Simple Stop Loss Procedure to Measure Expected Return of the Portfolio

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Abstract

A simple stop loss procedure to measure expected return of the portfolio with and without the stop-loss rule is proposed. A strategy for setting stop loss levels based on historical data and using moving average and average true range methods is given. Obtained results were compared by running back test for different values of stop-loss.

Keywords: Stop loss; Technical analysis; Moving average

1. Introduction

Rather than continuously monitor the price of stocks or other securities, investors can place a limit order or a stop order with their broker. These orders are instructions to execute trades when a stock price hits a certain level. A limit order is used to try to take advantage of a certain target price and can be used for both buy and sell orders. A limit order instructs the broker to trade a certain number of shares at a specific price or better. To buy orders, means purchase at the limit price or lower, and for sell limit orders – to sell at the limit price or higher.

A stop order, sometimes called a stop-loss order, is used to limit losses; it instructs the broker to execute a trade when a stock reaches a price beyond which the investor is unwilling to sustain losses. For buy orders, this means buying as soon as the price climbs above the stop price. For sell orders, this means selling as soon as the price drops below the stop price (Sehgal and Jasuja 2016).

Many investors struggle with the task of determining where to set their stop loss levels. Investors don’t want to set their stop loss levels too far away and lose too much money if the stock moves in
the wrong direction. On the other hand, investors don’t want to set their stop loss levels too close and lose money by being taken out of their trades too early.

Learning markets (2011) present the following three methods how to determine where to set stop losses: the percentage method, the support method and the moving average method.

The Percentage Method. This method is one of the most popular methods, which investors use in their portfolios. It based on determination of the percentage of the stock price which trades are willing to give up before exit their trades. For instance, if investor is comfortable with a stock losing 10 percent of its value and he owns a stock that is trading at $100 per share, then he will set his stop loss at $90, i.e., $10 below the current market price of the stock ($100 * 10% = $10). It is clear, that we can keep the same percentage (12%, 15% etc.) of out stop loss order, as a price of a stock continues to move higher.

The Support Method. The support method for setting stop losses is slightly more difficult to implement than the percentage method, but it also allows you to tailor your stop loss level to the stock you are trading. We just need to identify the most recent stock levels of support in order to use this method. For example, if there is a stock that is currently trading at $100 per share and we identify $55 as the most recent support level, we should set our stop loss just below $55. Of course, we can move our stop loss level up or down, if a new support level has been established. Therefore, stop loss can be dynamic and moves along with a price of the stock.

The Moving Average Method. To use this method, we need to find moving average and apply it to our stock chart. It is clear, that it is better to use longer-term moving average instead of shorter-term moving average, since during the long term moving average is less volatile. Thus, we can use a longer-term moving average as opposed to a shorter-term moving average to avoid setting our stop loss too close to the price of the stock and getting whipped out of our trade too early. For instance, if a stock that is currently trading at $100 and the moving average is at $85, then we will set our stop loss just below $85.

So, stop loss and stop buy levels are very important for traders and we should be able to distinguish where to set them. A too tight or too wide stop loss or stop buy can be easily triggered even when we choose the right direction.

Therefore, in this article we propose the strategy how correctly to choose stop loss level based on historical data with implementation of moving average method, conduct a statistical analysis of these data and compare obtained results of the expected return of the portfolio with and without the stop-loss rule.

2. Main Results

We can check whether stop-loss rule stops losses, by comparing the expected return of the portfolio with and without the stop-loss rule. Namely, if the expected return of the portfolio is higher with stop-loss rule than without it, then the stop-loss rule has impact on trading strategy. In the real market stop orders have to be below major moving averages, trend lines, swing highs, swing lows or other key support or resistance levels. Let briefly look on some of them.
Trend lines. Trend lines are basics on which the entire charting process is based and in a way it forms the backbone of most trading activity across markets. Technical analysts come up with many different ways to identify a trend. In simple terms, a trend line is based on historical price action and represents the general direction in which the trade is expected to progress and give an idea about potential support and resistance levels. However, one must remember that drawing a trend line can be at times very subjective. One sure way of gauging the validity of a trend line is by checking the points they touch as they chart the direction of trade. Usually in an uptrend, a strong trend line should be connecting the relatively low points on the chart. Thus in a long-term rally, this line connecting all the lows forms the support line and can be used as a floor for trading. Similarly, the reverse is expected in case of a downtrend. A strong trend line covers every high, and the resultant chart should be an ideal means of determining the resistance zone for traders. The most basic forms of trend lines are the ones that are drawn by connecting the points or the support area in the course of an uptrend or the peaks or the resistance points during a downtrend (Pottorff, 2014).

Swing Highs & Lows. The idea of this method is to find a range in the past where price had a difficult time breaking through on a chart in order to identify support and resistance levels. As price moves up and down, each level that price has bounced off of could be a level in the future that price bounces off of again. This is a manually intensive method and takes time to draw, but can pay off in the long run (Pasche, 2014). These pricing levels can be found by connecting a series of recent of market highs and lows using horizontal lines (see Figure 1). Later when price approached these levels again, they bounced off the same levels. Resistance is the current ceiling on price and can be seen on the chart above near 92.18 $. Support is the current markets pricing floor which stands at 91.60 $.

Since price is moving sideways between pricing levels, traders may look to take a non-bias market approach and either buy or sell the market without having a preference to specific order type. The key is to wait till the market reaches support or resistance before trading. Note, that with price...
trading in the center of our range, it is best to wait for a better price before trading. If price moves to resistance at 92.18 $ traders will look to sell the market. If prices trade to 91.60 $ first, traders will want to buy the shares. Nevertheless, eventually price could be break through our marked levels of support and resistance, that is why we should set stop loss and stop buy levels. This method is used quite often in range trading. We can buy at support level with our stop loss below and we can sell at resistance level with our stop loss above.

Exponential Moving Average (EMA). Among the most popular technical indicators, simple and exponential moving averages are used to gauge the direction of the current trend. Moving averages are termed “moving” because the group of prices used in the calculation move according to the point on the chart. This means, that old days are dropped in favor of new closing price days, so a new calculation is always needed corresponding to the time frame of the average employed.

The exponential moving average would focus more on the most recent prices rather than on a long series of data points, as the simple moving average required. Twomey (2011) propose to calculate EMA by the following formula:

$$EMA = P \times \alpha + EMA_{i-1} \times (1 - \alpha)$$

$$\alpha = \frac{2}{(1+N)} , i = 1,2,3,...$$

where $P$ – current price, $\alpha$ – smoothing factor, $N$ – number of time periods and $EMA$- simple average of the first $N$ days. Note, that there is no specific rule for choosing time period. The longer time span, the less sensitive or more smoothened out the average will be.

The EMA method works by weighting the difference between the current period’s price and the previous EMA, and adding the result to the previous EMA. Obviously, the shorter period, the more weight applied to the most recent price. In the next chapter we propose a strategy of stop-loss determination based on the indicator of exponential moving averages.

Average True Range Stop Loss. The Average True Range (ATR) is an indicator that measures volatility and was developed by J. Welles Wilder. Typically, ATR is based on 14 periods and can be calculated on an intraday, daily, weekly or monthly basis. Jyothi (2015) and Yamanaka (2012) give a detailed algorithm how to calculate ATR.

The first TR value is simply the High minus the Low price, because there must be a beginning. The rest of values of TR can be obtained by choosing maximum among three prices: Current High – Current Low (H-L), Current High – Previous Close (H-PC), Current Low – Previous Close (L-PC). Note, that during calculation of (H-PC) and (L-PC) prices we take absolute values of them. Having TR we can start to calculate ATR by the following formula:

$$TR = \max (H_i - L_i, |H_i - C_{i-1}|, |L_i - C_{i-1}|)$$

$$ATR = \frac{ATR_{i-1} \times (k-1) + TR_i}{k} , k = 1,2,3,...$$

where $k$ – is a number of time period. Note, that the first $ATR_0$ can be calculated as a $k$ - period simple average of True Range values. Since, $ATR_k$ is always a positive number thus $ATR_k$ reflects volatility as absolute level. In other words, $ATR_k$ is not shown as a percentage of the current close.
This means low priced stocks will have lower ATR values than high price stocks. Based on ATR values we can set our stop loss level simply as:

\[ SL_i = sl_{\text{factor}} \times ATR_i, i = 1, 2, 3, \ldots \]  

(4)

where for simplicity, we put \( sl_{\text{factor}} = 1 \). Now we can easily to calculate maximum daily (weekly, monthly) drawdowns, having stop loss levels, which will tell us if stop loss activated at particular day (week, month) as difference of previous close and current low prices.

### 3. Numerical Study

Our mathematical calculations will be done on historical data of Apple Inc., [8]. We will construct a back-test in order to demonstrate the results of using stop-loss order strategy and simply buy and hold strategy.

In order to have something compare our strategy to, we are going to look for a profit which would be gained by simply buying index at the start date \( A \) and holding it till date \( B \) with initial capital of 1000$ and compare obtained profit with a value gained by buying index above \( EMA \) and above \( EMA-ATR-SL \) (exponential moving average-average true range-stop loss).

In this paper will propose the following procedure of trading strategy:

1) Calculate \( EMA \) for historical data using formula (1).
2) Set initial capital which can be used for buying shares and dates of the first and last day of trading.
3) Calculate a profit gained for initial capital and period defined on step 2 using next formula:

\[ P_i = C_i \times P_{i-1}, i = 1, 2, 3, \ldots \]  

(5)

where \( C_i \) - closing price of \( i-\)th day, \( P_0 \) - initial capital of investor.

4) Calculate a profit gained by buying shares above \( EMA \) as:

\[ P_i = \begin{cases} 
P_{i-1} \frac{C_i}{C_{i-1}}, & C_{i-1} > EMA_{i-1} \\
0, & P_{i-1}, C_{i-1} \leq EMA_{i-1} 
\end{cases} \]  

(6)

5) Calculate a profit gained by buying shares above \( EMA-ATR-SL \) as:

\[ P_i = \begin{cases} 
P_{i-1} \frac{C_i}{C_{i-1}}, & C_{i-1} > EMA_{i-1} \cap MDD > SL_{i-1} \\
P_{i-1} \frac{C_i}{C_{i-1}}, & C_{i-1} > EMA_{i-1} \cap MDD \leq SL_{i-1} \\
P_{i-1}, C_{i-1} \leq EMA_{i-1} 
\end{cases} \]  

(7)

where \( MDD = C_{i-1} - L_{i} \) is maximum daily dropdown.

6) Compare results from step (3-5).
Based on given algorithm we can start build our back test for historical data of Apple Inc. As we have mentioned above, we need to choose an interval of dates on which we can build our back test following steps (1)-(6). In our numerical study for better analysis we choose several intervals: 6 month, 1 year, 1.5 year and 2 years with $N = k = 10$. Now we can check the effectivity of proposed strategy by constructing back test and compare obtained results. Also we provide a detailed descriptive analysis in Table 1 and 2.

**Table 1** Economic metrics for stop loss factor $s_{factor} = 1$

<table>
<thead>
<tr>
<th>Period</th>
<th>1.01.16-1.07.16</th>
<th>1.07.15-1.07.16</th>
<th>1.01.15-1.07.16</th>
<th>1.07.14-1.07.16</th>
</tr>
</thead>
<tbody>
<tr>
<td>$s_{factor} = 1$</td>
<td>Buy index</td>
<td>Buy above EMA</td>
<td>Buy above EMA-ATR-SL</td>
<td>Buy index</td>
</tr>
<tr>
<td>Gross Profit</td>
<td>562</td>
<td>364</td>
<td>359</td>
<td>1218</td>
</tr>
<tr>
<td>Number of</td>
<td>55</td>
<td>82</td>
<td>82</td>
<td>113</td>
</tr>
<tr>
<td>winning trades</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of</td>
<td>51</td>
<td>24</td>
<td>24</td>
<td>121</td>
</tr>
<tr>
<td>losing trades</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winning trades</td>
<td>52%</td>
<td>77%</td>
<td>77%</td>
<td>48%</td>
</tr>
<tr>
<td>Largest</td>
<td>39</td>
<td>39</td>
<td>39</td>
<td>48</td>
</tr>
<tr>
<td>profitable trades</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2 Economic metrics for stop loss factor $sl_{factor}=3$

