DATASET AND TECHNICAL INDICATORS

Dataset Used - Black Rock Closing Dataset

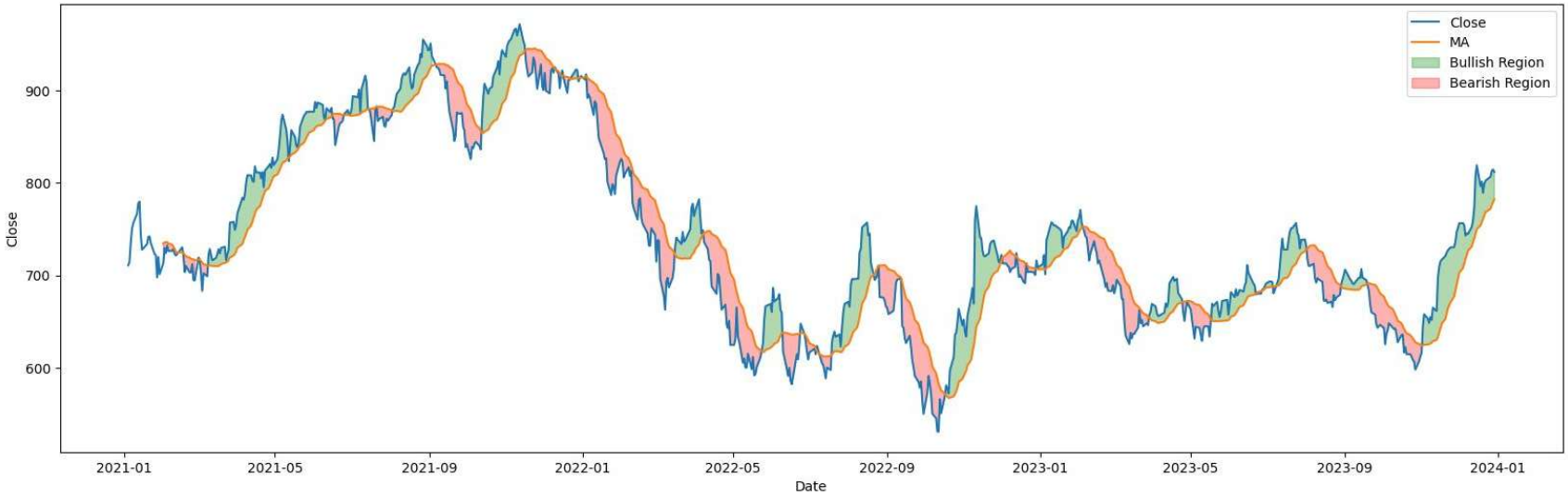
- MOVING AVERAGE (MA)
- BOLLINGER BANDS (BB)
- RELATIVE STRENGTH INDEX (RSI)
- MOVING AVERAGE CONVERGENCE DIVERGENCE (MACD)
- ON BALANCE VOLUME (OBV)
- AVERAGE DIRECTIONAL INDEX (ADX)

SIMPLE MOVING AVERAGE

- Average over n days window

$$SMA = (A_1 + A_2 + ...A_n) / n$$

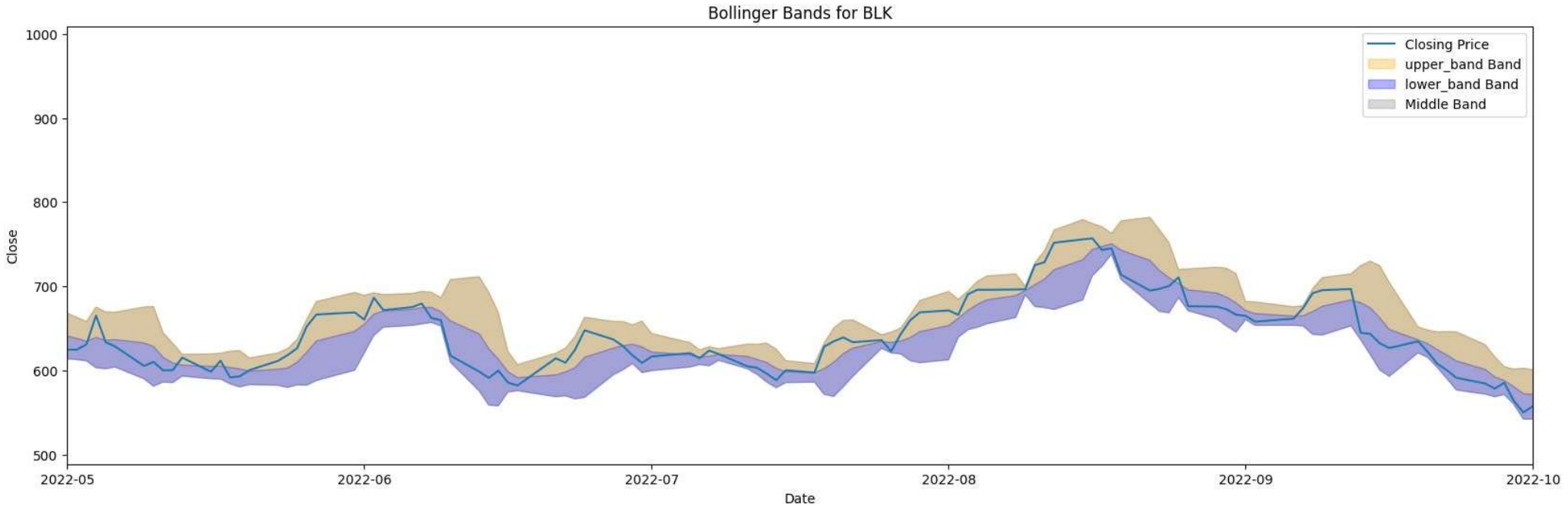
- For a particular timestamp if:
  - Close Price value is greater than Moving Average value then it is considered as Bullish
  - Close Price value is less than Moving Average value then it is considered as Bearish



BOLLINGER BANDS

- Upper band = 20-day SMA + (20-day SD x 2)
- Middle band = 20-day SMA
- Lower band = 20-day SMA – (20-day SD x 2)
- For a particular timestamp if –
  - Closing Price > Upper band → **Bearish**
  - Middle band < Closing Price < Upper Band → **Bullish**
  - Lower band < Closing Price < Middle Band → **Bearish**
  - Closing Price < Lower band → **Bullish**

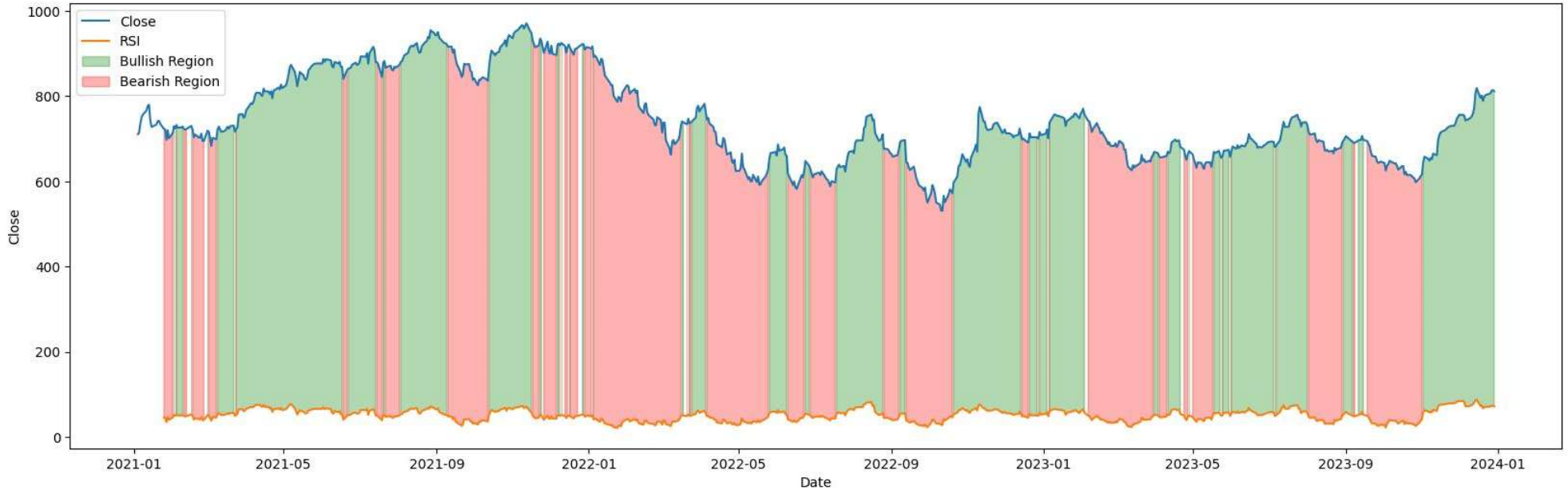
BOLLINGER BANDS



RELATIVE STRENGTH INDEX

- For a particular timestamp if:
  - RSI value is greater than 0.5 then it is considered as Bullish
  - RSI value is less than 0.5 then it is considered as Bearish

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



MOVING AVERAGE CONVERGENCE DIVERGENCE

- EMA - Exponential Moving Average

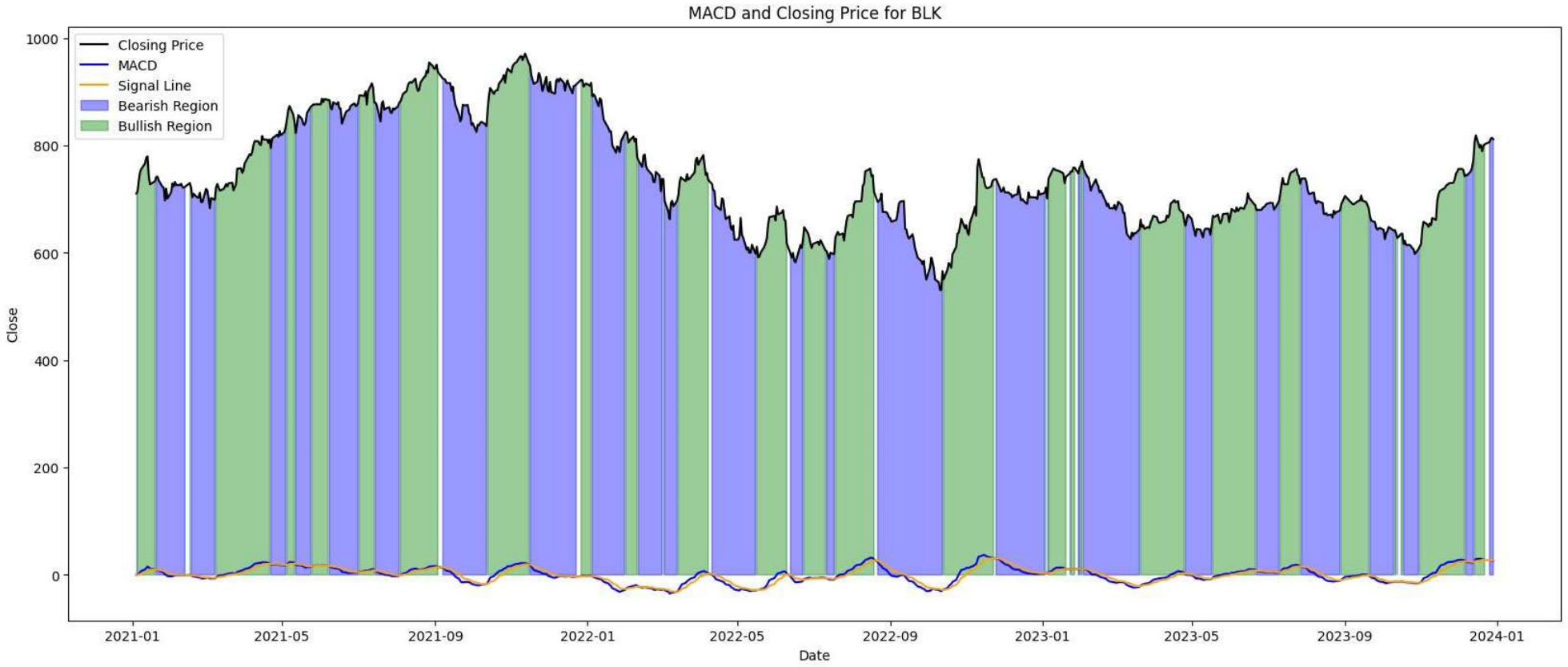
$$\text{EMA}_{\text{Today}} = \text{Price Today} \times \left(\frac{\text{Smoothing}}{1 + \text{Days}}\right) + \text{EMA}_{\text{Yesterday}} \left(1 - \left(\frac{\text{Smoothing}}{1 + \text{Days}}\right)\right)$$

- MACD = 12-Period EMA − 26-Period EMA
- Signal Line = 9-Period EMA

  For a particular timestamp if:

  - MACD Line value is greater than Signal Line value then it is considered as Bullish
  - MACD Line value is less than Signal Line value then it is considered as Bearish

MOVING AVERAGE CONVERGENCE DIVERGENCE



ON BALANCE VOLUME

- If the current OBV value is greater than then the previous one, then it is considered bullish
- Otherwise if current OBV value is smaller than then the previous one, then it is considered bearish

$$\text{OBV} = \text{OBV}_{prev} + \begin{cases} \text{volume}, & \text{if close} > \text{close}_{prev} \\ 0, & \text{if close} = \text{close}_{prev} \\ -\text{volume}, & \text{if close} < \text{close}_{prev} \end{cases}$$

where:

OBV = Current on-balance volume level

OBV_{prev} = Previous on-balance volume level

volume = Latest trading volume amount

AVERAGE DIRECTIONAL INDEX

- Predict bullish if ADX is high, greater than 25 (indicating a strong trend)
- Predict bearish if ADX is not high (indicating a weak or no clear trend)

$$+\text{DI} = \left(\frac{\text{Smoothed } +\text{DM}}{\text{ATR}}\right) \times 100$$

$$\text{-DI} = \left(\frac{\text{Smoothed -DM}}{\text{ATR}}\right) \times 100$$

$$\text{DX} = \left(\frac{|\ +\text{DI} - \text{-DI}\ |}{|\ +\text{DI} + \text{-DI}\ |}\right) \times 100$$

$$\text{ADX} = \frac{(\text{Prior ADX} \times 13) + \text{Current ADX}}{14}$$

where:

$+\text{DM (Directional Movement)} = \text{Current High} - \text{PH}$

$\text{PH} = \text{Previous High}$

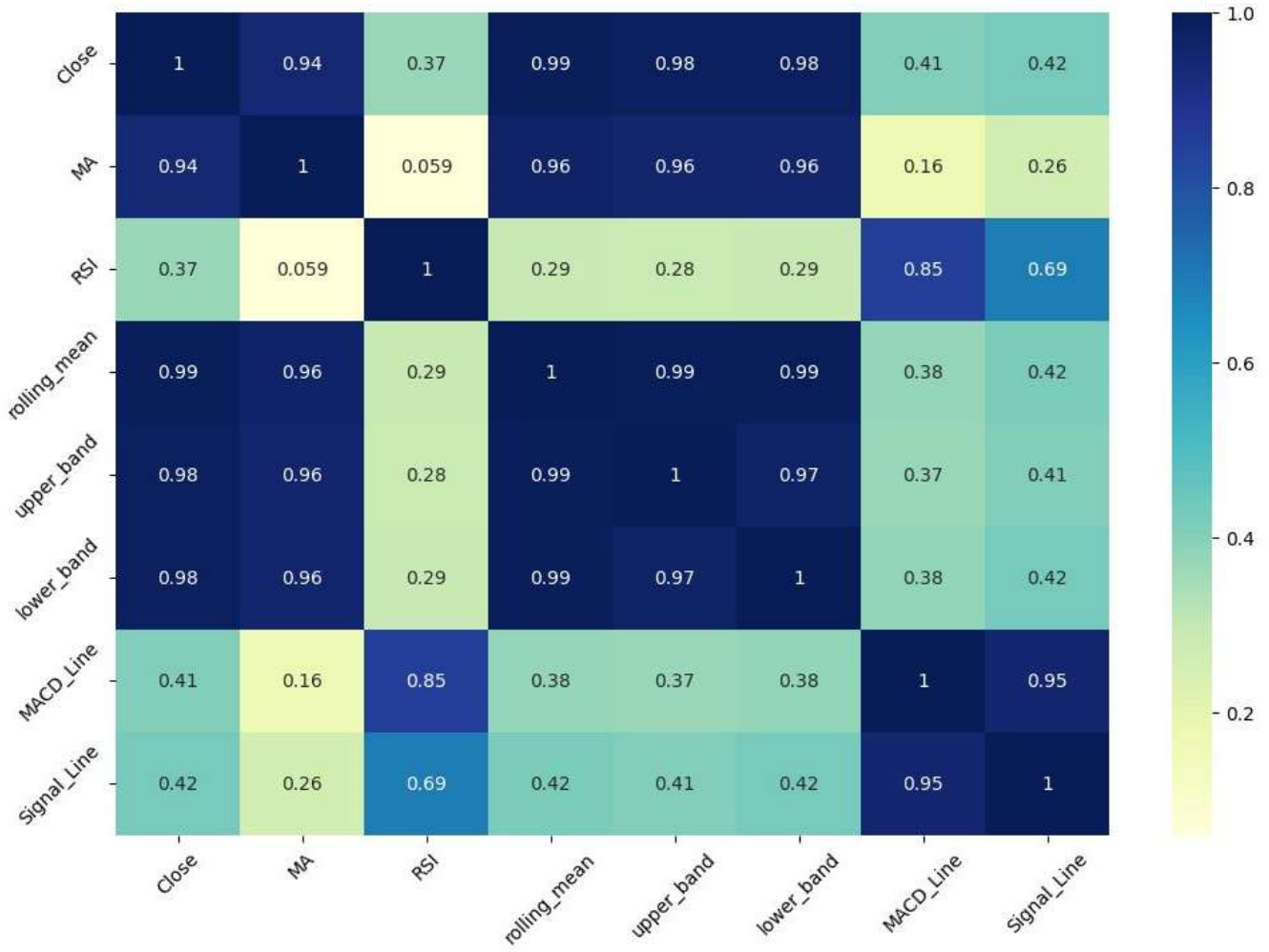
$\text{-DM} = \text{Previous Low} - \text{Current Low}$

$$\text{Smoothed } +/\text{-DM} = \sum_{t=1}^{14} \text{DM} - \left(\frac{\sum_{t=1}^{14} \text{DM}}{14}\right) + \text{CDM}$$

$\text{CDM} = \text{Current DM}$

$\text{ATR} = \text{Average True Range}$

Correlation Analysis



Key Points:

1. Considering weighing order as [MA, BB, RSI, MACD]
2. Correlation between MA and BB is very high. So in-order to reduce redundancy and to enhance the unique insights, we assigned lesser weights to one of them (MA).
3. Now, correlation between other indicators is not that high, so in-order to find weights we find correlation between indicators and closing price. That are [0.99, 0.37, 0.42]
4. Normalizing these we get [0.55, 0.2, 0.23] (rounded)
5. Weights sum needs to be 1, so 0.02 weight is given to MA.
6. Therefore, overall weights we get [0.02, 0.55, 0.2, 0.23]

Combining Indicators

We have considered two methods for combining indicators:

METHOD-1:

Combining weighted prediction of all the indicators.

a. If weighted prediction is greater than equal to 0, then it Bullish.
b. If weighted prediction is less than 0, then it Bearish.

METHOD-2:

1. Calculated three combined indicators (Combined_value_mean, Combined_value_lower, Combined_value_upper) using different combinations of normalized indicators and their assigned weights.
2. Based on below information we predict Long and Short:

   For a particular timestamp if –

   - Closing Price > Combined_value_upper → **Bearish**
   - Combined_value_mean < Closing Price < Combined_value_upper → **Bullish**
   - Combined_value_lower < Closing Price < Combined_value_mean → **Bearish**
   - Closing Price < Combined_value_lower → **Bullish**

Method - 3

- Indicators used : Moving Average , Relative Strength Index , On Balance Volume , Average Directional Index
- Using the closing prices from the previous 5 days and correlation, we determine the weights using the given equation. (Considering a linear relationship between indicators and the output (bullish or bearish) :

$$\mathbf{x}=(A^TA)^{-1}\ A^T\mathbf{b}$$

  - A → Matrix of samples with features as value of indicators , closing prices of previous 5 days, correlations of indicators and a unit value for biasness
  - b → Actual output for previous 5 days
  - X → weights
- Here the weights are dynamic in nature depending on the correlation between indicators and previous 5 days closing prices .

Close
Ma
RSI
OBV
ADX
1
0.94
0.37
0.9
0.0086
0.94
1
0.059
0.85
-0.01
0.37
0.059
1
0.35
0.098
0.9
0.85
0.35
1
-0.067
0.0086
-0.01
0.098
-0.067
1
1.0
0.8
0.6
0.4
0.2
0.0

Comparison

Methods	**Accuracy**
Method-1	77.17 %
Method-2	46.74 %
Method-3	92.39%

THANK YOU