Project 6 :
Indicators and TOS

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1 TECHNICAL INDICATORS

In this project, 5 technical indicators are considered and calculated to generate signals. They are:

1) Simple Moving Average
2) Bollinger Bands
3) Momentum
4) Commodity Channel Index
5) Stochastic Oscillator

1.1 Simple Moving Average

SMA is one of the easiest and ubiquitous techniques of analyzing price data by constantly calculating an average price based on prices in the "look back period". Here a period of 20 days is chosen as the "look back period" because this relatively short time frame is more responsive to prices changes than long time frames. Hence, we could take more prompt actions upon the price change by generating more accurate long and short signals.

A popular use of SMA is to compare a pair of simple moving averages with each representing different timeframe. Many Traders signal the beginning of an uptrend by witnessing the short-term averages to cross above longer-term averages. For example, we build 50-day and 200-day SMA at the same time, if the 50-day SMA cross below the longer one, we consider this as a bearish signal. Otherwise, if 200-day cross below the short one, it is considered there is a upward trend and thus we can long position.

$$SMA_t^n = \frac{1}{\mathrm{n}} * \sum_{i=0}^{n-1} Price_{t-i}$$

Figure 2 - Normalized price & SMA indicator

1.2 Bollinger Bond

BB is also a frequently used analysis technique where it calculates the standard deviation of each price data point away from the SMA, and generates two lines above and below SMA, and are 2 times of standard deviation (2 times is a typical practice) away from the SMA. Here SMA is calculated based on the first indicator.

Many traders believe if the price moves more closer to the upper band, the more overbought exist in the market. Therefore, Bollinger Bands can be used to generate overbought and oversold trade signals. One strategy to use with Bollinger bond is squeeze strategy. Here squeeze is a key concept. A squeeze occurs when the bands come closer, constricting the band, this usually means the volatility of the asset has decreased. Conversely, the wider the band, higher the possibility of a decrease in volatility.

In this implementation, my graph has 3 curves: upper band, lower band, and SMA.

$$Upper\ Band = rolling\ mean + 2 * \sigma(price)$$

$$Lower\ Band = rolling\ mean - 2 * \sigma(price)$$

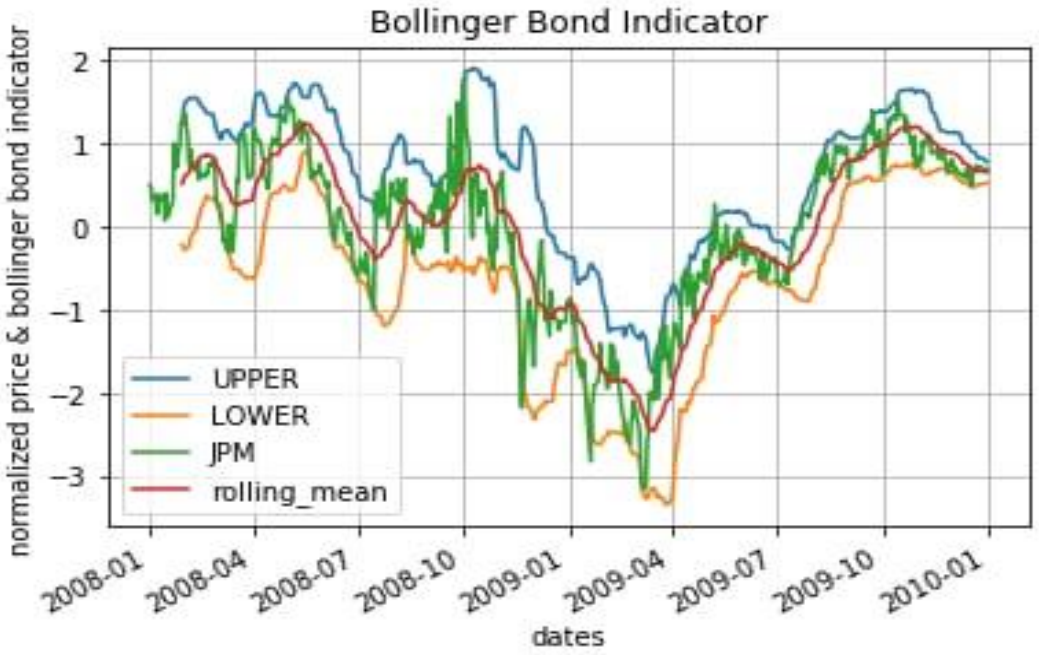

Figure 2 - Normalized price & Bollinger Band

1.3 Rate of Change - Momentum Indicator

Rate-Of-Change is a measure of the rate of increase or decrease in the price of the stock. Here we use the ratio of current price and the price of the "look back period" of 20 days minus - 1, i.e. curr_price(t)/past_price(t-n) - 1, as the value of the momentum. This value indicates the direction and the rate of change of the price, where positive values indicate an increase in the price and negative indicates a decrease in the price. Higher absolute values indicate a higher rate of change and vice versa.

We can generate signals by looking ROC value. An upward surge in the ROC reflects a sharp price advance. A downward plunge indicates a steep price decline. As long as the ROC remains positive, prices are rising. Conversely, as a decline accelerates, ROC moves deeper into the negative zone.

$$momentum(t) = \frac{price(t)}{price(t-n)} - 1$$

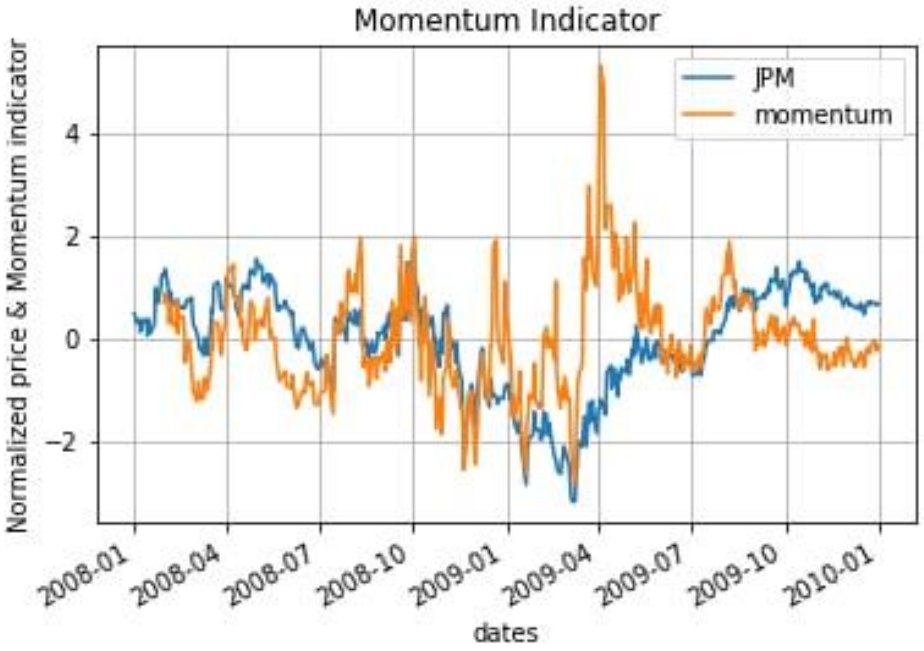

Figure 3 - Normalized price & ROC indicator

1.4 Commodity Channel Index (CCI)

Commodity Channel Index (CCI) is an analyzing technique based on momentum. It indicates when the stock is being overbought or oversold by analyzing the trend of the price change in terms of its direction and rate of change.

$$CCI = \frac{Typical\ Price - MA}{0.15 * Mean\ Deviation}$$

$$Mean\ Deviation = (\sum_{i=1}^{p} |Typical\ Price - MA|)/P$$

Here for Typical Price, I use close price to represent (because we don't have high-low price). MA is moving average of our look-back period close prices. (here our look-back period is 20 days). P = Number of periods.

The CCI compares the current price to an average price over a period of time. The indicator value varies below and above zero. It is estimated with historical data that approximately 75% fall between -100 and +100 and about 25% of the values fall outside this range.

A basic CCI strategy is to track CCI for movement above +100, which generates buy signals and movements below -100 generate short signals. The below chart shows how CCI can be used as an indicator.

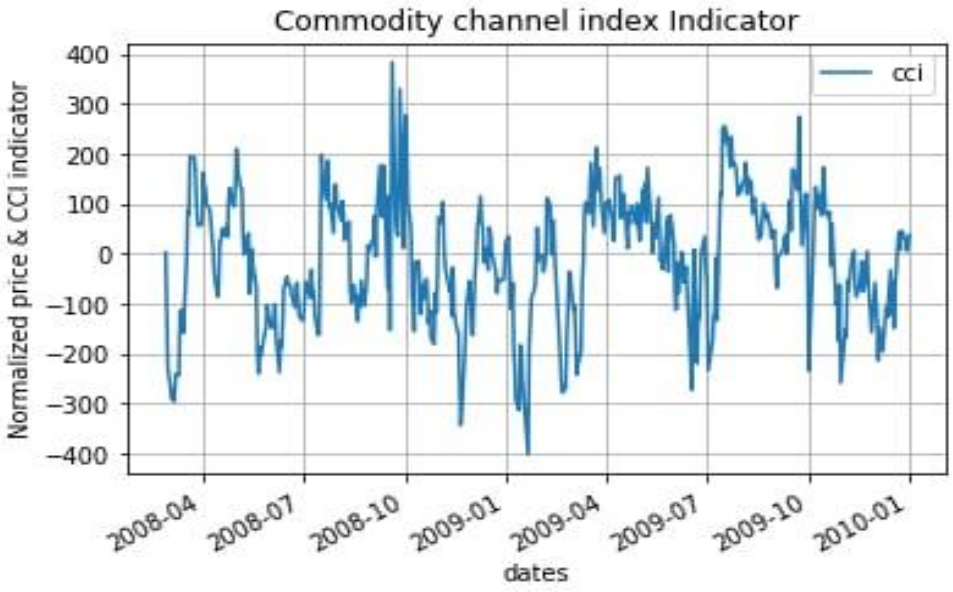

Figure 4 **-** Normalized price & CCI indicator

1.5 Stochastic Oscillator

Stochastic Oscillator is a very popular indicator for generating overbought and oversold signals and it is a common momentum indicator. Measurement over 80 can be thought of as a signal of overbought and below 20 is signal of oversold.

$$Stochastic\ Oscillator = (C - \text{L14})/(\text{H14-L14}) * 100$$

C: the most recent closing price

L14: the lowest price traded in the previous 14 trading days

H14: the highest price traded in the previous 14 trading days

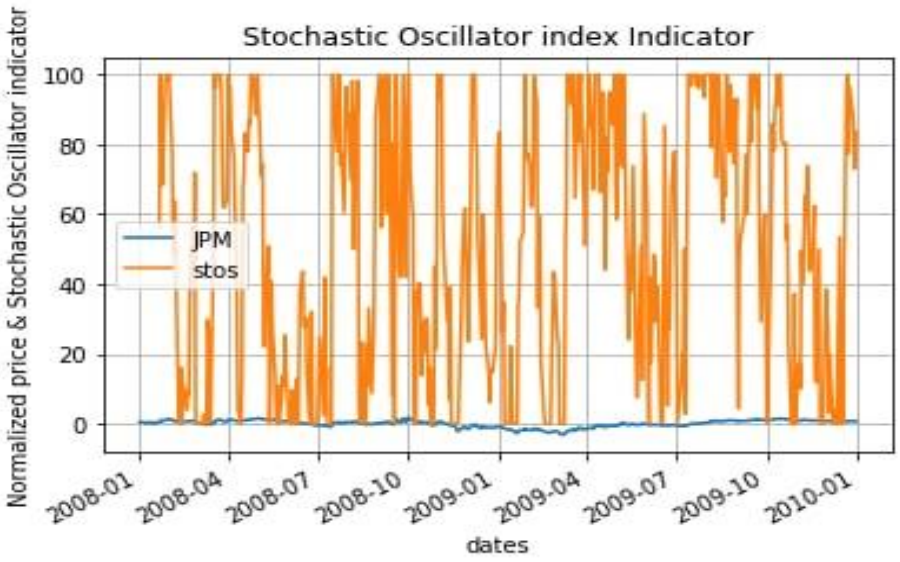

Figure 5 **-** Normalized price & Stochastic Ocillator

2 THEORETICALLY OPTIMAL STRATEGY

The TOS is not difficult to build. The general assumptions are:

1) No price impact and commission
2) Only consider allowable positions 1000, -1000 and 0
3) We can see the future prices

The idea is buying the stock if tomorrow's (or next trading day) price will be higher, selling the stock if tomorrow's price will be lower else we just hold current positions.

From the below chart and table we can see that the performance of OTS is much better than benchmark in respect of cumulative return, average daily return and standard deviation of daily return.

Strategy	Cumulative Return	Average Daily Return	Standard Daily Return
Benchmark	*5.7861*	0.0038	0.0045
TOS	*0.0123*	0.0002	0.0170

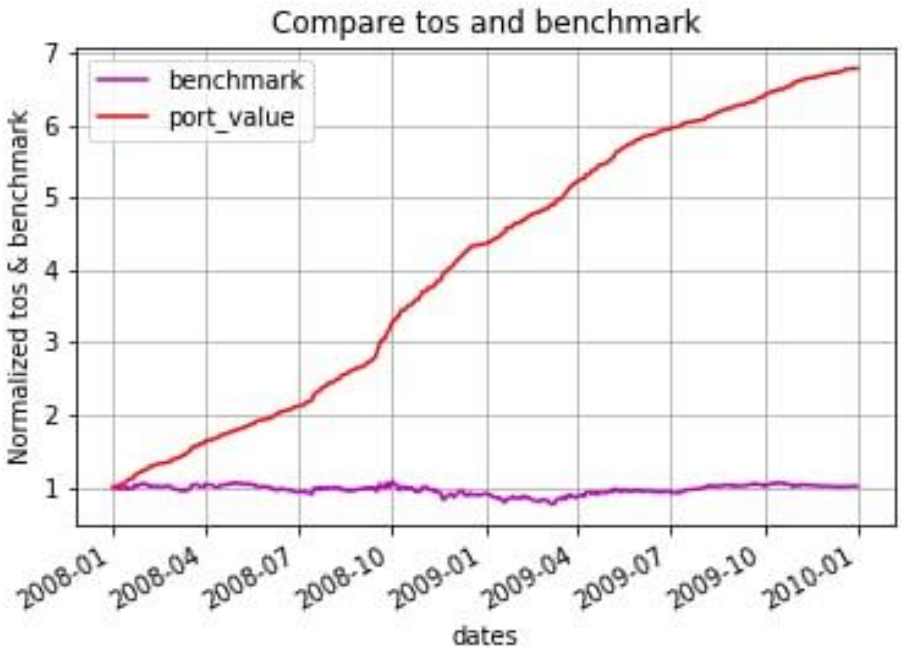

Figure 6 - TOS & Benchmark performance