<table>
<thead>
<tr>
<th>Period</th>
<th>1.01.16-1.07.16</th>
<th>1.07.15-1.07.16</th>
<th>1.01.15-1.07.16</th>
<th>1.07.14-1.07.16</th>
</tr>
</thead>
<tbody>
<tr>
<td>$sl_{factor}=3$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buy index</td>
<td>562</td>
<td>364</td>
<td>1218</td>
<td>1956</td>
</tr>
<tr>
<td>Buy above EMA</td>
<td>-580</td>
<td>-219</td>
<td>-1444</td>
<td>-2152</td>
</tr>
<tr>
<td>Buy above EMA-ATR-SL</td>
<td>-196</td>
<td>-131</td>
<td>-177</td>
<td>-35</td>
</tr>
<tr>
<td>Buy above EMA-ATR-SL</td>
<td>-18</td>
<td>144</td>
<td>144</td>
<td>179</td>
</tr>
<tr>
<td>Gross Profit</td>
<td>562</td>
<td>364</td>
<td>1218</td>
<td>1956</td>
</tr>
<tr>
<td>Gross Loss</td>
<td>-580</td>
<td>-219</td>
<td>-1444</td>
<td>-2152</td>
</tr>
<tr>
<td>Net Profit</td>
<td>-18</td>
<td>144</td>
<td>144</td>
<td>179</td>
</tr>
<tr>
<td>Number of winning trades</td>
<td>55</td>
<td>82</td>
<td>82</td>
<td>113</td>
</tr>
<tr>
<td>Number of losing trades</td>
<td>51</td>
<td>24</td>
<td>24</td>
<td>121</td>
</tr>
<tr>
<td>Winning trades</td>
<td>52%</td>
<td>77%</td>
<td>77%</td>
<td>48%</td>
</tr>
<tr>
<td>Largest profitable trades</td>
<td>39</td>
<td>39</td>
<td>39</td>
<td>48</td>
</tr>
<tr>
<td>Largest losing</td>
<td>-67</td>
<td>-25</td>
<td>-25</td>
<td>-56</td>
</tr>
</tbody>
</table>

We observe from table 1 and 2 that our procedure of choosing stop-loss works quite good for different values of stop loss factor. The back test demonstrates that using stop loss procedure provides significant benefit compared to simple buy and hold strategy only in short time period. During the long time period our procedure is less effective which could be cause by unpredictable situation of market at future. If we look at the chart below then we can observe some gaps during 2 years period. A gap occurs when the previous close is greater than the current high (signaling a potential gap down or limit move) or the previous close is lower than the current low (signaling a potential gap up or limit move). These gaps have impact on our back test and obtained results.

Therefore we should take into account the probability of average daily (weekly) share price falling below the stop loss level during certain time of period. In our next article we would propose new optimal criterion by calculating the probability density of minimal shares prices after stop loss and find optimal repurchase levels.
Summarizing all the above written we conclude that our moving stop losses can be used to limit losses in short time period. They can also be used to guarantee profits, by ensuring that a stock is sold before it falls below purchasing price.

4. Conclusion

In this paper we proposed an algorithm for back test construction using different levels of stop loss and measure expected return of the portfolio with and without the stop-loss rule. Back test demonstrates that using stop loss procedure provides significant benefit compared to simple buy and hold strategy only in short time period strategy and it can be used in management of static block of shares. In case of big volatility of stock under uncertainty, stop-loss rules simply force the portfolio out of higher or lower-yielding assets on occasion, thereby decreasing or increasing the overall expected return. However, we showed that during long-time period proposed levels of stop loss are less effective and deeper analysis of historical data are required.

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