

05__zipline__data__demo

September 29, 2021

1 Data Access with Zipline

Zipline is the algorithmic trading library that used to power the now-defunct Quantopian back-testing and live-trading platform. It is also available offline to develop a strategy using a limited number of free data bundles that can be ingested and used to test the performance of trading ideas.

1.1 Zipline installation

This notebook requires the `conda` environment `backtest`. Please see the [installation instructions](#) for running the latest Docker image or alternative ways to set up your environment.

There is much more information about Zipline in [Chapter 8](#).

1.2 Imports & Settings

```
[1]: %matplotlib inline
import pandas as pd
```

```
[2]: %load_ext zipline
```

1.3 zipline Demo

1.3.1 Ingest Data

Get QUANDL API key and follow instructions to download zipline bundles [here](#). This boils down to running:

```
[3]: # !zipline ingest
```

See [zipline docs](#) on the download and management of data bundles used to simulate backtests.

The following commandline instruction lists the available bundles (store per default in `~/zipline`).

```
[4]: # !zipline bundles
```

1.3.2 Data access using zipline

The following code illustrates how zipline permits us to access daily stock data for a range of companies. You can run zipline scripts in the Jupyter Notebook using the magic function of the

same name.

First, you need to initialize the context with the desired security symbols. We'll also use a counter variable. Then zipline calls `handle_data`, where we use the `data.history()` method to look back a single period and append the data for the last day to a .csv file:

```
[5]: %zipline --start 2010-1-1 --end 2018-1-1 --data-frequency daily --no-benchmark
from zipline.api import order_target, record, symbol
import pandas as pd

def initialize(context):
    context.i = 0
    context.assets = [symbol('FB'), symbol('GOOG'), symbol('AMZN')]

def handle_data(context, data):
    df = data.history(context.assets, fields=['price', 'volume'], bar_count=1,
    frequency="1d")
    df = df.reset_index()

    if context.i == 0:
        df.columns = ['date', 'asset', 'price', 'volume']
        df.to_csv('stock_data.csv', index=False)
    else:
        df.to_csv('stock_data.csv', index=False, mode='a', header=None)
    context.i += 1
```

```
/home/stefan/.pyenv/versions/miniconda3-latest/envs/ml4t-zipline/lib/python3.5/site-packages/empyrical/stats.py:711: RuntimeWarning: invalid value encountered
in true_divide
    out=out,
/home/stefan/.pyenv/versions/miniconda3-latest/envs/ml4t-zipline/lib/python3.5/site-packages/empyrical/stats.py:797: RuntimeWarning: invalid value encountered
in true_divide
    np.divide(average_annual_return, annualized_downside_risk, out=out)
```

```
[5]:          algo_volatility  algorithm_period_return  alpha
benchmark_period_return  benchmark_volatility  beta  capital_used  ending_cash
ending_exposure  ending_value          ...          short_exposure
short_value  shorts_count  sortino  starting_cash  starting_exposure
starting_value  trading_days  transactions  treasury_period_return
2010-01-04 21:00:00+00:00          NaN          0.0      NaN
0.002012          NaN  NaN          0.0  10000000.0          0.0
0.0          ...          0.0          0.0          0      None
10000000.0          0.0          0.0          1      []
0.0
2010-01-05 21:00:00+00:00          0.0          0.0      NaN
0.004029          0.000000  NaN          0.0  10000000.0          0.0
0.0          ...          0.0          0.0          0      None
```

10000000.0	0.0	0.0	2	[]
0.0				
2010-01-06 21:00:00+00:00	0.0	0.0	NaN	
0.006049	0.000000	NaN	0.0	10000000.0
0.0	...	0.0	0.0	0
10000000.0	0.0	0.0	3	[]
0.0				
2010-01-07 21:00:00+00:00	0.0	0.0	NaN	
0.008073	0.000000	NaN	0.0	10000000.0
0.0	...	0.0	0.0	0
10000000.0	0.0	0.0	4	[]
0.0				
2010-01-08 21:00:00+00:00	0.0	0.0	NaN	
0.010102	0.000000	NaN	0.0	10000000.0
0.0	...	0.0	0.0	0
10000000.0	0.0	0.0	5	[]
0.0				
2010-01-11 21:00:00+00:00	0.0	0.0	NaN	
0.012134	0.000000	NaN	0.0	10000000.0
0.0	...	0.0	0.0	0
10000000.0	0.0	0.0	6	[]
0.0				
2010-01-12 21:00:00+00:00	0.0	0.0	NaN	
0.014171	0.000000	NaN	0.0	10000000.0
0.0	...	0.0	0.0	0
10000000.0	0.0	0.0	7	[]
0.0				
2010-01-13 21:00:00+00:00	0.0	0.0	NaN	
0.016212	0.000000	NaN	0.0	10000000.0
0.0	...	0.0	0.0	0
10000000.0	0.0	0.0	8	[]
0.0				
2010-01-14 21:00:00+00:00	0.0	0.0	NaN	
0.018257	0.000000	NaN	0.0	10000000.0
0.0	...	0.0	0.0	0
10000000.0	0.0	0.0	9	[]
0.0				
2010-01-15 21:00:00+00:00	0.0	0.0	NaN	
0.020306	0.000000	NaN	0.0	10000000.0
0.0	...	0.0	0.0	0
10000000.0	0.0	0.0	10	[]
0.0				
2010-01-19 21:00:00+00:00	0.0	0.0	NaN	
0.022359	0.000000	NaN	0.0	10000000.0
0.0	...	0.0	0.0	0
10000000.0	0.0	0.0	11	[]
0.0				

