PROJECT REPORT

FINANCIAL TRADING STRATEGY

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March 21, 2017

Contents

```
##              Open  High   Low Close Volume Ex-Dividend Split Ratio
## 2000-01-03 32.00 32.00 31.12 31.44 396900           0           1
## 2000-01-04 31.38 31.94 31.38 31.81 325500           0           1
## 2000-01-05 31.81 33.12 31.81 33.00 392200           0           1
## 2000-01-06 32.75 33.69 32.75 33.19 433000           0           1
## 2000-01-07 33.38 33.75 33.06 33.62 250500           0           1
## 2000-01-10 33.62 33.81 33.44 33.50 307700           0           1
##            Adj. Open Adj. High Adj. Low Adj. Close Adj. Volume
## 2000-01-03  14.41997  14.41997 14.02342   14.16762      396900
## 2000-01-04  14.14059  14.39294 14.14059   14.33436      325500
## 2000-01-05  14.33436  14.92467 14.33436   14.87060      392200
## 2000-01-06  14.75794  15.18153 14.75794   14.95622      433000
## 2000-01-07  15.04184  15.20857 14.89764   15.14999      250500
## 2000-01-10  15.14999  15.23560 15.06887   15.09591      307700
```

```
##            Open High  Low Close Volume Ex-Dividend Split Ratio Adj. Open
## 2000-01-03 2.31 2.38 2.25  2.25 369700           0           1  1.969680
## 2000-01-04 2.19 2.25 2.06  2.06 719400           0           1  1.867359
## 2000-01-05 2.12 2.19 1.94  2.06 807100           0           1  1.807672
## 2000-01-06 1.94 2.12 1.94  2.12 444900           0           1  1.654190
## 2000-01-07 2.06 2.12 2.06  2.06 207400           0           1  1.756511
## 2000-01-10 2.06 2.12 2.06  2.12 166700           0           1  1.756511
##            Adj. High Adj. Low Adj. Close Adj. Volume
## 2000-01-03  2.029367 1.918519   1.918519      369700
## 2000-01-04  1.918519 1.756511   1.756511      719400
## 2000-01-05  1.867359 1.654190   1.756511      807100
## 2000-01-06  1.807672 1.654190   1.807672      444900
## 2000-01-07  1.807672 1.756511   1.756511      207400
## 2000-01-10  1.807672 1.756511   1.807672      166700
```

1 INTRODUCTION

This project aims at building a model that will ideally always output successful bids in the stock market. For that, it builds a model which gives better results when constantly trained in a sliding-time window. The goal is to design a simple financial trading strategy that will be profitable and that will provide a good risk-adjusted measure of return.

2 DATA SETS

Two datasets will be used here to test the strategy:

- The American Electric Company (AEP) dataset from Quandl

Open	High	Low	Close	Volume	Ex-Dividend
32.00	32.00	31.12	31.44	396900	0
31.38	31.94	31.38	31.81	325500	0
31.81	33.12	31.81	33.00	392200	0
32.75	33.69	32.75	33.19	433000	0
33.38	33.75	33.06	33.62	250500	0
33.62	33.81	33.44	33.50	307700	0

- The Chesapeake Energy Corporation (CHK) from Quandl.

Open	High	Low	Close	Volume	Ex-Dividend
2.31	2.38	2.25	2.25	369700	0
2.19	2.25	2.06	2.06	719400	0
2.12	2.19	1.94	2.06	807100	0
1.94	2.12	1.94	2.12	444900	0
2.06	2.12	2.06	2.06	207400	0
2.06	2.12	2.06	2.12	166700	0

An initial exploration of the AEP dataset reveals 5 important fields:

- The date
- The Open price
- The High price
- The Low price
- The Close price.

Some of the issues encountered with the data:

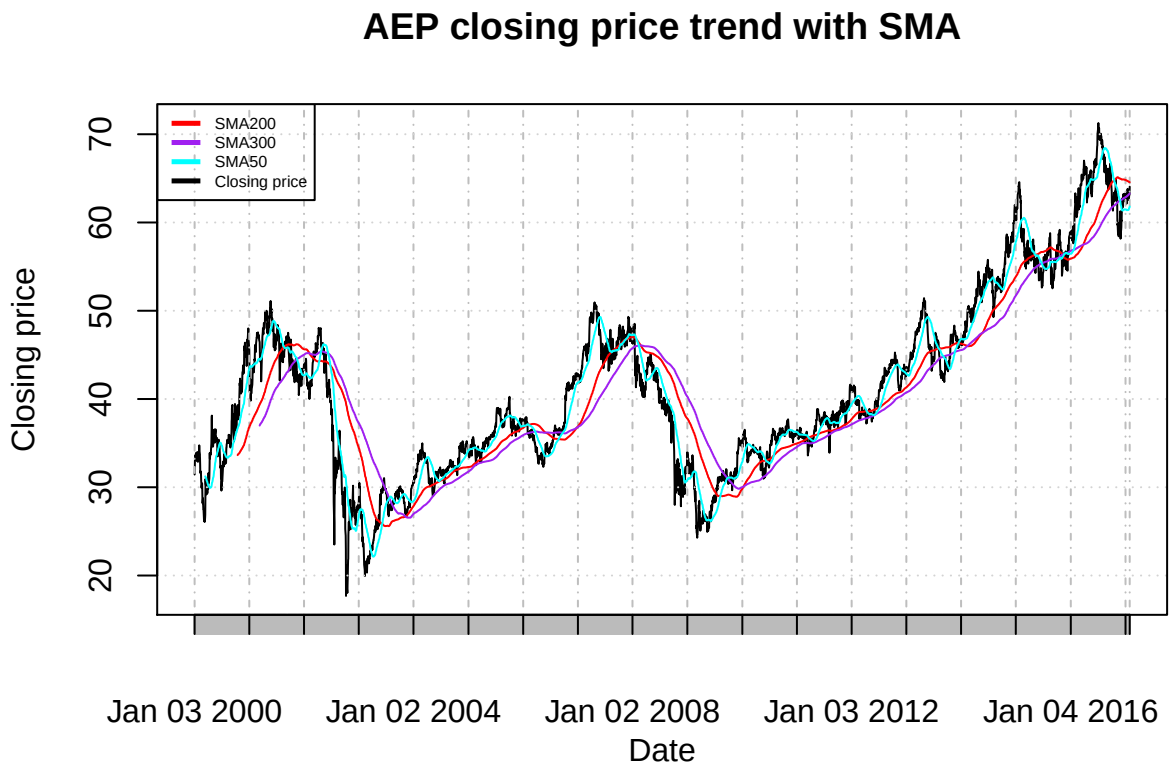
- The presence of the adjusted closing price was confusing for some methods in the packages Quandstrat and xts, as those methods kept throwing errors. I had to remove the adjusted closing price from my data sets and just keep the closing price
- Some functions and arguments were not found because the Quandstrat package is not yet stable.

3 PRELIMINARY EXPLORATION

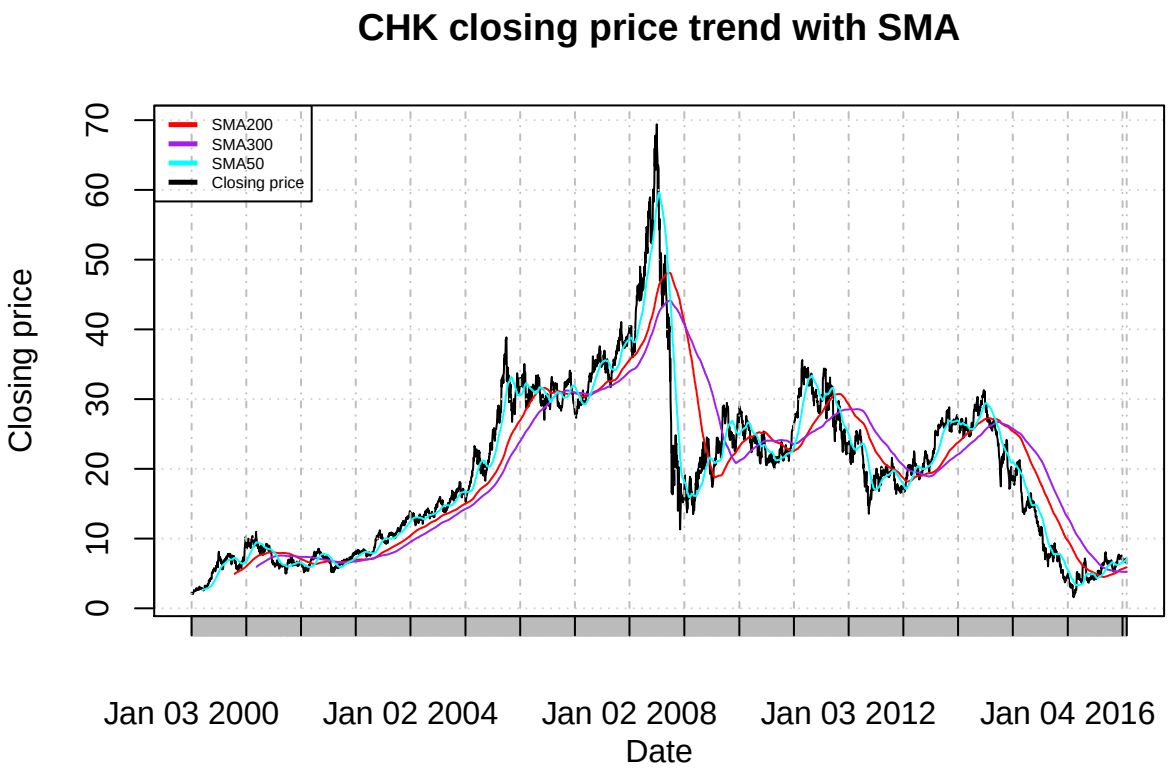
Indicators are transformations of market data that give an insight into the overall market behavior by measuring current conditions and/or forecasting trends. Among others, there are trend-following indicators which depict the general price direction, and oscillators used to discover on a scale of 0 to 100 short-term overbought (above 70 to 80) or oversold (below 30 to 20) conditions . Combining trend-following indicators and oscillator/reversion indicators gives more insight into the data for this project. The preliminary oscillator used is an RSI

(Relative Strength Index) with a 3-days lookback period. The preliminary trend indicators are 3 SMA (Simple Moving Average). After applying those indicators to the stocks, there are some periods of time during which none of the indicators seem to be right. Also, the SMA50 (Simple Moving Average) seems to better mimic the trend of the closing prices for both data sets

