

# Prediction of Closing Stock Prices

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**Abstract**—Data analysis is one way of predicting if future stocks prices will increase or decrease. Five methods of analyzing stocks were combined to predict if the following day's closing price would increase or decrease. These methods were On Balance Volume (OBV), Price Momentum Oscillator (PMO), Relative Strength Index (RSI), Stochastic (%K) and Moving Average (MA). A binomial test was then performed to see if these methods performed better than chance (50%). This paper demonstrated that these widely used techniques were able to predict that tomorrow's closing stock price will increase or decrease better than chance (50%) with a high level of significance.

## I. INTRODUCTION

This paper attempts to determine if it is possible to predict if the closing price of stocks will increase or decrease on the following day. The methods used to perform this prediction were based on the book "How Technical Analysis Works:" written by Bruce M. Kamich. The approach taken in this paper was to combine five methods of analyzing stocks and use them to automatically generate a prediction of whether or not stock prices will go up or go down. After the predictions were made they were tested with the following day's closing price. If the following day's closing price can be predicted to increase or decrease 50% of the time at the 0.05 confidence level, then this analysis would be an easy and useful aid in financial investing. Furthermore, the results would show that the results are better than random at a reasonable level of significance.

## II. METHODOLOGY

Five methods of analyzing stocks were combined to predict if the following day's closing price would increase or decrease. All five methods needed to be in agreement for the algorithm to predict a stock price increase or decrease. The five methods were On Balance Volume (OBV), Price Momentum Oscillator (PMO), Relative Strength Index (RSI), Stochastic (%K) and Moving Average (MA).

### A. On Balance Volume (OBV)

TC = today's close price

YC = yesterday's close price

Volume = today's volume

The following algorithm was used to calculate OBV:

If (TC < YC)

OBV = OBV - Volume

Else If (TC > YC)

OBV = OBV + Volume;

End if

The following algorithm, based on OBV was used to predict an increase or decrease in tomorrow's closing stock price OBV:

If (Today's OBV > Yesterday's OBV)

Predict increase in tomorrow's closing price

Else if (Today's OBV < Yesterday's OBV)

Predict decrease in tomorrow's closing price

End if

### B. Price Momentum Oscillator (PMO)

TC = today's close price

TDAC = close price ten days ago

The following algorithm was used to calculate PMO:

PMO = TC - TDAC

The following algorithm, based on PMO was used to predict an increase or decrease in tomorrow's closing stock price PMO:

If (PMO > 0)

Predict increase in tomorrow's closing price

Else

Predict decrease in tomorrow's closing price

End if

### C. Relative Strength Index (RSI)

TC = today's close price

YC = yesterday's close price

The following algorithm was used to calculate RSI:

UpClose = 0

DownClose = 0

Repeat for nine consecutive days ending today

If (TC > YC)

UpClose = UpClose + TC

Else if (TC < YC)

DownClose = DownClose + TC

End if

RSI = 100 - 100/(1 + (UpClose / DownClose))

The following algorithm, based on RSI was used to predict an increase or decrease in tomorrow's closing stock price RSI:

If (RSI > 50)

Predict increase in tomorrow's closing price

Else

Predict decrease in tomorrow's closing price

End if

#### D. Stochastic (%K)

The following algorithm was used to calculate %K.

TC = today's close price

LN = lowest low for 5 days

HN = highest high for 5 days

$\%K = (TC - LN)/(HN - LN)*100$

The following algorithm, based on %K was used to predict an increase or decrease in tomorrow's closing stock price %K:

If (%K > 80)

Predict increase in tomorrow's closing price

Else if (%K < 20)

Predict decrease in tomorrow's closing price

End if

#### E. Moving Average (MA)

The following algorithm was used to calculate MA:

MA = the sum of the most recent ten days closing divided by ten.

The following algorithm, based on MA was used to predict an increase or decrease in tomorrow's closing stock price MA:

If ( Today's MA > Yesterday's MA )

Predict increase in tomorrow's closing price

Else

Predict decrease in tomorrow's closing price

End if

If all five methods predicted an increase in tomorrow's close price, then the algorithm would predict an increase in tomorrow's close price. If all five methods predicted a decrease in tomorrow's close price, then the algorithm would predict a decrease in tomorrow's close price. If neither of the two conditions (increase prediction or decrease prediction) were met, then no prediction was made.

All of the methods used the typical values based on the book by Kamich. This led to a PMO using ten days, RSI using 9 days and %K using 80% and 20%. The MA did not have a typical value. A value of ten days was used partially based on the RSI using nine days. Ten days was the closest even day in terms of business weekdays. It was also speculated that since the PMO used ten days, ten days for MA would also be a good choice.

Five stocks were chosen randomly. The five stocks were taken having a ticker symbol starting with the letter A. The first stock attempted had too much data for the PC running the MATLAB program, therefore the five stocks were chosen randomly, except the file sizes were kept below 80k. It was assumed that excluding files due to their size did not effect the randomness of the data used.

The evaluation of the algorithm utilized a hypothesis test. The hypotheses test was setup to test if the algorithm did better than chance. It was assumed that there was always an equal probability of the stocks going up or down. The null hypothesis stated that the prediction would be wrong 50% or more of the time. The alternative hypotheses stated that the prediction would be correct more than 50% of the time at the 0.05 level of significance.

The algorithm was then judged by how many predictions were correct. A test statistic was used to evaluate the algorithm. The test statistic used for this test was the number of correct predictions. This test used the binomial CDF (binocdf) provided by MATLAB where both the number of correct predictions and the total number of predictions were used with the binomial CDF. The performance on each individual stock was evaluated and then the performance on all stocks combined was evaluated.

### III. RESULTS

The following figures show the closing price of five stocks and the algorithm predictions. The predictions for increasing and decreasing prices are shown on separate graphs. The closing price of the stocks was shown in blue, while each time the algorithm made a correct prediction there was an upward green spike and each time an incorrect prediction was made there was a downward red spike.

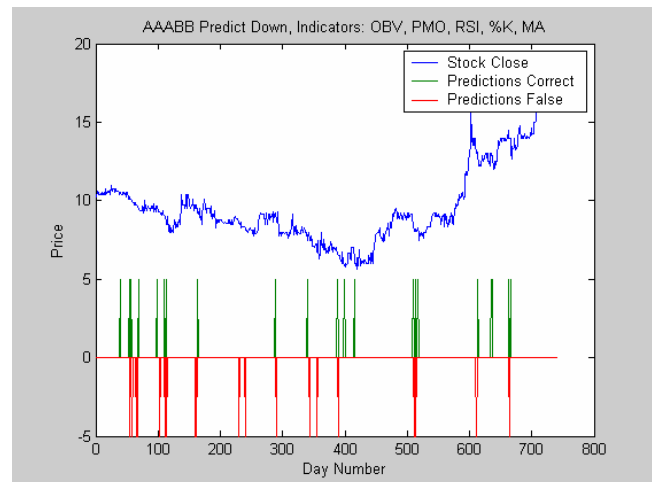


Figure 1 Prediction of decreasing closing price for AAABB

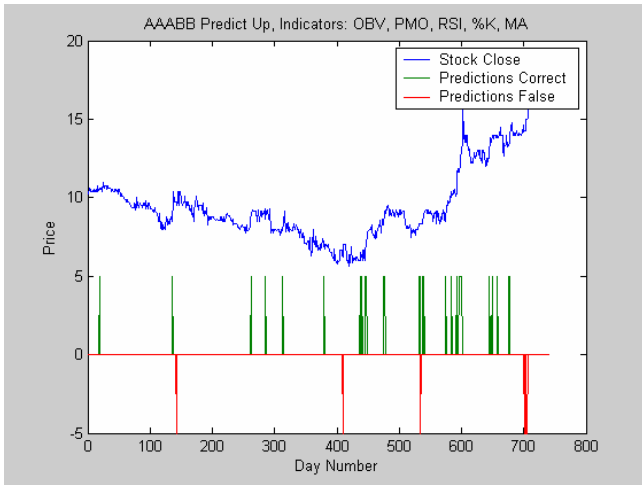


Figure 2 Prediction of increasing closing price for AAAB

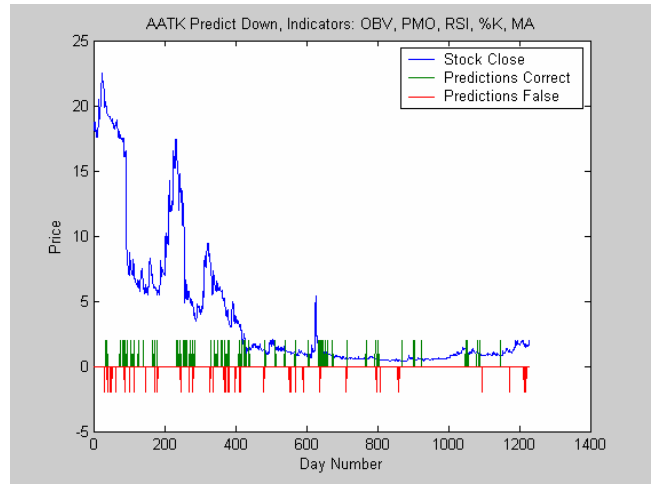


Figure 5 Prediction of decreasing closing price for AATK

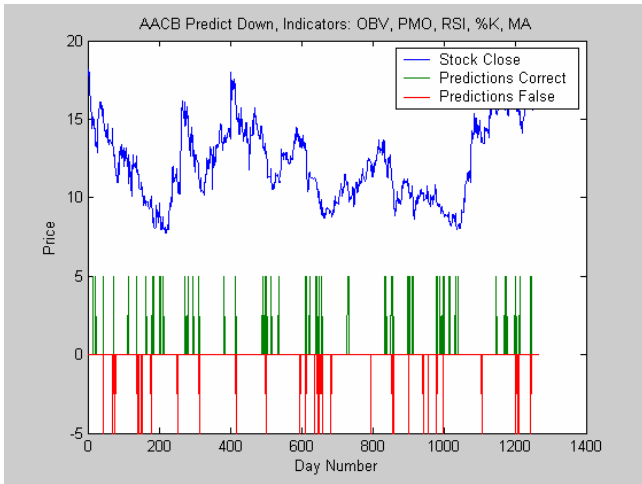


Figure 3 Prediction of decreasing closing price for AACB

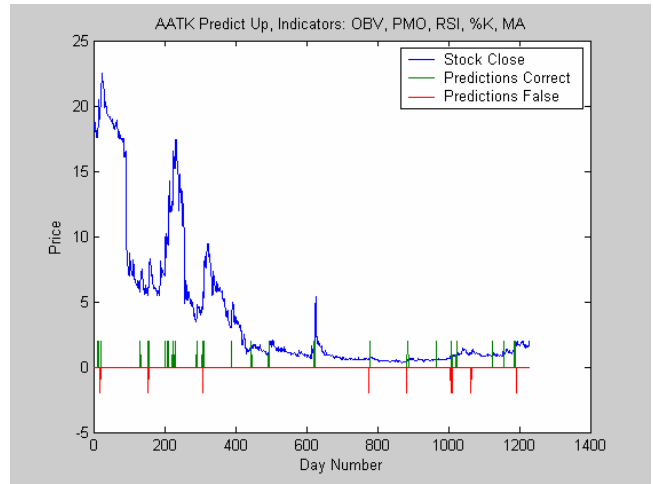


Figure 6 Prediction of increasing closing price for AATK

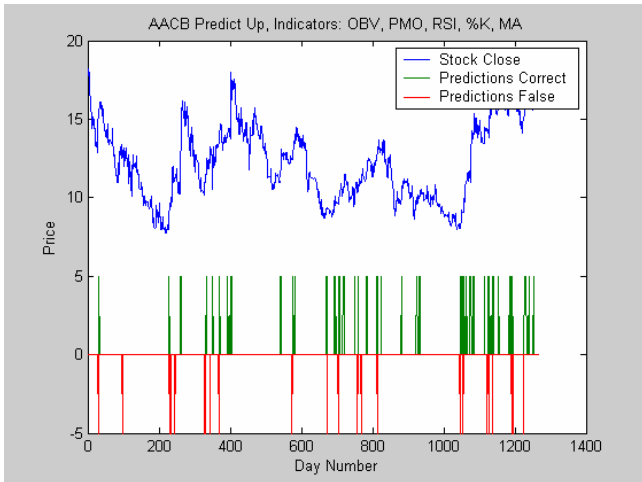


Figure 4 Prediction of increasing closing price for AACB

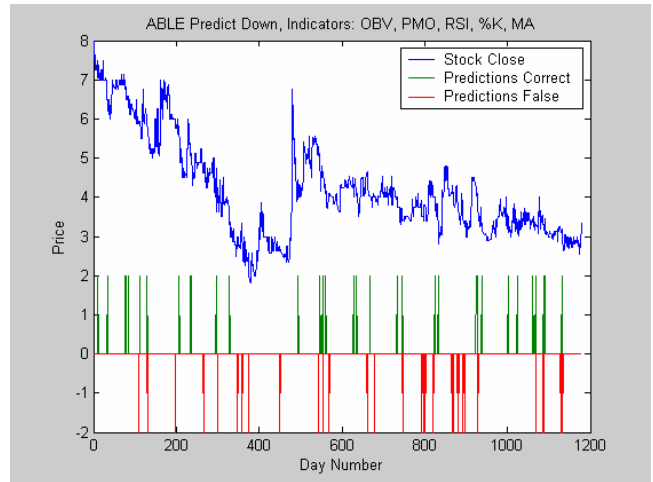


Figure 7 Prediction of decreasing closing price for ABLE

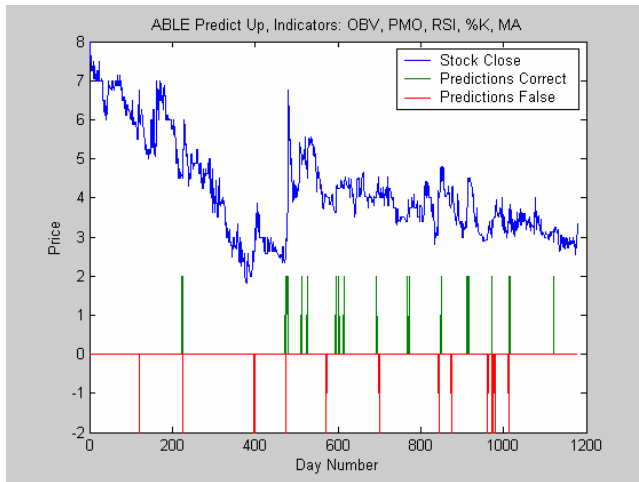


Figure 8 Prediction of increasing closing price for ABLE

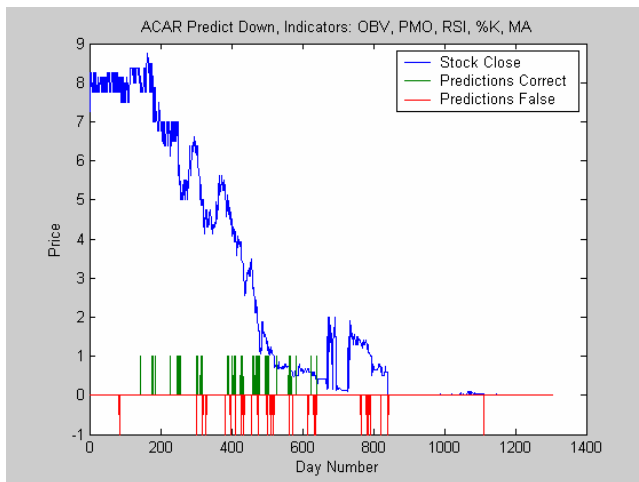


Figure 9 Prediction of decreasing closing price for ACAR

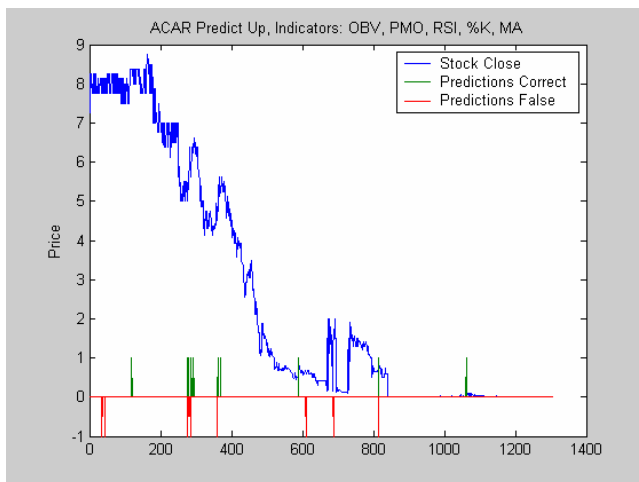


Figure 10 Prediction of increasing closing price for ACAR

The following table summarizes the results of the five stocks:

Table 1 Summary of Indicator Performance

Total Predictions	Total Predictions Correct	Stock	Level of Significance
77	52	AAABB	~0
162	218	AACB	~0
171	123	AATK	~0
111	66	ABLE	0.0182
92	55	ACAR	0.0235
669	458	All 5 Stocks	~0

#### IV. DISCUSSION

The algorithm produced predictions for an increase or decrease in tomorrow's closing price. All stocks except, ACAR did not show a constant trend in either the up or down direction. All five stocks rejected the null hypothesis when both increasing and decreasing predictions were included. However when only predictions for a decrease were used AAABB and ABLE failed to reject the null hypothesis, while the other three stocks AACB, AATK and ACAR rejected the null hypothesis at the 0.05 level of significance. The prediction of increase performed better than the prediction of decrease. Furthermore when the stocks were combined and both prediction types, increase and decrease, were included the null hypothesis was very strongly rejected.

#### V. CONCLUSION

The results show that this algorithm was able to predict if the following day's closing price would increase or decrease better than chance (50%) with a high level of significance. Furthermore, this shows that there is some validity to technical analysis of stocks. This is not to say that this algorithm would make anyone rich, but it may be useful for trading analysis.

The algorithm did very well on three stocks, but not on the other two stocks. In other words, the algorithm performed well on half of the stocks and not so well on the other half of the stocks. In either case the prediction was correct at least 50% of the time. This raises the question how much could you lose before you actually won. You could win 50% of the time, but still lose a lot consecutively before you actually won.

The algorithm generated both increase and decrease predictions, but the predictions did not come very often. Therefore, if you trusted the indication of an increase as a buy signal you would not be able to use the algorithm as an indicator of when to sell because the algorithm is usually silent. In other words the algorithm does not make very many predictions. Maybe this solution could be half of an automated system to buy and sell stocks. This algorithm

could perhaps be used as a buying or selling signal or it could be used to give confidence to a trader's prediction of stock prices.

#### REFERENCES

- [1] Bruce M. Kamich, "How Technical Analysis Works" New York Institute of Finance, 2003.