2010-01-20 21:00:00+00:00	0.0	0.0	NaN	0.0	10000000.0	0.0	NaN	0.0
0.024416	0.000000	NaN	0.0	0.0	10000000.0	0	None	0.0
0.0	...	0.0	0.0	0.0	12	0	None	0.0
10000000.0	0.0	0.0	0.0	0.0	12	0	None	0.0
0.0								
2010-01-21 21:00:00+00:00	0.0	0.0	NaN	0.0	10000000.0	0.0	NaN	0.0
0.026478	0.000000	NaN	0.0	0.0	10000000.0	0	None	0.0
0.0	...	0.0	0.0	0.0	13	0	None	0.0
10000000.0	0.0	0.0	0.0	0.0	13	0	None	0.0
0.0								
2010-01-22 21:00:00+00:00	0.0	0.0	NaN	0.0	10000000.0	0.0	NaN	0.0
0.028543	0.000000	NaN	0.0	0.0	10000000.0	0	None	0.0
0.0	...	0.0	0.0	0.0	14	0	None	0.0
10000000.0	0.0	0.0	0.0	0.0	14	0	None	0.0
0.0								
2010-01-25 21:00:00+00:00	0.0	0.0	NaN	0.0	10000000.0	0.0	NaN	0.0
0.030613	0.000000	NaN	0.0	0.0	10000000.0	0	None	0.0
0.0	...	0.0	0.0	0.0	15	0	None	0.0
10000000.0	0.0	0.0	0.0	0.0	15	0	None	0.0
0.0								
2010-01-26 21:00:00+00:00	0.0	0.0	NaN	0.0	10000000.0	0.0	NaN	0.0
0.032687	0.000000	NaN	0.0	0.0	10000000.0	0	None	0.0
0.0	...	0.0	0.0	0.0	16	0	None	0.0
10000000.0	0.0	0.0	0.0	0.0	16	0	None	0.0
0.0								
2010-01-27 21:00:00+00:00	0.0	0.0	NaN	0.0	10000000.0	0.0	NaN	0.0
0.034765	0.000000	NaN	0.0	0.0	10000000.0	0	None	0.0
0.0	...	0.0	0.0	0.0	17	0	None	0.0
10000000.0	0.0	0.0	0.0	0.0	17	0	None	0.0
0.0								
2010-01-28 21:00:00+00:00	0.0	0.0	NaN	0.0	10000000.0	0.0	NaN	0.0
0.036847	0.000000	NaN	0.0	0.0	10000000.0	0	None	0.0
0.0	...	0.0	0.0	0.0	18	0	None	0.0
10000000.0	0.0	0.0	0.0	0.0	18	0	None	0.0
0.0								
2010-01-29 21:00:00+00:00	0.0	0.0	NaN	0.0	10000000.0	0.0	NaN	0.0
0.038933	0.000000	NaN	0.0	0.0	10000000.0	0	None	0.0
0.0	...	0.0	0.0	0.0	19	0	None	0.0
10000000.0	0.0	0.0	0.0	0.0	19	0	None	0.0
0.0								
2010-02-01 21:00:00+00:00	0.0	0.0	NaN	0.0	10000000.0	0.0	NaN	0.0
0.041024	0.000000	NaN	0.0	0.0	10000000.0	0	None	0.0
0.0	...	0.0	0.0	0.0	20	0	None	0.0
10000000.0	0.0	0.0	0.0	0.0	20	0	None	0.0
0.0								
2010-02-02 21:00:00+00:00	0.0	0.0	NaN	0.0	10000000.0	0.0	NaN	0.0
0.043119	0.000000	NaN	0.0	0.0	10000000.0	0	None	0.0

