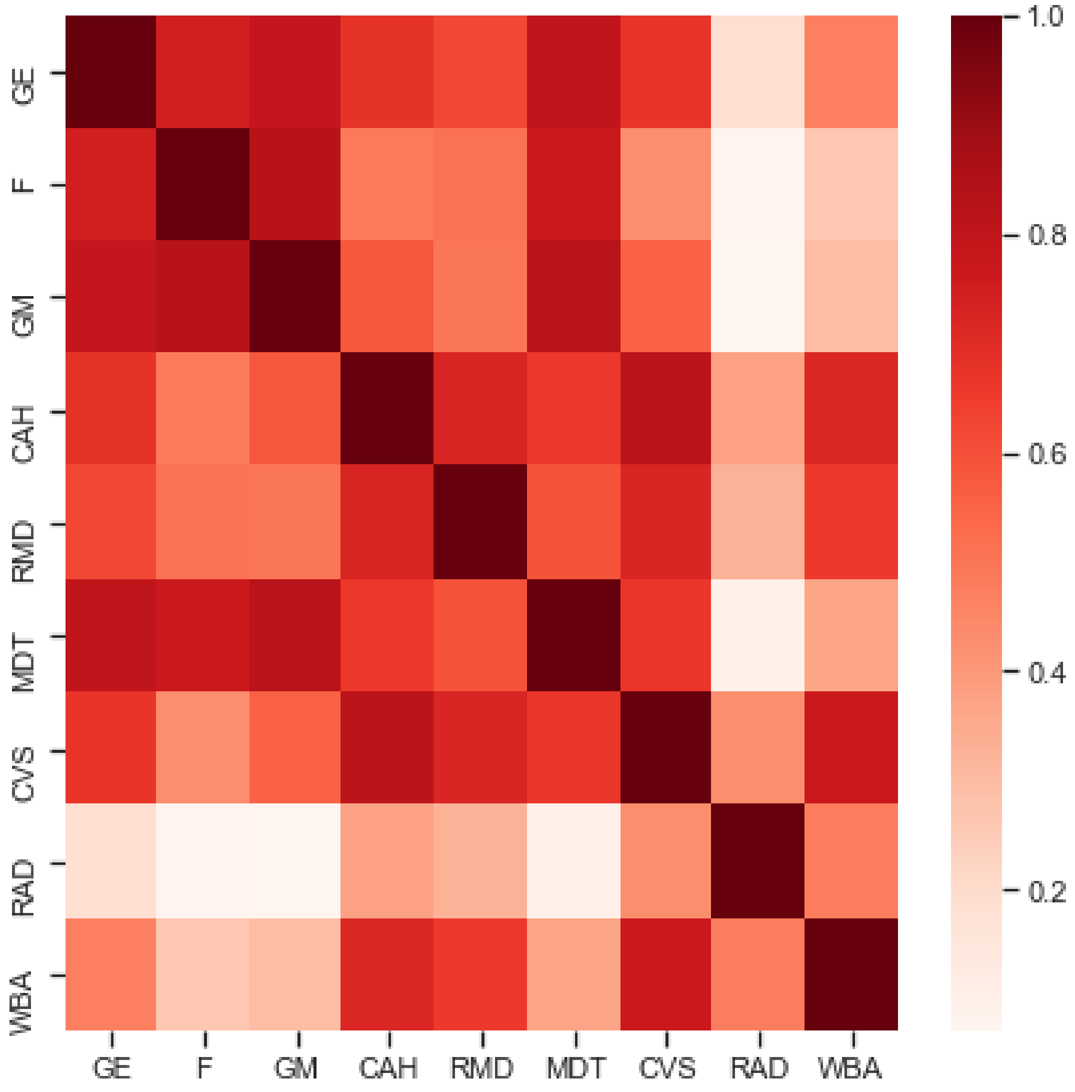


```
[16]: ax = sns.PairGrid(stock_rets)
      ax.map_upper(plt.scatter, color='purple')
      ax.map_lower(sns.kdeplot, color='blue')
      ax.map_diag(plt.hist, bins=30)
      for i in range(nplot) :
          for j in range(nplot) :
              ax.axes[i, j].locator_params(axis='x', nbins=6, tight=True)
```

