Manual Strategy Project Report

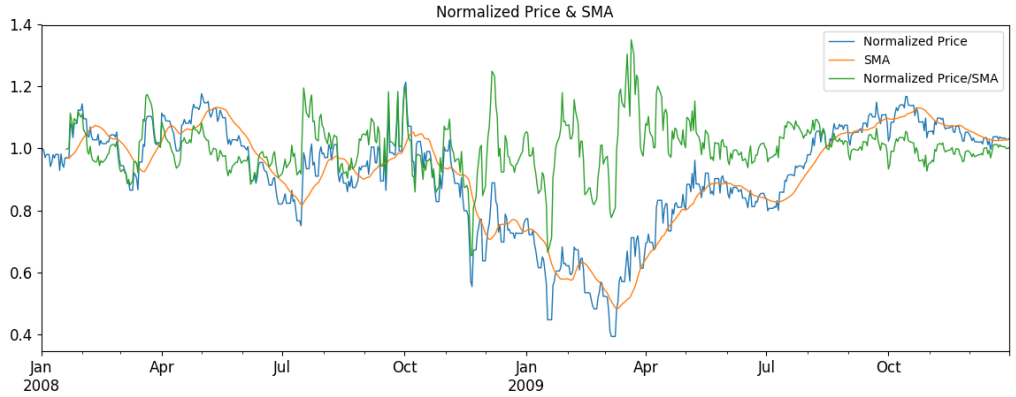
Part 1: Technical Indicators

I use SMA, Bollinger Bands and Momentum as indicators. And I choose the window size N=20. SMA (simple moving average) is an arithmetic moving average calculated by adding the adjusted closing price for a number of time periods and then dividing this total by the number of time periods. The formula is as follows:

$$\mathrm{SMA[t]} = \mathrm{price[t-N:t].mean()}$$

It represents proxy for underlying value, which means if we look back over a certain period of time and take that average price, that might represent the true value of the company. So If we see a large excursion from that price, we should expect that the price will come down to that average. It turns out that where there is a strong diversion from that moving average, we get SELL and BUY opportunities. Moreover, if the price has strong momentum and it is crossing through that simple moving average, that can be a trading signal.

Here is the SMA value together with Normalized Price and Normalized Price/SMA for the in sample data period.



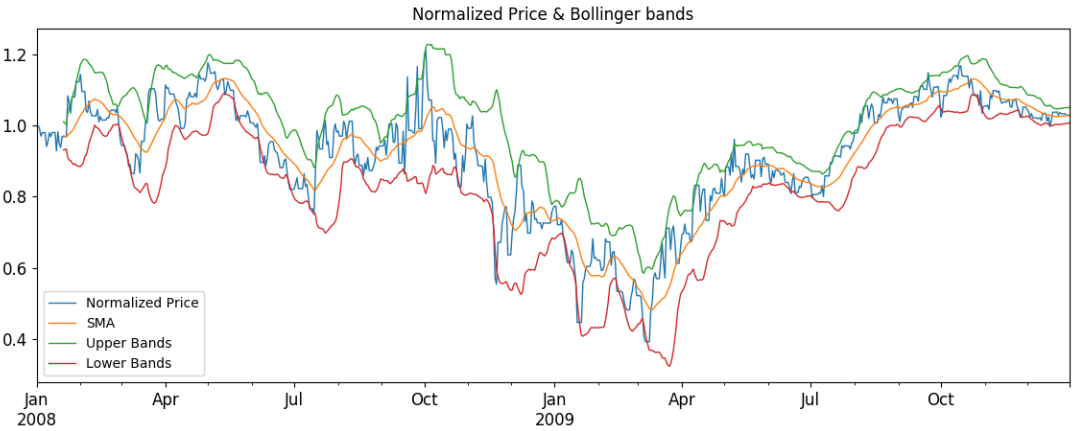
Bollinger Bands, which is developed by famous technical trader John Bollinger, is plotted two standard deviations away from a simple moving average. The formula is as follows:

$$\mathrm{Bollinger\ Bands[t]} = \frac{\mathrm{price[t]} - \mathrm{SMA[t]}}{2 * \mathrm{std[t]}}$$

Since John Bollinger observed that for low volatility stocks or stocks that are currently experiencing low volatility and for high volatility a larger number, we can accomplish it using the standard deviation. First we take the simple moving average, and then add a

band above and below that is two standard deviations (2-sigma). So here comes our measure that where there is a strong diversion from the upper or lower band, we get SELL and BUY opportunities.

