

NUS INVESTMENT SOCIETY
Technical Report

A Panic-Selling Mean Reversion Trading Strategy

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Introduction

Our project utilizes technical analysis to identify trading opportunities in the U.S. stock market and automation to execute the trades. Our team is split into two groups, the forward testing team and the backtesting team. The forward testing team implements the strategy described below on a simulated trading account with Interactive Brokers¹. We also collect data² from the simulated trades and share it with the backtesting team for analysis. In addition, the backtesting team evaluates the strategy against historical market data. Finally, the backtesting team informs the forward testing team their analysis to ensure our trading strategy remains profitable.

The philosophy behind our short-term long-only strategy is to buy a stock/ETF after a big drop in price, when everyone who wanted to sell their stock has done so. The remaining participants are investors willing to long the stock. During this period, the stock will be sufficiently low and ready for a rebound. This is when we enter a long position (buying low) and exiting when our predetermined take profit is achieved (selling high).

Our strategy is applicable (based on forward testing results) to most stock/ETF across the U.S. stock markets, as long as they satisfy the various conditions mentioned below:

Conditions³

1. *Williams %R (10) < -80*
2. *Williams %R (260) < -80*
3. *Low{candle(0)} > low{candle(1)}*
4. *Close{candle(0)} > high{candle(1)}*
5. *Candle(0) must be bullish*
6. *Open{candle(0)} ≥ close{candle(1)}*
7. *At least a 1:2 Risk-to-return ratio to max{most recent swing high, 50 SMA⁴}*
8. *close {candle(0)} ≥ 5 USD*
9. *Volume of last 60 candles ≥ 150,000 (for stocks) or 100,000 (for ETFs)*
10. *R = (entry price - stop loss) ≥ 1 ATR*
11. *No earnings in the next 10 days*
12. *low{candle(1)} is the lowest among the last 120 daily candles*
13. *Entry stop ≥ 1R from 20 EMA*
14. *Entry stop ≥ 2R from 50 SMA*

¹ Our group has chosen Interactive Brokers as our broker. A reason for this choice is because of IB's low commission fees: approximately \$2.00 for a stock (to open and close the trade).

² Includes information on our executed trades and potential modifications to trading strategy

³ See Appendix A

⁴ Simple Moving Average

Note that the screener for the above mentioned conditions have been implemented with the ThinkOrSwim platform.

Position Sizing

For position sizing, we adopt an Order-Cancel-Order approach, with a daily buy stop-limit order with predetermined Good-Till-Cancelled (GTC) take-profit and stop-loss prices calculated from the following:

$$\begin{aligned} \text{Sell limit} &= \min\{\text{swing high}, 50 \text{ SMA}\} \\ \text{Buy stop} &= \text{high}\{\text{candle}(0)\} + 0.05 \\ \text{Sell stop} &= \text{low}\{\text{candle}(1)\} - 0.05 \\ \text{Buy limit} &= \text{buy stop} + 0.1(\text{buy stop} - \text{sell stop}) \\ \text{Quantity} &= \text{floor}\left(\frac{1\% \cdot \text{Net Liquidation Value}}{\text{Buy stop} - \text{Sell Stop}}\right) \end{aligned}$$

Sell limit is commonly known as take profit, sell stop as stop loss, buy stop is the lower bound of our buy order and buy limit is the upper bound of our buy order. The quantity of any trade is fixed at a 1% risk of our Net Liquidation Value (NLV).

Results from forward testing

A total of 16 closed positions: 15 during 30 Oct 2018 - 29 Nov 2018, and 1 during 4 Dec 2018 - 18 Dec 2018⁵. Given an initial capital (NLV) of USD 10,000, our strategy has returned USD 1834.46 in profit⁶. Out of these trades, 10 profited. These profits range from USD 5.53 to 443.71. On the contrary, our losses for the remaining trades range from USD 98.48 to 122.51. On average, the return from these 16 trades is USD 114.65.

However, there were anomalies during our forward testing. Out of the 16 trades, 3 were sold before achieving the take profit price. This was unusual since we adopted a GTC limit order. Our team contacted Interactive Brokers and were informed that the problem was because these trades were of odd-lots⁷. Nevertheless, these trades were profitable.

⁵ Inactivity between that period due to academic commitments

⁶ As of 18 Dec 2018

⁷ An odd lot is an order with less than 100 shares and are not posted to the bid/ask data on exchanges. These orders are only filled when the exchange is able to submit them as a round lot, combined with other similar odd lots. This led to the unexpected take profit of our trades.

