# AI_Learning_Portfolio

September 29, 2021

## 1 Artificial Intelligence Portfolio Risk and Returns

[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")

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

[2]:
```
# input
# A.I. Stock
symbols =␣
 ↪['TCEHY','NVDA','MSFT','TWLO','AMZN','GOOGL','NFLX','CRM','DE','SPLK','VERI','SNPS','QUIK',
 ↪AX']
start = '2016-01-01'
end = '2019-12-28'
```

[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?
3 years
```

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

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

[6]:
```
1453
```

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

[7]:

| Date | TCEHY | NVDA | MSFT | TWLO | AMZN | GOOGL | \ |
|---|---|---|---|---|---|---|---|
| 2016-01-04 | 18.936167 | 31.724598 | 50.536495 | NaN | 636.989990 | 759.440002 | |
| 2016-01-05 | 18.886673 | 32.234219 | 50.767044 | NaN | 633.789978 | 761.530029 | |
| 2016-01-06 | 18.470930 | 30.901340 | 49.844841 | NaN | 632.650024 | 759.330017 | |
| 2016-01-07 | 17.728529 | 29.676266 | 48.111115 | NaN | 607.940002 | 741.000000 | |
| 2016-01-08 | 17.787920 | 29.039225 | 48.258663 | NaN | 607.049988 | 730.909973 | |

| Date | NFLX | CRM | DE | SPLK | VERI | SNPS | \ |
|---|---|---|---|---|---|---|---|
| 2016-01-04 | 109.959999 | 76.709999 | 70.244408 | 57.650002 | NaN | 44.919998 | |
| 2016-01-05 | 107.660004 | 77.050003 | 70.650658 | 57.200001 | NaN | 44.970001 | |
| 2016-01-06 | 117.680000 | 76.290001 | 69.856628 | 55.189999 | NaN | 44.310001 | |
| 2016-01-07 | 114.559998 | 74.300003 | 69.238022 | 52.980000 | NaN | 43.279999 | |
| 2016-01-08 | 111.389999 | 73.230003 | 68.102364 | 52.009998 | NaN | 42.349998 | |

| Date | QUIK | BRN.AX |
|---|---|---|
| 2016-01-04 | 17.639999 | 0.24090 |
| 2016-01-05 | 19.320000 | 0.23627 |
| 2016-01-06 | 17.080000 | 0.23627 |

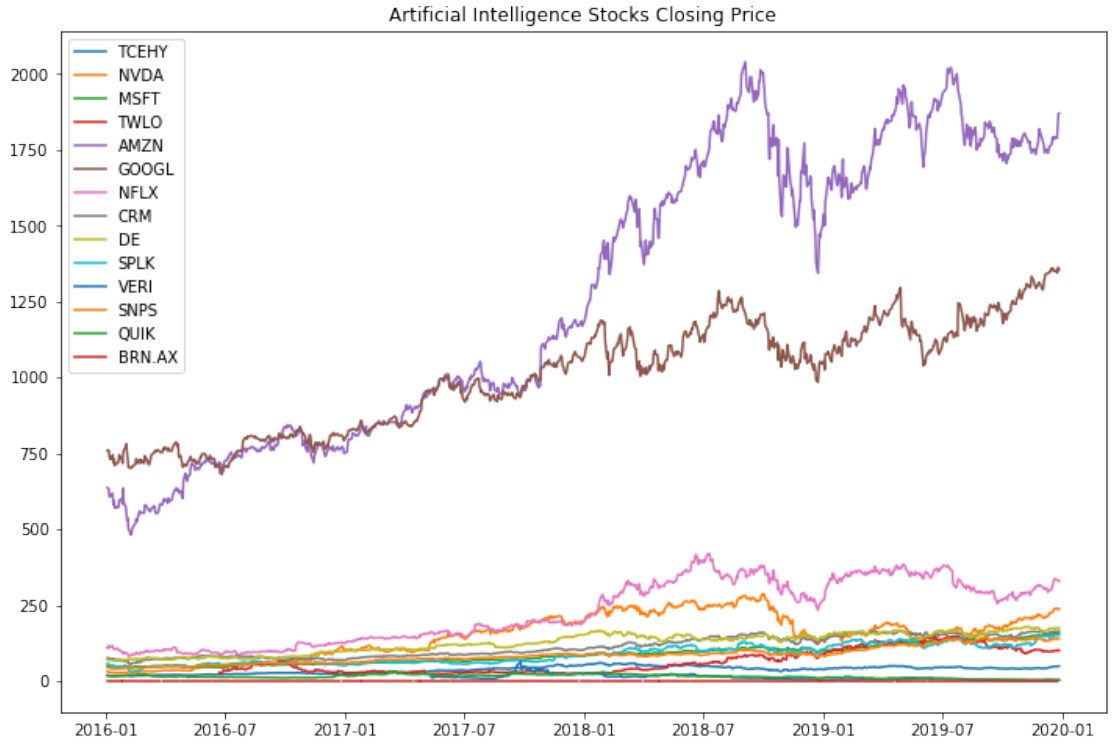
```
2016-01-07  17.080000  0.24554
2016-01-08  16.799999  0.23164
```

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

[8]:
```
                TCEHY        NVDA        MSFT        TWLO         AMZN  \
Date
2019-12-20  48.150002  239.369995  157.410004  100.260002  1786.500000
2019-12-23  48.459999  238.820007  157.410004  100.389999  1793.000000
2019-12-24  48.340000  238.619995  157.380005  100.550003  1789.209961
2019-12-26  48.810001  239.190002  158.669998  102.610001  1868.770020
2019-12-27  49.240002  236.869995  158.960007  100.430000  1869.800049

                 GOOGL        NFLX         CRM          DE        SPLK  VERI  \
Date
2019-12-20  1351.219971  336.899994  164.550003  174.649994  150.960007  2.61
2019-12-23  1350.630005  333.100006  163.740005  175.050003  150.050003  2.60
2019-12-24  1344.430054  333.200012  163.250000  174.500000  150.350006  2.64
2019-12-26  1362.469971  332.630005  164.509995  174.800003  151.919998  2.52
2019-12-27  1354.640015  329.089996  164.979996  175.809998  151.509995  2.55

                 SNPS  QUIK  BRN.AX
Date
2019-12-20  139.880005  4.62  0.0420
2019-12-23  139.910004  4.20  0.0425
2019-12-24  138.210007  4.06  0.0420
2019-12-26  140.070007  4.43     NaN
2019-12-27  140.619995  4.58  0.0440
```

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

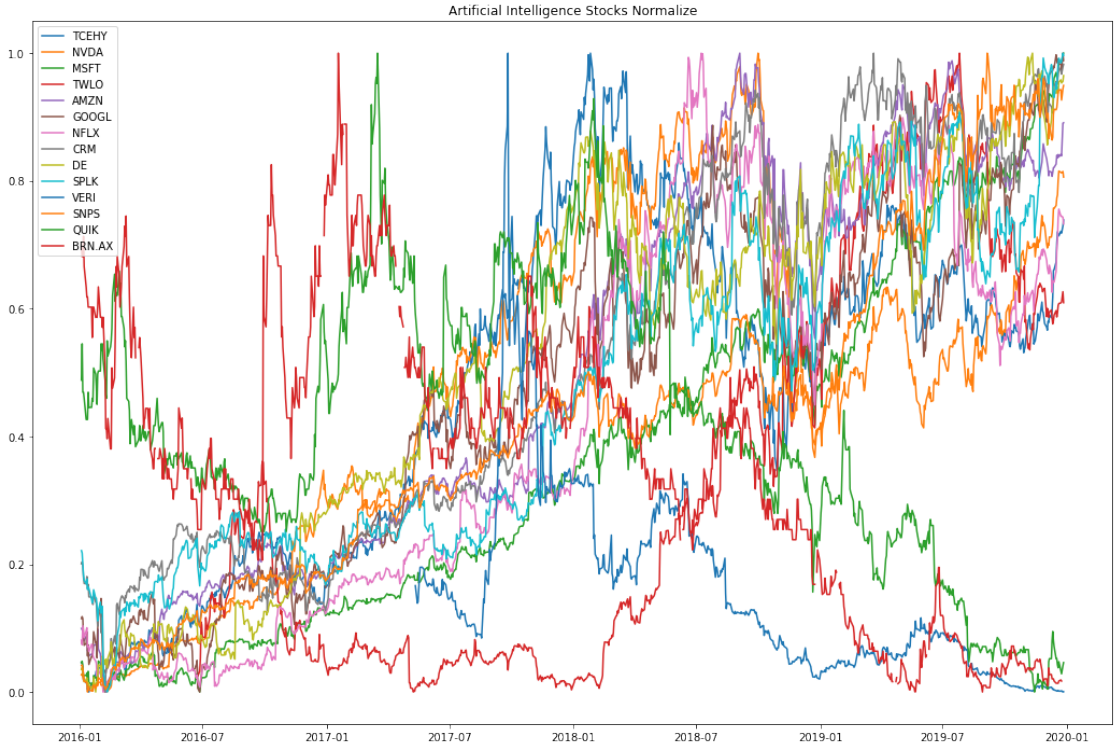
[9]:
```
<matplotlib.legend.Legend at 0x15e4d602c18>
```




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

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

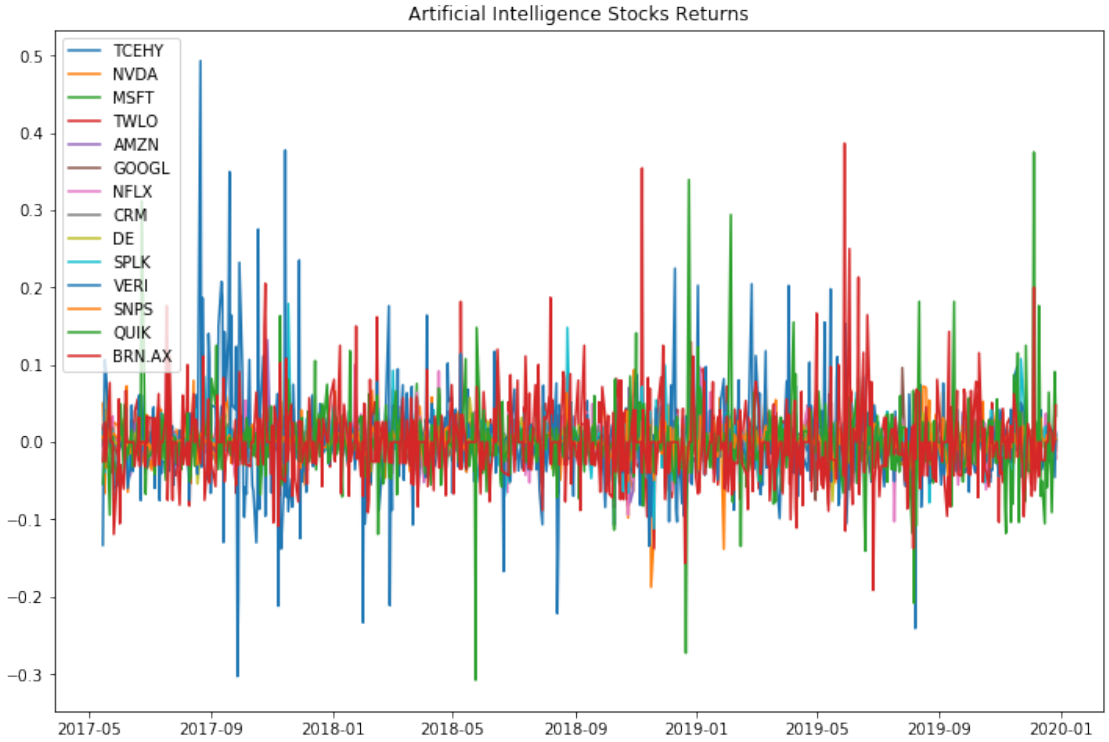
[11]:
```
<matplotlib.legend.Legend at 0x15e4e87a048>
```




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

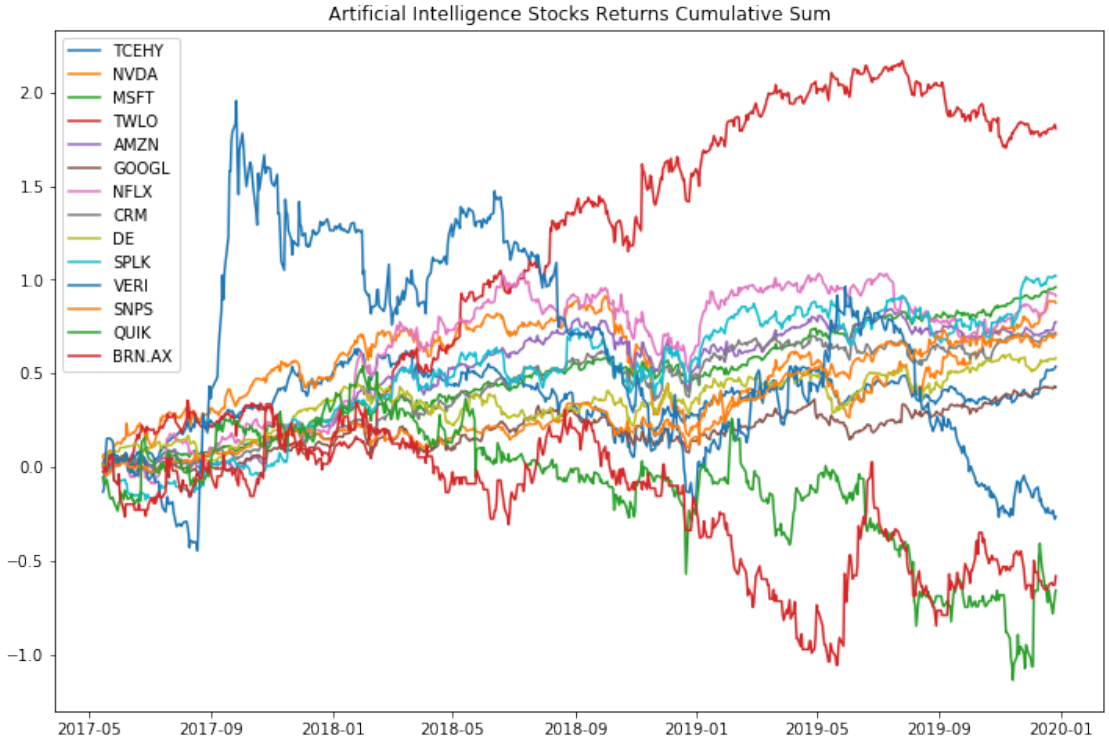
[13]:
```
plt.figure(figsize=(12,8))
plt.plot(stock_rets)
plt.title('Artificial Intelligence Stocks Returns')
plt.legend(labels=stock_rets.columns)
```

[13]: <matplotlib.legend.Legend at 0x15e4e68cf28>

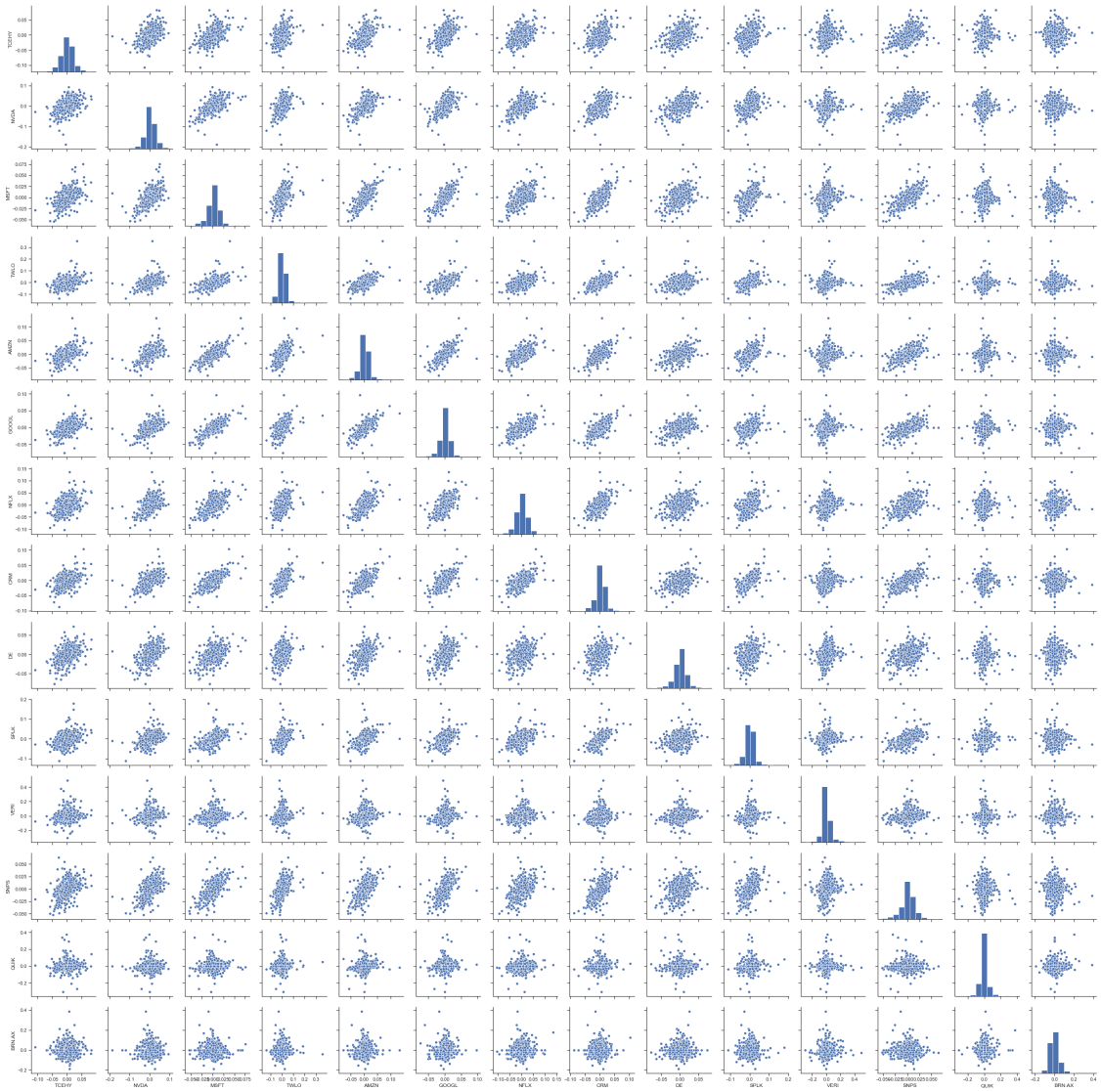



[14]:
```
plt.figure(figsize=(12,8))
plt.plot(stock_rets.cumsum())
plt.title('Artificial Intelligence Stocks Returns Cumulative Sum')
plt.legend(labels=stock_rets.columns)
```

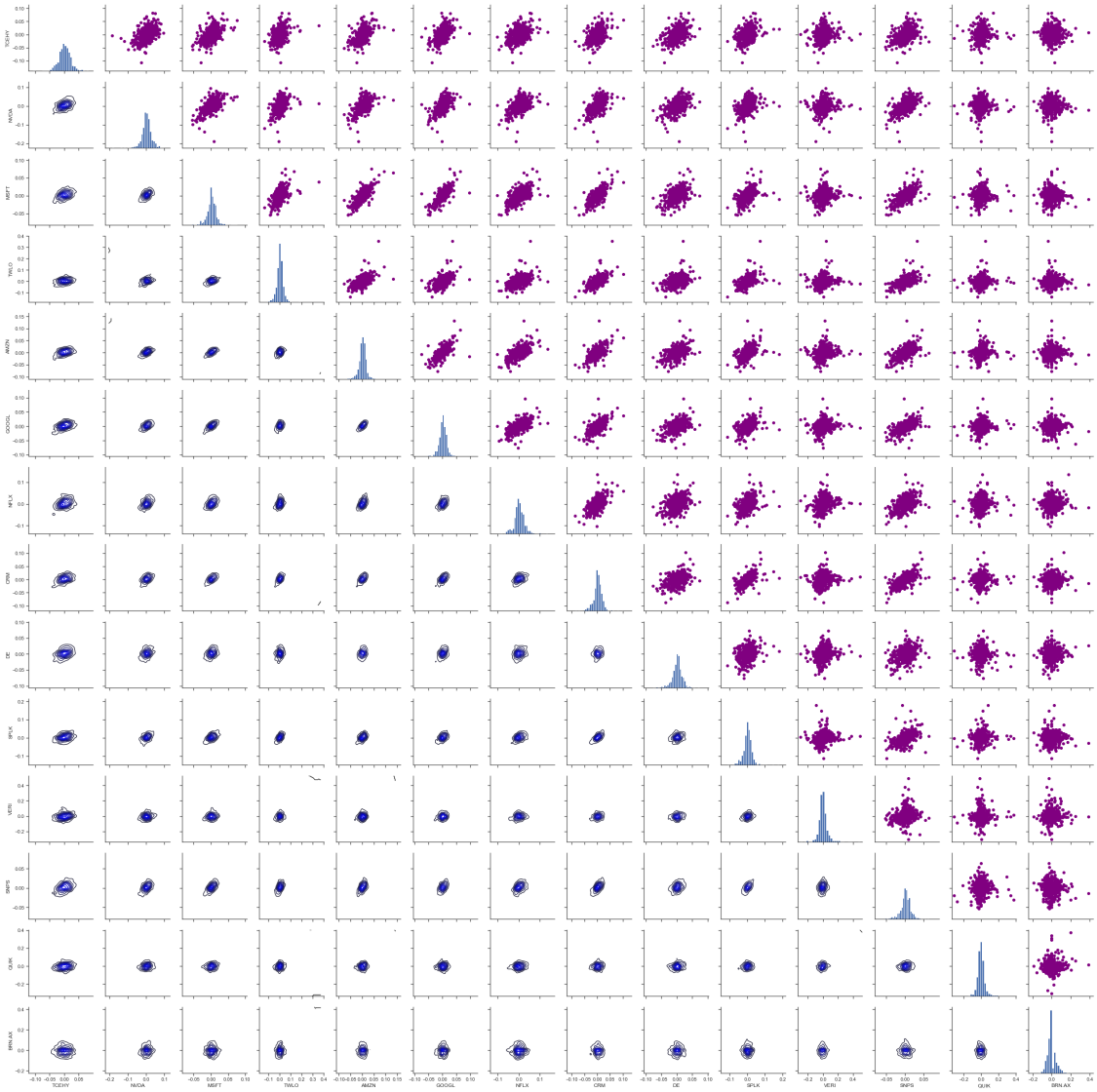
[14]: <matplotlib.legend.Legend at 0x15e4e703d30>




[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)
```

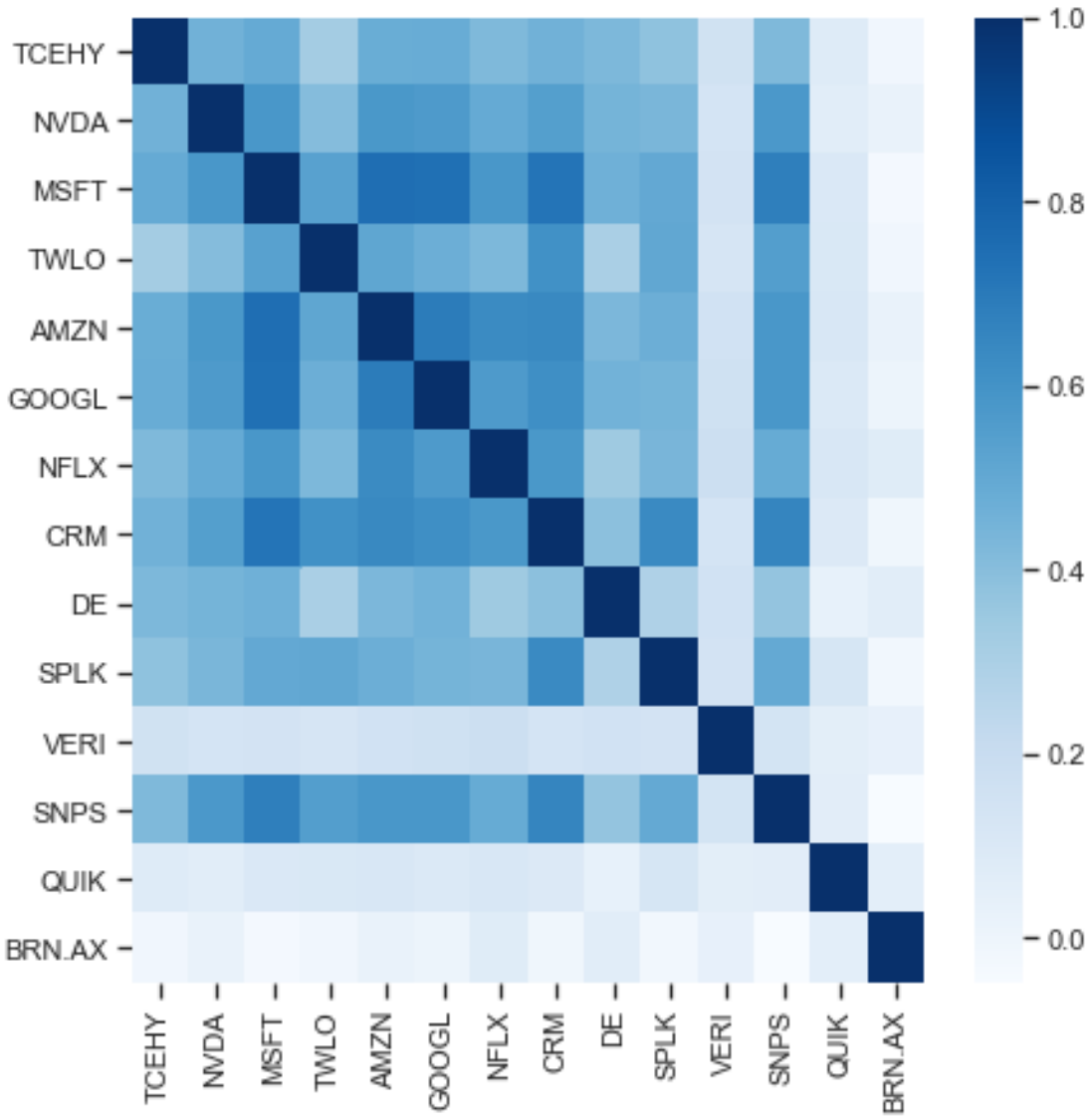


[16]:
```
ax = sns.PairGrid(stock_rets)
ax.map_upper(plt.scatter, color='purple')
ax.map_lower(sns.kdeplot, color='blue')
ax.map_diag(plt.hist, bins=30)
for i in range(nplot) :
    for j in range(nplot) :
        ax.axes[i, j].locator_params(axis='x', nbins=6, tight=True)
```



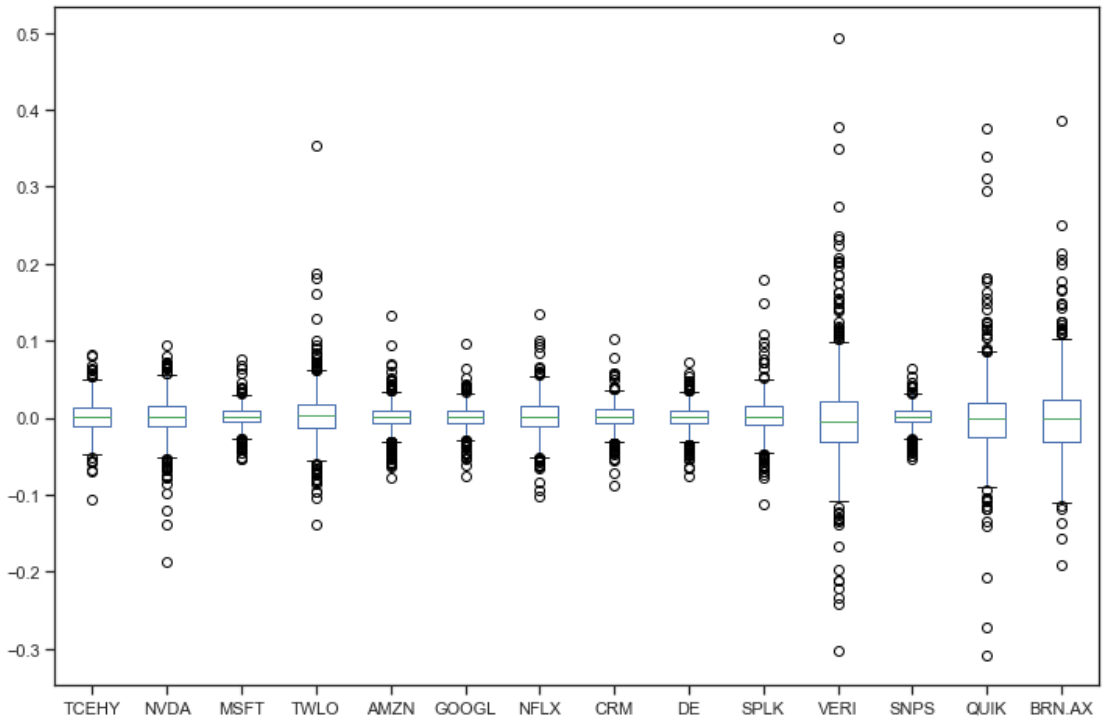
[17]:
```
plt.figure(figsize=(7,7))
corr = stock_rets.corr()

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

[17]: <matplotlib.axes._subplots.AxesSubplot at 0x15e5e455ba8>

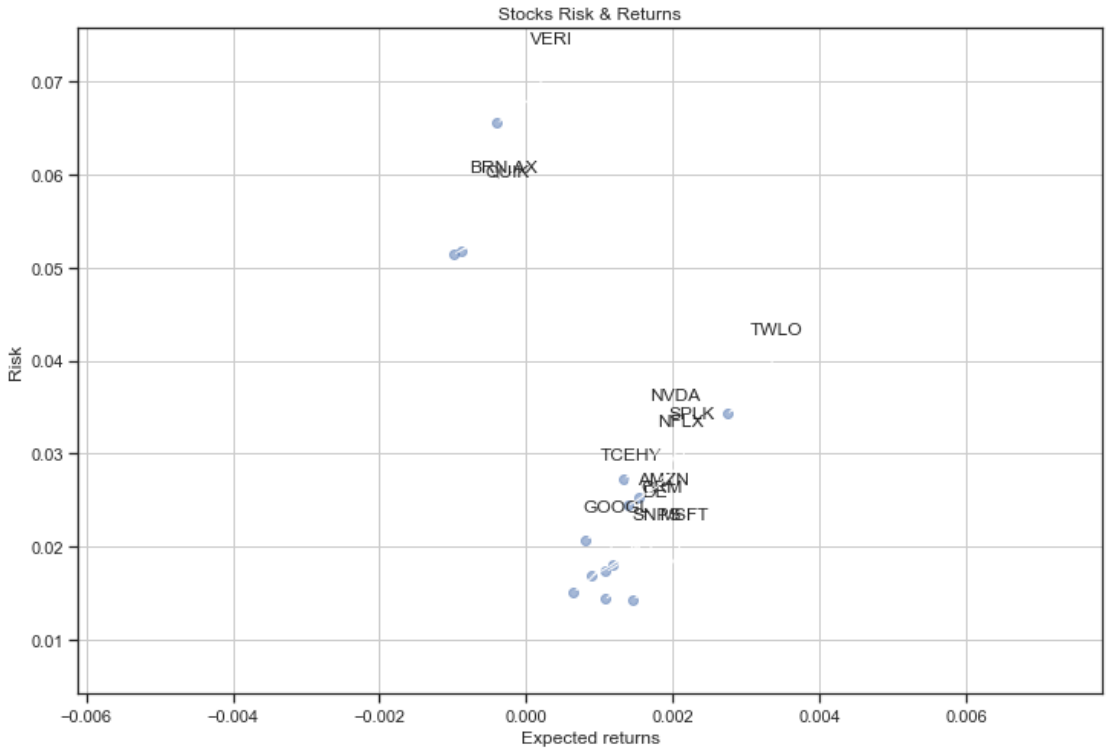



[18]:
```
# Box plot
stock_rets.plot(kind='box',figsize=(12,8))
```

[18]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x15e56761978>
```




[19]:
```
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]:
```
BRN.AX  BRN.AX    1.000000
QUIK    QUIK      1.000000
NVDA    NVDA      1.000000
MSFT    MSFT      1.000000
TWLO    TWLO      1.000000
AMZN    AMZN      1.000000
GOOGL   GOOGL     1.000000
NFLX    NFLX      1.000000
CRM     CRM       1.000000
DE      DE        1.000000
SPLK    SPLK      1.000000
VERI    VERI      1.000000
SNPS    SNPS      1.000000
TCEHY   TCEHY     1.000000
AMZN    MSFT      0.749717
MSFT    AMZN      0.749717
        GOOGL     0.741069
GOOGL   MSFT      0.741069
MSFT    CRM       0.723773
```

```
CRM     MSFT      0.723773
AMZN    GOOGL     0.693280
GOOGL   AMZN      0.693280
MSFT    SNPS      0.680529
SNPS    MSFT      0.680529
        CRM       0.659417
CRM     SNPS      0.659417
AMZN    CRM       0.640889
CRM     AMZN      0.640889
SPLK    CRM       0.635718
CRM     SPLK      0.635718
                    …
QUIK    NVDA      0.066894
NVDA    QUIK      0.066894
QUIK    SNPS      0.063031
SNPS    QUIK      0.063031
QUIK    VERI      0.057122
VERI    QUIK      0.057122
QUIK    BRN.AX    0.054093
BRN.AX  QUIK      0.054093
SNPS    BRN.AX    0.049678
BRN.AX  SNPS      0.049678
        VERI      0.037270
VERI    BRN.AX    0.037270
QUIK    DE        0.036152
DE      QUIK      0.036152
BRN.AX  AMZN      0.027664
AMZN    BRN.AX    0.027664
MSFT    BRN.AX    0.027661
BRN.AX  MSFT      0.027661
        NVDA      0.027138
NVDA    BRN.AX    0.027138
SPLK    BRN.AX    0.014774
BRN.AX  SPLK      0.014774
        TWLO      0.010263
TWLO    BRN.AX    0.010263
BRN.AX  TCEHY     0.009593
TCEHY   BRN.AX    0.009593
BRN.AX  GOOGL     0.009283
GOOGL   BRN.AX    0.009283
BRN.AX  CRM       0.005423
CRM     BRN.AX    0.005423
Length: 196, dtype: float64
```

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

[22]:

| Date | TCEHY | NVDA | MSFT | TWLO | AMZN | GOOGL |
|---|---|---|---|---|---|---|
| 2017-05-15 | 0.604207 | 0.845541 | 0.423468 | 0.305080 | 0.355014 | 0.463089 |
| 2017-05-16 | 0.543056 | 0.733211 | 0.572682 | 0.328186 | 0.411922 | 0.470960 |
| 2017-05-17 | 0.541203 | 0.430727 | 0.204026 | 0.273956 | 0.266867 | 0.302275 |
| 2017-05-18 | 0.673671 | 0.815984 | 0.444054 | 0.243629 | 0.440813 | 0.489778 |
| 2017-05-19 | 0.680667 | 0.749147 | 0.415574 | 0.345561 | 0.378423 | 0.463642 |

| Date | NFLX | CRM | DE | SPLK | VERI | SNPS |
|---|---|---|---|---|---|---|
| 2017-05-15 | 0.410687 | 0.503740 | 0.552379 | 0.431741 | 0.213241 | 0.514984 |
| 2017-05-16 | 0.415309 | 0.455829 | 0.570345 | 0.411476 | 0.397156 | 0.470888 |
| 2017-05-17 | 0.267741 | 0.346623 | 0.420149 | 0.252423 | 0.514054 | 0.255375 |
| 2017-05-18 | 0.499835 | 0.453364 | 0.478520 | 0.339598 | 0.499247 | 0.162781 |
| 2017-05-19 | 0.466913 | 0.437746 | 1.000000 | 0.417436 | 0.470014 | 0.459793 |

| Date | QUIK | BRN.AX |
|---|---|---|
| 2017-05-15 | 0.371527 | 0.288117 |
| 2017-05-16 | 0.398390 | 0.331400 |
| 2017-05-17 | 0.450704 | 0.375793 |
| 2017-05-18 | 0.450704 | 0.288117 |
| 2017-05-19 | 0.483255 | 0.331400 |

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

[23]:

| | TCEHY | NVDA | MSFT | TWLO | AMZN | GOOGL | NFLX |
|---|---|---|---|---|---|---|---|
| TCEHY | 1.000000 | 0.461313 | 0.495002 | 0.327239 | 0.480675 | 0.486139 | 0.423656 |
| NVDA | 0.461313 | 1.000000 | 0.582348 | 0.406732 | 0.579325 | 0.566149 | 0.492555 |
| MSFT | 0.495002 | 0.582348 | 1.000000 | 0.533268 | 0.749717 | 0.741069 | 0.582075 |
| TWLO | 0.327239 | 0.406732 | 0.533268 | 1.000000 | 0.512671 | 0.473900 | 0.426523 |
| AMZN | 0.480675 | 0.579325 | 0.749717 | 0.512671 | 1.000000 | 0.693280 | 0.631191 |
| GOOGL | 0.486139 | 0.566149 | 0.741069 | 0.473900 | 0.693280 | 1.000000 | 0.567633 |
| NFLX | 0.423656 | 0.492555 | 0.582075 | 0.426523 | 0.631191 | 0.567633 | 1.000000 |
| CRM | 0.460030 | 0.545321 | 0.723773 | 0.609668 | 0.640889 | 0.616621 | 0.579740 |
| DE | 0.426640 | 0.448220 | 0.466336 | 0.303066 | 0.430530 | 0.457178 | 0.341174 |
| SPLK | 0.382437 | 0.434418 | 0.501719 | 0.505737 | 0.473525 | 0.447449 | 0.441888 |
| VERI | 0.158167 | 0.138721 | 0.144108 | 0.127248 | 0.152899 | 0.165993 | 0.181313 |
| SNPS | 0.423648 | 0.575646 | 0.680529 | 0.550771 | 0.582122 | 0.585296 | 0.488839 |
| QUIK | 0.085437 | 0.066894 | 0.102503 | 0.108106 | 0.118188 | 0.098187 | 0.117592 |
| BRN.AX | -0.009593 | 0.027138 | -0.027661 | -0.010263 | 0.027664 | 0.009283 | 0.075573 |

| | CRM | DE | SPLK | VERI | SNPS | QUIK | BRN.AX |
|---|---|---|---|---|---|---|---|
| TCEHY | 0.460030 | 0.426640 | 0.382437 | 0.158167 | 0.423648 | 0.085437 | -0.009593 |
| NVDA | 0.545321 | 0.448220 | 0.434418 | 0.138721 | 0.575646 | 0.066894 | 0.027138 |
| MSFT | 0.723773 | 0.466336 | 0.501719 | 0.144108 | 0.680529 | 0.102503 | -0.027661 |
| TWLO | 0.609668 | 0.303066 | 0.505737 | 0.127248 | 0.550771 | 0.108106 | -0.010263 |

```
AMZN     0.640889  0.430530  0.473525  0.152899  0.582122  0.118188  0.027664
GOOGL    0.616621  0.457178  0.447449  0.165993  0.585296  0.098187  0.009283
NFLX     0.579740  0.341174  0.441888  0.181313  0.488839  0.117592  0.075573
CRM      1.000000  0.391727  0.635718  0.138729  0.659417  0.094335 -0.005423
DE       0.391727  1.000000  0.286567  0.152714  0.371667  0.036152  0.067035
SPLK     0.635718  0.286567  1.000000  0.143642  0.499238  0.126354 -0.014774
VERI     0.138729  0.152714  0.143642  1.000000  0.141900  0.057122  0.037270
SNPS     0.659417  0.371667  0.499238  0.141900  1.000000  0.063031 -0.049678
QUIK     0.094335  0.036152  0.126354  0.057122  0.063031  1.000000  0.054093
BRN.AX -0.005423  0.067035 -0.014774  0.037270 -0.049678  0.054093  1.000000
```

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

[24]:
```
BRN.AX  BRN.AX    1.000000
QUIK    QUIK      1.000000
NVDA    NVDA      1.000000
MSFT    MSFT      1.000000
TWLO    TWLO      1.000000
AMZN    AMZN      1.000000
GOOGL   GOOGL     1.000000
NFLX    NFLX      1.000000
CRM     CRM       1.000000
DE      DE        1.000000
SPLK    SPLK      1.000000
VERI    VERI      1.000000
SNPS    SNPS      1.000000
TCEHY   TCEHY     1.000000
AMZN    MSFT      0.749717
MSFT    AMZN      0.749717
        GOOGL     0.741069
GOOGL   MSFT      0.741069
MSFT    CRM       0.723773
CRM     MSFT      0.723773
AMZN    GOOGL     0.693280
GOOGL   AMZN      0.693280
MSFT    SNPS      0.680529
SNPS    MSFT      0.680529
        CRM       0.659417
CRM     SNPS      0.659417
AMZN    CRM       0.640889
CRM     AMZN      0.640889
SPLK    CRM       0.635718
CRM     SPLK      0.635718
                    …
QUIK    NVDA      0.066894
```

```
NVDA    QUIK      0.066894
QUIK    SNPS      0.063031
SNPS    QUIK      0.063031
QUIK    VERI      0.057122
VERI    QUIK      0.057122
QUIK    BRN.AX    0.054093
BRN.AX  QUIK      0.054093
SNPS    BRN.AX    0.049678
BRN.AX  SNPS      0.049678
        VERI      0.037270
VERI    BRN.AX    0.037270
QUIK    DE        0.036152
DE      QUIK      0.036152
BRN.AX  AMZN      0.027664
AMZN    BRN.AX    0.027664
MSFT    BRN.AX    0.027661
BRN.AX  MSFT      0.027661
        NVDA      0.027138
NVDA    BRN.AX    0.027138
SPLK    BRN.AX    0.014774
BRN.AX  SPLK      0.014774
        TWLO      0.010263
TWLO    BRN.AX    0.010263
BRN.AX  TCEHY     0.009593
TCEHY   BRN.AX    0.009593
BRN.AX  GOOGL     0.009283
GOOGL   BRN.AX    0.009283
BRN.AX  CRM       0.005423
CRM     BRN.AX    0.005423
Length: 196, dtype: float64
```

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

```
Stock returns:
TCEHY     0.000811
NVDA      0.001325
MSFT      0.001452
TWLO      0.002733
AMZN      0.001170
GOOGL     0.000644
NFLX      0.001380
CRM       0.001084
DE        0.000880
```

```
SPLK      0.001542
VERI     -0.000402
SNPS      0.001067
QUIK     -0.000995
BRN.AX   -0.000880
dtype: float64
--------------------------------------------------
Stock risks:
TCEHY     0.020757
NVDA      0.027282
MSFT      0.014360
TWLO      0.034306
AMZN      0.018133
GOOGL     0.015159
NFLX      0.024406
CRM       0.017334
DE        0.016866
SPLK      0.025274
VERI      0.065553
SNPS      0.014377
QUIK      0.051383
BRN.AX    0.051811
dtype: float64
```

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

[26]:

| | Returns | Risk |
|---|---|---|
| QUIK | -0.000995 | 0.051383 |
| BRN.AX | -0.000880 | 0.051811 |
| VERI | -0.000402 | 0.065553 |
| GOOGL | 0.000644 | 0.015159 |
| TCEHY | 0.000811 | 0.020757 |
| DE | 0.000880 | 0.016866 |
| SNPS | 0.001067 | 0.014377 |
| CRM | 0.001084 | 0.017334 |
| AMZN | 0.001170 | 0.018133 |
| NVDA | 0.001325 | 0.027282 |
| NFLX | 0.001380 | 0.024406 |
| MSFT | 0.001452 | 0.014360 |
| SPLK | 0.001542 | 0.025274 |
| TWLO | 0.002733 | 0.034306 |

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

[27]:

| | Returns | Risk |
|---|---|---|
| MSFT | 0.001452 | 0.014360 |
| SNPS | 0.001067 | 0.014377 |
| GOOGL | 0.000644 | 0.015159 |
| DE | 0.000880 | 0.016866 |
| CRM | 0.001084 | 0.017334 |
| AMZN | 0.001170 | 0.018133 |
| TCEHY | 0.000811 | 0.020757 |
| NFLX | 0.001380 | 0.024406 |
| SPLK | 0.001542 | 0.025274 |
| NVDA | 0.001325 | 0.027282 |
| TWLO | 0.002733 | 0.034306 |
| QUIK | -0.000995 | 0.051383 |
| BRN.AX | -0.000880 | 0.051811 |
| VERI | -0.000402 | 0.065553 |

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

[28]:

| | Returns | Risk | Sharpe Ratio |
|---|---|---|---|
| TCEHY | 0.000811 | 0.020757 | -0.442704 |
| NVDA | 0.001325 | 0.027282 | -0.317969 |
| MSFT | 0.001452 | 0.014360 | -0.595245 |
| TWLO | 0.002733 | 0.034306 | -0.211827 |
| AMZN | 0.001170 | 0.018133 | -0.486935 |
| GOOGL | 0.000644 | 0.015159 | -0.617195 |
| NFLX | 0.001380 | 0.024406 | -0.353175 |
| CRM | 0.001084 | 0.017334 | -0.514396 |
| DE | 0.000880 | 0.016866 | -0.540723 |
| SPLK | 0.001542 | 0.025274 | -0.334653 |
| VERI | -0.000402 | 0.065553 | -0.158685 |
| SNPS | 0.001067 | 0.014377 | -0.621371 |
| QUIK | -0.000995 | 0.051383 | -0.213989 |
| BRN.AX | -0.000880 | 0.051811 | -0.210003 |

[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 | Median Returns | Total Return |
|---|---|---|---|---|---|---|---|
| TCEHY | 0.000811 | 0.020757 | -0.442704 | 0.083018 | -0.107100 | 0.000786 | 0.880968 |
| NVDA | 0.001325 | 0.027282 | -0.317969 | 0.093632 | -0.187559 | 0.002067 | -0.969943 |
| MSFT | 0.001452 | 0.014360 | -0.595245 | 0.075705 | -0.054338 | 0.001475 | 0.182775 |
| TWLO | 0.002733 | 0.034306 | -0.211827 | 0.354407 | -0.137602 | 0.002354 | -2.124550 |
| AMZN | 0.001170 | 0.018133 | -0.486935 | 0.132164 | -0.078197 | 0.001425 | 0.055118 |
| GOOGL | 0.000644 | 0.015159 | -0.617195 | 0.096202 | -0.075019 | 0.001013 | -0.574688 |
| NFLX | 0.001380 | 0.024406 | -0.353175 | 0.135436 | -0.102720 | 0.000590 | -1.064248 |
| CRM | 0.001084 | 0.017334 | -0.514396 | 0.102713 | -0.087061 | 0.001696 | 0.285698 |
| DE | 0.000880 | 0.016866 | -0.540723 | 0.073045 | -0.076512 | 0.001518 | 0.577800 |
| SPLK | 0.001542 | 0.025274 | -0.334653 | 0.178932 | -0.111918 | 0.001420 | -0.269881 |
| VERI | -0.000402 | 0.065553 | -0.158685 | 0.493011 | -0.302837 | -0.005348 | 1.190475 |
| SNPS | 0.001067 | 0.014377 | -0.621371 | 0.063589 | -0.052558 | 0.001783 | 0.392652 |
| QUIK | -0.000995 | 0.051383 | -0.213989 | 0.375000 | -0.307692 | 0.000000 | 3.386007 |
| BRN.AX | -0.000880 | 0.051811 | -0.210003 | 0.386330 | -0.191489 | 0.000000 | 4.761906 |

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

[33]:

| | Returns | Risk | Sharpe Ratio | Max Returns | Min Returns |
|---|---|---|---|---|---|
| TCEHY | 0.000811 | 0.020757 | -0.442704 | 0.083018 | -0.107100 |
| NVDA | 0.001325 | 0.027282 | -0.317969 | 0.093632 | -0.187559 |
| MSFT | 0.001452 | 0.014360 | -0.595245 | 0.075705 | -0.054338 |
| TWLO | 0.002733 | 0.034306 | -0.211827 | 0.354407 | -0.137602 |
| AMZN | 0.001170 | 0.018133 | -0.486935 | 0.132164 | -0.078197 |
| GOOGL | 0.000644 | 0.015159 | -0.617195 | 0.096202 | -0.075019 |
| NFLX | 0.001380 | 0.024406 | -0.353175 | 0.135436 | -0.102720 |
| CRM | 0.001084 | 0.017334 | -0.514396 | 0.102713 | -0.087061 |
| DE | 0.000880 | 0.016866 | -0.540723 | 0.073045 | -0.076512 |
| SPLK | 0.001542 | 0.025274 | -0.334653 | 0.178932 | -0.111918 |
| VERI | -0.000402 | 0.065553 | -0.158685 | 0.493011 | -0.302837 |

```
SNPS    0.001067  0.014377     -0.621371     0.063589    -0.052558
QUIK   -0.000995  0.051383     -0.213989     0.375000    -0.307692
BRN.AX -0.000880  0.051811     -0.210003     0.386330    -0.191489

        Median Returns  Total Return  Average Return Yearly
TCEHY         0.000786      0.880968               0.002928
NVDA          0.002067     -0.969943              -0.003244
MSFT          0.001475      0.182775               0.000609
TWLO          0.002354     -2.124550              -0.007133
AMZN          0.001425      0.055118               0.000184
GOOGL         0.001013     -0.574688              -0.001919
NFLX          0.000590     -1.064248              -0.003560
CRM           0.001696      0.285698               0.000951
DE            0.001518      0.577800               0.001922
SPLK          0.001420     -0.269881              -0.000900
VERI         -0.005348      1.190475               0.003953
SNPS          0.001783      0.392652               0.001307
QUIK          0.000000      3.386007               0.011162
BRN.AX        0.000000      4.761906               0.015628
```

[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  \
TCEHY    0.000811  0.020757     -0.442704     0.083018    -0.107100
NVDA     0.001325  0.027282     -0.317969     0.093632    -0.187559
MSFT     0.001452  0.014360     -0.595245     0.075705    -0.054338
TWLO     0.002733  0.034306     -0.211827     0.354407    -0.137602
AMZN     0.001170  0.018133     -0.486935     0.132164    -0.078197
GOOGL    0.000644  0.015159     -0.617195     0.096202    -0.075019
NFLX     0.001380  0.024406     -0.353175     0.135436    -0.102720
CRM      0.001084  0.017334     -0.514396     0.102713    -0.087061
DE       0.000880  0.016866     -0.540723     0.073045    -0.076512
SPLK     0.001542  0.025274     -0.334653     0.178932    -0.111918
VERI    -0.000402  0.065553     -0.158685     0.493011    -0.302837
SNPS     0.001067  0.014377     -0.621371     0.063589    -0.052558
QUIK    -0.000995  0.051383     -0.213989     0.375000    -0.307692
BRN.AX -0.000880  0.051811     -0.210003     0.386330    -0.191489

        Median Returns  Total Return  Average Return Yearly      CAGR
TCEHY         0.000786      0.880968               0.002928  0.180266
NVDA          0.002067     -0.969943              -0.003244  0.417189
MSFT          0.001475      0.182775               0.000609  0.219875
TWLO          0.002354     -2.124550              -0.007133       NaN
AMZN          0.001425      0.055118               0.000184  0.205338
```

| | | | | | |
|---|---|---|---|---|---|
| GOOGL | 0.001013 | -0.574688 | -0.001919 | 0.105578 | |
| NFLX | 0.000590 | -1.064248 | -0.003560 | 0.209396 | |
| CRM | 0.001696 | 0.285698 | 0.000951 | 0.142038 | |
| DE | 0.001518 | 0.577800 | 0.001922 | 0.172470 | |
| SPLK | 0.001420 | -0.269881 | -0.000900 | 0.182443 | |
| VERI | -0.005348 | 1.190475 | 0.003953 | NaN | |
| SNPS | 0.001783 | 0.392652 | 0.001307 | 0.218864 | |
| QUIK | 0.000000 | 3.386007 | 0.011162 | -0.208536 | |
| BRN.AX | 0.000000 | 4.761906 | 0.015628 | -0.255373 | |

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

[35]:

| | Returns | Risk | Sharpe Ratio | Max Returns | Min Returns | \ |
|---|---|---|---|---|---|---|
| TWLO | 0.002733 | 0.034306 | -0.211827 | 0.354407 | -0.137602 | |
| NFLX | 0.001380 | 0.024406 | -0.353175 | 0.135436 | -0.102720 | |
| NVDA | 0.001325 | 0.027282 | -0.317969 | 0.093632 | -0.187559 | |
| GOOGL | 0.000644 | 0.015159 | -0.617195 | 0.096202 | -0.075019 | |
| SPLK | 0.001542 | 0.025274 | -0.334653 | 0.178932 | -0.111918 | |
| AMZN | 0.001170 | 0.018133 | -0.486935 | 0.132164 | -0.078197 | |
| MSFT | 0.001452 | 0.014360 | -0.595245 | 0.075705 | -0.054338 | |
| CRM | 0.001084 | 0.017334 | -0.514396 | 0.102713 | -0.087061 | |
| SNPS | 0.001067 | 0.014377 | -0.621371 | 0.063589 | -0.052558 | |
| DE | 0.000880 | 0.016866 | -0.540723 | 0.073045 | -0.076512 | |
| TCEHY | 0.000811 | 0.020757 | -0.442704 | 0.083018 | -0.107100 | |
| VERI | -0.000402 | 0.065553 | -0.158685 | 0.493011 | -0.302837 | |
| QUIK | -0.000995 | 0.051383 | -0.213989 | 0.375000 | -0.307692 | |
| BRN.AX | -0.000880 | 0.051811 | -0.210003 | 0.386330 | -0.191489 | |

| | Median Returns | Total Return | Average Return Yearly | CAGR |
|---|---|---|---|---|
| TWLO | 0.002354 | -2.124550 | -0.007133 | NaN |
| NFLX | 0.000590 | -1.064248 | -0.003560 | 0.209396 |
| NVDA | 0.002067 | -0.969943 | -0.003244 | 0.417189 |
| GOOGL | 0.001013 | -0.574688 | -0.001919 | 0.105578 |
| SPLK | 0.001420 | -0.269881 | -0.000900 | 0.182443 |
| AMZN | 0.001425 | 0.055118 | 0.000184 | 0.205338 |
| MSFT | 0.001475 | 0.182775 | 0.000609 | 0.219875 |
| CRM | 0.001696 | 0.285698 | 0.000951 | 0.142038 |
| SNPS | 0.001783 | 0.392652 | 0.001307 | 0.218864 |
| DE | 0.001518 | 0.577800 | 0.001922 | 0.172470 |
| TCEHY | 0.000786 | 0.880968 | 0.002928 | 0.180266 |
| VERI | -0.005348 | 1.190475 | 0.003953 | NaN |
| QUIK | 0.000000 | 3.386007 | 0.011162 | -0.208536 |
| BRN.AX | 0.000000 | 4.761906 | 0.015628 | -0.255373 |