

01_single_factor_zipline

September 29, 2021

0.1 Setup

```
[1]: import re
import warnings
import seaborn as sns
import matplotlib.pyplot as plt
from alphasens.utils import get_clean_factor_and_forward_returns
from alphasens.performance import *
from alphasens.plotting import *
from alphasens.tears import *
```

```
[2]: warnings.filterwarnings('ignore')
%matplotlib inline
plt.style.use('fivethirtyeight')
```

0.1.1 Version conflict

At the time of writing, `zipline` required `pandas<=0.22` so you may need to run `pip install -U zipline` to temporarily downgrade `pandas` or set up a separate environment.

```
[ ]: !pip install -U zipline
```

0.2 Zipline AlphaFactor Test

We are first going to illustrate the zipline alpha factor research workflow in an offline environment. In particular, we will develop and test a simple mean-reversion factor that measures how much recent performance has deviated from the historical average.

Short-term reversal is a common strategy that takes advantage of the weakly predictive pattern that stock price increases are likely to mean-revert back down over horizons from less than a minute to one month.

To this end, the factor computes the z-score for the last monthly return relative to the rolling monthly returns over the last year. At this point, we will not place any orders to simply illustrate the implementation of a `CustomFactor` and record the results during the simulation.

After some basic settings, `MeanReversion` subclasses `CustomFactor` and defines a `compute()` method. It creates default inputs of monthly returns over an also default year-long window so that the `monthly_return` variable will have 252 rows and one column for each security in the Quandl dataset on a given day.

The `compute_factors()` method creates a `MeanReversion` factor instance and creates long, short, and ranking pipeline columns. The former two contain Boolean values that could be used to place orders, and the latter reflects that overall ranking to evaluate the overall factor performance. Furthermore, it uses the built-in `AverageDollarVolume` factor to limit the computation to more liquid stocks

The result would allow us to place long and short orders. We will see in the next chapter how to build a portfolio by choosing a rebalancing period and adjusting portfolio holdings as new signals arrive.

- The `initialize()` method registers the `compute_factors()` pipeline, and the `before_trading_start()` method ensures the pipeline runs on a daily basis.
- The `record()` function adds the pipeline's ranking column as well as the current asset prices to the performance DataFrame returned by the `run_algorithm()` function

We will use the factor and pricing data stored in the performance DataFrame to evaluate the factor performance for various holding periods in the next section, but first, we'll take a look at how to create more complex signals by combining several alpha factors from a diverse set of data sources on the Quantopian platform.

Run using jupyter notebook extension

```
[3]: %load_ext zipline
```

```
[4]: %%zipline --start 2015-1-1 --end 2018-1-1 --output single_factor.pickle

from zipline.api import (
    attach_pipeline,
    date_rules,
    time_rules,
    order_target_percent,
    pipeline_output,
    record,
    schedule_function,
    get_open_orders,
    calendars
)
from zipline.finance import commission, slippage
from zipline.pipeline import Pipeline, CustomFactor
from zipline.pipeline.factors import Returns, AverageDollarVolume
import numpy as np
import pandas as pd

MONTH = 21
YEAR = 12 * MONTH
N_LONGS = N_SHORTS = 25
VOL_SCREEN = 1000
```

```

class MeanReversion(CustomFactor):
    """Compute ratio of latest monthly return to 12m average,
       normalized by std dev of monthly returns"""
    inputs = [Returns(window_length=MONTH)]
    window_length = YEAR

    def compute(self, today, assets, out, monthly_returns):
        df = pd.DataFrame(monthly_returns)
        out[:] = df.iloc[-1].sub(df.mean()).div(df.std())

def compute_factors():
    """Create factor pipeline incl. mean reversion,
       filtered by 30d Dollar Volume; capture factor ranks"""
    mean_reversion = MeanReversion()
    dollar_volume = AverageDollarVolume(window_length=30)
    return Pipeline(columns={'longs': mean_reversion.bottom(N_LONGS),
                             'shorts': mean_reversion.top(N_SHORTS),
                             'ranking': mean_reversion.rank(ascending=False)},
                    screen=dollar_volume.top(VOL_SCREEN))

def exec_trades(data, assets, target_percent):
    """Place orders for assets using target portfolio percentage"""
    for asset in assets:
        if data.can_trade(asset) and not get_open_orders(asset):
            order_target_percent(asset, target_percent)

def rebalance(context, data):
    """Compute long, short and obsolete holdings; place trade orders"""
    factor_data = context.factor_data
    record(factor_data=factor_data.ranking)

    assets = factor_data.index
    record(prices=data.current(assets, 'price'))

    longs = assets[factor_data.longs]
    shorts = assets[factor_data.shorts]
    divest = set(context.portfolio.positions.keys()) - set(longs.union(shorts))

    exec_trades(data, assets=divest, target_percent=0)
    exec_trades(data, assets=longs, target_percent=1 / N_LONGS)
    exec_trades(data, assets=shorts, target_percent=-1 / N_SHORTS)

def initialize(context):

```

```

"""Setup: register pipeline, schedule rebalancing,
    and set trading params"""
attach_pipeline(compute_factors(), 'factor_pipeline')
schedule_function(rebalance,
                  date_rules.week_start(),
                  time_rules.market_open(),
                  calendar=calendars.US_EQUITIES)
context.set_commission(commission.PerShare(cost=.01, min_trade_cost=0))
context.set_slippage(slippage.VolumeShareSlippage())

def before_trading_start(context, data):
    """Run factor pipeline"""
    context.factor_data = pipeline_output('factor_pipeline')

```

```

[4]:
      algo_volatility  algorithm_period_return  alpha \
2015-01-02 21:00:00+00:00      NaN      0.000000      NaN
2015-01-05 21:00:00+00:00      0.004462     -0.000398  0.001899
2015-01-06 21:00:00+00:00      0.087450     -0.010128 -0.837798
2015-01-07 21:00:00+00:00      0.080463     -0.008845 -0.404485
2015-01-08 21:00:00+00:00      0.092816     -0.002474 -0.147576
2015-01-09 21:00:00+00:00      0.085714     -0.006238 -0.187857
2015-01-12 21:00:00+00:00      0.078270     -0.007585 -0.136985
2015-01-13 21:00:00+00:00      0.074637     -0.005492 -0.033333
2015-01-14 21:00:00+00:00      0.070191     -0.007529 -0.044407
2015-01-15 21:00:00+00:00      0.066363     -0.007372  0.011076
2015-01-16 21:00:00+00:00      0.063027     -0.008715 -0.118679
2015-01-20 21:00:00+00:00      0.060586     -0.011163 -0.168624
2015-01-21 21:00:00+00:00      0.058034     -0.011682 -0.183191
2015-01-22 21:00:00+00:00      0.058471     -0.016670 -0.306486
2015-01-23 21:00:00+00:00      0.063054     -0.024635 -0.410991
2015-01-26 21:00:00+00:00      0.061035     -0.027186 -0.431826
2015-01-27 21:00:00+00:00      0.061349     -0.033015 -0.465968
2015-01-28 21:00:00+00:00      0.060095     -0.037065 -0.470039
2015-01-29 21:00:00+00:00      0.059083     -0.041441 -0.529345
2015-01-30 21:00:00+00:00      0.058975     -0.047099 -0.551910
2015-02-02 21:00:00+00:00      0.064714     -0.041211 -0.465267
2015-02-03 21:00:00+00:00      0.071862     -0.033410 -0.378885
2015-02-04 21:00:00+00:00      0.077340     -0.025420 -0.263093
2015-02-05 21:00:00+00:00      0.076103     -0.023978 -0.258658
2015-02-06 21:00:00+00:00      0.076079     -0.020215 -0.202399
2015-02-09 21:00:00+00:00      0.075383     -0.017472 -0.159599
2015-02-10 21:00:00+00:00      0.074474     -0.021047 -0.205704
2015-02-11 21:00:00+00:00      0.073109     -0.021165 -0.199391
2015-02-12 21:00:00+00:00      0.071879     -0.023080 -0.222842
2015-02-13 21:00:00+00:00      0.070825     -0.022080 -0.212686
...

```

2017-11-16 21:00:00+00:00	0.090724	0.133108	0.027434
2017-11-17 21:00:00+00:00	0.090689	0.137563	0.028994
2017-11-20 21:00:00+00:00	0.090715	0.130017	0.026569
2017-11-21 21:00:00+00:00	0.090689	0.125319	0.024645
2017-11-22 21:00:00+00:00	0.090634	0.123362	0.024067
2017-11-24 18:00:00+00:00	0.090612	0.118391	0.022363
2017-11-27 21:00:00+00:00	0.090609	0.124805	0.024345
2017-11-28 21:00:00+00:00	0.090553	0.122907	0.023033
2017-11-29 21:00:00+00:00	0.090588	0.131111	0.025550
2017-11-30 21:00:00+00:00	0.090537	0.128639	0.024192
2017-12-01 21:00:00+00:00	0.090486	0.131465	0.025189
2017-12-04 21:00:00+00:00	0.090494	0.138546	0.027395
2017-12-05 21:00:00+00:00	0.090472	0.133545	0.026117
2017-12-06 21:00:00+00:00	0.090512	0.142077	0.028665
2017-12-07 21:00:00+00:00	0.090474	0.138266	0.027284
2017-12-08 21:00:00+00:00	0.090420	0.140657	0.027528
2017-12-11 21:00:00+00:00	0.090365	0.138914	0.026739
2017-12-12 21:00:00+00:00	0.090327	0.135156	0.025474
2017-12-13 21:00:00+00:00	0.090270	0.133636	0.025020
2017-12-14 21:00:00+00:00	0.090217	0.136163	0.026081
2017-12-15 21:00:00+00:00	0.090159	0.137496	0.025772
2017-12-18 21:00:00+00:00	0.090098	0.137931	0.025467
2017-12-19 21:00:00+00:00	0.090129	0.130214	0.023348
2017-12-20 21:00:00+00:00	0.090084	0.127182	0.022470
2017-12-21 21:00:00+00:00	0.090221	0.115769	0.018923
2017-12-22 21:00:00+00:00	0.090167	0.114054	0.018414
2017-12-26 21:00:00+00:00	0.090138	0.109657	0.017136
2017-12-27 21:00:00+00:00	0.090102	0.113826	0.018308
2017-12-28 21:00:00+00:00	0.090051	0.116409	0.018914
2017-12-29 21:00:00+00:00	0.090023	0.121189	0.020773

	benchmark_period_return	benchmark_volatility \
2015-01-02 21:00:00+00:00	-0.000340	NaN
2015-01-05 21:00:00+00:00	-0.018612	0.201355
2015-01-06 21:00:00+00:00	-0.027340	0.142430
2015-01-07 21:00:00+00:00	-0.016028	0.201944
2015-01-08 21:00:00+00:00	0.001574	0.233811
2015-01-09 21:00:00+00:00	-0.006843	0.216773
2015-01-12 21:00:00+00:00	-0.014882	0.202328
2015-01-13 21:00:00+00:00	-0.017422	0.187341
2015-01-14 21:00:00+00:00	-0.023134	0.176320
2015-01-15 21:00:00+00:00	-0.032168	0.169609
2015-01-16 21:00:00+00:00	-0.019175	0.179532
2015-01-20 21:00:00+00:00	-0.017655	0.171824
2015-01-21 21:00:00+00:00	-0.013007	0.166731
2015-01-22 21:00:00+00:00	0.002064	0.174355
2015-01-23 21:00:00+00:00	-0.003439	0.169626

2015-01-26 21:00:00+00:00	-0.000879	0.164236
2015-01-27 21:00:00+00:00	-0.014255	0.167160
2015-01-28 21:00:00+00:00	-0.027558	0.168992
2015-01-29 21:00:00+00:00	-0.018286	0.169074
2015-01-30 21:00:00+00:00	-0.031041	0.170054
2015-02-02 21:00:00+00:00	-0.018481	0.173176
2015-02-03 21:00:00+00:00	-0.004308	0.176728
2015-02-04 21:00:00+00:00	-0.008446	0.173177
2015-02-05 21:00:00+00:00	0.001758	0.172820
2015-02-06 21:00:00+00:00	-0.001666	0.169556
2015-02-09 21:00:00+00:00	-0.005906	0.166653
2015-02-10 21:00:00+00:00	0.004706	0.166744
2015-02-11 21:00:00+00:00	0.004677	0.163629
2015-02-12 21:00:00+00:00	0.014367	0.163066
2015-02-13 21:00:00+00:00	0.018500	0.160556
...
2017-11-16 21:00:00+00:00	0.255836	0.125123
2017-11-17 21:00:00+00:00	0.252538	0.125049
2017-11-20 21:00:00+00:00	0.254136	0.124965
2017-11-21 21:00:00+00:00	0.262339	0.124932
2017-11-22 21:00:00+00:00	0.261392	0.124848
2017-11-24 18:00:00+00:00	0.263986	0.124766
2017-11-27 21:00:00+00:00	0.263500	0.124682
2017-11-28 21:00:00+00:00	0.275943	0.124721
2017-11-29 21:00:00+00:00	0.275472	0.124637
2017-11-30 21:00:00+00:00	0.285920	0.124636
2017-12-01 21:00:00+00:00	0.283316	0.124559
2017-12-04 21:00:00+00:00	0.281966	0.124477
2017-12-05 21:00:00+00:00	0.277172	0.124416
2017-12-06 21:00:00+00:00	0.277027	0.124332
2017-12-07 21:00:00+00:00	0.280771	0.124257
2017-12-08 21:00:00+00:00	0.287824	0.124209
2017-12-11 21:00:00+00:00	0.291947	0.124136
2017-12-12 21:00:00+00:00	0.293948	0.124054
2017-12-13 21:00:00+00:00	0.293336	0.123972
2017-12-14 21:00:00+00:00	0.288071	0.123915
2017-12-15 21:00:00+00:00	0.299631	0.123933
2017-12-18 21:00:00+00:00	0.306601	0.123884
2017-12-19 21:00:00+00:00	0.302380	0.123819
2017-12-20 21:00:00+00:00	0.301302	0.123738
2017-12-21 21:00:00+00:00	0.303886	0.123659
2017-12-22 21:00:00+00:00	0.303288	0.123577
2017-12-26 21:00:00+00:00	0.301909	0.123498
2017-12-27 21:00:00+00:00	0.302938	0.123416
2017-12-28 21:00:00+00:00	0.305328	0.123337
2017-12-29 21:00:00+00:00	0.298562	0.123297

		beta	capital_used	ending_cash \
2015-01-02 21:00:00+00:00		NaN	0.000000e+00	1.000000e+07
2015-01-05 21:00:00+00:00		0.022161	-3.471997e+06	6.528003e+06
2015-01-06 21:00:00+00:00		0.005737	2.579878e+05	6.785990e+06
2015-01-07 21:00:00+00:00		0.152069	0.000000e+00	6.785990e+06
2015-01-08 21:00:00+00:00		0.259123	0.000000e+00	6.785990e+06
2015-01-09 21:00:00+00:00		0.267071	0.000000e+00	6.785990e+06
2015-01-12 21:00:00+00:00		0.257479	0.000000e+00	6.785990e+06
2015-01-13 21:00:00+00:00		0.255966	1.675249e+06	8.461239e+06
2015-01-14 21:00:00+00:00		0.257384	4.236868e+04	8.503608e+06
2015-01-15 21:00:00+00:00		0.241443	0.000000e+00	8.503608e+06
2015-01-16 21:00:00+00:00		0.186598	0.000000e+00	8.503608e+06
2015-01-20 21:00:00+00:00		0.181309	0.000000e+00	8.503608e+06
2015-01-21 21:00:00+00:00		0.178244	1.432843e+06	9.936451e+06
2015-01-22 21:00:00+00:00		0.110587	1.313561e+05	1.006781e+07
2015-01-23 21:00:00+00:00		0.131455	1.000881e+05	1.016790e+07
2015-01-26 21:00:00+00:00		0.129335	0.000000e+00	1.016790e+07
2015-01-27 21:00:00+00:00		0.147416	-2.518824e+06	7.649071e+06
2015-01-28 21:00:00+00:00		0.149592	1.515283e+05	7.800599e+06
2015-01-29 21:00:00+00:00		0.128578	0.000000e+00	7.800599e+06
2015-01-30 21:00:00+00:00		0.139795	0.000000e+00	7.800599e+06
2015-02-02 21:00:00+00:00		0.177794	0.000000e+00	7.800599e+06
2015-02-03 21:00:00+00:00		0.219328	2.067950e+06	9.868550e+06
2015-02-04 21:00:00+00:00		0.203646	1.579582e+05	1.002651e+07
2015-02-05 21:00:00+00:00		0.205239	0.000000e+00	1.002651e+07
2015-02-06 21:00:00+00:00		0.198293	0.000000e+00	1.002651e+07
2015-02-09 21:00:00+00:00		0.191722	0.000000e+00	1.002651e+07
2015-02-10 21:00:00+00:00		0.173319	5.172944e+05	1.054380e+07
2015-02-11 21:00:00+00:00		0.173259	-1.149561e+04	1.053231e+07
2015-02-12 21:00:00+00:00		0.164521	0.000000e+00	1.053231e+07
2015-02-13 21:00:00+00:00		0.165945	0.000000e+00	1.053231e+07
...	
2017-11-16 21:00:00+00:00		0.230681	0.000000e+00	1.127917e+07
2017-11-17 21:00:00+00:00		0.230389	0.000000e+00	1.127917e+07
2017-11-20 21:00:00+00:00		0.230243	0.000000e+00	1.127917e+07
2017-11-21 21:00:00+00:00		0.229451	-1.773461e+06	9.505708e+06
2017-11-22 21:00:00+00:00		0.229492	0.000000e+00	9.505708e+06
2017-11-24 18:00:00+00:00		0.229303	0.000000e+00	9.505708e+06
2017-11-27 21:00:00+00:00		0.229210	0.000000e+00	9.505708e+06
2017-11-28 21:00:00+00:00		0.228361	1.202759e+06	1.070847e+07
2017-11-29 21:00:00+00:00		0.228243	4.856431e+04	1.075703e+07
2017-11-30 21:00:00+00:00		0.227525	0.000000e+00	1.075703e+07
2017-12-01 21:00:00+00:00		0.227373	0.000000e+00	1.075703e+07
2017-12-04 21:00:00+00:00		0.227173	0.000000e+00	1.075703e+07
2017-12-05 21:00:00+00:00		0.227503	4.225982e+06	1.498301e+07
2017-12-06 21:00:00+00:00		0.227425	0.000000e+00	1.498301e+07
2017-12-07 21:00:00+00:00		0.227192	0.000000e+00	1.498301e+07

2017-12-08	21:00:00+00:00	0.227276	0.000000e+00	1.498301e+07
2017-12-11	21:00:00+00:00	0.227128	0.000000e+00	1.498301e+07
2017-12-12	21:00:00+00:00	0.227031	-5.417948e+06	9.565065e+06
2017-12-13	21:00:00+00:00	0.227056	0.000000e+00	9.565065e+06
2017-12-14	21:00:00+00:00	0.226757	0.000000e+00	9.565065e+06
2017-12-15	21:00:00+00:00	0.226574	0.000000e+00	9.565065e+06
2017-12-18	21:00:00+00:00	0.226472	0.000000e+00	9.565065e+06
2017-12-19	21:00:00+00:00	0.226961	8.234594e+05	1.038852e+07
2017-12-20	21:00:00+00:00	0.227030	7.652852e+04	1.046505e+07
2017-12-21	21:00:00+00:00	0.226654	0.000000e+00	1.046505e+07
2017-12-22	21:00:00+00:00	0.226682	0.000000e+00	1.046505e+07
2017-12-26	21:00:00+00:00	0.226802	0.000000e+00	1.046505e+07
2017-12-27	21:00:00+00:00	0.226833	1.965171e+06	1.243022e+07
2017-12-28	21:00:00+00:00	0.226892	-6.235342e+04	1.236787e+07
2017-12-29	21:00:00+00:00	0.226234	0.000000e+00	1.236787e+07

		ending_exposure	ending_value \
2015-01-02	21:00:00+00:00	0.000	0.000
2015-01-05	21:00:00+00:00	3468022.250	3468022.250
2015-01-06	21:00:00+00:00	3112732.065	3112732.065
2015-01-07	21:00:00+00:00	3125561.843	3125561.843
2015-01-08	21:00:00+00:00	3189267.130	3189267.130
2015-01-09	21:00:00+00:00	3151628.598	3151628.598
2015-01-12	21:00:00+00:00	3138163.975	3138163.975
2015-01-13	21:00:00+00:00	1483843.830	1483843.830
2015-01-14	21:00:00+00:00	1421106.150	1421106.150
2015-01-15	21:00:00+00:00	1422668.199	1422668.199
2015-01-16	21:00:00+00:00	1409239.610	1409239.610
2015-01-20	21:00:00+00:00	1384761.660	1384761.660
2015-01-21	21:00:00+00:00	-53269.470	-53269.470
2015-01-22	21:00:00+00:00	-234510.290	-234510.290
2015-01-23	21:00:00+00:00	-414241.040	-414241.040
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2015-01-27	21:00:00+00:00	2020778.970	2020778.970
2015-01-28	21:00:00+00:00	1828752.990	1828752.990
2015-01-29	21:00:00+00:00	1784995.650	1784995.650
2015-01-30	21:00:00+00:00	1728410.610	1728410.610
2015-02-02	21:00:00+00:00	1787289.170	1787289.170
2015-02-03	21:00:00+00:00	-202644.600	-202644.600
2015-02-04	21:00:00+00:00	-280707.490	-280707.490
2015-02-05	21:00:00+00:00	-266291.530	-266291.530
2015-02-06	21:00:00+00:00	-228662.150	-228662.150
2015-02-09	21:00:00+00:00	-201224.580	-201224.580
2015-02-10	21:00:00+00:00	-754275.715	-754275.715
2015-02-11	21:00:00+00:00	-743956.650	-743956.650
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2015-02-13	21:00:00+00:00	-753111.370	-753111.370

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2017-11-16 21:00:00+00:00	51914.790	51914.790
2017-11-17 21:00:00+00:00	96456.963	96456.963
2017-11-20 21:00:00+00:00	20996.840	20996.840
2017-11-21 21:00:00+00:00	1747478.140	1747478.140
2017-11-22 21:00:00+00:00	1727911.128	1727911.128
2017-11-24 18:00:00+00:00	1678206.580	1678206.580
2017-11-27 21:00:00+00:00	1742343.440	1742343.440
2017-11-28 21:00:00+00:00	520606.960	520606.960
2017-11-29 21:00:00+00:00	554079.920	554079.920
2017-11-30 21:00:00+00:00	529360.880	529360.880
2017-12-01 21:00:00+00:00	557621.265	557621.265
2017-12-04 21:00:00+00:00	628428.170	628428.170
2017-12-05 21:00:00+00:00	-3647566.665	-3647566.665
2017-12-06 21:00:00+00:00	-3562247.730	-3562247.730
2017-12-07 21:00:00+00:00	-3600352.950	-3600352.950
2017-12-08 21:00:00+00:00	-3576443.770	-3576443.770
2017-12-11 21:00:00+00:00	-3593876.820	-3593876.820
2017-12-12 21:00:00+00:00	1786492.140	1786492.140
2017-12-13 21:00:00+00:00	1771290.380	1771290.380
2017-12-14 21:00:00+00:00	1796564.050	1796564.050
2017-12-15 21:00:00+00:00	1809891.350	1809891.350
2017-12-18 21:00:00+00:00	1814240.530	1814240.530
2017-12-19 21:00:00+00:00	913619.780	913619.780
2017-12-20 21:00:00+00:00	806762.380	806762.380
2017-12-21 21:00:00+00:00	692632.778	692632.778
2017-12-22 21:00:00+00:00	675485.530	675485.530
2017-12-26 21:00:00+00:00	631513.830	631513.830
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2017-12-29 21:00:00+00:00	-1155984.243	-1155984.243

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2015-01-13 21:00:00+00:00	...	-1600072.490	-1600072.490
2015-01-14 21:00:00+00:00	...	-1571634.240	-1571634.240
2015-01-15 21:00:00+00:00	...	-1546157.361	-1546157.361
2015-01-16 21:00:00+00:00	...	-1575670.200	-1575670.200
2015-01-20 21:00:00+00:00	...	-1577079.900	-1577079.900
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2015-02-11 21:00:00+00:00	...	-3903834.020	-3903834.020
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2017-11-17 21:00:00+00:00	...	-4539299.887	-4539299.887
2017-11-20 21:00:00+00:00	...	-4584369.230	-4584369.230
2017-11-21 21:00:00+00:00	...	-4147942.180	-4147942.180
2017-11-22 21:00:00+00:00	...	-4217044.822	-4217044.822
2017-11-24 18:00:00+00:00	...	-4251229.370	-4251229.370
2017-11-27 21:00:00+00:00	...	-4202457.750	-4202457.750
2017-11-28 21:00:00+00:00	...	-4065651.640	-4065651.640
2017-11-29 21:00:00+00:00	...	-4054267.730	-4054267.730
2017-11-30 21:00:00+00:00	...	-4113520.090	-4113520.090
2017-12-01 21:00:00+00:00	...	-4076026.647	-4076026.647
2017-12-04 21:00:00+00:00	...	-4026102.320	-4026102.320
2017-12-05 21:00:00+00:00	...	-6373114.885	-6373114.885
2017-12-06 21:00:00+00:00	...	-6314328.040	-6314328.040
2017-12-07 21:00:00+00:00	...	-6409933.270	-6409933.270
2017-12-08 21:00:00+00:00	...	-6402146.360	-6402146.360
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2017-12-12 21:00:00+00:00	...	-4103656.950	-4103656.950
2017-12-13 21:00:00+00:00	...	-4115750.710	-4115750.710
2017-12-14 21:00:00+00:00	...	-4063924.680	-4063924.680
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2017-12-18 21:00:00+00:00	...	-4136292.120	-4136292.120
2017-12-19 21:00:00+00:00	...	-4584215.880	-4584215.880
2017-12-20 21:00:00+00:00	...	-4583961.070	-4583961.070
2017-12-21 21:00:00+00:00	...	-4630929.752	-4630929.752
2017-12-22 21:00:00+00:00	...	-4648657.670	-4648657.670
2017-12-26 21:00:00+00:00	...	-4642925.770	-4642925.770
2017-12-27 21:00:00+00:00	...	-5301963.695	-5301963.695
2017-12-28 21:00:00+00:00	...	-5214770.344	-5214770.344
2017-12-29 21:00:00+00:00	...	-5153054.230	-5153054.230

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2015-01-07 21:00:00+00:00	4	-7.198541	6.785990e+06
2015-01-08 21:00:00+00:00	4	-1.754848	6.785990e+06
2015-01-09 21:00:00+00:00	4	-3.834416	6.785990e+06
2015-01-12 21:00:00+00:00	4	-4.292170	6.785990e+06
2015-01-13 21:00:00+00:00	4	-2.891468	6.785990e+06
2015-01-14 21:00:00+00:00	4	-3.685843	8.461239e+06
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2015-01-16 21:00:00+00:00	4	-3.836755	8.503608e+06
2015-01-20 21:00:00+00:00	4	-4.601158	8.503608e+06
2015-01-21 21:00:00+00:00	9	-4.623664	8.503608e+06
2015-01-22 21:00:00+00:00	9	-5.811501	9.936451e+06
2015-01-23 21:00:00+00:00	9	-6.944499	1.006781e+07
2015-01-26 21:00:00+00:00	9	-7.317081	1.016790e+07
2015-01-27 21:00:00+00:00	4	-8.023024	1.016790e+07
2015-01-28 21:00:00+00:00	4	-8.489384	7.649071e+06
2015-01-29 21:00:00+00:00	4	-8.931810	7.800599e+06
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2015-02-06 21:00:00+00:00	9	-3.518415	1.002651e+07
2015-02-09 21:00:00+00:00	9	-2.970339	1.002651e+07
2015-02-10 21:00:00+00:00	11	-3.457966	1.002651e+07
2015-02-11 21:00:00+00:00	10	-3.415038	1.054380e+07
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2015-02-13 21:00:00+00:00	10	-3.426144	1.053231e+07
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2017-11-16 21:00:00+00:00	10	0.789244	1.127917e+07
2017-11-17 21:00:00+00:00	10	0.811365	1.127917e+07
2017-11-20 21:00:00+00:00	10	0.770964	1.127917e+07
2017-11-21 21:00:00+00:00	9	0.745933	1.127917e+07
2017-11-22 21:00:00+00:00	9	0.735341	9.505708e+06
2017-11-24 18:00:00+00:00	9	0.708815	9.505708e+06
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2017-12-05 21:00:00+00:00	14	0.781599	1.075703e+07
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2017-12-28 21:00:00+00:00	12	0.681859	1.243022e+07
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2015-01-08 21:00:00+00:00	3125561.843	3125561.843	5
2015-01-09 21:00:00+00:00	3189267.130	3189267.130	6
2015-01-12 21:00:00+00:00	3151628.598	3151628.598	7
2015-01-13 21:00:00+00:00	3138163.975	3138163.975	8
2015-01-14 21:00:00+00:00	1483843.830	1483843.830	9
2015-01-15 21:00:00+00:00	1421106.150	1421106.150	10
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2015-01-21 21:00:00+00:00	1384761.660	1384761.660	13
2015-01-22 21:00:00+00:00	-53269.470	-53269.470	14
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2015-01-26 21:00:00+00:00	-414241.040	-414241.040	16
2015-01-27 21:00:00+00:00	-439756.050	-439756.050	17
2015-01-28 21:00:00+00:00	2020778.970	2020778.970	18
2015-01-29 21:00:00+00:00	1828752.990	1828752.990	19
2015-01-30 21:00:00+00:00	1784995.650	1784995.650	20
2015-02-02 21:00:00+00:00	1728410.610	1728410.610	21
2015-02-03 21:00:00+00:00	1787289.170	1787289.170	22
2015-02-04 21:00:00+00:00	-202644.600	-202644.600	23
2015-02-05 21:00:00+00:00	-280707.490	-280707.490	24
2015-02-06 21:00:00+00:00	-266291.530	-266291.530	25
2015-02-09 21:00:00+00:00	-228662.150	-228662.150	26
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2015-02-11 21:00:00+00:00	-754275.715	-754275.715	28
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2017-11-17 21:00:00+00:00	51914.790	51914.790	727
2017-11-20 21:00:00+00:00	96456.963	96456.963	728
2017-11-21 21:00:00+00:00	20996.840	20996.840	729
2017-11-22 21:00:00+00:00	1747478.140	1747478.140	730
2017-11-24 18:00:00+00:00	1727911.128	1727911.128	731
2017-11-27 21:00:00+00:00	1678206.580	1678206.580	732
2017-11-28 21:00:00+00:00	1742343.440	1742343.440	733
2017-11-29 21:00:00+00:00	520606.960	520606.960	734
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2017-12-12 21:00:00+00:00	-3593876.820	-3593876.820	743
2017-12-13 21:00:00+00:00	1786492.140	1786492.140	744
2017-12-14 21:00:00+00:00	1771290.380	1771290.380	745
2017-12-15 21:00:00+00:00	1796564.050	1796564.050	746
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2017-12-19 21:00:00+00:00	1814240.530	1814240.530	748
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2017-12-22 21:00:00+00:00	692632.778	692632.778	751
2017-12-26 21:00:00+00:00	675485.530	675485.530	752
2017-12-27 21:00:00+00:00	631513.830	631513.830	753
2017-12-28 21:00:00+00:00	-1291961.335	-1291961.335	754
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2017-12-29 21:00:00+00:00

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2015-01-05 21:00:00+00:00	0.0
2015-01-06 21:00:00+00:00	0.0
2015-01-07 21:00:00+00:00	0.0
2015-01-08 21:00:00+00:00	0.0
2015-01-09 21:00:00+00:00	0.0
2015-01-12 21:00:00+00:00	0.0
2015-01-13 21:00:00+00:00	0.0
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2015-01-15 21:00:00+00:00	0.0
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2015-01-20 21:00:00+00:00	0.0
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