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Project 6 – Manual Strategy

Part 1: Technical Indicators

Technical indicators in trading perspectives are used to predict future stock prices using historic data. I have used the following technical indicators in this project,

- Price/SMA ratio
- Bollinger Band Percentage (BBP)
- Momentum

Price/SMA ratio:

This is calculated by diving the Price by the SMA (Simple Moving Average). The SMA is calculated as the average of the prices over a particular window before the current date.

Usage in Trading:

When the price to SMA ratio falls below 0.95, the stock trend is going down and it's a "BUY" signal. When the value goes above 1.05, the stock trend is going up and it's a "SELL" signal.

I have implemented the calculation in the code as,

To Calculate SMA:

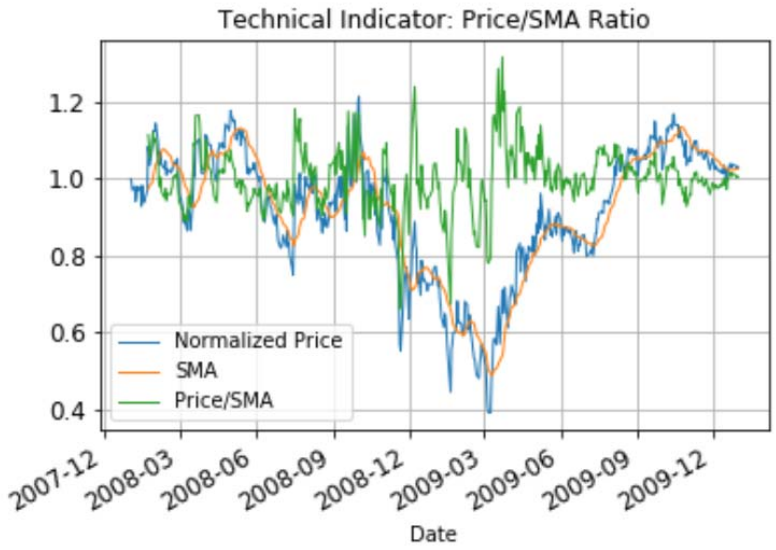
1. Get the Price dataframe. (Adjusted close prices of the stock)
2. Calculate the Rolling mean of the specified "Lookback" window using the pandas' "rolling mean" functionality for each date.

To Calculate Price/SMA ratio:

1. Get the Price dataframe
2. Calculate the SMA for the dates.
3. Divide the Price by the SMA for each date.

I have generated the following graph, with the Lookback window of 14 days using the normalized price values of the "JPM" stock over the period January 1, 2008 to December 31, 2009.

We can note that the "SMA" is a smoothened curve over the "Price".



Bollinger Band Percentage (BBP):

The Bollinger Bands is a technical analysis tool which is made up of the Simple Moving Average, Upper Bollinger band and the Lower Bollinger band. The Bollinger Band percentage is calculated as the difference between price and the lower band divided by the difference between upper band and lower band.

Usage in trading:

When the price moves above the upper band, it means that the stock is **overbought**. The place where the price curve travels back down and meets the upper band is said to indicate a "**SELL**" signal, since it is anticipated that the price is going to fall down.

When the price moves below the lower band, it means that the stock is **oversold**. The place where the price curve climbs up and meets the lower band is said to indicate a "**BUY**" signal, since it is anticipated that the price is going back up.

The Bollinger Band Percentage values helps in quantifying the Bollinger bands. BBP values reaching above 1 denotes that the stock is overbought and gives a "SELL" signal and the values reaching below 0 denotes that the stock is oversold and gives a "BUY" signal.

I have implemented the calculation in the code as,

To Calculate SMA:

1. Get the Price dataframe. (Adjusted close prices of the stock)
2. Calculate the Rolling mean of the specified "Lookback" window using the pandas' "rolling mean" functionality for each date.

