

A STUDENT TERM PAPER EVALUATING BUY AND SELL SIGNALS IN THE STOCK MARKET

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ABSTRACT

This paper presents the methodology and pedagogy of a term paper used to grab student interest and throw them into the world of predicting the price of a stock, when to buy and sell that stock, and maximizing future wealth using quantitative buy and sell signals. The goal is to forecast the expected price of a stock over a planning horizon of 65 weeks using a time series analysis model. A timely example is presented to aid in the development of the case using a variety of buy and sell trigger points. Topics: time series, Bollinger Bands, and basic accounting. Track: Experiential Learning.

INTRODUCTION

During the first class of the term students are presented with the expectation that they will not collect any social security. Either the social security fund will be fully depleted by the time they retire or they will be means tested out of the possibility of receiving any social security because of their college degrees and expectation of good jobs and comfortable incomes.

It is further stated that since this is “their lot in life”, they must have a method of making enough money to retire comfortably without any expectation of government help. They could be professional athletes, invent a new computer language, or learn to “slow trade” in the stock market. There are at minimum three methods of using the stock market. The most used by “normal” people is to invest in stocks--buy a stock or many stocks and keep them “forever.” The other end of the spectrum is “day-trading.” This method is for the experts (or crazies) who buy and sell the same stock at least two times per day. This has an official name from the Securities and Exchange Commission--”patterned day trader.” The third method is “slow trading” which includes buying and selling of the same stock over a number of weeks or months totaling as few as two or as many as ten times over a one year period. This method takes advantage of stocks “highs” and “lows.”

Few expect to be the next Brett Farve or Bill Gates. Therefore they are left with the exciting prospect of making money in the stock market--and not by merely investing money from every paycheck. Learning to slow-trade stocks is exciting and extremely interesting to students in the 21st century and they jump at the opportunity to learn the ropes.

BACKGROUND

John Bollinger developed the concept of “Bollinger Bands” in the early 1980’s as a means to have a relative definition of a “high price” and “low price” of a stock or really a “too high price” and a “too low price” of a stock and thus is developed the concept of a “buy” and “sell” signals using the Bollinger Band technique.[3] Bollinger developed his technique using a simple

moving average over time and with the addition of the use of a 95% confidence interval quantified the “too high” and “too low” price of a stock. Bollinger showed that volatility is dynamic and not static and thus the width of the Bollinger Band changes with the volatility of the stock price over time. He has become wealthy and is well spoken around the world from this simplistic beginning.

The model used in this research is a Time Series Model with Seasonal Indices (13 weekly indices) to forecast the price of a stock. Every 13 weeks a company releases earnings per share information and thus it is possible that there is a 13 week seasonal pattern. The confidence intervals are determined by using a time series decomposition model to determine a forecast and then the end points are determined by adding and subtracting different numbers of standard deviations, two (Z-score = 1.96) for example, to create different interval widths, a 95% confidence interval for example. Using different values for the Z-score create the interesting research project for this case.

GOALS OF THIS PROJECT

Several goals are important in developing this case for junior/senior level students.

- 1) It is important to use statistical analysis that has been taught in the course so that students see a real application of the technique--Time Series Analysis;
- 2) It is important to use software that students have learned in other courses--Excel;
- 3) It is important to assign unique tasks (stocks) to each group so that information transfer is limited or eliminated;
- 4) It is important to make the case “meaty”; and
- 5) It is important to make the case meaningful and repeatable by students later in life.

STUDENT RESEARCH SETTING

Students are allowed to form two or three person teams or complete the project individually. The goal of the project is to maximize their wealth over a 65 week planning horizon. Each team starts with \$100,000. Each team picks a stock from a group of stocks that the faculty member approves. These stocks in the acceptable pool are known as “blue chip” stocks such as Johnson and Johnson, McDonalds, and Wal-Mart. Buy and Sell triggers are set by the use of a time series model with trend and seasonal indices and the use of the “Bollinger Bands” as the trigger points. Buy and Sell triggers are set by the use six different Z-score values--the width of the confidence interval. The overall goal is to determine what level of Z-score (width of the confidence interval) will maximize the wealth of the team.

Ideally, the planning horizon of 65 weeks would be forecasted individually each week using the following process:

- 1) forecasting for the first week into the future,
- 2) setting the buy/sell triggers,
- 3) buying or selling the stock if the trigger is crossed, and finally,
- 4) updating the dataset by adding the newest or latest week of actual price data and removing the oldest week of data.

This would continue for 65 weeks.

