

```
In [6]: import ffn
import matplotlib as pyplot
import numpy as np
import pandas as pd
import datetime as dt
from empyrical import alpha_beta
from pypfopt.efficient_frontier import EfficientFrontier
from pypfopt import risk_models
from pypfopt import expected_returns
from pypfopt import discrete_allocation
from pypfopt.discrete_allocation import DiscreteAllocation, get_latest_prices
from pandas_datareader import data
%matplotlib inline
import matplotlib.pyplot as plt
%config InlineBackend.figure_format = 'retina'
```

```
In [7]: #Calculate beta of each stock in the Dow Jones 30
price = list()
benchmark = ffn.get('spy', start='2016-11-01',end='2018-11-01')
names = ['mmm','axp','aapl','ba','cat','cvx','csc','ko','xom','gs','hd','ibm','intc','jnj','jpm','mcd','mrk','msft','nke','pfe','pg','trv','unh','utx','vz','v','wmt','wba','dis']
for i in names:

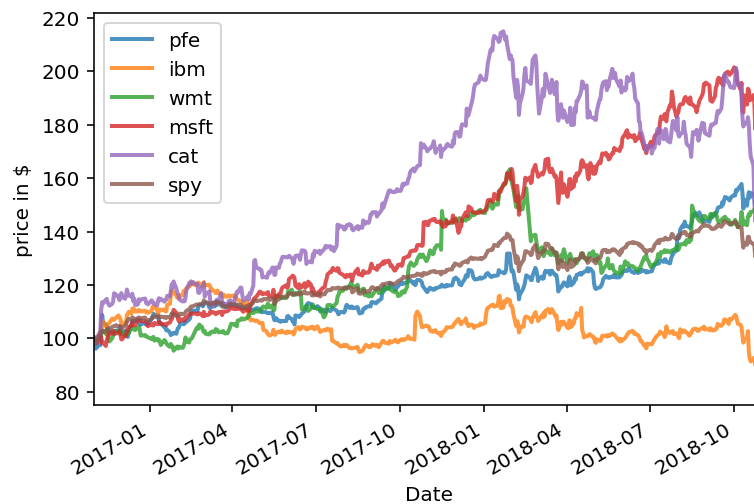
    temp = ffn.get(i, start='2016-11-01',end='2018-11-01')
    price.append(temp)
    alpha, beta = alpha_beta(temp, benchmark)
    print('name: ',i,'\tbeta value: ',beta)
```

C:\Users\samra\Anaconda3\lib\site-packages\empyrical\stats.py:1294: RuntimeWarning: overflow encountered in power
out=out

