

# Project 8: Strategy Evaluation

## CS7646

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***Abstract**— In this paper I will be comparing using stock indicators, (Such as TEMA, RSI, ROC) to create a Manual Trading Strategy vs using those indicators as features for a Random Forest learner as a Learned strategy. This is to gain an insight into how these methods can build a strategy for trading and what the pros and cons of each strategy are.*

### 1 INDICATOR OVERVIEW

#### 1.1 TEMA (Triple Exponential Moving Average)

TEMA is a more refined version of EMA. It takes a moving average of the stock value with a stronger emphasis on the most recent data. The way this indicator is normally interpreted is plotting the moving average of a set number of days, let say 30, and then any time the index crosses the average it is seen as a buy or sell single. If the price goes above the average from below, that could be seen as a buy single. In the same way if the price drops below the from being above, that could be seen as a sell single.

The parameter that was adjusted in this indicator for the manual and the learner strategy was the number of days to look back for the moving average. This would define how smooth the average line was.

#### 1.2 RSI (Relative Strength Index)

RSI is a momentum indicator that works by finding the percentage change of gains and losses over a pre-set period of time in days. The way this is normally interpreted is when RSI crosses over 70, this indicates that the stock is overbought and thus when it drops back below 70 it is a sell single. Similarly when RSI drops below 30 this indicates that the stock is oversold. So when the RSI comes back above 30 this can be seen as a buy single.

The parameter that was adjusted for the manual and learner strategy in this indicator was the number of days to look back to determine RSI. This determines how big the momentum swings are.

### **1.3 ROC (Rate of Change)**

ROC is also a momentum indicator that looks at the rate of change of a stock over a specific time in days. The way this indicator is interpreted is if the stock has strong upward momentum it is positive and if it has strong negative momentum it is negative. Here the buy signal is when the line crosses from negative to positive and the sell signal is when the line crosses from positive to negative.

The parameter that was adjusted for the manual and learner strategy in this indicator was the number of days to look back to determine ROC. This determines the period over which momentum is calculated.

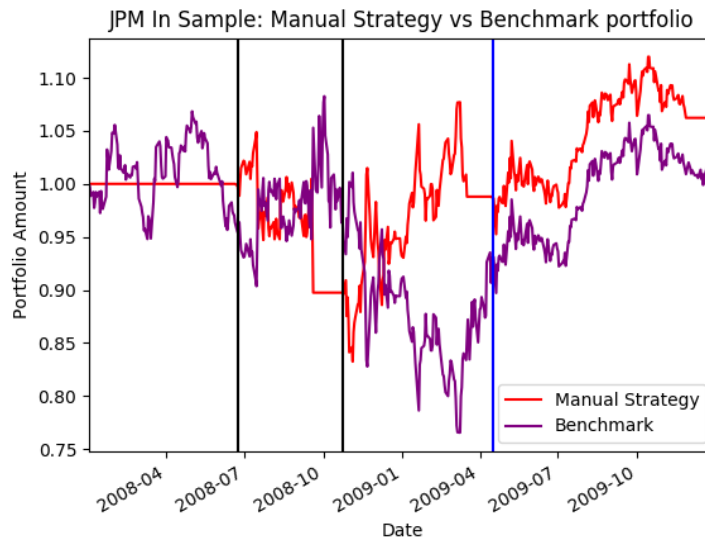
## **2 MANUAL STRATEGY**

In order to create my manual strategy for each one of my indicators I created an array for each day and if any of the indicators returned a buy signal it would place a 1 in the array. If any indicator returned a sell signal it would place a -1 in the array. If none was triggered it was placed a 0 in the array.

In order to combine all three indicators I created a conservative system of choosing when to enter a long or short. On any given day I would add all three points together and if the day had any amount of 2 or greater it would enter a long position. If any day has -2 or less I would enter a short position. Otherwise it would move to a 0 holding. This needs not only two indicators to agree but would require the third indicator to not strongly disagree. For example, if we had a 1,1,-1 even though two indicators agree a long position would not be entered. Similarly if only one indicator has a single (Ex. 1,0,0) it does not have a position strong enough to make a move so it exits all positions.

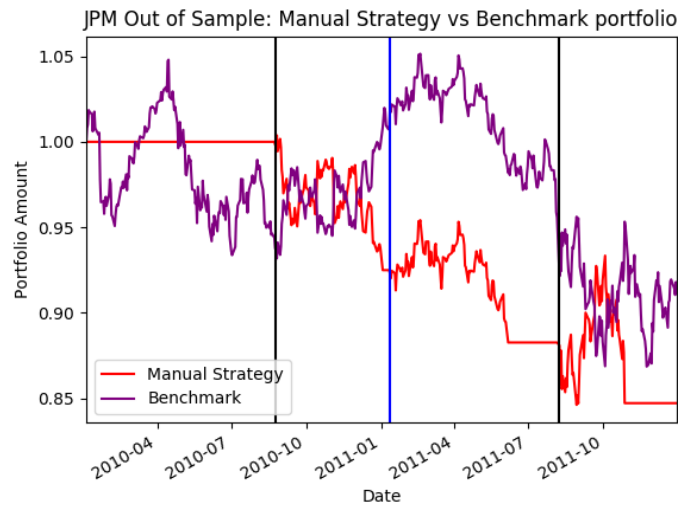
I believe that this is an effective yet conservative strategy because it only enters positions when it has a strong agreement with two indicators and when they disagree it does nothing. This allows the trader to make safe trades and not take many risks.

Here is the manual strategy in sample returns compared a the benchmark of buying 1000 shares on day one and holding:



*Figure 1 - JPM In Sample Manual Strategy Performance*

This strategy was able to successfully beat the benchmark with in sample data. Unfortunately this did not work as well with out of sample data.



*Figure 2 - JPM Out of Sample Manual Strategy Performance*

	Sharpe Ratio	Cumulative Return	Standard Deviation	Average Daily Return
<b>In Sample: Manual</b>	0.2502	0.0622	0.0127	0.0002
<b>In Sample: Benchmark</b>	0.1533	0.010	0.01704	0.00016
<b>Out of Sample: Manual</b>	-0.8030	-0.1527	0.0061	-0.00031
<b>Out of Sample: Benchmark</b>	-0.2636	-0.0853	0.0085	-0.00014

This reason the out of sample data performs worse then the in sample data is because the indicators were tuned to work specifically for in sample data. This means they are not as well suited for a different time. And since indicators aren't perfect they aren't always going to perform well even when combined together.

### 3 STRATEGY LEARNER

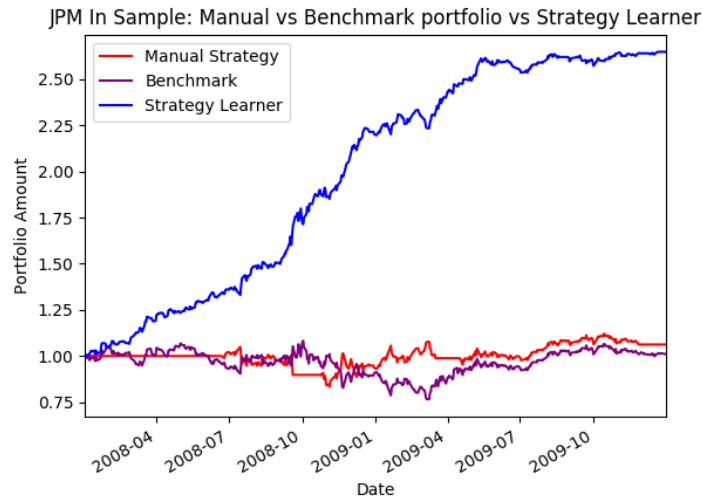
#### 3.1 Indicators Utilization/ Framing Problem

In order to frame this problem as a learner problem the indicator data have to be framed in a way to make it optimal for a random learner. The first step in making a learner was to standardize the indicator data. I first normalized TEMA and RSI to be between 0 and 1. I also normalized ROC to be between -1 and 1. This made it so that one indicator doesn't over power any of the other ones. I then used those as my factors (X values). Next I needed to create a Y value to pass into my learner to learn from. I did this by creating an array of values by looping through each day and looking forward to 8 days. Then if in 8 days the stock price goes up by at least 0.02 it would mark a buy single as a 1. If in 8 days the stock price goes down by 0.01 it gives a sell signal as a -1. If none are hit it sets an exit position as 0. Next I had to tune my indicator to look back on the days. I set TEMA to 190, ROC to 100, and RSI to 130. All of these parameters were tuned through much

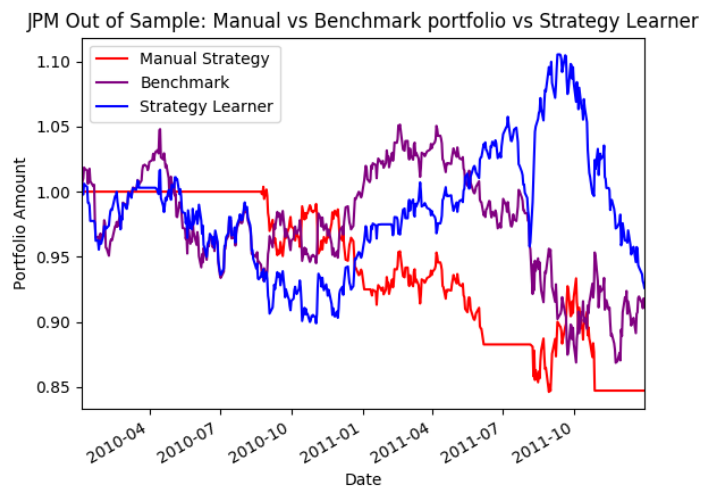
experimentation. I simply ran through many different examples until I was positive I had reached the optimal strategy.

### 3.2 Experiment 1 Manual Strategy vs Strategy Learner

For experiment one I compared the results of my Manual Strategy described earlier to the Strategy learner and the benchmark. Here are the in sample and out of sample results



*Figure 3 - JPM In Sample Manual vs Learner vs Benchmark*

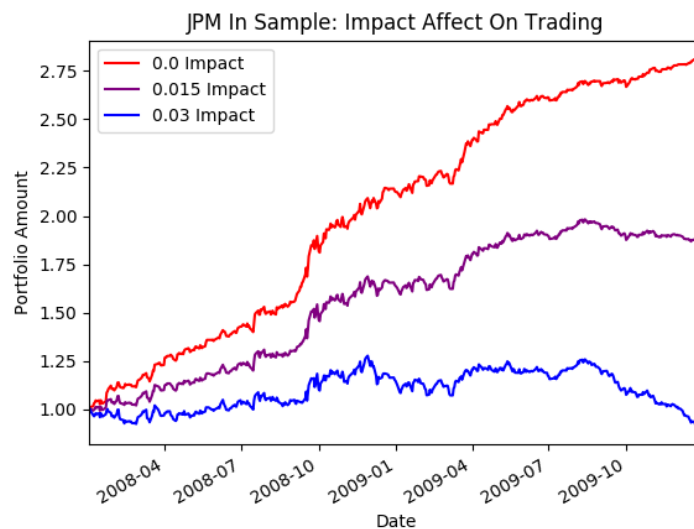


*Figure 4 - JPM Out of Sample Manual vs Learner vs Benchmark*

As you can see, the in sample results were as expected. Because the random forest was trained on the sample data it performed very well on that sample data. It out performed before the benchmark and manual by a significant amount. This same result was seen over and over again in many different tests. The out of sample data shows a little different story. It shows that the strategy learner outperformed the benchmark and manual learner but not by much. This was also seen in many different tests. This is also expected because we expect the strategy learner to learn much better than we can do manually.

### 3.3 Experiment 2 Effect Impact has on Strategy Learner

In this experiment I tested 3 different levels of impact to see how they affect my strategy learner. The 3 levels of impact measured were 0.0, 0.015, 0.03. Here are the charts showing the effect over in sample data:



*Figure 5 - Impact Affect on Trading, In Sample Data*

These results are expected. As the level of impact increases the worse the learner performs. The learner goes from a strong return to a smaller return to even losing money because of impact. This is because this is because every trade we make the market moves against us. Even though my learner takes impact into account before deciding to make a trade it still has a negative effect on trading. The following table provides more information on the effect impact has on Sharpe Ratio and Cumulative Return.

	Sharpe Ratio	Cumulative Return
<b>Impact: 0.0</b>	3.8061	1.8138
<b>Impact: 0.015</b>	2.0341	0.8692
<b>Impact: 0.03</b>	-0.1026	-0.0863

## REFERENCES

1. Fernando, J. (2023, April 1). Relative strength index (RSI) indicator explained with formula. Investopedia. Retrieved April 16, 2023, from <https://www.investopedia.com/terms/r/rsi.asp>
2. GeeksforGeeks. (2020, May 3). Matplotlib.pyplot.colors() in Python. GeeksforGeeks. Retrieved April 16, 2023, from <https://www.geeksforgeeks.org/matplotlib-pyplot-colors-in-python/>
3. Lewis, L. (2022, July 6). Python: No unique mode; found 2 equally common values. CopyProgramming. Retrieved April 16, 2023, from <https://copyprogramming.com/howto/no-unique-mode-found-2-equally-common-values>
4. Mitchell, C. (2022, December 13). Triple exponential moving average (TEMA): Definition and formula. Investopedia. Retrieved April 16, 2023, from <https://www.investopedia.com/terms/t/triple-exponential-moving-average.asp>
5. Mitchell, C. (2022, October 16). Price rate of change (ROC) indicator: Definition and formula. Investopedia. Retrieved April 16, 2023, from <https://www.investopedia.com/terms/p/pricerateofchange.asp>
6. Patil, V. (2023, March 9). Reset index in Pandas DataFrame. PYNative. Retrieved April 16, 2023, from <https://pynative.com/pandas-reset-index/>
7. Zach. (2023, February 2). How to add vertical line at specific date in Matplotlib. Statology. Retrieved April 16, 2023, from <https://www.statology.org/matplotlib-add-vertical-line-at-date/>