CS-7646 Machine Learning for Trading
Report- Strategy learner

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Implementation

My learning trading agent is a random tree learner, to implement this Strategy Learner, I followed these steps:

1. Utilize bagging and draw on previous results the bags number is adjusted to 20. (Result of the comparsion between different bag numbers can be found in assess_learners)
2. Convert my random tree regression learner into a classification learner followed the hint in classification trader hints provided by instructor.
3. Use the same indicator I used in my manual_strategy which is simply moving average (SMA) for this learner, and the threshold for SMA indicator is 0.03. (Although I also tried combining all three indicators I mentioned in previous assignment: SMA, Bollinger bands and Momentum to build the learner and in experiment1 I have compared these two models.)
4. According to previous results and requirements of this assignment, the leaf_size of the learner is 5.
5. This Strategy learner has passed all tests in autograder.

Experiment 1

In this experiment, I used exactly the same indicator and indicator parameters(window_size) that I used in my manual_strategy, SMA indicator with my learning strategy in sample.

Formula and usage of SMA indicator:

SMA = (sum (price, n))/ n (n: time period)

SMA_indicator = price / SMA -1

If SMA_indicator > threshold, it's a sell signal

If SMA_indicator < threshold, it's a buy signal

Assumption:

Machine learning trading agents should be able to beat manual strategy trader.

Parameter values:

1. Trade only the symbol JPM
2. In sample period is January 1,2008 to December 31 2009
3. Starting cash is $100,000
5. Allowed positions are 1000 shares long, 1000 shares short, 0 share
6. Benchmark: The performance of a portfolio starting with $100,000 cash, investing in 1000 shares of the symbol in use and holding that position.
7. No limit on leverage
8. Transaction costs: Commission is $0.00, impact is 0.

Result:

The machine learning trading agent is comprised of bagging random tree learner (RTLearner_ Strategy). Both strategies are using the exactly same indicator which is SMA indicator. Overall, the performance of RTLearner_Strategy is a lot better than Manual_Strategy, while the performances of both strategies are better than benchmark (Figure 1.).

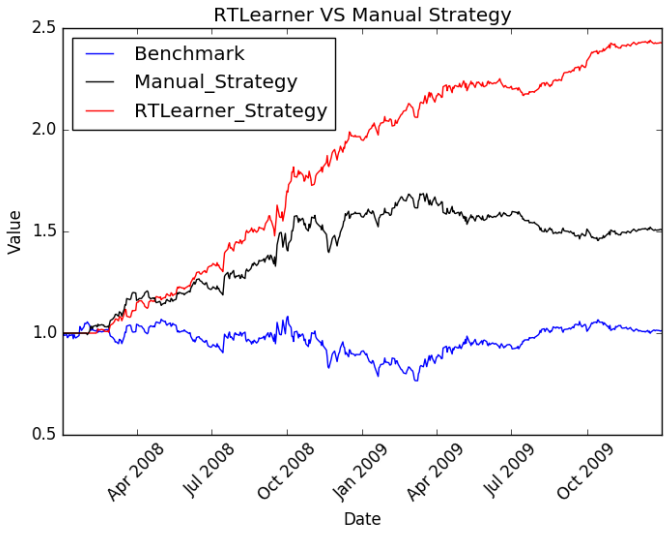
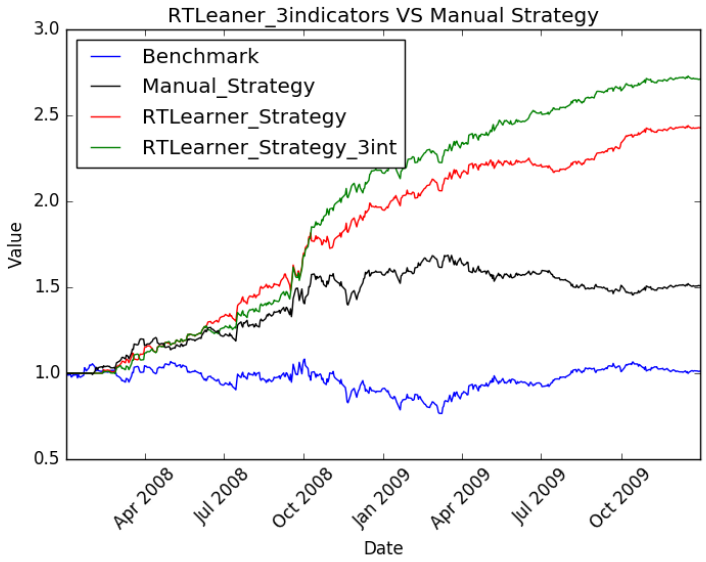


Figure 1. Performance of RTLearner and Manual strategy trader in sample along with the benchmark

To maximize the power of machine learning trader, I also tried to build the learner using a combination of 3 indicators I have used in a previous assignment, they are SMA_indicator along with Bollinger bands indicator and Momentum indicator. Compared to the original RTLearner_Strategy, the performance of the 3 indicators version of RTLearner_Strategy_3int is better, but the difference is not as huge as between RTLearner_Strategy and Manual_Strategy (Supplementary Figure 1.). And contrast to Manual_Strategy and benchmark, the performance of the RTLearner using SMA indicator only is already quite acceptable.



Supplementary Figure 1. Performance of 2 RTLearner traders and Manual Strategy trader in sample along with the benchmark

I expect this relative result every time with in_sample data, since the bagging Random tree model is quite stable under the current parameters.

Experiment 2

In this experiment, I also used the bagging Random tree learner with the same indicator and indicator parameters (window_size) that I used in my manual_strategy, SMA indicator.
But here I checked how changing the value of impact will affect in sample trading behavior and results, particularly looked at the number of trades and the performance of learners with different impacts.

Hypothesis:

Impact will affect threshold and therefor change the trading behavior like number of trades and the overall performance of trading agent.

Parameter values:

1. Trade only the symbol JPM
2. In sample period is January 1,2008 to December 31 2009
3. Starting cash is $100,000
5. Allowed positions are 1000 shares long, 1000 shares short, 0 share
6. Benchmark: The performance of a portfolio starting with $100,000 cash, investing in 1000 shares of the symbol in use and holding that position.
7. No limit on leverage
8. The base threshold is 0.03
9. Transaction costs: Commission is $0.00, impact varies from [0.0,0.025,0.05,0.1,0.2,0.4]

Result:

The plot shows that when impact is increasing, the number of trades is decreasing (Figure 2.), the decrease is very dramatic from impact 0 to 0.05, after that the downward trend has slowed.

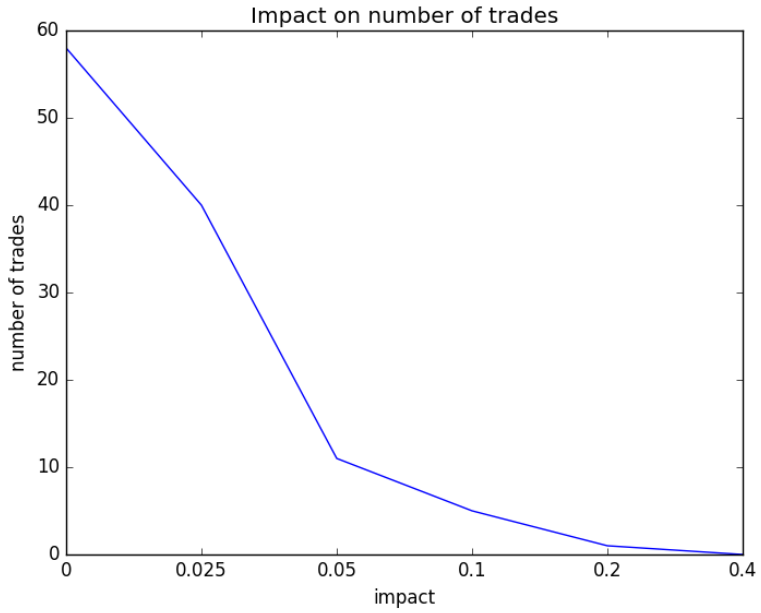


Figure 2. Impact on number of trades

When market impact increases, the threshold for triggering a trade is becoming higher, that's the reason of less number of total trades. When the impact increases to 0.025, the cumulative return drops dramatically in sample, and when impact increases to 0.2, the cumulative return is very close to baseline (Figure 3).

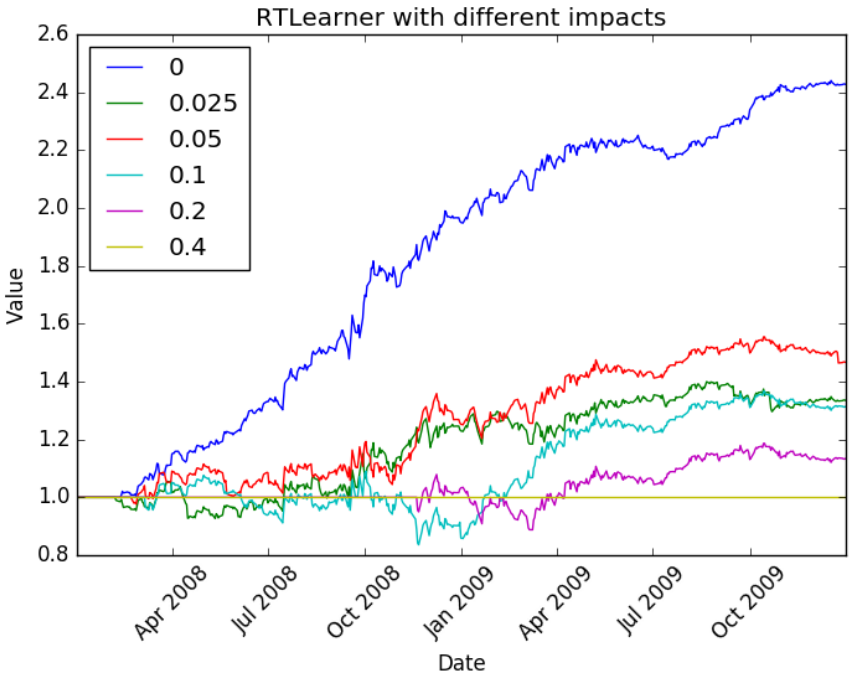


Figure 3. The performance of RTLearner with different impacts

From the Table 1, we can clearly see the changing number of trades along with impact values, and the performance of RTLearner in the form of cumulative return.

Table 1. RTLearner performance on different impacts

Impact value	Cumulative Return	Number of trades
0	1.4271	58
0.025	0.3346975	40
0.05	0.46647	11
0.1	0.31388	5
0.2	0.13408	1