CS 7646 Manual Strategy Report

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1 Indicators

1.1 Simple Moving Average

(a) Definition

Simple moving average with window size w days at time t can be defined as

SMA[t] = price[t-w:t].mean()

And the indicator of Simple Moving Average at time t is:

$$\textbf{indicator\_SMA[t]} = \frac{\textbf{price[t]}}{\textbf{SMA[t]}} - 1$$

(b) Intuition

The intuition is simple, if the current stock price is higher than the average of past few days, then maybe we should expect it to go down, and vice versa. So when the indicator has a positive value, we should generally sell, and buy if a negative one.

(c) Chart and Analysis

The chart above is generated by window size 10, and we can see that if the value deviates a lot from the average, it will finally get back to average generally.

1.2 Bollinger Band

(a) Definition

First define STD[t] with window size w as:

STD[t] = price[t-w:t].std()

With the same SMA definition as above mentioned, the indicator of Bollinger Band at time t with window size w is:

$$\textbf{indicator\_BB[t]} = \frac{\textbf{price[t]-SMA[t]}}{\textbf{STD[t]}}$$

(b) Intuition

This is actually similar to SMA, however, Bollinger Band quantitize the deviation from moving average by dividing the difference of stock price and moving average by the standard deviation of the last few days. It reflects how stable the stock is and decide to buy or sell depending on the information. With this indicator, we expect value bigger than 1 to be a selling signal, and smaller than -1 to be a buying signal.

(c) Chart and Analysis

The chart above is created with window size 10. And we can see from the chart that when the price (green line) goes outside of the Bollinger Band (blue lines), it typically will bounce back soon, and so the indicator should probably work.

1.3 Exponential Moving Average

(a) Definition

Simple moving average with window size w days at time t can be defined as

$$\alpha = \frac{2}{w+1}$$

$$EMA[t] = \begin{cases} price[0] \text{ if t} = 0 \\ (1-\alpha)EMA[t-1] + \alpha price[t], \text{ otherwise} \end{cases}$$

And the indicator of Exponential Moving Average at time t can be defined similarly as indicator of SMA:

$$\textbf{indicator\_EMA[t]} = \frac{\textbf{price[t]}}{\textbf{EMA[t]}} - 1$$

(b) Intuition

It is quite similar to the one to SMA, the difference is how you calculate the average, and one of the advantage of this is that EMA has values everywhere, whereas simple moving average will not have values in the first window. Also, it actually takes into account of all the values before, but gradually decays.

(c) Chart and Analysis

The charts below look very similar, and they work similarly.

Figure 1: Exponential moving average

Figure 2: Simple moving average

2 Best Possible Strategy

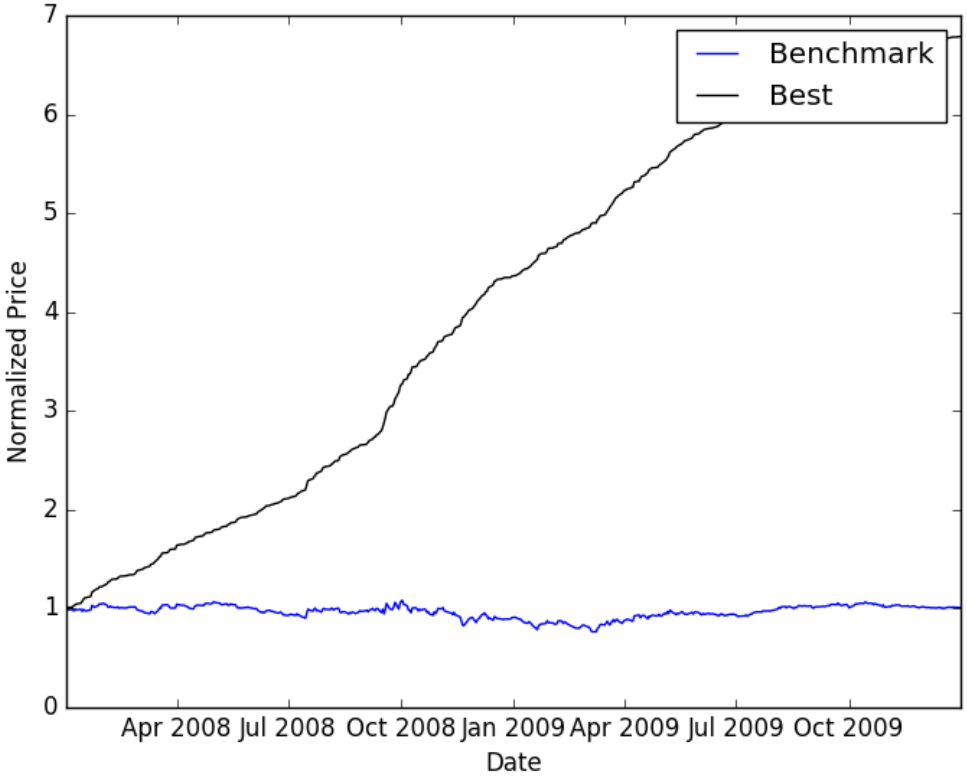
2.1 Assumptions

1. No transaction fee
2. No market impact
3. Allowed to buy at adjusted close only
4. Only trade for JPM
5. Stock positions are 1 of 3: short 1000 shares, 0 share, long 1000 shares
6. No limit on leverage

2.2 Algorithm

Since we already know the future, so we can always buy at low and sell at high. Also, since there's no transaction fee and market impact, we can make as many transactions as we want. Furthermore, we don't need to worry about running out of money because we can leverage as much as we can.
So the algorithm combined with above mentioned conditions is very simple, at the first day, we see if the price is going down or up, buy 1000 if going up, sell 1000 otherwise. And for the trades afterwards, when hitting local maxima, sell 2000 shares, and when hitting local minima, buy 2000 shares, and we can guarantee the holding will be within the three positions, and at the same time get the highest yield.

2.3 Results



Comparison between the two strategies:

	Benchmark	Best Possible Strategy
Cumulative Return	0.0123	5.7861
Standard Deviation	0.0170	0.0045
Standard Deviation	0.0001	0.0038

3 Manual Strategy

3.1 Trading Strategy

My strategy is simple, I simply look at the simple moving average indicator, if the indicator is smaller than -0.1, I buy as much as I can, and if the indicator is bigger than 0.1, I sell as much as I can. Typically, I would like to buy whenever the indicator is smaller than 0, and sell whenever the indicator is bigger than 0. However, mainly because of the assumption of impact 0.05, we need to do less trades. So I only do trades when the absolute values are big enough, and after my tuning, 0.1 is a good one, with bigger value, it barely does trades, with smaller ones, it does too many.

3.2 Performance

The strategy I proposed has a cumulative return of 9.7% which is better than 1.7% benchmark.

4 Comparative Analysis

4.1 Results

	Benchmark	Manual
In sample cumulative return	0.017	0.097
Out of sample cumulative return	-0.083	0.052

4.2 Observation and Analysis

Since we only tune the parameters based on in sample data, the performance betweeen in sample data and out of sample data can be very different. With the same parameters, I only trade for three times in the out of sample data, and made 10 in in sample data. I would say the reason I make money is partly because of my strategy is more conservative. I don't do trades until there's an obvious enough signal, and by doing this, I circumvent the situation of paying a lot of 5 percent fee (impact).