

# Healthcare\_Portfolio\_2

September 29, 2021

## 1 Health Care Stocks

```
[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")

# yahoo finance data
import yfinance as yf
yf.pdr_override()
```

```
[2]: # input
# Online Gaming
title = "Health Care"
symbols = ['BIIB', 'BIO', 'ALXN', 'ABC', 'TFX', 'DXCM', 'REGN', 'WST', 'XLV']
start = '2018-01-01'
end = '2020-06-26'
```

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

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

```
[4]: 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?  
2 years

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

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

```
[6]: 905
```

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

```
[7]:
```

	BIIB	BIO	ALXN	ABC	TFX \
Date					
2018-01-02	334.170013	241.419998	124.050003	89.840126	251.766602
2018-01-03	339.850006	250.470001	124.949997	90.174469	253.654373
2018-01-04	339.989990	248.490005	122.690002	89.973854	251.054962
2018-01-05	342.489990	249.050003	122.800003	91.062935	254.731705
2018-01-08	329.649994	251.000000	119.699997	92.572395	255.670639

	DXCM	REGN	WST	XLV
Date				
2018-01-02	57.990002	382.600006	98.237854	79.736702
2018-01-03	58.080002	393.779999	98.356316	80.499641
2018-01-04	52.250000	382.950012	98.326698	80.614067
2018-01-05	53.259998	385.100006	99.560852	81.300713
2018-01-08	55.439999	372.519989	100.123627	81.005074

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

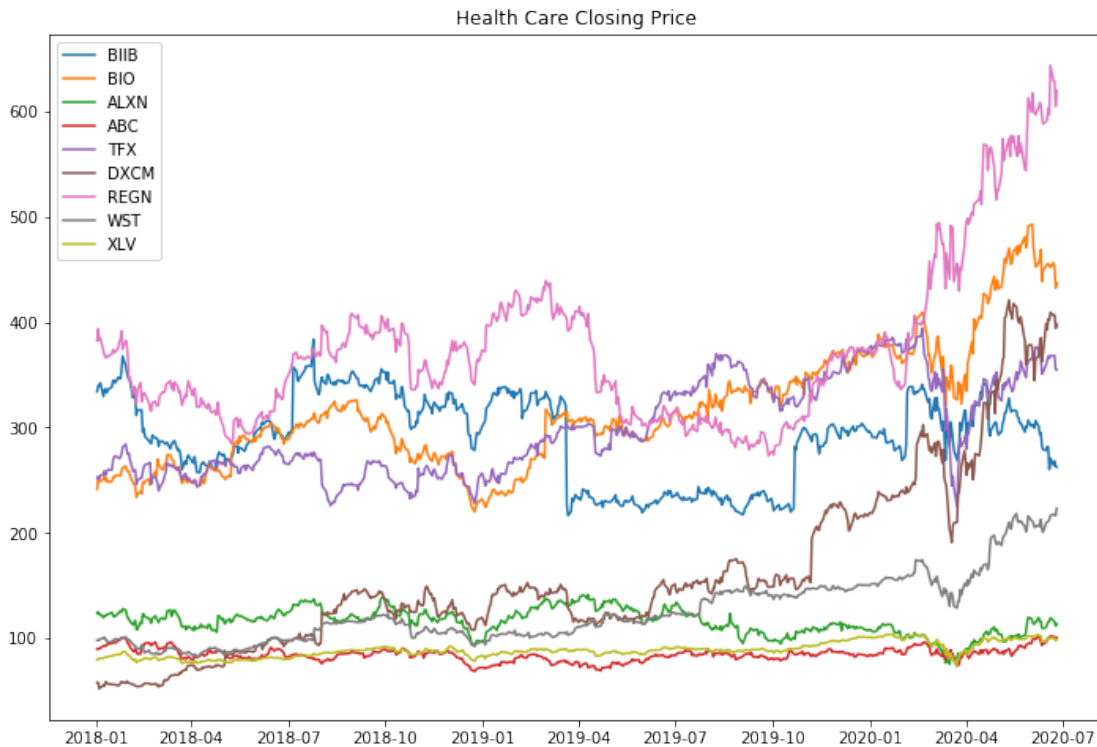
```
[8]:
```

	BIIB	BIO	ALXN	ABC	TFX \
Date					
2020-06-19	271.000000	451.959991	119.349998	102.150002	368.390015
2020-06-22	264.290009	456.489990	116.919998	101.730003	368.100006
2020-06-23	268.190002	451.779999	115.489998	101.500000	368.470001
2020-06-24	263.040009	432.420013	111.949997	98.839996	355.309998
2020-06-25	262.630005	437.239990	113.470001	100.669998	354.959991

	DXCM	REGN	WST	XLV
Date				
2020-06-19	409.359985	643.919983	216.589996	100.325005
2020-06-22	406.329987	628.479980	217.800003	99.940002
2020-06-23	406.899994	628.760010	217.539993	100.370003
2020-06-24	394.299988	605.039978	216.509995	97.750000
2020-06-25	398.089996	619.960022	223.360001	98.709999

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

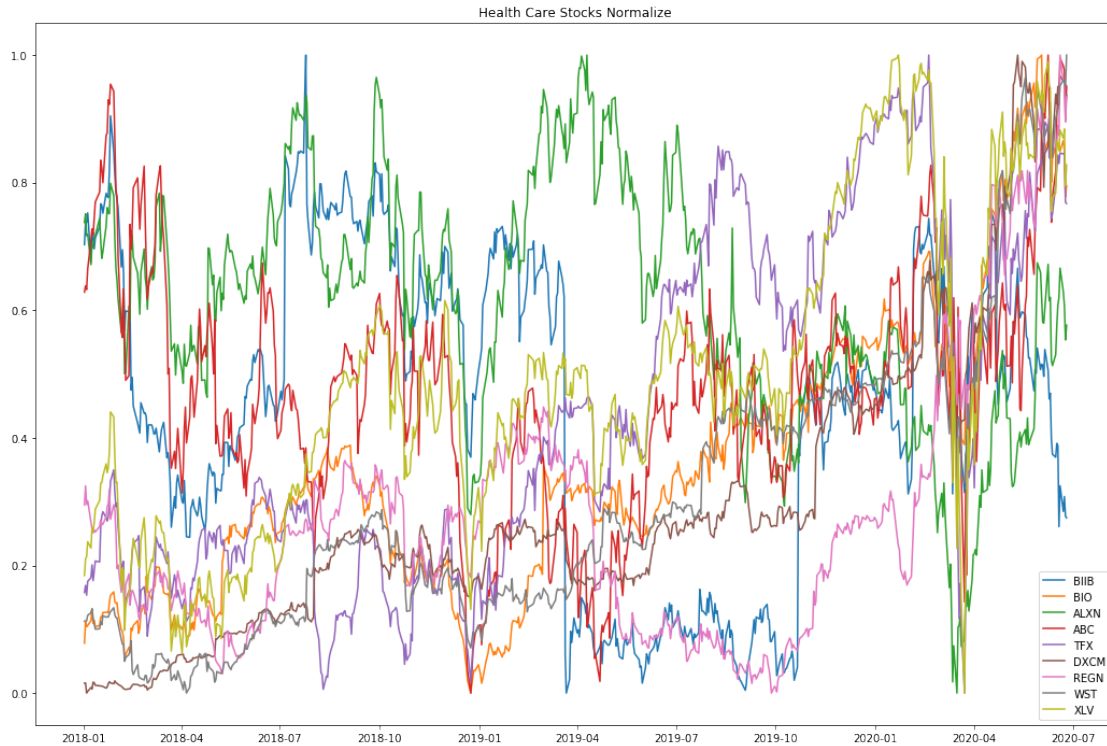
```
[9]: <matplotlib.legend.Legend at 0x21dad0e4da0>
```



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

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

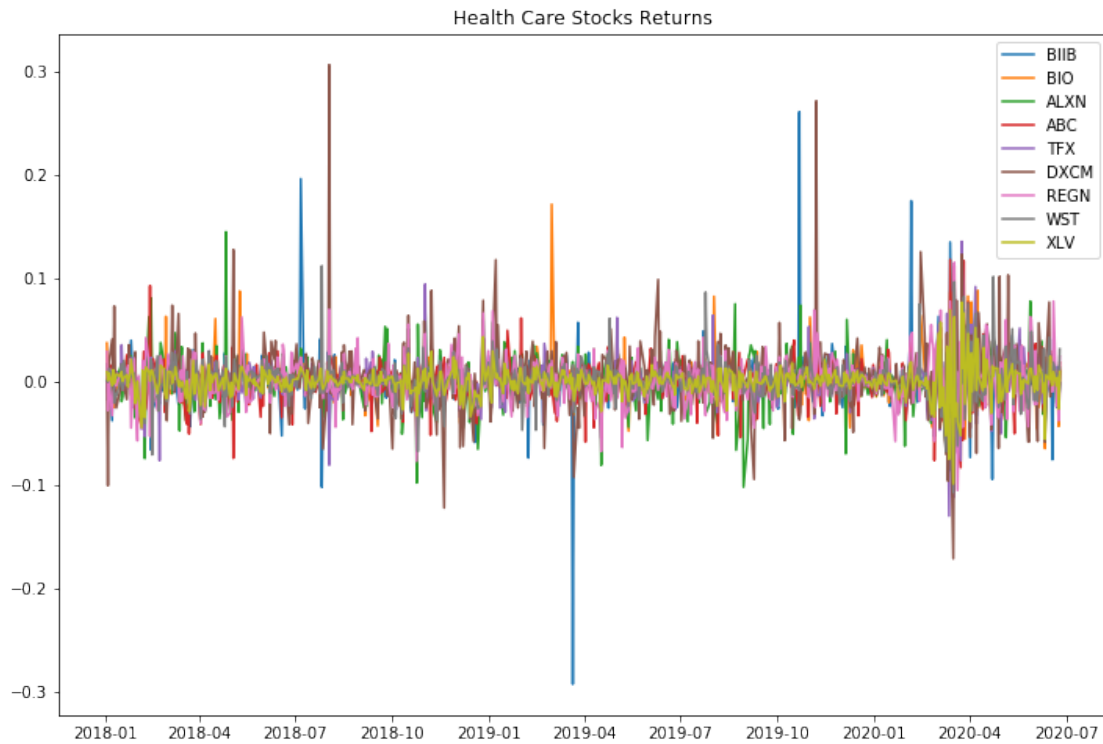
[11]: <matplotlib.legend.Legend at 0x21dad160710>



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

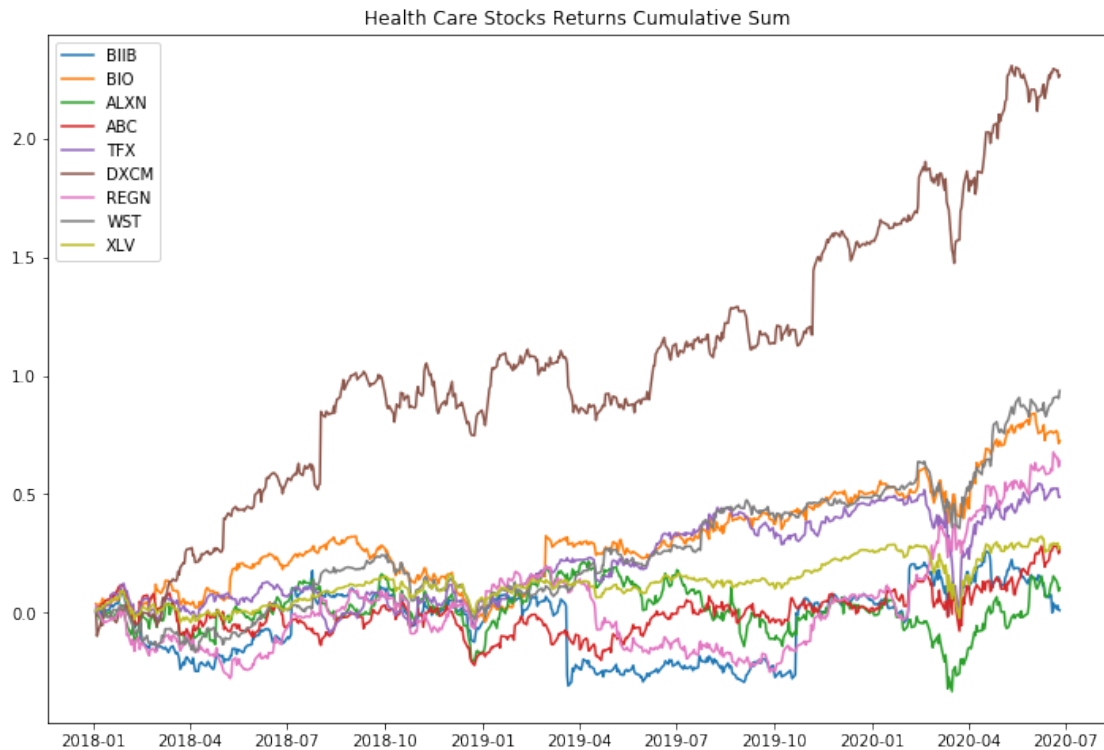
```
[13]: plt.figure(figsize=(12,8))
plt.plot(stock_rets)
plt.title(title + ' Stocks Returns')
plt.legend(labels=stock_rets.columns)
```

[13]: <matplotlib.legend.Legend at 0x21dad1d16a0>



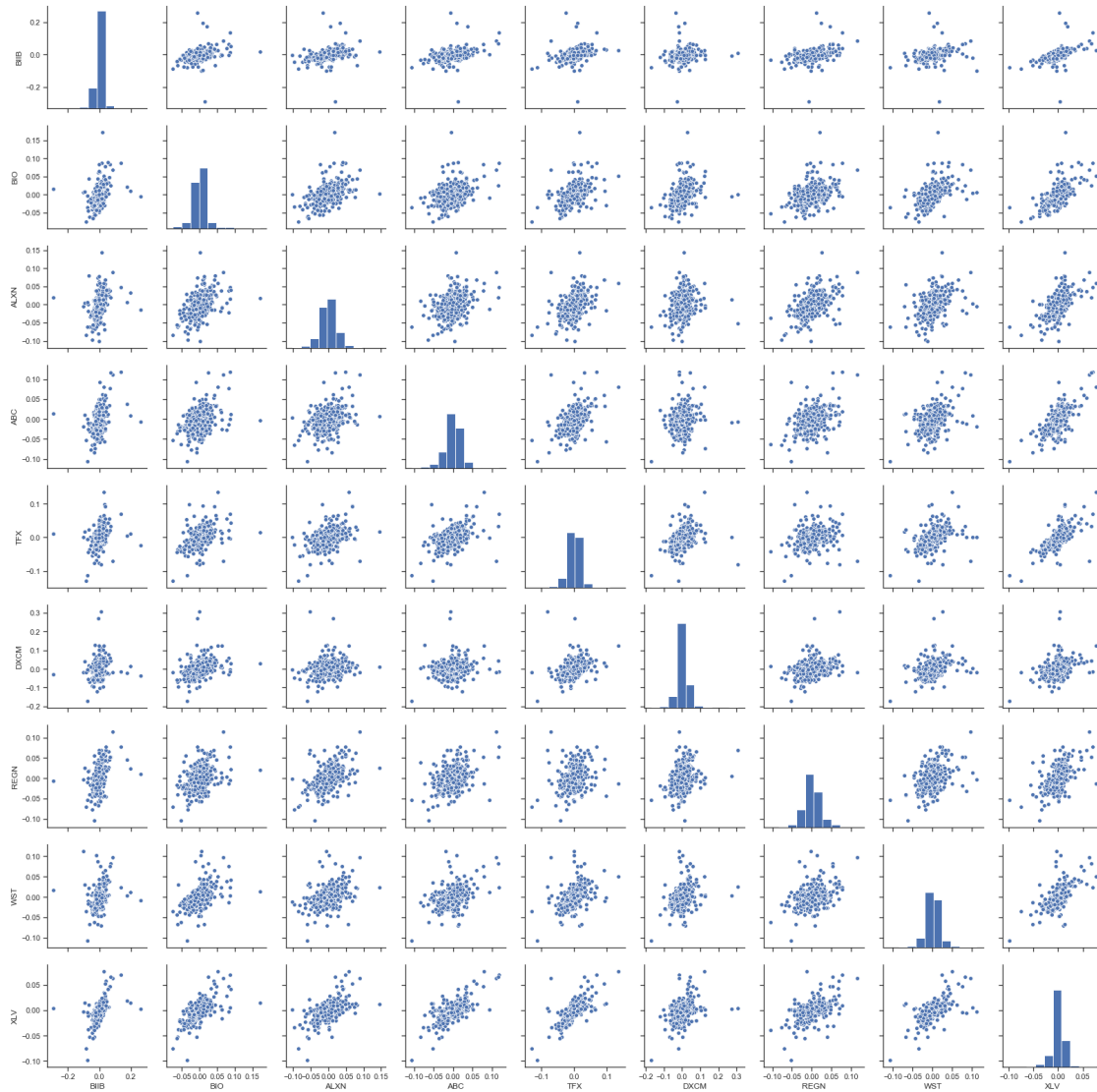
```
[14]: plt.figure(figsize=(12,8))
plt.plot(stock_rets.cumsum())
plt.title(title + ' Stocks Returns Cumulative Sum')
plt.legend(labels=stock_rets.columns)
```

```
[14]: <matplotlib.legend.Legend at 0x21dad23c710>
```

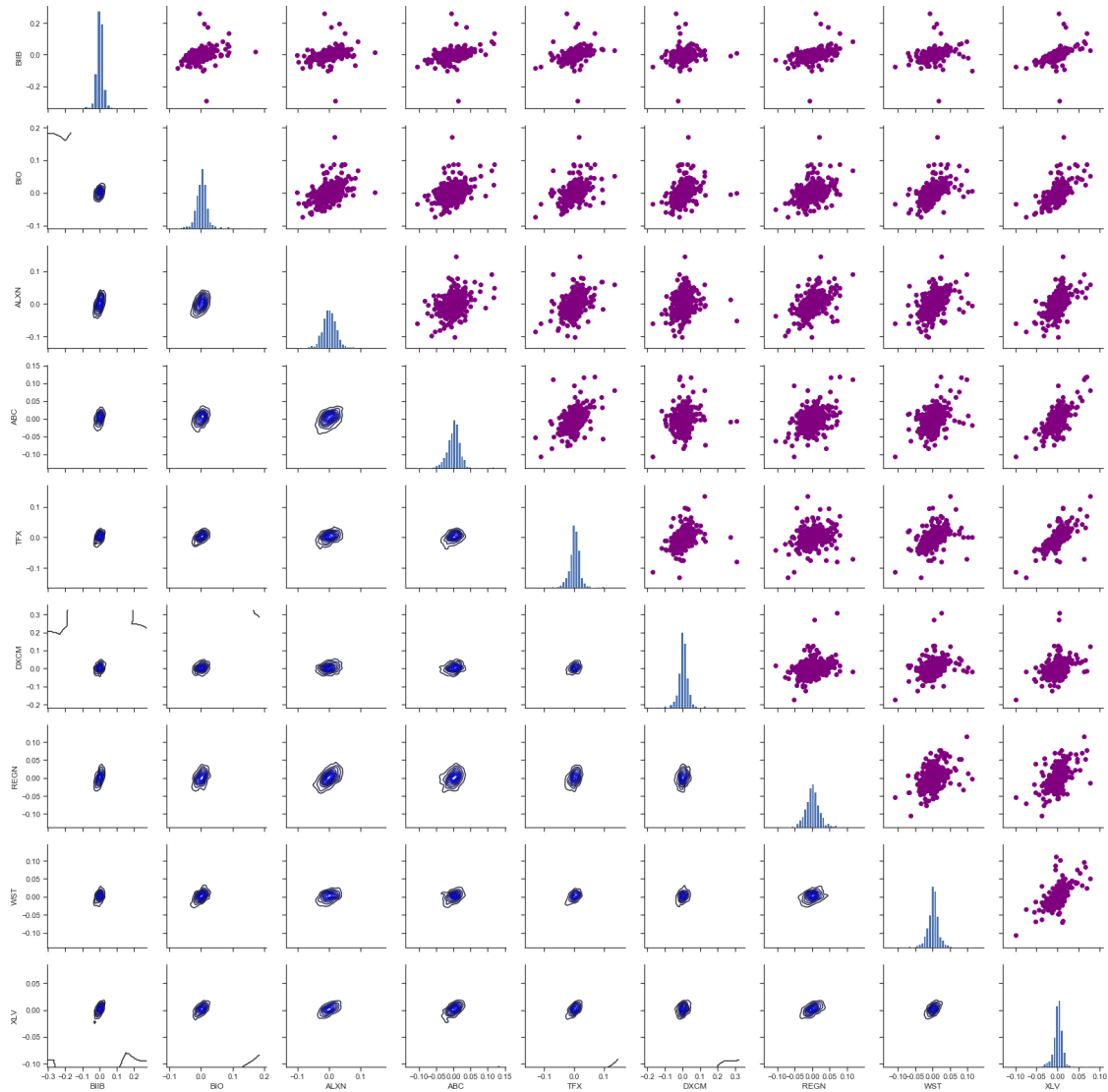


```
[15]: sns.set(style='ticks')
ax = sns.pairplot(stock_rets, diag_kind='hist')

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_returns)
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)
```

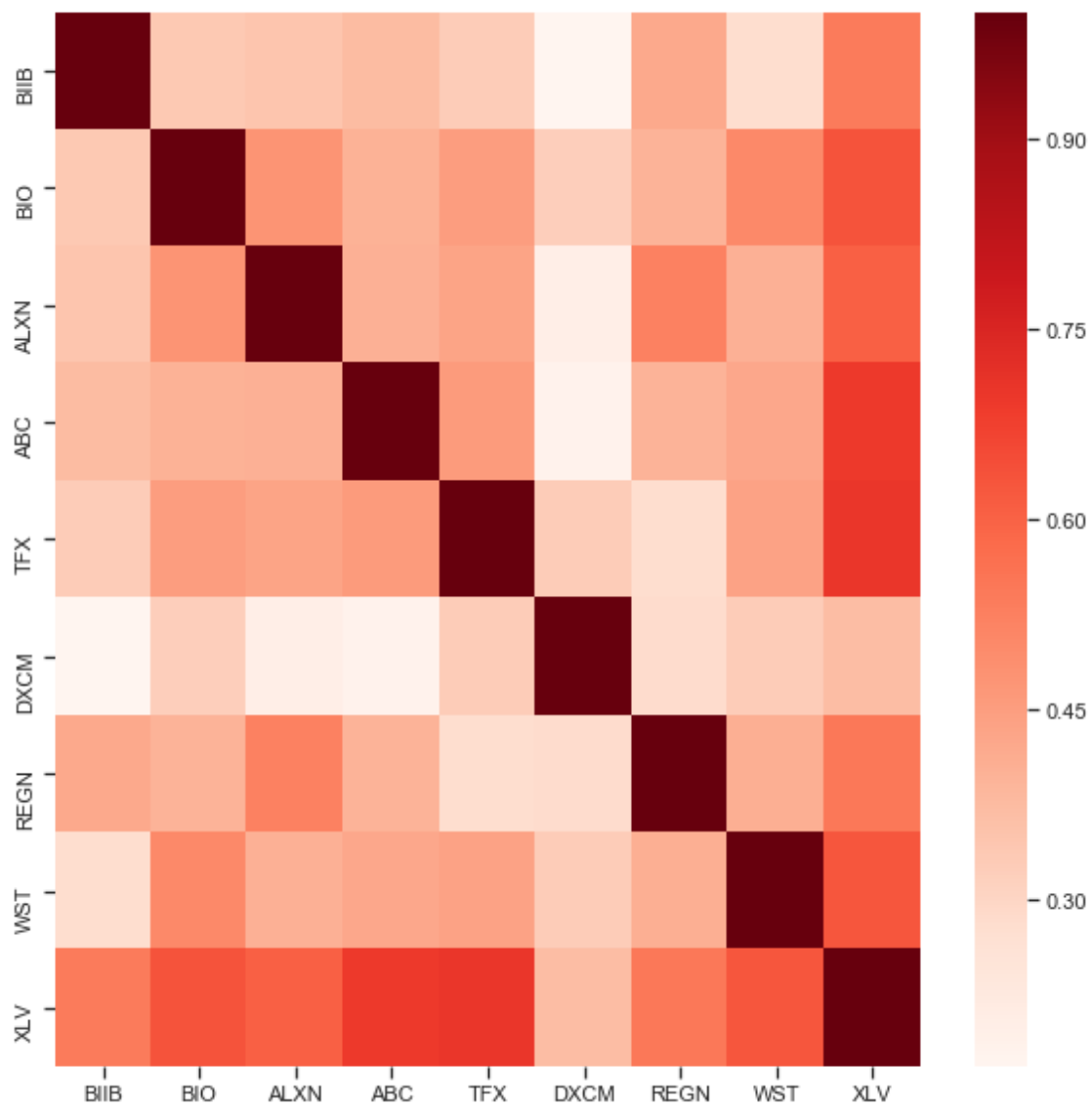


```
[17]: plt.figure(figsize=(10,10))
      corr = stock_rets.corr()

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

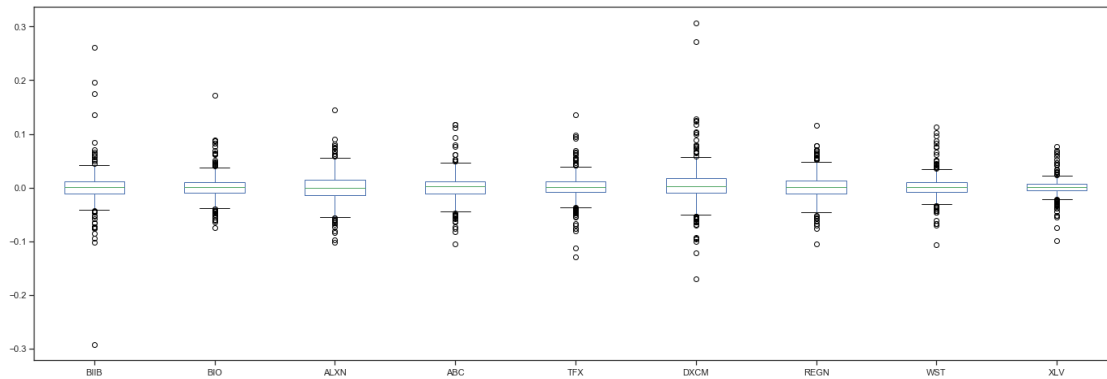
```
[17]: <matplotlib.axes._subplots.AxesSubplot at 0x21dad340f60>
```





```
[18]: # Box plot
stock_rets.plot(kind='box',figsize=(24,8))
```

```
[18]: <matplotlib.axes._subplots.AxesSubplot at 0x21db1079b38>
```

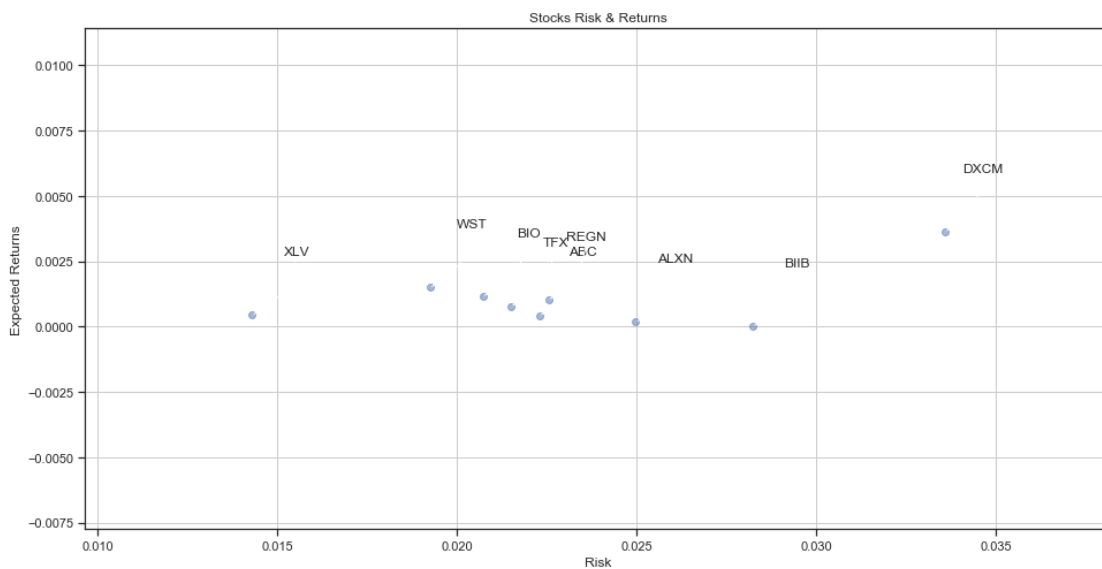


```
[19]: rets = stock_rets.dropna()

plt.figure(figsize=(16,8))
plt.scatter(rets.std(), rets.mean(),alpha = 0.5)

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

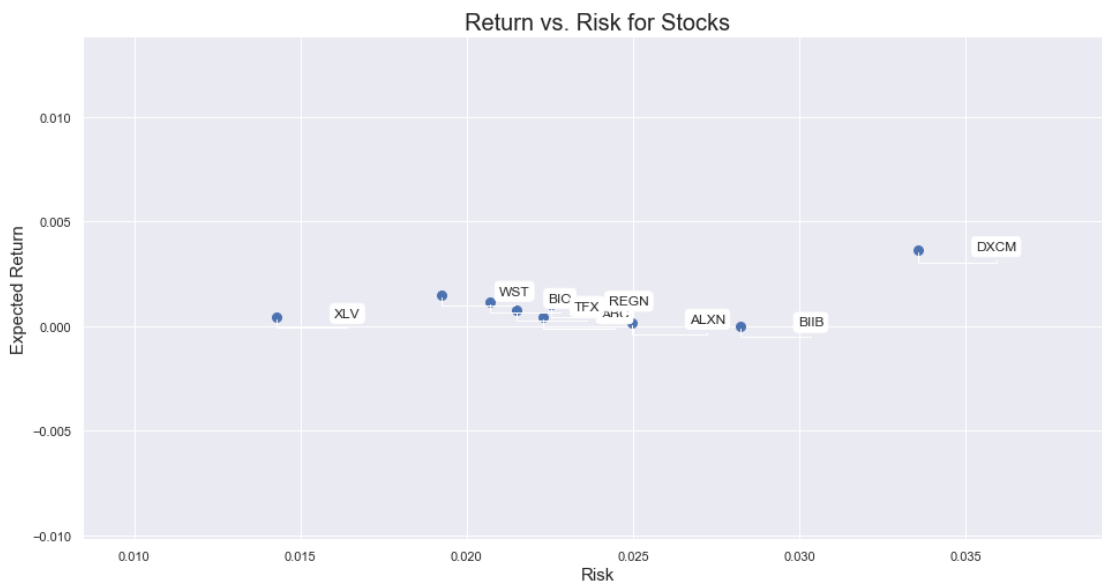
for label, x, y in zip(rets.columns, rets.std(), rets.mean()):
    plt.annotate(
        label,
        xy = (x, y), xytext = (50, 50),
        textcoords = 'offset points', ha = 'right', va = 'bottom',
        arrowprops = dict(arrowstyle = '-', connectionstyle = 'arc3,rad=-0.3'))
```



```
[20]: rets = stock_rets.dropna()
area = np.pi*20.0

sns.set(style='darkgrid')
plt.figure(figsize=(16,8))
plt.scatter(rets.std(), rets.mean(), s=area)
plt.xlabel("Risk", fontsize=15)
plt.ylabel("Expected Return", fontsize=15)
plt.title("Return vs. Risk for Stocks", fontsize=20)

for label, x, y in zip(rets.columns, rets.std(), rets.mean()) :
    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]: def annual_risk_return(stock_rets):
tradeoff = stock_rets.agg(["mean", "std"]).T
tradeoff.columns = ["Return", "Risk"]
tradeoff.Return = tradeoff.Return*252
tradeoff.Risk = tradeoff.Risk * np.sqrt(252)
return tradeoff
```

```
[22]: tradeoff = annual_risk_return(stock_rets)
tradeoff
```

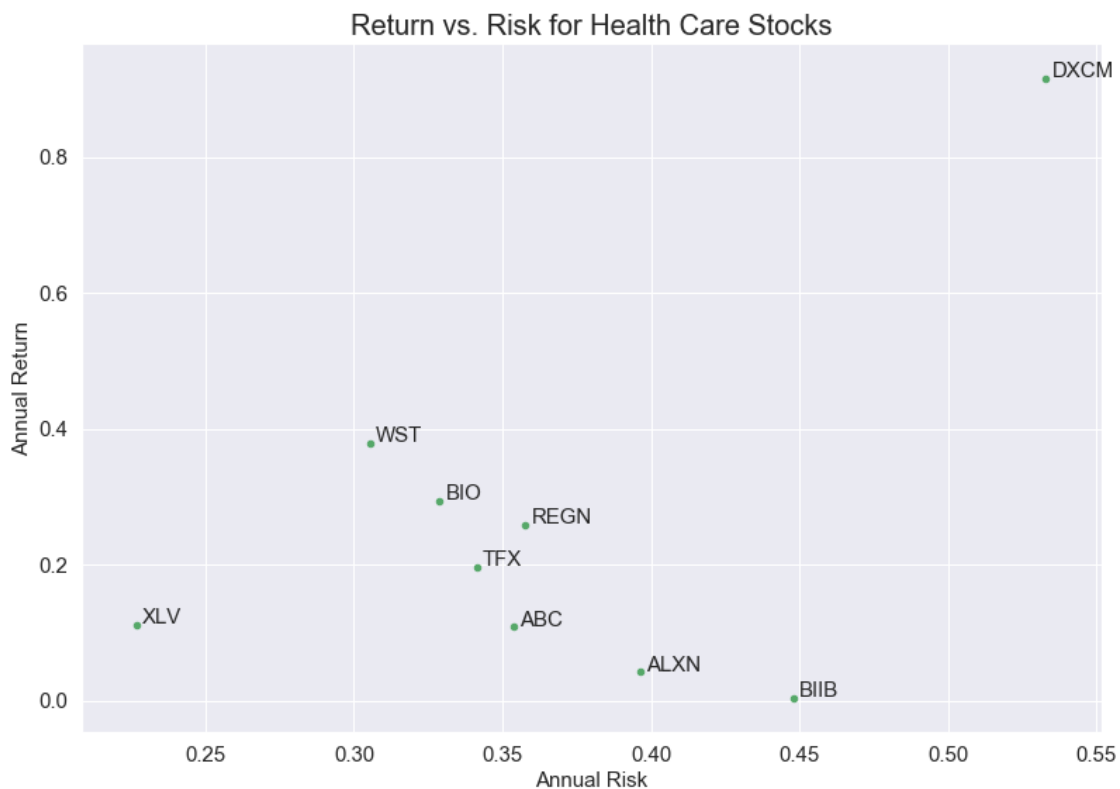
```
[22]:
```

	Return	Risk
BIIB	0.003970	0.448064
BIO	0.293049	0.328829
ALXN	0.042335	0.396347
ABC	0.108282	0.353835
TFX	0.197045	0.341278
DXCM	0.916019	0.533070
REGN	0.258684	0.357796
WST	0.378157	0.305488
XLV	0.111998	0.226870

```
[23]: import itertools

colors = itertools.cycle(["r", "b", "g"])

tradeoff.plot(x = "Risk", y = "Return", kind = "scatter", figsize = (13,9), s = 20,
              fontsize = 15, c='g')
for i in tradeoff.index:
    plt.annotate(i, xy=(tradeoff.loc[i, "Risk"]+0.002, tradeoff.loc[i, "Return"]+0.002), size = 15)
plt.xlabel("Annual Risk", fontsize = 15)
plt.ylabel("Annual Return", fontsize = 15)
plt.title("Return vs. Risk for " + title + " Stocks", fontsize = 20)
plt.show()
```



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

```
[24]: XLV    XLV    1.000000
      WST    WST    1.000000
      BIO    BIO    1.000000
      ALXN   ALXN    1.000000
      ABC    ABC    1.000000
      DXCM   DXCM    1.000000
      REGN   REGN    1.000000
      TFX    TFX    1.000000
      BIIB   BIIB    1.000000
      XLV    TFX    0.701636
      TFX    XLV    0.701636
      XLV    ABC    0.691927
      ABC    XLV    0.691927
      XLV    BIO    0.635489
      BIO    XLV    0.635489
      WST    XLV    0.627892
      XLV    WST    0.627892
      ALXN   XLV    0.604720
      XLV    ALXN    0.604720
           REGN    0.546016
      REGN   XLV    0.546016
      BIIB   XLV    0.541614
      XLV    BIIB    0.541614
      ALXN   REGN    0.525419
      REGN   ALXN    0.525419
      BIO    WST    0.505116
      WST    BIO    0.505116
      ALXN   BIO    0.474431
      BIO    ALXN    0.474431
      ABC    TFX    0.458145
           ...
      REGN   ABC    0.395685
      ABC    REGN    0.395685
      BIIB   ABC    0.374884
      ABC    BIIB    0.374884
      XLV    DXCM    0.369974
      DXCM   XLV    0.369974
      BIIB   ALXN    0.349674
      ALXN   BIIB    0.349674
      BIIB   BIO    0.340252
      BIO    BIIB    0.340252
```

```

DXCM WST      0.329310
WST  DXCM     0.329310
TFX  BIIB     0.329127
BIIB TFX      0.329127
DXCM TFX      0.328802
TFX  DXCM     0.328802
BIO  DXCM     0.322785
DXCM BIO      0.322785
      REGN     0.284672
REGN DXCM     0.284672
BIIB WST      0.279698
WST  BIIB     0.279698
REGN TFX      0.279387
TFX  REGN     0.279387
DXCM ALXN     0.201351
ALXN DXCM     0.201351
DXCM ABC      0.183582
ABC  DXCM     0.183582
DXCM BIIB     0.168099
BIIB DXCM     0.168099
Length: 81, dtype: float64