0.0	...		0.0	0.0	0	None
10000000.0		0.0	0.0	21		[]
0.0						
2010-02-03 21:00:00+00:00			0.0		0.0	NaN
0.045218		0.000000	NaN	0.0	10000000.0	0.0
0.0	...		0.0	0.0	0	None
10000000.0		0.0	0.0	22		[]
0.0						
2010-02-04 21:00:00+00:00			0.0		0.0	NaN
0.047321		0.000000	NaN	0.0	10000000.0	0.0
0.0	...		0.0	0.0	0	None
10000000.0		0.0	0.0	23		[]
0.0						
2010-02-05 21:00:00+00:00			0.0		0.0	NaN
0.049429		0.000000	NaN	0.0	10000000.0	0.0
0.0	...		0.0	0.0	0	None
10000000.0		0.0	0.0	24		[]
0.0						
2010-02-08 21:00:00+00:00			0.0		0.0	NaN
0.051540		0.000000	NaN	0.0	10000000.0	0.0
0.0	...		0.0	0.0	0	None
10000000.0		0.0	0.0	25		[]
0.0						
2010-02-09 21:00:00+00:00			0.0		0.0	NaN
0.053656		0.000000	NaN	0.0	10000000.0	0.0
0.0	...		0.0	0.0	0	None
10000000.0		0.0	0.0	26		[]
0.0						
2010-02-10 21:00:00+00:00			0.0		0.0	NaN
0.055776		0.000000	NaN	0.0	10000000.0	0.0
0.0	...		0.0	0.0	0	None
10000000.0		0.0	0.0	27		[]
0.0						
2010-02-11 21:00:00+00:00			0.0		0.0	NaN
0.057901		0.000000	NaN	0.0	10000000.0	0.0
0.0	...		0.0	0.0	0	None
10000000.0		0.0	0.0	28		[]
0.0						
2010-02-12 21:00:00+00:00			0.0		0.0	NaN
0.060030		0.000000	NaN	0.0	10000000.0	0.0
0.0	...		0.0	0.0	0	None
10000000.0		0.0	0.0	29		[]
0.0						
2010-02-16 21:00:00+00:00			0.0		0.0	NaN
0.062163		0.000000	NaN	0.0	10000000.0	0.0
0.0	...		0.0	0.0	0	None
10000000.0		0.0	0.0	30		[]

```

0.0
...
...
...
...
...
...
...
...
...
2017-11-16 21:00:00+00:00 0.0 0.0 0.0
25.150448 0.052440 0.0 0.0 10000000.0
0.0 0.0 ... 0.0 0.0
0 None 10000000.0 0.0 0.0 1984
[] 0.0
2017-11-17 21:00:00+00:00 0.0 0.0 0.0
25.081776 0.052449 0.0 0.0 10000000.0
0.0 0.0 ... 0.0 0.0
0 None 10000000.0 0.0 0.0 1985
[] 0.0
2017-11-20 21:00:00+00:00 0.0 0.0 0.0
25.115050 0.052435 0.0 0.0 10000000.0
0.0 0.0 ... 0.0 0.0
0 None 10000000.0 0.0 0.0 1986
[] 0.0
2017-11-21 21:00:00+00:00 0.0 0.0 0.0
25.285871 0.052451 0.0 0.0 10000000.0
0.0 0.0 ... 0.0 0.0
0 None 10000000.0 0.0 0.0 1987
[] 0.0
2017-11-22 21:00:00+00:00 0.0 0.0 0.0
25.266149 0.052445 0.0 0.0 10000000.0
0.0 0.0 ... 0.0 0.0
0 None 10000000.0 0.0 0.0 1988
[] 0.0
2017-11-24 18:00:00+00:00 0.0 0.0 0.0
25.320156 0.052432 0.0 0.0 10000000.0
0.0 0.0 ... 0.0 0.0
0 None 10000000.0 0.0 0.0 1989
[] 0.0
2017-11-27 21:00:00+00:00 0.0 0.0 0.0
25.310043 0.052424 0.0 0.0 10000000.0
0.0 0.0 ... 0.0 0.0
0 None 10000000.0 0.0 0.0 1990
[] 0.0
2017-11-28 21:00:00+00:00 0.0 0.0 0.0
25.569156 0.052492 0.0 0.0 10000000.0
0.0 0.0 ... 0.0 0.0
0 None 10000000.0 0.0 0.0 1991
[] 0.0
2017-11-29 21:00:00+00:00 0.0 0.0 0.0

```

25.559346		0.052483	0.0	0.0	10000000.0	
0.0	0.0	...		0.0	0.0	
0	None	10000000.0	0.0	0.0		1992
[]		0.0				
2017-11-30	21:00:00+00:00		0.0		0.0	0.0
25.776892		0.052522	0.0	0.0	10000000.0	
0.0	0.0	...		0.0	0.0	
0	None	10000000.0	0.0	0.0		1993
[]		0.0				
2017-12-01	21:00:00+00:00		0.0		0.0	0.0
25.722683		0.052525	0.0	0.0	10000000.0	
0.0	0.0	...		0.0	0.0	
0	None	10000000.0	0.0	0.0		1994
[]		0.0				
2017-12-04	21:00:00+00:00		0.0		0.0	0.0
25.694566		0.052521	0.0	0.0	10000000.0	
0.0	0.0	...		0.0	0.0	
0	None	10000000.0	0.0	0.0		1995
[]		0.0				
2017-12-05	21:00:00+00:00		0.0		0.0	0.0
25.594744		0.052542	0.0	0.0	10000000.0	
0.0	0.0	...		0.0	0.0	
0	None	10000000.0	0.0	0.0		1996
[]		0.0				
2017-12-06	21:00:00+00:00		0.0		0.0	0.0
25.591710		0.052533	0.0	0.0	10000000.0	
0.0	0.0	...		0.0	0.0	
0	None	10000000.0	0.0	0.0		1997
[]		0.0				
2017-12-07	21:00:00+00:00		0.0		0.0	0.0
25.669687		0.052522	0.0	0.0	10000000.0	
0.0	0.0	...		0.0	0.0	
0	None	10000000.0	0.0	0.0		1998
[]		0.0				
2017-12-08	21:00:00+00:00		0.0		0.0	0.0
25.816538		0.052526	0.0	0.0	10000000.0	
0.0	0.0	...		0.0	0.0	
0	None	10000000.0	0.0	0.0		1999
[]		0.0				
2017-12-11	21:00:00+00:00		0.0		0.0	0.0
25.902403		0.052516	0.0	0.0	10000000.0	
0.0	0.0	...		0.0	0.0	
0	None	10000000.0	0.0	0.0		2000
[]		0.0				
2017-12-12	21:00:00+00:00		0.0		0.0	0.0
25.944072		0.052503	0.0	0.0	10000000.0	
0.0	0.0	...		0.0	0.0	

0	None	10000000.0		0.0		0.0	2001
[		0.0					
2017-12-13	21:00:00+00:00			0.0		0.0	0.0
25.931329		0.052495	0.0		0.0	10000000.0	
0.0		0.0	...			0.0	0.0
0	None	10000000.0		0.0		0.0	2002
[		0.0					
2017-12-14	21:00:00+00:00			0.0		0.0	0.0
25.821696		0.052521	0.0		0.0	10000000.0	
0.0		0.0	...			0.0	0.0
0	None	10000000.0		0.0		0.0	2003
[		0.0					
2017-12-15	21:00:00+00:00			0.0		0.0	0.0
26.062403		0.052573	0.0		0.0	10000000.0	
0.0		0.0	...			0.0	0.0
0	None	10000000.0		0.0		0.0	2004
[		0.0					
2017-12-18	21:00:00+00:00			0.0		0.0	0.0
26.207534		0.052576	0.0		0.0	10000000.0	
0.0		0.0	...			0.0	0.0
0	None	10000000.0		0.0		0.0	2005
[		0.0					
2017-12-19	21:00:00+00:00			0.0		0.0	0.0
26.119646		0.052591	0.0		0.0	10000000.0	
0.0		0.0	...			0.0	0.0
0	None	10000000.0		0.0		0.0	2006
[		0.0					
2017-12-20	21:00:00+00:00			0.0		0.0	0.0
26.097194		0.052586	0.0		0.0	10000000.0	
0.0		0.0	...			0.0	0.0
0	None	10000000.0		0.0		0.0	2007
[		0.0					
2017-12-21	21:00:00+00:00			0.0		0.0	0.0
26.150999		0.052573	0.0		0.0	10000000.0	
0.0		0.0	...			0.0	0.0
0	None	10000000.0		0.0		0.0	2008
[		0.0					
2017-12-22	21:00:00+00:00			0.0		0.0	0.0
26.138559		0.052565	0.0		0.0	10000000.0	
0.0		0.0	...			0.0	0.0
0	None	10000000.0		0.0		0.0	2009
[		0.0					
2017-12-26	21:00:00+00:00			0.0		0.0	0.0
26.109836		0.052560	0.0		0.0	10000000.0	
0.0		0.0	...			0.0	0.0
0	None	10000000.0		0.0		0.0	2010
[		0.0					


```

2017-12-27 21:00:00+00:00      0.0      0.0      0.0
26.131277      0.052548  0.0      0.0  10000000.0
0.0      0.0      ...      0.0      0.0
0      None      10000000.0      0.0      0.0      2011
[]      0.0
2017-12-28 21:00:00+00:00      0.0      0.0      0.0
26.181037      0.052535  0.0      0.0  10000000.0
0.0      0.0      ...      0.0      0.0
0      None      10000000.0      0.0      0.0      2012
[]      0.0
2017-12-29 21:00:00+00:00      0.0      0.0      0.0
26.040152      0.052578  0.0      0.0  10000000.0
0.0      0.0      ...      0.0      0.0
0      None      10000000.0      0.0      0.0      2013
[]      0.0

```

[2013 rows x 37 columns]

We can plot the data as follows:

```

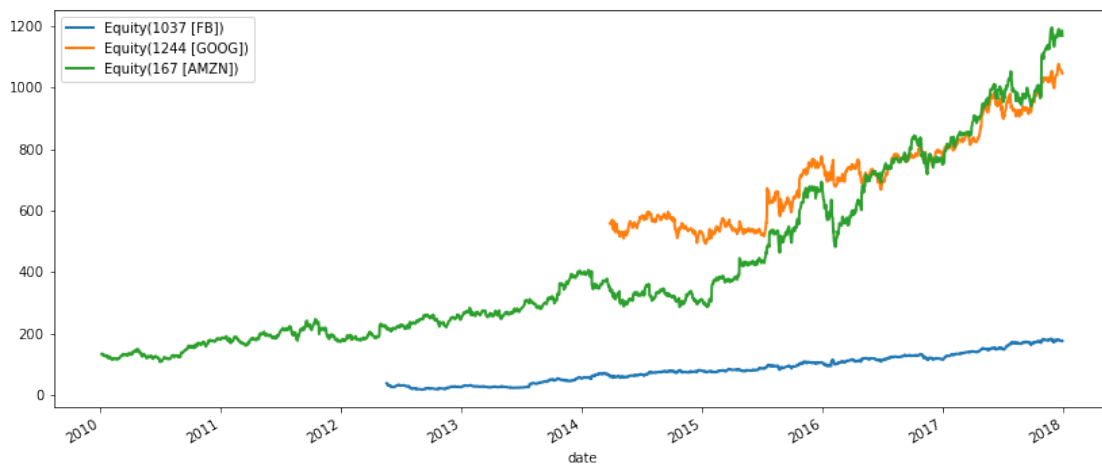
[6]: df = pd.read_csv('stock_data.csv')
df.date = pd.to_datetime(df.date)
df.set_index('date').groupby('asset').price.plot(lw=2, legend=True,
→figsize=(14, 6))

```

```

[6]: asset
Equity(1037 [FB])      AxesSubplot(0.125,0.2;0.775x0.68)
Equity(1244 [GOOG])    AxesSubplot(0.125,0.2;0.775x0.68)
Equity(167 [AMZN])     AxesSubplot(0.125,0.2;0.775x0.68)
Name: price, dtype: object

```



1.3.3 Simple moving average strategy

The following code example illustrates a [Dual Moving Average Cross-Over Strategy](#) to demonstrate Zipline in action:

```
[7]: %%zipline --start 2014-1-1 --end 2018-1-1 --no-benchmark -o dma.pickle
from zipline.api import order_target, record, symbol
import matplotlib.pyplot as plt

def initialize(context):
    context.i = 0
    context.asset = symbol('AAPL')

def handle_data(context, data):
    # Skip first 300 days to get full windows
    context.i += 1
    if context.i < 300:
        return

    # Compute averages
    # data.history() has to be called with the same params
    # from above and returns a pandas dataframe.
    short_mavg = data.history(context.asset, 'price', bar_count=100,
↪frequency="1d").mean()
    long_mavg = data.history(context.asset, 'price', bar_count=300,
↪frequency="1d").mean()

    # Trading logic
    if short_mavg > long_mavg:
        # order_target orders as many shares as needed to
        # achieve the desired number of shares.
        order_target(context.asset, 100)
    elif short_mavg < long_mavg:
        order_target(context.asset, 0)

    # Save values for later inspection
    record(AAPL=data.current(context.asset, 'price'),
          short_mavg=short_mavg,
          long_mavg=long_mavg)

def analyze(context, perf):
    fig, (ax1, ax2) = plt.subplots(nrows=2,figsize=(14, 8))
    perf.portfolio_value.plot(ax=ax1)
    ax1.set_ylabel('portfolio value in $')

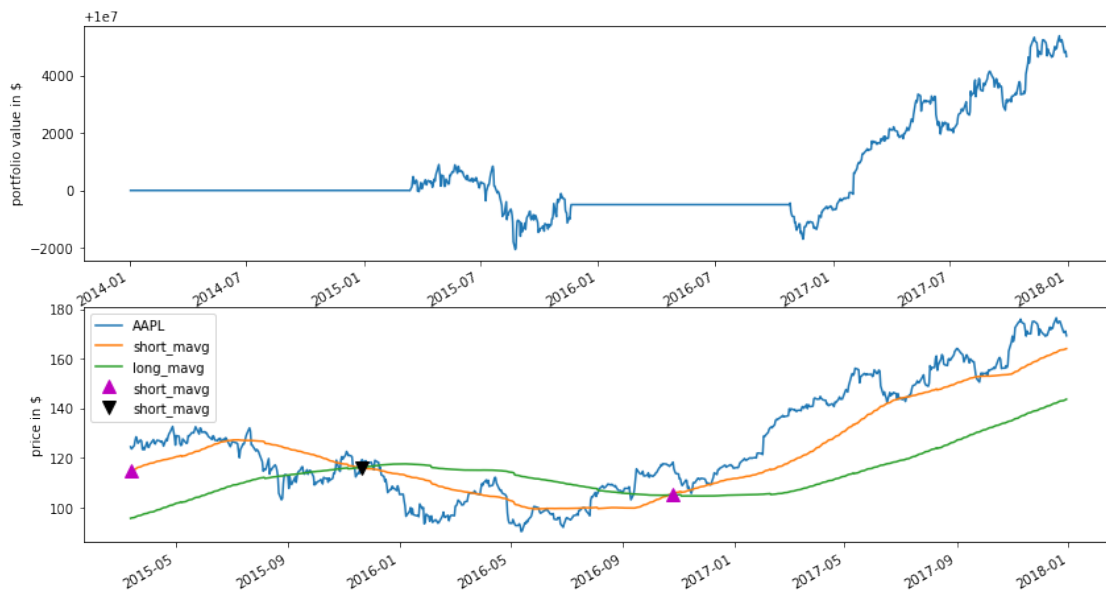
    perf['AAPL'].plot(ax=ax2)
```

```

perf[['short_mavg', 'long_mavg']].plot(ax=ax2)

perf_trans = perf.loc[[t != [] for t in perf.transactions]]
buys = perf_trans.loc[[t[0]['amount'] > 0 for t in perf_trans.transactions]]
sells = perf_trans.loc[
    [t[0]['amount'] < 0 for t in perf_trans.transactions]]
ax2.plot(buys.index, perf.short_mavg.loc[buys.index],
         '^', markersize=10, color='m')
ax2.plot(sells.index, perf.short_mavg.loc[sells.index],
         'v', markersize=10, color='k')
ax2.set_ylabel('price in $')
plt.legend(loc=0)
plt.show()

```



```

[7]: AAPL algo_volatility algorithm_period_return
alpha benchmark_period_return benchmark_volatility beta capital_used
ending_cash ending_exposure ... short_mavg short_value
shorts_count sortino starting_cash starting_exposure starting_value
trading_days transactions treasury_period_return
2014-01-02 21:00:00+00:00 NaN NaN 0.000000
NaN 0.002012 NaN NaN 0.0
1.000000e+07 0.0 ... NaN 0.0
0 NaN 1.000000e+07 0.0 0.0 1
[] 0.0
2014-01-03 21:00:00+00:00 NaN 0.000000 0.000000
NaN 0.004029 0.000000 NaN 0.0
1.000000e+07 0.0 ... NaN 0.0

```

0	NaN	1.000000e+07	0.0	0.0	2
[		0.0			
2014-01-06 21:00:00+00:00	NaN	0.000000		0.000000	
NaN		0.006049	0.000000	NaN	0.0
1.000000e+07		0.0	...	NaN	0.0
0	NaN	1.000000e+07	0.0	0.0	3
[		0.0			
2014-01-07 21:00:00+00:00	NaN	0.000000		0.000000	
NaN		0.008073	0.000000	NaN	0.0
1.000000e+07		0.0	...	NaN	0.0
0	NaN	1.000000e+07	0.0	0.0	4
[		0.0			
2014-01-08 21:00:00+00:00	NaN	0.000000		0.000000	
NaN		0.010102	0.000000	NaN	0.0
1.000000e+07		0.0	...	NaN	0.0
0	NaN	1.000000e+07	0.0	0.0	5
[		0.0			
2014-01-09 21:00:00+00:00	NaN	0.000000		0.000000	
NaN		0.012134	0.000000	NaN	0.0
1.000000e+07		0.0	...	NaN	0.0
0	NaN	1.000000e+07	0.0	0.0	6
[		0.0			
2014-01-10 21:00:00+00:00	NaN	0.000000		0.000000	
NaN		0.014171	0.000000	NaN	0.0
1.000000e+07		0.0	...	NaN	0.0
0	NaN	1.000000e+07	0.0	0.0	7
[		0.0			
2014-01-13 21:00:00+00:00	NaN	0.000000		0.000000	
NaN		0.016212	0.000000	NaN	0.0
1.000000e+07		0.0	...	NaN	0.0
0	NaN	1.000000e+07	0.0	0.0	8
[		0.0			
2014-01-14 21:00:00+00:00	NaN	0.000000		0.000000	
NaN		0.018257	0.000000	NaN	0.0
1.000000e+07		0.0	...	NaN	0.0
0	NaN	1.000000e+07	0.0	0.0	9
[		0.0			
2014-01-15 21:00:00+00:00	NaN	0.000000		0.000000	
NaN		0.020306	0.000000	NaN	0.0
1.000000e+07		0.0	...	NaN	0.0
0	NaN	1.000000e+07	0.0	0.0	10
[		0.0			
2014-01-16 21:00:00+00:00	NaN	0.000000		0.000000	
NaN		0.022359	0.000000	NaN	0.0
1.000000e+07		0.0	...	NaN	0.0
0	NaN	1.000000e+07	0.0	0.0	11
[		0.0			

2014-01-17 21:00:00+00:00	NaN	0.000000	0.000000
NaN 0.024416	0.000000	NaN	0.0
1.000000e+07 0.0	...	NaN	0.0
0 NaN 1.000000e+07	0.0	0.0	12
[] 0.0			
2014-01-21 21:00:00+00:00	NaN	0.000000	0.000000
NaN 0.026478	0.000000	NaN	0.0
1.000000e+07 0.0	...	NaN	0.0
0 NaN 1.000000e+07	0.0	0.0	13
[] 0.0			
2014-01-22 21:00:00+00:00	NaN	0.000000	0.000000
NaN 0.028543	0.000000	NaN	0.0
1.000000e+07 0.0	...	NaN	0.0
0 NaN 1.000000e+07	0.0	0.0	14
[] 0.0			
2014-01-23 21:00:00+00:00	NaN	0.000000	0.000000
NaN 0.030613	0.000000	NaN	0.0
1.000000e+07 0.0	...	NaN	0.0
0 NaN 1.000000e+07	0.0	0.0	15
[] 0.0			
2014-01-24 21:00:00+00:00	NaN	0.000000	0.000000
NaN 0.032687	0.000000	NaN	0.0
1.000000e+07 0.0	...	NaN	0.0
0 NaN 1.000000e+07	0.0	0.0	16
[] 0.0			
2014-01-27 21:00:00+00:00	NaN	0.000000	0.000000
NaN 0.034765	0.000000	NaN	0.0
1.000000e+07 0.0	...	NaN	0.0
0 NaN 1.000000e+07	0.0	0.0	17
[] 0.0			
2014-01-28 21:00:00+00:00	NaN	0.000000	0.000000
NaN 0.036847	0.000000	NaN	0.0
1.000000e+07 0.0	...	NaN	0.0
0 NaN 1.000000e+07	0.0	0.0	18
[] 0.0			
2014-01-29 21:00:00+00:00	NaN	0.000000	0.000000
NaN 0.038933	0.000000	NaN	0.0
1.000000e+07 0.0	...	NaN	0.0
0 NaN 1.000000e+07	0.0	0.0	19
[] 0.0			
2014-01-30 21:00:00+00:00	NaN	0.000000	0.000000
NaN 0.041024	0.000000	NaN	0.0
1.000000e+07 0.0	...	NaN	0.0
0 NaN 1.000000e+07	0.0	0.0	20
[] 0.0			
2014-01-31 21:00:00+00:00	NaN	0.000000	0.000000
NaN 0.043119	0.000000	NaN	0.0

1.000000e+07	0.0	...	NaN	0.0
0	NaN	1.000000e+07	0.0	21
[]	0.0			
2014-02-03 21:00:00+00:00	NaN	0.000000		0.000000
NaN	0.045218	0.000000	NaN	0.0
1.000000e+07	0.0	...	NaN	0.0
0	NaN	1.000000e+07	0.0	22
[]	0.0			
2014-02-04 21:00:00+00:00	NaN	0.000000		0.000000
NaN	0.047321	0.000000	NaN	0.0
1.000000e+07	0.0	...	NaN	0.0
0	NaN	1.000000e+07	0.0	23
[]	0.0			
2014-02-05 21:00:00+00:00	NaN	0.000000		0.000000
NaN	0.049429	0.000000	NaN	0.0
1.000000e+07	0.0	...	NaN	0.0
0	NaN	1.000000e+07	0.0	24
[]	0.0			
2014-02-06 21:00:00+00:00	NaN	0.000000		0.000000
NaN	0.051540	0.000000	NaN	0.0
1.000000e+07	0.0	...	NaN	0.0
0	NaN	1.000000e+07	0.0	25
[]	0.0			
2014-02-07 21:00:00+00:00	NaN	0.000000		0.000000
NaN	0.053656	0.000000	NaN	0.0
1.000000e+07	0.0	...	NaN	0.0
0	NaN	1.000000e+07	0.0	26
[]	0.0			
2014-02-10 21:00:00+00:00	NaN	0.000000		0.000000
NaN	0.055776	0.000000	NaN	0.0
1.000000e+07	0.0	...	NaN	0.0
0	NaN	1.000000e+07	0.0	27
[]	0.0			
2014-02-11 21:00:00+00:00	NaN	0.000000		0.000000
NaN	0.057901	0.000000	NaN	0.0
1.000000e+07	0.0	...	NaN	0.0
0	NaN	1.000000e+07	0.0	28
[]	0.0			
2014-02-12 21:00:00+00:00	NaN	0.000000		0.000000
NaN	0.060030	0.000000	NaN	0.0
1.000000e+07	0.0	...	NaN	0.0
0	NaN	1.000000e+07	0.0	29
[]	0.0			
2014-02-13 21:00:00+00:00	NaN	0.000000		0.000000
NaN	0.062163	0.000000	NaN	0.0
1.000000e+07	0.0	...	NaN	0.0
0	NaN	1.000000e+07	0.0	30

[]	0.0			
...	
...	
...
...
...	...			
2017-11-16 21:00:00+00:00	171.100	0.000190		0.000485
-0.000017	2.517134	0.074234	0.000434	0.0
9.987736e+06	17110.0	...	157.284790	0.0
0 0.965627	9.987736e+06	16908.0	16908.0	978
[]	0.0			
2017-11-17 21:00:00+00:00	170.150	0.000190		0.000475
-0.000020	2.507897	0.074223	0.000436	0.0
9.987736e+06	17015.0	...	157.533690	0.0
0 0.945562	9.987736e+06	17110.0	17110.0	979
[]	0.0			
2017-11-20 21:00:00+00:00	169.980	0.000189		0.000473
-0.000020	2.512373	0.074185	0.000436	0.0
9.987736e+06	16998.0	...	157.802310	0.0
0 0.941678	9.987736e+06	17015.0	17015.0	980
[]	0.0			
2017-11-21 21:00:00+00:00	173.140	0.000190		0.000505
-0.000015	2.535347	0.074195	0.000443	0.0
9.987736e+06	17314.0	...	158.099140	0.0
0 1.004004	9.987736e+06	16998.0	16998.0	981
[]	0.0			
2017-11-22 21:00:00+00:00	174.960	0.000190		0.000523
-0.000010	2.532695	0.074164	0.000441	0.0
9.987736e+06	17496.0	...	158.419350	0.0
0 1.039646	9.987736e+06	17314.0	17314.0	982
[]	0.0			
2017-11-24 18:00:00+00:00	174.970	0.000190		0.000523
-0.000010	2.539959	0.074128	0.000441	0.0
9.987736e+06	17497.0	...	158.733790	0.0
0 1.039316	9.987736e+06	17496.0	17496.0	983
[]	0.0			
2017-11-27 21:00:00+00:00	174.090	0.000190		0.000514
-0.000012	2.538598	0.074095	0.000441	0.0
9.987736e+06	17409.0	...	159.052970	0.0
0 1.020718	9.987736e+06	17497.0	17497.0	984
[]	0.0			
2017-11-28 21:00:00+00:00	173.070	0.000190		0.000504
-0.000014	2.573448	0.074183	0.000436	0.0
9.987736e+06	17307.0	...	159.347510	0.0
0 0.999183	9.987736e+06	17409.0	17409.0	985
[]	0.0			
2017-11-29 21:00:00+00:00	169.480	0.000191		0.000468

