

# Introduction to Business Analytics

## Lecture 9: Technical Analysis in R

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# Agenda

1. Intro to Technical Analysis
2. Types of Technical Analysis
3. Basics of Technical Analysis in Practice
4. Strategy Development
5. In-class Assignment

# **1. Intro to Technical Analysis**

# *What is Technical Analysis?*

It is the study of past market data, primarily price and volume, to identify potential trading opportunities and make informed trading decisions.



# *Usefulness of Technical Analysis for Business Analytics*

While technical analysis is primarily used in the field of finance and investment, it can also be useful in business analytics.

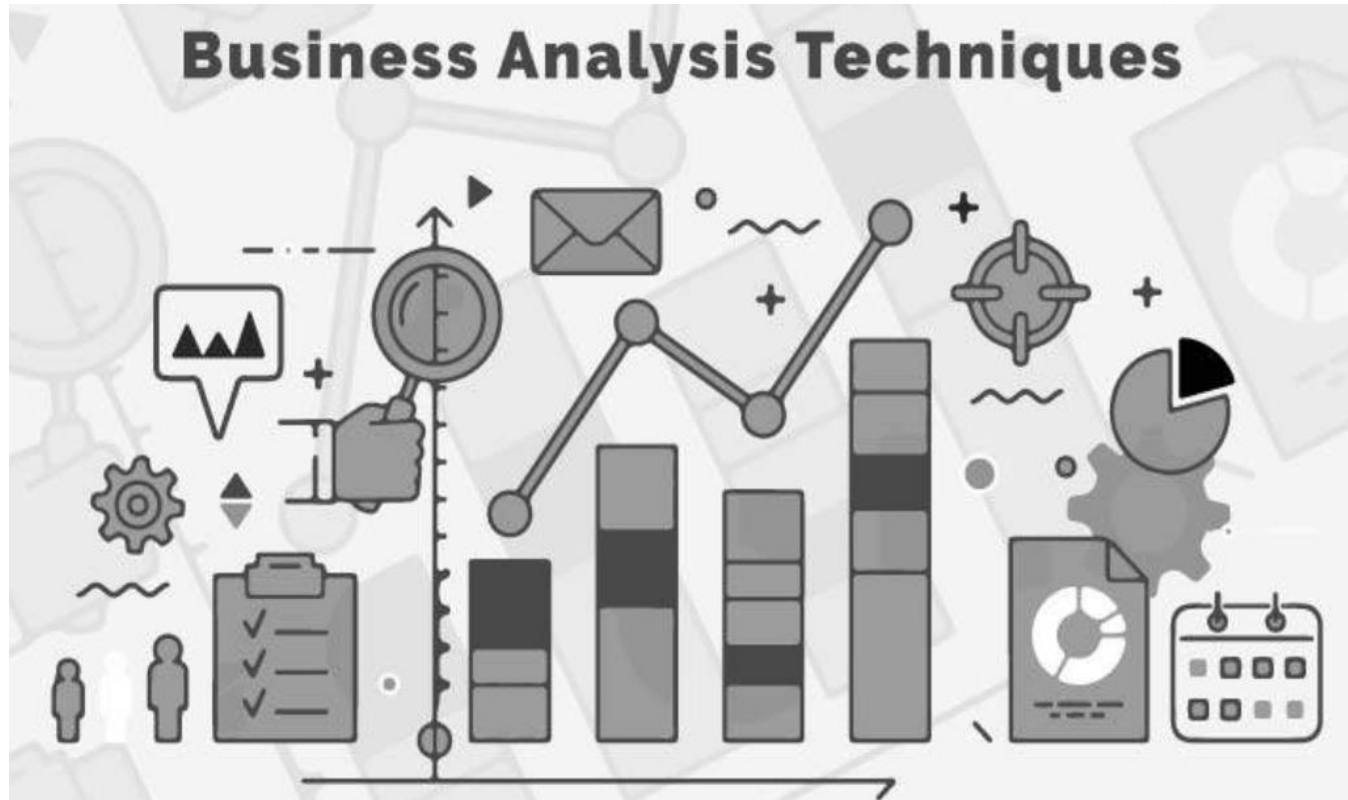
Here are a few ways that technical analysis can be beneficial in this context:

- ***Identifying trends:*** Technical analysis can be used to identify trends in business data, such as sales figures or website traffic. By looking at past data points, analysts can identify patterns that can help them forecast future trends and make strategic decisions based on that information.
- ***Predicting outcomes:*** By analyzing data patterns, technical analysis can help businesses predict future outcomes with greater accuracy. For example, by analyzing consumer behavior patterns, a business might be able to anticipate which products will be popular and adjust their production or marketing accordingly.
- ***Identifying opportunities:*** Technical analysis can help businesses identify opportunities for growth and expansion. By analyzing data from various sources, businesses can identify trends that suggest new markets or opportunities for innovation.

# ***Usefulness of Technical Analysis for Business Analytics***

Overall, technical analysis can be a valuable tool for businesses looking to make data-driven decisions.

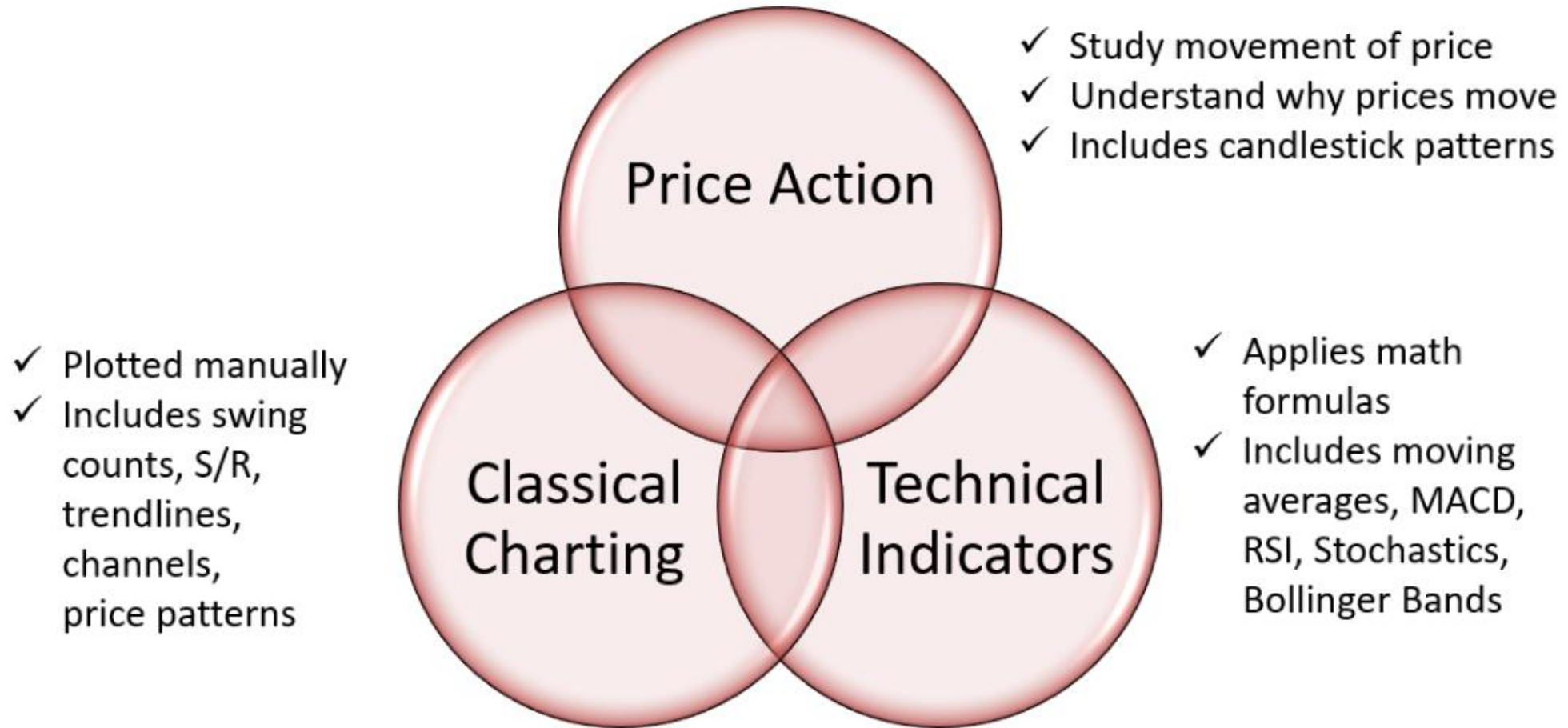
However, it should be used in conjunction with other analytical methods to ensure a comprehensive and accurate understanding of business data.



Resources: <https://www.analyticssteps.com/blogs/8-most-popular-business-analysis-techniques-used-business-analyst>

## **2. Types of Technical Analysis**

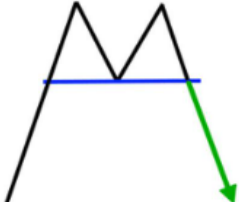
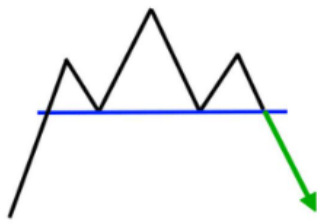
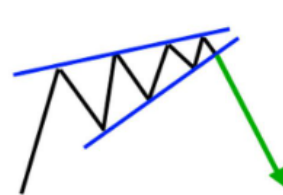
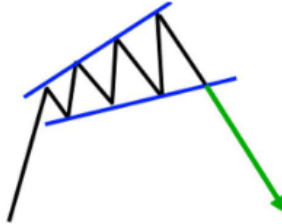
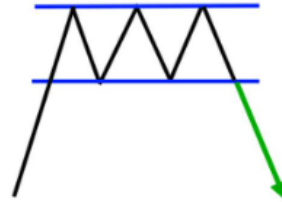
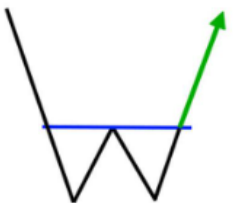
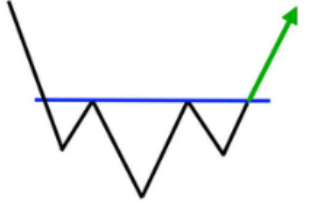
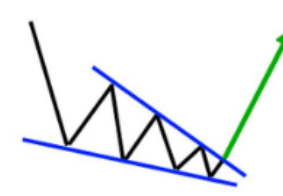
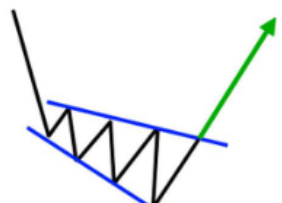
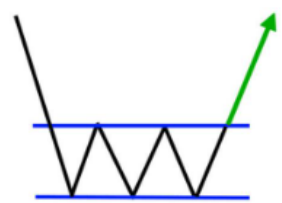
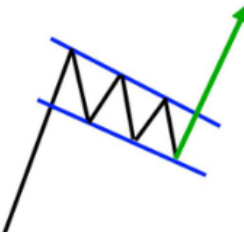

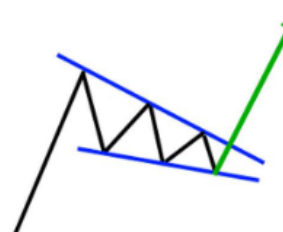
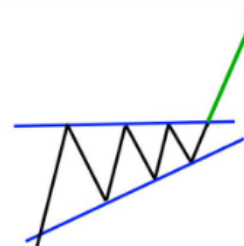
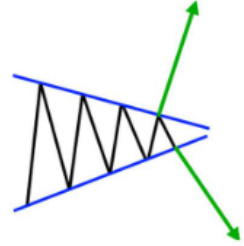
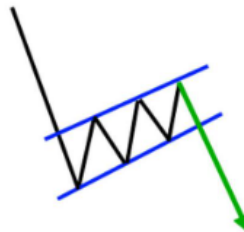
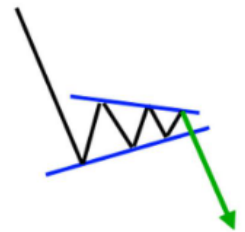
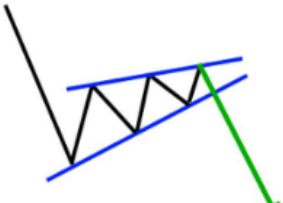
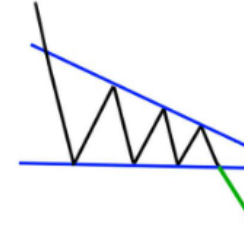
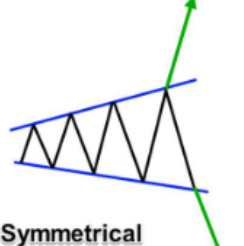
# *Types of Technical Analysis*



Resources: <http://synapsetrading.com/trading-guides/>



# Examples of Technical Analysis

|                       |   |   |   |   |   |
|-----------------------|---|---|---|---|---|
| Reversal Patterns     |  <p>Bearish Double Top</p>     |  <p>Bearish Head and Shoulders</p>          |  <p>Bearish Rising Wedge</p>   |  <p>Bearish Expanding Triangle</p> |  <p>Bearish Triple Top</p>               |
|                       |  <p>Bullish Double Bottom</p>  |  <p>Bullish Inverted Head and Shoulders</p> |  <p>Bullish Falling Wedge</p>  |  <p>Bullish Expanding Triangle</p> |  <p>Bullish Triple Bottom</p>            |
| Continuation Patterns |  <p>Bullish Flag Pattern</p>  |  <p>Bullish Pennant Pattern</p>            |  <p>Bullish Falling Wedge</p> |  <p>Ascending Triangle</p>        |  <p>Symmetrical Triangle</p>            |
|                       |  <p>Bearish Flag Pattern</p> |  <p>Bearish Pennant Pattern</p>           |  <p>Bearish Rising Wedge</p> |  <p>Descending Triangle</p>      |  <p>Symmetrical Expanding Triangle</p> |

