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Report: Project 06 – Manual Strategy
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Part 1: Technical Indicators

Technical analysis assumes that there is information in historical price and volume data that we can discover and exploit in advance of the market while fundamental analysis assumes there is information in fundamental data, like earnings, that can be exploited and traded upon in advance of the market. Technical indicators are statistics calculated from price and volume data that can be used to understand investment portfolio. In this project, different technical indicators are explored in order to build a trading strategy to outperform the benchmark strategy (buy and hold long term).

Simple moving average (SMA), Bollinger Bands and momentum are the indicators of choice in this report. The three indicators are all calculated from stock price. Part 1 will explain what the indicators are, how to calculate them and demonstrated their relationship with stock price with the prices of a stock JPM. Part 2 explores the best possible strategy given the prices of future days. Finally, part 3 will explore ways to utilize the three indicators to build a manual strategy to trade.

Simple moving average (SMA) for today is simply the average of the prices of a stock or portfolio over a period of a look back window. Essentially, the SMA looks like a smoothed value of the price chart as it moves around. Technicians use usually use SMA to look for trading signals or use SMA as a proxy for the true value of the stock. It is expected that the stock price will regress to that average. To quantify the SMA, we use the current price with the current SMA to construct a ratio, price/SMA ratio (PSR).
$$SMA[t] = \text{mean}(\text{price}[t-n:t]); t = \text{current day}, n = \text{lookback window}.$$

$$PSR[t] = price[t] / SMA[t] - 1$$

The PSR ranges from -50% to +50% (see Figure 1.) Generally, when PSR is great than zero then we should short the stock and when it is less than zero we should long the stock. However, PSR along might not be a great indicator, it is advised to use it with the momentum (see the momentum section below).

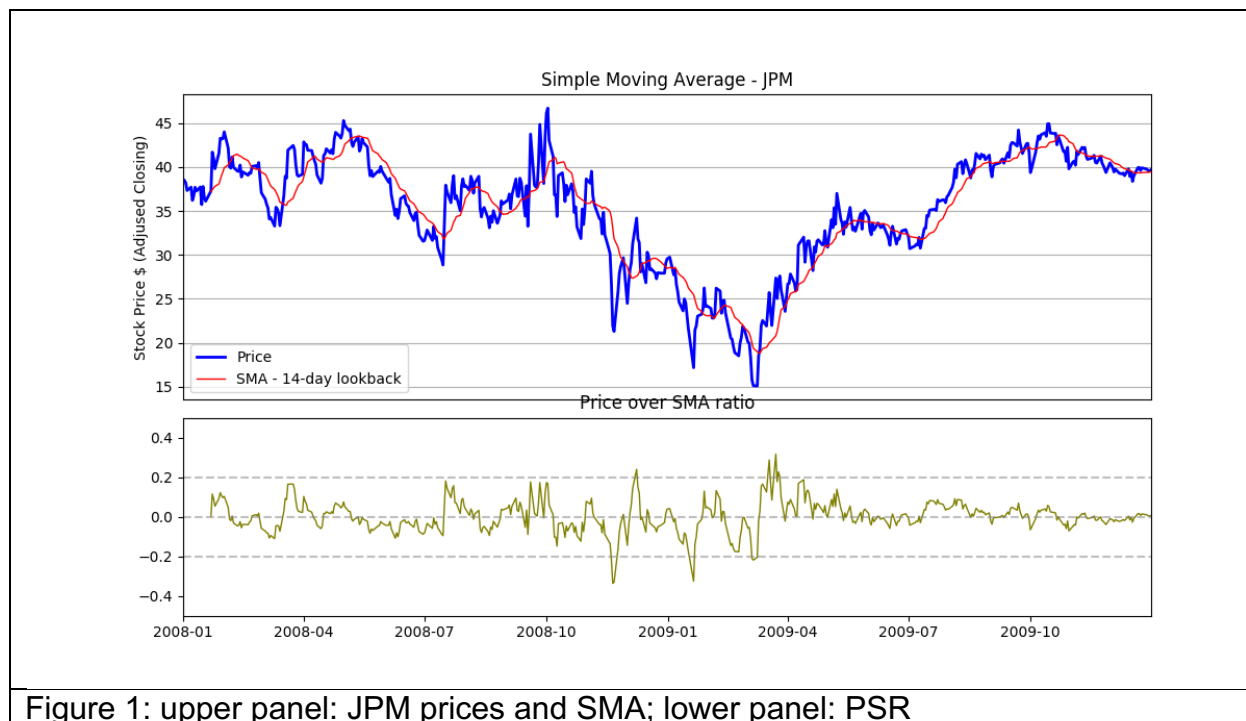


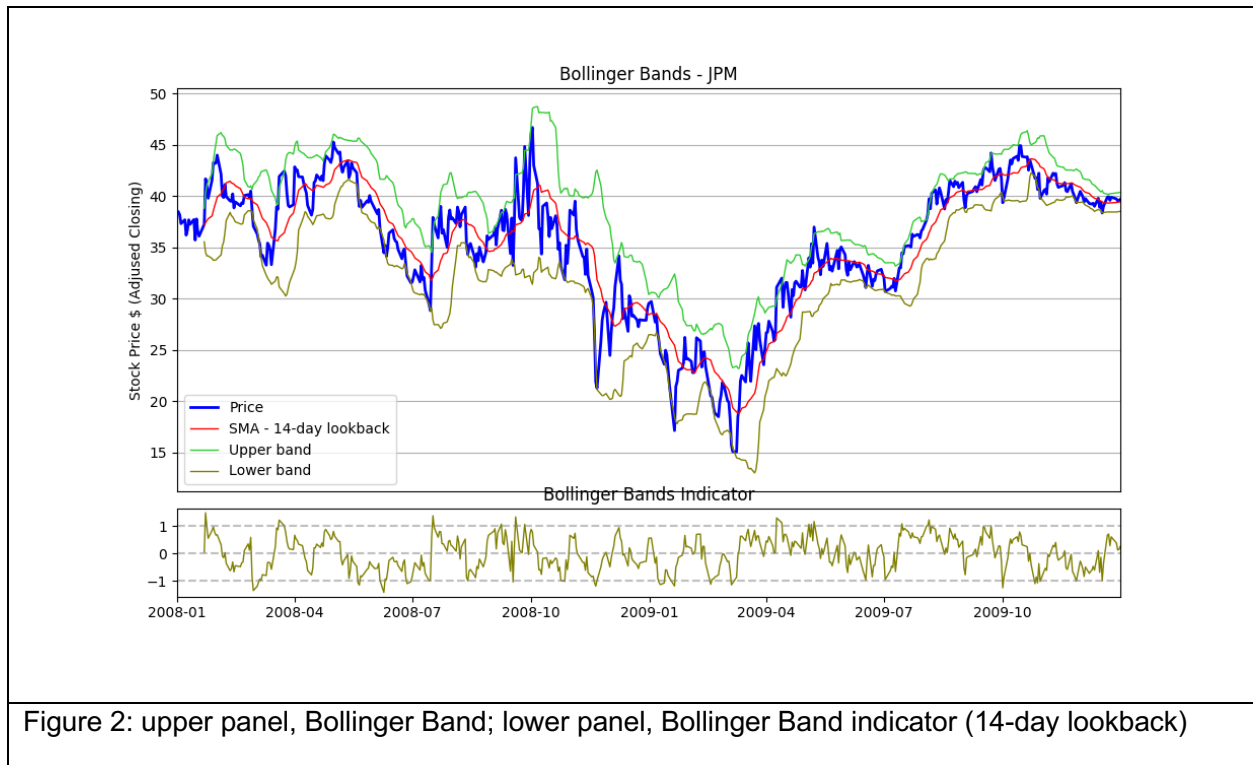
Figure 1: upper panel: JPM prices and SMA; lower panel: PSR

Bollinger Bands takes the SMA and add a band above and below 2 standard deviations from SMA. When the prices cross the Bollinger Band from outside to the inside of the band, it is often a trading signal. For example, prices moving from above the upper band and crossing to the inside signals selling. And, prices moving from below the lower band and crossing to the inside signals buying. The Bollinger Band indicator is calculated using the formula below:

For a given day, t , $BB[t] = (Price[t] - SMA[t]) / (2 * std[t])$; std is standard deviation.

$BB[t] = -1$ or $BB[t] = 1$ are the crossing point.

Typically, BB indicator has a value between -1 and 1. When it is outside the range, it is often a trading opportunity (See Figure 2)

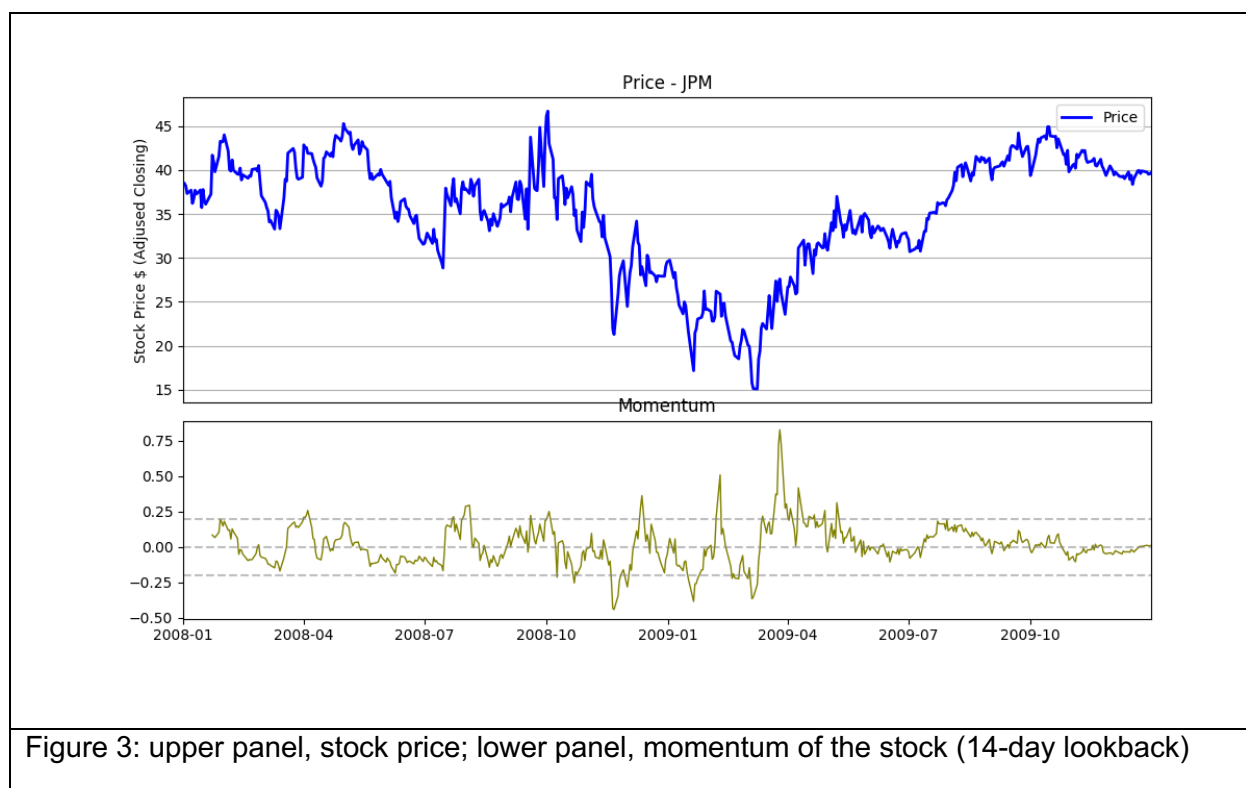


Momentum is over some number of days how much has the price changed. Positive momentum happens when the current price is higher than the it was on the lookback day. And, negative momentum happens the current price is lower than the price on the lookback day. The pseudo code for how the momentum on a particular day was calculated.

$$momentum[t] = price[t] / price[t - n] - 1$$
, n is the number of days between two time point.

The steepness of that line between $price[t - n]$ and $price[t]$ is the strength of the momentum, either positive or negative. Momentum combine with SMA can be used to start a trading policy. E.g., When the stock price has strong momentum, and it's

crossing through SMA, that can be a signal of trading. Strong positive momentum indicates buy opportunity and negative momentum is sell opportunity. $\text{momentum}[t]$ has a typical value between -0.5 and 0.5 (Figure 3).



Part 2: Theoretically Optimal Strategy

The maximum return on a stock can only be achieved if the daily price of the stock is known. In this case, the theoretically optimal strategy is to long the stock if we know the price will increase the next day. And of course, if the price will drop tomorrow, we will short it today. The strategy will make sure we take advantage of the market no matter what way it goes. To evaluate the strategy, we apply the strategy to JPM stock, using its historical prices from 01/01/2008 to 12/31/2009. A benchmark strategy (buy and hold) were also applied to same data. The net holding of the stock is limited in the range of -1000 to 1000 with a starting value of \$100,000. The final return of the Theoretically

Optimal Strategy performed five times better than the benchmark strategy in terms of the final value of the portfolio (see Table 1 and Figure 4).

Table 1: Theoretically Optimal Strategy vs. benchmark

Strategy	Theoretically Optimal Strategy	Benchmark
Sharpe Ratio	13.3650848	0.15691841
Cumulative Return	5.7844	0.0123
Standard deviation	0.00455089	0.01700437
Average daily Return	0.00383149	0.00016809
Final Value	\$678,440.00	\$ 101,230.00

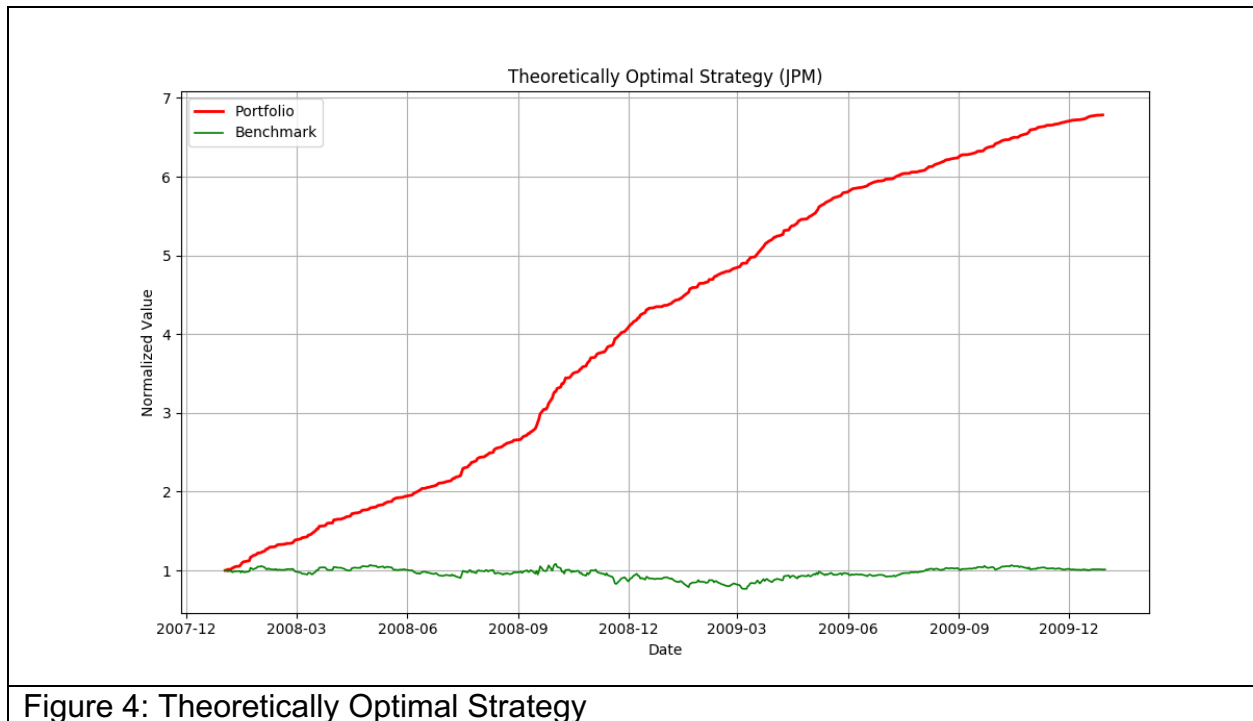


Figure 4: Theoretically Optimal Strategy

Part 3: Manual Rule-Based Strategy

For my manual strategy, I used all the indicators introduced above. The rule I chose is that when PSR is negative (price is lower than SMA) and BB indicator is smaller than -0.8 (when it is close to the lower band), and when we see a strong negative momentum, I chose to buy the stock hoping to make money since they might regress to SMA soon.

When the PSR is positive (price is higher than SMA) and BB indicator is larger than -0.8 (when it is close to the upper band), and when we see a strong positive momentum, I chose to sell the stock. This strategy should ride along when the market is positive but will do better when the market is negative.

The results of the manual strategy were tested in sample and out sample using the JPM stock prices from 01/01/2008 to 12/31/2009 and stock prices from 01/01/2010 and 12/31/2011, respectively. The results are summarized in Table 2, Figure 5 and Figure 6.

Overall both the in-sample and out sample analysis showed that the manual strategy performed better than the benchmarks. The strategy has a higher cumulative return in both the in-sample time period and the out sample period and did significantly better in returns (cumulated and average returns). At the same time, the volatilities of the portfolio are compatible with the benchmarks

Table 2: Manual strategy performance

	In-Sample Analysis		Out Sample Analysis	
	Manual Strategy	Benchmark	Manual Strategy	Benchmark
Sharpe Ratio	0.777816675	0.15702281	1.129318386	-0.25705856
Cumulative Return	0.285126359	0.012225232	0.258799205	-0.08367882
Standard Deviation	0.013935675	0.017041235	0.007205639	0.0085002
Average Daily Return	0.000682818	0.000168563	0.000512612	-0.00013765
Final Value	\$128,231.90	\$101,017.75	\$125,632.00	\$ 91,435.70

