Strategy Evaluation Project 8

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Indicator Overview

The three indicators used in the project were Bolling Bands, Golden Death Cross(GDC) , and Moving Average Convergence/Divergence (MACD). The first Indicator Bollinger Bands% is implement by first calculating the simple moving average(SMA), $\Sigma pi/i$ where p is the price at i period and i being the number of days back (window size), where a summation of all the prices and dividing the number of days in the window. Next we calculate the standard deviation sqrt($\Sigma(pi - \mu)/n$)(sum of all prices subtracted by mean divided the number prices in the window) of n days back like SMA we will then add sma + standard deviation*2 to get the upper band and sma - standard deviation*2 to get the lower band. The final step is to calculate the percentage signal which is price - lower band / (upper band - lower band). The optimized parameters that were used in ManualStrategy and StrategyLeaner have a lookback or "Window size" of 20 days in ManualStrategy and StrategyLearner. For the second Indicator Golden Death Cross is used. Golden Death Cross is calculated by calculating "SMA Long" and "SMA Short" to see where SMA Long and SMA Short intersect. To calculate SMA Long $\Sigma pi/i$ where p is the price at i period and i being the number of days back. The SMA Long should have a higher window size than SMA Short. In implementation for this project the algorithm has a window size of 50 for both ManualStrategy and StrategyLearner. For SMA Short the calculations are consistent with SMA Long, but have a smaller window size. For the implementation for SMA short the size of the window is 20 for Manual Strategy and StrategyLearner . The last indicator used is MACD where it takes the exponential moving average (price x smoother) + yesterday's average x 1-smoother). The exponential moving average is calculated for a window size of 12 to find the MACD short window, next the exponential moving average is calculated with a window of 26 to find the long window, lastly exponential moving average is calculated with a window size of 9 to get the signal. Next the long and short window sizes are subtracted to get the average for the MACD to find the signals. Buy is determined in MACD if the signal is greater than the MACD average and yesterday's MACD average is greater than the signal, while sell is determined by the opposite criteria that is used throughout the project.

Manual Strategy

To create the overall combined signal all three indicators were converted to signify 1 for buy, 0 for hold, and -1 for sell of a stock to have a unified scale. First indicator Bollinger Bands was converted to %B where if the signal was less than 0 then 1 or buy would be given for that day. If the percentage greater than 1 a value of -1 or sell is given for that day and 0 is given if it does not meet any of the criteria. For Golden Death Cross if the SMA short is greater than SMA long and the SMA Short for the previous days is less than the SMA Long for the previous day then a 1 is given signifying a buy. A -1 or sell is given for Golden Death Cross if the SMA short is less than SMA long and the SMA short for the previous day is greater than the SMA Long for the previous day. MACD is given a 1 or buy if the previous day MACD difference average is greater than Than the signals of the previous day and The MACD difference average is less than the signal. Signal of sell or -1 is given if the MACD difference average of the previous day is less than the signal of the previous day and MACD difference average is greater than signal, a zero is given if results do not meet both criteria. To create the overall signal the summation of all three signals is done. A sell is given if the overall signals is equal to or less than -1, a buy is given if the overall signals yield a result of 1 and above. This strategy is effective and yields the best results as it doesn't make criteria to buy or sell too strict and not too loose based on my indicators that were selected. This yields great results because if an indicator misses some buy or sell days and another does then it will happen if the others determine to hold, but if the majority say buy or sell for that day and others do not signal then the majority will win. When using a traditional majority wins logic where two out of three of the indicators had to signal a buy or sell for a action yields bad results as the criteria is to strict and lead to very few trades as the Golden Death Cross had very few days that would have trade signal and Bollinger Bands %B and MACD has a few contradicting days to trade. The Traditional majority had very few trading days leading to significant profit that could have been had. The add on of the ability of the indicator to look back a day also lead to a significant increase in profit as make sure to check if the price of today is not anything out of the ordinary that will trigger a false buy or sell signal. With the combination of look back and the summation of the three signals it ultimately leads to good buy and sell indicators. With this logic Manual Strategy outperformed the benchmark of just holding the JPM stock in the in-sample period of January 1st 2008 to December 31st 2009.

InSampleManualvsBenchMark

Metrics	Manual	Benchmark
Cumalitive Return	0.3754475000000020	0.01232493334014720
Mean	0.0007386899720461590	0.0001687591621464020 0
Standard Deviation	0.014588453233760800	0.017041247068174300

OutofSampleManualvsBenchMark

Cumalitive Return	-0.31120050000000000	-0.08357911003280030
Mean	-0.0006960128619148090	-0.0001374292303891650 0
Standard Deviation	0.009470016744316920	0.008500158322332450

Table 1 In-Sample/Out-of-Sample Metrics Manual vs Benchmark

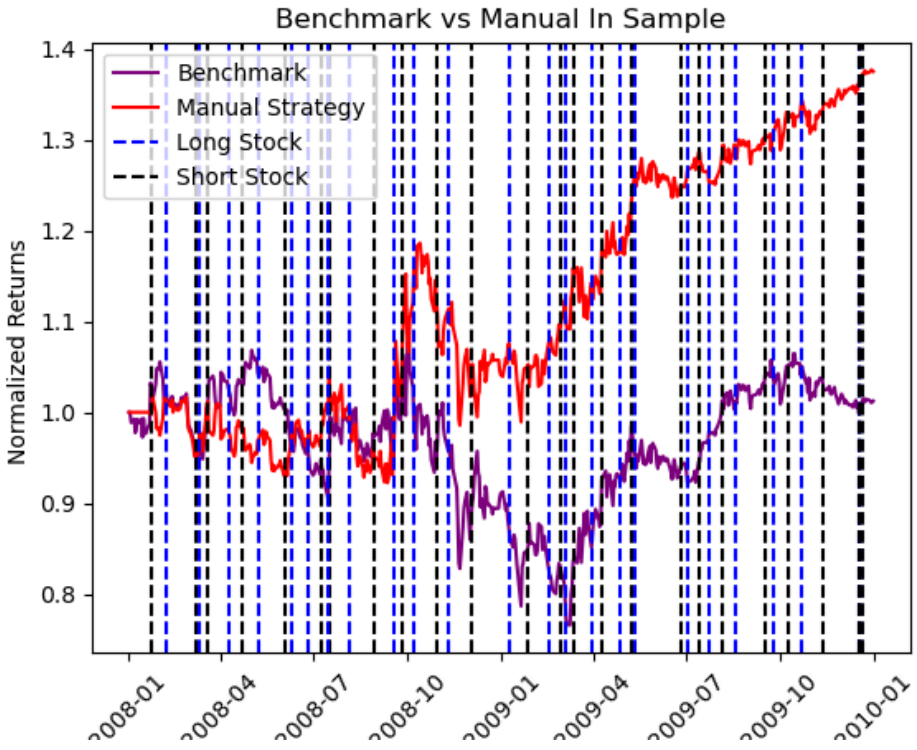

Figure 1— Benchmark vs Manual 01 -2008 to 12 -2009

The performance of Manual Strategy is significantly better than benchmark seen in figure 1. Manual Strategy starts to have consistent positive returns from October 2008 and on as longing and shoring of the JPM during that time results in higher returns than just holding the JPM stock during October 2008 to December 2009. Throughout the 2008 to 2009 from figure 1 there is consistent trading occurring with gaps indicating that holding of the stock is best during that time. The volatility of Benchmark and Manual are similar with a 0.14 standard deviation for daily returns for Manual Strategy and a 0.17 standard deviation for Benchmark, which indicates that the returns in from the Manual Strategy returns do not fluctuate as much as benchmark strategy. The average daily returns for Manual Strategy is 0.0007 and the average daily returns for Benchmark is 0.00016.

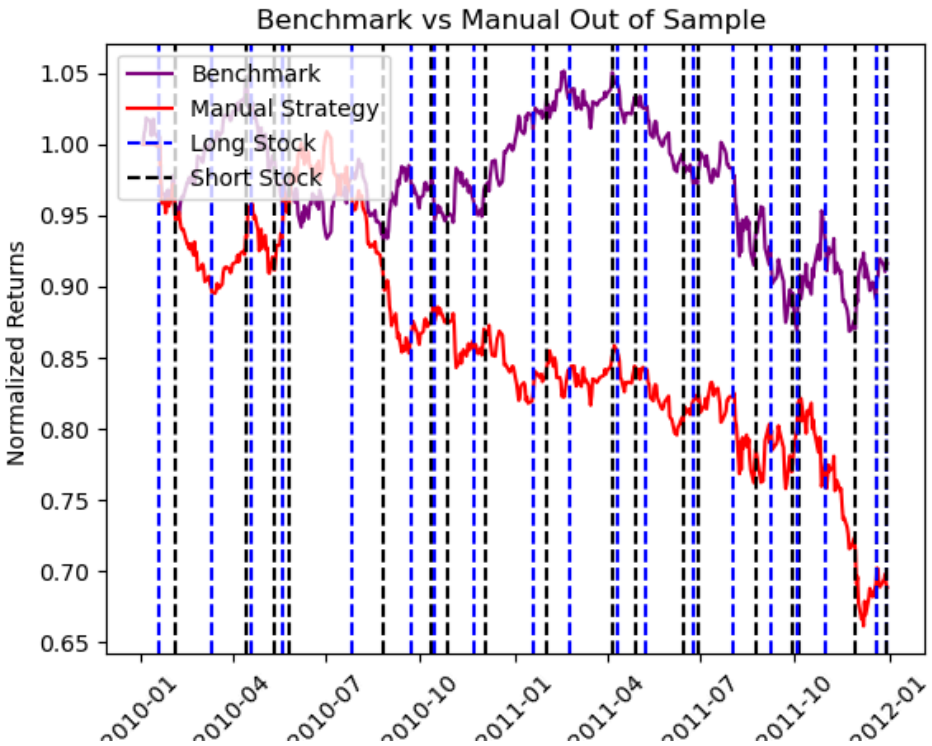

Figure 2— Benchmark vs Manual Out of Sample 01 -2010 to 12 -2011 JPM

From figure 2 we see that when using the same logic from figure 1 from 2010 to 2011 the performance of the Manual Strategy dips significantly. The Manual Strategy only results in higher returns than benchmark from May 2010 to about June 2010. Manual Strategy then proceeds to consistently have negative returns as it wrongly identifies a long opportunity and short opportunities throughout the rest of the time period resulting in significant loss in returns supposed to just holding the stock.

When comparing the In-sample to the Out-of-Sample results the In-sample results is a 0.37 cumulative return while the Out-of- Sample results in -0.31 cumulative return. Differences in returns indicates there is a systematic error in the indicators as it gears more to the In-sample data resulting in false longing and shorting opportunities in the Out-of-Sample case.The Out-of-Sample results in a 0.0094 standard deviation and In-Sample results in a 0.0.14 indicating that In-Sample daily returns differs more than the Out-of-Sample. The cause of more fluctuations in daily returns in In- Sample is due to the spikes of profit from the In-Sample after August 2008.

Strategy Learner

Random Tree is a machine learning algorithm that is particularly used for regression and classification problems. The Random tree uses a decision tree to train data. For the use of this project the random will be using classification to make this possible the Random tree takes the mode of the leaf to get the predicted class. Bagging is also used by taking numerous Random Trees that use a random subset of training data and aggregates the results of all the bags to get the results.

For the purposes of the project to be able to use Random Tree algorithm the training data is constructed by taking all the results of indicators until the last N days peaked into the future by putting each indicator's signal results into 1 column and combining each column into an array to get X train. To get Y train the returns of profit was calculated for each day peaking 5 days into the future if the profit was less than -0.29 plus the impact a -1 was assigned indicating a sell. Buy or 1 label is given if profit is greater than 0.029 + impact, if both criteria is not met then a 0 is given for hold. Lastly mode had to be used instead of mean to get the most often used label in leaf to get the class.

For the indicators used a window size of 20 was used of Bolling Band %B. For Golden Death Cross a window long of 50 was used and a window short of 20 is used. The last indicator MACD used a window long of 26 and window short of 12 for the parameters. For the Random Tree a leaf size of 5 is used and a bag size of 20 is used. To determine the indicator and Random Tree parameters was decided by numerous trial and error attempts until the best results were outputted.

Discretization is not needed for Random Trees due to ability to handle continuous and categorical data well. Discretization sometimes leads to the loss of information which has a negative impact on the Random Tree algorithm.The lack of discretization still yielded good results for Out-Sample results, which is also a sign that it is not needed to be able to implement Random Trees.

Experiment 1

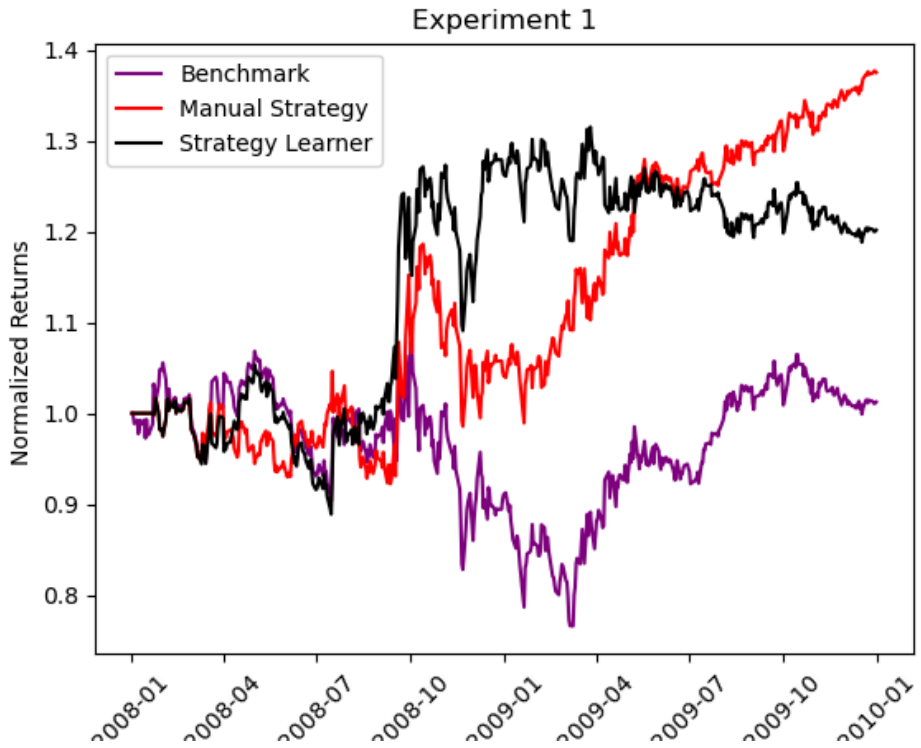

Figure 3— Benchmark vs Manual vs Strategy Out of Sample 01 -2010 to 12 -2011 JPM

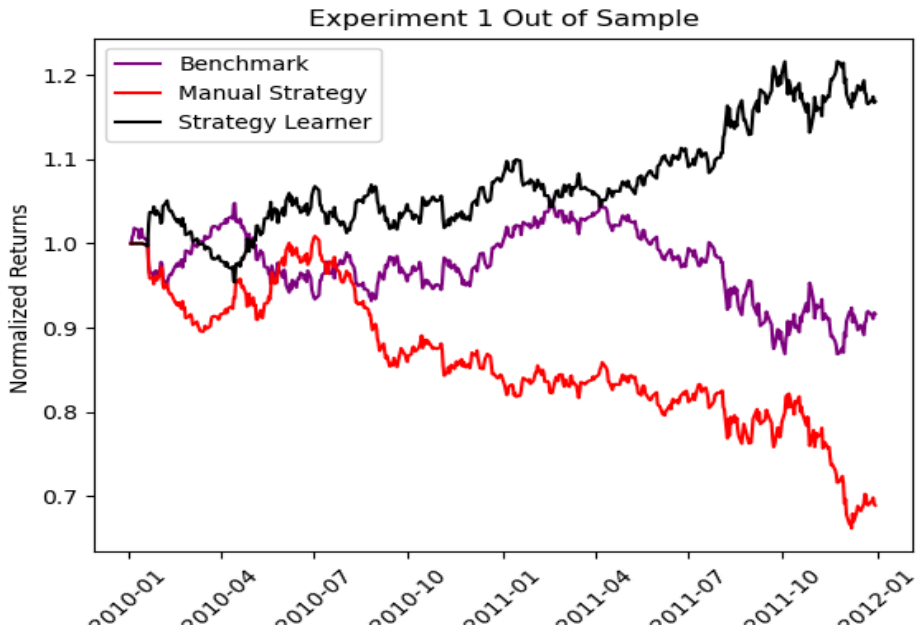

Figure 4— Benchmark vs Manual vs Strategy Out of Sample 01 -2010 to 12 -2011 JPM

In Experiment 1 the task was to compare the Benchmark to Manual Strategy and Strategy Learner for In-Sample and Out-of-Sample. To complete this experiment first the Strategy Learner is fed In-Sample data to train on, Manual Strategy only has the indicators to help decide on sell or buy, and benchmark holds the stock throughout the duration. The parameters conducted for this experiment did not change from discussed earlier. Next part of the experiment Strategy Learner will predict sell and buy for the Out-of-Sample date range, Manual Strategy will have to decide when to buy or sell based on the optimal parameter from In-Sample data and benchmark holding the data for duration of the Out-of-Sample date range. From figure 3 Manual Strategy had the highest return, which was a bit surprising as my Hypothesis was that Strategy Learner would yield the best results due to the ability to peak in the future of training data. Benchmark yielded the worst return as expected to due to incapability of capitalizing on longing and shorting of stocks. For part 2 My hypothesis for Out-of-Sample was Strategy Learner will result in the best return while Manual Strategy will have the worst return out of the strategies. The hypothesis was right as Strategy had the best return as the model was able to learn from the training data to learn to

capitalize on longing and shorting of stocks, while Manual Strategy was biased to in-sample data it did not fare well at all the new data presented.

Experiment 2

Experiment 2's fist part was to pick three different impacts to see the effects on the model based on changing the impact. To conduct this an impact of 0, 0.05 and 0.1 was chosen. My hypothesis was as Impact increases the returns of the model should decrease which is proven below in figure 6 below, but I did not expect the difference in returns to have a drop on return by that much seen in figure 6. The second part of experiment 2 seen in figure 5 below shows the average daily returns based on the different changes in impact 0 to 0.1 . The hypothesis that I had was that as impact increases the average daily returns will decrease. From figure 5 below we see that is the case as there is about a 0.175 average at impact of 0 and an average of 0 at impact 0.1.

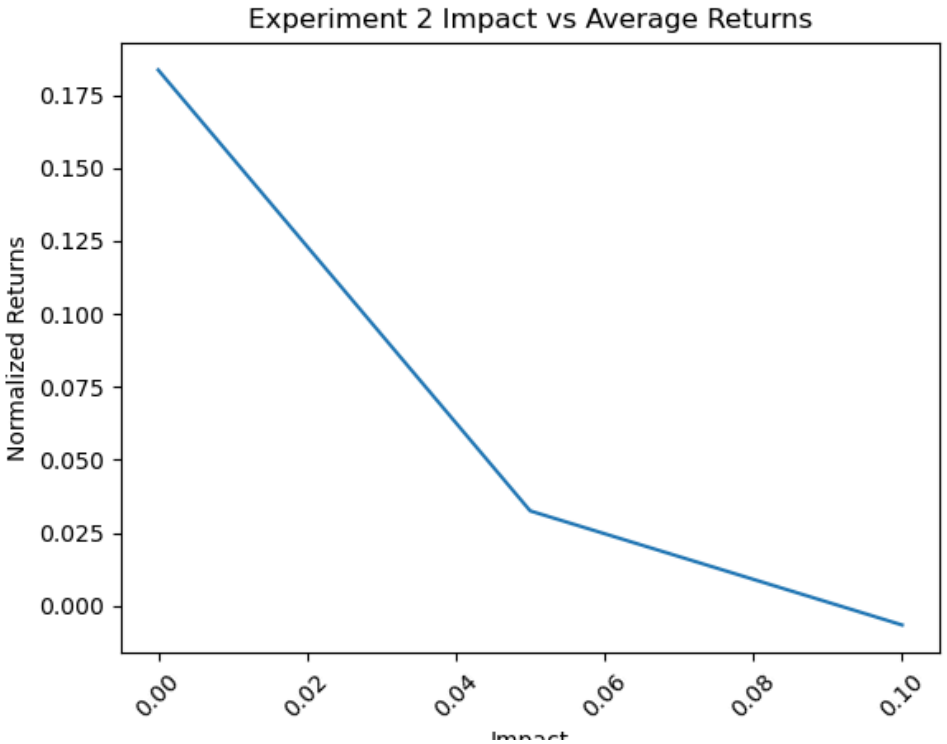

Figure 5—Impact on Performance Out of Sample 01 -2010 to 12 -2011 JPM

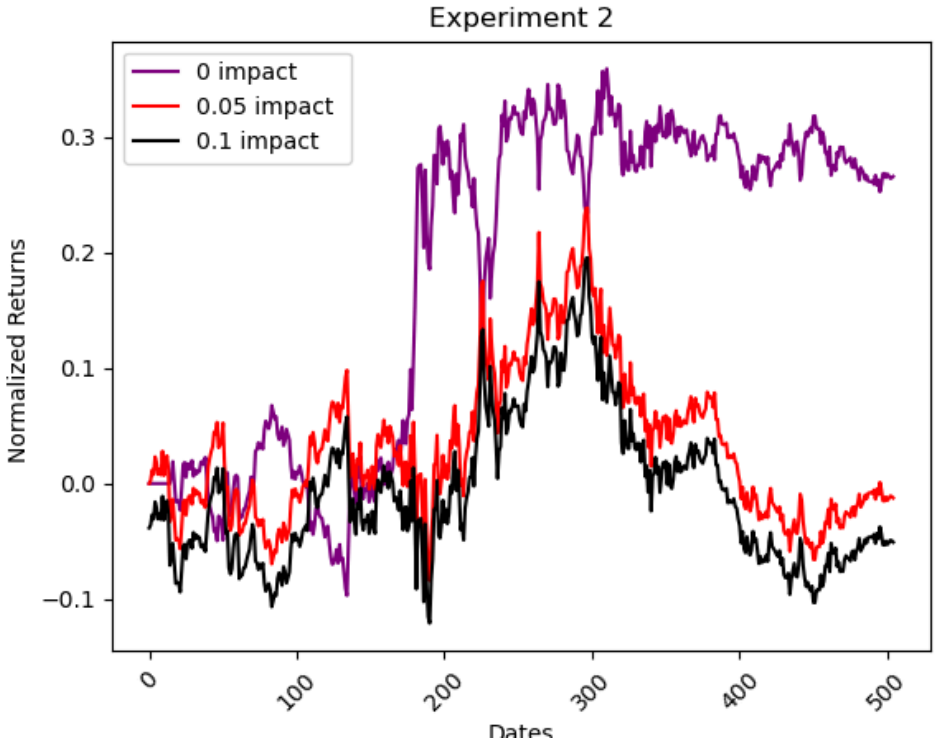

Figure 6—Impact on Performance Out of Sample 01 -2010 to 12 -2011 JPM

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