- Example of head and shoulder pattern



# Examples of Candlestick Patterns



**BULLISH HAMMER**



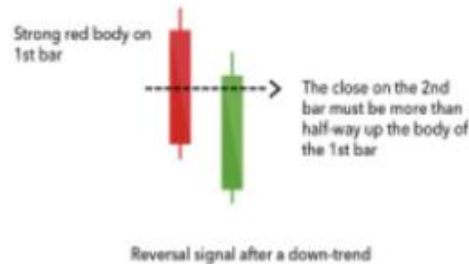
**INVERTED HAMMER**



**BULLISH ENGULFING**



**MORNING STAR**

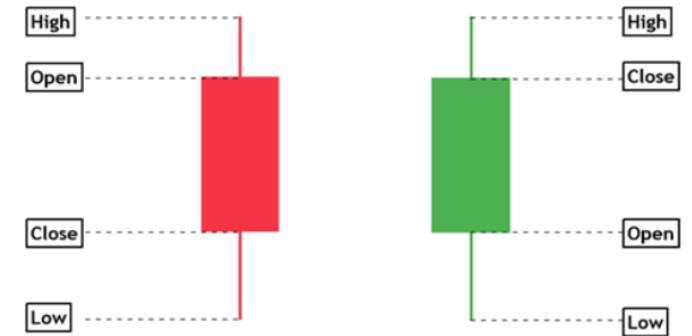


**PIERCING LINE**



**THREE WHITE SOLDIERS**

## The Anatomy of a Candlestick



# *Technical indicators*

mathematical calculations based on price and/or volume data that are plotted on a chart to help traders identify potential trading opportunities.

These indicators are used to analyze past price movements and to identify potential patterns or trends in the market.

There are hundreds of technical indicators that are commonly used in trading.

***!!! It's worth noting that while there are many technical indicators available, no single indicator can provide a foolproof trading signal, and traders often use a combination of indicators and other types of analysis to form a complete trading strategy.***

# ***Examples of Most Popular Types of Technical indicators***

- Moving Averages (MA)
- Relative Strength Index (RSI)
- Stochastic Oscillator
- Moving Average Convergence Divergence (MACD)
- Bollinger Bands
- Fibonacci Retracement
- Average Directional Index (ADX)
- Ichimoku Kinko Hyo
- On-Balance Volume (OBV)
- Commodity Channel Index (CCI)

Let's consider some of them in more details.

# Relative Strength Index (RSI) indicator

$$RSI = 100 - \frac{100}{1 + RS}$$

$$RS = \frac{Avg.Gain}{Avg.Loss}$$



The resulting number will oscillate between 0 and 100.

Readings 70 or higher mean the market is **overbought**.

Next, readings coming in at 30 or below mean the market is **oversold**.

# Bollinger Bands

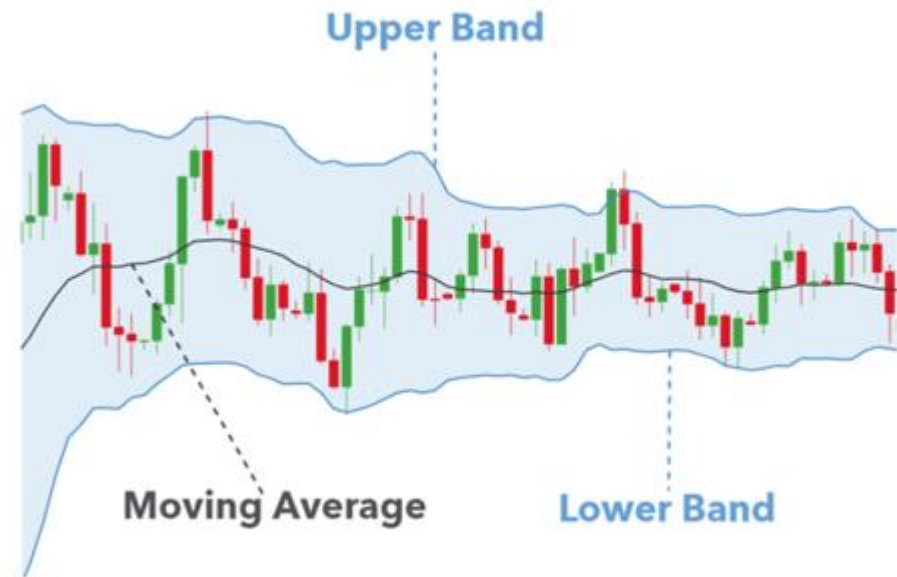
$$BBands_i = x_i \pm \sigma_i * d$$

observed value for single period

SMA of price for given period

# of standard deviations away from mean (bandwidth / 2)

standard deviation of SMA over a given period



When stock prices continually touch the upper Bollinger Band, the prices are thought to be **overbought**;  
conversely, when they continually touch the lower band, prices are thought to be **oversold**, triggering a buy signal.



# Moving Average Convergence/Divergence

'slow' signal line

12-period EMA of Price (fast)

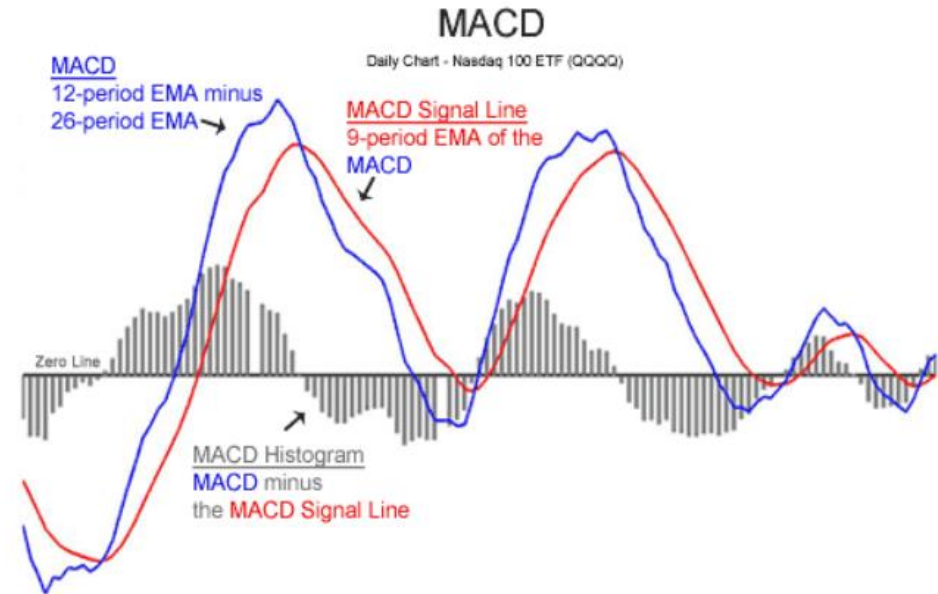
26-period EMA of Price (slow)

$$MACD_p = EMA_{12}(p) - EMA_{26}(p)$$

'fast' signal line

9-period EMA of MACD signal

$$S_{MACD} = EMA_9(MACD)$$



When MACD falls below the signal line, it is a bearish signal indicating that it may be time to sell.

Conversely, when MACD rises above the signal line, the indicator gives a bullish signal, suggesting that the price of the asset is likely to experience upward momentum.

Resources: <https://www.alpharithms.com/moving-average-convergence-divergence-macd-031217/>

<https://commodity.com/technical-analysis/macd/>



# **3. Basics of Technical Analysis in Practice**

# Loading the data

```
# Load tidyverse library
library(tidyverse)

# Install and load quantmod library
install.packages("quantmod")
library(quantmod)

# Retrieve Microsoft stock prices from Yahoo Finance from 2022-01-01 to present
prices <- getSymbols(Symbols = "MSFT", src = "yahoo", from = "2022-03-01",
  auto.assign = FALSE)
```

If you set `auto.assign = TRUE` in the `getSymbols` function call, the resulting price data will be assigned to an object with the same name as the symbol (in this case, "MSFT")

```
> head(prices)
```

|            | MSFT.Open | MSFT.High | MSFT.Low | MSFT.Close | MSFT.Volume | MSFT.Adjusted |
|------------|-----------|-----------|----------|------------|-------------|---------------|
| 2022-03-01 | 296.40    | 299.97    | 292.15   | 294.95     | 31217800    | 292.0846      |
| 2022-03-02 | 295.36    | 301.47    | 293.70   | 300.19     | 31873000    | 297.2737      |
| 2022-03-03 | 302.89    | 303.13    | 294.05   | 295.92     | 27314500    | 293.0452      |
| 2022-03-04 | 294.29    | 295.66    | 287.17   | 289.86     | 32356500    | 287.0440      |
| 2022-03-07 | 288.53    | 289.69    | 278.53   | 278.91     | 43157200    | 276.2004      |
| 2022-03-08 | 277.80    | 283.96    | 270.00   | 275.85     | 48159500    | 273.1701      |

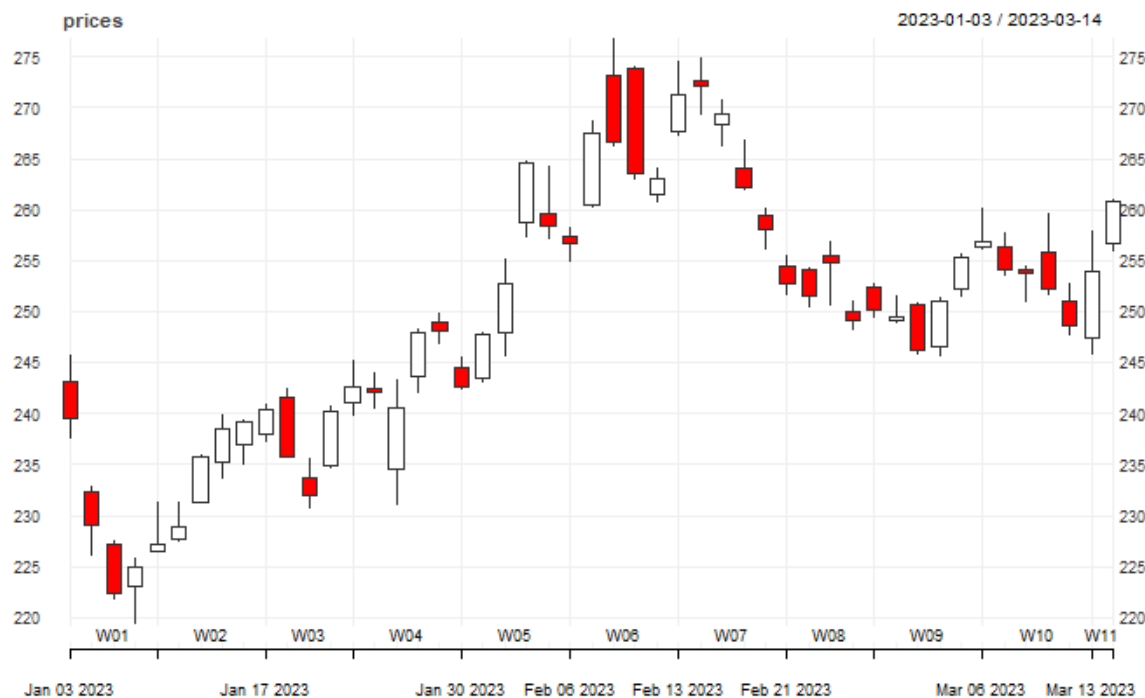
# Candlestick charting

```
# Display candlestick chart with black color  
chart_Series(prices, col = "black")
```



# Zooming the chart

```
#zoom for period of 2023  
zoom_Chart("2023")
```



```
#zoom for period from 2022-06 to 2022-12  
zoom_Chart("2022-06/2022-12")
```



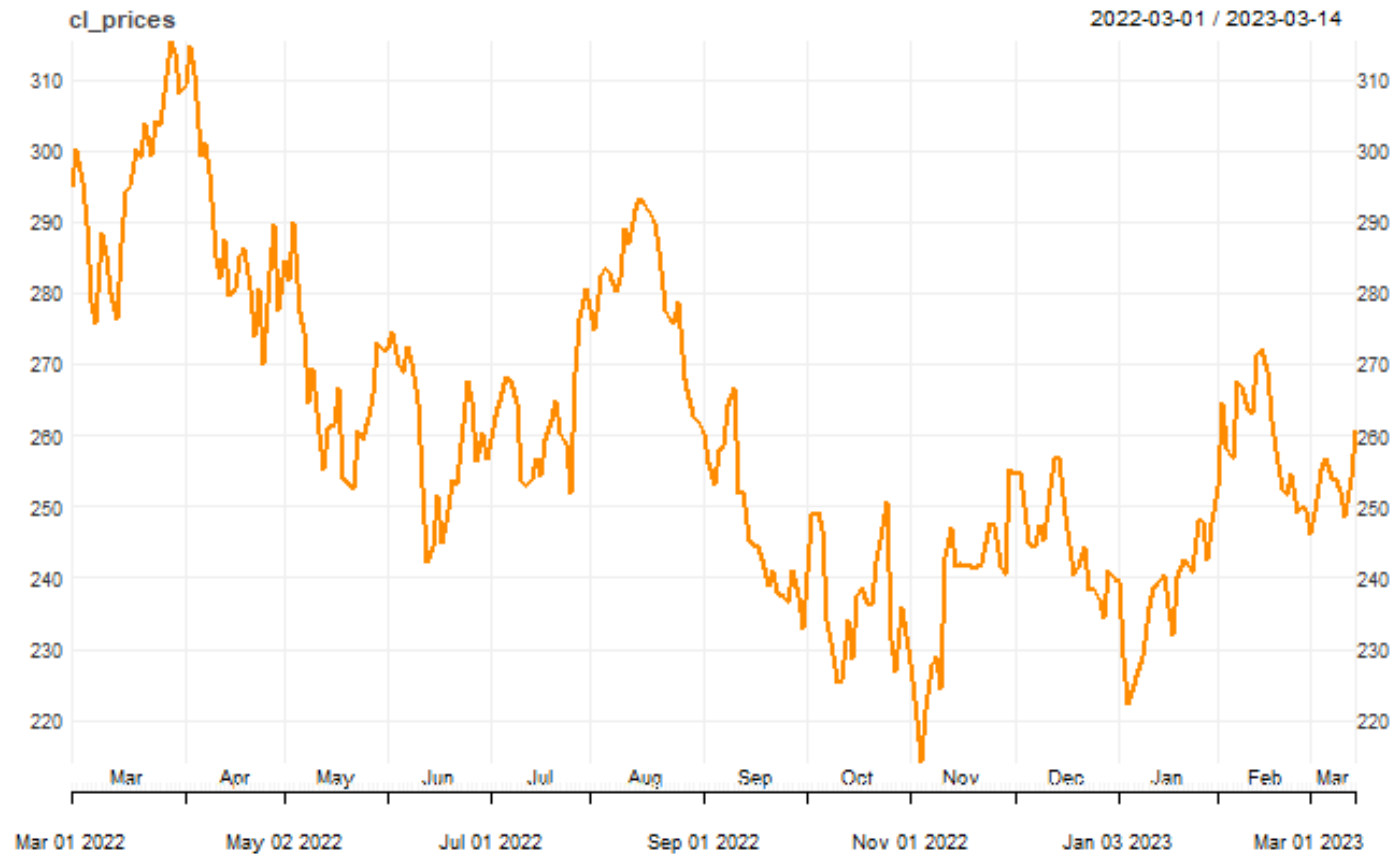
# Zooming the chart (cont.)

```
#zoom for the period starting from 2023-02 to the last available data in the data set  
zoom_Chart("2023-02::")
```



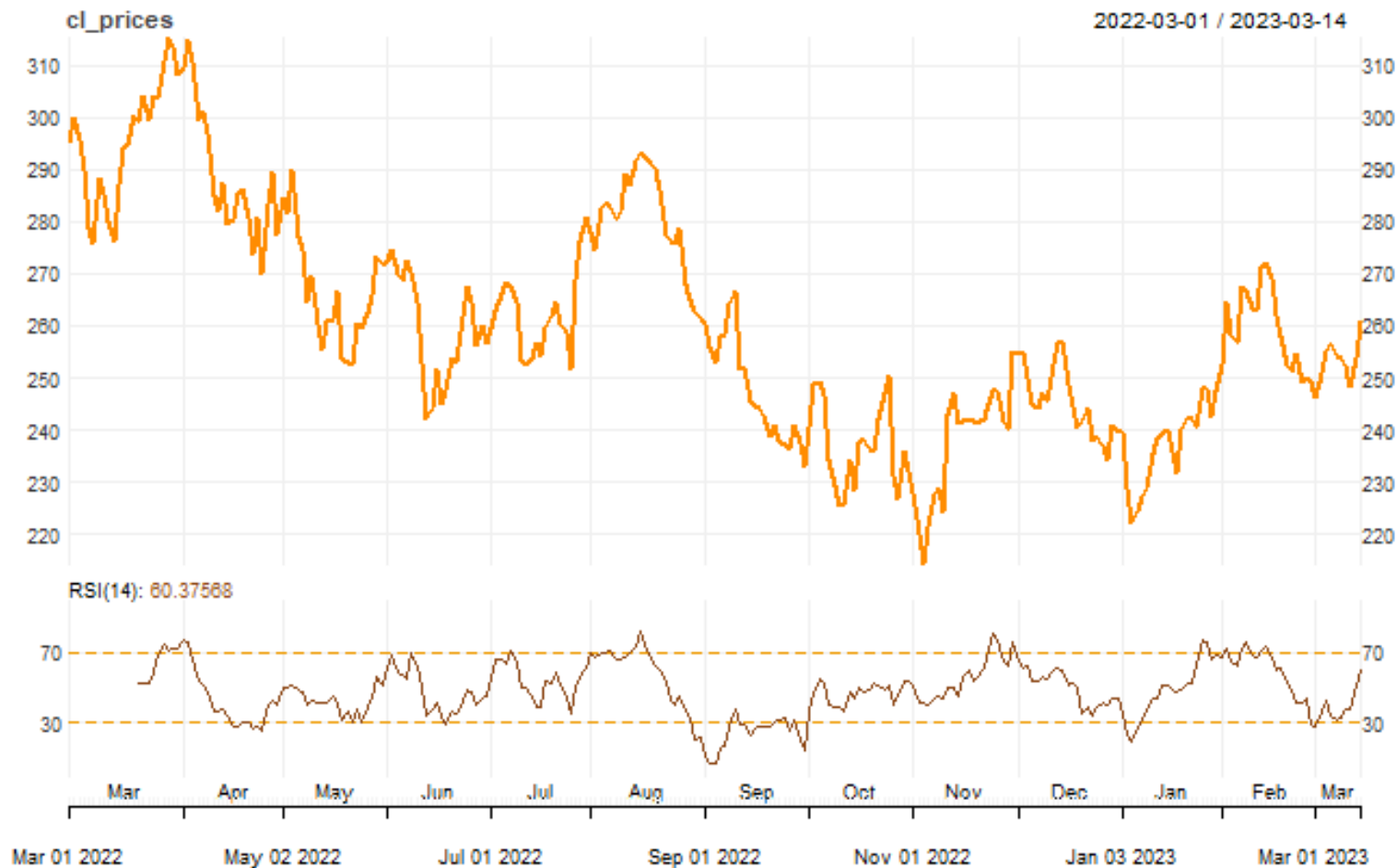
# Plot the Closing Prices

```
# Retrieve closing prices and remove missing values from closing prices if any  
cl_prices <- Cl(prices)  
  
#plot the closing prices  
chart_Series(cl_prices)
```