-0.000024	2.572129	0.074151	0.000438	0.0
9.987736e+06	16948.0	...	159.597380	0.0
0 0.918573	9.987736e+06	17307.0	17307.0	986
[]	0.0			
2017-11-30 21:00:00+00:00	171.850	0.000191		0.000492
-0.000021	2.601388	0.074195	0.000445	0.0
9.987736e+06	17185.0	...	159.866270	0.0
0 0.964547	9.987736e+06	16948.0	16948.0	987
[]	0.0			
2017-12-01 21:00:00+00:00	171.050	0.000191		0.000484
-0.000023	2.594097	0.074176	0.000446	0.0
9.987736e+06	17105.0	...	160.125070	0.0
0 0.947936	9.987736e+06	17185.0	17185.0	988
[]	0.0			
2017-12-04 21:00:00+00:00	169.800	0.000191		0.000472
-0.000027	2.590315	0.074148	0.000447	0.0
9.987736e+06	16980.0	...	160.351150	0.0
0 0.921919	9.987736e+06	17105.0	17105.0	989
[]	0.0			
2017-12-05 21:00:00+00:00	169.640	0.000191		0.000470
-0.000027	2.576890	0.074154	0.000447	0.0
9.987736e+06	16964.0	...	160.562980	0.0
0 0.918310	9.987736e+06	16980.0	16980.0	990
[]	0.0			
2017-12-06 21:00:00+00:00	169.010	0.000191		0.000464
-0.000029	2.576482	0.074120	0.000448	0.0
9.987736e+06	16901.0	...	160.763330	0.0
0 0.905278	9.987736e+06	16964.0	16964.0	991
[]	0.0			
2017-12-07 21:00:00+00:00	169.452	0.000191		0.000468
-0.000028	2.586969	0.074088	0.000448	0.0
9.987736e+06	16945.2	...	160.962920	0.0
0 0.913444	9.987736e+06	16901.0	16901.0	992
[]	0.0			
2017-12-08 21:00:00+00:00	169.370	0.000191		0.000467
-0.000028	2.606720	0.074080	0.000447	0.0
9.987736e+06	16937.0	...	161.152330	0.0
0 0.911380	9.987736e+06	16945.2	16945.2	993
[]	0.0			
2017-12-11 21:00:00+00:00	172.670	0.000191		0.000500
-0.000021	2.618269	0.074049	0.000450	0.0
9.987736e+06	17267.0	...	161.381510	0.0
0 0.975229	9.987736e+06	16937.0	16937.0	994
[]	0.0			
2017-12-12 21:00:00+00:00	171.700	0.000191		0.000491
-0.000024	2.623873	0.074012	0.000450	0.0
9.987736e+06	17170.0	...	161.601690	0.0

0	0.955174	9.987736e+06	17267.0	17267.0	995
[]		0.0			
2017-12-13	21:00:00+00:00	172.270	0.000191		0.000496
-0.000022		2.622159	0.073980	0.000449	0.0
9.987736e+06		17227.0	...	161.809440	0.0
0	0.965782	9.987736e+06	17170.0	17170.0	996
[]		0.0			
2017-12-14	21:00:00+00:00	172.220	0.000191		0.000496
-0.000022		2.607414	0.073993	0.000449	0.0
9.987736e+06		17222.0	...	162.010210	0.0
0	0.964324	9.987736e+06	17227.0	17227.0	997
[]		0.0			
2017-12-15	21:00:00+00:00	173.870	0.000191		0.000512
-0.000020		2.639788	0.074056	0.000454	0.0
9.987736e+06		17387.0	...	162.220310	0.0
0	0.995906	9.987736e+06	17222.0	17222.0	998
[]		0.0			
2017-12-18	21:00:00+00:00	176.420	0.000191		0.000538
-0.000016		2.659308	0.074047	0.000458	0.0
9.987736e+06		17642.0	...	162.484800	0.0
0	1.044938	9.987736e+06	17387.0	17387.0	999
[]		0.0			
2017-12-19	21:00:00+00:00	174.540	0.000192		0.000519
-0.000021		2.647487	0.074045	0.000461	0.0
9.987736e+06		17454.0	...	162.741050	0.0
0	1.005265	9.987736e+06	17642.0	17642.0	1000
[]		0.0			
2017-12-20	21:00:00+00:00	174.350	0.000191		0.000517
-0.000021		2.644467	0.074016	0.000462	0.0
9.987736e+06		17435.0	...	163.001870	0.0
0	1.001059	9.987736e+06	17454.0	17454.0	1001
[]		0.0			
2017-12-21	21:00:00+00:00	175.010	0.000191		0.000524
-0.000020		2.651704	0.073979	0.000462	0.0
9.987736e+06		17501.0	...	163.257340	0.0
0	1.013325	9.987736e+06	17435.0	17435.0	1002
[]		0.0			
2017-12-22	21:00:00+00:00	175.010	0.000191		0.000524
-0.000020		2.650031	0.073948	0.000462	0.0
9.987736e+06		17501.0	...	163.442190	0.0
0	1.012820	9.987736e+06	17501.0	17501.0	1003
[]		0.0			
2017-12-26	21:00:00+00:00	170.570	0.000193		0.000479
-0.000033		2.646167	0.073920	0.000467	0.0
9.987736e+06		17057.0	...	163.598280	0.0
0	0.913225	9.987736e+06	17501.0	17501.0	1004
[]		0.0			

```

2017-12-27 21:00:00+00:00 170.600      0.000192      0.000480
-0.000033      2.649051      0.073884  0.000467      0.0
9.987736e+06      17060.0      ...      163.746503      0.0
0  0.913342  9.987736e+06      17057.0      17057.0      1005
[]      0.0
2017-12-28 21:00:00+00:00 171.080      0.000192      0.000484
-0.000032      2.655744      0.073848  0.000467      0.0
9.987736e+06      17108.0      ...      163.899520      0.0
0  0.922021  9.987736e+06      17060.0      17060.0      1006
[]      0.0
2017-12-29 21:00:00+00:00 169.230      0.000193      0.000466
-0.000037      2.636795      0.073882  0.000471      0.0
9.987736e+06      16923.0      ...      163.997280      0.0
0  0.884195  9.987736e+06      17108.0      17108.0      1007
[]      0.0

```

[1007 rows x 40 columns]

[]: