Electric_Car_Portfolio

September 29, 2021

1 Electric Car Portfolio

1.1 Auto Industry Electric Car. Tesla is number one making electric cars.

[1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import matplotlib.mlab as mlab
import seaborn as sns
from tabulate import tabulate
from scipy.stats import norm
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
symbols = ['APTV','DLPH','BWA','MGA', 'TEL', 'APH']
start = '2012-01-01'
end = '2019-01-01'

# Read data
df = yf.download(symbols,start,end)['Adj Close']

# View Columns
df.head()
```

```
[*********************100%***********************]  6 of 6 downloaded
```

[2]:

	APH	APTV	BWA	DLPH	MGA	TEL
Date						
2012-01-03	20.987455	16.755810	29.935097	20.233074	13.095776	26.712214
2012-01-04	20.923529	16.981829	30.205029	20.505997	12.999539	26.788586
2012-01-05	21.101624	16.680466	30.241634	20.142094	13.115023	27.085575

2012-01-06	21.110752	16.989363	29.793272	20.515102	13.942646	27.458939
2012-01-09	21.471506	17.109905	29.445557	20.660658	13.934944	27.840778

[3]:

```
df.tail()
```

[3]:

	APH	APTV	BWA	DLPH	MGA	TEL
Date						
2018-12-24	75.083298	59.447056	32.739914	13.84	43.011356	69.623863
2018-12-26	78.259315	61.089565	33.923286	14.34	44.535961	72.006348
2018-12-27	79.817551	61.307251	34.288158	14.24	45.523048	74.044266
2018-12-28	79.867188	60.733360	34.031761	14.31	44.496872	73.591400
2018-12-31	80.413063	60.921356	34.258575	14.32	44.418686	74.457756

[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?
7 years
```

[5]:

```
for s in symbols:
    df[s].plot(label = s, figsize = (15,10))
plt.legend()
```

[5]: <matplotlib.legend.Legend at 0x24bab650e10>

[6]:
```
for s in symbols:
    print(s + ":",  df[s].max())
```

```
APTV: 101.32328000000001
DLPH: 100.869919
BWA: 62.548565
MGA: 63.601349
TEL: 102.523895
APH: 95.84391
```

[7]:
```
for s in symbols:
    print(s + ":",  df[s].min())
```

```
APTV: 16.680466
DLPH: 13.78
BWA: 26.344611999999998
MGA: 12.999539
TEL: 26.155306
APH: 20.923529000000002
```

[8]:
```
returns = pd.DataFrame()
for s in symbols:
    returns[s + " Return"] = (np.log(1 + df[s].pct_change())).dropna()

returns.head(4)
```

[8]:

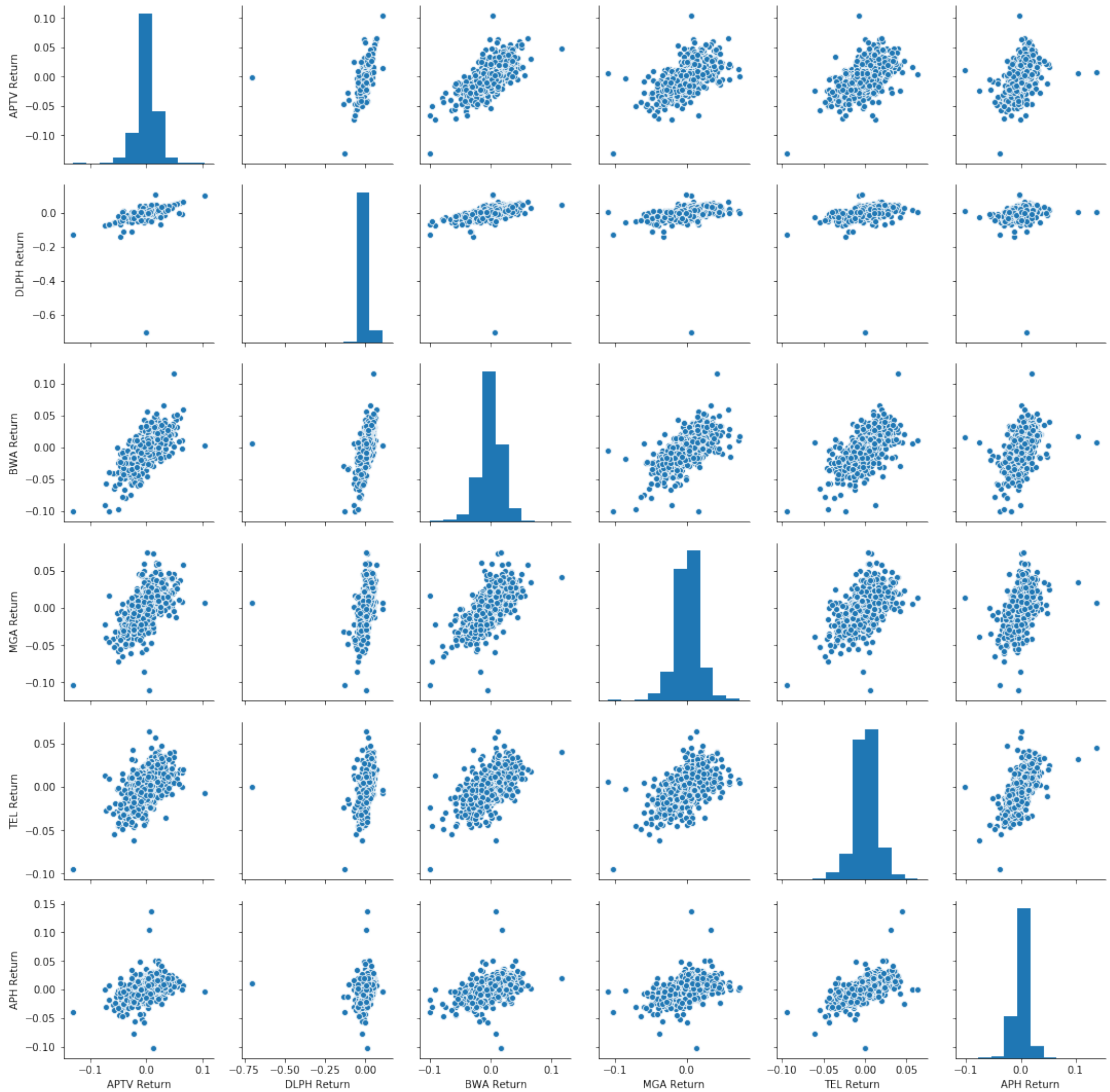
```
            APTV Return  DLPH Return  BWA Return  MGA Return  TEL Return  \
Date
2012-01-04     0.013399     0.013399    0.008977   -0.007376    0.002855
2012-01-05    -0.017906    -0.017906    0.001211    0.008844    0.011025
2012-01-06     0.018349     0.018349   -0.014937    0.061194    0.013690
2012-01-09     0.007070     0.007070   -0.011740   -0.000553    0.013810

            APH Return
Date
2012-01-04   -0.003051
2012-01-05    0.008476
2012-01-06    0.000432
2012-01-09    0.016944
```

[9]:

```
sns.pairplot(returns[1:])
```

[9]:

```
<seaborn.axisgrid.PairGrid at 0x24bab9fd8d0>
```



[10]:

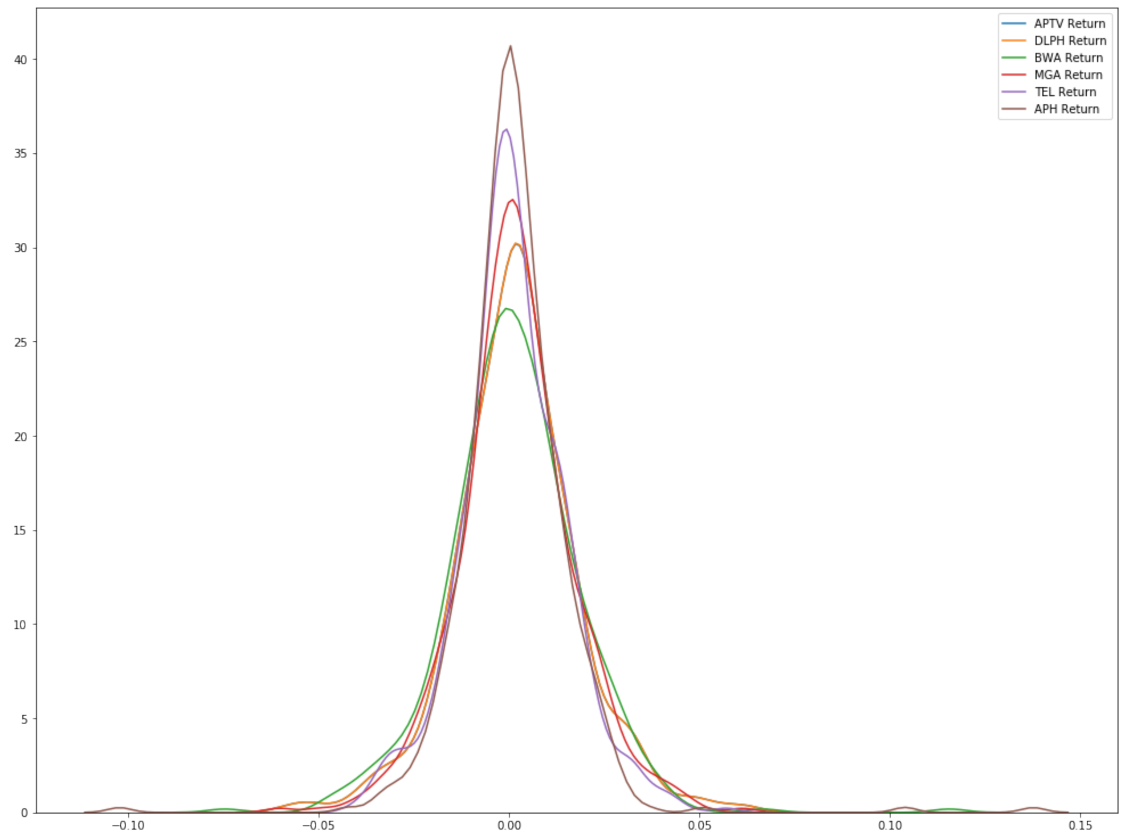
```
# dates each bank stock had the best and worst single day returns.
print('Best Day Returns')
print('-'*20)
print(returns.idxmax())
print('\n')
print('Worst Day Returns')
print('-'*20)
print(returns.idxmin())
```

```
Best Day Returns
--------------------
APTV Return    2017-05-03
DLPH Return    2017-12-05
BWA Return     2012-01-10
```

```
MGA Return    2016-02-26
TEL Return    2014-01-22
APH Return    2012-07-18
dtype: datetime64[ns]


Worst Day Returns
--------------------
APTV Return   2016-06-24
DLPH Return   2017-11-21
BWA Return    2016-01-13
MGA Return    2015-11-05
TEL Return    2016-06-24
APH Return    2013-07-18
dtype: datetime64[ns]
```

[11]:

```
plt.figure(figsize=(17,13))

for r in returns:
    sns.kdeplot(returns.ix["2012-01-01" : "2013-12-31 "][r])
```

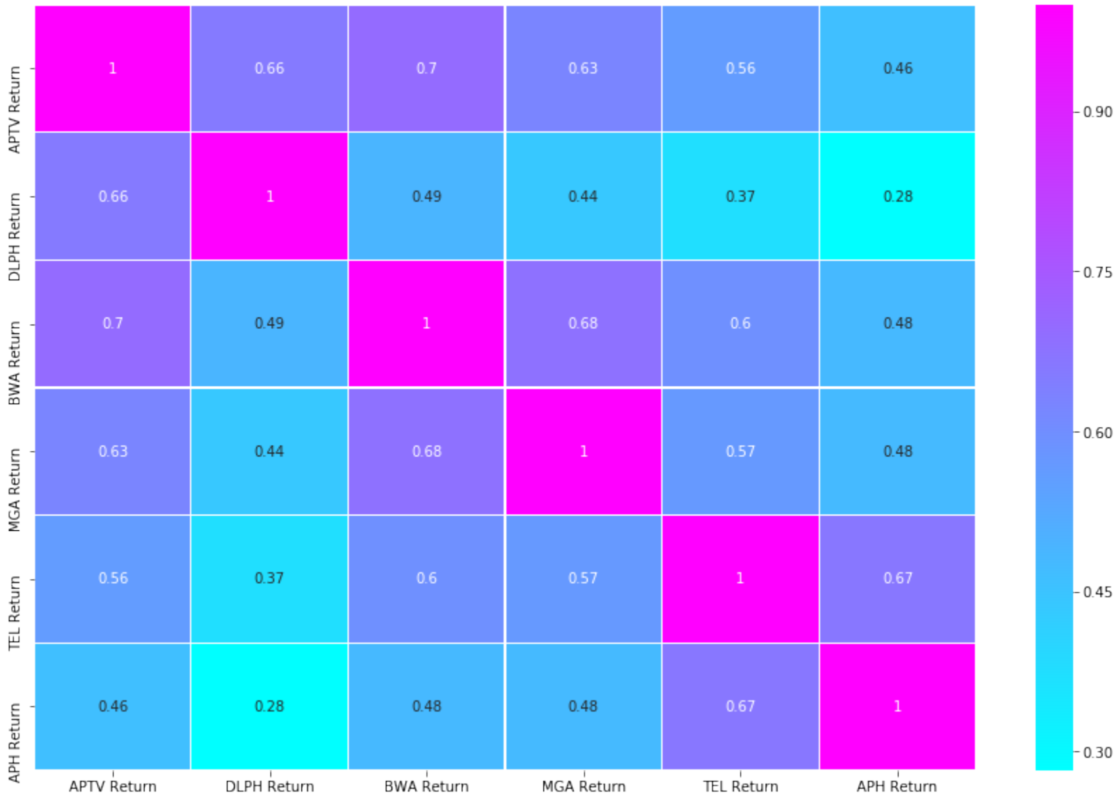


[12]:
```
returns.corr()
```

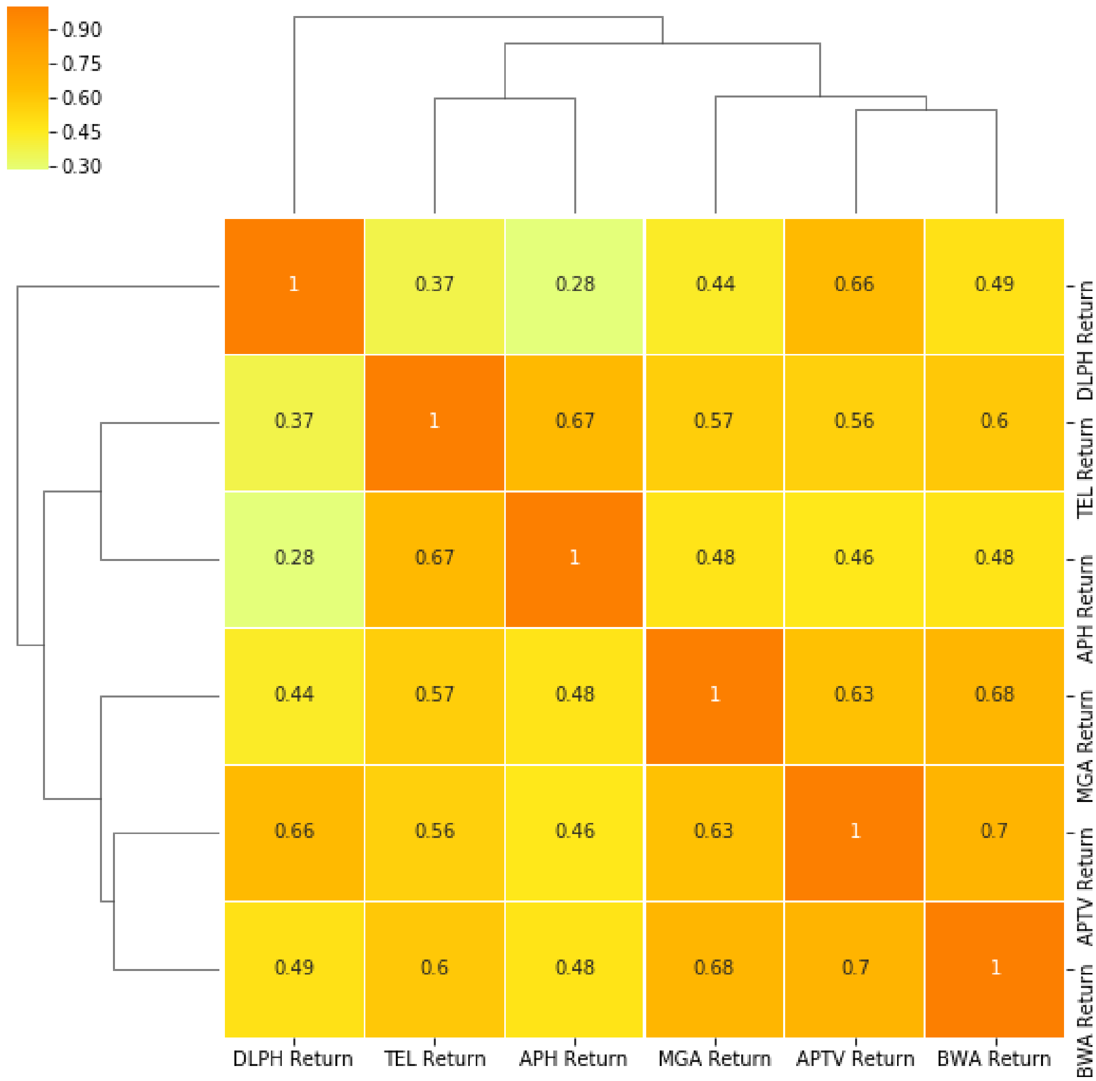
[12]:
```
             APTV Return  DLPH Return  BWA Return  MGA Return  TEL Return  \
APTV Return     1.000000     0.655947    0.699680    0.625162    0.560528
DLPH Return     0.655947     1.000000    0.489578    0.437349    0.373882
BWA Return      0.699680     0.489578    1.000000    0.680684    0.595405
MGA Return      0.625162     0.437349    0.680684    1.000000    0.569181
TEL Return      0.560528     0.373882    0.595405    0.569181    1.000000
APH Return      0.462075     0.281982    0.479691    0.477818    0.665304

             APH Return
APTV Return    0.462075
DLPH Return    0.281982
BWA Return     0.479691
MGA Return     0.477818
TEL Return     0.665304
APH Return     1.000000
```

[13]:
```
# Heatmap for return of all the banks
plt.figure(figsize=(15,10))
sns.heatmap(returns.corr(), cmap="cool",linewidths=.1, annot= True)

sns.clustermap(returns.corr(), cmap="Wistia",linewidths=.1, annot= True)
```

[13]:
```
<seaborn.matrix.ClusterGrid at 0x24bad59de10>
```

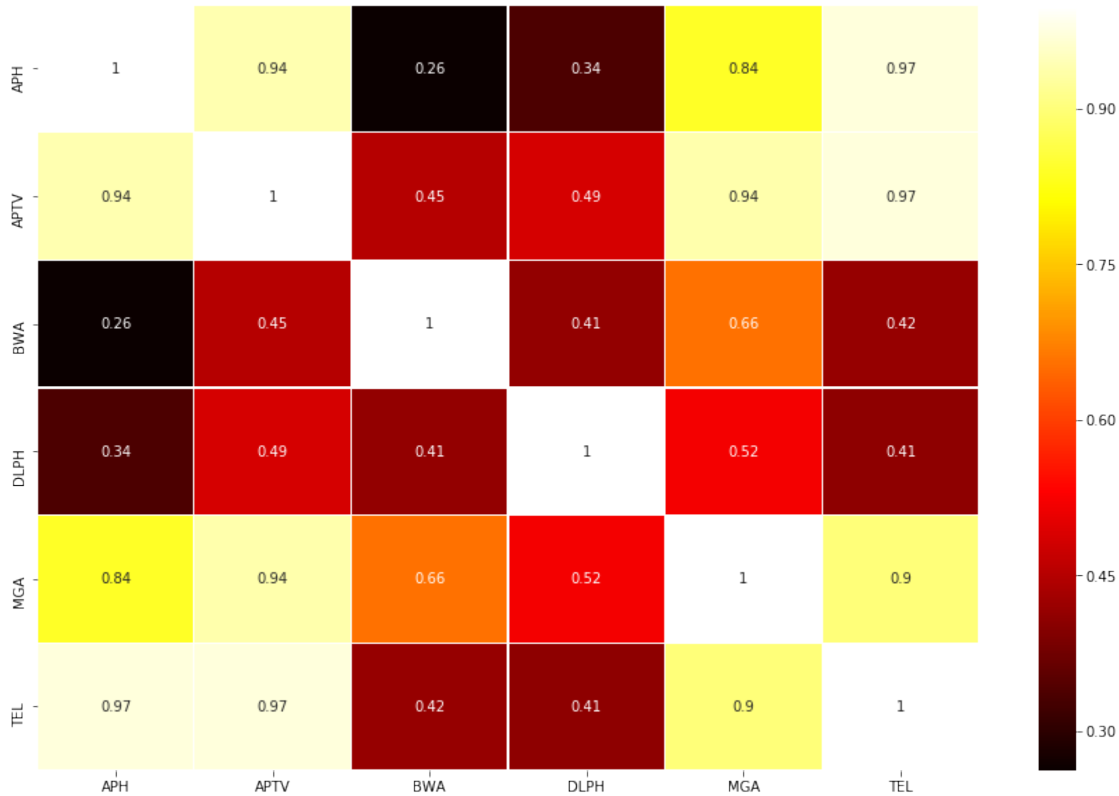


APTV Return
DLPH Return
BWA Return
MGA Return
TEL Return
APH Return
1
0.66
0.7
0.63
0.56
0.46
0.66
1
0.49
0.44
0.37
0.28
0.7
0.49
1
0.68
0.6
0.48
0.63
0.44
0.68
1
0.57
0.48
0.56
0.37
0.6
0.57
1
0.67
0.46
0.28
0.48
0.48
0.67
1
0.90
0.75
0.60
0.45
0.30

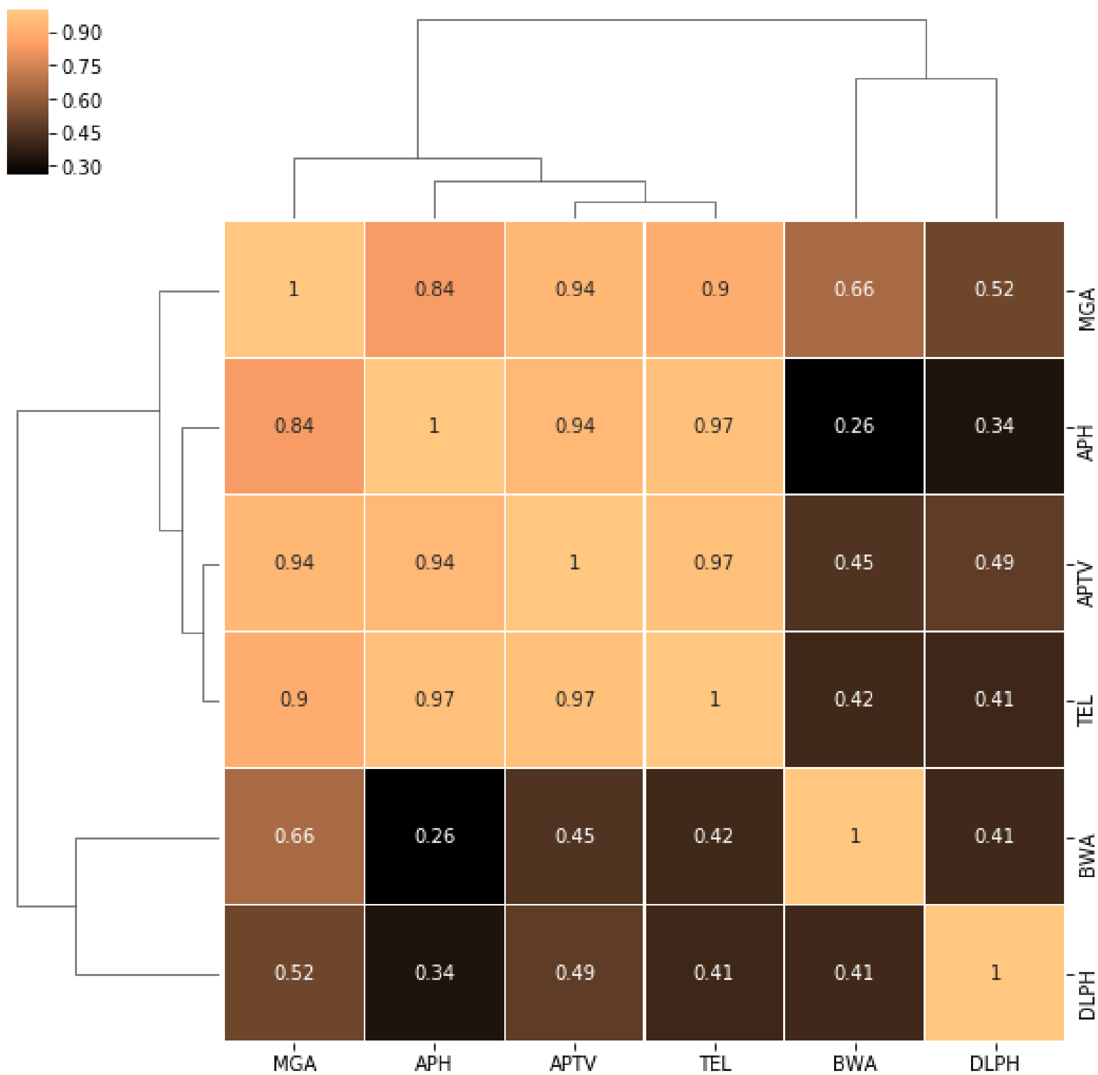


[14]:
```
plt.figure(figsize=(15,10))
sns.heatmap(df.corr(), cmap="hot",linewidths=.1, annot= True)

sns.clustermap(df.corr(), cmap="copper",linewidths=.1, annot= True)
```

[14]: <seaborn.matrix.ClusterGrid at 0x24bad59d5c0>



APH
APTV
BWA
DLPH
MGA
TEL
1
0.94
0.26
0.34
0.84
0.97
0.94
1
0.45
0.49
0.94
0.97
0.26
0.45
1
0.41
0.66
0.42
0.34
0.49
0.41
1
0.52
0.41
0.84
0.94
0.66
0.52
1
0.9
0.97
0.97
0.42
0.41
0.9
1
0.90
0.75
0.60
0.45
0.30



[15]:
```
Cash = 100000
print('Percentage of invest:')
percent_invest = [0.16, 0.16, 0.16, 0.16, 0.16, 0.16]
for i, x in zip(df.columns, percent_invest):
    cost = x * Cash
    print('{}: {}'.format(i, cost))
```

```
Percentage of invest:
APH: 16000.0
APTV: 16000.0
BWA: 16000.0
DLPH: 16000.0
MGA: 16000.0
TEL: 16000.0
```

[16]:

```
print('Number of Shares:')
percent_invest = [0.16, 0.16, 0.16, 0.16, 0.16, 0.16]
for i, x, y in zip(df.columns, percent_invest, df.iloc[0]):
    cost = x * Cash
    shares = int(cost/y)
    print('{}: {}'.format(i, shares))
```

```
Number of Shares:
APH: 762
APTV: 954
BWA: 534
DLPH: 790
MGA: 1221
TEL: 598
```

[17]:

```
print('Beginning Value:')
percent_invest = [0.16, 0.16, 0.16, 0.16, 0.16, 0.16]
for i, x, y in zip(df.columns, percent_invest, df.iloc[0]):
    cost = x * Cash
    shares = int(cost/y)
    Begin_Value = round(shares * y, 2)
    print('{}: ${}'.format(i, Begin_Value))
```

```
Beginning Value:
APH: $15992.44
APTV: $15985.04
BWA: $15985.34
DLPH: $15984.13
MGA: $15989.94
TEL: $15973.9
```

[18]:

```
print('Current Value:')
percent_invest = [0.16, 0.16, 0.16, 0.16, 0.16, 0.16]
for i, x, y, z in zip(df.columns, percent_invest, df.iloc[0], df.iloc[-1]):
    cost = x * Cash
    shares = int(cost/y)
    Current_Value = round(shares * z, 2)
    print('{}: ${}'.format(i, Current_Value))
```

```
Current Value:
APH: $61274.75
APTV: $58118.97
BWA: $18294.08
DLPH: $11312.8
MGA: $54235.22
TEL: $44525.74
```

[19]:
```
result = []
percent_invest = [0.16, 0.16, 0.16, 0.16, 0.16, 0.16]
for i, x, y, z in zip(df.columns, percent_invest, df.iloc[0], df.iloc[-1]):
    cost = x * Cash
    shares = int(cost/y)
    Current_Value = round(shares * z, 2)
    result.append(Current_Value)
print('Total Value: $%s' % round(sum(result),2))
```

```
Total Value: $247761.56
```

[20]:
```
# Calculate Daily Returns
returns = df.pct_change()
returns = returns.dropna()
```

[21]:
```
# Calculate mean returns
meanDailyReturns = returns.mean()
print(meanDailyReturns)
```

```
APH     0.000842
APTV    0.000879
BWA     0.000242
DLPH    0.000088
MGA     0.000836
TEL     0.000671
dtype: float64
```

[22]:
```
# Calculate std returns
stdDailyReturns = returns.std()
print(stdDailyReturns)
```

```
APH     0.012556
APTV    0.017006
BWA     0.018171
DLPH    0.022068
MGA     0.016787
TEL     0.013232
dtype: float64
```

[23]:
```
# Define weights for the portfolio
weights = np.array([0.16, 0.16, 0.16, 0.16, 0.16, 0.16])
```

[24]:
```
# Calculate the covariance matrix on daily returns
cov_matrix = (returns.cov())*250
print (cov_matrix)
```

```
           APH      APTV       BWA      DLPH       MGA       TEL
APH   0.039413  0.024463  0.027225  0.022212  0.025013  0.027519
```

```
APTV  0.024463  0.072297  0.053788  0.069516  0.044385  0.031306
BWA   0.027225  0.053788  0.082546  0.055476  0.051807  0.035694
DLPH  0.022212  0.069516  0.055476  0.121744  0.045733  0.030671
MGA   0.025013  0.044385  0.051807  0.045733  0.070447  0.031455
TEL   0.027519  0.031306  0.035694  0.030671  0.031455  0.043769
```

[25]:
```python
# Calculate expected portfolio performance
portReturn = np.sum(meanDailyReturns*weights)
```

[26]:
```python
# Print the portfolio return
print(portReturn)
```

```
0.0005693437365548716
```

[27]:
```python
# Create portfolio returns column
returns['Portfolio'] = returns.dot(weights)
```

[28]:
```python
returns.head()
```

[28]:
```
                 APH      APTV       BWA      DLPH       MGA       TEL  \
Date
2012-01-04 -0.003046  0.013489  0.009017  0.013489 -0.007349  0.002859
2012-01-05  0.008512 -0.017746  0.001212 -0.017746  0.008884  0.011086
2012-01-06  0.000433  0.018518 -0.014826  0.018519  0.063105  0.013785
2012-01-09  0.017089  0.007095 -0.011671  0.007095 -0.000552  0.013906
2012-01-10  0.020417  0.049318  0.122592  0.049317  0.042818  0.041146

            Portfolio
Date
2012-01-04   0.004554
2012-01-05  -0.000928
2012-01-06   0.015925
2012-01-09   0.005274
2012-01-10   0.052097
```

[29]:
```python
returns.tail()
```

[29]:
```
                 APH      APTV       BWA      DLPH       MGA       TEL  \
Date
2018-12-24 -0.020965 -0.022135 -0.016879  0.004354 -0.028262 -0.017641
2018-12-26  0.042300  0.027630  0.036145  0.036127  0.035447  0.034219
2018-12-27  0.019911  0.003563  0.010756 -0.006974  0.022164  0.028302
2018-12-28  0.000622 -0.009361 -0.007478  0.004916 -0.022542 -0.006116
2018-12-31  0.006835  0.003095  0.006665  0.000699 -0.001757  0.011773

            Portfolio
Date
```

```
2018-12-24  -0.016245
2018-12-26   0.033899
2018-12-27   0.012436
2018-12-28  -0.006393
2018-12-31   0.004369
```

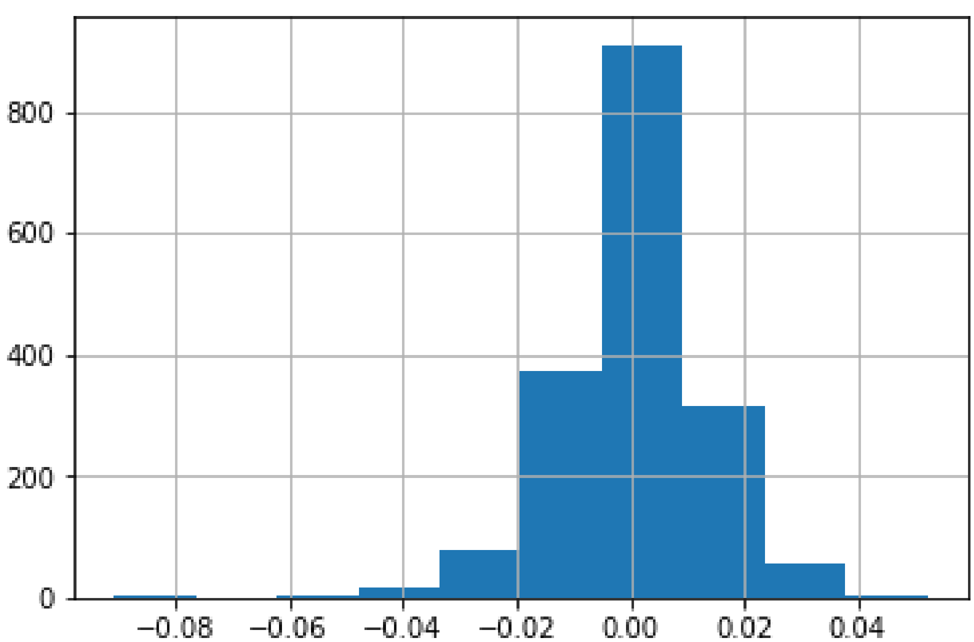
[30]:

```
# Calculate cumulative returns
daily_cum_ret=(1+returns).cumprod()
print(daily_cum_ret.tail())
```

```
                 APH      APTV       BWA      DLPH       MGA       TEL  \
Date
2018-12-24  3.577532  3.547847  1.093697  0.684029  3.284369  2.606443
2018-12-26  3.728862  3.645874  1.133228  0.708741  3.400788  2.695634
2018-12-27  3.803108  3.658865  1.145417  0.703798  3.476163  2.771925
2018-12-28  3.805473  3.624615  1.136852  0.707258  3.397803  2.754972
2018-12-31  3.831482  3.635835  1.144428  0.707752  3.391833  2.787405

            Portfolio
Date
2018-12-24   2.257880
2018-12-26   2.334419
2018-12-27   2.363449
2018-12-28   2.348338
2018-12-31   2.358599
```

[31]:

```
returns['Portfolio'].hist()
plt.show()
```



[32]:
```
# 99% confidence interval
# 0.01 empirical quantile of daily returns
var99 = round((returns['Portfolio']).quantile(0.01), 3)
```

[33]:
```
print('Value at Risk (99% confidence)')
print(var99)
```

```
Value at Risk (99% confidence)
-0.036
```

[34]:
```
# the percent value of the 5th quantile
print('Percent Value-at-Risk of the 5th quantile')
var_1_perc = round(np.quantile(var99, 0.01), 3)
print("{:.1f}%".format(-var_1_perc*100))
```

```
Percent Value-at-Risk of the 5th quantile
3.6%
```

[35]:
```
print('Value-at-Risk of 99% for 100,000 investment')
print("${}".format(-var99 * 100000))
```

```
Value-at-Risk of 99% for 100,000 investment
$3599.9999999999995
```

[36]:
```
# 95% confidence interval
# 0.05 empirical quantile of daily returns
var95 = round((returns['Portfolio']).quantile(0.05), 3)
```

[37]:
```
print('Value at Risk (95% confidence)')
print(var95)
```

```
Value at Risk (95% confidence)
-0.021
```

[38]:
```
print('Percent Value-at-Risk of the 5th quantile')
print("{:.1f}%".format(-var95*100))
```

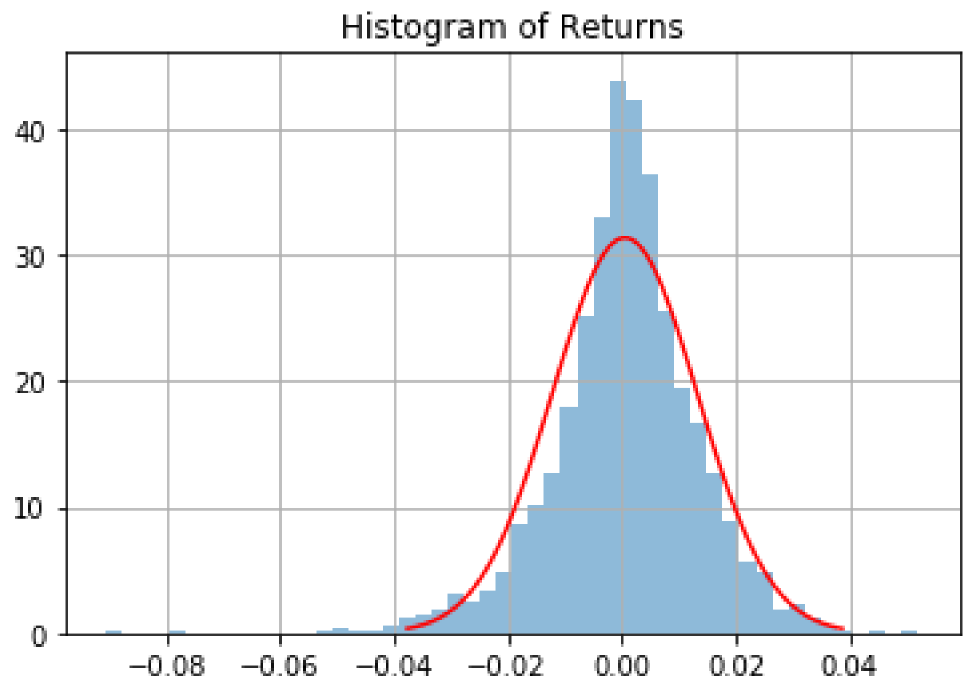
```
Percent Value-at-Risk of the 5th quantile
2.1%
```

[39]:
```
# VaR for 100,000 investment
print('Value-at-Risk of 99% for 100,000 investment')
var_100k = "${}".format(int(-var95 * 100000))
print("${}".format(int(-var95 * 100000)))
```

```
Value-at-Risk of 99% for 100,000 investment
$2100
```

[40]:
```
mean = np.mean(returns['Portfolio'])
std_dev = np.std(returns['Portfolio'])
```

[41]:
```
returns['Portfolio'].hist(bins=50, normed=True, histtype='stepfilled', alpha=0.
 ↪5)
x = np.linspace(mean - 3*std_dev, mean + 3*std_dev, 100)
plt.plot(x, mlab.normpdf(x, mean, std_dev), "r")
plt.title('Histogram of Returns')
plt.show()
```

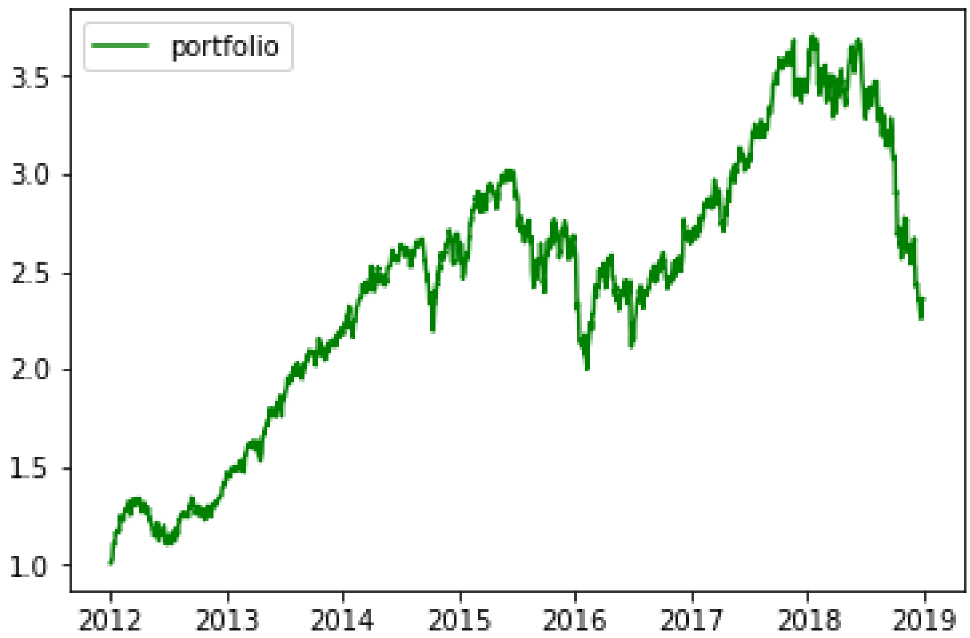


[42]:
```
VaR_90 = norm.ppf(1-0.9, mean, std_dev)
VaR_95 = norm.ppf(1-0.95, mean, std_dev)
VaR_99 = norm.ppf(1-0.99, mean, std_dev)
```

[43]:
```
print(tabulate([['90%', VaR_90], ['95%', VaR_95], ['99%', VaR_99]],␣
 ↪headers=['Confidence Level', 'Value at Risk']))
```

```
Confidence Level      Value at Risk
------------------  ---------------
90%                      -0.0157412
95%                      -0.020365
99%                      -0.0290385
```

[44]:
```python
import matplotlib.dates

# Plot the portfolio cumulative returns only
fig, ax = plt.subplots()
ax.plot(daily_cum_ret.index, daily_cum_ret.Portfolio, color='green',␣
 ↪label="portfolio")
ax.xaxis.set_major_locator(matplotlib.dates.YearLocator())
plt.legend()
plt.show()
```



[45]:
```python
# Print the mean
print("mean : ", returns['Portfolio'].mean()*100)

# Print the standard deviation
print("Std. dev: ", returns['Portfolio'].std()*100)

# Print the skewness
print("skew: ", returns['Portfolio'].skew())

# Print the kurtosis
print("kurt: ", returns['Portfolio'].kurtosis())
```

```
mean :  0.0569343736554873
Std. dev:  1.2730791008104436
skew:  -0.6206217132623457
kurt:  3.253055023400178
```

[46]:
```python
# Calculate the standard deviation by taking the square root
port_standard_dev = np.sqrt(np.dot(weights.T, np.dot(weights, cov_matrix)))

# Print the results
print(str(np.round(port_standard_dev, 4) * 100) + '%')
```

```
20.13%
```

[47]:
```python
# Calculate the portfolio variance
port_variance = np.dot(weights.T, np.dot(cov_matrix, weights))

# Print the result
print(str(np.round(port_variance, 4) * 100) + '%')
```

```
4.05%
```

[48]:
```python
# Calculate total return and annualized return from price data
total_return = returns['Portfolio'][-1] - returns['Portfolio'][0]

# Annualize the total return over 5 year
annualized_return = ((1+total_return)**(1/7))-1
```

[49]:
```python
# Calculate annualized volatility from the standard deviation
vol_port = returns['Portfolio'].std() * np.sqrt(250)
```

[50]:
```python
# Calculate the Sharpe ratio
rf = 0.001
sharpe_ratio = (annualized_return - rf) / vol_port
print(sharpe_ratio)
```

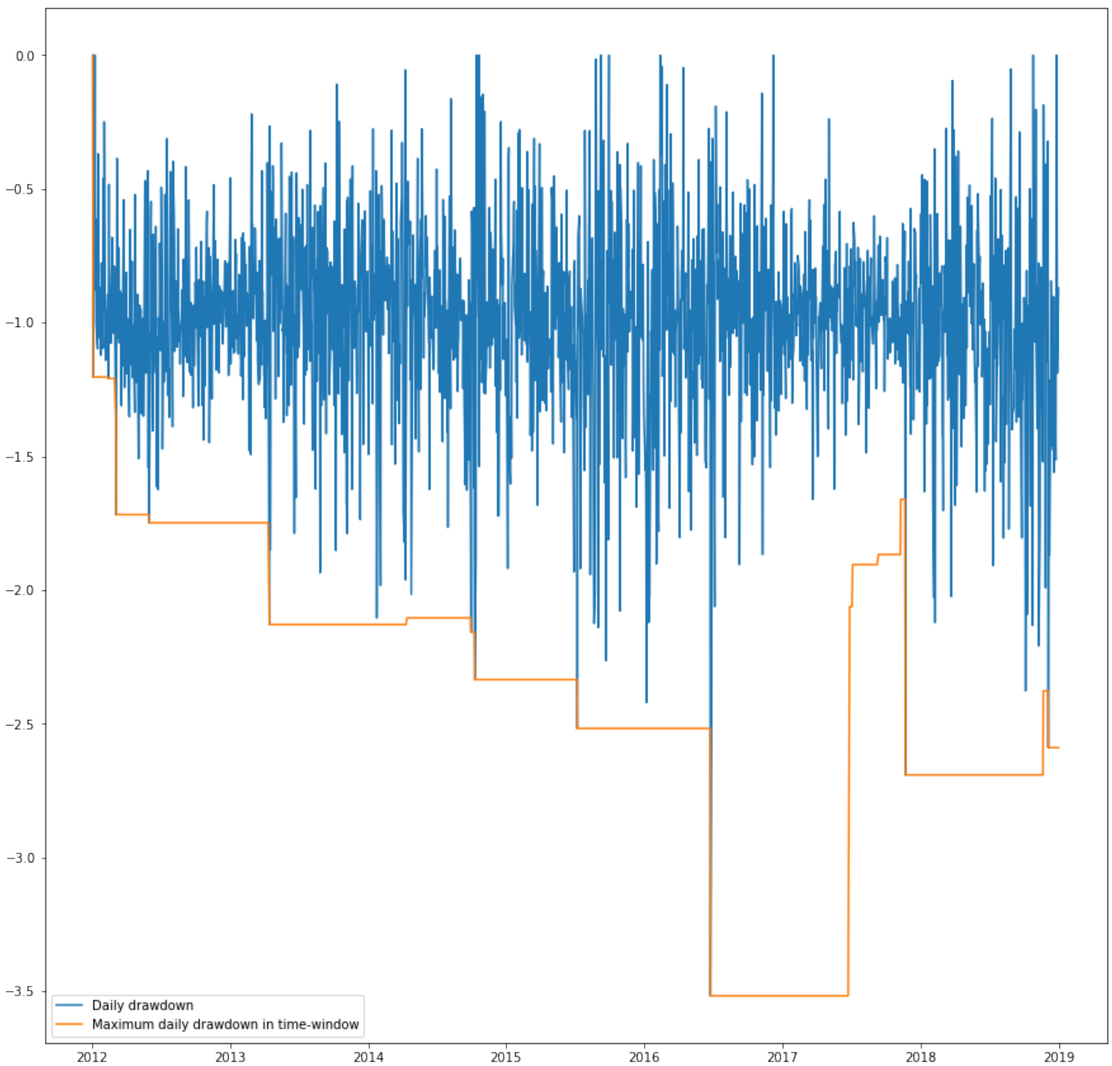
```
-0.005098564303148075
```

[51]:
```python
# Create a downside return column with the negative returns only
target = 0
downside_returns = returns.loc[returns['Portfolio'] < target]

# Calculate expected return and std dev of downside
expected_return = returns['Portfolio'].mean()
down_stdev = downside_returns.std()

# Calculate the sortino ratio
rf = 0.01
sortino_ratio = (expected_return - rf)/down_stdev

# Print the results
print("Expected return: ", expected_return*100)
print('-' * 50)
```

```
print("Downside risk:")
print(down_stdev*100)
print('-' * 50)
print("Sortino ratio:")
print(sortino_ratio)
```

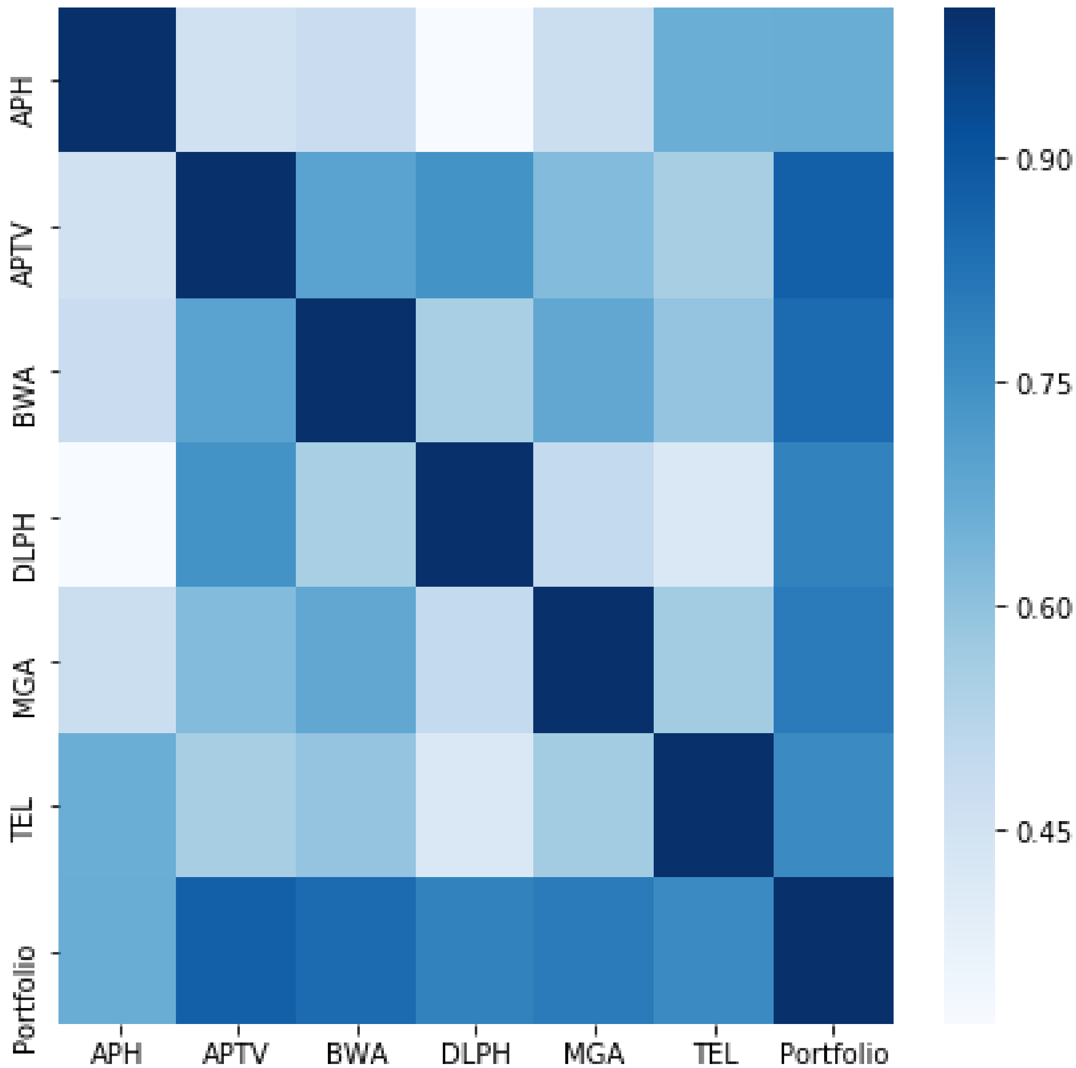
```
Expected return:  0.0569343736554873
--------------------------------------------------
Downside risk:
APH          1.096121
APTV         1.344966
BWA          1.480301
DLPH         2.298698
MGA          1.438537
TEL          1.168615
Portfolio    0.974102
dtype: float64
--------------------------------------------------
Sortino ratio:
APH         -0.860366
APTV        -0.701182
BWA         -0.637077
DLPH        -0.410261
MGA         -0.655573
TEL         -0.806994
Portfolio   -0.968138
dtype: float64
```

[52]:
```
# Calculate the max value
roll_max = returns['Portfolio'].rolling(center=False,min_periods=1,window=252).
 ↪max()

# Calculate the daily draw-down relative to the max
daily_draw_down = returns['Portfolio']/roll_max - 1.0

# Calculate the minimum (negative) daily draw-down
max_daily_draw_down = daily_draw_down.
 ↪rolling(center=False,min_periods=1,window=252).min()

# Plot the results
plt.figure(figsize=(15,15))
plt.plot(returns.index, daily_draw_down, label='Daily drawdown')
plt.plot(returns.index, max_daily_draw_down, label='Maximum daily drawdown in␣
 ↪time-window')
plt.legend()
plt.show()
```



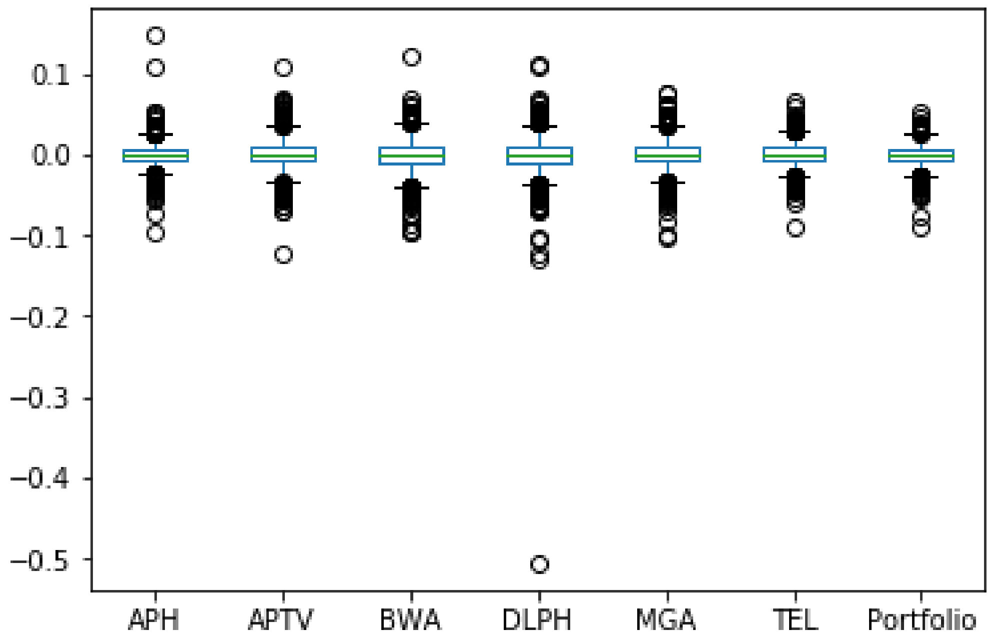
[53]:
```
plt.figure(figsize=(7,7))
corr = returns.corr()

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

[53]: <matplotlib.axes._subplots.AxesSubplot at 0x24bad597470>



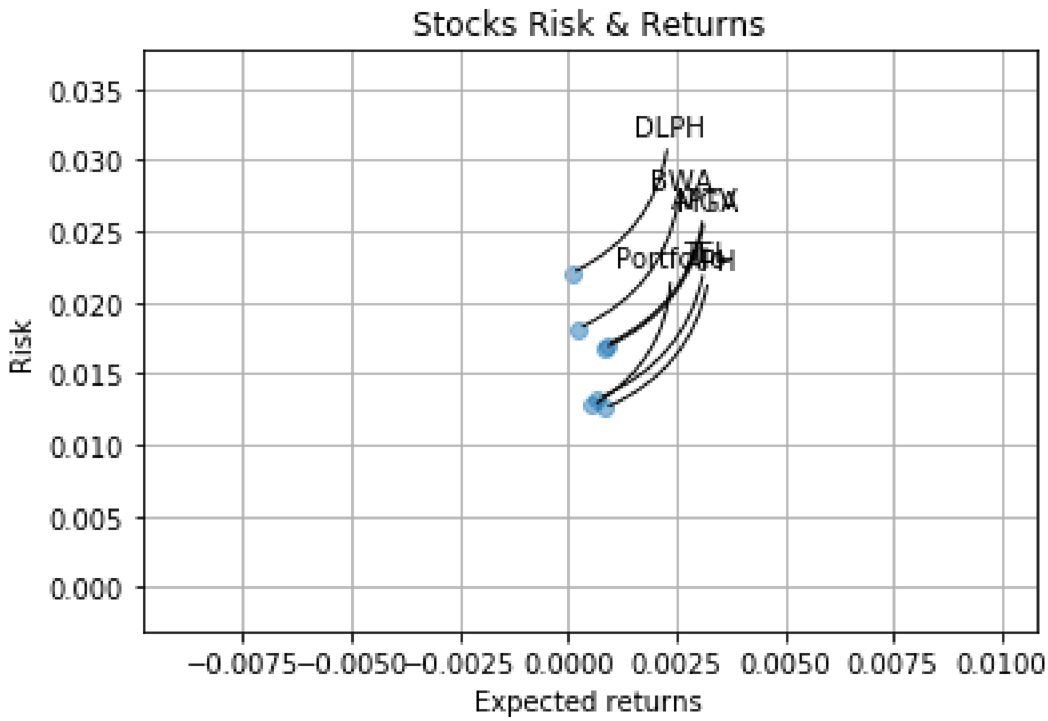
[54]:
```
# Box plot
returns.plot(kind='box')
```

[54]: <matplotlib.axes._subplots.AxesSubplot at 0x24badd3e128>



[55]:

```
rets = returns.dropna()

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'))
```



[56]:

```
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 Core and Satellite", 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"))
```

[57]:
```python
table = pd.DataFrame()
table['Returns'] = rets.mean()
table['Risk'] = rets.std()
table.sort_values(by='Returns')
```

[57]:

	Returns	Risk
DLPH	0.000088	0.022068
BWA	0.000242	0.018171
Portfolio	0.000569	0.012731
TEL	0.000671	0.013232
MGA	0.000836	0.016787
APH	0.000842	0.012556
APTV	0.000879	0.017006

[58]:
```python
table.sort_values(by='Risk')
```

[58]:

	Returns	Risk
APH	0.000842	0.012556
Portfolio	0.000569	0.012731
TEL	0.000671	0.013232
MGA	0.000836	0.016787
APTV	0.000879	0.017006
BWA	0.000242	0.018171

```
DLPH       0.000088  0.022068
```

[59]:
```
rf = 0.001
table['Sharpe_Ratio'] = ((table['Returns'] - rf) / table['Risk']) * np.sqrt(252)
table
```

[59]:

	Returns	Risk	Sharpe_Ratio
APH	0.000842	0.012556	-0.199414
APTV	0.000879	0.017006	-0.113060
BWA	0.000242	0.018171	-0.661827
DLPH	0.000088	0.022068	-0.655917
MGA	0.000836	0.016787	-0.155114
TEL	0.000671	0.013232	-0.395143
Portfolio	0.000569	0.012731	-0.537002