

Technical Indicators

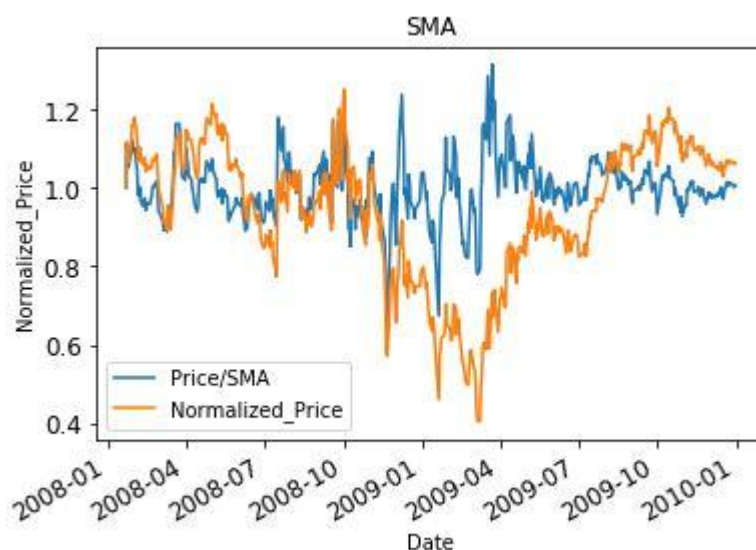
Three technical indicators are selected: SMA, Bollinger Band and Volatility. All of them are normalized, meaning that the beginning of each is set at 1.

- SMA

SMA is the simple moving average of prices during certain periods. In my project, the length of period is 14 days. As a result, SMA for any given day in my project is the average of stock prices of the last 14 days from that day.

The factor of our real concern is price/SMA, since it shows a trend of whether the stock price is rising compared to the average of past 14 days.

Here is a visualization of price/SMA against normalized price:



- Bollinger Band

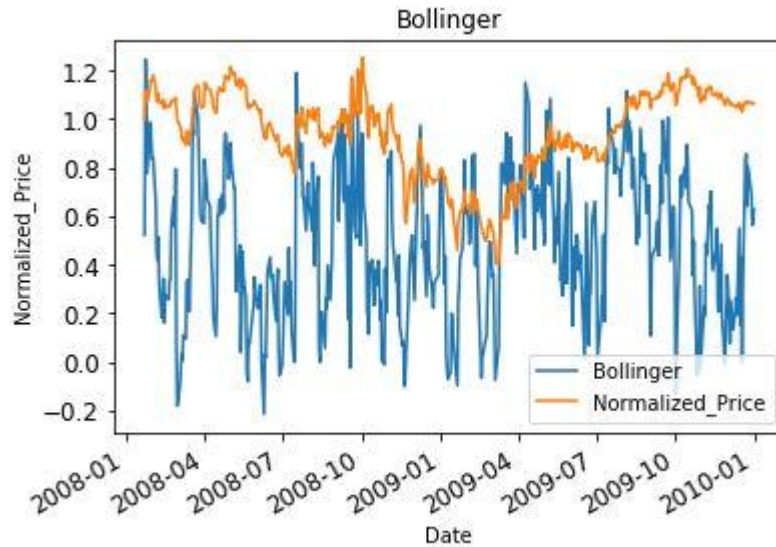
For Bollinger Band, we need to have SMA as discussed above. We then choose a top band – which is a price above the SMA for a certain day in the 14-day period – and similarly, a lower band. For any given day, the top band is determined by adding the SMA for that day and two times the rolling standard deviation for the past 14 day. The same logic applies to the bottom band.

$$\text{SMA} \pm (\text{rolling_std} * 2)$$

And the Bollinger value is:

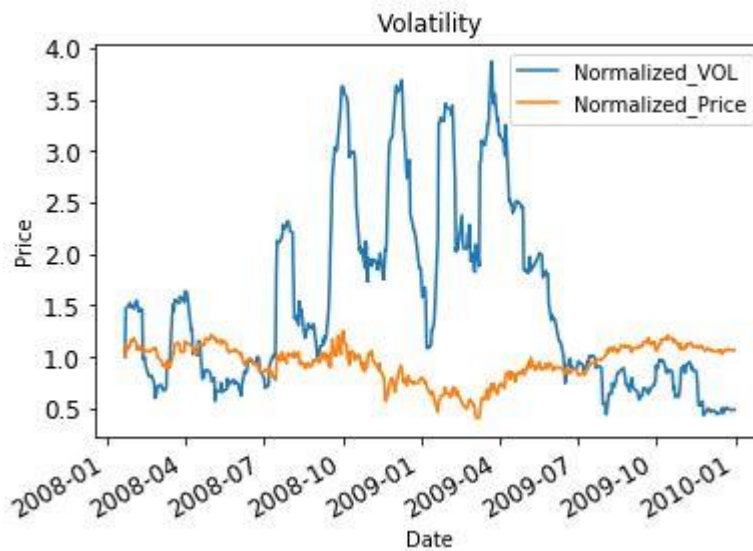
$$(\text{price} - \text{bottom_band}) / (\text{top_band} - \text{bottom_band})$$

Here is a visualization of Bollinger Band:



- Volatility

Volatility is the standard deviation of daily returns of a stock. In my project, for any given day the volatility is calculated based on stock prices for the last 14 days from that day. Here is a visualization of Volatility:

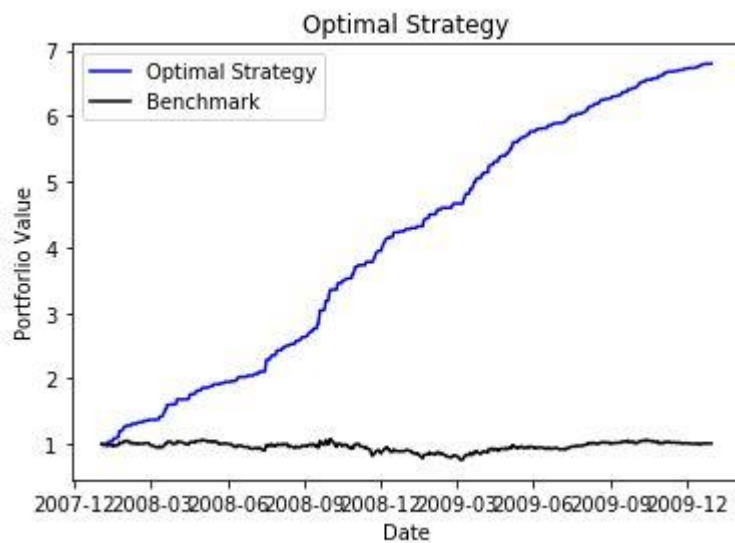


Theoretically Optimal Strategy:

Basically, the theoretically optimal strategy is operated as if we know the future. On the second day in the testing period, we observe whether the stock price has increased or decreased. If it increases, we will long 1000 shares of the stock on the first day, and vice versa. From then, if the price of the stock increases on the next day, we will hold a position of 1000 shares long on the stock; otherwise we will hold a position of 1000 shares short. We set the limits of our

positions to be either 1000 or -1000, so in many cases we buy or sell 2000 of shares, but we would not do more operations beyond that.

Here is a visualization of the optimal strategy's performance:



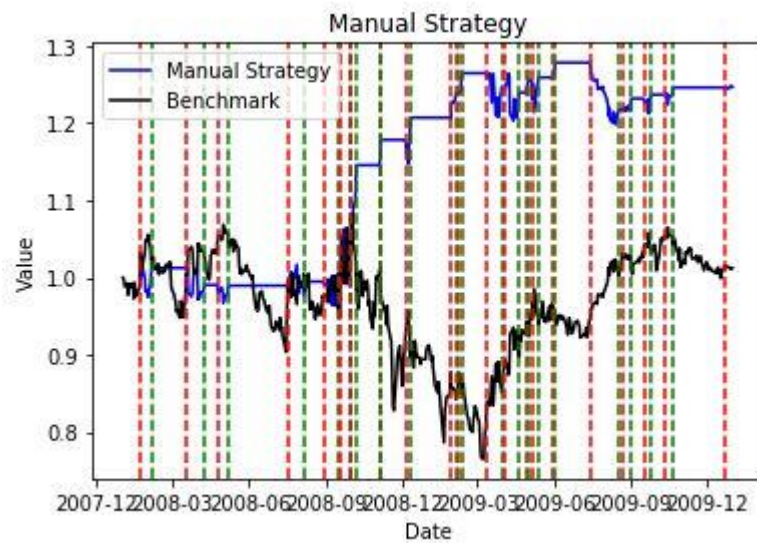
Here are some details of such a portfolio:

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The Cumulative Return of the Optimal Strategy is 5.7984
The Cumulative Return of the Benchmark is 0.012299999999999978
The Average Daily Return of the Optimal Strategy is 0.00384342052502
The Average Daily Return of benchmark is 0.000168086978191
The std of the Optimal Strategy is 0.00825381538836
The std of the benchmark is 0.0169874884842
```

Manual Strategy:

The strategy I uses is rather simple. If volatility is smaller than 0.2 then we enter with a long position. If Bollinger value is greater than 0.8 then we enter with a short position. Otherwise we do not do anything. Here is a visualization of the strategy's performance:

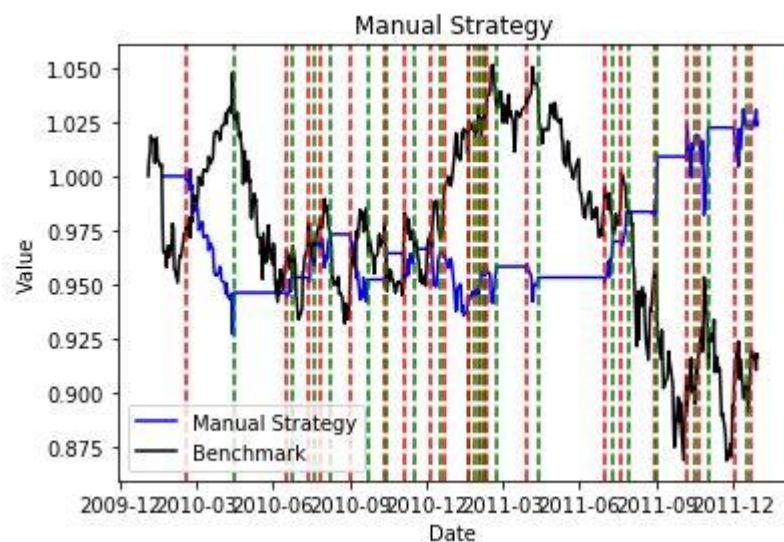
In Sample:



And the details:

```
The cumulative return of the strategy is 0.2463850000000003
The cumulative return of benchmark is 0.01232493334014717
The average daily return of the strategy is 0.000488822209159
The standard deviation of daily return of the strategy is 0.00898552512929
The average daily return of benchmark is 0.000168759162146
The standard deviation of daily return of benchmark is 0.0170243326749
```

Out-Sample:



And some details:

The cumulative return of the strategy is 0.024730499999999545
The cumulative return of benchmark is -0.08357911003280027
The average daily return of the strategy is 5.97049916101e-05
The standard deviation of daily return of the strategy is 0.00443813262573
The average daily return of benchmark is -0.000137429230389
The standard deviation of daily return of benchmark is 0.00849170465707

As shown above, in both in-sample and out-sample testing, our manual strategy beats the benchmark. As for absolute returns, since the market is not doing well during our out-sample testing period, we are not gaining as much as we did in our in-sample testing; indeed, we are only gaining less than 10% of what we could generate in the in-sample testing.

In past summers I did multiple internships on multi-factor investing methods. In Chinese markets, volatility is the single most effective method since the crisis, and that is why I tried to use volatility measure in this project. It turns out that volatility is a rather effective method in this case. I chose Bollinger as another indicator after multiple attempts on different indicators.