

CS7646 Project 6 Report

GTID: gyan31

Part 1 Technical Indicators

1. Price/SMA Ratio

Usage:

This indicator is the stock daily closed price to SMA(simple moving average) price ratio. The moving window is set to 7 for capturing the market fluctuations more quickly. Compared with SMA alone, this ratio provided a more quantified way of determining if an asset price will continue or reverse the current trend.

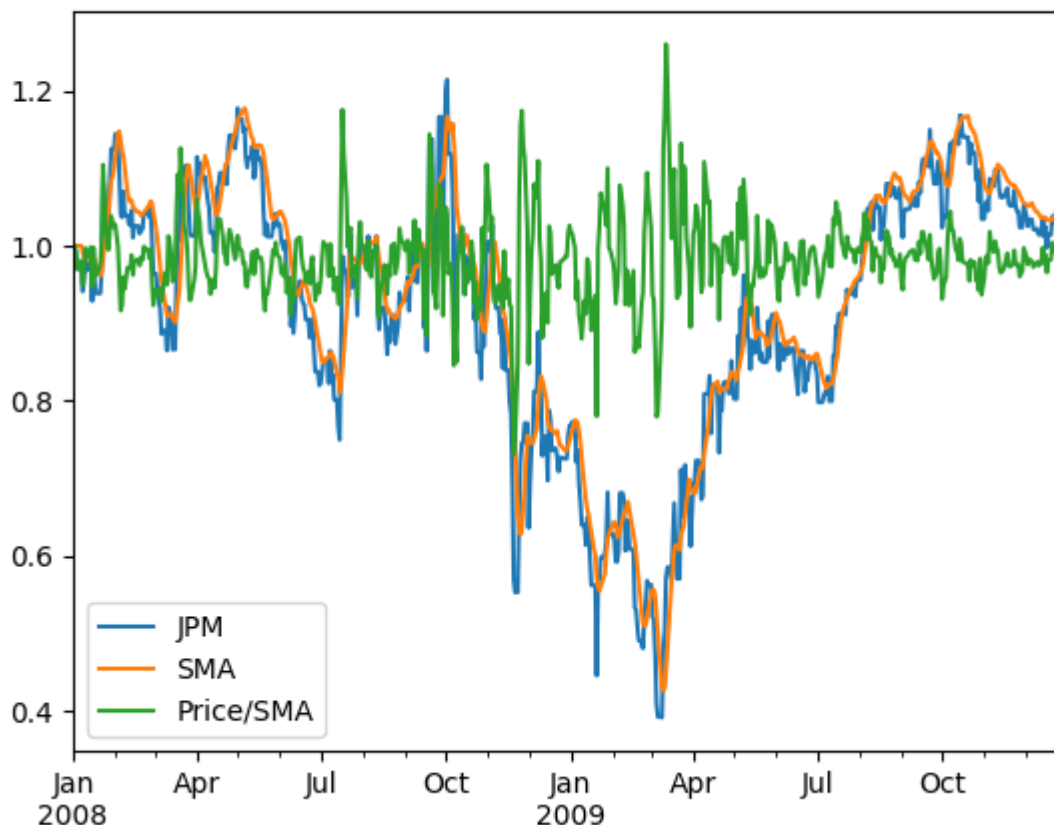
Method:

To implement this indicator, simply:

$$\text{Price/SMA} = \text{price_df} / \text{sma_df}$$

Illustrative Chart is shown below:

Indicator: Price/SMA(Price and SMA normalized)



2. Bollinger Bands %

Usage:

Bollinger Bands % (BBP) is the indicator derived from the registered Bollinger Bands (BB) indicator. While the BB is a volatility indicator, the BBP quantifying the price's relationship to the BB providing a more consistent and technical analysis friendly indicator.

Method:

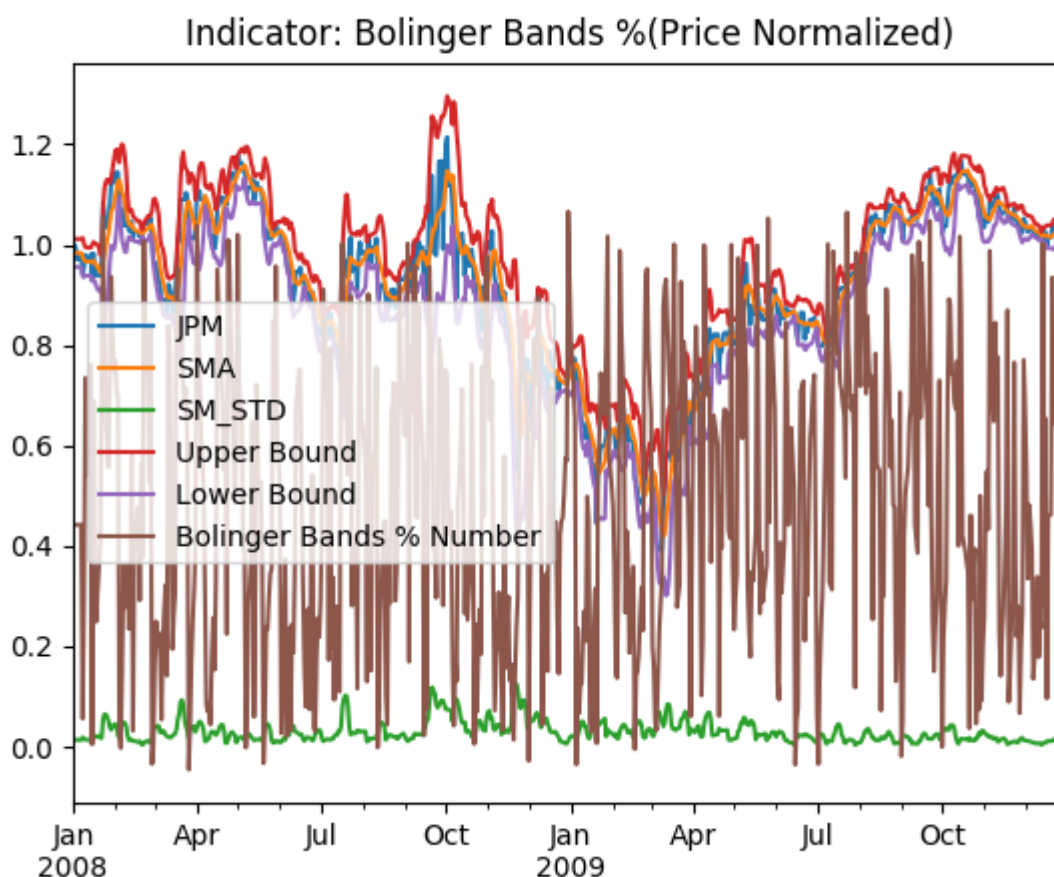
To calculate the BBP number, follow the equation below:

$$\text{Lower_Band} = \text{SMA} - 2 * \text{STD}$$

$$\text{Upper_Band} = \text{SMA} + 2 * \text{STD}$$

$$\text{BBP} = (\text{Price} - \text{Lower_Band}) / (\text{Upper_Band} - \text{Lower_Band})$$

Example figure:



For short-term traders, BBP can be a useful tool in discovering the entry/exit point when taking positions.

3. Momentum

Usage:

Momentum is an indicator that tells the rate of the changes in the price of a particular asset. It