Backtesting

Backtesting is the process of applying a trading strategy or analytical method to historical data to see how accurately the strategy or method would have predicted actual results. In our case, this means applying our set of trading conditions defined earlier to historical stock prices to determine if they would be able to generate profitable trades.

In this situation, we will be translating our trading strategy into Python 3 code, and we will be using the past 5 years worth of stock price data for the NASDAQ exchange in the US. The current code can be found below:

Loading Python Libraries

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
```

Definitions

```
def Williams_R(ts, lag):

    high = ts.high.rolling(lag).max()
    low = ts.low.rolling(lag).min()
    close = ts.close

    return (high - close)/(high - low) * -100

def MA(ts, lag):
    return ts.high.rolling(lag).mean()
```

Initial Setup

```
data = pd.read_csv("C:/Users/seale/Desktop/NUS BAS/S&P Past 5 Years.csv",index_col='date')
data.index = pd.to_datetime(data.index)
tickers = []
ticker = data.Name.drop_duplicates()
trades = 0
```

Trading Conditions

```
for ticker in tickers:

    ts = data[data.Name == ticker]

    ts['24W_min'] = (ts.low == ts.rolling(120).low.min())
```

ts['MA20'] = MA(ts, 20)

ts['MA50'] = MA(ts, 50)

ts['R%10'] = (Williams_R(ts, 10) < -80)

ts['R%260'] = (Williams_R(ts, 260) < -80)

ts['bullish'] = (ts.open < ts.close)

ts['higher_low'] = (ts.low > ts.shift(-1).low)

ts['higher_close'] = (ts.close > ts.shift(-1).high)

ts['higher_open'] = (ts.open > ts.shift(-1).close)

opportunities = ts[ts['R%10'] & ts['R%260'] & ts['bullish'] & ts['higher_close'] & ts['higher_close'] & ts['higher_open'] & ts['24W_min']]

We are currently still in the process of finalizing the code that would allow us to identify places in the time series data where trading opportunities exist for each of the various stocks in the NASDAQ exchange, as defined by our trading conditions, as well as the final 2 trading conditions.

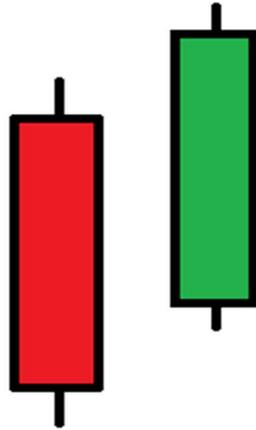
Conclusion

The strategy has been implemented and the forward testing results look promising. Further investigation is needed regarding the odd-lot size issue. In the next phase, more data coming from both forward testing and backtesting will help get a more complete picture of the performance of the strategy and possibly provide insights useful to improve the results.

Appendix A

A brief description on the trading conditions:

The Williams %R() is a momentum indicator that identifies overbought and oversold levels. Our first two conditions ensure that both short term and long term sellers have sold their shares, resulting in an oversold share. Conditions 3 through 6 form the features of a One White Soldier candlestick pattern.



One White Soldier

[http://www.traderpedia.it/wiki/index.php/One white sol](http://www.traderpedia.it/wiki/index.php/One_white_sol)

The bearish candle in red is candle(1) while the bullish candle in green represents candle(0). candle(1) occurs before candle(0). This distinctive pattern indicates the optimal position for us to enter. Actually, we also consider valid situations where candle(1) is bullish.

For Condition 7, we have chosen our risk-to-return ratio to be at least 1:2. A high risk-to-return ratio (e.g. 1:1) may be unfavorable as a winning rate of more than 50% is required to be profitable (excluding commissions). On the other hand, if we set a lower threshold (e.g. 1:5), few stocks/ETFs can pass the filtering. Hence, 1:2 represent a good trade-off between profitability and feasibility. For further explanation on the swing high pattern:

<https://www.investopedia.com/terms/s/swinghigh.asp>

We observe Condition 8 to avoid penny stocks. Condition 9 ensures the stocks we trade have sufficient liquidity. For Condition 10, Average True Range (ATR) is a volatility indicator that ensures the stock can sufficiently accommodate the daily volatility in price. This prevents us from closing our positions unnecessarily. Condition 11 limits potential gap-downs that may impair our performance. Condition 12 ensures the stock has reached its lowest over the past six months, increasing the chance the stock's price is soon to revert. Finally, Conditions 13 and 14 are used to avoid buying when the price is too close to the moving averages that may represent resistance levels.