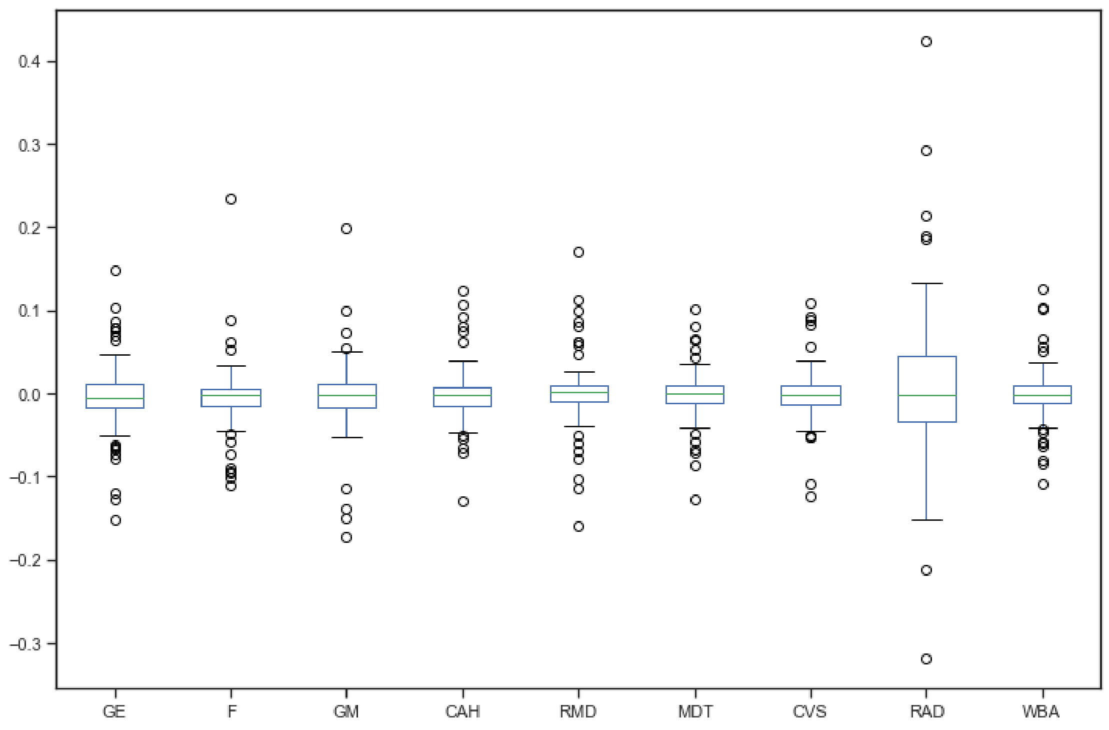


```
[17]: plt.figure(figsize=(7,7))
      corr = stock_rets.corr()

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

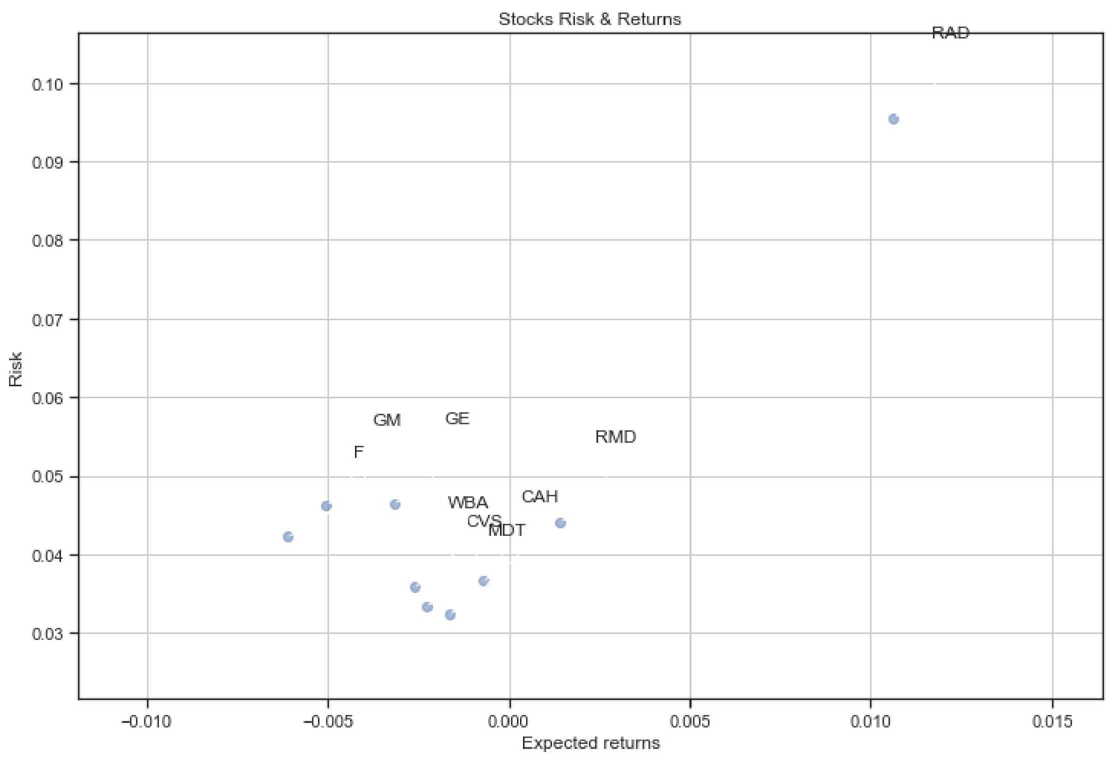
