Algorithm Trading Project

Python was used in Jupyter Notebook to do these programming for algorithm trading. I have tried to create a replica of S&P 500, but instead of 500 stocks I chose top 150 stocks and created a portfolio using Efficient Market Frontier and Shrape Ratio optimization by the use of various financial metrics and indicators that present a niche view of a stock's financial health. Various libraries were used like pandas, numpy, statsmodels.api etc.

Downloaded S&P Data:

[106]:
```
from statsmodels.regression.rolling import RollingOLS
import pandas_datareader.data as web
import matplotlib.pyplot as plt
import statsmodels.api as sm
import pandas as pd
import numpy as np
import datetime as dt
import yfinance as yf
import pandas_ta
import warnings
warnings.filterwarnings('ignore')

sp500 = pd.read_html('https://en.wikipedia.org/wiki/List_of_S%26P_500_companies')[0]

sp500['Symbol'] = sp500['Symbol'].str.replace('.', '-')

symbols_list = sp500['Symbol'].unique().tolist()

end_date = '2023-09-27'

start_date = pd.to_datetime(end_date)-pd.DateOffset(365*8)

df = yf.download(tickers=symbols_list,
                 start=start_date,
                 end=end_date).stack()

df.index.names = ['date', 'ticker']

df.columns = df.columns.str.lower()

df
```

```
[**********100%%**********]  503 of 503 completed
```

[106]:

date	ticker	adj close	close	high	low	open	volume
	A	31.651722	33.740002	34.060001	33.240002	33.360001	2252400.0
	AAL	37.361626	39.180000	39.770000	38.790001	39.049999	7478800.0
2015-09-29	AAPL	24.748625	27.264999	28.377501	26.965000	28.207500	293461600.0
	ABBV	37.395229	52.790001	54.189999	51.880001	53.099998	12842800.0
	ABT	33.994415	39.500000	40.150002	39.029999	39.259998	12287500.0
...	...	...	...	...	...	...	...
	YUM	124.010002	124.010002	124.739998	123.449997	124.239998	1500600.0
	ZBH	112.216316	112.459999	117.110001	112.419998	116.769997	3610500.0
2023-09-26	ZBRA	223.960007	223.960007	226.649994	222.580002	225.970001	355400.0
	ZION	33.990002	33.990002	34.700001	33.840000	33.840000	1586100.0
	ZTS	176.869995	176.869995	178.449997	176.270004	176.580002	1463200.0

994684 rows × 6 columns

Calculated Technical Indicators:

```
df['dollar_volume'] = (df['adj close']*df['volume'])/1e6

df
```

date	ticker	adj close	close	high	low	open	volume	garman_klass_vol	rsi	bb_low	bb_mid	bb_high	atr	mac
	A	31.651722	33.740002	34.060001	33.240002	33.360001	2252400.0	-0.000770	NaN	NaN	NaN	NaN	NaN	Na
	AAL	37.361626	39.180000	39.770000	38.790001	39.049999	7478800.0	-0.000443	NaN	NaN	NaN	NaN	NaN	Na
2015-09-29	AAPL	24.748625	27.264999	28.377501	26.965000	28.207500	293461600.0	-0.005307	NaN	NaN	NaN	NaN	NaN	Na
	ABBV	37.395229	52.790001	54.189999	51.880001	53.099998	12842800.0	-0.046544	NaN	NaN	NaN	NaN	NaN	Na
	ABT	33.994415	39.500000	40.150002	39.029999	39.259998	12287500.0	-0.007611	NaN	NaN	NaN	NaN	NaN	Na
...	...	...	...	...	...	...	...	...	...	...	...	...	...	
	YUM	124.010002	124.010002	124.739998	123.449997	124.239998	1500600.0	0.000053	36.057176	4.826202	4.856171	4.886139	0.142547	-1.36369
	ZBH	112.216316	112.459999	117.110001	112.419998	116.769997	3610500.0	0.000224	31.893246	4.751923	4.791592	4.831260	-0.381708	-0.88106
2023-09-26	ZBRA	223.960007	223.960007	226.649994	222.580002	225.970001	355400.0	0.000133	29.494977	5.400991	5.539167	5.677342	-0.057389	-1.60079
	ZION	33.990002	33.990002	34.700001	33.840000	33.840000	1586100.0	0.000307	46.707773	3.539073	3.594527	3.649982	-0.161699	-0.16462
	ZTS	176.869995	176.869995	178.449997	176.270004	176.580002	1463200.0	0.000075	42.623470	5.163569	5.222385	5.281201	0.651515	-1.18827

Aggregate to monthly level and filter top 150 most liquid stocks for each month:

```
                    axis=1)).dropna()

data
```

date	ticker	dollar_volume	adj close	atr	bb_high	bb_low	bb_mid	garman_klass_vol	macd	rsi
	A	136.719233	39.231625	-1.033887	3.696083	3.551166	3.623625	-0.001703	0.567157	73.421479
	AAL	287.915796	39.429928	0.190822	3.827635	3.672028	3.749832	-0.000966	-0.418772	40.718930
2015-11-30	AAPL	4039.898974	26.960346	-0.967900	3.372114	3.285478	3.328796	-0.003027	-0.142790	55.537339
	ABBV	347.414748	41.572300	-0.526809	3.851336	3.754777	3.803056	-0.051090	0.145678	49.376877
	ABT	214.919509	38.883465	-1.064842	3.714675	3.670950	3.692812	-0.009286	0.335558	56.962635
...	...	...	...	...	...	...	...	...	...	...
	YUM	177.642329	124.010002	0.142547	4.886139	4.826202	4.856171	0.000053	-1.363696	36.057176
	ZBH	192.575129	112.216316	-0.381708	4.831260	4.751923	4.791592	0.000224	-0.881067	31.893246
2023-09-30	ZBRA	105.780863	223.960007	-0.057389	5.677342	5.400991	5.539167	0.000133	-1.600791	29.494977
	ZION	101.500216	33.990002	-0.161699	3.649982	3.539073	3.594527	0.000307	-0.164625	46.707773
	ZTS	289.685271	176.869995	0.651515	5.281201	5.163569	5.222385	0.000075	-1.188278	42.623470

Calculate Monthly Returns for different time horizons as features:

date	ticker	adj close	atr	bb_high	bb_low	bb_mid	garman_klass_vol	macd	rsi	return_1m	return_2m	return_3m	return_6m	return_9m
	AAL	45.534168	1.011062	3.994389	3.849110	3.921750	-0.000363	-0.018697	41.051784	-0.014108	0.022981	-0.023860	0.016495	0.007008
	AAPL	39.870972	-0.906642	3.692324	3.598569	3.645447	-0.000892	-0.039275	69.196833	0.096808	0.015250	0.044955	0.028875	0.038941
2017-10-31	ABBV	69.460686	0.375557	4.317799	4.225041	4.271420	-0.027715	0.473814	55.247862	0.022728	0.098590	0.091379	0.056495	0.047273
	ABT	49.240391	-1.040044	3.954699	3.907545	3.931122	-0.003906	0.276133	53.844941	0.021276	0.034308	0.034801	0.038672	0.031320
	ACN	130.915802	-0.986514	4.893594	4.814228	4.853911	-0.003066	0.352342	69.365078	0.064180	0.048454	0.037202	0.028692	0.027398
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	VRTX	351.690002	0.029799	5.879295	5.838959	5.859127	0.000037	0.027907	52.406728	0.009617	-0.000923	-0.000208	0.018495	0.022140
	VZ	32.990002	-1.078816	3.584371	3.519855	3.552113	0.000056	-0.350385	42.222486	-0.056890	-0.016122	-0.033458	-0.021495	-0.014100
2023-09-30	WFC	40.650002	-0.558742	3.798900	3.718132	3.758516	0.000234	-0.282325	40.920273	-0.015500	-0.057917	-0.013554	0.016712	0.000702
	WMT	162.500000	-0.196379	5.116986	5.081613	5.099300	0.000024	0.399459	54.722508	-0.000676	0.010014	0.012354	0.017574	0.016553
	XOM	116.410004	0.601335	4.793504	4.713293	4.753399	0.000045	1.400623	59.440192	0.046947	0.046139	0.030496	0.012838	0.008747

Define portfolio optimization function

```
new_df
```

```
[**********100%**********]  153 of 153 completed
```

	Adj Close											...				
Date	AAL	AAPL	ABBV	ABT	ACN	ADBE	ADP	ADSK	AIG	AMAT	...	V	VLO	VRTX	VZ
2016-10-31	39.134327	26.316149	41.419556	34.821724	104.783096	107.510002	75.138802	72.279999	51.253304	26.757372	...	10024000	4969500	1928200	12459400
2016-11-01	38.363201	25.840994	41.917068	34.653122	104.692986	106.870003	75.017982	70.099998	50.406013	26.591753	...	10881500	7816800	2458200	13229400
2016-11-02	38.276459	25.864183	42.169540	34.342529	106.919510	105.889999	77.658951	68.680000	50.298012	26.306513	...	9170900	7317600	2580400	16488200
2016-11-03	38.054203	25.586943	41.501225	34.058559	105.423119	107.169998	77.097977	67.610001	48.304379	26.012074	...	7563100	3855900	2371000	12605100
2016-11-04	38.402088	25.356310	41.612629	34.688618	105.675537	106.199997	76.882202	69.440002	47.664745	25.966064	...	7588100	3729900	1902100	14410200
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
2023-09-25	12.910000	176.080002	154.649994	97.470001	316.989990	511.600006	240.020004	205.669998	62.130001	136.589996	...	5921600	3241900	698100	17616900
2023-09-26	12.700000	171.960007	153.910004	96.230003	310.609985	506.299988	237.240005	201.660004	61.259998	134.080002	...	6193200	4936800	633600	18841600
2023-09-27	12.610000	170.429993	153.130005	95.529999	314.380005	502.600006	242.630005	202.279999	61.009998	135.059998	...	6006700	3644000	860600	22083500
2023-09-28	12.920000	170.690002	152.250000	98.120003	300.769989	504.670013	243.309998	207.889999	61.279999	138.220001	...	4203900	3587300	578900	18772100
2023-09-29	12.810000	171.210007	149.059998	96.849998	307.109985	509.899994	240.580002	206.910004	60.599998	138.449997	...	6044200	4302200	896800	19759400

Visualized Portfolio returns and compared to SP500 returns: