**Senior Capstone Project**

Evaluating Success of Technical Analysis Investment Strategies

Chapter 2: Bollinger Bands



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**Background**

The Bollinger Bands Investment technique is a popular technical analysis tool created by John Bollinger in the 1980's. They measure market volatility and utilize moving averages to understand whether a stock is overbought (price is high) or oversold (price is low). This can be used to create buy and sell signals which can be used by themselves or a part of more elaborate trading techniques in which they give insight into the price of the stock. Bollinger Band technique creates the following parameters:

- Middle band: The 20 day moving average

- Upper band: The 20 day moving average plus 2 standard deviations of the current moving average

- Lower band: The 20 day moving average minus 2 standard deviations of the current moving average

Bollinger Bands assume a weak confidence for the truth of the efficient market hypothesis which states that each stock is the exact representation of all market data. This would imply that under or over valued stocks do not exist and Bollinger Bands would be deemed as a futile investment strategy.

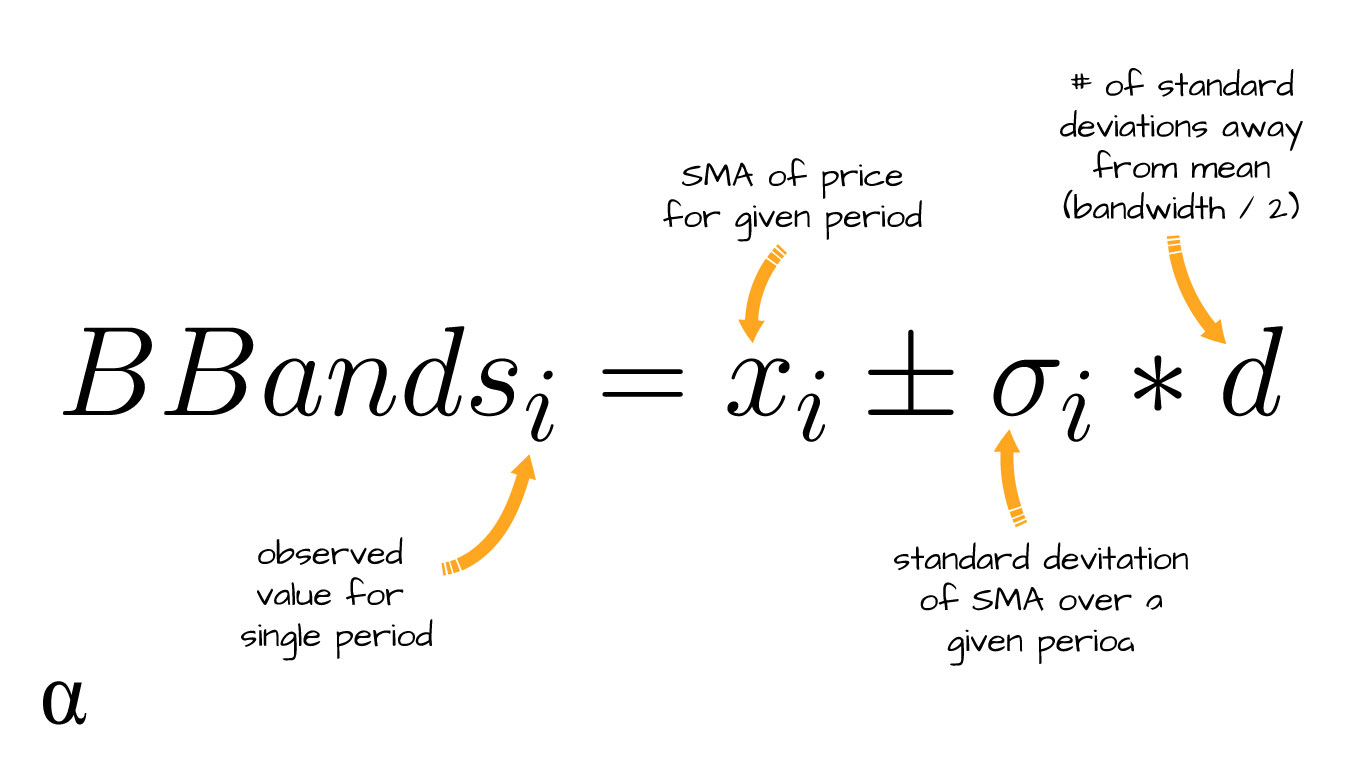
A graph of a line graph

Description automatically generated with medium confidence

*Image 1: Example of Buy/Sell Signals from Bollinger Bands Investment Strategy*

**Parameters**

Bollinger Bands are made up of two parameters which can be adjusted to return different buy/sell actions. They are made up of a rolling average and standard deviations of that rolling average. John Bollinger suggested a default of 20 rolling average and 2 standard deviations, this will be used as the base model.



**Actions**

A buy signal is triggered whenever the rolling average falls below the lower band and a sell signal is triggered whenever the rolling averages rises above the upper band.

From the above example it creates the following signals.

A screen shot of a computer

Description automatically generated

*Table 1: Table of buy/sell actions for XLV healthcare sector ETF during a trough*

Observe that signals usually come in intervals where there seems to be a strength towards the buy or the sell signal, based on the number of times the same signal has taken place.

**Stochastic Modeling**

As there are multiple buy and sell signals these are algorithmically created actions that will not change per day. For example in *table 1* there is a buy signal on 2008-11-21 which will never change but the time period in which the investments can take place will. This allows for stochastic modeling during different time periods to get a distribution of expected returns. The purchases and sales will pull from the cash balance and stock balance respectively. This allows for an accurate representation of what investing with that particular method could see return.

**Amount to buy/sell**

The amount to buy/sell will be standard across technical analysis techniques. There will be a 20% purchase of the cash balance and a 20% sale of the stock balance when there is a respective buy/sell action. This should allow for multiple buy and sell periods in a row without creating a very small cash balance or a ver small stock balance. The downside is that it puts a greater emphasis on the beginning days of the investment period. However, with the stochastic modeling of different days it should reduce the impact of this on understanding technical analysis techniques.

**Cash Balance**

This balance is going to be set at $100 for the investment period. Whenever there is a buy signal it will pull from this amount. A sell signal will add cash to the balance this relationship should allow for a true representation of stock investing.

**Stock Balance**

This is set at $0, representing investing in stocks purely based on the signals of the technical analysis. There will be times where incorporating the initial balance of stocks can used in testing as it will represent a buy/hold with a technical analysis strategy.

**Distribution of Data**

A distribution of the returns from the 1000 iterations of modeling is created for each stock during each macroeconomic cycle. This is done for testing to further understand how different models perform with different sector ETF’s rather than letting individual stock performance influence the results of the investigation.

A graph showing the growth of the stock market

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*Graph 1: Distribution of XLV Healthcare Sector ETF during Trough*

**Results**

Base Model

20 day rolling average with a confidence interval of 0.95% (1.96 std) above and below the rolling average

A table of numbers with different colored numbers

Description automatically generated

*Table 2: Expected returns from stochastic modeling using Bollinger Band Base Model*

Hyperparameter Optimization Bollinger Bands Model

A rolling window of 15 with a confidence interval of 0.90 (1.640 std)

A table of numbers with different colored numbers

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*Table 3: Expected returns from hyperparameter optimization for Bollinger Band Model parameters*

**Price Investment Optimized Model**

A table of numbers with different colored squares

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*Table 4: Expected returns from hyperparameter optimization for price investment for buy/sell actions*

**Price Investment and Bollinger Band Parameter Optimzation Model**

**A table of numbers with different colored numbers

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*Table 5: Expected returns from hyperparameter optimization for price investment and parameters for buy/sell actions*

**Initial Investment with Bollinger Band Investing**

A table of numbers with different colored numbers

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*Table 6: Bollinger Bands with Buy & Hold Strategy implemented*

*A graph of different colored lines

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*Graph 1: Relationship between Bollinger Bands and a Buy/Hold Strategy (money invested in the stock prior to investment period)*

There is an inverse exponential relationship between return and the percentage of cash given to initial investments. Meaning that the Bollinger Bands perform the best when there is no initial investment suggesting that it does well when volatility is highest.

**Discussion**

**A graph with red green and blue lines

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