```
[17]: <matplotlib.axes._subplots.AxesSubplot at 0x2665449ce48>
```



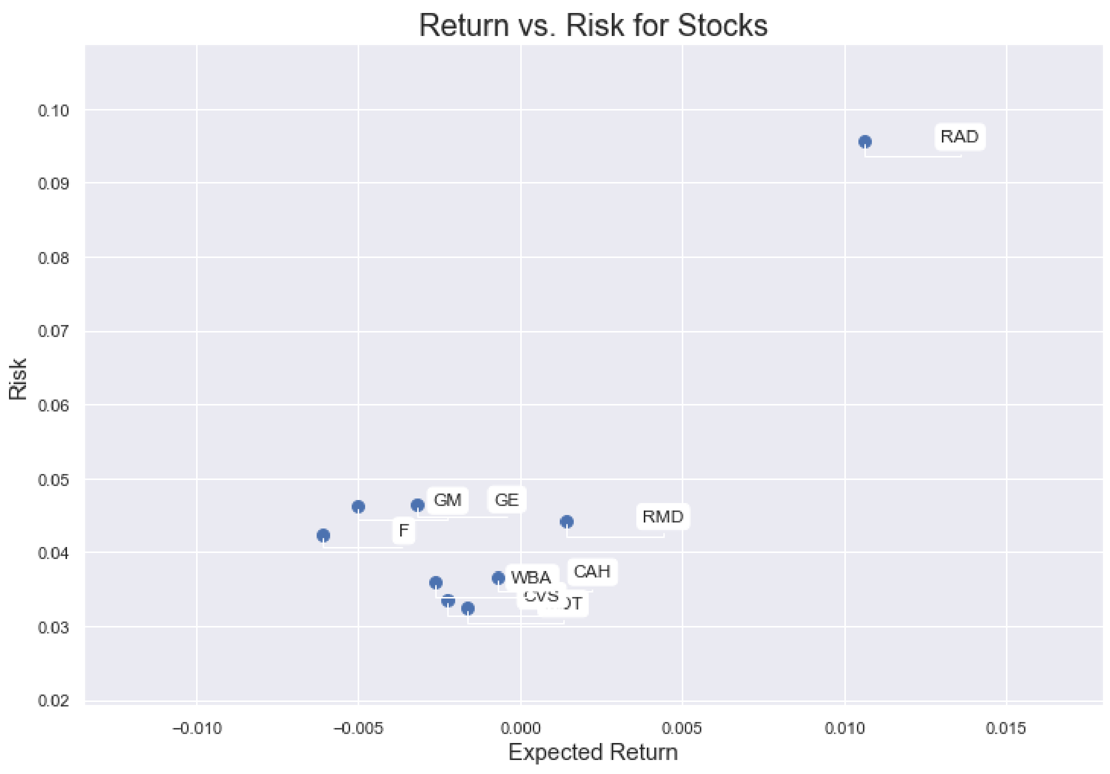
```
[18]: # Box plot
      stock_rets.plot(kind='box',figsize=(12,8))

