Optimal Stop Placement Strategies for Momentum Trades in Equities

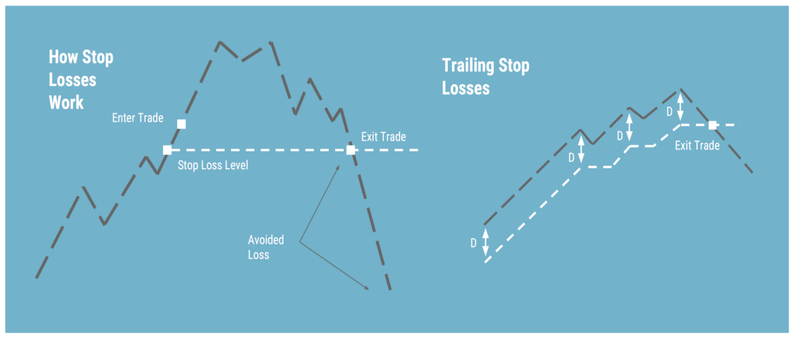
Robbie Selwyn[1], Ayush Gupta[1], and Sameer Gupta[2]
Palo Alto High School[1], Lindamar Capital[2]

RESEARCH PROBLEM

When investing, investors use stop losses in order to minimize trading losses. However, they do not always account for the past history, volatility, and volume of the stock, so the stop losses can be placed too loosely or too tightly [1]. In essence, these stop losses are not optimally placed.

Associated risk would be much lower if stop losses could be intelligently placed [2]. Strategies to accomplish this already exist, but are developed by private parties that receive significant financial gain from the exclusive use of those strategies. Therefore, these placement strategies are not in the public domain.

There are some resources that exist for independent traders, but they are mainly books [3, 4]. Consequently, there is an opportunity for a public, freely usable strategy for the placement of stop losses, providing independent traders (who do not have the resources of a large investment firm) a base to work with.



RESEARCH QUESTION

With the research problem established, the guiding research question can now be set:

<u>How can an algorithm be developed that sets a stop loss for an equity momentum trade to optimize the trade outcome, based on analysis of that security's historical price?</u>

Note: The "Clarifications" section has useful definitions for understanding the specific terminology found throughout this project.

<u>What does this research question mean?</u>
The purpose of this project is to write a computer program that sets a stop loss for an equity momentum trade such that the least money is lost (or the most money is made), and the trade risk is significantly reduced. The program, written in Python, looks at past history of the stock to determine where to place the stop loss.
After conducting research on topics pertaining to stop losses, we have found extensive work covering various ways to predict stop losses. However, we have not seen any research that is specific to momentum trades, where the trading strategy and other relevant statistical information on the expected profit from the strategy are laid out. Our project extends previously developed general concepts to the specific case of momentum trading strategies. This differentiates it from existing research in this area.

PROCEDURE

STEP 1 Conduct background research on stop losses, technical analysis, and related topics.

STEP 2 Acquire data on historical values of stocks from sources such as S&P500.

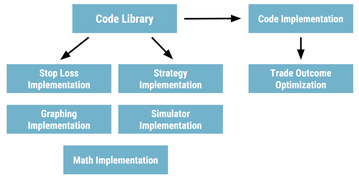
STEP 3 Collect a list of existing strategies used for placing stop losses.

STEP 4 Write a program that develops signals for a specific stock based on historical prices, using one strategy.

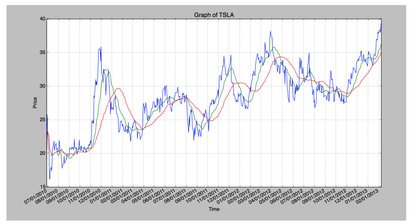
STEP 5 Write another program that takes in a data set, a stop loss, and signals from the previous program to return a trade outcome.

STEP 6 Optimize the return for the one strategy used, with metrics such as the Sharpe ratio, and then test the stop losses with a different strategy.

DIAGRAMS AND MATHEMATICS



A simple stop loss can be defined as a binary function that will return whether or not the current value is less than the original. However, the stop loss can also be made to "trail" behind the current price, thereby locking in gains. The moving average function is the average price over the past n days. Moving average is important for momentum trades because a growth trend is indicated if the p day moving average is higher than the p + q day moving average. The p + q day average is weighted down by previous, lower prices. The Sharpe ratio is a measure of risk. It is the sum of the returns in a portfolio divided by the standard deviation of the returns.

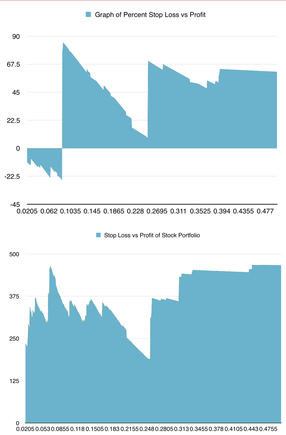


$$stoploss(original, current) = \begin{cases} 1 \; if \; current > original \\ 0 \; if \; current < original \end{cases}$$

$$MA_n = \frac{P_{-1} + P_{-2} + P_{-3} + \cdots + P_{-n}}{n}$$

$$\text{Sharpe}(\mathbf{r}) = \frac{\sum(\mathbf{r})}{\sigma(\mathbf{r})}$$

DATA ANALYSIS



On the top left is the result of applying a stop loss to a certain stock. As seen in the first part of the graph, a small percent (2%-10%) trailing stop loss will cause an investor to lose money. The stop loss will trigger too soon without giving the stock an opportunity to rebound. The sloping lines seen further in the graph are caused by a different number of stop losses being triggered. If a stop loss is set at a certain distance, then some number of stops will be triggered. The other exits of the trade will be the strategic exits (when the moving averages cross). This stop loss can be moved around until a different number of stop losses occur, which is what causes the jump in the graph. Overall, we want the highest profit, so we can choose the point in the graph that has the optimal profit. However, when combined in a portfolio (lower graph), the sloping lines combine differently and the overlap is not perfect, as shown with several small peaks in different areas.

CONCLUSIONS

This project was largely successful in that it met the major criteria outlined in the project proposal. The major components of the project are in place, namely the simulation program and the signal generation program. This program optimizes the outcome of a trade as compared to a typical strategy. For example, the optimized statistics for a simple stop loss optimization on Apple stock (AAPL) show profit at a percentage of 32.15% compared to if money was simply invested (without our stop loss strategy) for the same period of time (tested between 2010 and 2013).

Running the test on an entire portfolio created some issues, mainly that the program generated less money than a regular investment. However, this was because the code does not weight stocks equally, so stocks that had a much higher price were given more weight in the portfolio. This issue was not related to optimization on a single stock. However, the maximum drawdown (see "Clarifications") was significantly reduced when the program was applied to the portfolio. So, in times of negative market turmoil, the strategy performs strongly.

Furthermore, this program is not currently operated in a user-friendly manner. Someone who does not understand Python would likely have a difficult time operating the program. Therefore, extensions that will be made include putting the code in a mobile application or hosting it on a website.

CLARIFICATIONS

A <u>stop loss</u> is a type of market order where shares in a security are sold if the price drops below a pre-specified limit. A <u>trailing stop loss</u> is similar, but where the lower limit follows the price upwards if it increases.
An <u>equity</u> is a tradeable asset that represents ownership of a publicly traded company, essentially stocks, ETFs (exchange traded funds), etc. x
A <u>momentum trade</u> relies on the assumption that a stock that has been moving in one direction consistently (based on a quantifiable metric, such as moving average comparison) will continue to move in that direction for some time.
A <u>signal</u> is an indicator of a time to buy or sell a stock.
The <u>maximum drawdown</u> of a trade is an indicator of risk that is used by investors. It is the distance from the entry price to the lowest price.

ACKNOWLEDGEMENTS AND REFERENCES

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