

# Mean Reversion Trading Algorithm

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# Mean Reversion Trading Report

## Introduction

Mean reversion is a technical trading strategy build that on the assumption that over an extended period of time all stock values will eventually return to a long-term average. This involves determining when a stock price has significantly diverted from its mean, making entering the market accordingly, and exiting the market once the stock price has reverted to its mean.

This is determined in our strategy using multiple technical indicators, namely the Stochastic Oscillator, the Relative Strength Indicator (RSI), and the Moving Average Convergence Divergence (MACD).

## Stochastic Oscillator

The Stochastic Oscillator is a technical indicator based on the high, low and closing prices of a stock over a set lookback period. The Oscillator produces an index between 0 and 100, which can be used as an indicator if a stock is notably oversold or overbought when compared to its price variation over the set lookback period.

The equation used to calculate the indicator is quite simple:

$$K_{fast} = \frac{close-low}{high-low}$$

The  $K_{fast}$  value is used in conjunction with a 3 period moving average,  $D_{fast}$ . This is form is quite volatile, and in our testing was too volatile to give consistent results. We opted for a slower variant of the the Stochastic Oscillator where  $K_{slow}$  is a 3-period moving average of  $K_{fast}$ , and  $D_{slow}$  is a 3-period moving average of  $K_{slow}$ .

In our algorithm we used a 14 day lookback period.

## Relative Strength Index

The Relative Strength Indicator is another technical indicator used to evaluate overbought and oversold stocks. While in this regard it is similar to the Stochastic Oscillator, in our algorithm we used it to indicate overall momentum of the stock rather than as an indicator of mean reversion. The indicator is based on the average gain and loss of a stock over a set lookback period, resulting in an index between 0 and 100.

The equation for RSI is also quite simple:

$$RSI = 100 - \left( \frac{100}{1 + \frac{avggain}{avgloss}} \right)$$

In our algorithm, average gain and loss were exponential weighted mean calculations, and was calculated over a 14-day lookback period.

## **Moving Average Convergence Divergence**

Moving Average Convergence Divergence is a momentum indicator based on the relationship between two exponential moving averages of different period lengths. The subtraction of these two reveals the relative shift in the market between the two lookback periods in use. This is used in conjunction with a third moving average of an even shorter period to represent the signal line.

In our algorithm these two moving averages converging is used as a signal to enter the market, when previous conditions have been met. We used a 26-day period and a 12-day period for fast and slow metrics, and a 9-day period for the signal line.

## **Algorithm**

### **Core Logic**

Our algorithm implemented all three of these indicators to determine trading decisions, each of them used for different purposes. The hybrid nature of this algorithm was designed with the intent to allow it to more discerning than any of the indicators used individually, and result in a higher win-rate.

The slow variant of the Stochastic Oscillator is used as a measure of mean dispersion, where particularly low and high values are indicators of oversold and overbought states of a stock, presumably set to revert to its mean. This is the primary indicator of the algorithm.

To confirm the trend, our algorithm implements RSI as a trend confirmation indicator. Rather than using RSI to determine overbought and oversold signals like the Stochastic Oscillator, our algorithm uses it to determine the overall direction of the stock in the form of uptrends or downtrends. In terms of the RSI value, our algorithm treats below 50% as a downtrend and above 50% as an uptrend.

If the Stochastic Oscillator is below 20%, indicating a stock is oversold, and the RSI is above 50%, indicating an uptrend, the algorithm waits for the MACD to cross its signal line. If the MACD crosses the signal line before the Stochastic Oscillator shifts to indicating overbought, the algorithm enters a long position on the stock.

The inverse is true for short positions. If the Stochastic Oscillator is above 80%, indicating a stock is overbought, and the RSI is below 50%, indicating a downtrend, the algorithm waits for MACD to cross its signal line. If the MACD crosses the signal line before the Stochastic Oscillator shifts to indicating oversold, the algorithm enters a short position on the stock.

### **Stoploss and Profit Target**

PUT EXPLANATION OF STOPLOSS AND PROFIT TARGET MATH HERE

*stoplossmathhere*

### **Combined Implementation**

This core logic has a minor impact on an account when used alone as a trading algorithm. Due to the stringent conditions required for it to enter the market, and the relatively small stoploss and profit target margin do not allow for large shifts in account value. Due to this, in our testing, the core logic on its own results in net profits from -10% to 10% of the initial investment.

To amplify the effects of this, we suggest that this logic be combined with another trading strategy that is fallen back on when the core logic doesn't detect any significant mean dispersion.