Here is the Bollinger Bands (upper and lower bands) together with SMA and Normalized Price for the in sample data period.

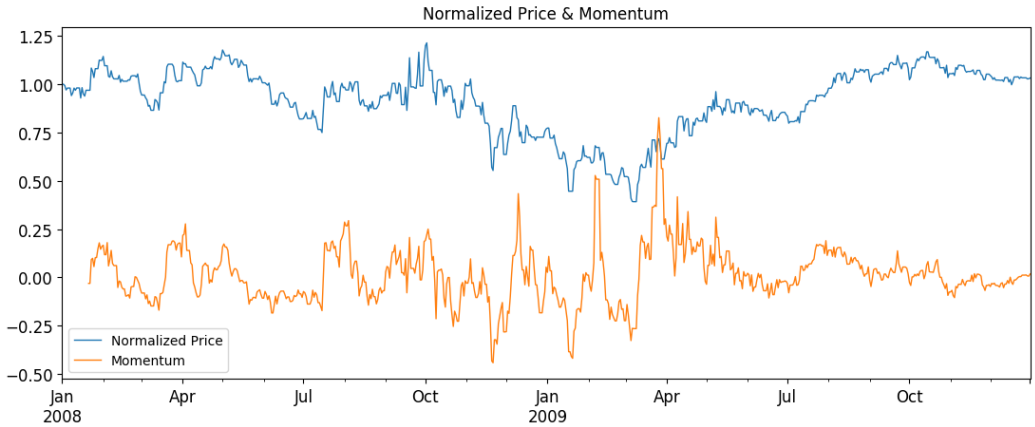


Momentum is the rate of acceleration of a price or volume. In technical analysis, momentum is considered an oscillator and is used to help identify trend lines. So in the world of investments, momentum refers to the rate of change on price movements for a particular asset. That is, the speed at which the price is changing. The formula is as follows:

$$\text{Momentum}[t] = \frac{\text{price}[t]}{\text{price}[t-N]} - 1$$

So if the momentum is larger than a threshold, which means the stock price is accelerating quickly, that is a good time for buy shares and vice versa.

Here is the Momentum together with Normalized Price for the in sample data period.



Part 2: Best Possible Strategy

My best possible strategy is as follows:

(1) If the price[t] < price[t+1] and net holdings is not equal to 1000, which means net holdings is 0 or -1000, it is an entry to long position so we buy shares to make net holdings to 1000.

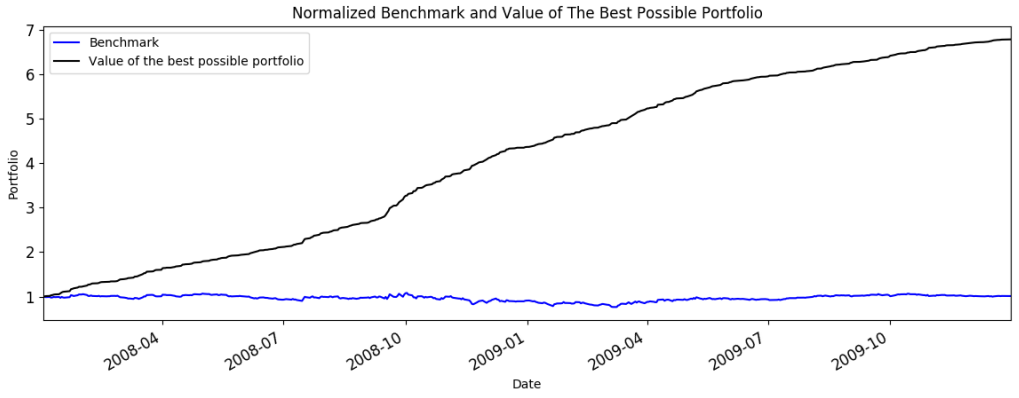
(2) If the price[t] > price[t+1] and net holdings is not equal to -1000, which means net holdings is 0 or 1000, it is an entry to short position so we sell shares to make net holdings to -1000.

Assumptions:
While we are on day t, we know the price on day (t+1). That is, we know if tomorrow stock price is higher or lower than today stock price on trading time periods. Also, we have to make sure that our start value is able to allow us to buy 1000 or sell 1000 shares at the beginning. And we set the transaction costs Commission = 0.00, Impact = 0.00.

Here is the table revealing some statistical features for my best possible strategy versus the benchmark.

	My Best Possible Strategy	**Benchmark**
Cumulative return	5.7861	0.0123
Stdev of daily returns	0.00454782319791	0.0170043662712
Mean of daily returns	0.00381678615086	0.000168086978191
Sharpe Ratio	13.3227698482	0.156918406424
Final Value of portfolio	678610.0	101230.0

Here is the chart revealing total value of portfolio for the benchmark (blue line) and my manual strategy (black line) over the in sample period. Both of them are normalized to 1.0 at the start. We can see that my best possible strategy performs extremely better than benchmark.



Part 3: Manual Rule-Based Trader

I combine the indicators SMA, Bollinger Bands and Momentum to determine short, long and out positions. The signal outputs with following strategy:

(1) When price on t-1 is above the upper Bollinger Band and price on t below it or Momentum on t is smaller than lower threshold, the signal output is -1.
(2) When price on t-1 is below the lower Bollinger Band and price on t above it or Momentum on t is larger than upper threshold, the signal output is 1.
(3) When price on t-1 is above SMA and price on t below it or price on t-1 is below SMA and price on t above it (the crossing points), the signal output is 0.

According to the signal generation method illustrated above, my manual strategy is as follows:

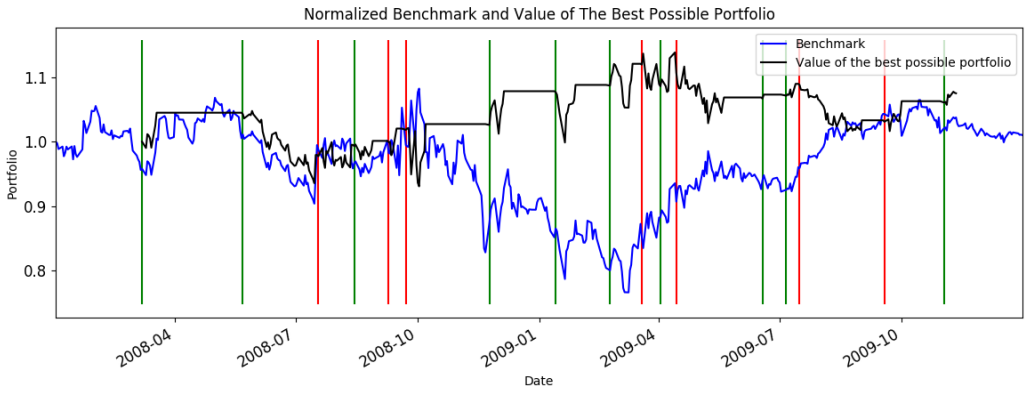
(1) If price[t-1] > upper_band[t-1] and price[t] < upper_band[t] and net holdings is not equal to -1000, which means net holdings is 0 or 1000, it is an entry to short position so we sell shares to make net holdings to -1000. The output data on the Dataframe df_trades is equal to -1000-nethold.
(2) If price[t-1] > SMA[t-1] and price[t] < SMA[t] and net holdings is equal to -1000, it is an exit to short position so we buy 1000 shares to make net holdings to 0. The output data on the Dataframe df_trades is equal to 1000.
(3) If price[t-1] < lower_band[t-1] and price[t] > lower_band[t] and net holdings is not equal to 1000, which means net holdings is 0 or -1000, it is an entry to long position so we buy shares to make net holdings to 1000. The output data on the Dataframe df_trades is equal to 1000-nethold.
(4) If price[t-1] < SMA[t-1] and price[t] > SMA[t] and net holdings is equal to 1000, it is an exit to long position so we sell 1000 shares to make net holdings to 0. The output data on the Dataframe df_trades is equal to -1000.
(5) If Momentum < -0.5(lower threshold), it is an entry to short position and we do same thing as in (1).
(6) If Momentum > 0.6 (upper threshold), it is an entry to long position and we do same thing as in (3).

Here is the table revealing those statistical features for my manual strategy versus the benchmark.

	My Manual Strategy	Benchmark
Cumulative return	0.0752719303738	0.0102362078485
Stdev of daily returns	0.0120876075633	0.0170412256784
Mean of daily returns	0.000243436760932	0.000164660047203
Sharpe Ratio	0.319702534696	0.153386690836
Final Value of portfolio	107332.3	100819.25

I think it is an effective strategy (not very effective if comparing to those financial products on real world) because it outperforms the benchmark over the in sample period. That is, cumulative return, mean of daily returns, sharp ratio and final value of portfolio of my manual strategy are larger than benchmark and stdev of daily returns is less than benchmark.

Here is the chart revealing total value of portfolio for the benchmark (blue line) and my manual strategy (black line) over the in sample period. Both of them are normalized to 1.0 at the start. And the vertical green lines indicate LONG entry points while vertical red lines indicate SHORT entry points.



Part 4: Comparative Analysis

Here are two tables revealing those statistical features for my manual strategy versus the benchmark for the in sample and out of sample time periods.

For the in sample data period:

	My Manual Strategy	Benchmark
Cumulative return	0.0752719303738	0.0102362078485
Stdev of daily returns	0.0120876075633	0.0170412256784
Mean of daily returns	0.000243436760932	0.000164660047203
Sharpe Ratio	0.319702534696	0.153386690836
Final Value of portfolio	107332.3	100819.25

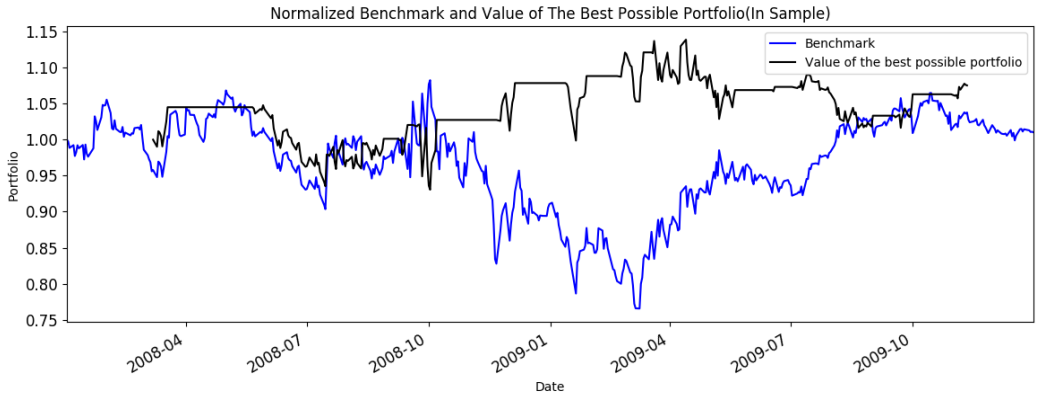
For the out of sample data period:

	My Manual Strategy	Benchmark
Cumulative return	-0.0367614969554	-0.0853088167944
Stdev of daily returns	0.00646514986462	0.00850128395312
Mean of daily returns	-6.31509171532e-05	-0.000141175079753
Sharpe Ratio	-0.155060555766	-0.263617228461
Final Value of portfolio	96122.1	91273.1

In-sample backtests should perform very well. And Out-of-sample backtests should also perform as well as In-sample backtests, because we use same algorithm and did not do any training step. Actually my manual strategy outperforms the benchmark both for the in sample and out of sample data period. That is, cumulative return, mean of daily returns, sharp ratio and final value of portfolio of my manual strategy are larger than benchmark and stdev of daily returns is less than benchmark both for the in sample and out of sample data. However, over the in sample data period we earn money with rate of 3.7% per year, and over the out of sample data period we lose money with rate of -1.9% per year. This performance still needs some improvements while comparing to real market financial products. So the main difference is that we earn money over in sample data period but lose money over out of sample data period. But on the out of sample period, we lose less money than benchmark.

Here are two charts revealing total value of portfolio for the benchmark (blue line) and my manual strategy (black line) over the in sample and out of sample data period. Both of them are normalized to 1.0 at the start.

For the in sample data period:



For the out of sample data period: