

Introduction to Financial Engineering

Technical Analysis

Team Members

Akriti Gupta (B21AI005)

Rishav Aich (B21AI029)

Sagnik Goswami (B21AI034)

Tanish Pagaria (B21AI040)

Asset Selection

The asset chosen for the project was **Alphabet Inc Class A (GOOGL)** stock data.

The closing price dataset over the last 3 years for the chosen asset was taken from Yahoo Finance.



Technical Indicators

- **Trend indicators:**

Moving Average (MA), Exponential Moving Average (EMA), Moving Average Convergence Divergence (MACD)

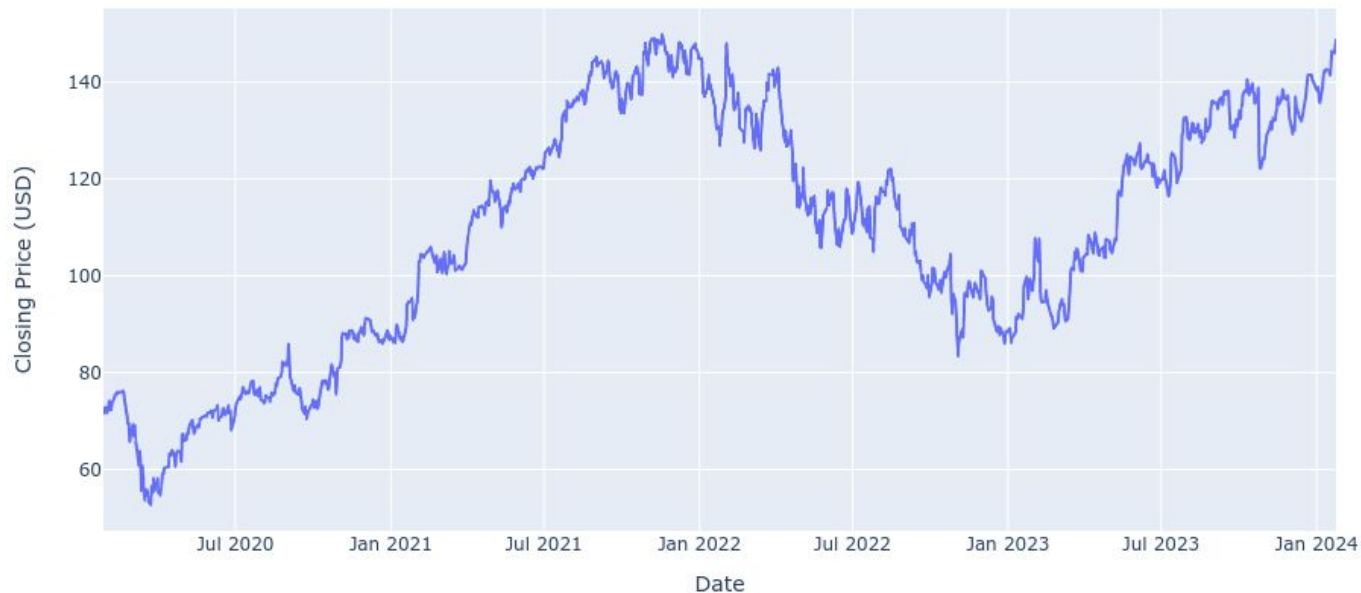
- **Momentum Indicators:**

Relative Strength Index (RSI), Stochastic RSI, Kaufman's Adaptive Moving Average (KAMA), True Strength Index (TSI), Rate of Change (ROC)

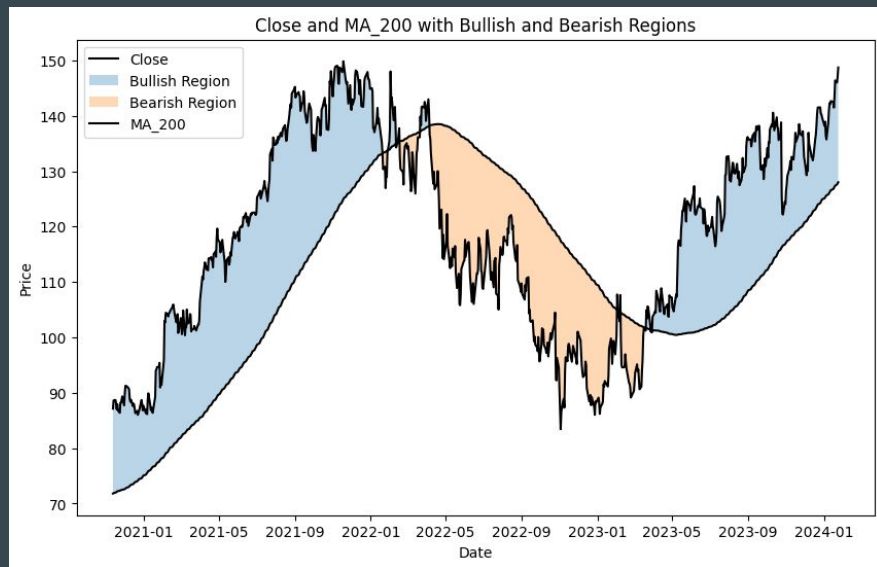
- **Volatility Indicators:** Bollinger Bands