[18]: <matplotlib.axes._subplots.AxesSubplot at 0x26654099048>
```



[19]:
```python
rets = stock_rets.dropna()

plt.figure(figsize=(12,8))
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'))
```



[20]:
```
rets = stock_rets.dropna()
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 Stocks", 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"))
```



[21]:
```
rest_rets = rets.corr()
pair_value = rest_rets.abs().unstack()
pair_value.sort_values(ascending = False)
```

[21]:
```
WBA  WBA    1.000000
RAD  RAD    1.000000
F    F      1.000000
GM   GM     1.000000
CAH  CAH    1.000000
MDT  MDT    1.000000
CVS  CVS    1.000000
RMD  RMD    1.000000
GE   GE     1.000000
F    GM     0.828619
GM   F      0.828619
     MDT    0.821094
MDT  GM     0.821094
CAH  CVS    0.816546
CVS  CAH    0.816546
GE   MDT    0.800432
MDT  GE     0.800432
GE   GM     0.788193
GM   GE     0.788193
```

```
F    MDT    0.768480
MDT  F      0.768480
WBA  CVS    0.767721
CVS  WBA    0.767721
F    GE     0.746950
GE   F      0.746950
CAH  RMD    0.726041
RMD  CAH    0.726041
CVS  RMD    0.720843
RMD  CVS    0.720843
WBA  CAH    0.717412
                ...
RMD  GM     0.500164
GM   RMD    0.500164
CAH  F      0.490819
F    CAH    0.490819
RAD  WBA    0.479228
WBA  RAD    0.479228
GE   WBA    0.471037
WBA  GE     0.471037
CVS  F      0.435186
F    CVS    0.435186
CVS  RAD    0.430186
RAD  CVS    0.430186
     CAH    0.378033
CAH  RAD    0.378033
MDT  WBA    0.370077
WBA  MDT    0.370077
RAD  RMD    0.329223
RMD  RAD    0.329223
GM   WBA    0.296149
WBA  GM     0.296149
F    WBA    0.265812
WBA  F      0.265812
RAD  GE     0.191933
GE   RAD    0.191933
RAD  MDT    0.094568
MDT  RAD    0.094568
F    RAD    0.076675
RAD  F      0.076675
     GM     0.070843
GM   RAD    0.070843
Length: 81, dtype: float64
```

[22]:
```
# Normalized Returns Data
Normalized_Value = ((rets[:] - rets[:].min()) /(rets[:].max() - rets[:].min()))
Normalized_Value.head()
```

[22]:
```
                  GE         F        GM       CAH       RMD       MDT  \
Date
2019-12-03  0.456216  0.280973  0.438667  0.502518  0.493460  0.560373
2019-12-04  0.479782  0.339218  0.485234  0.528695  0.497888  0.594432
2019-12-05  0.473418  0.313143  0.456510  0.472121  0.484718  0.567331
2019-12-06  0.603304  0.348881  0.482322  0.555848  0.492379  0.591707
2019-12-09  0.474026  0.316411  0.452762  0.472184  0.458577  0.481927

