Machine_Learning_Portfolio

September 29, 2021

1 Machine Learning Portfolio Risk and Returns

```python
[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 fix_yahoo_finance as yf
     yf.pdr_override()
```

```python
[2]: # input
     # Machine Learning Stock
     symbols =␣
      ↪['GOOGL','MSFT','FB','AMZN','NFLX','CRM','ADBE','MTCH','IAC','TTD','FIVN','V','MA','PANW','
     start = '2017-01-01'
     end = '2019-01-01'
```

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

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```python
[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
```

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

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

```
[6]: 727
```

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

```
[7]:                    GOOGL       MSFT          FB        AMZN         NFLX  \
     Date
     2017-01-03  808.010010  59.294807  116.860001  753.669983  127.489998
     2017-01-04  807.770020  59.029503  118.690002  757.179993  129.410004
     2017-01-05  813.020020  59.029503  120.669998  780.450012  131.809998
     2017-01-06  825.210022  59.541157  123.410004  795.989990  131.070007
     2017-01-09  827.179993  59.351658  124.900002  796.919983  130.949997

                       CRM        ADBE       MTCH        IAC        TTD  …  \
     Date                                                                …
     2017-01-03  70.540001  103.480003  16.494013  67.440002  26.930000  …
     2017-01-04  72.800003  104.139999  16.455944  68.169998  27.100000  …
     2017-01-05  72.790001  105.910004  17.122175  69.349998  27.450001  …
     2017-01-06  73.800003  108.300003  17.160246  69.650002  27.700001  …
```

```
2017-01-09  73.959999  108.570000  17.274456  69.779999  28.440001  …

                     V          MA        PANW          IBM        FTNT  \
Date
2017-01-03  77.918709  103.471863  126.940002  146.935089  30.120001
2017-01-04  78.555786  104.453651  128.000000  148.754303  30.420000
2017-01-05  79.477066  105.260406  131.970001  148.262131  30.830000
2017-01-06  80.574791  106.017982  135.050003  148.991577  31.010000
2017-01-09  80.123962  105.811363  133.720001  147.339340  31.309999

                  NVDA        INTC         CUB         ACN        EPAM
Date
2017-01-03  100.937172  33.873764  48.126457  110.738106  63.660000
2017-01-04  103.292122  33.697922  49.556442  111.004356  64.360001
2017-01-05  100.670013  33.642395  47.140259  109.340340  64.750000
2017-01-06  102.015701  33.762699  46.203373  110.585968  66.870003
2017-01-09  106.151749  33.883030  46.104755  109.349854  66.839996

[5 rows x 21 columns]
```
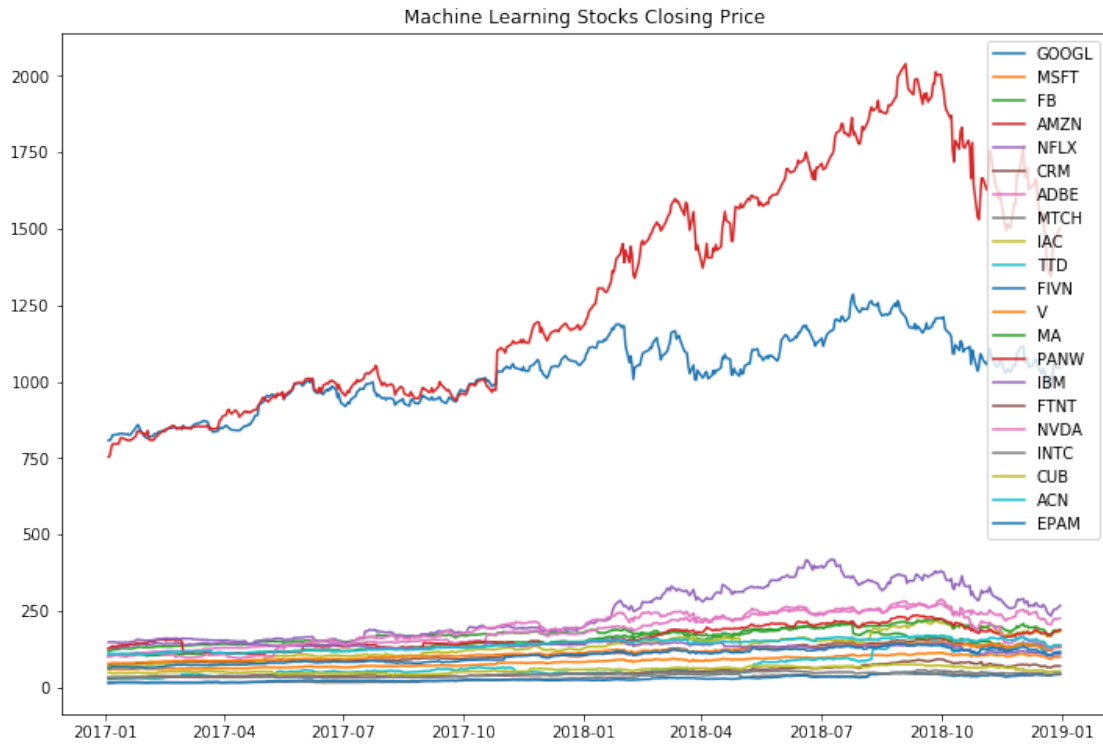
```python
plt.figure(figsize=(12,8))
plt.plot(df)
plt.title('Machine Learning Stocks Closing Price')
plt.legend(labels=df.columns)
```
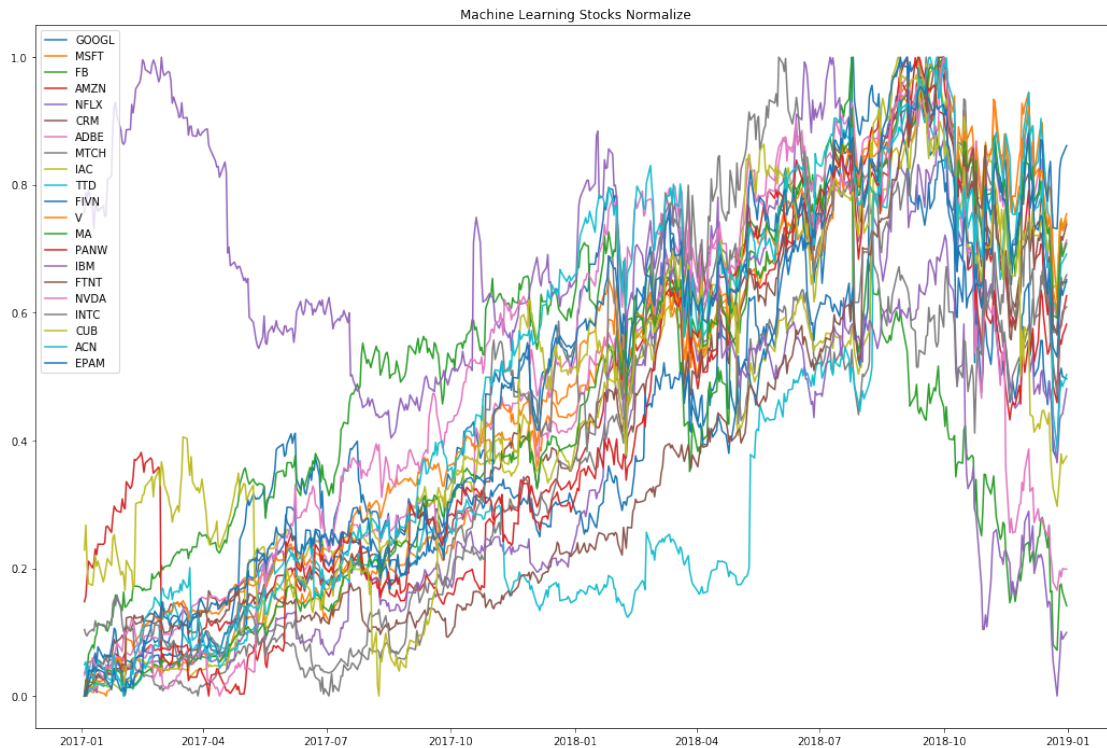
[8]: <matplotlib.legend.Legend at 0x1dc4f915550>

Machine Learning Stocks Closing Price


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

```
[10]: plt.figure(figsize=(18,12))
      plt.plot(normalize)
      plt.title('Machine Learning Stocks Normalize')
      plt.legend(labels=normalize.columns)
```
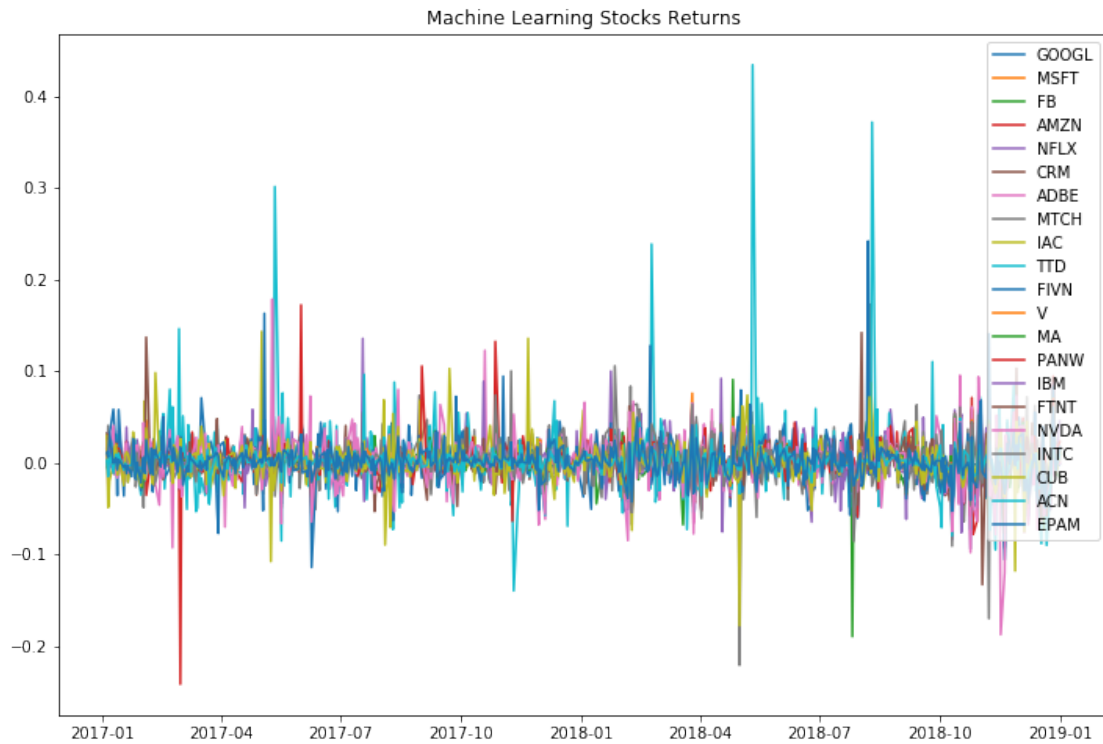
```
[10]: <matplotlib.legend.Legend at 0x1dc4f9b3b70>
```

Machine Learning Stocks Normalize

```
[11]: stock_rets = df.pct_change().dropna()
```
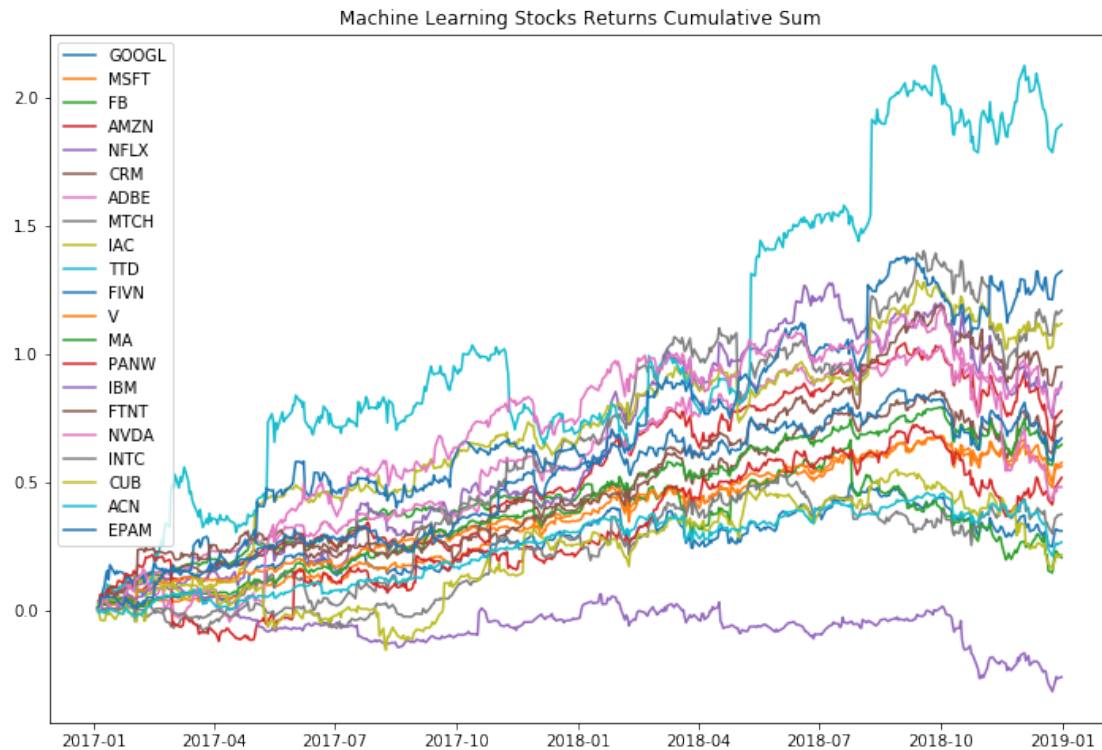
```
[12]: plt.figure(figsize=(12,8))
      plt.plot(stock_rets)
      plt.title('Machine Learning Stocks Returns')
      plt.legend(labels=stock_rets.columns)
```

```
[12]: <matplotlib.legend.Legend at 0x1dc4fa4dfd0>
```

Machine Learning Stocks Returns

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

[13]: <matplotlib.legend.Legend at 0x1dc4fae8898>

Machine Learning Stocks Returns Cumulative Sum

```
[14]: 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)
```
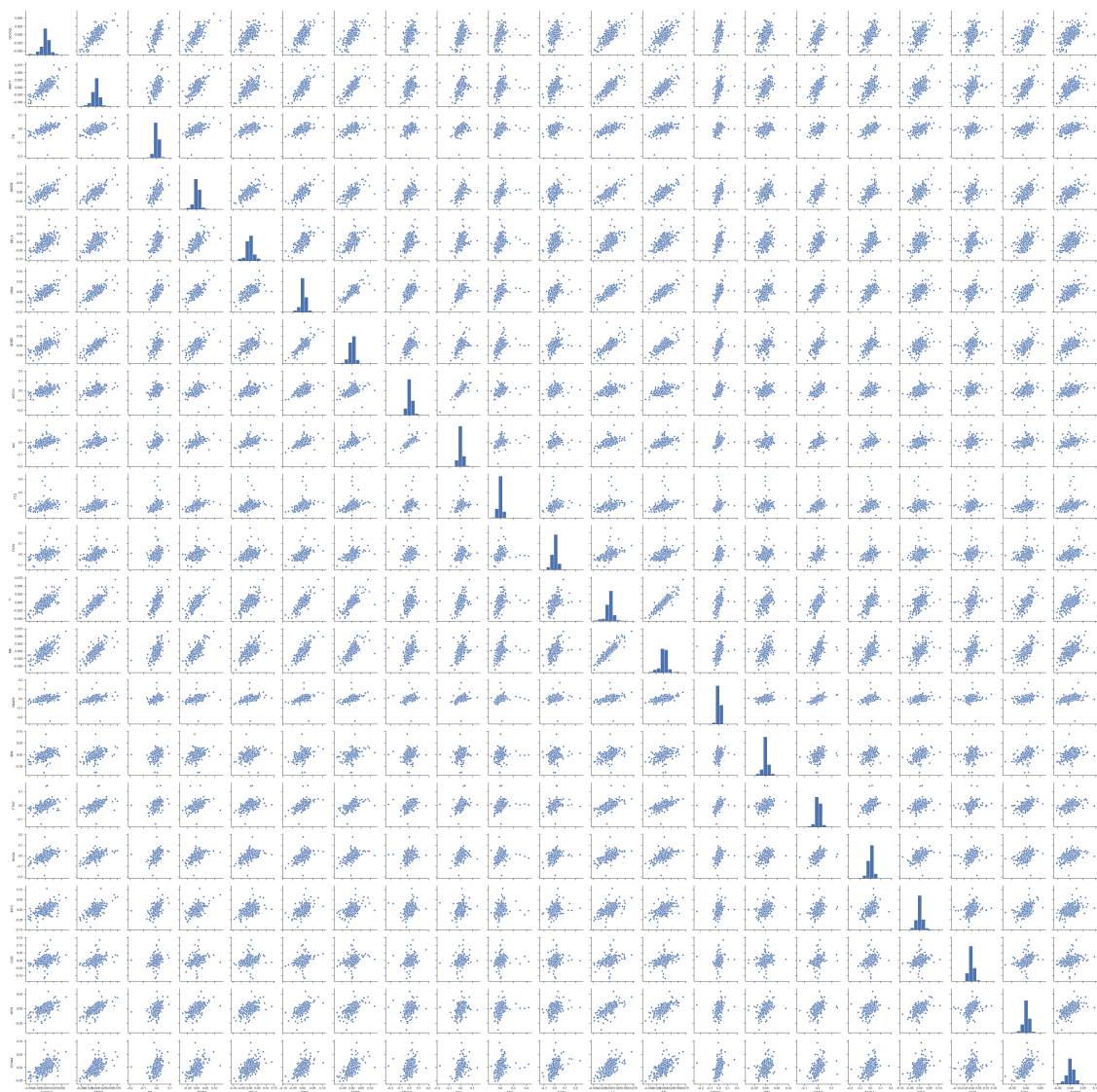
```
[15]: ax = sns.PairGrid(stock_rets)
      ax.map_upper(plt.scatter, color='purple')
      ax.map_lower(sns.kdeplot, color='blue')
      ax.map_diag(plt.hist, bins=30)
      for i in range(nplot) :
          for j in range(nplot) :
              ax.axes[i, j].locator_params(axis='x', nbins=6, tight=True)
```
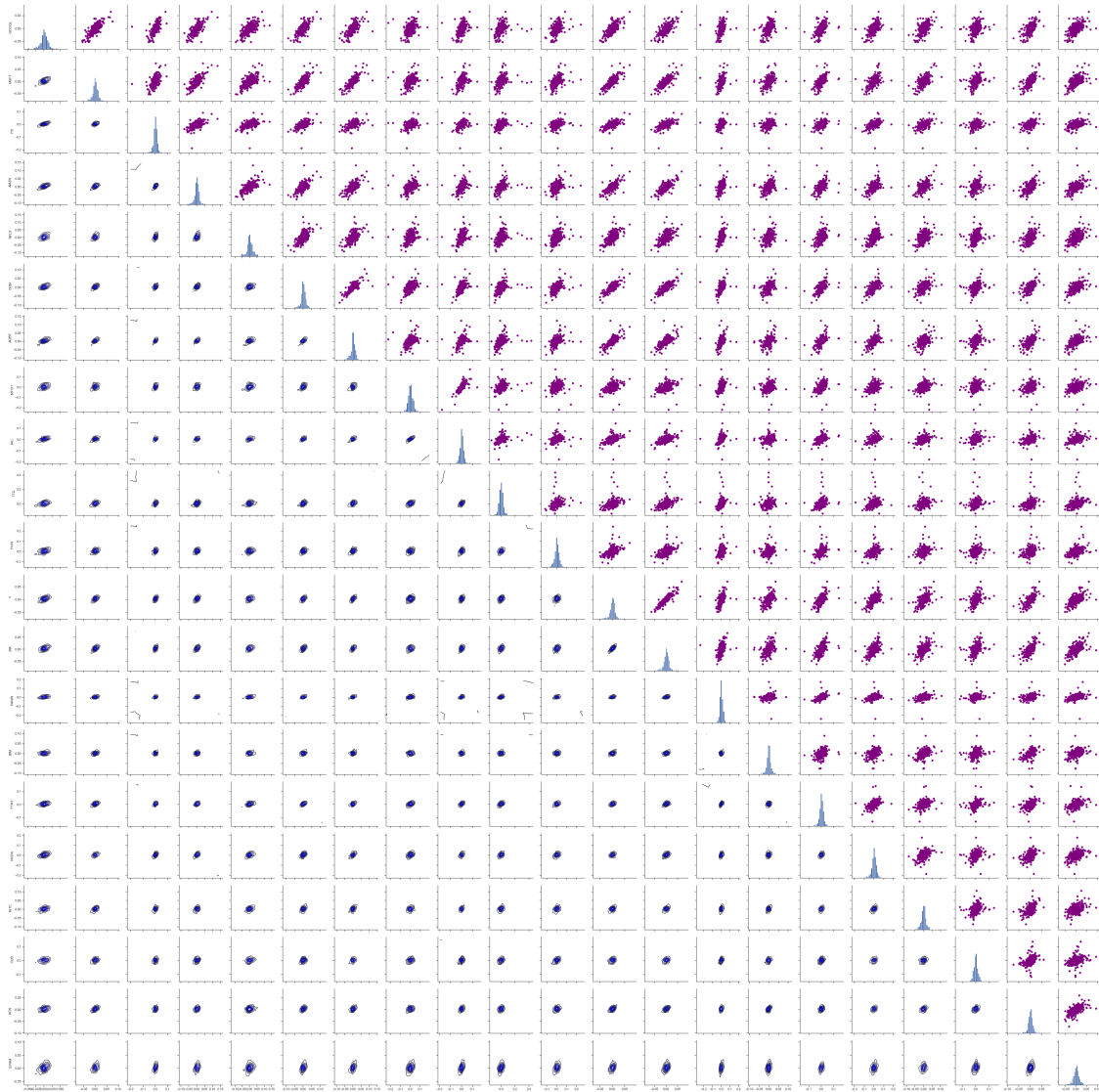
```
[16]: plt.figure(figsize=(7,7))
      corr = stock_rets.corr()

      # plot the heatmap
      sns.heatmap(corr,
              xticklabels=corr.columns,
              yticklabels=corr.columns,
                  cmap="Blues")
```
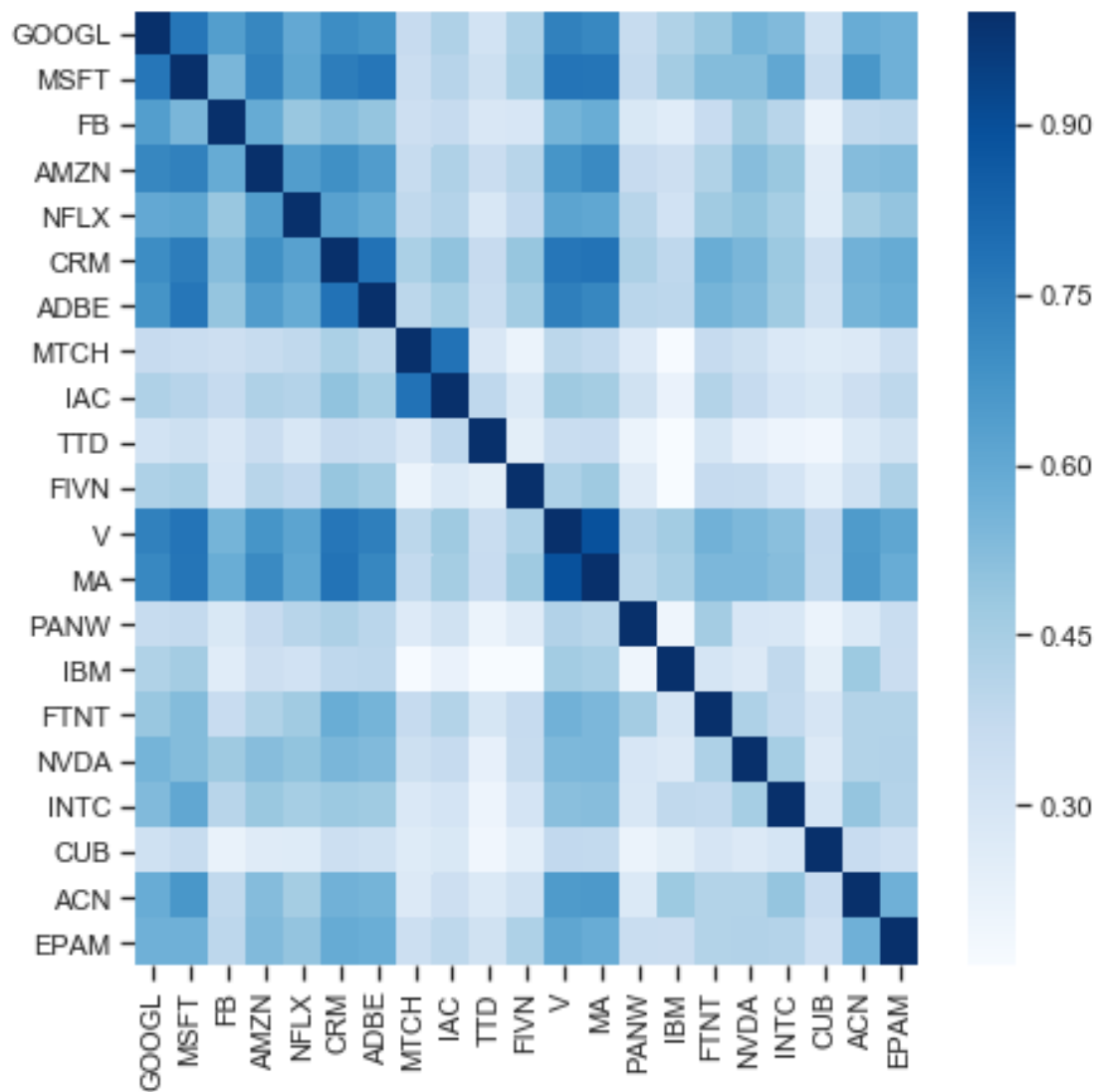
[16]: <matplotlib.axes._subplots.AxesSubplot at 0x1dc61ee4518>

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

[17]: <matplotlib.axes._subplots.AxesSubplot at 0x1dc5d13fcc0>
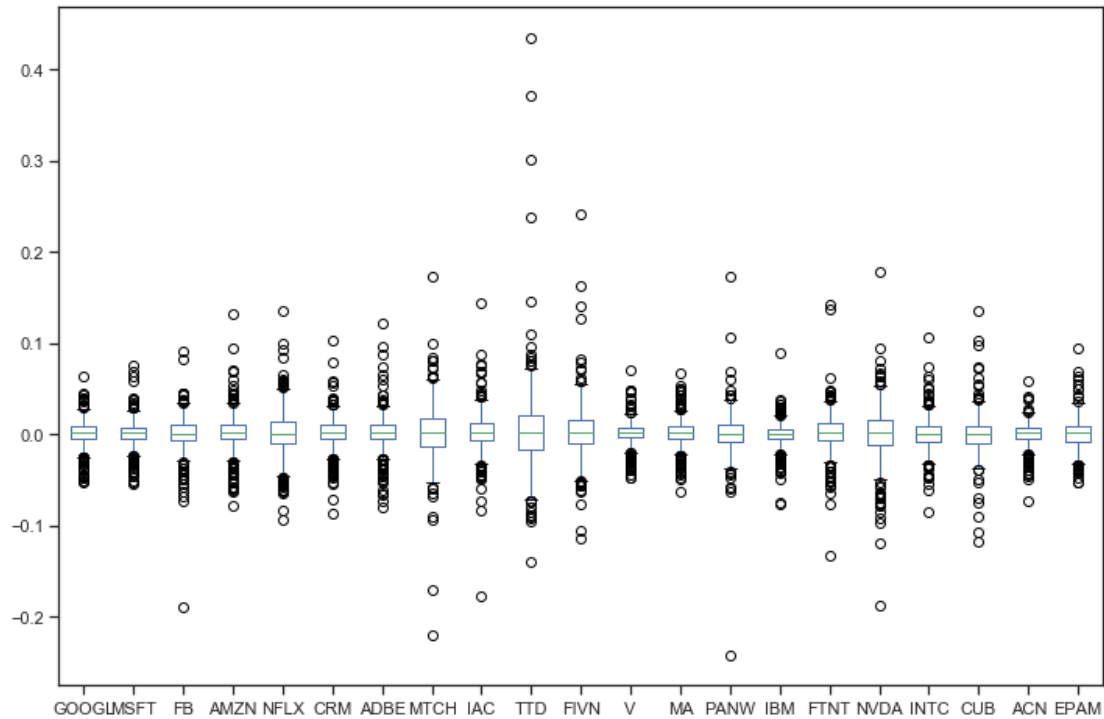
```
[18]: rets = stock_rets.dropna()

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'))
```

Stocks Risk & Returns
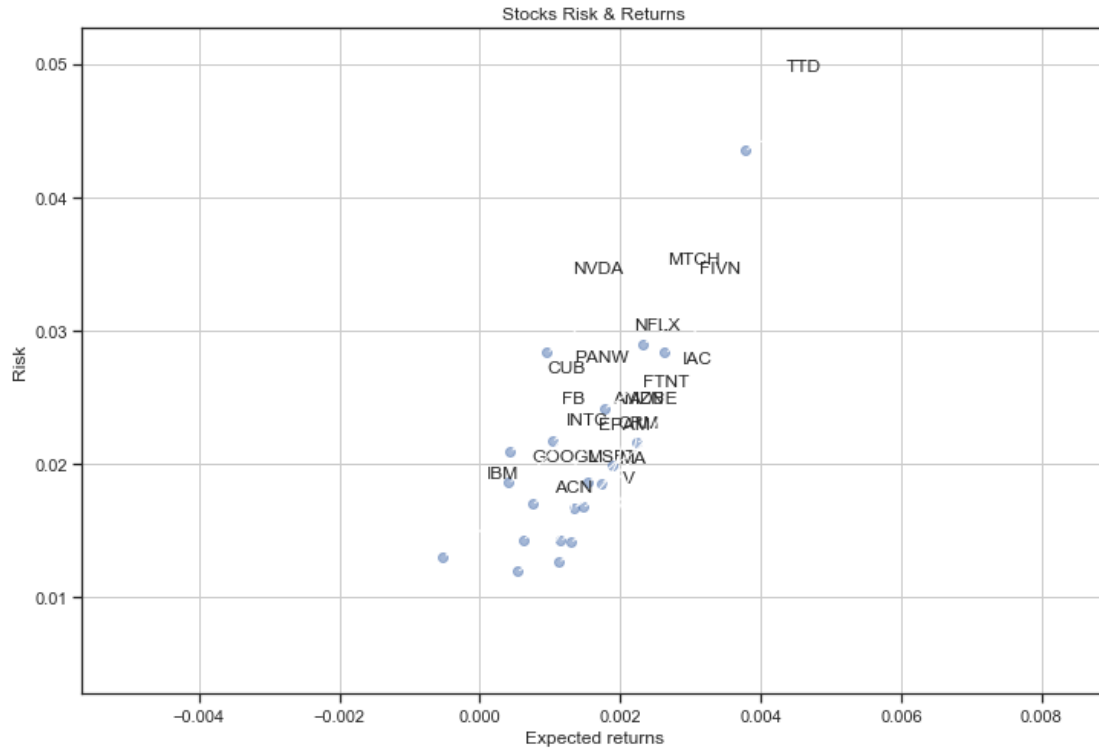
```
[19]: rets = stock_rets.dropna()
      area = np.pi*20.0

      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"))
```

Return vs. Risk for Stocks
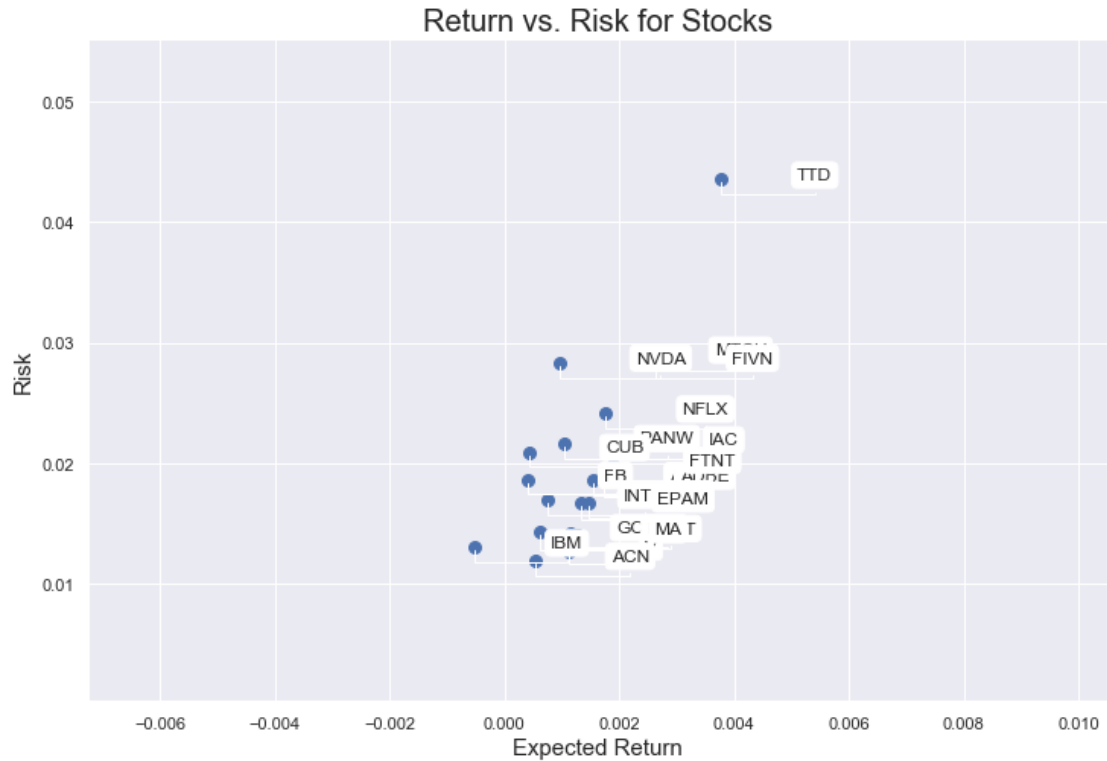
```
[20]: rest_rets = rets.corr()
      pair_value = rest_rets.abs().unstack()
      pair_value.sort_values(ascending = False)
```

```
[20]: EPAM    EPAM    1.000000
      TTD     TTD     1.000000
      INTC    INTC    1.000000
      NVDA    NVDA    1.000000
      FTNT    FTNT    1.000000
      IBM     IBM     1.000000
      PANW    PANW    1.000000
      MA      MA      1.000000
      V       V       1.000000
      IAC     IAC     1.000000
      ACN     ACN     1.000000
      MTCH    MTCH    1.000000
      ADBE    ADBE    1.000000
      CRM     CRM     1.000000
      NFLX    NFLX    1.000000
      AMZN    AMZN    1.000000
      FB      FB      1.000000
      MSFT    MSFT    1.000000
      CUB     CUB     1.000000
```

```
FIVN    FIVN     1.000000
GOOGL   GOOGL    1.000000
MA      V        0.892900
V       MA       0.892900
MTCH    IAC      0.786228
IAC     MTCH     0.786228
CRM     ADBE     0.785597
ADBE    CRM      0.785597
CRM     MA       0.781389
MA      CRM      0.781389
MSFT    V        0.777083
                   …
TTD     FIVN     0.245916
FIVN    TTD      0.245916
CUB     IBM      0.245631
IBM     CUB      0.245631
FIVN    CUB      0.244070
CUB     FIVN     0.244070
TTD     NVDA     0.230372
NVDA    TTD      0.230372
CUB     FB       0.220368
FB      CUB      0.220368
IBM     IAC      0.217917
IAC     IBM      0.217917
PANW    TTD      0.210500
TTD     PANW     0.210500
MTCH    FIVN     0.210139
FIVN    MTCH     0.210139
CUB     PANW     0.208563
PANW    CUB      0.208563
INTC    TTD      0.205115
TTD     INTC     0.205115
IBM     PANW     0.197830
PANW    IBM      0.197830
CUB     TTD      0.190216
TTD     CUB      0.190216
MTCH    IBM      0.165667
IBM     MTCH     0.165667
        FIVN     0.161164
FIVN    IBM      0.161164
TTD     IBM      0.159211
IBM     TTD      0.159211
Length: 441, dtype: float64
```

[21]:
```python
# Normalized Returns Data
Normalized_Value = ((rets[:] - rets[:].min()) /(rets[:].max() - rets[:].min()))
Normalized_Value.head()
```

```
[21]:                 GOOGL       MSFT         FB       AMZN       NFLX        CRM  \
      Date
      2017-01-04   0.448891   0.383439   0.732522   0.393867   0.475429   0.627588
      2017-01-05   0.506997   0.417845   0.736170   0.517822   0.490618   0.458039
      2017-01-06   0.579618   0.484498   0.757669   0.466382   0.385336   0.531879
      2017-01-09   0.471840   0.393372   0.719724   0.377282   0.405810   0.470187
      2017-01-10   0.439338   0.415390   0.660924   0.365643   0.374526   0.460188

                     ADBE       MTCH        IAC        TTD  …          V         MA  \
      Date                                                  …
      2017-01-04   0.427781   0.555197   0.587599   0.254630  …   0.478502   0.553318
      2017-01-05   0.480143   0.663876   0.607814   0.266139  …   0.508544   0.539717
      2017-01-06   0.507609   0.566706   0.567343   0.259501  …   0.526173   0.535660
      2017-01-09   0.408624   0.577961   0.559677   0.290194  …   0.362010   0.465174
      2017-01-10   0.382250   0.579249   0.559666   0.269369  …   0.363812   0.463713

                     PANW        IBM       FTNT       NVDA       INTC        CUB  \
      Date
      2017-01-04   0.604241   0.537590   0.520225   0.576488   0.421603   0.582652
      2017-01-05   0.659046   0.442458   0.533028   0.443317   0.440115   0.273118
      2017-01-06   0.640483   0.492351   0.505226   0.549251   0.467406   0.387046
      2017-01-09   0.560236   0.395281   0.519185   0.623540   0.467344   0.457025
      2017-01-10   0.601409   0.385485   0.559529   0.492071   0.438734   0.532946

                      ACN       EPAM
      Date
      2017-01-04   0.570820   0.434195
      2017-01-05   0.438834   0.400648
      2017-01-06   0.639017   0.581980
      2017-01-09   0.467764   0.356416
      2017-01-10   0.556535   0.370650

      [5 rows x 21 columns]
```

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

```
[22]:             GOOGL       MSFT         FB       AMZN       NFLX        CRM       ADBE  \
      GOOGL   1.000000   0.771586   0.640550   0.719742   0.602570   0.699130   0.675725
      MSFT    0.771586   1.000000   0.547119   0.738228   0.609286   0.752413   0.770251
      FB      0.640550   0.547119   1.000000   0.590811   0.486307   0.522392   0.493976
      AMZN    0.719742   0.738228   0.590811   1.000000   0.644157   0.690820   0.648191
      NFLX    0.602570   0.609286   0.486307   0.644157   1.000000   0.628014   0.590377
      CRM     0.699130   0.752413   0.522392   0.690820   0.628014   1.000000   0.785597
      ADBE    0.675725   0.770251   0.493976   0.648191   0.590377   0.785597   1.000000
      MTCH    0.368385   0.354319   0.342744   0.364880   0.383384   0.440203   0.397581
      IAC     0.431154   0.411753   0.372240   0.431046   0.417863   0.502546   0.452810
      TTD     0.319827   0.337338   0.289511   0.355095   0.291443   0.366959   0.358018
```

```
FIVN   0.433943  0.445142  0.296260  0.406407  0.381199  0.489272  0.462129
V      0.737875  0.777083  0.557580  0.672126  0.617772  0.771157  0.743943
MA     0.714641  0.773570  0.584230  0.709773  0.607967  0.781389  0.718496
PANW   0.364781  0.375190  0.284690  0.366557  0.406267  0.437981  0.400318
IBM    0.425271  0.459310  0.254803  0.341746  0.323364  0.386509  0.393894
FTNT   0.484578  0.529380  0.362659  0.426744  0.466309  0.583155  0.557200
NVDA   0.559668  0.529161  0.472328  0.523415  0.498667  0.549895  0.534651
INTC   0.533903  0.605375  0.406506  0.481682  0.454671  0.481022  0.469750
CUB    0.332338  0.365568  0.220368  0.263359  0.265071  0.346299  0.332117
ACN    0.588746  0.667848  0.383739  0.526520  0.457673  0.569139  0.556661
EPAM   0.571456  0.572117  0.394378  0.536802  0.496877  0.589638  0.582843

            MTCH       IAC       TTD   …          V        MA      PANW  \
GOOGL   0.368385  0.431154  0.319827   …   0.737875  0.714641  0.364781
MSFT    0.354319  0.411753  0.337338   …   0.777083  0.773570  0.375190
FB      0.342744  0.372240  0.289511   …   0.557580  0.584230  0.284690
AMZN    0.364880  0.431046  0.355095   …   0.672126  0.709773  0.366557
NFLX    0.383384  0.417863  0.291443   …   0.617772  0.607967  0.406267
CRM     0.440203  0.502546  0.366959   …   0.771157  0.781389  0.437981
ADBE    0.397581  0.452810  0.358018   …   0.743943  0.718496  0.400318
MTCH    1.000000  0.786228  0.289128   …   0.397208  0.379119  0.270165
IAC     0.786228  1.000000  0.387182   …   0.473497  0.455092  0.326356
TTD     0.289128  0.387182  1.000000   …   0.359367  0.359957  0.210500
FIVN    0.210139  0.279335  0.245916   …   0.434688  0.472931  0.262595
V       0.397208  0.473497  0.359367   …   1.000000  0.892900  0.423170
MA      0.379119  0.455092  0.359957   …   0.892900  1.000000  0.404769
PANW    0.270165  0.326356  0.210500   …   0.423170  0.404769  1.000000
IBM     0.165667  0.217917  0.159211   …   0.462394  0.448107  0.197830
FTNT    0.372520  0.421267  0.298966   …   0.569341  0.544509  0.460549
NVDA    0.336972  0.370356  0.230372   …   0.541747  0.545350  0.296546
INTC    0.282441  0.309624  0.205115   …   0.515151  0.520801  0.293506
CUB     0.267054  0.285079  0.190216   …   0.382200  0.379033  0.208563
ACN     0.275456  0.339965  0.278909   …   0.651217  0.655655  0.278169
EPAM    0.346317  0.389252  0.326512   …   0.612359  0.588460  0.358673

             IBM      FTNT      NVDA      INTC       CUB       ACN      EPAM
GOOGL   0.425271  0.484578  0.559668  0.533903  0.332338  0.588746  0.571456
MSFT    0.459310  0.529380  0.529161  0.605375  0.365568  0.667848  0.572117
FB      0.254803  0.362659  0.472328  0.406506  0.220368  0.383739  0.394378
AMZN    0.341746  0.426744  0.523415  0.481682  0.263359  0.526520  0.536802
NFLX    0.323364  0.466309  0.498667  0.454671  0.265071  0.457673  0.496877
CRM     0.386509  0.583155  0.549895  0.481022  0.346299  0.569139  0.589638
ADBE    0.393894  0.557200  0.534651  0.469750  0.332117  0.556661  0.582843
MTCH    0.165667  0.372520  0.336972  0.282441  0.267054  0.275456  0.346317
IAC     0.217917  0.421267  0.370356  0.309624  0.285079  0.339965  0.389252
TTD     0.159211  0.298966  0.230372  0.205115  0.190216  0.278909  0.326512
FIVN    0.161164  0.370785  0.365666  0.309627  0.244070  0.330560  0.432436
```

```
V      0.462394   0.569341   0.541747   0.515151   0.382200   0.651217   0.612359
MA     0.448107   0.544509   0.545350   0.520801   0.379033   0.655655   0.588460
PANW   0.197830   0.460549   0.296546   0.293506   0.208563   0.278169   0.358673
IBM    1.000000   0.304057   0.276994   0.382657   0.245631   0.474890   0.355813
FTNT   0.304057   1.000000   0.433000   0.378521   0.302912   0.419296   0.419359
NVDA   0.276994   0.433000   1.000000   0.453898   0.276076   0.420250   0.424380
INTC   0.382657   0.378521   0.453898   1.000000   0.305463   0.493593   0.417215
CUB    0.245631   0.302912   0.276076   0.305463   1.000000   0.360593   0.335412
ACN    0.474890   0.419296   0.420250   0.493593   0.360593   1.000000   0.571060
EPAM   0.355813   0.419359   0.424380   0.417215   0.335412   0.571060   1.000000

[21 rows x 21 columns]
```

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

```
[23]:  EPAM    EPAM    1.000000
       TTD     TTD     1.000000
       INTC    INTC    1.000000
       NVDA    NVDA    1.000000
       FTNT    FTNT    1.000000
       IBM     IBM     1.000000
       PANW    PANW    1.000000
       MA      MA      1.000000
       V       V       1.000000
       IAC     IAC     1.000000
       ACN     ACN     1.000000
       MTCH    MTCH    1.000000
       ADBE    ADBE    1.000000
       CRM     CRM     1.000000
       NFLX    NFLX    1.000000
       AMZN    AMZN    1.000000
       FB      FB      1.000000
       MSFT    MSFT    1.000000
       CUB     CUB     1.000000
       FIVN    FIVN    1.000000
       GOOGL   GOOGL   1.000000
       MA      V       0.892900
       V       MA      0.892900
       MTCH    IAC     0.786228
       IAC     MTCH    0.786228
       CRM     ADBE    0.785597
       ADBE    CRM     0.785597
       CRM     MA      0.781389
       MA      CRM     0.781389
       MSFT    V       0.777083
```

```
                              …
        TTD      FIVN      0.245916
        FIVN     TTD       0.245916
        CUB      IBM       0.245631
        IBM      CUB       0.245631
        FIVN     CUB       0.244070
        CUB      FIVN      0.244070
        TTD      NVDA      0.230372
        NVDA     TTD       0.230372
        CUB      FB        0.220368
        FB       CUB       0.220368
        IBM      IAC       0.217917
        IAC      IBM       0.217917
        PANW     TTD       0.210500
        TTD      PANW      0.210500
        MTCH     FIVN      0.210139
        FIVN     MTCH      0.210139
        CUB      PANW      0.208563
        PANW     CUB       0.208563
        INTC     TTD       0.205115
        TTD      INTC      0.205115
        IBM      PANW      0.197830
        PANW     IBM       0.197830
        CUB      TTD       0.190216
        TTD      CUB       0.190216
        MTCH     IBM       0.165667
        IBM      MTCH      0.165667
                 FIVN      0.161164
        FIVN     IBM       0.161164
        TTD      IBM       0.159211
        IBM      TTD       0.159211
        Length: 441, dtype: float64
```

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

```
      Stock returns:
      GOOGL    0.000615
      MSFT     0.001146
      FB       0.000408
      AMZN     0.001549
      NFLX     0.001770
      CRM      0.001465
      ADBE     0.001733
```

```
MTCH       0.002332
IAC        0.002229
TTD        0.003777
FIVN       0.002638
V          0.001119
MA         0.001288
PANW       0.001030
IBM       -0.000521
FTNT       0.001893
NVDA       0.000956
INTC       0.000745
CUB        0.000430
ACN        0.000529
EPAM       0.001336
dtype: float64
-------------------------------------------------
Stock risks:
GOOGL      0.014273
MSFT       0.014212
FB         0.018601
AMZN       0.018599
NFLX       0.024110
CRM        0.016717
ADBE       0.018543
MTCH       0.028996
IAC        0.021549
TTD        0.043501
FIVN       0.028332
V          0.012656
MA         0.014115
PANW       0.021671
IBM        0.013002
FTNT       0.019859
NVDA       0.028336
INTC       0.016951
CUB        0.020920
ACN        0.011893
EPAM       0.016664
dtype: float64
```

[25]:
```python
table = pd.DataFrame()
table['Returns'] = rets.mean()
table['Risk'] = rets.std()
table.sort_values(by='Returns')
```

[25]:
```
        Returns      Risk
IBM    -0.000521  0.013002
```

```
FB      0.000408  0.018601
CUB     0.000430  0.020920
ACN     0.000529  0.011893
GOOGL   0.000615  0.014273
INTC    0.000745  0.016951
NVDA    0.000956  0.028336
PANW    0.001030  0.021671
V       0.001119  0.012656
MSFT    0.001146  0.014212
MA      0.001288  0.014115
EPAM    0.001336  0.016664
CRM     0.001465  0.016717
AMZN    0.001549  0.018599
ADBE    0.001733  0.018543
NFLX    0.001770  0.024110
FTNT    0.001893  0.019859
IAC     0.002229  0.021549
MTCH    0.002332  0.028996
FIVN    0.002638  0.028332
TTD     0.003777  0.043501
```

[26]:
```
table.sort_values(by='Risk')
```

[26]:
```
         Returns      Risk
ACN     0.000529  0.011893
V       0.001119  0.012656
IBM    -0.000521  0.013002
MA      0.001288  0.014115
MSFT    0.001146  0.014212
GOOGL   0.000615  0.014273
EPAM    0.001336  0.016664
CRM     0.001465  0.016717
INTC    0.000745  0.016951
ADBE    0.001733  0.018543
AMZN    0.001549  0.018599
FB      0.000408  0.018601
FTNT    0.001893  0.019859
CUB     0.000430  0.020920
IAC     0.002229  0.021549
PANW    0.001030  0.021671
NFLX    0.001770  0.024110
FIVN    0.002638  0.028332
NVDA    0.000956  0.028336
MTCH    0.002332  0.028996
TTD     0.003777  0.043501
```

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

```
[27]:        Returns      Risk   Sharpe Ratio
      GOOGL  0.000615   0.014273    -0.657515
      MSFT   0.001146   0.014212    -0.623003
      FB     0.000408   0.018601    -0.515678
      AMZN   0.001549   0.018599    -0.454387
      NFLX   0.001770   0.024110    -0.341342
      CRM    0.001465   0.016717    -0.510572
      ADBE   0.001733   0.018543    -0.445825
      MTCH   0.002332   0.028996    -0.264458
      IAC    0.002229   0.021549    -0.360636
      TTD    0.003777   0.043501    -0.143054
      FIVN   0.002638   0.028332    -0.259846
      V      0.001119   0.012656    -0.701735
      MA     0.001288   0.014115    -0.617221
      PANW   0.001030   0.021671    -0.413920
      IBM   -0.000521   0.013002    -0.809147
      FTNT   0.001893   0.019859    -0.408216
      NVDA   0.000956   0.028336    -0.319160
      INTC   0.000745   0.016951    -0.546021
      CUB    0.000430   0.020920    -0.457448
      ACN    0.000529   0.011893    -0.796362
      EPAM   0.001336   0.016664    -0.519909
```

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

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

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

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

```
[31]:        Returns      Risk   Sharpe Ratio   Max Returns   Min Returns  \
      GOOGL  0.000615   0.014273    -0.657515      0.064164     -0.052802
      MSFT   0.001146   0.014212    -0.623003      0.075705     -0.054338
      FB     0.000408   0.018601    -0.515678      0.090613     -0.189609
      AMZN   0.001549   0.018599    -0.454387      0.132164     -0.078197
      NFLX   0.001770   0.024110    -0.341342      0.135436     -0.094039
      CRM    0.001465   0.016717    -0.510572      0.102713     -0.087061
      ADBE   0.001733   0.018543    -0.445825      0.122418     -0.080372
      MTCH   0.002332   0.028996    -0.264458      0.172840     -0.220925
      IAC    0.002229   0.021549    -0.360636      0.143129     -0.177686
```

```
TTD     0.003777  0.043501      -0.143054      0.433909    -0.139760
FIVN    0.002638  0.028332      -0.259846      0.241724    -0.114168
V       0.001119  0.012656      -0.701735      0.069827    -0.048391
MA      0.001288  0.014115      -0.617221      0.067449    -0.062309
PANW    0.001030  0.021671      -0.413920      0.172021    -0.241540
IBM    -0.000521  0.013002      -0.809147      0.088645    -0.076282
FTNT    0.001893  0.019859      -0.408216      0.141796    -0.132991
NVDA    0.000956  0.028336      -0.319160      0.178259    -0.187559
INTC    0.000745  0.016951      -0.546021      0.105519    -0.085890
CUB     0.000430  0.020920      -0.457448      0.135514    -0.117994
ACN     0.000529  0.011893      -0.796362      0.058967    -0.072826
EPAM    0.001336  0.016664      -0.519909      0.094250    -0.052893


        Median Returns   Total Return
GOOGL         0.001230      -0.164338
MSFT          0.001430       1.175420
FB            0.001056      -1.584085
AMZN          0.001709       1.620408
NFLX          0.000892       4.522031
CRM           0.001771       1.700333
ADBE          0.002196       1.393806
MTCH          0.002493       1.663894
IAC           0.001866       1.026603
TTD           0.002027       1.406729
FIVN          0.001834       1.180287
V             0.001905       0.763706
MA            0.001788       1.337554
PANW          0.000669       2.291859
IBM           0.000212       0.566223
FTNT          0.002306       0.127956
NVDA          0.001654      -0.112232
INTC          0.000754       0.385032
CUB           0.000000       0.825517
ACN           0.001374       0.851080
EPAM          0.001370       1.727465
```

[32]:
```python
table['Average Return Yearly'] = (1 + total_return)**(1 / number_of_years) - 1
table
```

[32]:
```
        Returns      Risk  Sharpe Ratio  Max Returns  Min Returns  \
GOOGL  0.000615  0.014273     -0.657515     0.064164    -0.052802
MSFT   0.001146  0.014212     -0.623003     0.075705    -0.054338
FB     0.000408  0.018601     -0.515678     0.090613    -0.189609
AMZN   0.001549  0.018599     -0.454387     0.132164    -0.078197
NFLX   0.001770  0.024110     -0.341342     0.135436    -0.094039
CRM    0.001465  0.016717     -0.510572     0.102713    -0.087061
ADBE   0.001733  0.018543     -0.445825     0.122418    -0.080372
```

```
MTCH    0.002332   0.028996      -0.264458       0.172840       -0.220925
IAC     0.002229   0.021549      -0.360636       0.143129       -0.177686
TTD     0.003777   0.043501      -0.143054       0.433909       -0.139760
FIVN    0.002638   0.028332      -0.259846       0.241724       -0.114168
V       0.001119   0.012656      -0.701735       0.069827       -0.048391
MA      0.001288   0.014115      -0.617221       0.067449       -0.062309
PANW    0.001030   0.021671      -0.413920       0.172021       -0.241540
IBM    -0.000521   0.013002      -0.809147       0.088645       -0.076282
FTNT    0.001893   0.019859      -0.408216       0.141796       -0.132991
NVDA    0.000956   0.028336      -0.319160       0.178259       -0.187559
INTC    0.000745   0.016951      -0.546021       0.105519       -0.085890
CUB     0.000430   0.020920      -0.457448       0.135514       -0.117994
ACN     0.000529   0.011893      -0.796362       0.058967       -0.072826
EPAM    0.001336   0.016664      -0.519909       0.094250       -0.052893

       Median Returns  Total Return  Average Return Yearly
GOOGL        0.001230     -0.164338                -0.000822
MSFT         0.001430      1.175420                 0.005860
FB           0.001056     -1.584085                -0.007952
AMZN         0.001709      1.620408                 0.008069
NFLX         0.000892      4.522031                 0.022360
CRM          0.001771      1.700333                 0.008466
ADBE         0.002196      1.393806                 0.006945
MTCH         0.002493      1.663894                 0.008285
IAC          0.001866      1.026603                 0.005120
TTD          0.002027      1.406729                 0.007009
FIVN         0.001834      1.180287                 0.005884
V            0.001905      0.763706                 0.003811
MA           0.001788      1.337554                 0.006666
PANW         0.000669      2.291859                 0.011394
IBM          0.000212      0.566223                 0.002827
FTNT         0.002306      0.127956                 0.000640
NVDA         0.001654     -0.112232                -0.000561
INTC         0.000754      0.385032                 0.001923
CUB          0.000000      0.825517                 0.004119
ACN          0.001374      0.851080                 0.004246
EPAM         0.001370      1.727465                 0.008600
```

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

```
[33]:        Returns      Risk  Sharpe Ratio  Max Returns  Min Returns  \
      GOOGL  0.000615  0.014273     -0.657515     0.064164    -0.052802
      MSFT   0.001146  0.014212     -0.623003     0.075705    -0.054338
      FB     0.000408  0.018601     -0.515678     0.090613    -0.189609
```

```
AMZN    0.001549   0.018599     -0.454387      0.132164       -0.078197
NFLX    0.001770   0.024110     -0.341342      0.135436       -0.094039
CRM     0.001465   0.016717     -0.510572      0.102713       -0.087061
ADBE    0.001733   0.018543     -0.445825      0.122418       -0.080372
MTCH    0.002332   0.028996     -0.264458      0.172840       -0.220925
IAC     0.002229   0.021549     -0.360636      0.143129       -0.177686
TTD     0.003777   0.043501     -0.143054      0.433909       -0.139760
FIVN    0.002638   0.028332     -0.259846      0.241724       -0.114168
V       0.001119   0.012656     -0.701735      0.069827       -0.048391
MA      0.001288   0.014115     -0.617221      0.067449       -0.062309
PANW    0.001030   0.021671     -0.413920      0.172021       -0.241540
IBM    -0.000521   0.013002     -0.809147      0.088645       -0.076282
FTNT    0.001893   0.019859     -0.408216      0.141796       -0.132991
NVDA    0.000956   0.028336     -0.319160      0.178259       -0.187559
INTC    0.000745   0.016951     -0.546021      0.105519       -0.085890
CUB     0.000430   0.020920     -0.457448      0.135514       -0.117994
ACN     0.000529   0.011893     -0.796362      0.058967       -0.072826
EPAM    0.001336   0.016664     -0.519909      0.094250       -0.052893

         Median Returns   Total Return   Average Return Yearly        CAGR
GOOGL          0.001230      -0.164338                -0.000822    0.093233
MSFT           0.001430       1.175420                 0.005860    0.198988
FB             0.001056      -1.584085                -0.007952    0.040634
AMZN           0.001709       1.620408                 0.008069    0.270015
NFLX           0.000892       4.522031                 0.022360    0.293159
CRM            0.001771       1.700333                 0.008466    0.258622
ADBE           0.002196       1.393806                 0.006945    0.311459
MTCH           0.002493       1.663894                 0.008285    0.391361
IAC            0.001866       1.026603                 0.005120    0.413542
TTD            0.002027       1.406729                 0.007009    0.659274
FIVN           0.001834       1.180287                 0.005884    0.477057
V              0.001905       0.763706                 0.003811    0.197632
MA             0.001788       1.337554                 0.006666    0.229073
PANW           0.000669       2.291859                 0.011394    0.146571
IBM            0.000212       0.566223                 0.002827   -0.099870
FTNT           0.002306       0.127956                 0.000640    0.342372
NVDA           0.001654      -0.112232                -0.000561    0.100283
INTC           0.000754       0.385032                 0.001923    0.110117
CUB            0.000000       0.825517                 0.004119    0.037490
ACN            0.001374       0.851080                 0.004246    0.082661
EPAM           0.001370       1.727465                 0.008600    0.231237
```

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

[34]:
```
          Returns      Risk   Sharpe Ratio   Max Returns   Min Returns  \
FB       0.000408   0.018601      -0.515678      0.090613     -0.189609
GOOGL    0.000615   0.014273      -0.657515      0.064164     -0.052802
```

```
NVDA   0.000956  0.028336    -0.319160     0.178259    -0.187559
FTNT   0.001893  0.019859    -0.408216     0.141796    -0.132991
INTC   0.000745  0.016951    -0.546021     0.105519    -0.085890
IBM   -0.000521  0.013002    -0.809147     0.088645    -0.076282
V      0.001119  0.012656    -0.701735     0.069827    -0.048391
CUB    0.000430  0.020920    -0.457448     0.135514    -0.117994
ACN    0.000529  0.011893    -0.796362     0.058967    -0.072826
IAC    0.002229  0.021549    -0.360636     0.143129    -0.177686
MSFT   0.001146  0.014212    -0.623003     0.075705    -0.054338
FIVN   0.002638  0.028332    -0.259846     0.241724    -0.114168
MA     0.001288  0.014115    -0.617221     0.067449    -0.062309
ADBE   0.001733  0.018543    -0.445825     0.122418    -0.080372
TTD    0.003777  0.043501    -0.143054     0.433909    -0.139760
AMZN   0.001549  0.018599    -0.454387     0.132164    -0.078197
MTCH   0.002332  0.028996    -0.264458     0.172840    -0.220925
CRM    0.001465  0.016717    -0.510572     0.102713    -0.087061
EPAM   0.001336  0.016664    -0.519909     0.094250    -0.052893
PANW   0.001030  0.021671    -0.413920     0.172021    -0.241540
NFLX   0.001770  0.024110    -0.341342     0.135436    -0.094039
```

	Median Returns	Total Return	Average Return Yearly	CAGR
FB	0.001056	-1.584085	-0.007952	0.040634
GOOGL	0.001230	-0.164338	-0.000822	0.093233
NVDA	0.001654	-0.112232	-0.000561	0.100283
FTNT	0.002306	0.127956	0.000640	0.342372
INTC	0.000754	0.385032	0.001923	0.110117
IBM	0.000212	0.566223	0.002827	-0.099870
V	0.001905	0.763706	0.003811	0.197632
CUB	0.000000	0.825517	0.004119	0.037490
ACN	0.001374	0.851080	0.004246	0.082661
IAC	0.001866	1.026603	0.005120	0.413542
MSFT	0.001430	1.175420	0.005860	0.198988
FIVN	0.001834	1.180287	0.005884	0.477057
MA	0.001788	1.337554	0.006666	0.229073
ADBE	0.002196	1.393806	0.006945	0.311459
TTD	0.002027	1.406729	0.007009	0.659274
AMZN	0.001709	1.620408	0.008069	0.270015
MTCH	0.002493	1.663894	0.008285	0.391361
CRM	0.001771	1.700333	0.008466	0.258622
EPAM	0.001370	1.727465	0.008600	0.231237
PANW	0.000669	2.291859	0.011394	0.146571
NFLX	0.000892	4.522031	0.022360	0.293159