To Calculate Rolling Standard Deviation (RSTD):

1. Get the Price dataframe.

2. Calculate the standard deviation over the specified “Lookback” window using the pandas’ “rolling std” functionality

To Calculate the Upper band:

1. Get SMA and RSTD
2. Calculate Upper band by adding twice the standard deviation to the simple moving average. i.e., **Upper band = SMA + (2 * RSTD).**

To Calculate the Lower band:

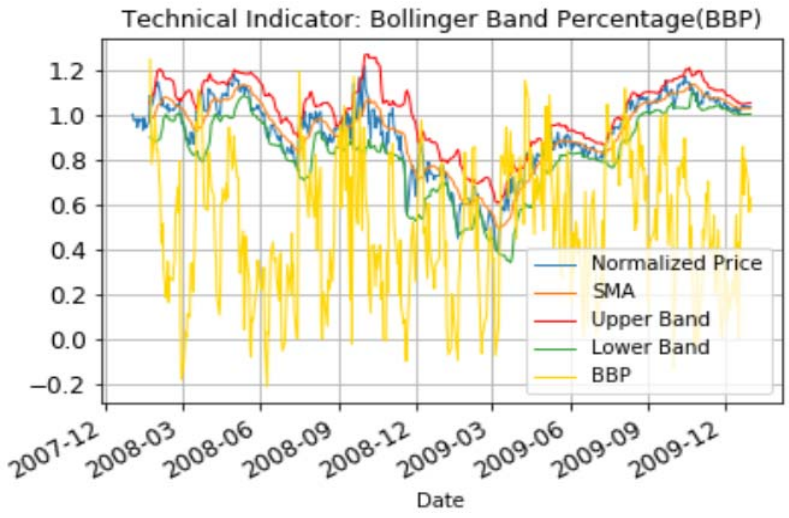
1. Get SMA and RSTD
2. Calculate Upper band by subtracting twice the standard deviation from the simple moving average. i.e., **Lower band = SMA - (2 * RSTD).**

To Calculate Bollinger Band Percentage (BBP):

1. Get the Price dataframe.
2. Calculate the SMA and RSTD for the given lookback window.
3. Calculate the upper and lower bands.
4. Calculate the Bollinger band percentage as,
   BBP = (Price – Lower Band) / (Upper band – Lower band)

I have generated the following graph, with the Lookback window of 14 days using the normalized price values of the “JPM” stock over the period January 1, 2008 to December 31 2009.

We can note that the Upper and lower bands are the curves following above and below the SMA.



Momentum:

Momentum is a simple technical indicator which represents the rate at which the current price has changed in relation to the price N days back, where N is the specified “lookback” window size.

Usage in trading:

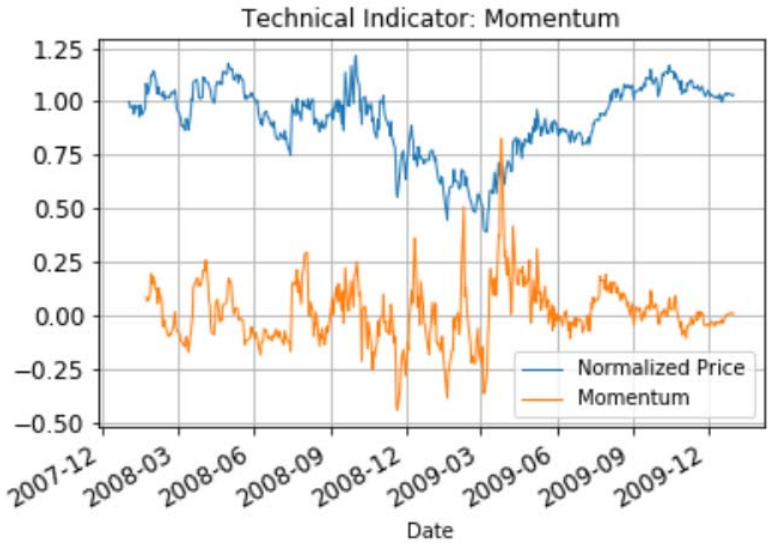
Usually a negative 50% denotes that the stock is oversold and denotes a “BUY” signal and a positive 50% denotes that the stock is overbought and denotes a “SELL” signal. In the code, I have used it as values less than -0.05 denotes a “BUY” signal and values greater than 0.05 denotes a “SELL” signal.

I have implemented the calculation in the code as,

To Calculate Momentum:

1. Get the Price dataframe.
2. Calculate the Momentum as the current price divided by the price N days back minus 1.
   i.e., **Momentum = (Today’s Price / Price N days back) – 1**
   This can be done using the pandas’ “shift” functionality to get the price N days back.

I have generated the following graph, with the Lookback window of 14 days using the normalized price values of the “JPM” stock over the period January 1, 2008 to December 31 2009.



Part 2: Theoretically Optimal Strategy

The strategy I have used for trading in this part is where I peek into the future, seeing the next day's price of the stock. I implement the following strategy,

1. If tomorrow's price is **more** than today's price, "**BUY**" shares or enter position, taking care of the value of the allowed holdings.
2. If tomorrow's price is **less** than today's price, "**SELL**" shares or exit position, taking care of the value of the allowed holdings.
3. Otherwise, if the prices are same, do no trading.

The following graphs and tables are generated using the following input parameters,

Stock Symbol = JPM

Start Date = January 1, 2008

End Date = December 31 2009

Start value = $100,000

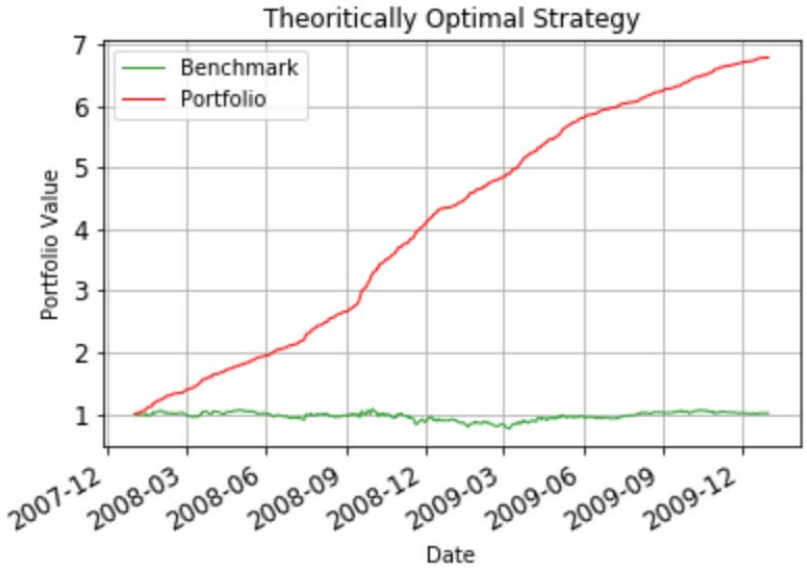
Commission = $0.00

Impact = $0.0

Holdings = At any given day, the holdings of a stock should either be 1000, 0 or -1000.

Benchmark = A portfolio starting with $100,000 cash, investing in 1000 shares of JPM and holding that position.

The graph below clearly denotes how the **Portfolio** curve **climbs up** yielding way **more gains** compared to the benchmark curve which is almost stable.



Theoretically Optimal Strategy Results

	Benchmark	Portfolio
Sharpe Ratio	0.156918406424	13.3227698482
Cumulative Return	0.0123	5.7861
Standard Deviation of Daily Returns	0.0170043662712	0.00454782319791
Mean of Daily Returns	0.000168086978191	0.00381678615086
Final Portfolio Value	$101,230.0	$678,610.0

From the results, it's very clear that the "**Portfolio**" using the theoretically optimal strategy **performs way better** than the "Benchmark" in all aspects. It is due to the obvious fact that, since we get to **peek into the future**, the trading strategy yields promising gains. The final portfolio value is a whopping $678,000, about 6 times that of the benchmark.

Part 3: Manual Rule-Based Trader

I have used three technical indicators – ***Price/SMA ratio***, ***Bollinger band percentage*** & ***Momentum*** to implement my "Manual Rule-Based" strategy. Rather than a single indicator, a "*basket*" of technical indicators used wisely is said to yield good results.

The Bollinger band percentage combined with the Price/SMA ratio helps us in understanding the volatility of the price change and predicting the stock trend. The momentum indicator helps us in predicting the rate at which the price will change. So, combining these 3 indicators is a effective strategy for trading.

I have used the following rules to implement my Manual Rule-Based Trader,

1. If the ***Price/SMA*** ratio is less than ***0.95*** and Bollinger band percentage (***BBP***) is less than ***0*** and ***momentum*** is less than ***-0.05***, it predicts that the stock may be oversold and it's a signal to "***BUY***" or ***enter*** position.
2. If the ***Price/SMA*** ratio is more than ***1.05*** and Bollinger band percentage (***BBP***) is more than ***1*** and ***momentum*** is more than ***0.05***, it predicts that the stock may be overbought and it's a signal to "***SELL***" or ***exit*** position.

The following graphs and tables are generated using the following input parameters,

Stock Symbol = JPM

Start Date = January 1, 2008

End Date = December 31, 2009

Start value = $100,000

Commission = $ 9.95

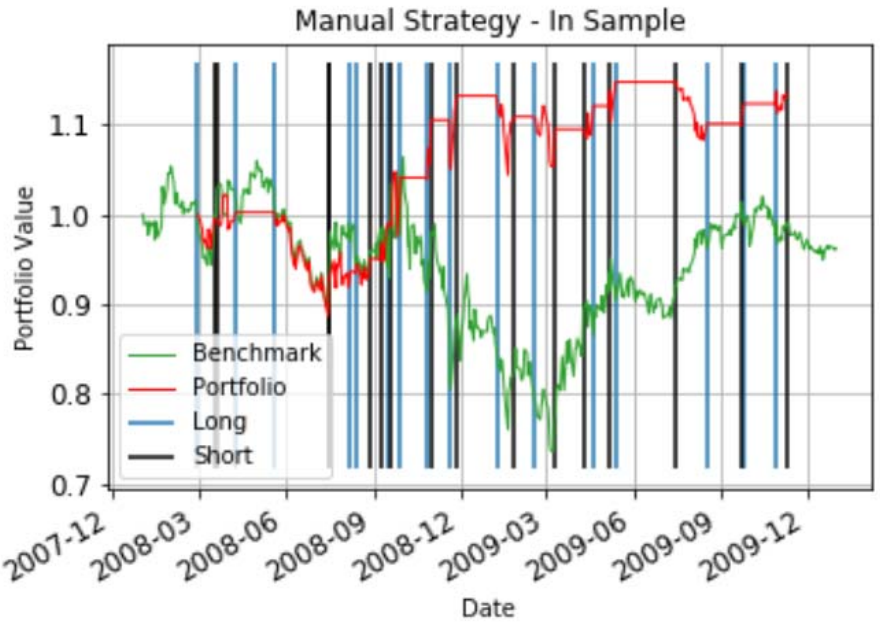
Impact = $ 0.005

Lookback window for indicators = 14 days

Holdings = At any given day, the holdings of a stock should either be 1000, 0 or -1000.

Benchmark = A portfolio starting with $100,000 cash, investing in 1000 shares of JPM and holding that position.

The graph below denotes that the performance of the **portfolio** using the "Manual Rule-Based strategy" is **better** than the benchmark. While the benchmark curve follows the market, the portfolio using the technical indicators creates specific entry (Long) and exit(short) positions to yield better **profits**.



Manual Rule-Based Strategy – In Sample Results

	Benchmark	Portfolio
Sharpe Ratio	0.0682287821157	0.525087844819
Cumulative Return	-0.037924721712	0.135243698565
Standard Deviation of Daily Returns	0.0174682829173	0.0106617332646
Mean of Daily Returns	7.50788420738e-05	0.000352662683408
Final Portfolio Value	$ 96,012.9	$ 113,302.6

The results clearly depict that the "Portfolio" using the manual strategy performs better than the benchmark. The "Cumulative return" and the "Mean of daily returns" of the portfolio are higher than the benchmark which means better yields. The "Standard deviation of daily returns" of the portfolio is less than that of the benchmark, which is means more stable performance. The final portfolio value denotes a gain of around $ 13,000, whereas the benchmark has resulted in a loss of $ 4,000.

Part 4: Comparative Analysis

The following graphs and tables are generated using the following input parameters,

Stock Symbol = JPM

Start Date = January 1, 2010

End Date = December 31, 2011

Start value = $100,000

Commission = $ 9.95

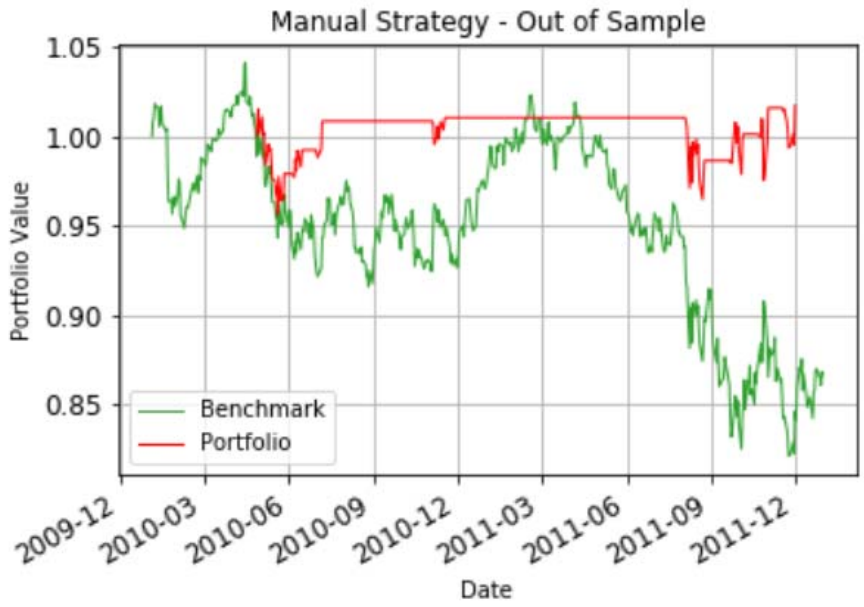
Impact = $ 0.005

Lookback window for indicators = 14 days

Holdings = At any given day, the holdings of a stock should either be 1000, 0 or -1000.

Benchmark = A portfolio starting with $100,000 cash, investing in 1000 shares of JPM and holding that position.

The graph below depicts that the performance of the "**Portfolio**" using **Manual strategy** for the **out** of sample testing period performs **better** than the benchmark. From this, we can interpret that the trend of the stock might be similar to that of the in-sample development period we used for informing the strategy, which has facilitated in better results even in the out of sample period.



The following table clearly showcases the comparison between the In-sample and Out of Sample results for the Portfolio and the benchmark.

The **Portfolio** in the **Out** of sample period still **outperforms** the **benchmark** in the same period, with better cumulative return and standard deviation, yielding a gain of $1500, while the benchmark results in the loss of $14,000, implying that our technical indicators must have led to useful decision strategies even in the out of sample period.

But, the **Portfolio** in the **out** of sample period **performs low** compared to the Portfolio in the **in-sample** period. This is because the trading model is informed using the data from the in-sample data and the out of sample period might have had different stock trends and therefore, the same entry and exit point decisions from the in-sample period may not have been the wisest ones for these.

Manual Rule-Based Strategy – Comparative Analysis (In Sample Vs Out of Sample)

	Benchmark (In Sample)	Portfolio (In Sample)	Benchmark (Out of Sample)	Portfolio (Out of sample)
Sharpe Ratio	0.0682287821157	0.525087844819	0.0682287821157	0.172118107301
Cumulative Return	-0.037924721712	0.135243698565	-0.037924721712	0.0172912352292
Standard Deviation of Daily Returns	0.0174682829173	0.0106617332646	0.0174682829173	0.00512073007989
Mean of Daily Returns	7.50788420738e-05	0.000352662683408	7.50788420738e-05	5.55211145295e-05
Final Portfolio Value	$ 96,012.9	$ 113,302.6	$ 86,440.85	$ 101,513.0