                 CVS       RAD       WBA
Date
2019-12-03  0.482436  0.398280  0.445113
2019-12-04  0.547075  0.402272  0.459405
2019-12-05  0.500471  0.364951  0.478847
2019-12-06  0.581263  0.470895  0.431413
2019-12-09  0.509191  0.397986  0.470950
```

[23]:
```python
Normalized_Value.corr()
```

[23]:
```
           GE         F        GM       CAH       RMD       MDT       CVS  \
GE   1.000000  0.746950  0.788193  0.678642  0.619876  0.800432  0.671014
F    0.746950  1.000000  0.828619  0.490819  0.513466  0.768480  0.435186
GM   0.788193  0.828619  1.000000  0.581750  0.500164  0.821094  0.555005
CAH  0.678642  0.490819  0.581750  1.000000  0.726041  0.661041  0.816546
RMD  0.619876  0.513466  0.500164  0.726041  1.000000  0.596323  0.720843
MDT  0.800432  0.768480  0.821094  0.661041  0.596323  1.000000  0.666279
CVS  0.671014  0.435186  0.555005  0.816546  0.720843  0.666279  1.000000
RAD  0.191933  0.076675  0.070843  0.378033  0.329223  0.094568  0.430186
WBA  0.471037  0.265812  0.296149  0.717412  0.657893  0.370077  0.767721

          RAD       WBA
GE   0.191933  0.471037
F    0.076675  0.265812
GM   0.070843  0.296149
CAH  0.378033  0.717412
RMD  0.329223  0.657893
MDT  0.094568  0.370077
CVS  0.430186  0.767721
RAD  1.000000  0.479228
WBA  0.479228  1.000000
```

[24]:
```python
normalized_rets = Normalized_Value.corr()
normalized_pair_value = normalized_rets.abs().unstack()
normalized_pair_value.sort_values(ascending = False)
```

[24]:
```
WBA  WBA     1.000000
RAD  RAD     1.000000
F    F       1.000000
```

```
GM   GM     1.000000
CAH  CAH    1.000000
MDT  MDT    1.000000
CVS  CVS    1.000000
RMD  RMD    1.000000
GE   GE     1.000000
F    GM     0.828619
GM   F      0.828619
     MDT    0.821094
MDT  GM     0.821094
CAH  CVS    0.816546
CVS  CAH    0.816546
GE   MDT    0.800432
MDT  GE     0.800432
GE   GM     0.788193
GM   GE     0.788193
F    MDT    0.768480
MDT  F      0.768480
WBA  CVS    0.767721
CVS  WBA    0.767721
F    GE     0.746950
GE   F      0.746950
CAH  RMD    0.726041
RMD  CAH    0.726041
CVS  RMD    0.720843
RMD  CVS    0.720843
WBA  CAH    0.717412
               …
RMD  GM     0.500164
GM   RMD    0.500164
CAH  F      0.490819
F    CAH    0.490819
RAD  WBA    0.479228
WBA  RAD    0.479228
GE   WBA    0.471037
WBA  GE     0.471037
CVS  F      0.435186
F    CVS    0.435186
CVS  RAD    0.430186
RAD  CVS    0.430186
     CAH    0.378033
CAH  RAD    0.378033
MDT  WBA    0.370077
WBA  MDT    0.370077
RAD  RMD    0.329223
RMD  RAD    0.329223
GM   WBA    0.296149
```

```
WBA  GM     0.296149
F    WBA    0.265812
WBA  F      0.265812
RAD  GE     0.191933
GE   RAD    0.191933
RAD  MDT    0.094568
MDT  RAD    0.094568
F    RAD    0.076675
RAD  F      0.076675
     GM     0.070843
GM   RAD    0.070843
Length: 81, dtype: float64
```

[25]:
```
print("Stock returns: ")
print(rets.mean())
print('-' * 50)
print("Stock risks:")
print(rets.std())
```

```
Stock returns:
GE    -0.003168
F     -0.006110
GM    -0.005045
CAH   -0.000709
RMD    0.001418
MDT   -0.001637
CVS   -0.002268
RAD    0.010633
WBA   -0.002613
dtype: float64
--------------------------------------------------
Stock risks:
GE     0.046514
F      0.042287
GM     0.046332
CAH    0.036667
RMD    0.044185
MDT    0.032416
CVS    0.033483
RAD    0.095548
WBA    0.035877
dtype: float64
```

[26]:
```
table = pd.DataFrame()
table['Returns'] = rets.mean()
table['Risk'] = rets.std()
table.sort_values(by='Returns')
```

[26]:
```
      Returns      Risk
F   -0.006110  0.042287
GM  -0.005045  0.046332
GE  -0.003168  0.046514
WBA -0.002613  0.035877
CVS -0.002268  0.033483
MDT -0.001637  0.032416
CAH -0.000709  0.036667
RMD  0.001418  0.044185
RAD  0.010633  0.095548
```

[27]:
```
table.sort_values(by='Risk')
```

[27]:
```
      Returns      Risk
MDT -0.001637  0.032416
CVS -0.002268  0.033483
WBA -0.002613  0.035877
CAH -0.000709  0.036667
F   -0.006110  0.042287
RMD  0.001418  0.044185
GM  -0.005045  0.046332
GE  -0.003168  0.046514
RAD  0.010633  0.095548
```

[28]:
```
rf = 0.01
table['Sharpe Ratio'] = (table['Returns'] - rf) / table['Risk']
table
```

[28]:
```
      Returns      Risk  Sharpe Ratio
GE  -0.003168  0.046514     -0.283100
F   -0.006110  0.042287     -0.380976
GM  -0.005045  0.046332     -0.324721
CAH -0.000709  0.036667     -0.292073
RMD  0.001418  0.044185     -0.194236
MDT -0.001637  0.032416     -0.358984
CVS -0.002268  0.033483     -0.366402
RAD  0.010633  0.095548      0.006622
WBA -0.002613  0.035877     -0.351561
```

[29]:
```
table['Max Returns'] = rets.max()
```

[30]:
```
table['Min Returns'] = rets.min()
```

[31]:
```
table['Median Returns'] = rets.median()
```

[32]:
```
total_return = stock_rets[-1:].transpose()
table['Total Return'] = 100 * total_return
```

```
table
```

```
[32]:        Returns      Risk  Sharpe Ratio  Max Returns  Min Returns  \
      GE   -0.003168  0.046514     -0.283100     0.147300    -0.151592
      F    -0.006110  0.042287     -0.380976     0.234414    -0.110124
      GM   -0.005045  0.046332     -0.324721     0.199432    -0.173228
      CAH  -0.000709  0.036667     -0.292073     0.123378    -0.128674
      RMD   0.001418  0.044185     -0.194236     0.170376    -0.159883
      MDT  -0.001637  0.032416     -0.358984     0.101893    -0.128237
      CVS  -0.002268  0.033483     -0.366402     0.108987    -0.123072
      RAD   0.010633  0.095548      0.006622     0.423077    -0.317764
      WBA  -0.002613  0.035877     -0.351561     0.126036    -0.109616

           Median Returns  Total Return
      GE        -0.006267      3.543307
      F         -0.002235     -3.082849
      GM        -0.002286     -0.280634
      CAH       -0.002013      9.148264
      RMD        0.002632      8.636851
      MDT        0.000721      2.402941
      CVS       -0.002528      1.843007
      RAD       -0.002066     -3.052422
      WBA       -0.002246      2.636363
```

```
[33]: table['Average Return Days'] = (1 + total_return)**(1 / days) - 1
      table
```

```
[33]:        Returns      Risk  Sharpe Ratio  Max Returns  Min Returns  \
      GE   -0.003168  0.046514     -0.283100     0.147300    -0.151592
      F    -0.006110  0.042287     -0.380976     0.234414    -0.110124
      GM   -0.005045  0.046332     -0.324721     0.199432    -0.173228
      CAH  -0.000709  0.036667     -0.292073     0.123378    -0.128674
      RMD   0.001418  0.044185     -0.194236     0.170376    -0.159883
      MDT  -0.001637  0.032416     -0.358984     0.101893    -0.128237
      CVS  -0.002268  0.033483     -0.366402     0.108987    -0.123072
      RAD   0.010633  0.095548      0.006622     0.423077    -0.317764
      WBA  -0.002613  0.035877     -0.351561     0.126036    -0.109616

           Median Returns  Total Return  Average Return Days
      GE        -0.006267      3.543307             0.000293
      F         -0.002235     -3.082849            -0.000263
      GM        -0.002286     -0.280634            -0.000024
      CAH       -0.002013      9.148264             0.000736
      RMD        0.002632      8.636851             0.000696
      MDT        0.000721      2.402941             0.000200
      CVS       -0.002528      1.843007             0.000153
      RAD       -0.002066     -3.052422            -0.000260
```

```
WBA       -0.002246      2.636363             0.000219
```

[34]:
```
initial_value = df.iloc[0]
ending_value = df.iloc[-1]
table['CAGR'] = ((ending_value / initial_value) ** (252.0 / days)) -1
table
```

[34]:
```
      Returns      Risk  Sharpe Ratio  Max Returns  Min Returns  \
GE  -0.003168  0.046514     -0.283100     0.147300    -0.151592
F   -0.006110  0.042287     -0.380976     0.234414    -0.110124
GM  -0.005045  0.046332     -0.324721     0.199432    -0.173228
CAH -0.000709  0.036667     -0.292073     0.123378    -0.128674
RMD  0.001418  0.044185     -0.194236     0.170376    -0.159883
MDT -0.001637  0.032416     -0.358984     0.101893    -0.128237
CVS -0.002268  0.033483     -0.366402     0.108987    -0.123072
RAD  0.010633  0.095548      0.006622     0.423077    -0.317764
WBA -0.002613  0.035877     -0.351561     0.126036    -0.109616

     Median Returns  Total Return  Average Return Days      CAGR
GE        -0.006267      3.543307             0.000293 -0.518212
F         -0.002235     -3.082849            -0.000263 -0.698413
GM        -0.002286     -0.280634            -0.000024 -0.651471
CAH       -0.002013      9.148264             0.000736 -0.209340
RMD        0.002632      8.636851             0.000696  0.080455
MDT        0.000721      2.402941             0.000200 -0.310242
CVS       -0.002528      1.843007             0.000153 -0.384360
RAD       -0.002066     -3.052422            -0.000260  1.918721
WBA       -0.002246      2.636363             0.000219 -0.427269
```

[35]:
```
table.sort_values(by='Average Return Days')
```

[35]:
```
      Returns      Risk  Sharpe Ratio  Max Returns  Min Returns  \
F   -0.006110  0.042287     -0.380976     0.234414    -0.110124
RAD  0.010633  0.095548      0.006622     0.423077    -0.317764
GM  -0.005045  0.046332     -0.324721     0.199432    -0.173228
CVS -0.002268  0.033483     -0.366402     0.108987    -0.123072
MDT -0.001637  0.032416     -0.358984     0.101893    -0.128237
WBA -0.002613  0.035877     -0.351561     0.126036    -0.109616
GE  -0.003168  0.046514     -0.283100     0.147300    -0.151592
RMD  0.001418  0.044185     -0.194236     0.170376    -0.159883
CAH -0.000709  0.036667     -0.292073     0.123378    -0.128674

     Median Returns  Total Return  Average Return Days      CAGR
F         -0.002235     -3.082849            -0.000263 -0.698413
RAD       -0.002066     -3.052422            -0.000260  1.918721
GM        -0.002286     -0.280634            -0.000024 -0.651471
CVS       -0.002528      1.843007             0.000153 -0.384360
```

```
MDT        0.000721      2.402941             0.000200 -0.310242
WBA       -0.002246      2.636363             0.000219 -0.427269
GE        -0.006267      3.543307             0.000293 -0.518212
RMD        0.002632      8.636851             0.000696  0.080455
CAH       -0.002013      9.148264             0.000736 -0.209340
```