

Machine Learning Portfolio

September 29, 2021

1 Machine Learning 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 fix_yahoo_finance as yf
yf.pdr_override()
```

```
[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'
```

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

[illegible]

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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]: 727

```

```

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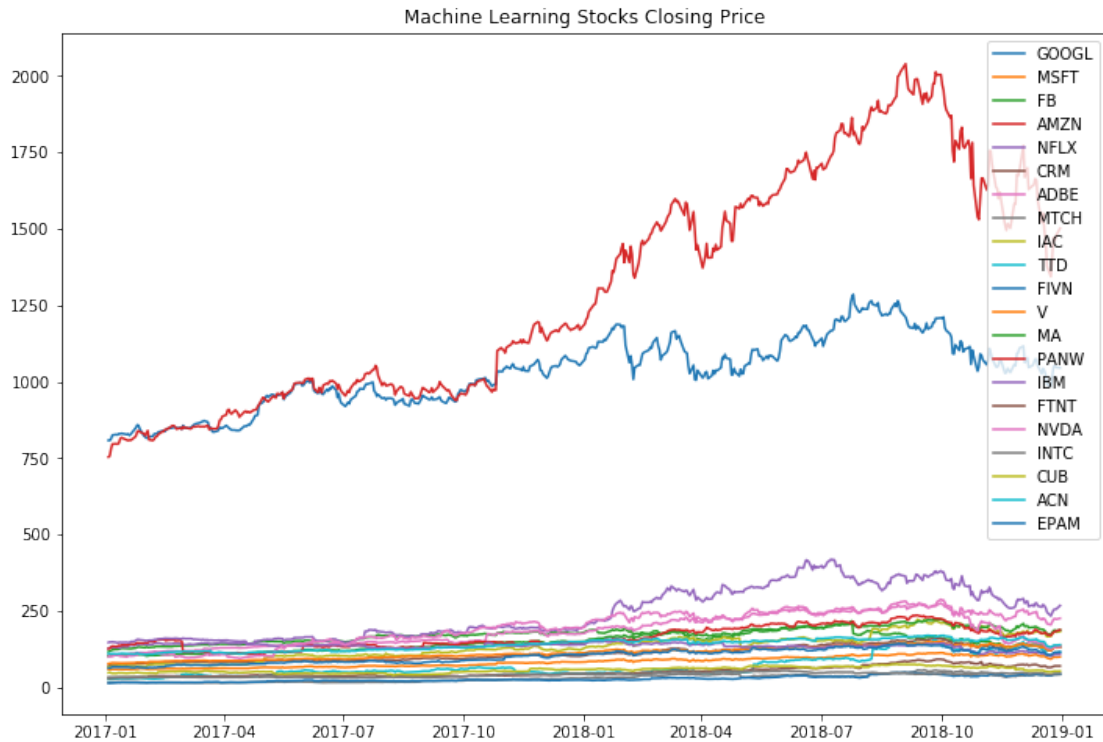
	V	MA	PANW	IBM	FTNT	\
Date						
2017-01-03	77.918709	103.471863	126.940002	146.935089	30.120001	
2017-01-04	78.555786	104.453651	128.000000	148.754303	30.420000	
2017-01-05	79.477066	105.260406	131.970001	148.262131	30.830000	
2017-01-06	80.574791	106.017982	135.050003	148.991577	31.010000	
2017-01-09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

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

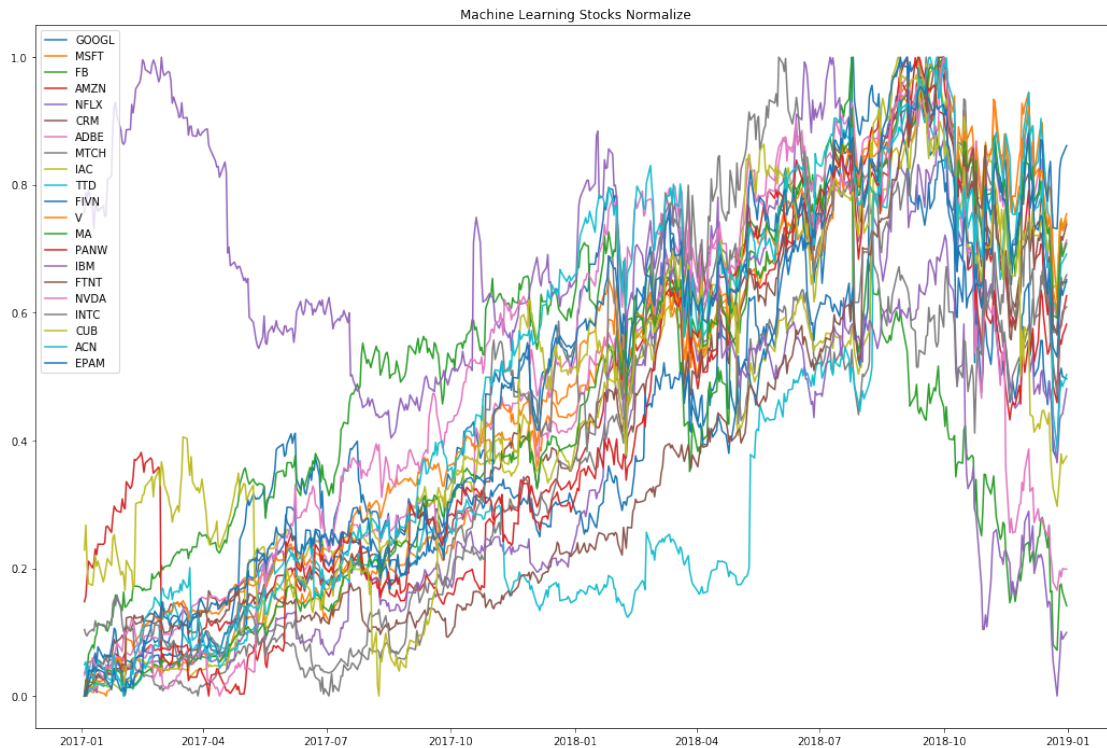
[8]: <matplotlib.legend.Legend at 0x1dc4f915550>



```
[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)
```

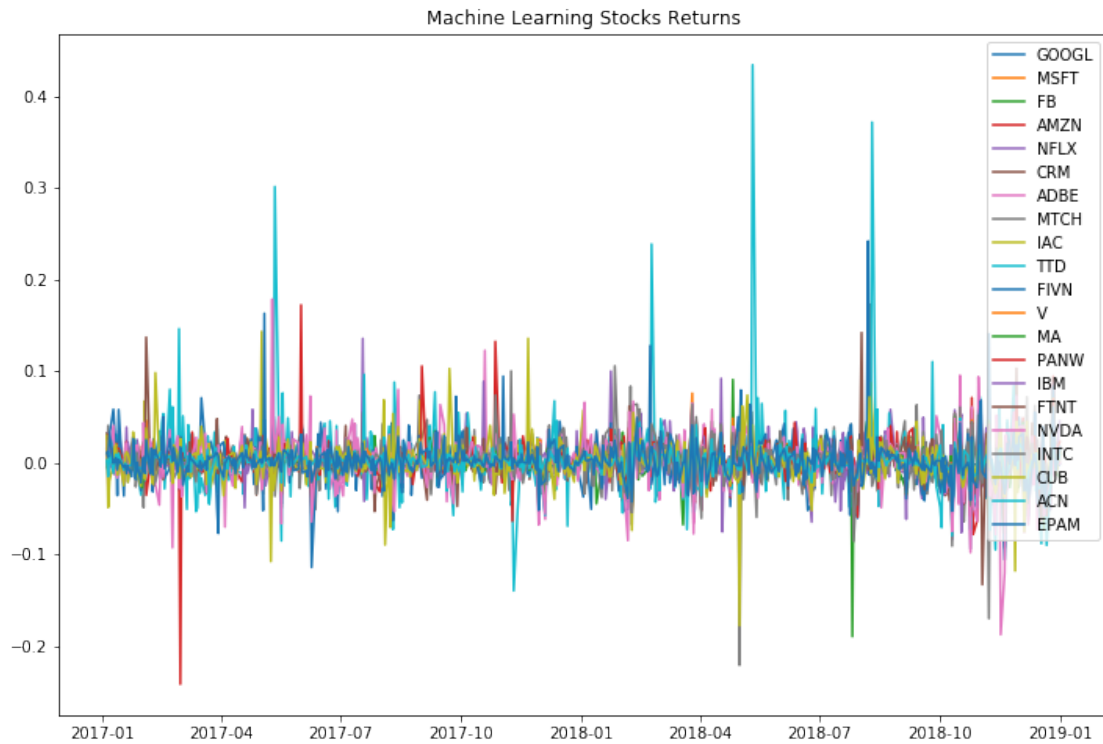
```
[10]: <matplotlib.legend.Legend at 0x1dc4f9b3b70>
```



```
[11]: stock_returns = df.pct_change().dropna()
```

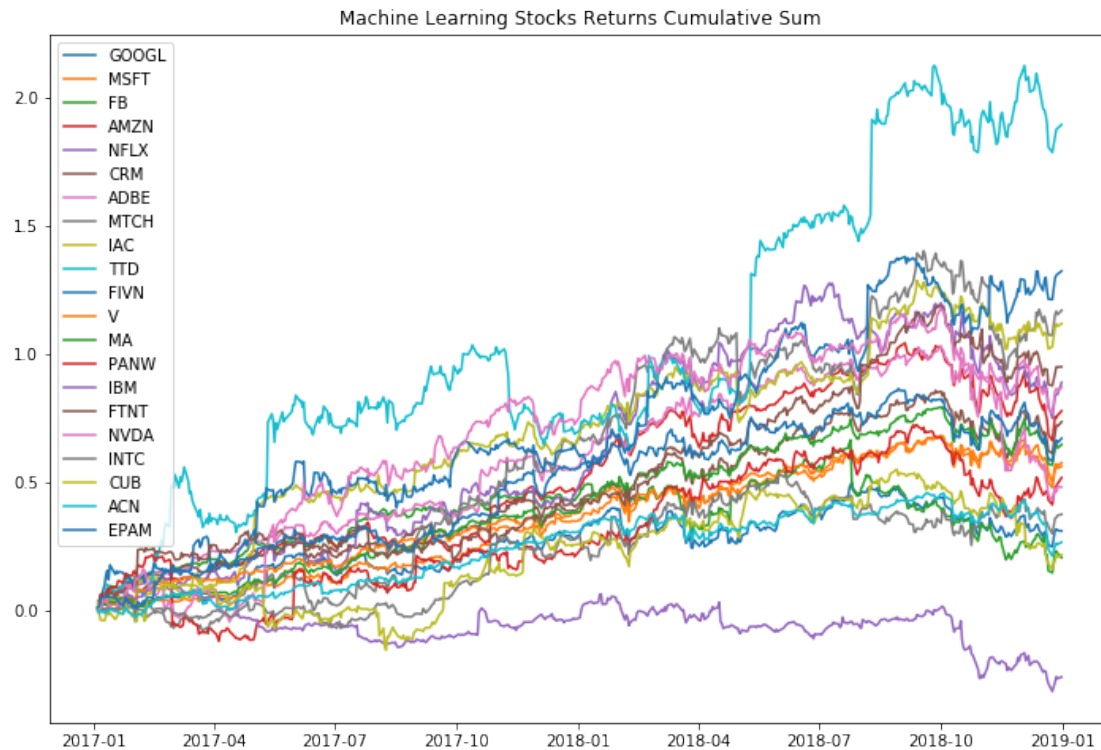
```
[12]: plt.figure(figsize=(12,8))
plt.plot(stock_returns)
plt.title('Machine Learning Stocks Returns')
plt.legend(labels=stock_returns.columns)
```

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



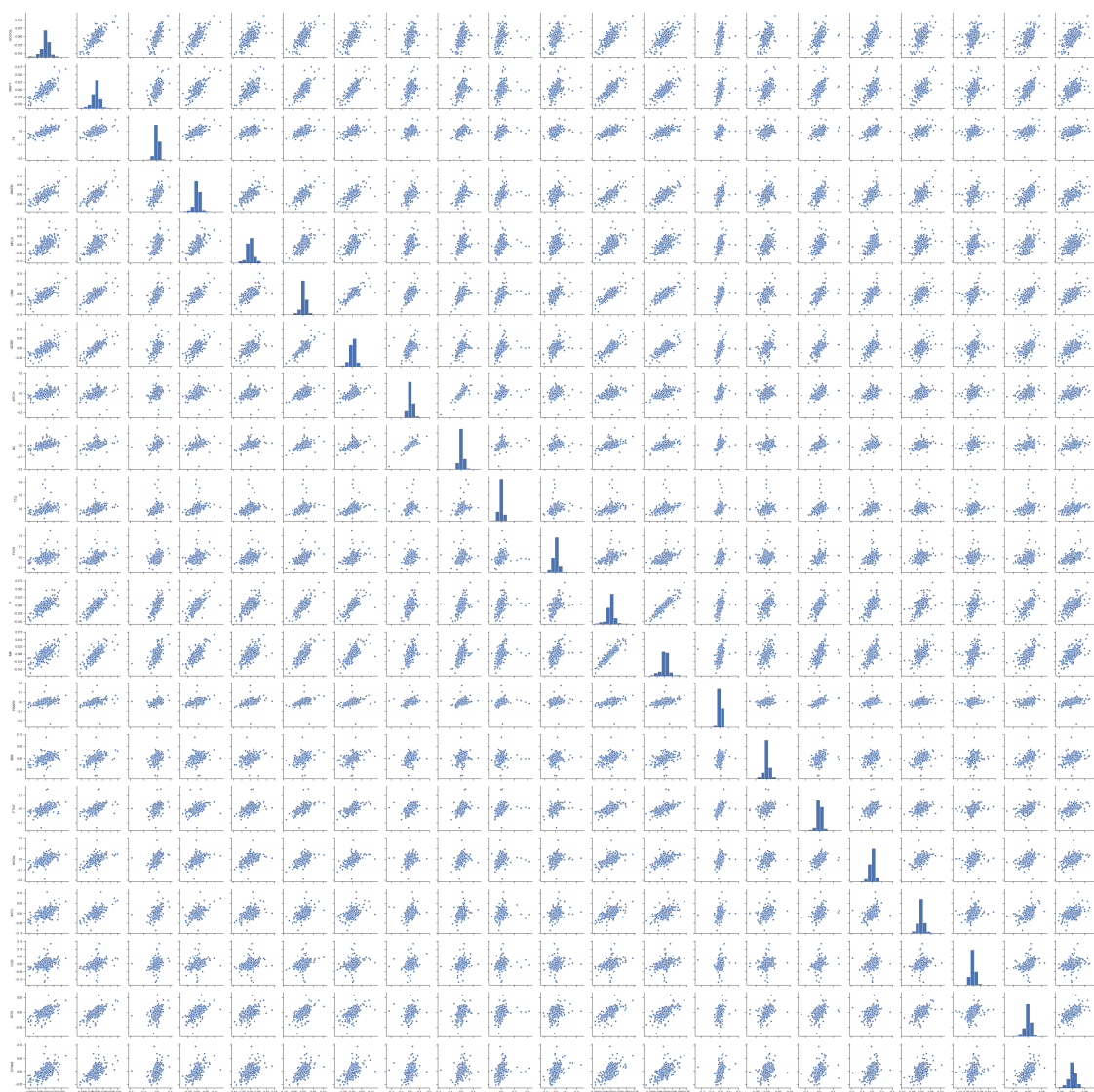
```
[13]: plt.figure(figsize=(12,8))
plt.plot(stock_rets.cumsum())
plt.title('Machine Learning Stocks Returns Cumulative Sum')
plt.legend(labels=stock_rets.columns)
```

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

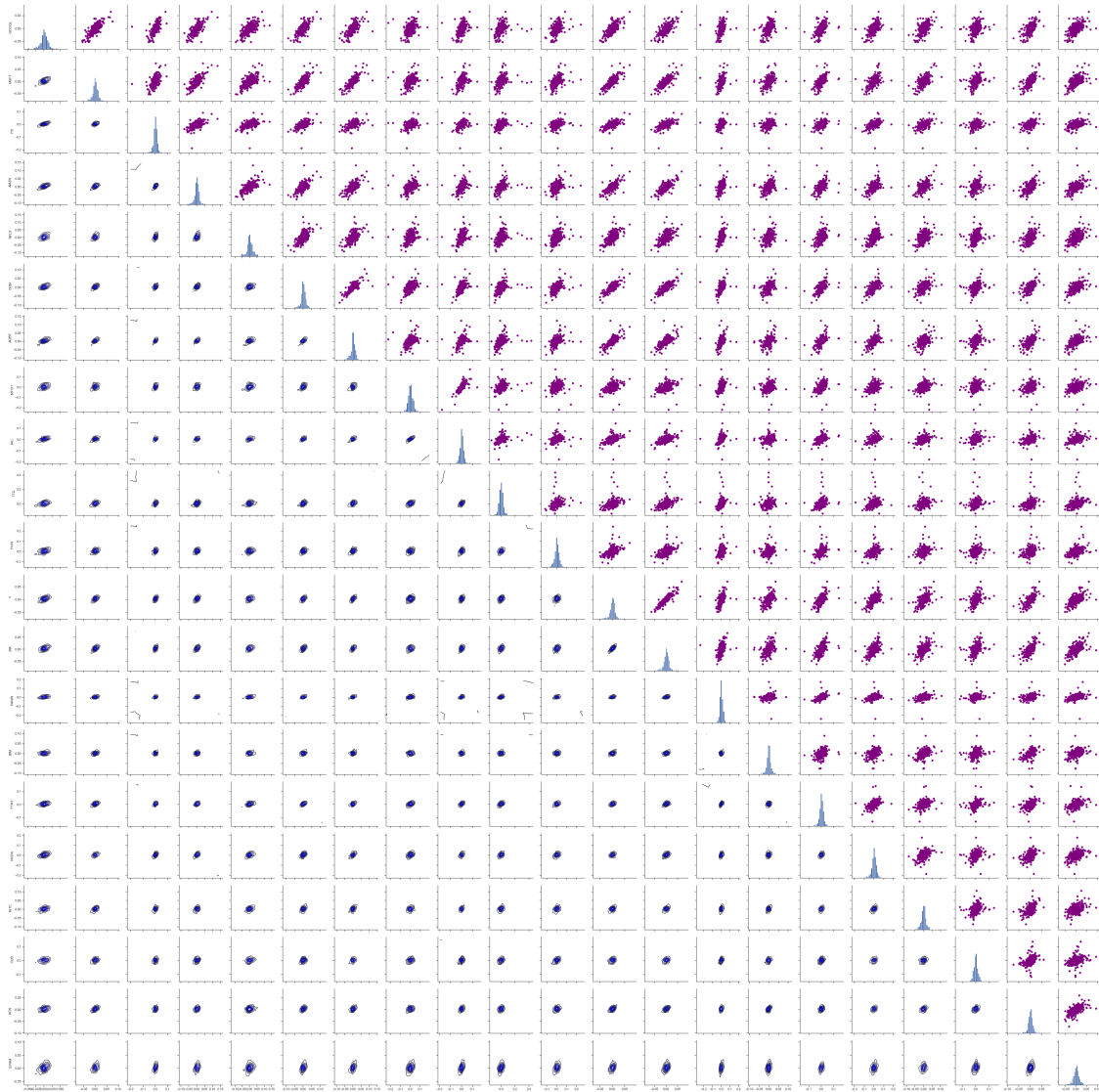


```
[14]: sns.set(style='ticks')
ax = sns.pairplot(stock_returns, diag_kind='hist')

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



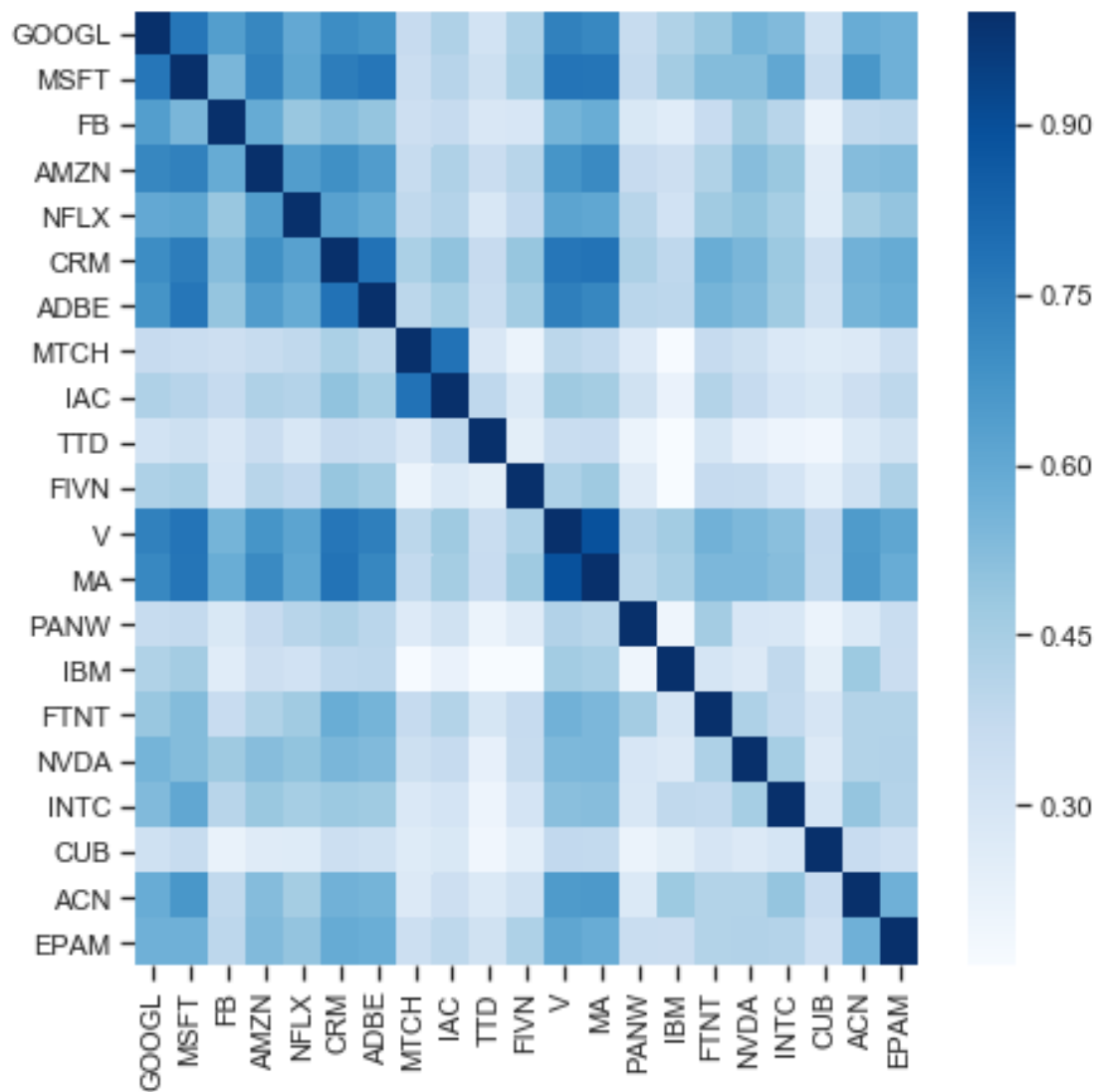
```
[15]: ax = sns.PairGrid(stock_rets)
ax.map_upper(plt.scatter, color='purple')
ax.map_lower(sns.kdeplot, color='blue')
ax.map_diag(plt.hist, bins=30)
for i in range(nplot) :
    for j in range(nplot) :
        ax.axes[i, j].locator_params(axis='x', nbins=6, tight=True)
```

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

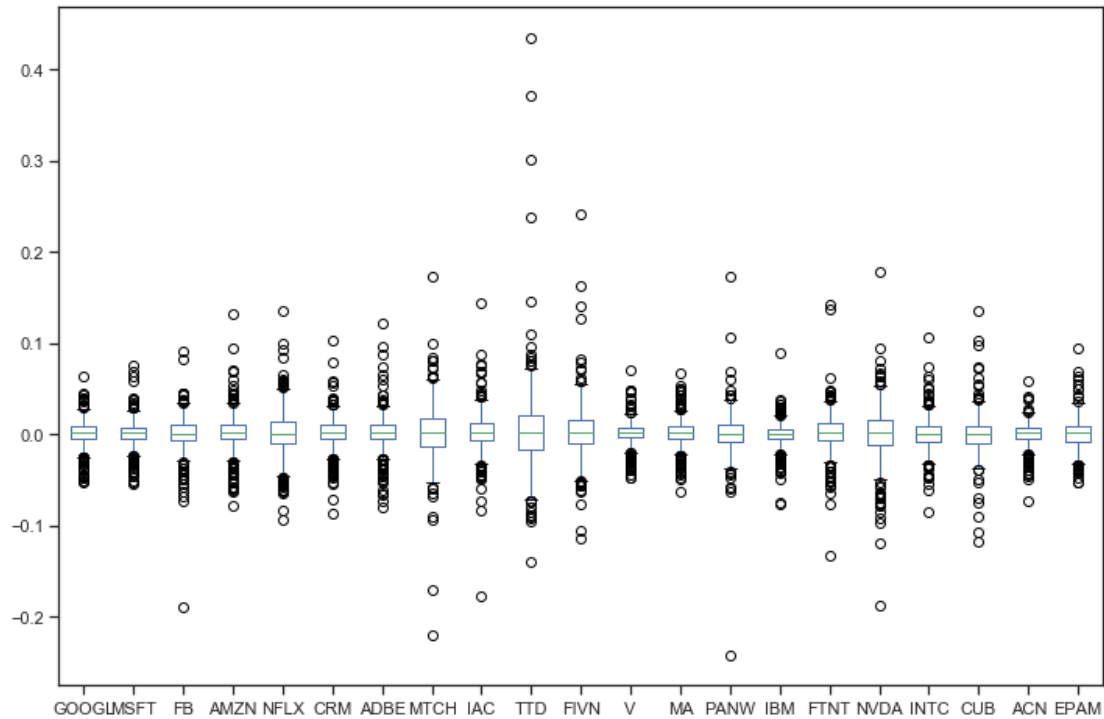
      # plot the heatmap
      sns.heatmap(corr,
                  xticklabels=corr.columns,
                  yticklabels=corr.columns,
                  cmap="Blues")
```

```
[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>
```

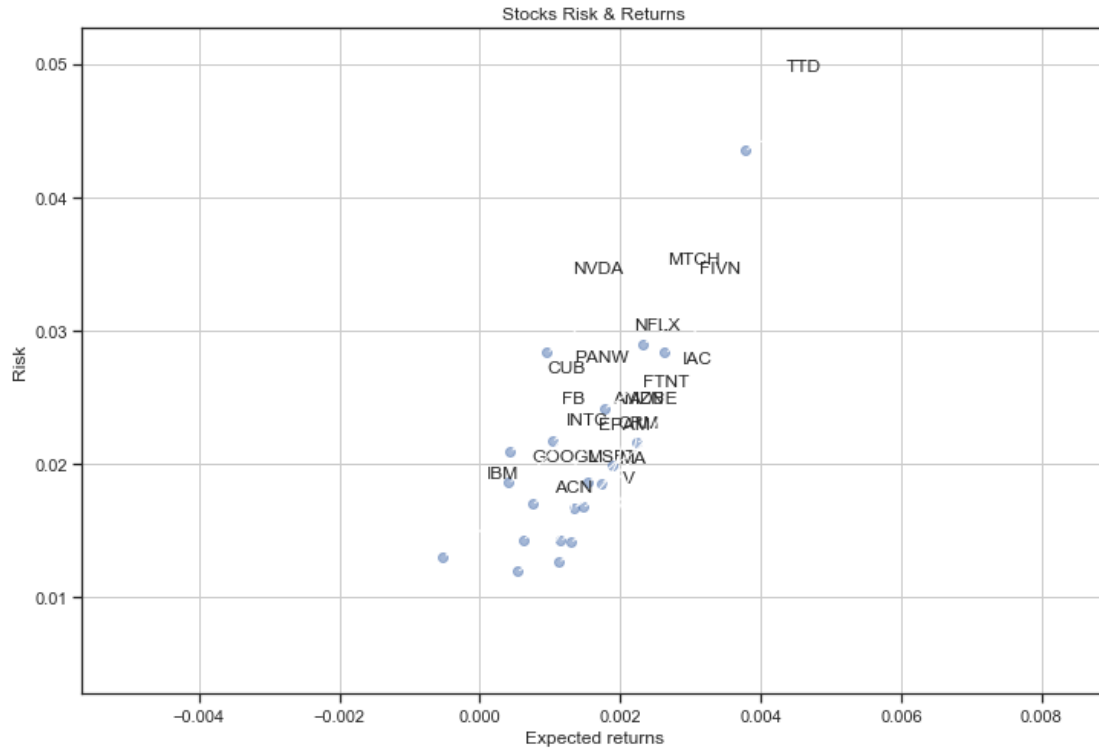


```
[18]: rets = stock_rets.dropna()

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')

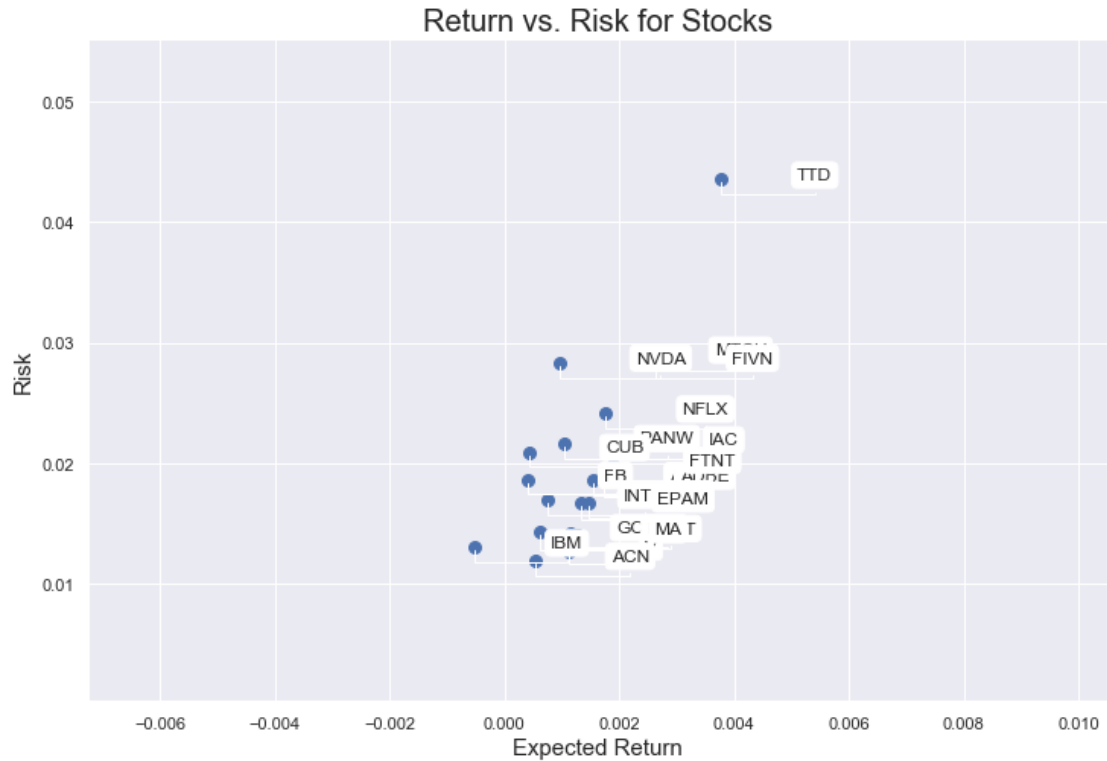
for label, x, y in zip(rets.columns, rets.mean(), rets.std()):
    plt.annotate(
        label,
        xy = (x, y), xytext = (50, 50),
        textcoords = 'offset points', ha = 'right', va = 'bottom',
        arrowprops = dict(arrowstyle = '-', connectionstyle = 'arc3,rad=-0.3'))
```



```
[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"))
```



```
[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]: # 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

```

```

[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]: 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]: 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