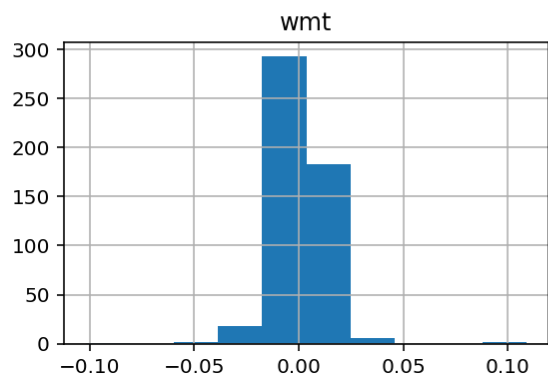
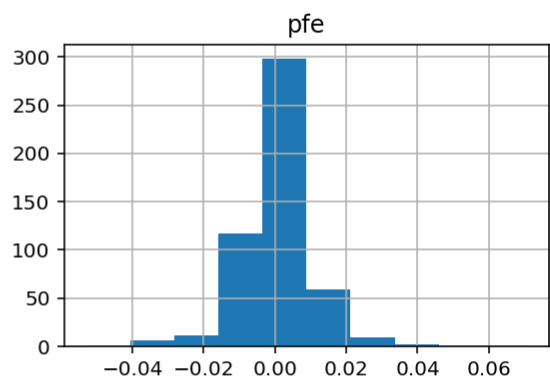
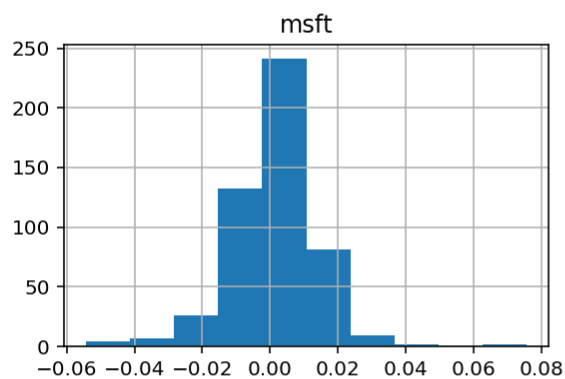
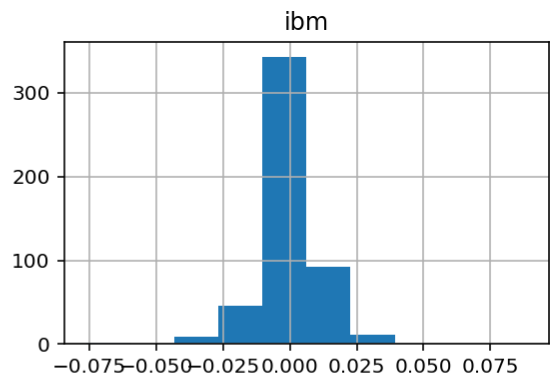
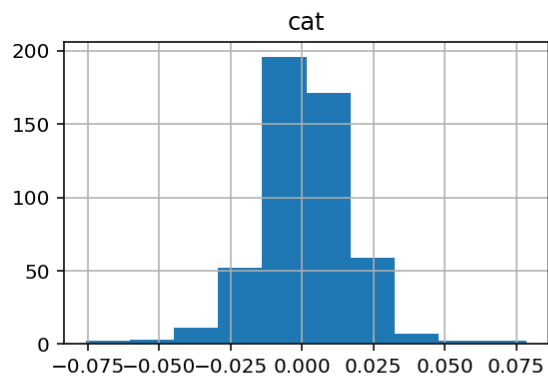
name: mmm	beta value: 0.6166690496672075
name: axp	beta value: 0.49324124956658455
name: aapl	beta value: 1.2814752120237054
name: ba	beta value: 3.338177801341278
name: cat	beta value: 0.9865648747460943
name: cvx	beta value: 0.30497004172699455
name: csc	beta value: 0.2583288771674521
name: ko	beta value: 0.08051303787606492
name: xom	beta value: 0.031170028583297853
name: gs	beta value: 0.31360330199716613
name: hd	beta value: 1.0575558680664585
name: ibm	beta value: -0.11748307706015737
name: intc	beta value: 0.2664495498066668
name: jnj	beta value: 0.3017684323440961
name: jpm	beta value: 0.5479576051769822
name: mcd	beta value: 0.6851956588427172
name: mrk	beta value: 0.06132061138922086
name: msft	beta value: 0.7293870878877612
name: nke	beta value: 0.4103539452328578
name: pfe	beta value: 0.14542335785963392
name: pg	beta value: -0.03549027606365109
name: trv	beta value: 0.29758504608502334
name: unh	beta value: 1.625797995832064
name: utx	beta value: 0.40906332169405885
name: vz	beta value: 0.10636904174209937
name: v	beta value: 0.9158042487147368
name: wmt	beta value: 0.4300338521121386
name: wba	beta value: -0.20816347449337422
name: dis	beta value: 0.10552614916960182

```
In [8]: #Stock selection is made! Top five stocks for our portfolio
#Plot of each stock to show price evolution within the given time frame including the benchmark
prices1 = ffnd.get('pfe,ibm,wmt,msft,cat,spy', start='2016-11-01', end='2018-11-01')
prices = ffnd.get('pfe,ibm,wmt,msft,cat', start='2016-11-01', end='2018-11-01')
benchmark = ffnd.get('spy', start='2016-11-01')
ax = prices1.rebase().plot(lw=2, alpha=0.8)
plt.ylabel('price in $')
```

```
Out[8]: Text(0,0.5,'price in $')
```



```
In [9]: returns = prices.to_returns().dropna()  
ax = returns.hist(figsize=(10,10))
```



```
In [10]: #Report of some important performance matrix  
stats = prices.calc_stats()  
stats.display()
```

```
C:\Users\samra\Anaconda3\lib\site-packages\ffn\core.py:2056: RuntimeWarning:  
divide by zero encountered in true_divide  
    res = np.divide(er.mean(), std)
```

Stat	pfe	ibm	wmt	msft	cat
--					
Start	2016-11-01	2016-11-01	2016-11-01	2016-11-01	2016-11-01
End	2018-11-02	2018-11-02	2018-11-02	2018-11-02	2018-11-02
Risk-free rate	0.00%	0.00%	0.00%	0.00%	0.00%
Total Return	49.07%	-18.10%	53.83%	85.08%	61.09%
Daily Sharpe	1.30	-0.42	1.15	1.60	1.05
Daily Sortino	2.21	-0.62	1.95	2.72	1.72
CAGR	22.08%	-9.49%	24.01%	36.01%	26.90%
Max Drawdown	-13.01%	-32.54%	-23.86%	-11.50%	-33.10%
Calmar Ratio	1.70	-0.29	1.01	3.13	0.81
MTD	-0.30%	0.21%	1.06%	-0.61%	3.68%
3m	8.27%	-18.22%	14.84%	-0.93%	-8.27%
6m	25.30%	-17.01%	18.80%	14.46%	-11.46%
YTD	21.82%	-22.19%	4.49%	25.71%	-18.39%
1Y	25.57%	-21.37%	16.81%	28.58%	-5.76%
3Y (ann.)	22.08%	-9.49%	24.01%	36.01%	26.90%
5Y (ann.)	-	-	-	-	-
10Y (ann.)	-	-	-	-	-
Since Incep. (ann.)	22.08%	-9.49%	24.01%	36.01%	26.90%
Daily Sharpe	1.30	-0.42	1.15	1.60	1.05
Daily Sortino	2.21	-0.62	1.95	2.72	1.72
Daily Mean (ann.)	21.26%	-8.07%	23.60%	32.84%	27.12%
Daily Vol (ann.)	16.36%	19.41%	20.55%	20.55%	25.77%
Daily Skew	0.33	-0.44	0.69	0.16	-0.16
Daily Kurt	7.77	11.92	22.06	5.52	3.70
Best Day	7.07%	8.86%	10.90%	7.57%	7.86%
Worst Day	-5.30%	-7.63%	-10.18%	-5.43%	-7.56%
Monthly Sharpe	1.50	-0.51	1.11	2.18	0.78
Monthly Sortino	5.68	-0.62	1.96	6.35	1.24
Monthly Mean (ann.)	18.62%	-10.91%	23.01%	31.40%	19.63%
Monthly Vol (ann.)	12.37%	21.40%	20.78%	14.38%	25.23%
Monthly Skew	0.85	-2.22	-0.84	0.29	-1.17
Monthly Kurt	0.01	7.45	1.85	0.67	2.06
Best Month	10.06%	6.70%	11.74%	11.67%	11.64%
Worst Month	-2.81%	-23.66%	-15.56%	-6.61%	-19.93%
Yearly Sharpe	4.51	-1.02	0.86	3.13	0.43
Yearly Sortino	inf	-1.02	inf	inf	2.18
Yearly Mean	18.86%	-13.09%	25.52%	33.22%	28.32%
Yearly Vol	4.18%	12.87%	29.75%	10.62%	66.06%
Yearly Skew	-	-	-	-	-
Yearly Kurt	-	-	-	-	-
Best Year	21.82%	-3.99%	46.56%	40.73%	75.03%
Worst Year	15.90%	-22.19%	4.49%	25.71%	-18.39%
Avg. Drawdown	-2.68%	-3.92%	-2.83%	-2.17%	-2.62%
Avg. Drawdown Days	24.62	57.83	24.42	11.62	17.19
Avg. Up Month	4.09%	3.06%	5.40%	4.74%	5.72%
Avg. Down Month	-1.45%	-4.88%	-3.88%	-1.63%	-6.54%

Win Year %	100.00%	0.00%	100.00%	100.00%	50.00%
Win 12m %	100.00%	28.57%	100.00%	100.00%	85.71%

```
In [11]: #Calculate beta value for each stock choice
price = list()
benchmark = ffn.get('spy', start='2016-11-01',end='2018-11-01')
names = ['pfe','ibm','wmt','msft','cat']
for i in names:

    temp = ffn.get(i, start='2016-11-01',end='2018-11-01')
    price.append(temp)
    alpha, beta = alpha_beta(temp, benchmark)
    print('name: ',i,'\tbeta value: ',beta)
```

```
name: pfe      beta value: 0.14542335785963392
name: ibm      beta value: -0.11748307706015737
name: wmt      beta value: 0.4300338521121386
name: msft     beta value: 0.7293870878877612
name: cat      beta value: 0.9865648747460943
```

```
In [12]: # Expected returns and sample covariance
mu = expected_returns.mean_historical_return(prices)
S = risk_models.sample_cov(prices)
#Minimum volatility. May be useful if you're trying to get an idea of how low
the volatility could be,
#but in practice it makes a lot more sense to me to use the portfolio that max
imises the Sharpe ratio.
# Optimise portfolio for maximum Sharpe Ratio to serve as benchmark
ef = EfficientFrontier(mu, S)
raw_weights = ef.max_sharpe()
cleaned_weights = ef.clean_weights()
print(cleaned_weights)
ef.portfolio_performance(verbose=True)
```

```
{'pfe': 0.26419, 'ibm': 0.0, 'wmt': 0.2568, 'msft': 0.42678, 'cat': 0.05223}
Expected annual return: 27.1%
Annual volatility: 13.9%
Sharpe Ratio: 1.81
```

```
Out[12]: (0.2711053123030498, 0.13898948383733048, 1.8066497217655446)
```



```
In [13]: # Expected returns and sample covariance
mu = expected_returns.mean_historical_return(prices)
S = risk_models.sample_cov(prices)
#Minimum volatility. May be useful if you're trying to get an idea of how low
  the volatility could be,
#but in practice it makes a lot more sense to me to use the portfolio that max
  imises the Sharpe ratio.
# Optimise portfolio for maximum Sharpe Ratio to serve as benchmark
ef = EfficientFrontier(mu, S)
raw_weights = ef.min_volatility() #ef.max_sharpe()
cleaned_weights = ef.clean_weights()
print(cleaned_weights)
ef.portfolio_performance(verbose=True)

{'pfe': 0.3606, 'ibm': 0.22088, 'wmt': 0.23008, 'msft': 0.16456, 'cat': 0.023
89}
Expected annual return: 17.4%
Annual volatility: 12.7%
Sharpe Ratio: 1.21
```

```
Out[13]: (0.1736669204869989, 0.12678844114593588, 1.2119947141721332)
```

```
In [14]: #To achieve beta neutrality
ef = EfficientFrontier(mu, S, weight_bounds=(-1, 1))
ef.efficient_return(target_return=0.2, market_neutral=True)
```

```
Out[14]: {'pfe': 0.0715653728132859,
'ibm': -0.5396245533036399,
'wmt': 0.09662027756007492,
'msft': 0.3091565484880527,
'cat': 0.06228235444222637}
```

```
In [15]: #The result of market neutral optimisation is essentially a long and short por
  tfolio.
#We normalize the results as weights as shown below
weights = ef.efficient_return(target_return=0.2, market_neutral=True)
weight_sum = sum(w for w in weights.values() if w > 0)
normalised_weights = {k:v/weight_sum for k,v in weights.items()}
normalised_weights
```

```
Out[15]: {'pfe': 0.13262067556999574,
'ibm': -1.0,
'wmt': 0.17905092896265584,
'msft': 0.572910455232926,
'cat': 0.11541794023442235}
```

```
In [16]: #We then need to convert these weights into an actual allocation, telling you
         how many shares of each asset you should purchase.
latest_prices = get_latest_prices(prices)
da = DiscreteAllocation(weights, latest_prices, total_portfolio_value=1000000)
allocation, leftover = da.lp_portfolio()
print(allocation)
print("Funds remaining: ${:.2f}".format(leftover))
```