Exploratory Data Analysis

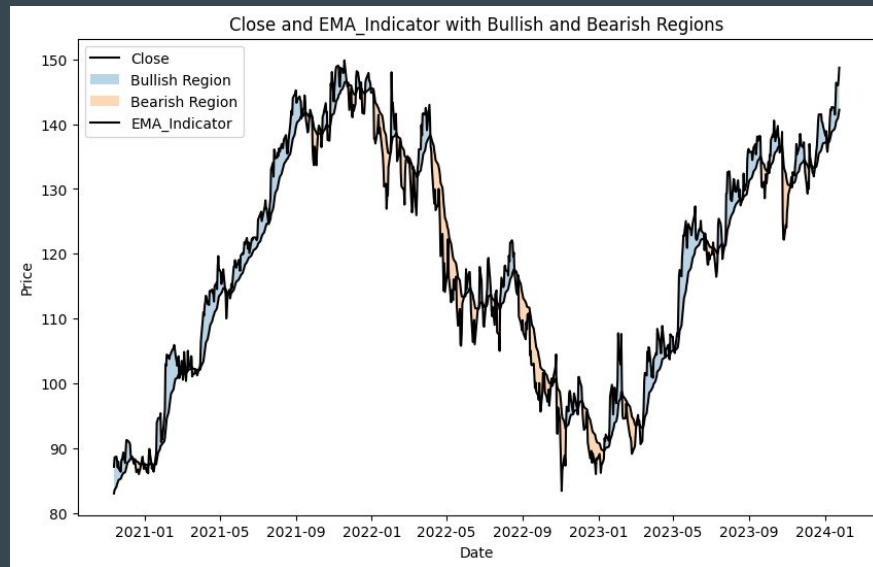
Alphabet Inc Class A (GOOGL) Equity Closing Prices (Last 3 Years)



Exploratory Data Analysis

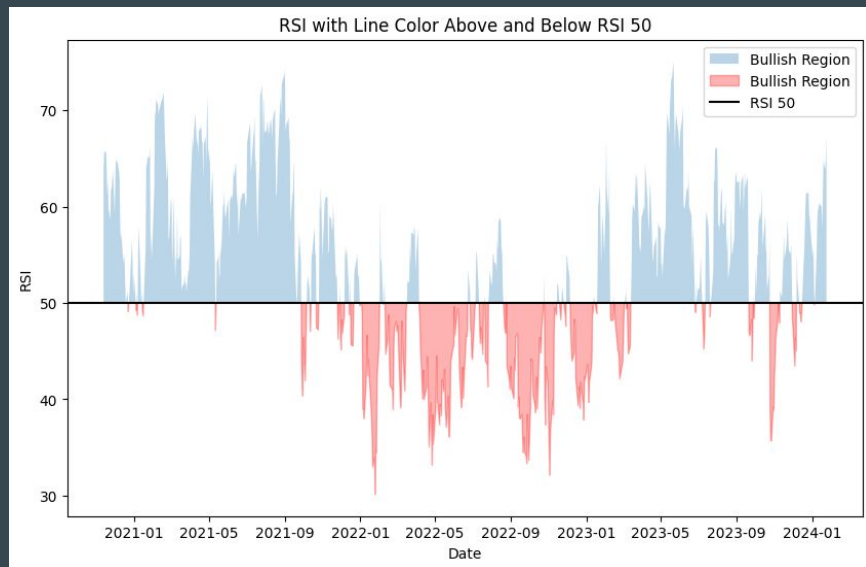


Moving Average (MA)
[window size: 200 days]

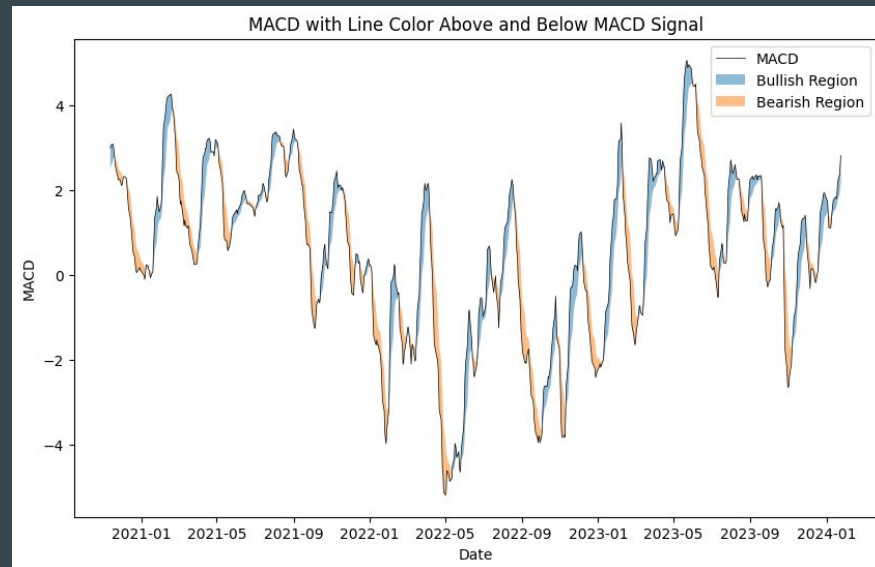


Exponential Moving Average (EMA)

Exploratory Data Analysis

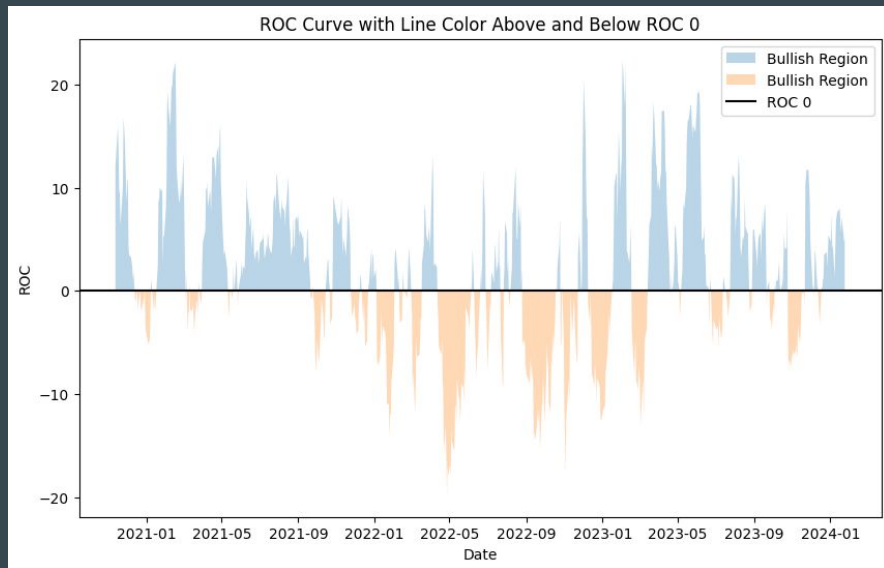


Relative Strength Index (RSI)

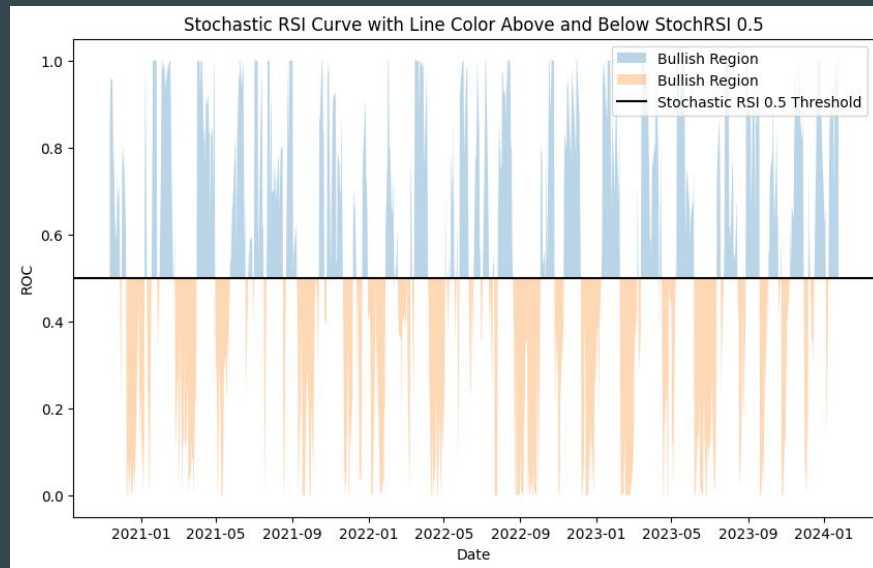


Moving Average Convergence Divergence (MACD)

Exploratory Data Analysis

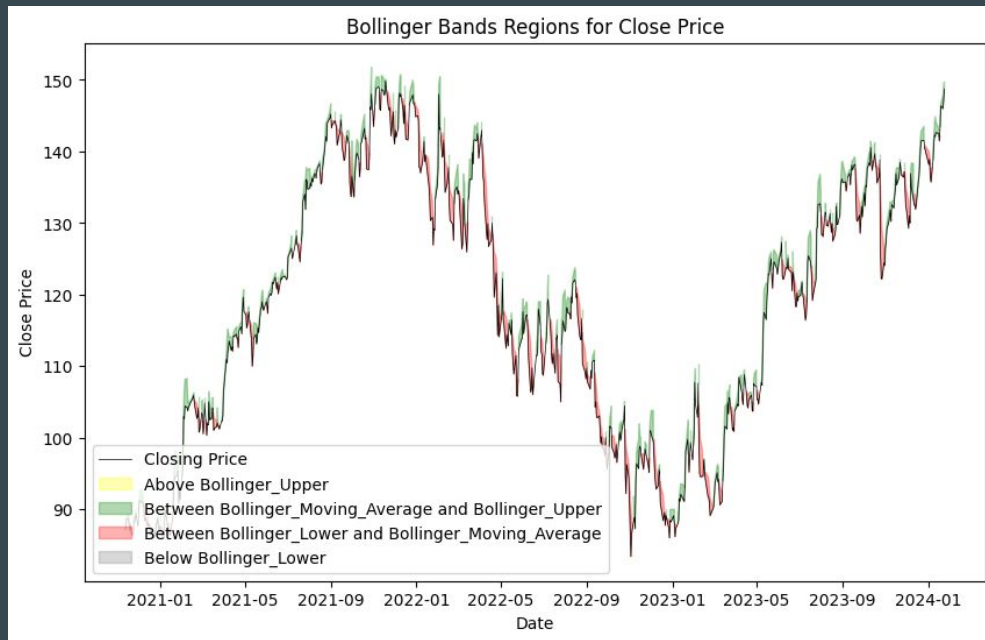


Rate of Change (ROC)



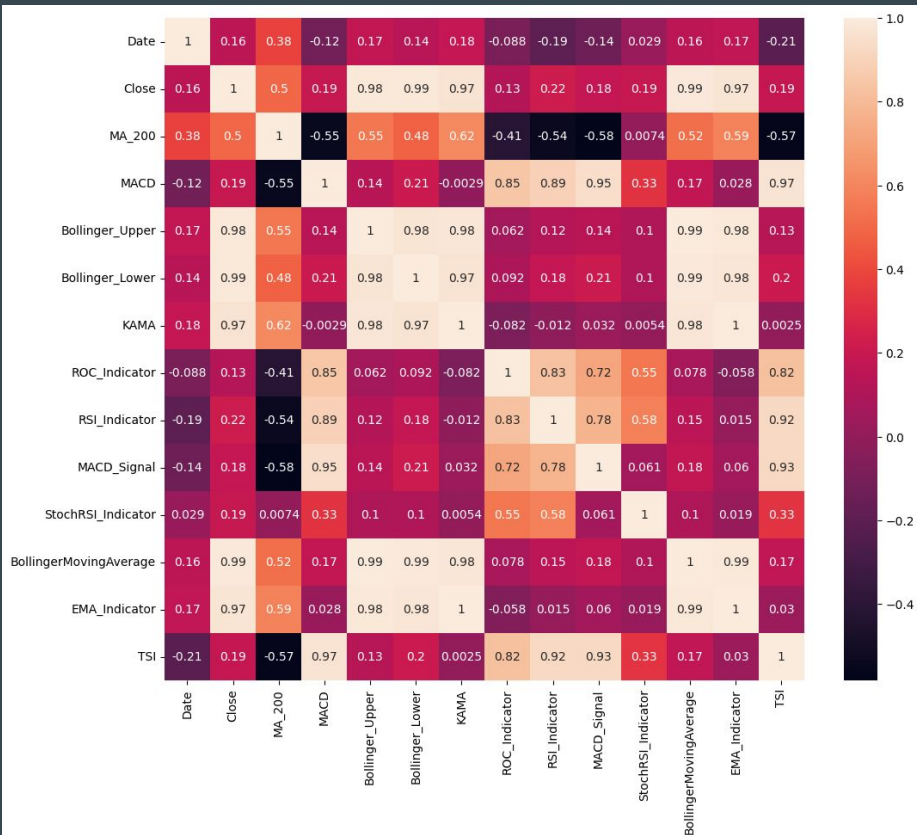
Stochastic Relative Strength Index
(Stochastic RSI)

Exploratory Data Analysis



Bollinger Bands

Correlation Analysis



Observations:

Indicators showing high (> 0.95) correlation with each other:

- KAMA, EMA & Bollinger Bands
- MACD and TSI

Correlation Analysis

Bollinger Bands	0.991184
EMA	0.974320
KAMA	0.965830
MA_200	0.498118
RSI	0.217430
MACD	0.194318
Stochastic RSI	0.192073
TSI	0.189873
ROC	0.125787

Observations:

Indicators showing very low low correlation with the "closing price":

- TSI
- Stochastic RSI
- ROC

Correlation Analysis

Based on the observations:

- Highly correlated indicators were eliminated:

KAMA, EMA and TSI

- Features with very low correlation with "Closing Price" were eliminated:

Stochastic RSI and ROC

Remaining indicators

(for constructing "Combined Indicator")

- Moving Average (MA)
 - Moving Average Convergence Divergence (MACD)
 - Relative Strength Index (RSI)
 - Bollinger Bands
-

"Combined" Indicator

Assigning the weights to indicators

The correlation values with the "closing price" were normalized to calculate the respective weights:

Bollinger Bands	0.52
MA_200	0.26
RSI	0.11
MACD	0.10

"Combined" Indicator

Predicting BULLISH or BEARISH positions

Due to the diverse value ranges provided by each technical indicator for the asset it was essential to **normalize the technical indicator values** to establish a **common threshold**, enabling the final prediction based on comparison with the resultant value of combined indicators.

NOTE: For the above predicted positions, the following resultant values was decided:

Predicted Position	Indicator Resultant Value
Bullish	+1
Bearish	-1

Bollinger Bands

$BOLU = MA(TP, n) + m * \sigma[TP, n]$

$BOLD = MA(TP, n) - m * \sigma[TP, n]$

where:

BOLU = Upper Bollinger Band

BOLD = Lower Bollinger Band

MA = Moving average

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

n = Number of days in smoothing period (typically 20)

m = Number of standard deviations (typically 2)

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

Condition	Predicted Position
Upper BB < Closing Price	Bearish
Middle BB < Closing Price < Upper BB	Bullish
Lower BB < Closing Price < Middle BB	Bearish
Closing Price < Lower BB	Bullish

Relative Strength Index (RSI)

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

Condition	Predicted Position
RSI < 50	Bearish
RSI > 50	Bullish

Moving Average (Window Length: 200 days)

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

where:

A_n = the price of an asset at period n

n = the number of total periods

Condition	Predicted Position
MA < Closing Price	Bearish
MA > Closing Price	Bullish

Moving Average Convergence Divergence (MACD)

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

Condition	Predicted Position
MACD < MACD Signal	Bearish
MACD > MACD Signal	Bullish

Prediction Accuracy

Based on the previous normalization, it was decided to **add weightage** to bullish or bearish positions according to the predictions of each indicator and their corresponding weights.

The **position with the dominant resultant weightage** was returned as the predicted position for each time-stamp.

The combined indicator gave an accuracy of 75.31%.

Literature Review (supporting the "Combined" Indicators)

- Combining **RSI with Bollinger Bands** helps identify market shifts and entry points. When the price hits the upper Bollinger Band and RSI goes above 70, it suggests the asset is overbought. Another signal is when the price crosses the middle Bollinger Band and RSI is rising above its 50 line.
- Using **Moving Average and Bollinger Bands** together is effective. Wider bands indicate high volatility, narrow bands suggest low volatility. Approaching a Bollinger Band signals a likely turnaround, while breaking the middle band indicates continued movement towards the outer band.
- Momentum indicators, like **RSI**, show the strength of price movements over time, while trend indicators, like the **200 MA**, reveal directional trends. An efficient strategy involves using the 200 MA for smoothing fluctuations and the RSI for identifying momentum shifts.

Further Improvements

- Only the "closing price" data of the asset was utilized, restricting the use of other indicators like volume.

The exclusion of additional parameters prevented the exploration of various indicator combinations to improve prediction accuracy.

- Inclusion of factors such as "volume", "low" and "high" could have facilitated experimentation with diverse indicator combinations, potentially enhancing predictive accuracy.

THANK YOU!