Assignment 1

Introduction to Financial Engineering (MAL4330)

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Problem Statement:

The task involves selecting an asset (e.g., stock, bond, ETF) and gathering its closing prices over the past 3 years. Four or more technical indicators, chosen from options like Moving Average, RSI, Bollinger Bands, and MACD, are to be calculated. A correlation analysis of the selected indicators is then performed, followed by creating a combined indicator with weighted averages based on the obtained correlations. The objective is to devise a methodology for predicting bullish and bearish positions on each timestamp using the combined indicator, with the final step being the reporting of prediction accuracy.

Data Set :

We have selected the data set of Reliance Industries stocks in the BSE, from the 1st January 2021 to 1st January 2024. Data consists of opening price , closing price , volume traded , high , low etc. . Out of which the closing price was used for modeling purposes.

Indicator Used:

1. Moving Average (MA), (Simple moving average)
2. Relative Strength Index (RSI)
3. Bollinger Bands
4. Moving Average Convergence Divergence (MACD)

Moving Average:

Moving averages are calculated to identify the trend direction of a stock or to determine its support and resistance levels. It is a trend-following or lagging indicator because it is based on past prices. A simple moving average (SMA), is calculated by taking the arithmetic mean of a given set of values over a specified period

$$SMA = \frac{A_1 + A_2 + \ldots + A_n}{n}$$

Where:
A=Average in period n
n=Number of time periods

Relative Strength Index:

The relative strength index (RSI) is a popular momentum oscillator introduced in 1978. The RSI

provides technical traders with signals about bullish and bearish price momentum, and it is often plotted beneath the graph of an asset's price.An asset is usually considered overbought when the RSI is above 70 and oversold when it is below 30.

$$RSI_{\text{step one}} = 100 - \left[\frac{100}{1 + \frac{\text{Average gain}}{\text{Average loss}}}\right]$$

Bollinger Bands :

Bollinger Bands is a technical analysis tool to generate oversold or overbought signals and was developed by John Bollinger. Three lines compose Bollinger Bands: A simple moving average, or the middle band, and an upper and lower band. The upper and lower bands are typically 2 standard deviations +/- from a 20-day simple moving average and can be modified.

$$\text{BOLU} = \text{MA}(\text{TP}, n) + m * \sigma[\text{TP}, n]$$
$$\text{BOLD} = \text{MA}(\text{TP}, n) - m * \sigma[\text{TP}, n]$$

where:

$\text{BOLU} = \text{Upper Bollinger Band}$

$\text{BOLD} = \text{Lower Bollinger Band}$

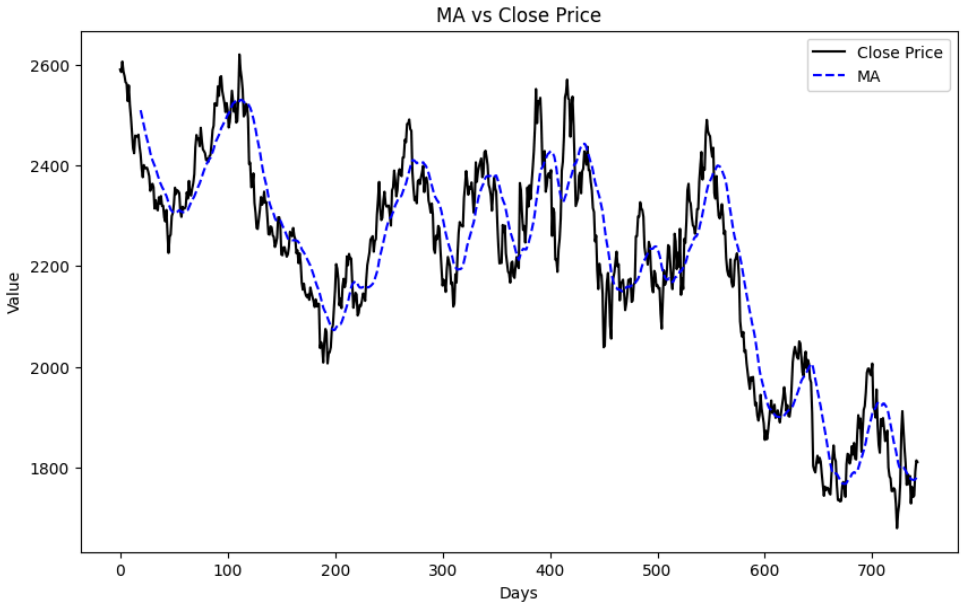
$\text{MA} = \text{Moving average}$

$\text{TP (typical price)} = (\text{High} + \text{Low} + \text{Close}) \div 3$

$n = \text{Number of days in smoothing period (typically 20)}$

$m = \text{Number of standard deviations (typically 2)}$

$\sigma[\text{TP}, n] = \text{Standard Deviation over last } n \text{ periods of TP}$



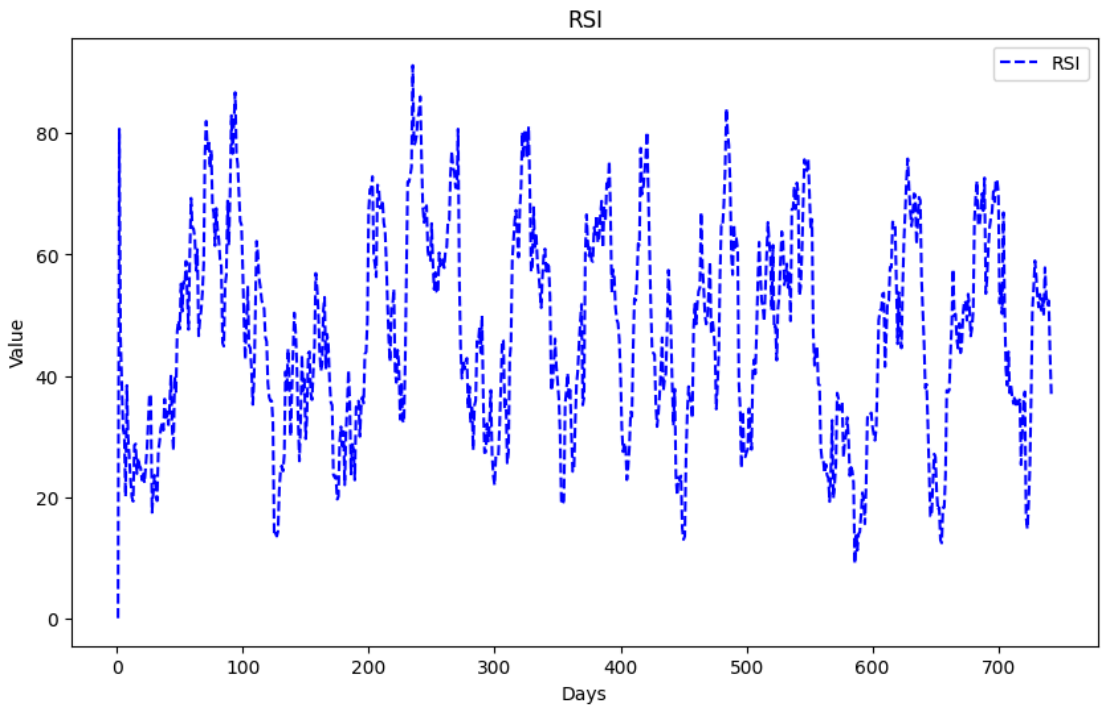
Moving Average Convergence Divergence (MACD) :

The moving average convergence/divergence (MACD, or MAC-D) line is calculated by subtracting the 26-period exponential moving average (EMA) from the 12-period EMA. The signal line is a nine-period EMA of the MACD line. MACD is best used with daily periods, where the traditional setting of 26/12/9 days is the default.

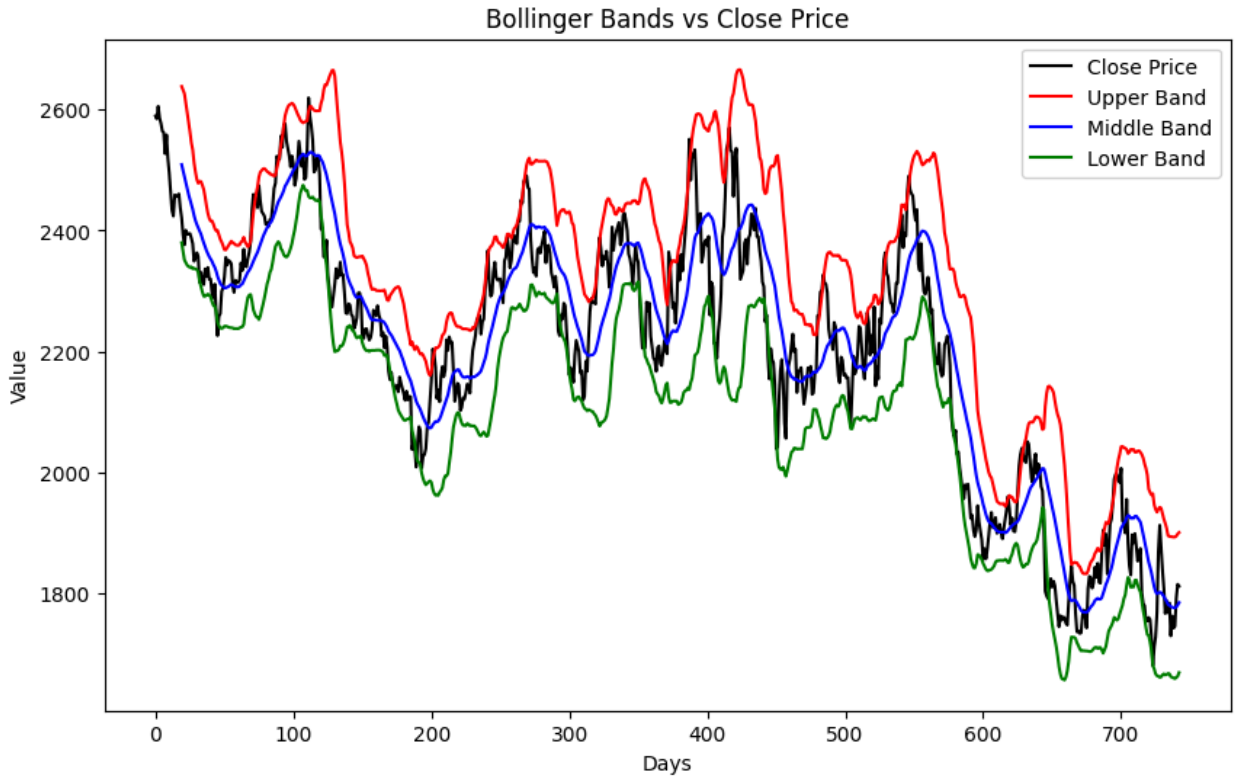
$$\text{MACD} = \text{12-Period EMA} - \text{26-Period EMA}$$

The plots for each indicator is shown below:

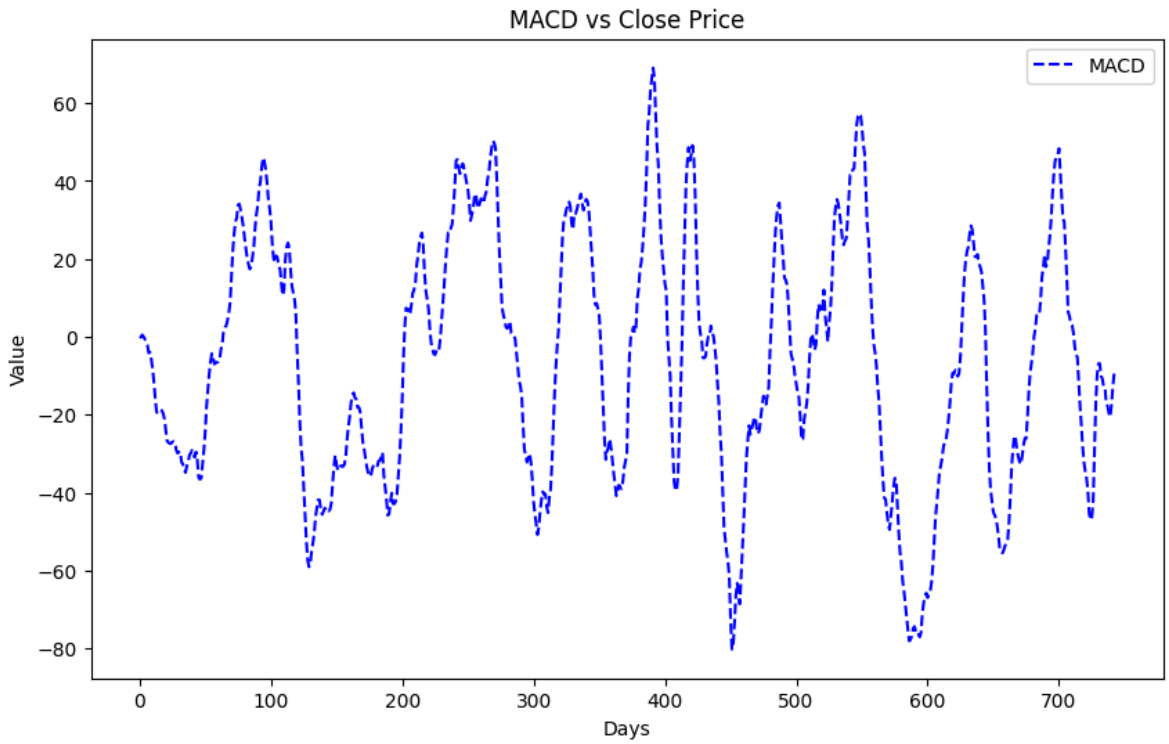
Moving Average (MA) [window size: 20 days]



Relative Strength Index (RSI)



(**Bollinger Bands)**



(Moving Average Convergence Divergence)

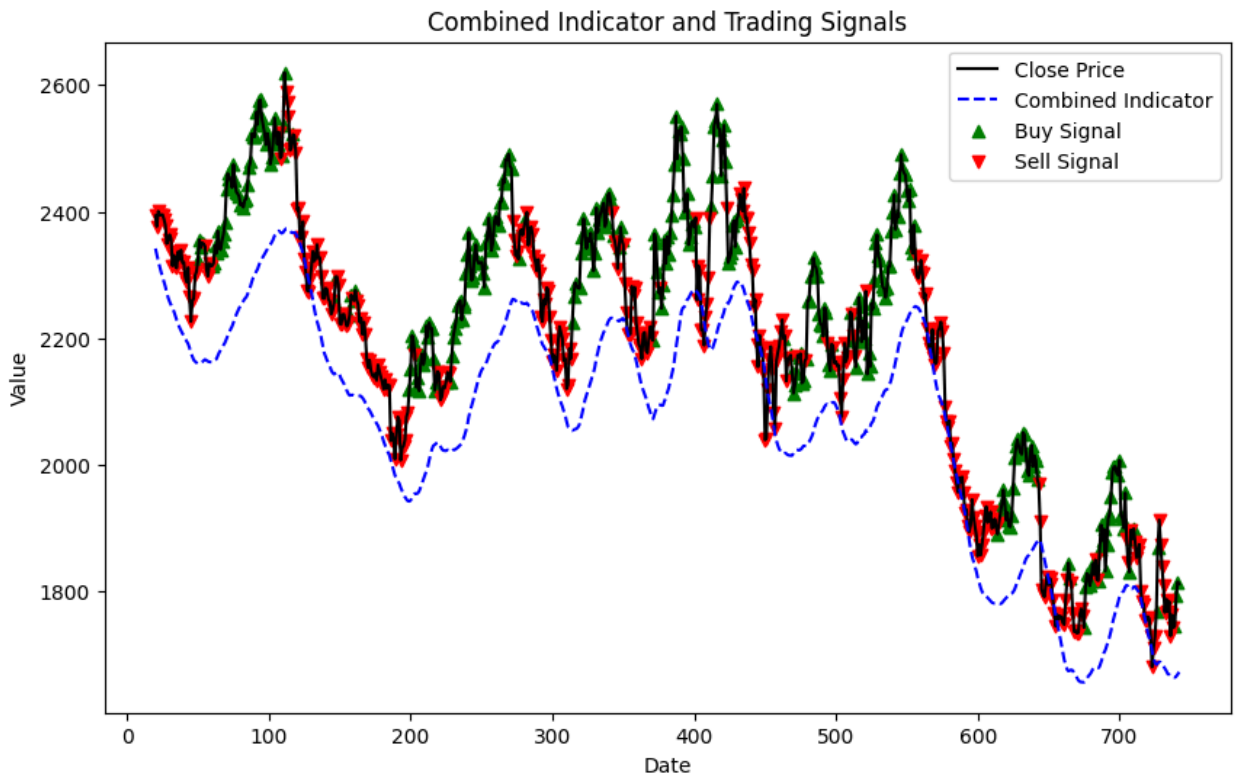
CORRELATION ANALYSIS

Based on the calculations of technical indicators. Correlation matrix is calculated and based on the correlation weights is assigned to each technical indicator which we call a combined indicator. Then we compare the values obtained using the combined indicators and the closing price we get from the data.

The correlation matrix (heatmap) plotted between the indicators and the closing price of the asset is shown below:

PREDICTION ACCURACY

The combined indicator gave an accuracy of 57.68%



(With the combined indicators)

REFERENCES:

The data is taken from https://www.investing.com/
To learn about the Indicators, we used https://www.investopedia.com/