- SMA AEP

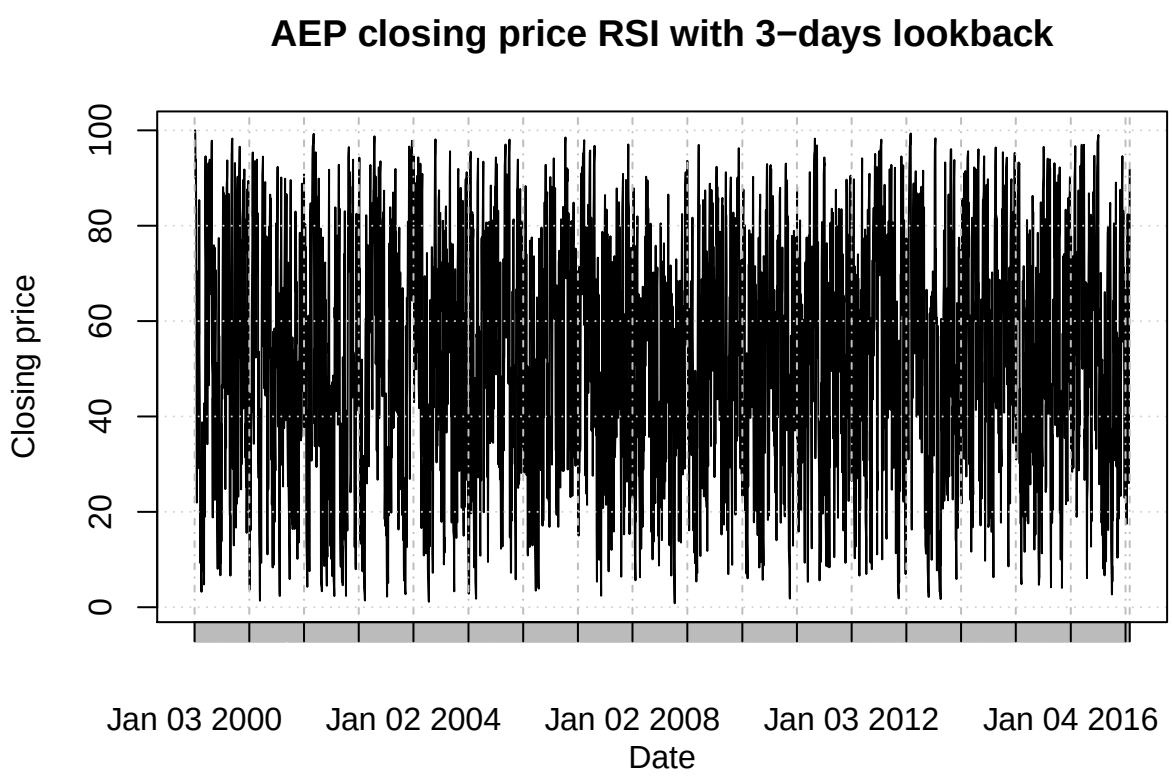


- SMA CHK

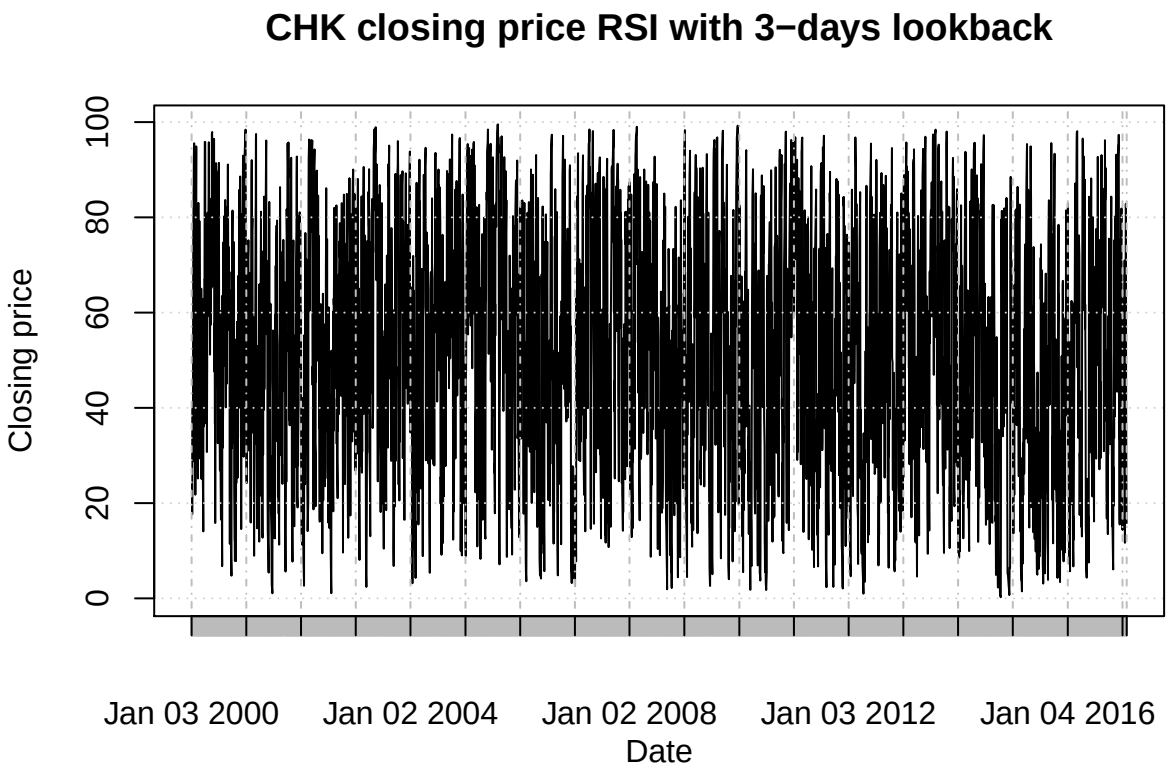


An observation of the graphs of the stocks' RSI reveals that there are effectively periods of reversion (2013-09-03 to 2013-9-05 for example) that won't be captured by a trend-following indicator:

- RSI AEP


AEP closing price RSI with 3−days lookback
Closing price
0
20
40
60
80
100
Jan 03 2000
Jan 02 2004
Jan 02 2008
Jan 03 2012
Jan 04 2016
Date

- RSI CHK



4 APPROACH

The main objective is to obtain a profit factor above 1 after running the strategy on each of the data sets. The approach here would be to combine both SMA50 and SMA200 with an oscillator to avoid false signals. The trend-following indicators would help catch up trends. The analysis is done on 13 years, from January 01s, 2013 to December 31st, 2016 . The time is Eastern time and the currency is US dollar.

4.1 STRATEGY 1: RSI

"RSI Strategy", the initial strategy for this project, uses simple averages (over 50 days and over 200 days) with a custom RSI_3_4 indicator acting as an average between RSI3 and RSI4 . Signals help interpret how indicators interact with the market and with each other. Those signals are:

- a comparison and a crossover , which show a buy signal when the 50-day simple moving average is above the 200-day simple moving average and show a sell signal when the 50-day simple moving average crosses below the 200-day simple moving average

- a threshold, which an oversold condition, thus a buy opportunity, for RSI_3_4 below 20, and an overbought condition, thus a sell opportunity, for RSI_3_4 above 80
- a combined comparison and threshold to buy when the 50-day simple moving average is above the 200-day simple moving average and RSI_3_4 is less then 20.

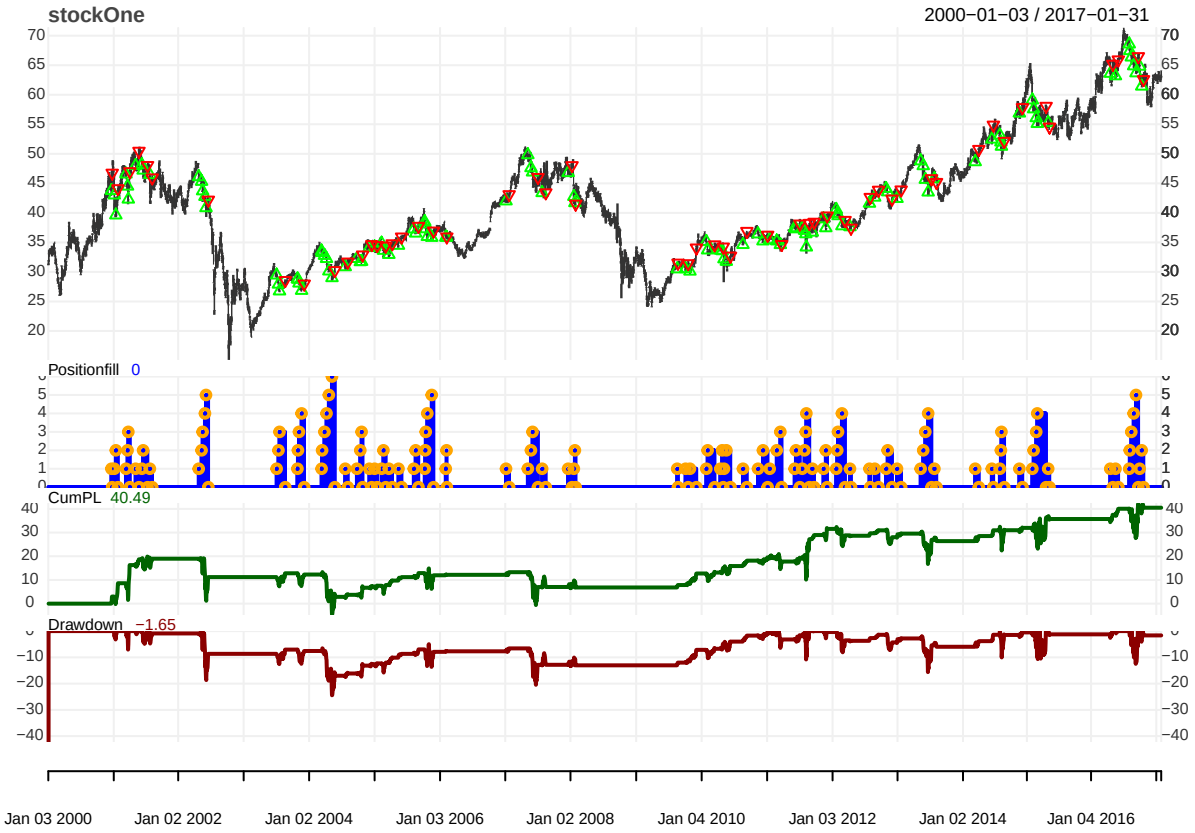
Rules help shape trading transactions at signal execution. This strategy has 2 rules:

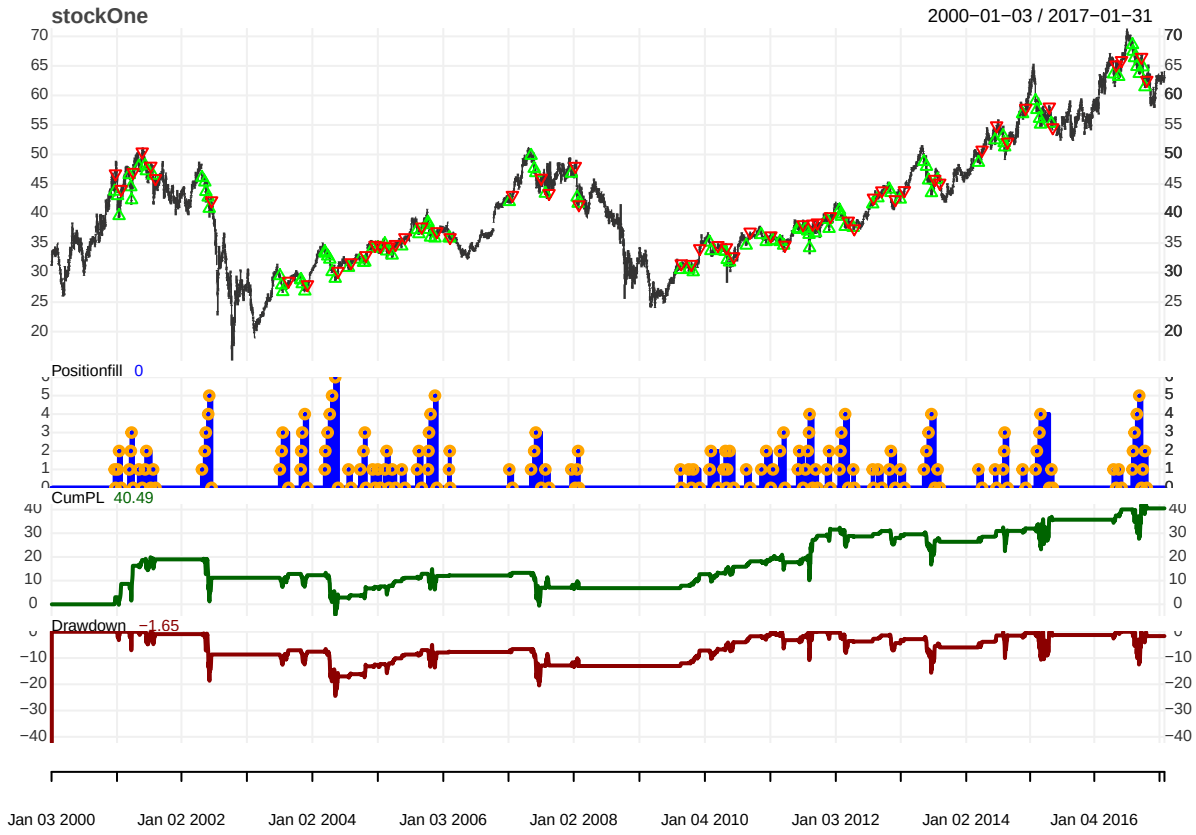
- an entry rule of 1 share for the combined comparison and threshold entry signals
- an exit rule for a treshold above 80.

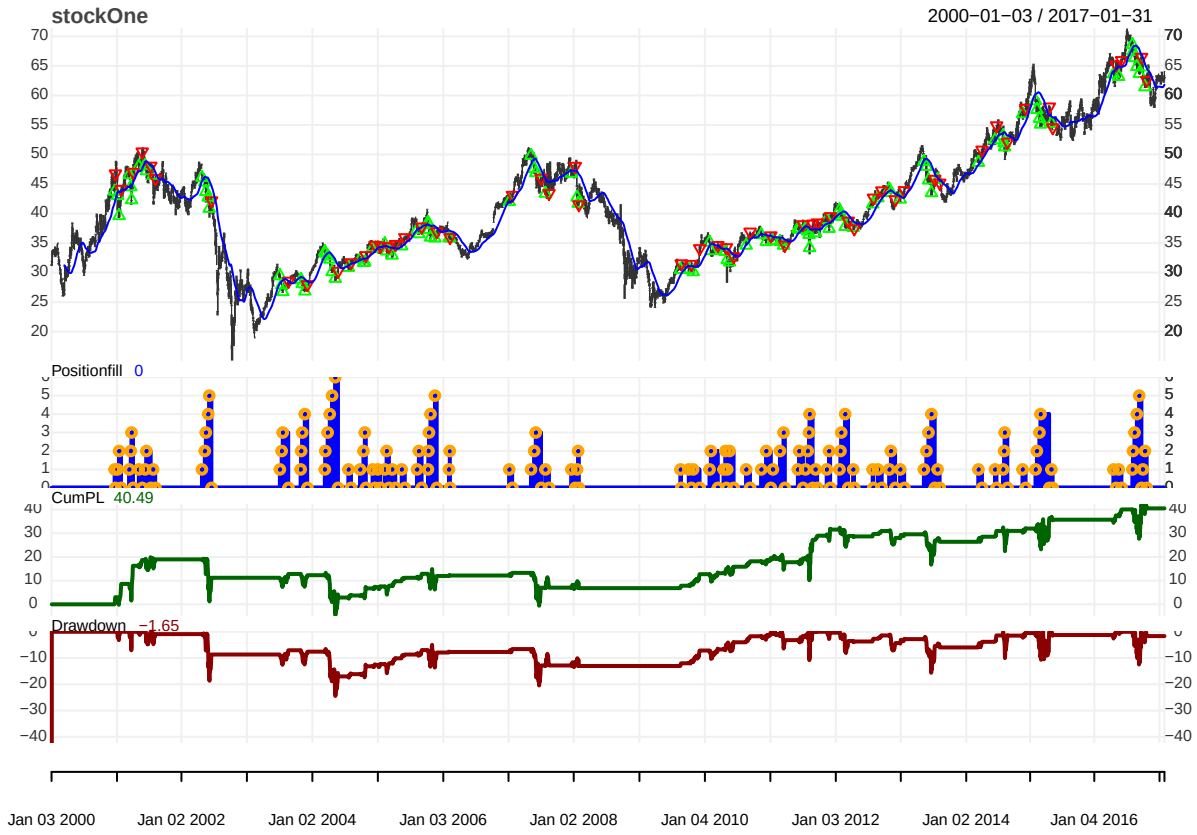
Running this RSI_3_4 strategy on the AES and the CHK over those 13 years, yields profit factors above 1, meaning that the strategy is profitable:

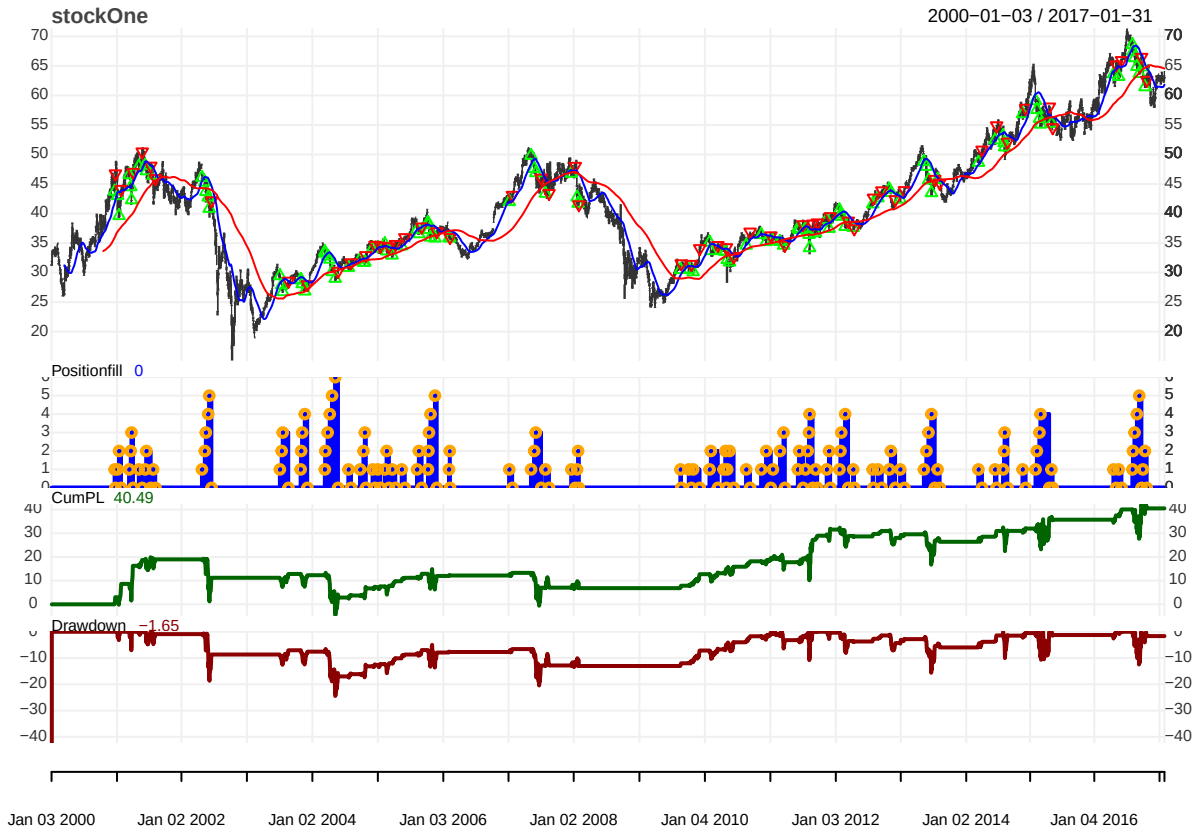
Let's take a look at the system performance for the 2 stocks:

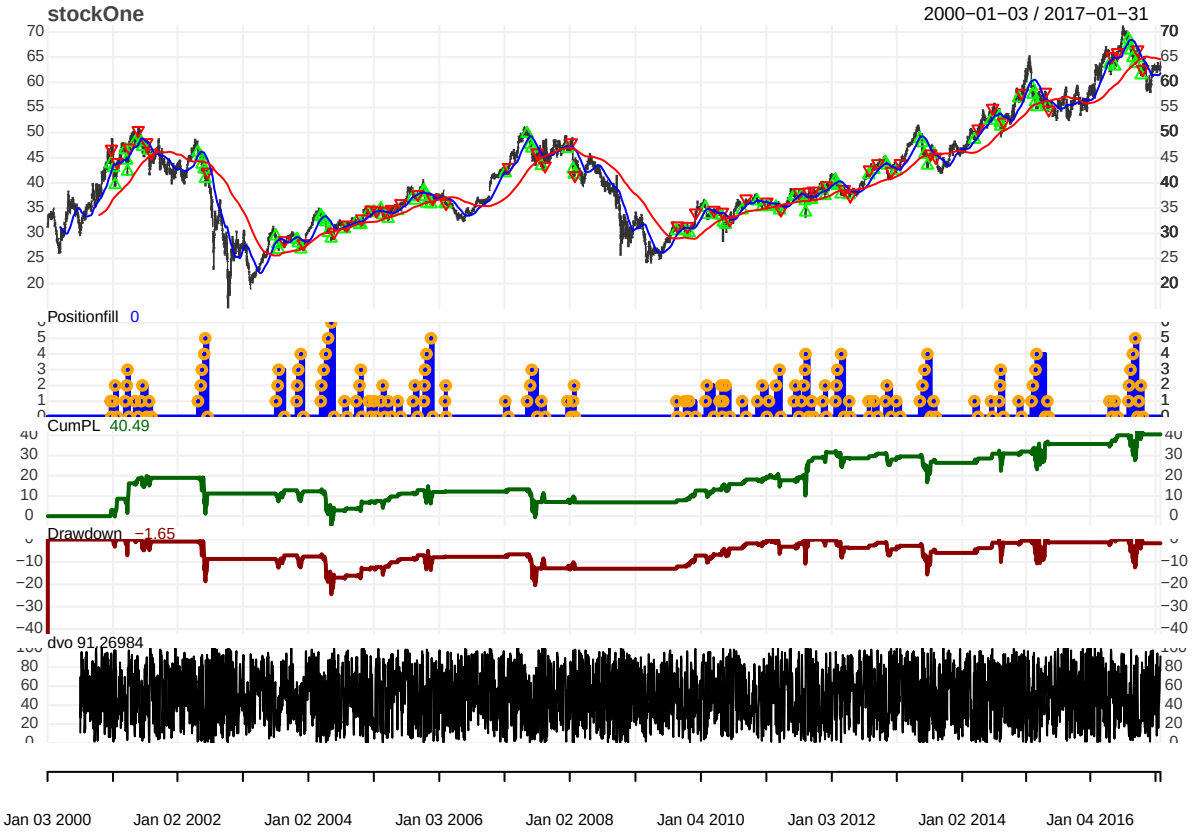
- Stock 1: AES



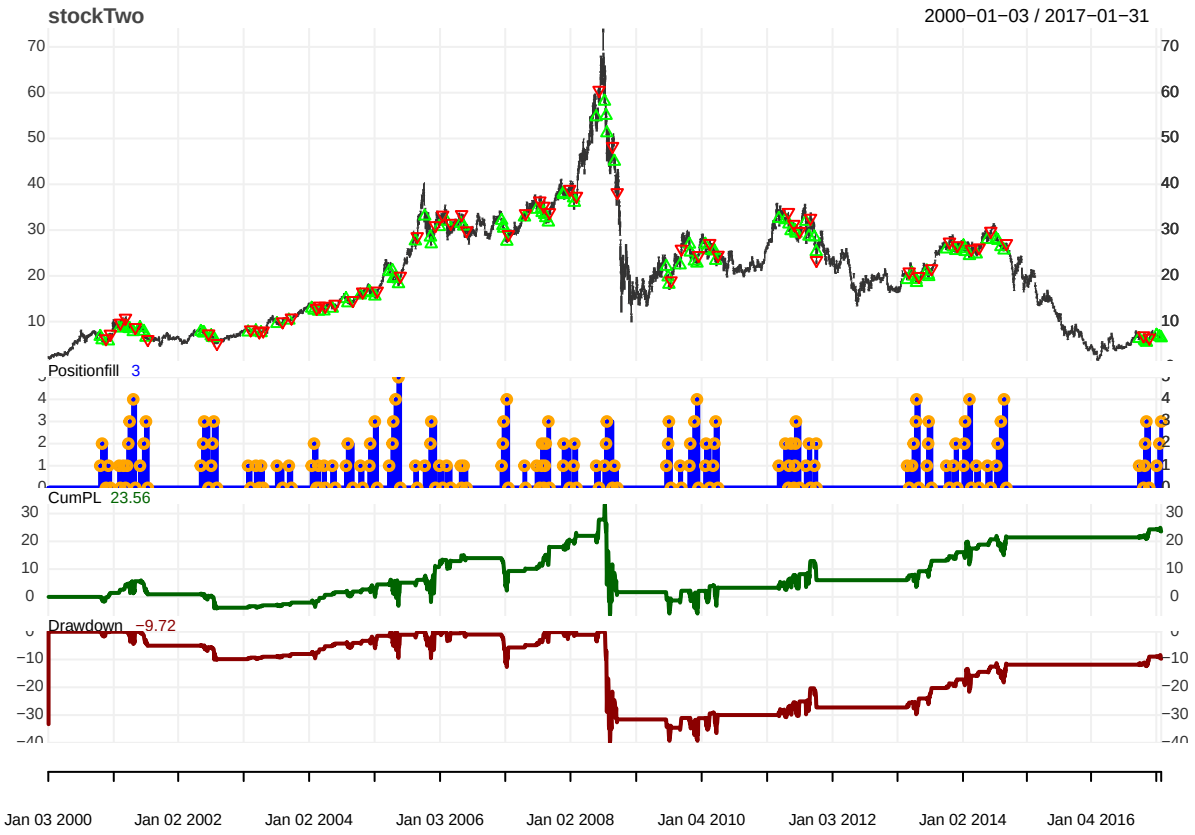

stockOne
2000−01−03 / 2017−01−31
Positionfill 0
CumPL 40.49
Drawdown −1.65
Jan 03 2000
Jan 02 2002
Jan 02 2004
Jan 03 2006
Jan 02 2008
Jan 04 2010
Jan 03 2012
Jan 02 2014
Jan 04 2016

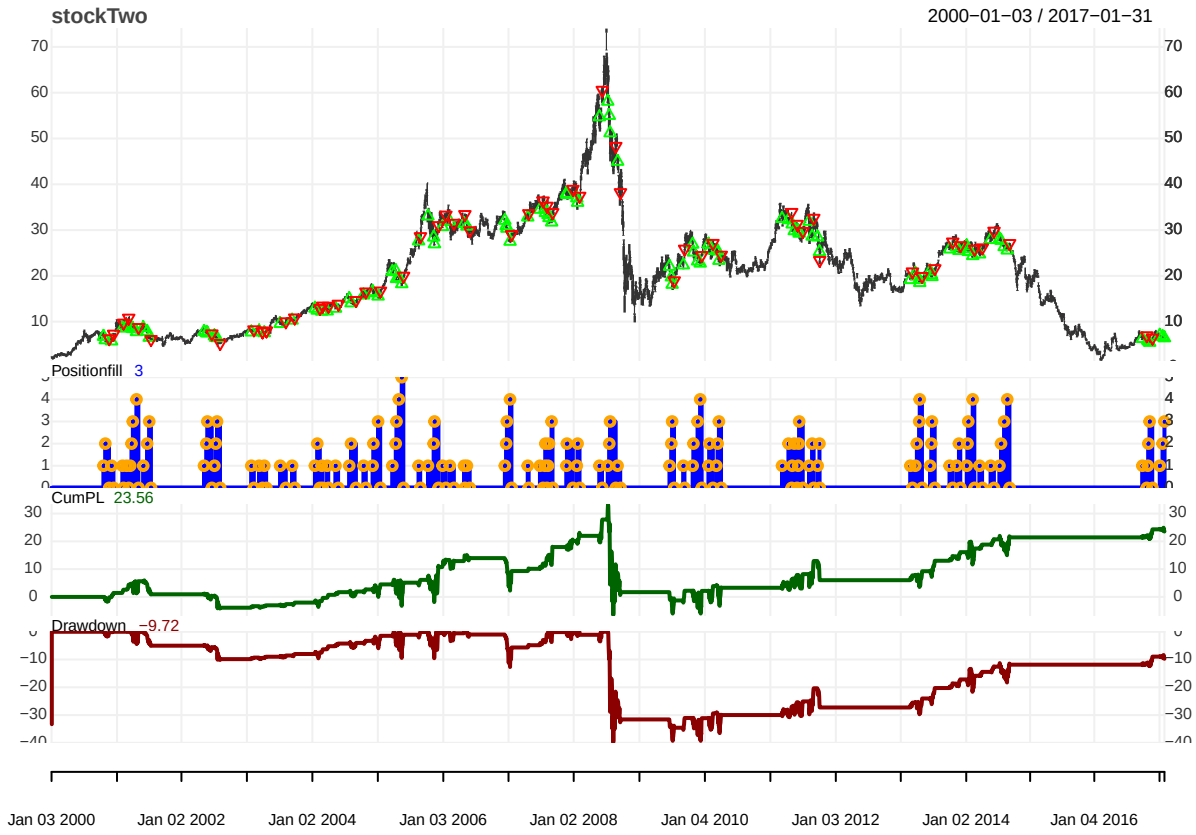

stockOne
2000−01−03 / 2017−01−31
Positionfill 0
CumPL 40.49
Drawdown −1.65
Jan 03 2000
Jan 02 2002
Jan 02 2004
Jan 03 2006
Jan 02 2008
Jan 04 2010
Jan 03 2012
Jan 02 2014
Jan 04 2016

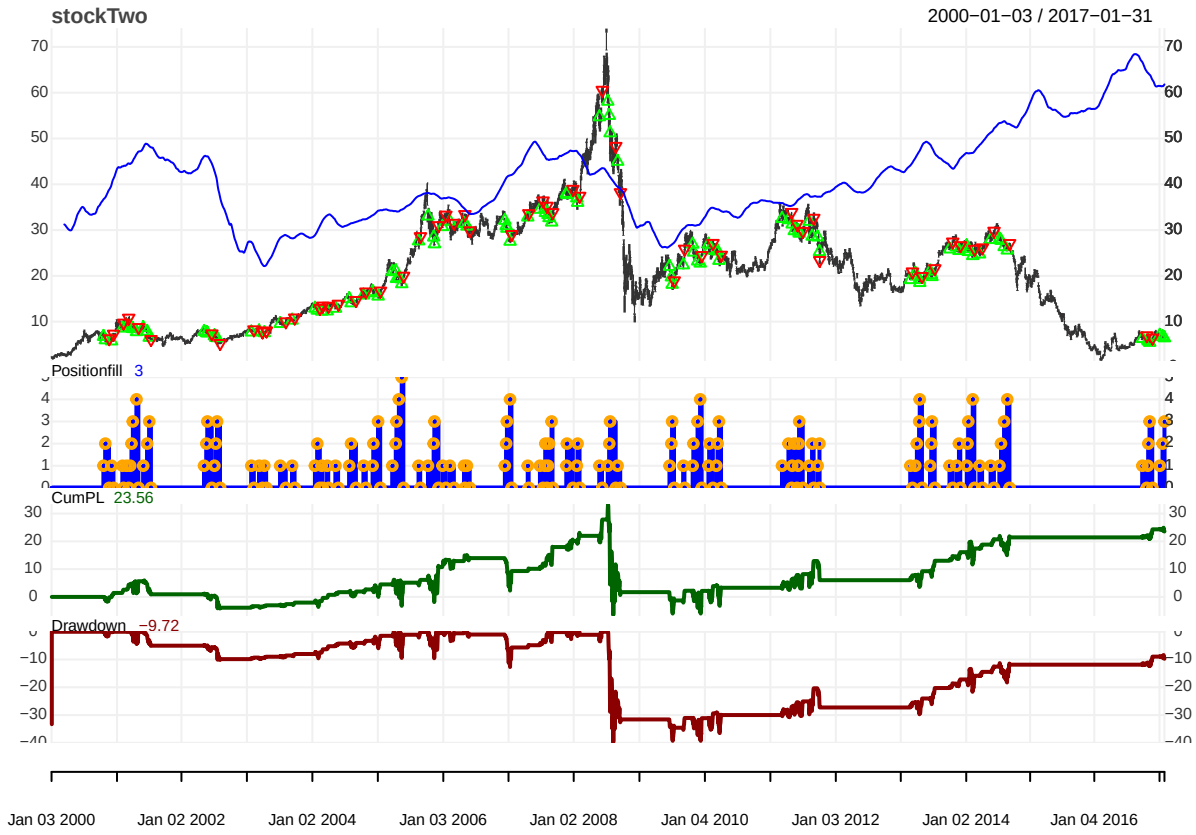

stockOne
2000−01−03 / 2017−01−31
Positionfill 0
CumPL 40.49
Drawdown −1.65
Jan 03 2000
Jan 02 2002
Jan 02 2004
Jan 03 2006
Jan 02 2008
Jan 04 2010
Jan 03 2012
Jan 02 2014
Jan 04 2016


stockOne
2000−01−03 / 2017−01−31
Positionfill 0
CumPL 40.49
Drawdown −1.65
dvo 91 26984
Jan 03 2000
Jan 02 2002
Jan 02 2004
Jan 03 2006
Jan 02 2008
Jan 04 2010
Jan 03 2012
Jan 02 2014
Jan 04 2016

- stock 2: CHK


stockTwo
2000−01−03 / 2017−01−31
Positionfill 3
CumPL 23.56
Drawdown −9.72
Jan 03 2000
Jan 02 2002
Jan 02 2004
Jan 03 2006
Jan 02 2008
Jan 04 2010
Jan 03 2012
Jan 02 2014
Jan 04 2016


stockTwo
2000−01−03 / 2017−01−31
Positionfill 3
CumPL 23.56
Drawdown −9.72
Jan 03 2000
Jan 02 2002
Jan 02 2004
Jan 03 2006
Jan 02 2008
Jan 04 2010
Jan 03 2012
Jan 02 2014
Jan 04 2016


stockTwo
2000−01−03 / 2017−01−31
Positionfill 3
CumPL 23.56
Drawdown −9.72
Jan 03 2000
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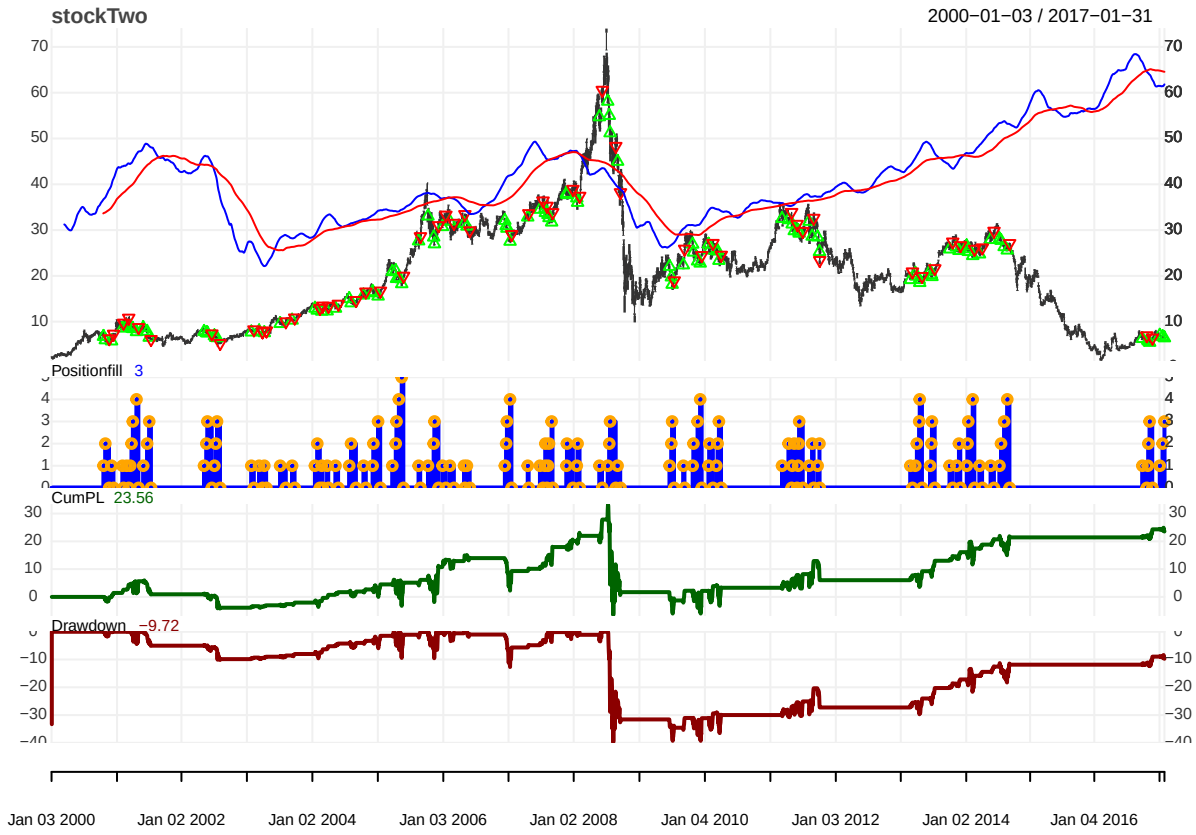
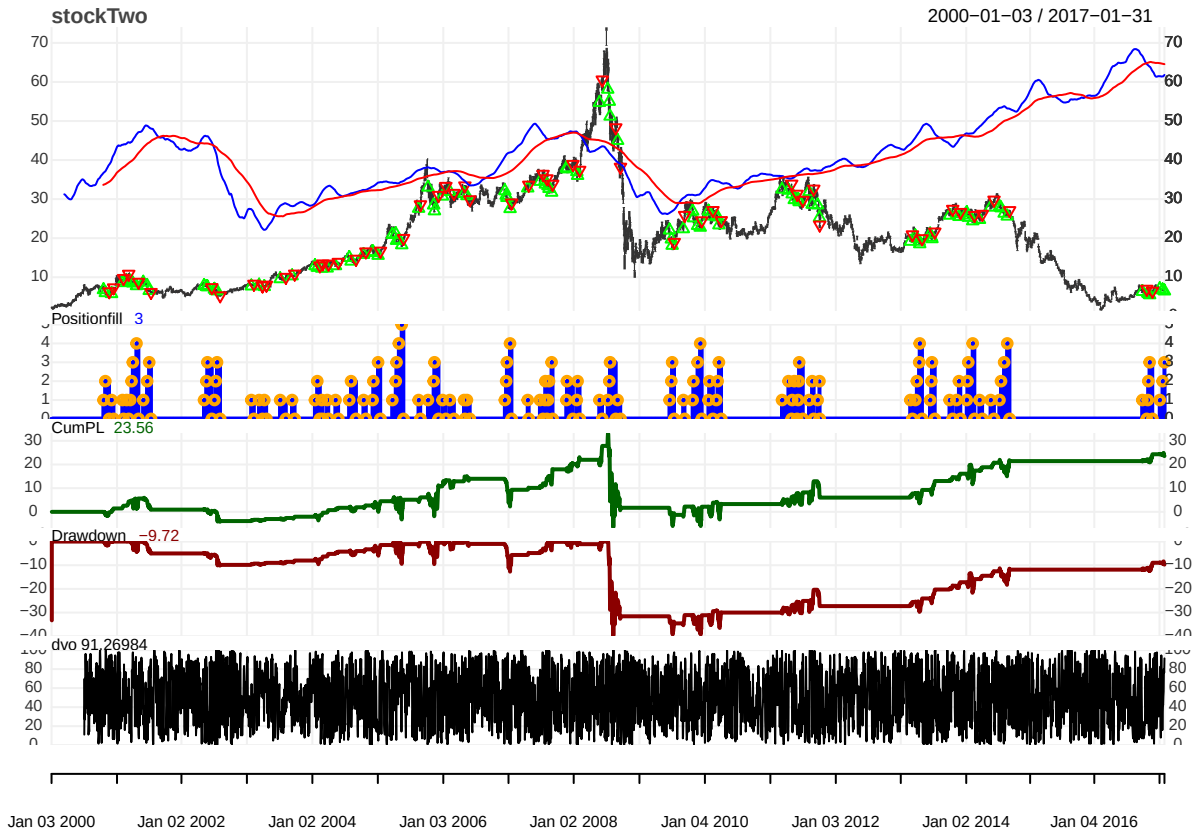

stockTwo
2000−01−03 / 2017−01−31
Positionfill 3
CumPL 23.56
Drawdown −9.72
Jan 03 2000
Jan 02 2002
Jan 02 2004
Jan 03 2006
Jan 02 2008
Jan 04 2010
Jan 03 2012
Jan 02 2014
Jan 04 2016



We can further analyze this RSI-3_4 strategy by getting the order book and retrieving th

This strategy is profitable but it can be enhanced.

Sharpe ratio = (Mean portfolio return - Risk-free rate) / Standard deviation of portfolio return

4.2 STRATEGY 2: DVO

Instead of using the RSI_3_4 as the oscillator, let's use a custom DVO with navg = 2 and a percentlookback period of 126 that we call DVO_2_126 .