This form of simulation is easy to execute in Fortran. Setting up a nested Do loop is an easy process. However, in Excel, there is no Do loop and a simplification must be made. Therefore the case includes the last 65 weeks of data, ending June 20, 2008. The team calculates the end points of the given interval for the previous 65 weeks, starting on March 30, 2007. The team then determines when the Bollinger Band or buy/sell triggers are penetrated. A buy or sell occurs at that point. The team proceeds through the 65 weeks ending June 20, 2008.

SPECIAL CONSIDERATIONS

- Six level of Z-scores are used: 2.0, 1.75, 1.5, 1.25, 1.0, and 0.75.
- Trade Commission: \$7.00 to buy the stock (price at Scottrade).
\$8.95 to sell the stock (price at Schwab).
[Faculty member uses both companies and talks about both in class.]
- There is no SEC tax paid. There is no interest paid on cash levels in account.
- You can buy only whole shares.
- You buy when the price of the stock crosses the lower Bollinger Band (BB).
- You sell when the price of the stock crosses the upper Bollinger Band (BB).
- Although the stock may go lower (or higher) than the respective Bollinger Band (BB) trigger point, you already bought (or sold) the stock.

HOW TO EXECUTE BUYS AND SELLS

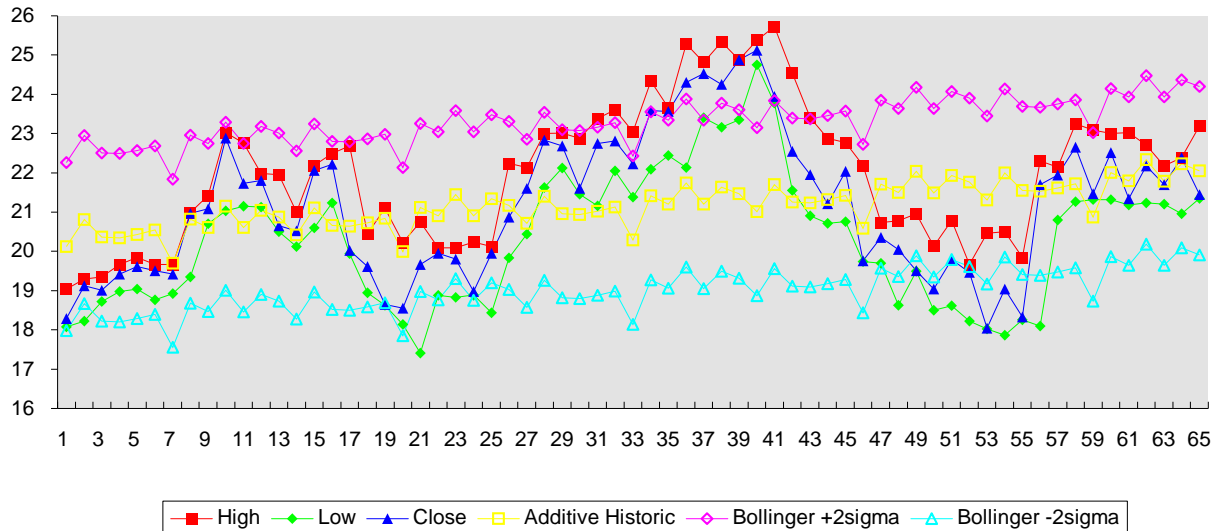
Start: The team may buy stock at the closing price of the first week or may wait until the stock price hits the lower BB. This seems a little unrealistic because the trader is going to make that first decision (what to do during week #1) by looking into a future that theoretically has not happened. However, you need to start somewhere and this is a method of making the simulation “fair.” If the stock is going up from the first week toward the upper BB, the trader would want to buy at the close of the first week to take advantage of the increasing price. If the stock is heading down toward the lower BB, the trader would want to wait until the stock price hits the lower BB.

Future buys and sells: If the stock price hits the upper BB during the week, using the high of the week, and you own the stock, you would sell all of your shares at the value of the upper BB. If the stock continues to a higher value, you already sold it (sorry). If the stock price hits the lower BB during the week, using the low of the week, and you did not own the stock, you would buy to the limit of your available cash (remembering that you must buy whole shares and have \$7.00 to pay the commission). You buy at the value of the lower BB. If the stock continues to go lower, you already own it (sorry).

How to determine the exact price of the BB's: The team must forecast the price of the stock for each week of the 65 week planning horizon. Remembering that this is a static model, not a dynamic model, makes this process very easy. The forecast is derived by using a Time Series

EXHIBIT TWO

Weekly HILOCL+F(t)+AddBB



Looking at the graph in Exhibit Two and comparing it to the graph in Table One, it is easy to see the difference. The Bollinger Bands are “pinched” toward the mean with the Z-score of 1.25. Thus as the stock price increases or decreases, it will hit the trigger points sooner and the purchase or sale will occur more often. This is both good and bad. There is a chance of more gains with more trades. However, it is disappointing when the buy is made and the stock price continues to go higher, sometimes much higher. The other situation is also as frustrating. The stock price crosses the Z-score of -1.25 trigger and the purchase is made. However, it is quite possible that the stock price continues to go down, sometimes a lot more. It is important to remember the theory of Normal Curves. There is only a 2 1/2% chance that the value of the dependent variable will be above the upper Bollinger Band and only a 2 1/2% probability that the stock price will be below the lower Bollinger Band at the classic Z-score of 2.0.

When a smaller Z-score is used, the probability that the stock prices goes above and continues to go higher than the 1.25σ trigger point is quite high. So, although the team may trade more often, they miss the best timing of the buy or sell. Because of these conflicting happenings, a mathematical equation cannot be used to determine the “best” Z-score to maximize wealth.

Table Three presents a summary of the six Z-scores used in the case.

TABLE THREE

Z-score	# of buys	# of sells	\$wealth
2.0	2	1	\$166,391.88
1.75	2	1	\$156,015.40
1.50	2	1	\$141995.14
1.25	3	3	\$179,499.91
1.00	3	3	\$167289.91
0.75	3	3	\$151707.13

STUDENT RESPONSE

This case is a huge hit, especially for the Finance majors. They stated that they had never traded like this--from a purely technical nature. They have had several courses where they evaluated the purchase or sale of a stock from a fundamental perspective . Although teams had four weeks to complete the project, two teams had the project completed in 24 hours. Students were so excited about the amount of money they “made” slow trading. Even for a stock such as Sun Trust which dropped about 50% in value during the 65 weeks, the team made a small amount of money by slow trading. Most teams would have evaluated another stock with no offer of extra credit.

FUTURE RESEARCH

The possibilities for future research are extensive. Below is a partial list of some of the future topics and questions to be researched.

- 1) Compare the wealth gained using a database of 40 different stocks. Students were allowed to choose from a group of 41 stocks. Which stock gained the trader the most wealth?
- 2) What level of Z-score is the best? Six are used. Again, as stated before this research can be performed in Fortran with less effort than Excel. A nested Do loop can be used to try Z-scores between 0.50 and 2.5 by 0.01.
- 3) This is a static simulation. A better method is to go back 130 weeks, and use the oldest 65 weeks of data to forecast the first week of the static model. Update the dataset and repeat 65 times. Is there a difference?

CONCLUSION

Innovative Education Topics are a key to keeping the United States the world leader in business and industry. "Hands-on" and "real-world" cases such as the Slow Trading case are an excellent and self-contained method of meaningful learning for students.

This is a wonderful exercise in the practical application of topics that students can bring to the table when they enter the business world. Why is this such a good case for the quantitative classroom?

- 1) The data is real and timely.
- 2) The situation is realistic and not just a "classroom exercise."
- 3) The computer is used extensively.
- 4) Sophisticated models are developed--by computer.
- 5) Several plots are analyzed.
- 6) This faculty member enjoys this real and very challenging case.

This faculty member could see the "light come on" in the students' minds. Seeing the light validated the usage of the class time and encouraged hope for these students to use the "slow trading" strategy.

REFERENCES

1. Achelis, Steven B., Technical Analysis from A to Z, 2nd edition, McGraw-Hill, 1995
2. Andrews, Robert L., "A Data Collection and Analysis Project for a Statistics or Quality Management Class," Proceedings of the Southeast Decision Science Institute, 1995, pg. 127.
3. Bollinger, John, Bollinger on Bollinger Bands, McGraw-Hill
4. Coleman, B. Jay, The Analysis of Statistical Relationships, 1993.
5. Murphy, John J., Technical Analysis of the Futures Markets, Prentice-Hall, 1986
6. Neter, John & Wasserman, William, Applied Linear Statistical Models, Richard D. Irwin, 1974.
7. Racheu, Svetlozar T., Menn, Christian, & Fabozzi, Frank J., Fat Tailed and Skewed Asset Return Distributions, Implication for Risk Management, Portfolio Selection, and Option Pricing.