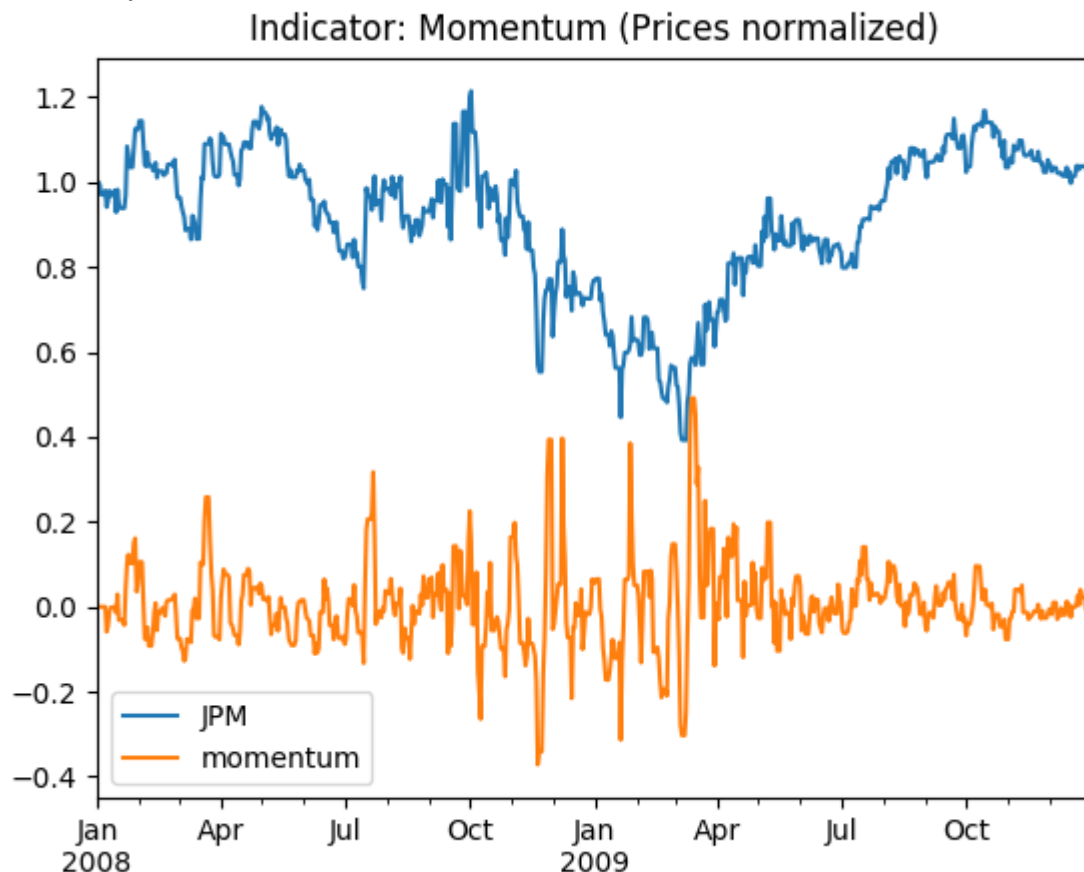
can be used in combination with other indicators to spot good positions to take long or take short. Momentum itself can also be useful to conduct short term trading strategies that aim to "sell low and buy lower" or "buy high and sell higher". Momentum can help catch trading opportunities in short terms ignoring long term market trends.

Method:

It is calculated through the following equation:

$$\text{momentum}[t] = (\text{price}[t] / \text{price}[t-N]) - 1$$

An example is shown here:



As one can see, whenever there are big price changes, the Momentum indicator reflects that drastically providing insights to short term trading opportunities.

4. True Strength Indicator

Usage:

The True Strength Indicator(TSI) is used to determine oversold and overbought positions. The TSI number fluctuates between positives and negatives. A positive number means bull rules the stock while a negative number means bear controls the market. When indicator diverges with the price, it might signal the price trend is weakening and may even reverse especially when the indicator shows overbought or oversold while the index disagrees.

Signal lines can be used with this indicator also, the crossover may show potential relevant buy/sell position.

Method:

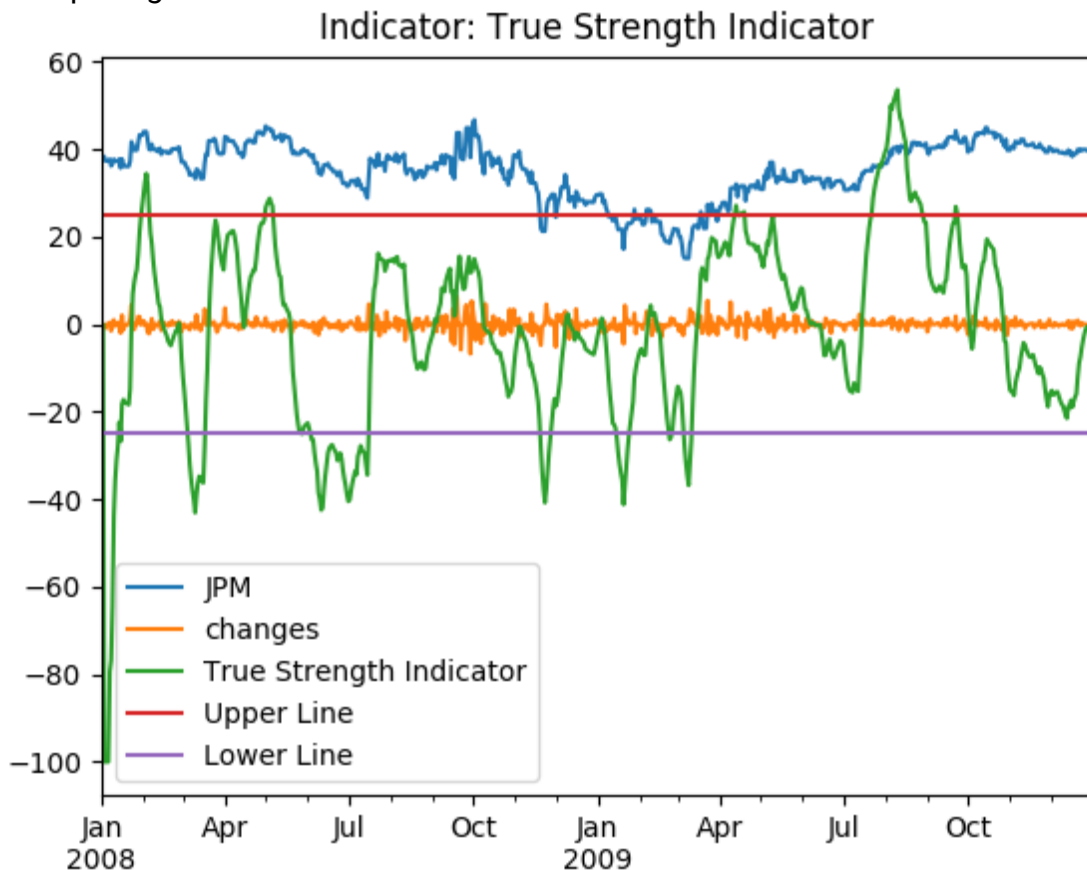
To calculate the TSI, follow these steps:

c=daily price changes (1 day lookback window)

$$TSI = 100 * (\text{ema}(\text{ema}(c, \text{window}=25), \text{window}=13)) / (\text{ema}(\text{ema}(\text{abs}(c), \text{window}=25), \text{window}=13))$$

*ema=Exponential Moving Average

Example Figure:



As you can see in the graph, when the TSI cross the signal upper line, the price tends to be at its local highest position. Same goes for the lower signal line. The price is likely to bounce back after TSI crosses the Lower signal line.

Part 2 Theoretically Optimal Strategy

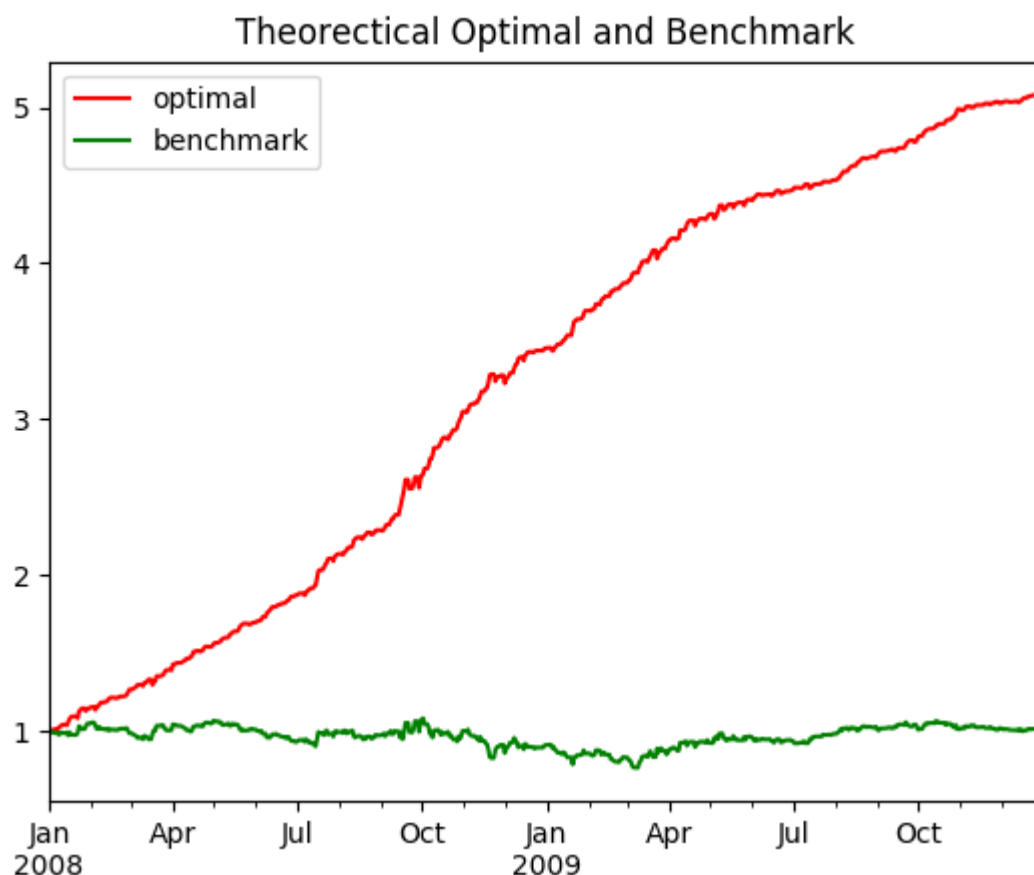
With the ability to see into the future, it is easy to create an optimal strategy that squeezes every inch of market advantage for a particular stock. The method I used to create the best possible strategy is:

Go long whenever you can when you see next day's adjusted close is rising up compared with today's;

Go short whenever you can when you see next day's adjusted close is declining compared with today's.

To make this strategy works as good as possible, the price data's all Null value should be filled in advance in order to deal with the discontinuity in the holidays.

The resulting figure is shown below:



Key Performance of the optimal strategy and the benchmark is summarised in the table below:

	Cumulative Return	Mean of Daily Return	Standard Deviation of Daily Return
Optimal Strategy	4.0789	0.00224193942142	0.00517637662814
Benchmark	0.0123	0.000116049091792	0.0141249611235

Part 3 Manual Strategy

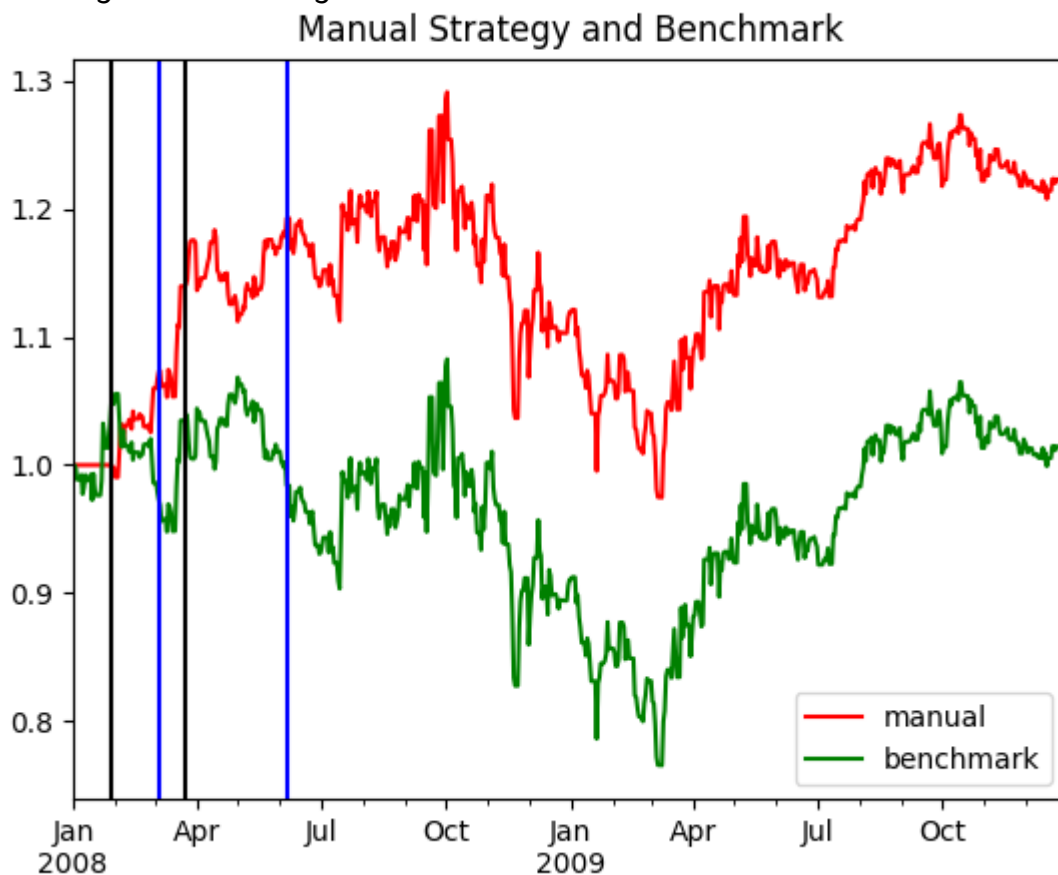
To generate appropriate trading rules, we pursue an as high as possible cumulative return while maintaining a reasonable number of trading actions. Not all the indicators calculated in Part 1
The primary strategy designing principle is:

Go short when the stock is overbought but the Index is not;
Go long when the stock is oversold but the Index is not.

With this goal and principle in mind, we first design the rules that

- Call Symbol overbought when:
 - Price/SMA ratio > 1.0
 - TSI > 20
 - SPY_TSI < 20
- Call Symbol oversold when:
 - Price/SMA ratio < 0.95
 - TSI < -25
 - SPY_TSI > -25

And we get the following chart:

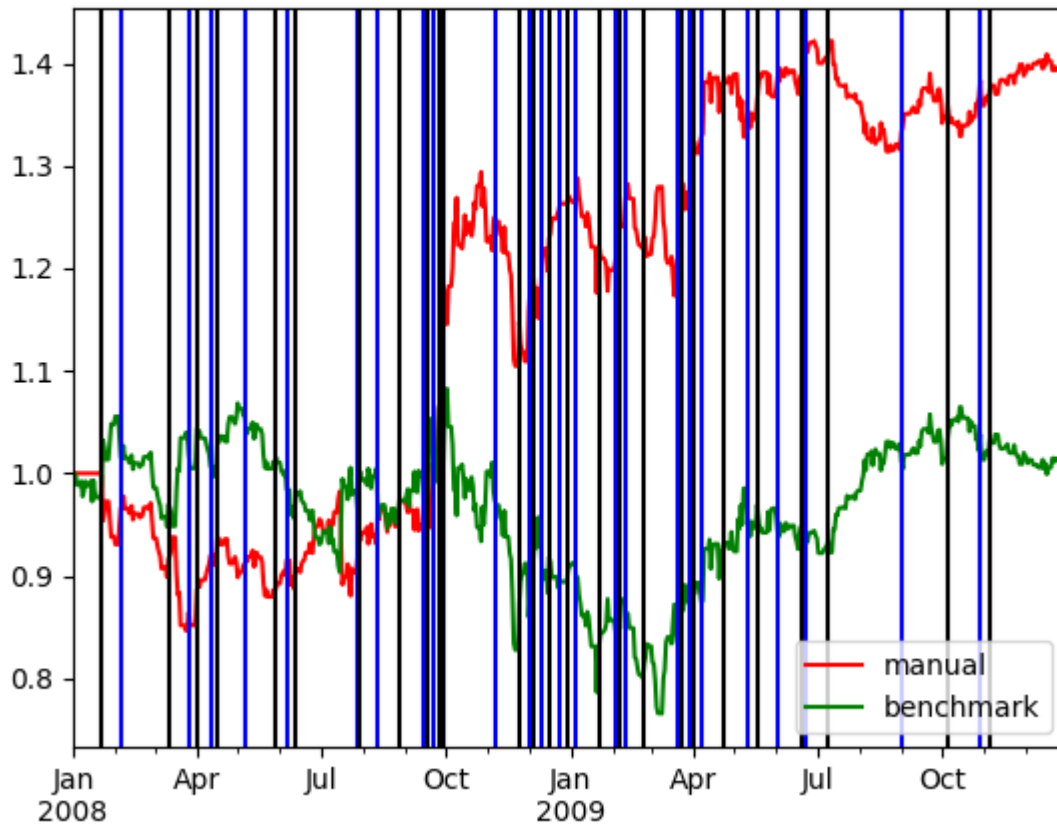


Even though the manual strategy beat the benchmark, it is worrying that with so many filtering indicators, the strategy produces so little actions that it might produce none in out-of-sample data, so we adjust the rules to a simpler form:

- Call Symbol overbought when:
 - Price/SMA ratio > 1.0
 - SPY_TSI < 20
- Call Symbol oversold when:
 - Price/SMA ratio < 0.95
 - SPY_TSI > -25

And we get the following chart which satisfied our goal and principle:

Manual Strategy and Benchmark

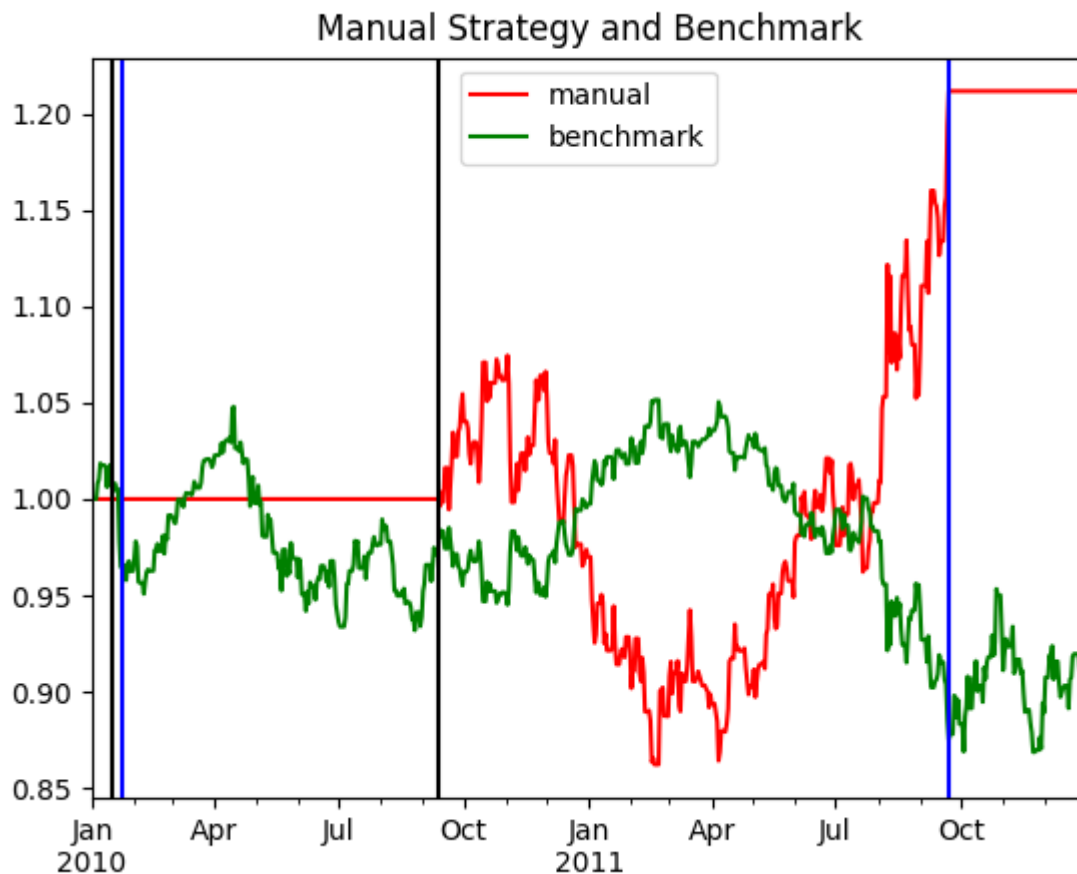


The performance is recorded below:

	Cumulative Return	Mean of Daily Return	Standard Deviation of Daily Return
Optimal Strategy	0.395509	0.000523469504519	0.0115746788183
Benchmark	0.0123249333401	0.000116513174961	0.0141555975583

Part 4 Comparative Analysis

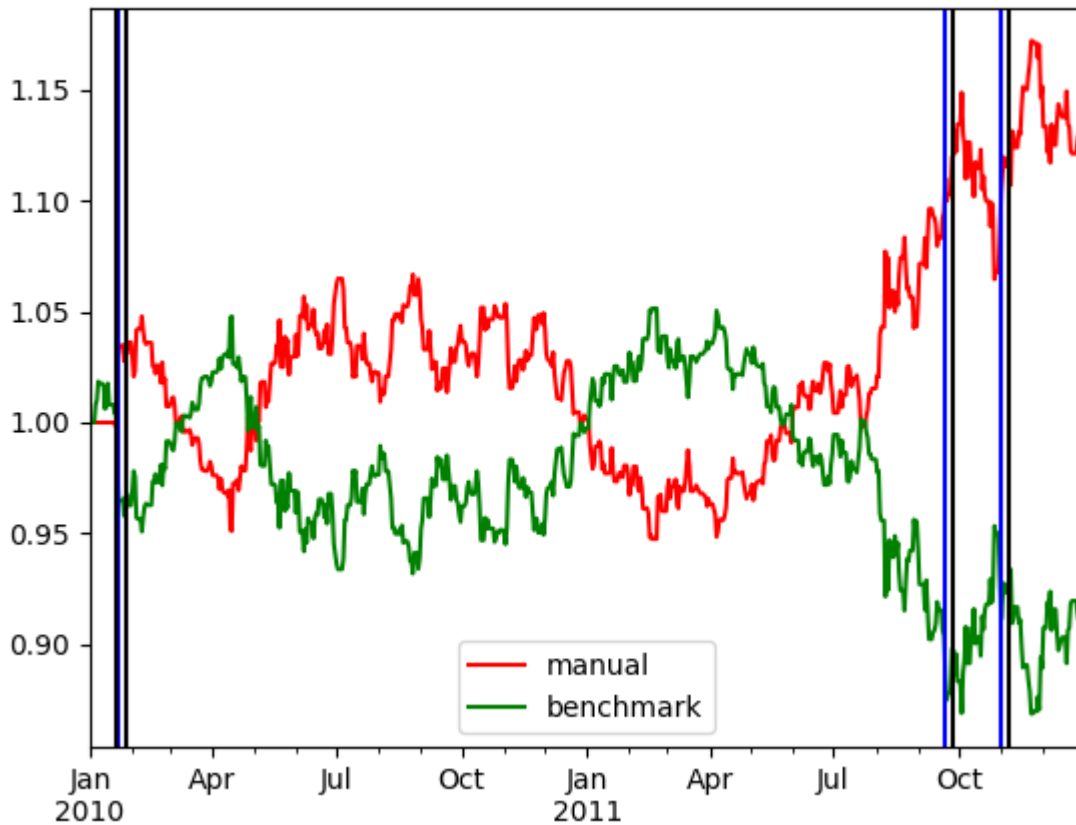
Same goes in Part 3, for the first rules, we have the following chart:



The number looks good but due to such a small number of actions, the profit is more likely to come from mere chances.

And our final result is given below:

Manual Strategy and Benchmark



Performance summary:

	Cumulative Return	Mean of Daily Return	Standard Deviation of Daily Return
Optimal Strategy	0.1244865	0.000181017317972	0.00634223248916
Benchmark	-0.0835791100328	9.48242837939e-05	0.00705879899462

Due to the fact the rules were designed out of in-sample data, even if a well-tweaked set of rules can perform less desirably in out-of-sample data. The expectation is that in-sample backtests should perform well while out-of-sample data.