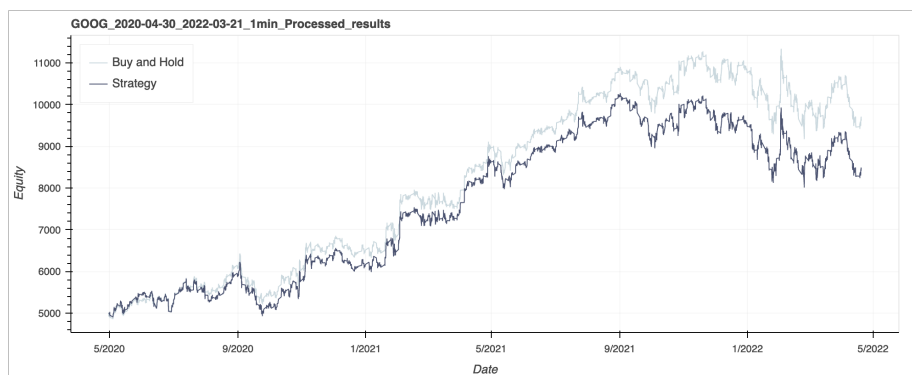
In our submitted implementation, we combined our core logic with a simple buy and hold strategy that was defaulted to when no mean dispersion was detected. While rendered the long position entry logic redundant, we have included it in our source code to show how it may be used if the fallback strategy were different. This implementation in effect holds a long position until it detects a mean dispersion, enters a short position accordingly, and returns to a long position once the mean reversion has occurred or stoploss triggered.

This combined implementation resulted in consistent profitability with the core mean reversion logic providing a wider range of results, sometimes falling short of simple buy and hold and other times pushing beyond it.

## Testing

Our algorithm preprocessing flattens all data to 30 minute periods which we found to be optimal in our testing. Our default parameters used a 14 period lookback window for the Stochastic Oscillator and RSI, and a 26-12-9 setting for MACD.

### GOOG 2020-04-30 to 2022-03-21 1 Minute Intervals



```
Buy and Hold : 92.95%
Net Profit   : 4647.56
Strategy     : 68.74%
Net Profit   : 3436.96
Longs        : 23
Sells        : 22
Shorts       : 22
Covers       : 23
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Total Trades : 90
```

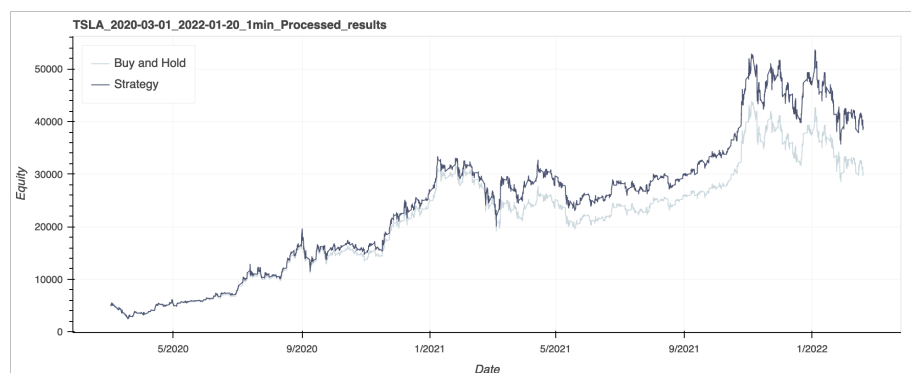
## AAPL 2020-03-24 to 2022-02-12 1 Minute Intervals



Buy and Hold : 168.75%  
 Net Profit : 8437.4  
 Strategy : 118.12%  
 Net Profit : 5906.12  
 Longs : 34  
 Sells : 33  
 Shorts : 33  
 Covers : 33

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 Total Trades : 133

## TSLA 2020-03-01 to 2022-01-20 1 Minute Intervals



Buy and Hold : 502.32%  
 Net Profit : 25116.22  
 Strategy : 677.86%  
 Net Profit : 33892.99  
 Longs : 31

Sells	: 30
Shorts	: 30
Covers	: 32
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Total Trades	: 123

### **Potential Improvements**

Our algorithm is limited by size of the stoploss and profit targets, and in our testing we found various stoploss parameters were favourable under different condition. Allowing the stoploss parameter to be variable depending on wider conditions could result in much higher returns.

Another potential improvement is altering the stoploss to be dynamic per market position. Having the stoploss move in response to market movements could limit losses further and result in higher returns.

### **FURTHER IMPROVEMENTS**