0 out of 5 tickers were removed

Allocating long sub-portfolio:
0 out of 4 tickers were removed

Allocating short sub-portfolio:
0 out of 1 tickers were removed
{'pfe': 3229, 'wmt': 1813, 'msft': 5500, 'cat': 943, 'ibm': -2752}
Funds remaining: \$77.36

```
In [17]: latest_prices
```

```
Out[17]: pfe      41.076160
         ibm      108.987953
         wmt      98.789253
         msft     104.163193
         cat      122.322792
         Name: 2018-11-02 00:00:00, dtype: float64
```

```
In [18]: prices2 = ffن.get('pfe,ibm,wmt,msft,cat', start='2018-11-01', end='2018-12-01'
         )
         latest_prices2 = get_latest_prices(prices2)
```

```
In [19]: latest_prices2
```

```
Out[19]: pfe      44.574997
         ibm      118.582451
         wmt      95.192131
         msft     109.274261
         cat      131.930450
         Name: 2018-11-30 00:00:00, dtype: float64
```

```
In [20]: sum1 = 0
         for key,val in allocation.items():
             sum1 = sum1 - (latest_prices[key]*val)
         print(sum1)
         new = 0
         for key,val in allocation.items():
             new = new + (latest_prices2[key]*val)
             sum1 = sum1 + (latest_prices2[key]*val)
         print(new)
         print(sum1)
```

-700052.9440040588
715595.9468154907
15543.002811431885

```

In [21]: def calc(stockStartTime,stockEndTime):
    #calculating 2 years prior of the start date
    tempdate = dt.datetime.fromisoformat(stockStartTime)
    tempdate = tempdate - dt.timedelta(weeks=104)
    prices = ffndata.get('pfe,ibm,wmt,msft,cat', start= tempdate.strftime('%Y-%m-%d'), end=stockStartTime)
    # Expected returns and sample covariance
    mu = expected_returns.mean_historical_return(prices)
    S = risk_models.sample_cov(prices)
    #Minimum volatility. May be useful if you're trying to get an idea of how low the volatility could be,
    #but in practice it makes a lot more sense to me to use the portfolio that maximises the Sharpe ratio.
    # Optimise portfolio for maximum Sharpe Ratio to serve as benchmark
    ef = EfficientFrontier(mu, S)
    raw_weights = ef.min_volatility() #ef.max_sharpe()
    cleaned_weights = ef.clean_weights()
    print("Cleaned weights:\n",cleaned_weights)
    print("Portfolio Performance:\n",ef.portfolio_performance(verbose=True))
    #To achieve beta neutrality
    ef = EfficientFrontier(mu, S, weight_bounds=(-1, 1))
    print("Weights: ",ef.efficient_return(target_return=0.15, market_neutral=True))
    weights = ef.efficient_return(target_return=0.2, market_neutral=True)
    weight_sum = sum(w for w in weights.values() if w > 0)
    normalised_weights = {k:v/weight_sum for k,v in weights.items()}
    #print("Normalized weights: ",normalised_weights)
    #We then need to convert these weights into an actual allocation, telling you how many shares of each asset you should purchase.
    latest_prices = get_latest_prices(prices)
    da = DiscreteAllocation(weights, latest_prices, total_portfolio_value=1000000)
    allocation, leftover = da.lp_portfolio()
    #print(allocation)
    print("")
    for key,val in allocation.items():
        print("Number of positions in ",key," stock: ",val)
    print("")
    print("Funds remaining: ${:.2f}".format(leftover))
    print("")
    prices2 = ffndata.get('pfe,ibm,wmt,msft,cat', start=stockStartTime, end=stockEndTime)
    latest_prices2 = get_latest_prices(prices2)
    sum1 = 0
    for key,val in allocation.items():
        sum1 = sum1 - (latest_prices[key]*val)
    print("Value of Portfolio after short sales :\t",abs(sum1))
    new = 0
    for key,val in allocation.items():
        new = new + (latest_prices2[key]*val)
        sum1 = sum1 + (latest_prices2[key]*val)
    print("Value at end of period :\t\t",new)
    print("Profit at end of time period :\t\t",sum1)
    return sum1

```

```
In [22]: calc(stockStartTime = "2018-11-01",stockEndTime = "2018-12-01")
```

Cleaned weights:

```
{'pfe': 0.36653, 'ibm': 0.21878, 'wmt': 0.22718, 'msft': 0.16404, 'cat': 0.02347}
```

Expected annual return: 18.3%

Annual volatility: 12.7%

Sharpe Ratio: 1.28

Portfolio Performance:

```
(0.18256989382586908, 0.12675995933515896, 1.2825019405065212)
```

```
Weights: {'pfe': 0.07780753417839327, 'ibm': -0.40095262697007006, 'wmt': 0.057495506014782254, 'msft': 0.22245907360138628, 'cat': 0.04319051317550822}
```

0 out of 5 tickers were removed

Allocating long sub-portfolio:

0 out of 4 tickers were removed

Allocating short sub-portfolio:

0 out of 1 tickers were removed

Number of positions in pfe stock: 4933

Number of positions in wmt stock: 1239

Number of positions in msft stock: 5424

Number of positions in cat stock: 899

Number of positions in ibm stock: -2752

Funds remaining: \$87.22

Value of Portfolio after short sales : 700043.0845222473

Value at end of period : 722801.6747055054

Profit at end of time period : 22758.590183258057

```
Out[22]: 22758.590183258057
```

```
In [23]: calc(stockStartTime = "2018-12-01", stockEndTime = "2019-01-01")
```

Cleaned weights:

```
{'pfe': 0.44155, 'ibm': 0.20499, 'wmt': 0.21502, 'msft': 0.11353, 'cat': 0.02491}
```

Expected annual return: 18.5%

Annual volatility: 12.8%

Sharpe Ratio: 1.29

Portfolio Performance:

```
(0.18472737263571107, 0.12761192957084685, 1.2908461864786607)
```

```
Weights: {'pfe': 0.09986221454374912, 'ibm': -0.40326456472872, 'wmt': 0.03864721908752407, 'msft': 0.2532999814550717, 'cat': 0.011455149642375095}
```

0 out of 5 tickers were removed

Allocating long sub-portfolio:

0 out of 4 tickers were removed

Allocating short sub-portfolio:

0 out of 1 tickers were removed

Number of positions in pfe stock: 5508

Number of positions in wmt stock: 1017

Number of positions in msft stock: 5754

Number of positions in cat stock: 219

Number of positions in ibm stock: -2529

Funds remaining: \$118.63

Value of Portfolio after short sales : 700091.3313903809

Value at end of period : 644985.262550354

Profit at end of time period : -55106.068840026855

```
Out[23]: -55106.068840026855
```

```
In [ ]:
```

```
In [24]: calc(stockStartTime = "2019-01-01",stockEndTime = "2019-02-01")
```

Cleaned weights:

```
{'pfe': 0.48307, 'ibm': 0.20787, 'wmt': 0.21761, 'msft': 0.07258, 'cat': 0.01886}
```

Expected annual return: 13.2%

Annual volatility: 13.7%

Sharpe Ratio: 0.82

Portfolio Performance:

```
(0.13245341739230287, 0.13722349618164242, 0.8194909801995465)
```

```
Weights: {'pfe': 0.08154191922058279, 'ibm': -0.4056520092146714, 'wmt': 0.0746382449192475, 'msft': 0.22376620198814146, 'cat': 0.025705643086699696}
```

0 out of 5 tickers were removed

Allocating long sub-portfolio:

0 out of 4 tickers were removed

Allocating short sub-portfolio:

0 out of 1 tickers were removed

Number of positions in pfe stock: 4786

Number of positions in wmt stock: 1854

Number of positions in msft stock: 5653

Number of positions in cat stock: 549

Number of positions in ibm stock: -2728

Funds remaining: \$117.67

Value of Portfolio after short sales : 700065.4560317993

Value at end of period : 663973.0623245239

Profit at end of time period : -36092.39370727539

```
Out[24]: -36092.39370727539
```

```

In [32]: def totalret(startDate):
    tempdate = dt.datetime.fromisoformat(startDate)
    monthend = tempdate + dt.timedelta(days=30)
    print("monthend:", monthend)
    total = 0
    monthlyRet = list()
    percentage = list()
    for i in range(12):
        print("\n\n*****", tempdate.strftime('%d %b %Y'), "*****
        *****\n\n")
        ret = calc( stockStartTime = tempdate.strftime('%Y-%m-%d') , stockEndT
ime = monthend.strftime('%Y-%m-%d'))
        monthlyRet.append(ret)
        total = total + ret
        tempdate = tempdate + dt.timedelta(days=30)
        print("temp:", tempdate)
        monthend = monthend + dt.timedelta(days=30)
        print("monthend:", monthend)
        i = i + 1
    print("\n")
    for i in monthlyRet:
        print("Returns per time period: {:.2f}".format(i), "\tReturns in perce
ntage:", i/1000000)
        print("\n\n\n*****The total return for 1 year : ", total, "*****
        *****")

```

```
In [33]: totalret("2018-11-01")
```


monthend: 2018-12-01 00:00:00

***** 01 Nov 2018 *****

Cleaned weights:

{'pfe': 0.36653, 'ibm': 0.21878, 'wmt': 0.22718, 'msft': 0.16404, 'cat': 0.02347}

Expected annual return: 18.3%

Annual volatility: 12.7%

Sharpe Ratio: 1.28

Portfolio Performance:

(0.18256989382586908, 0.12675995933515896, 1.2825019405065212)

Weights: {'pfe': 0.07780753417839327, 'ibm': -0.40095262697007006, 'wmt': 0.057495506014782254, 'msft': 0.22245907360138628, 'cat': 0.04319051317550822}

0 out of 5 tickers were removed

Allocating long sub-portfolio:

0 out of 4 tickers were removed

Allocating short sub-portfolio:

0 out of 1 tickers were removed

Number of positions in pfe stock: 4933

Number of positions in wmt stock: 1239

Number of positions in msft stock: 5424

Number of positions in cat stock: 899

Number of positions in ibm stock: -2752

Funds remaining: \$87.22

Value of Portfolio after short sales : 700043.0845222473

Value at end of period : 722801.6747055054

Profit at end of time period : 22758.590183258057

temp: 2018-12-01 00:00:00

monthend: 2018-12-31 00:00:00

***** 01 Dec 2018 *****

Cleaned weights:

{'pfe': 0.44155, 'ibm': 0.20499, 'wmt': 0.21502, 'msft': 0.11353, 'cat': 0.02491}

Expected annual return: 18.5%

Annual volatility: 12.8%

Sharpe Ratio: 1.29

Portfolio Performance:

(0.18472737263571107, 0.12761192957084685, 1.2908461864786607)

Weights: {'pfe': 0.09986221454374912, 'ibm': -0.40326456472872, 'wmt': 0.03864721908752407, 'msft': 0.2532999814550717, 'cat': 0.011455149642375095}

0 out of 5 tickers were removed

Allocating long sub-portfolio:

0 out of 4 tickers were removed

Allocating short sub-portfolio:
0 out of 1 tickers were removed

Number of positions in pfe stock: 5508
Number of positions in wmt stock: 1017
Number of positions in msft stock: 5754
Number of positions in cat stock: 219
Number of positions in ibm stock: -2529

Funds remaining: \$118.63

Value of Portfolio after short sales : 700091.3313903809
Value at end of period : 653335.1545944214
Profit at end of time period : -46756.17679595947
temp: 2018-12-31 00:00:00
monthend: 2019-01-30 00:00:00

***** 31 Dec 2018 *****

Cleaned weights:

{'pfe': 0.48353, 'ibm': 0.20754, 'wmt': 0.2174, 'msft': 0.07258, 'cat': 0.01896}

Expected annual return: 13.4%

Annual volatility: 13.7%

Sharpe Ratio: 0.83

Portfolio Performance:

(0.13362473838442582, 0.13735203196045903, 0.8272519653523303)

Weights: {'pfe': 0.08680277315202453, 'ibm': -0.39632583783305775, 'wmt': 0.06858883124052366, 'msft': 0.21481264184692456, 'cat': 0.02612159159358499}
0 out of 5 tickers were removed

Allocating long sub-portfolio:
0 out of 4 tickers were removed

Allocating short sub-portfolio:
0 out of 1 tickers were removed

Number of positions in pfe stock: 5140
Number of positions in wmt stock: 1926
Number of positions in msft stock: 5406
Number of positions in cat stock: 540
Number of positions in ibm stock: -2765

Funds remaining: \$99.20

Value of Portfolio after short sales : 700075.021194458
Value at end of period : 665160.2983856201
Profit at end of time period : -34914.72280883789
temp: 2019-01-30 00:00:00
monthend: 2019-03-01 00:00:00

***** 30 Jan 2019 *****

Cleaned weights:

{'pfe': 0.46364, 'ibm': 0.19429, 'wmt': 0.26062, 'msft': 0.06971, 'cat': 0.01174}

Expected annual return: 16.3%

Annual volatility: 14.2%

Sharpe Ratio: 1.01

Portfolio Performance:

(0.16279296787387068, 0.14184990861890312, 1.0066482894782909)

Weights: {'pfe': 0.05041531046242584, 'ibm': -0.4512160899106538, 'wmt': 0.10565266184407578, 'msft': 0.26965566701852334, 'cat': 0.02549245058562888}

0 out of 5 tickers were removed

Allocating long sub-portfolio:

0 out of 4 tickers were removed

Allocating short sub-portfolio:

0 out of 1 tickers were removed

Number of positions in pfe stock: 2691

Number of positions in wmt stock: 2499

Number of positions in msft stock: 5807

Number of positions in cat stock: 434

Number of positions in ibm stock: -2338

Funds remaining: \$129.68

Value of Portfolio after short sales : 700089.5561065674

Value at end of period : 744264.6083259583

Profit at end of time period : 44175.05221939087

temp: 2019-03-01 00:00:00

monthend: 2019-03-31 00:00:00

***** 01 Mar 2019 *****

Cleaned weights:

{'pfe': 0.46339, 'ibm': 0.19417, 'wmt': 0.26121, 'msft': 0.06729, 'cat': 0.01394}

Expected annual return: 14.6%

Annual volatility: 14.2%

Sharpe Ratio: 0.89

Portfolio Performance:

(0.14641343509865706, 0.14226533175665623, 0.8885751260531012)

Weights: {'pfe': -0.01978415393164747, 'ibm': -0.40837672516748713, 'wmt': 0.09217479871441848, 'msft': 0.3025167507008007, 'cat': 0.03346932968391544}

0 out of 5 tickers were removed

Allocating long sub-portfolio:

0 out of 3 tickers were removed

Allocating short sub-portfolio:

0 out of 2 tickers were removed

Number of positions in wmt stock: 2248

Number of positions in msft stock: 6340

Number of positions in cat stock: 581
Number of positions in pfe stock: -329
Number of positions in ibm stock: -2129

Funds remaining: \$44.76

Value of Portfolio after short sales : 700029.2724723816
Value at end of period : 734987.5371398926
Profit at end of time period : 34958.264667510986
temp: 2019-03-31 00:00:00
monthend: 2019-04-30 00:00:00

***** 31 Mar 2019 *****

Cleaned weights:

{'pfe': 0.45683, 'ibm': 0.1978, 'wmt': 0.26243, 'msft': 0.07271, 'cat': 0.01023}

Expected annual return: 14.9%

Annual volatility: 14.4%

Sharpe Ratio: 0.90

Portfolio Performance:

(0.14944575304330449, 0.14414588424476274, 0.8980190708983607)

Weights: {'pfe': -0.04427649099643745, 'ibm': -0.410279939595521, 'wmt': 0.07037251169372406, 'msft': 0.33511327602676044, 'cat': 0.04907064287147392}

0 out of 5 tickers were removed

Allocating long sub-portfolio:

0 out of 3 tickers were removed

Allocating short sub-portfolio:

0 out of 2 tickers were removed

Number of positions in wmt stock: 1610
Number of positions in msft stock: 6255
Number of positions in cat stock: 787
Number of positions in pfe stock: -702
Number of positions in ibm stock: -1957

Funds remaining: \$53.43

Value of Portfolio after short sales : 700003.8575134277
Value at end of period : 766082.4778823853
Profit at end of time period : 66078.62036895752
temp: 2019-04-30 00:00:00
monthend: 2019-05-30 00:00:00

***** 30 Apr 2019 *****

Cleaned weights:

{'pfe': 0.43377, 'ibm': 0.20308, 'wmt': 0.26813, 'msft': 0.07866, 'cat': 0.01636}

Expected annual return: 14.9%

Annual volatility: 14.5%

Sharpe Ratio: 0.89

Portfolio Performance:

(0.14892975793262458, 0.14531136606292178, 0.8872654729348307)

Weights: {'pfe': -0.08518414920963716, 'ibm': -0.4088334966431956, 'wmt': 0.07702889743760276, 'msft': 0.42903075419281905, 'cat': -0.012042005777589047}

0 out of 5 tickers were removed

Allocating long sub-portfolio:

0 out of 2 tickers were removed

Allocating short sub-portfolio:

0 out of 3 tickers were removed

Number of positions in wmt stock: 1525

Number of positions in msft stock: 6698

Number of positions in pfe stock: -1272

Number of positions in ibm stock: -1787

Number of positions in cat stock: -52

Funds remaining: \$24.20

Value of Portfolio after short sales : 699995.1230239868

Value at end of period : 696482.4429626465

Profit at end of time period : -3512.680061340332

temp: 2019-05-30 00:00:00

monthend: 2019-06-29 00:00:00

***** 30 May 2019 *****

Cleaned weights:

{'pfe': 0.44705, 'ibm': 0.19582, 'wmt': 0.27755, 'msft': 0.06266, 'cat': 0.01691}

Expected annual return: 14.1%

Annual volatility: 14.7%

Sharpe Ratio: 0.82

Portfolio Performance:

(0.14078133529631698, 0.14666387078923954, 0.8235248029822112)

Weights: {'pfe': 0.04279348108931623, 'ibm': -0.40509414803808763, 'wmt': 0.045356488756004884, 'msft': 0.41607900382279134, 'cat': -0.09913482563002482}

0 out of 5 tickers were removed

Allocating long sub-portfolio:

0 out of 3 tickers were removed

Allocating short sub-portfolio:

0 out of 2 tickers were removed

Number of positions in pfe stock: 2133

Number of positions in wmt stock: 899

Number of positions in msft stock: 6697

Number of positions in ibm stock: -1950

Number of positions in cat stock: -492

Funds remaining: \$89.56

Value of Portfolio after short sales : 700050.5202941895
Value at end of period : 751497.0369224548
Profit at end of time period : 51446.51662826538
temp: 2019-06-29 00:00:00
monthend: 2019-07-29 00:00:00

***** 29 Jun 2019 *****

Cleaned weights:

{'pfe': 0.45486, 'ibm': 0.19128, 'wmt': 0.28534, 'msft': 0.04751, 'cat': 0.02101}

Expected annual return: 17.2%

Annual volatility: 14.7%

Sharpe Ratio: 1.03

Portfolio Performance:

(0.1719843902168661, 0.14704284267005632, 1.0336061752961205)

Weights: {'pfe': -0.05665967849075383, 'ibm': -0.36298287515105965, 'wmt': 0.10200058893845995, 'msft': 0.39449990877580887, 'cat': -0.07685794407245539}

0 out of 5 tickers were removed

Allocating long sub-portfolio:

0 out of 2 tickers were removed

Allocating short sub-portfolio:

0 out of 3 tickers were removed

Number of positions in wmt stock: 1850
Number of positions in msft stock: 5993
Number of positions in pfe stock: -970
Number of positions in ibm stock: -1604
Number of positions in cat stock: -318

Funds remaining: \$88.67

Value of Portfolio after short sales : 699971.1767654419
Value at end of period : 727326.3788375854
Profit at end of time period : 27355.202072143555
temp: 2019-07-29 00:00:00
monthend: 2019-08-28 00:00:00

***** 29 Jul 2019 *****

Cleaned weights:

{'pfe': 0.40125, 'ibm': 0.19795, 'wmt': 0.30808, 'msft': 0.06358, 'cat': 0.02914}

Expected annual return: 16.4%

Annual volatility: 14.9%

Sharpe Ratio: 0.96

Portfolio Performance:

(0.16395401804655574, 0.1494565553732759, 0.963183031262983)

Weights: {'pfe': -0.19770879356826698, 'ibm': -0.29321630374935936, 'wmt': 0.10823334981227109, 'msft': 0.52674976352234, 'cat': -0.14405801601698467}
0 out of 5 tickers were removed

Allocating long sub-portfolio:
0 out of 2 tickers were removed

Allocating short sub-portfolio:
0 out of 3 tickers were removed

Number of positions in wmt stock: 1562
Number of positions in msft stock: 5929
Number of positions in pfe stock: -2427
Number of positions in ibm stock: -943
Number of positions in cat stock: -528

Funds remaining: \$49.58

Value of Portfolio after short sales : 699976.3212928772
Value at end of period : 721203.6981697083
Profit at end of time period : 21227.376876831055
temp: 2019-08-28 00:00:00
monthend: 2019-09-27 00:00:00

***** 28 Aug 2019 *****

Cleaned weights:

{'pfe': 0.41218, 'ibm': 0.18536, 'wmt': 0.30958, 'msft': 0.06374, 'cat': 0.02915}

Expected annual return: 13.9%

Annual volatility: 15.6%

Sharpe Ratio: 0.76

Portfolio Performance:

(0.13856259872104432, 0.1561202571503404, 0.7594312287538133)

Weights: {'pfe': -0.17743468291924577, 'ibm': -0.23713346030084217, 'wmt': 0.13989954373290836, 'msft': 0.4216057890033631, 'cat': -0.14693718951618356}
0 out of 5 tickers were removed

Allocating long sub-portfolio:
0 out of 2 tickers were removed

Allocating short sub-portfolio:
0 out of 3 tickers were removed

Number of positions in wmt stock: 2285
Number of positions in msft stock: 5379
Number of positions in pfe stock: -2859
Number of positions in ibm stock: -917
Number of positions in cat stock: -665

Funds remaining: \$74.22

Value of Portfolio after short sales : 699947.6723060608
Value at end of period : 691881.5174255371
Profit at end of time period : -8066.154880523682

temp: 2019-09-27 00:00:00
monthend: 2019-10-27 00:00:00

***** 27 Sep 2019 *****

Cleaned weights:

{'pfe': 0.42074, 'ibm': 0.17792, 'wmt': 0.31161, 'msft': 0.06555, 'cat': 0.02418}

Expected annual return: 14.2%

Annual volatility: 15.6%

Sharpe Ratio: 0.78

Portfolio Performance:

(0.1418743633591575, 0.15616463576748219, 0.7804222944599288)

Weights: {'pfe': -0.2344056349028582, 'ibm': -0.2052813687064524, 'wmt': 0.16968908230798352, 'msft': 0.4053114783808093, 'cat': -0.13531355707948223}

0 out of 5 tickers were removed

Allocating long sub-portfolio:

0 out of 2 tickers were removed

Allocating short sub-portfolio:

0 out of 3 tickers were removed

Number of positions in wmt stock: 2587

Number of positions in msft stock: 5062

Number of positions in pfe stock: -3546

Number of positions in ibm stock: -727

Number of positions in cat stock: -556

Funds remaining: \$151.50

Value of Portfolio after short sales : 699924.9809188843

Value at end of period : 727960.3113708496

Profit at end of time period : 28035.330451965332

temp: 2019-10-27 00:00:00

monthend: 2019-11-26 00:00:00

Returns per time period: \$22758.59 258057 Returns in percentage: 0.022758590183

Returns per time period: \$-46756.18 5959475 Returns in percentage: -0.04675617679

Returns per time period: \$-34914.72 883789 Returns in percentage: -0.03491472280

Returns per time period: \$44175.05 390866 Returns in percentage: 0.044175052219

Returns per time period: \$34958.26 51099 Returns in percentage: 0.034958264667

Returns per time period: \$66078.62 95752 Returns in percentage: 0.066078620368

Returns per time period: \$-3512.68 1340332 Returns in percentage: -0.00351268006

Returns per time period: \$51446.52 26538 Returns in percentage: 0.051446516628

Returns per time period: \$27355.20 Returns in percentage: 0.027355202072


```

143554
Returns per time period: $21227.38      Returns in percentage: 0.021227376876
831055
Returns per time period: $-8066.15      Returns in percentage: -0.00806615488
0523682
Returns per time period: $28035.33      Returns in percentage: 0.028035330451
96533

```

```

*****The total return for 1 year : 202785.21892166138 *****
****

```

```
In [27]: calc(stockStartTime = "2019-01-30",stockEndTime = "2019-03-31")
```

```

Cleaned weights:
{'pfe': 0.46364, 'ibm': 0.19429, 'wmt': 0.26062, 'msft': 0.06971, 'cat': 0.0
1174}
Expected annual return: 16.3%
Annual volatility: 14.2%
Sharpe Ratio: 1.01
Portfolio Performance:
(0.16279296787387068, 0.14184990861890312, 1.0066482894782909)
Weights: {'pfe': 0.05041531046242584, 'ibm': -0.4512160899106538, 'wmt': 0.
10565266184407578, 'msft': 0.26965566701852334, 'cat': 0.02549245058562888}
0 out of 5 tickers were removed

```

```

Allocating long sub-portfolio:
0 out of 4 tickers were removed

```

```

Allocating short sub-portfolio:
0 out of 1 tickers were removed

```

```

Number of positions in pfe stock: 2691
Number of positions in wmt stock: 2499
Number of positions in msft stock: 5807
Number of positions in cat stock: 434
Number of positions in ibm stock: -2338

```

```
Funds remaining: $129.68
```

```

Value of Portfolio after short sales : 700089.5561065674
Value at end of period : 773147.4195022583
Profit at end of time period : 73057.86339569092

```

```
Out[27]: 73057.86339569092
```

```
In [ ]:
```