```

```

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

```

```

[25]:
      BIIB      BIO      ALXN      ABC      TFX      DXCM  \
Date
2018-01-03  0.558901  0.455003  0.441626  0.488483  0.517000  0.361343
2018-01-04  0.528931  0.270665  0.338926  0.461903  0.450131  0.147851
2018-01-05  0.541474  0.311920  0.415858  0.525956  0.543930  0.398579
2018-01-08  0.460443  0.334565  0.309921  0.545945  0.502635  0.443823
2018-01-09  0.564968  0.385607  0.483321  0.500449  0.539147  0.326358

      REGN      WST      XLV
Date
2018-01-03  0.608873  0.493806  0.615814
2018-01-04  0.351351  0.486931  0.569438
2018-01-05  0.501700  0.545563  0.609834
2018-01-08  0.327905  0.514091  0.540646
2018-01-09  0.429047  0.528790  0.628366

```

```

[26]: Normalized_Value.corr()

```

```

[26]:
      BIIB      BIO      ALXN      ABC      TFX      DXCM      REGN  \
BIIB  1.000000  0.340252  0.349674  0.374884  0.329127  0.168099  0.424550
BIO   0.340252  1.000000  0.474431  0.399701  0.452347  0.322785  0.398075

```

ALXN	0.349674	0.474431	1.000000	0.404539	0.435907	0.201351	0.525419
ABC	0.374884	0.399701	0.404539	1.000000	0.458145	0.183582	0.395685
TFX	0.329127	0.452347	0.435907	0.458145	1.000000	0.328802	0.279387
DXCM	0.168099	0.322785	0.201351	0.183582	0.328802	1.000000	0.284672
REGN	0.424550	0.398075	0.525419	0.395685	0.279387	0.284672	1.000000
WST	0.279698	0.505116	0.404966	0.427410	0.440578	0.329310	0.408327
XLV	0.541614	0.635489	0.604720	0.691927	0.701636	0.369974	0.546016

	WST	XLV
BIIB	0.279698	0.541614
BIO	0.505116	0.635489
ALXN	0.404966	0.604720
ABC	0.427410	0.691927
TFX	0.440578	0.701636
DXCM	0.329310	0.369974
REGN	0.408327	0.546016
WST	1.000000	0.627892
XLV	0.627892	1.000000

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

```
[27]: XLV    XLV    1.000000
WST    WST    1.000000
BIO    BIO    1.000000
ALXN   ALXN    1.000000
ABC    ABC    1.000000
DXCM   DXCM    1.000000
REGN   REGN    1.000000
TFX    TFX    1.000000
BIIB   BIIB    1.000000
XLV    TFX    0.701636
TFX    XLV    0.701636
XLV    ABC    0.691927
ABC    XLV    0.691927
XLV    BIO    0.635489
BIO    XLV    0.635489
WST    XLV    0.627892
XLV    WST    0.627892
ALXN   XLV    0.604720
XLV    ALXN    0.604720
        REGN    0.546016
REGN   XLV    0.546016
BIIB   XLV    0.541614
XLV    BIIB    0.541614
ALXN   REGN    0.525419
```

REGN	ALXN	0.525419
BIO	WST	0.505116
WST	BIO	0.505116
ALXN	BIO	0.474431
BIO	ALXN	0.474431
ABC	TFX	0.458145
...		
REGN	ABC	0.395685
ABC	REGN	0.395685
BIIB	ABC	0.374884
ABC	BIIB	0.374884
XLV	DXCM	0.369974
DXCM	XLV	0.369974
BIIB	ALXN	0.349674
ALXN	BIIB	0.349674
BIIB	BIO	0.340252
BIO	BIIB	0.340252
DXCM	WST	0.329310
WST	DXCM	0.329310
TFX	BIIB	0.329127
BIIB	TFX	0.329127
DXCM	TFX	0.328802
TFX	DXCM	0.328802
BIO	DXCM	0.322785
DXCM	BIO	0.322785
	REGN	0.284672
REGN	DXCM	0.284672
BIIB	WST	0.279698
WST	BIIB	0.279698
REGN	TFX	0.279387
TFX	REGN	0.279387
DXCM	ALXN	0.201351
ALXN	DXCM	0.201351
DXCM	ABC	0.183582
ABC	DXCM	0.183582
DXCM	BIIB	0.168099
BIIB	DXCM	0.168099

Length: 81, dtype: float64

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

Stock returns:  
BIIB      0.000016



```

BIO      0.001163
ALXN     0.000168
ABC      0.000430
TFX      0.000782
DXCM     0.003635
REGN     0.001027
WST      0.001501
XLV      0.000444
dtype: float64

```

---

```

Stock risks:
BIIB     0.028225
BIO      0.020714
ALXN     0.024968
ABC      0.022290
TFX      0.021499
DXCM     0.033580
REGN     0.022539
WST      0.019244
XLV      0.014291
dtype: float64

```

```

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

```

```

[29]:      Returns      Risk
      BIIB  0.000016  0.028225
      ALXN  0.000168  0.024968
      ABC   0.000430  0.022290
      XLV   0.000444  0.014291
      TFX   0.000782  0.021499
      REGN  0.001027  0.022539
      BIO   0.001163  0.020714
      WST   0.001501  0.019244
      DXCM  0.003635  0.033580

```

```

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

```

```

[30]:      Returns      Risk
      XLV   0.000444  0.014291
      WST   0.001501  0.019244
      BIO   0.001163  0.020714
      TFX   0.000782  0.021499
      ABC   0.000430  0.022290
      REGN  0.001027  0.022539

```

ALXN	0.000168	0.024968
BIIB	0.000016	0.028225
DXCM	0.003635	0.033580

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

```
[31]:      Returns      Risk  Sharpe Ratio
      BIIB  0.000016  0.028225   -0.353733
      BIO  0.001163  0.020714   -0.426620
      ALXN  0.000168  0.024968   -0.393791
      ABC  0.000430  0.022290   -0.429364
      TFX  0.000782  0.021499   -0.428777
      DXCM  0.003635  0.033580   -0.189546
      REGN  0.001027  0.022539   -0.398131
      WST  0.001501  0.019244   -0.441665
      XLV  0.000444  0.014291   -0.668620
```

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

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

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

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

```
[35]:      Returns      Risk  Sharpe Ratio  Max Returns  Min Returns  \
      BIIB  0.000016  0.028225   -0.353733    0.261107   -0.292305
      BIO  0.001163  0.020714   -0.426620    0.171687   -0.074554
      ALXN  0.000168  0.024968   -0.393791    0.145040   -0.101721
      ABC  0.000430  0.022290   -0.429364    0.118151   -0.105556
      TFX  0.000782  0.021499   -0.428777    0.135680   -0.129706
      DXCM  0.003635  0.033580   -0.189546    0.306475   -0.170970
      REGN  0.001027  0.022539   -0.398131    0.115373   -0.104893
      WST  0.001501  0.019244   -0.441665    0.112170   -0.107043
      XLV  0.000444  0.014291   -0.668620    0.077057   -0.098610
```

	Median Returns	Total Return
BIIB	0.000733	-0.155871
BIO	0.001213	1.114652
ALXN	0.000041	1.357753
ABC	0.001600	1.851479
TFX	0.001447	-0.098507
DXCM	0.002311	0.961199

REGN	0.000971	2.465960
WST	0.001218	3.163829
XLV	0.001136	0.982096

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

```
[36]:
```

	Returns	Risk	Sharpe Ratio	Max Returns	Min Returns	\
BIIB	0.000016	0.028225	-0.353733	0.261107	-0.292305	
BIO	0.001163	0.020714	-0.426620	0.171687	-0.074554	
ALXN	0.000168	0.024968	-0.393791	0.145040	-0.101721	
ABC	0.000430	0.022290	-0.429364	0.118151	-0.105556	
TFX	0.000782	0.021499	-0.428777	0.135680	-0.129706	
DXCM	0.003635	0.033580	-0.189546	0.306475	-0.170970	
REGN	0.001027	0.022539	-0.398131	0.115373	-0.104893	
WST	0.001501	0.019244	-0.441665	0.112170	-0.107043	
XLV	0.000444	0.014291	-0.668620	0.077057	-0.098610	

	Median Returns	Total Return	Average Return Days
BIIB	0.000733	-0.155871	-0.000002
BIO	0.001213	1.114652	0.000012
ALXN	0.000041	1.357753	0.000015
ABC	0.001600	1.851479	0.000020
TFX	0.001447	-0.098507	-0.000001
DXCM	0.002311	0.961199	0.000011
REGN	0.000971	2.465960	0.000027
WST	0.001218	3.163829	0.000034
XLV	0.001136	0.982096	0.000011

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

```
[37]:
```

	Returns	Risk	Sharpe Ratio	Max Returns	Min Returns	\
BIIB	0.000016	0.028225	-0.353733	0.261107	-0.292305	
BIO	0.001163	0.020714	-0.426620	0.171687	-0.074554	
ALXN	0.000168	0.024968	-0.393791	0.145040	-0.101721	
ABC	0.000430	0.022290	-0.429364	0.118151	-0.105556	
TFX	0.000782	0.021499	-0.428777	0.135680	-0.129706	
DXCM	0.003635	0.033580	-0.189546	0.306475	-0.170970	
REGN	0.001027	0.022539	-0.398131	0.115373	-0.104893	
WST	0.001501	0.019244	-0.441665	0.112170	-0.107043	
XLV	0.000444	0.014291	-0.668620	0.077057	-0.098610	

	Median Returns	Total Return	Average Return Days	CAGR
BIIB	0.000733	-0.155871	-0.000002	-0.064880

BIO	0.001213	1.114652	0.000012	0.179848
ALXN	0.000041	1.357753	0.000015	-0.024517
ABC	0.001600	1.851479	0.000020	0.032200
TFX	0.001447	-0.098507	-0.000001	0.100373
DXCM	0.002311	0.961199	0.000011	0.709864
REGN	0.000971	2.465960	0.000027	0.143850
WST	0.001218	3.163829	0.000034	0.256989
XLV	0.001136	0.982096	0.000011	0.061239

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

```
[38]:
```

	Returns	Risk	Sharpe Ratio	Max Returns	Min Returns	\
BIIB	0.000016	0.028225	-0.353733	0.261107	-0.292305	
TFX	0.000782	0.021499	-0.428777	0.135680	-0.129706	
DXCM	0.003635	0.033580	-0.189546	0.306475	-0.170970	
XLV	0.000444	0.014291	-0.668620	0.077057	-0.098610	
BIO	0.001163	0.020714	-0.426620	0.171687	-0.074554	
ALXN	0.000168	0.024968	-0.393791	0.145040	-0.101721	
ABC	0.000430	0.022290	-0.429364	0.118151	-0.105556	
REGN	0.001027	0.022539	-0.398131	0.115373	-0.104893	
WST	0.001501	0.019244	-0.441665	0.112170	-0.107043	

	Median Returns	Total Return	Average Return Days	CAGR
BIIB	0.000733	-0.155871	-0.000002	-0.064880
TFX	0.001447	-0.098507	-0.000001	0.100373
DXCM	0.002311	0.961199	0.000011	0.709864
XLV	0.001136	0.982096	0.000011	0.061239
BIO	0.001213	1.114652	0.000012	0.179848
ALXN	0.000041	1.357753	0.000015	-0.024517
ABC	0.001600	1.851479	0.000020	0.032200
REGN	0.000971	2.465960	0.000027	0.143850
WST	0.001218	3.163829	0.000034	0.256989