# Add RSI indicator to the plot

```
#add RSI indicator with period of 14  
add_RSI(n = 14, maType = "SMA")
```



***n***: The number of days used to calculate the RSI.

***maType***: The type of moving average to use in the RSI calculation.

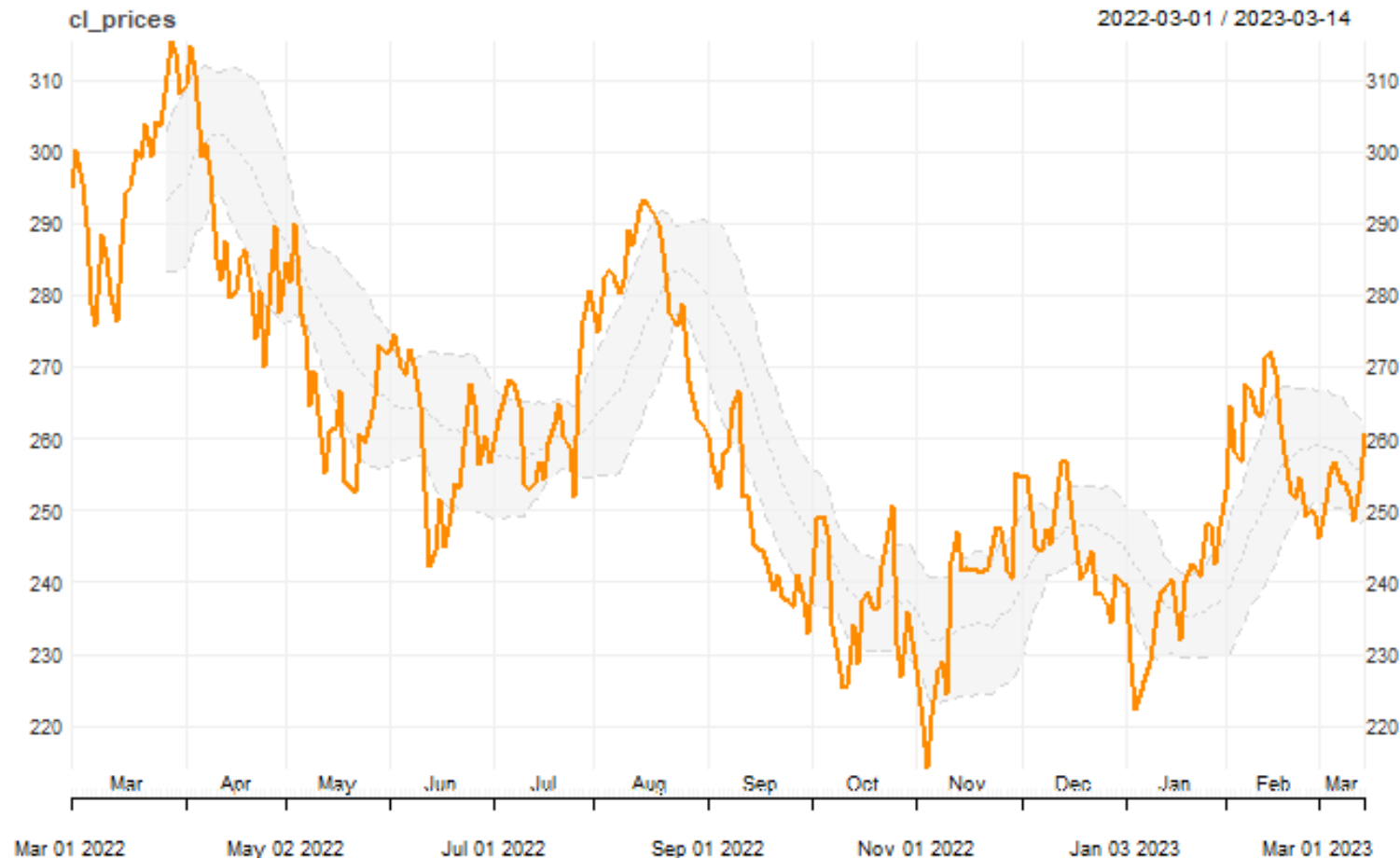
The default value is "SMA" (Simple Moving Average), but you can specify other types of moving averages such as:

"EMA" (Exponential Moving Average)

or "WMA" (Weighted Moving Average).

# Add Bollinger Bands to the Plot

```
# Add Bollinger Bands  
add_BBands(n = 20, maType = "SMA", sd = 1, on = -1)
```



***n***: The number of periods to use for the moving average.

***maType***: The type of moving average to use.

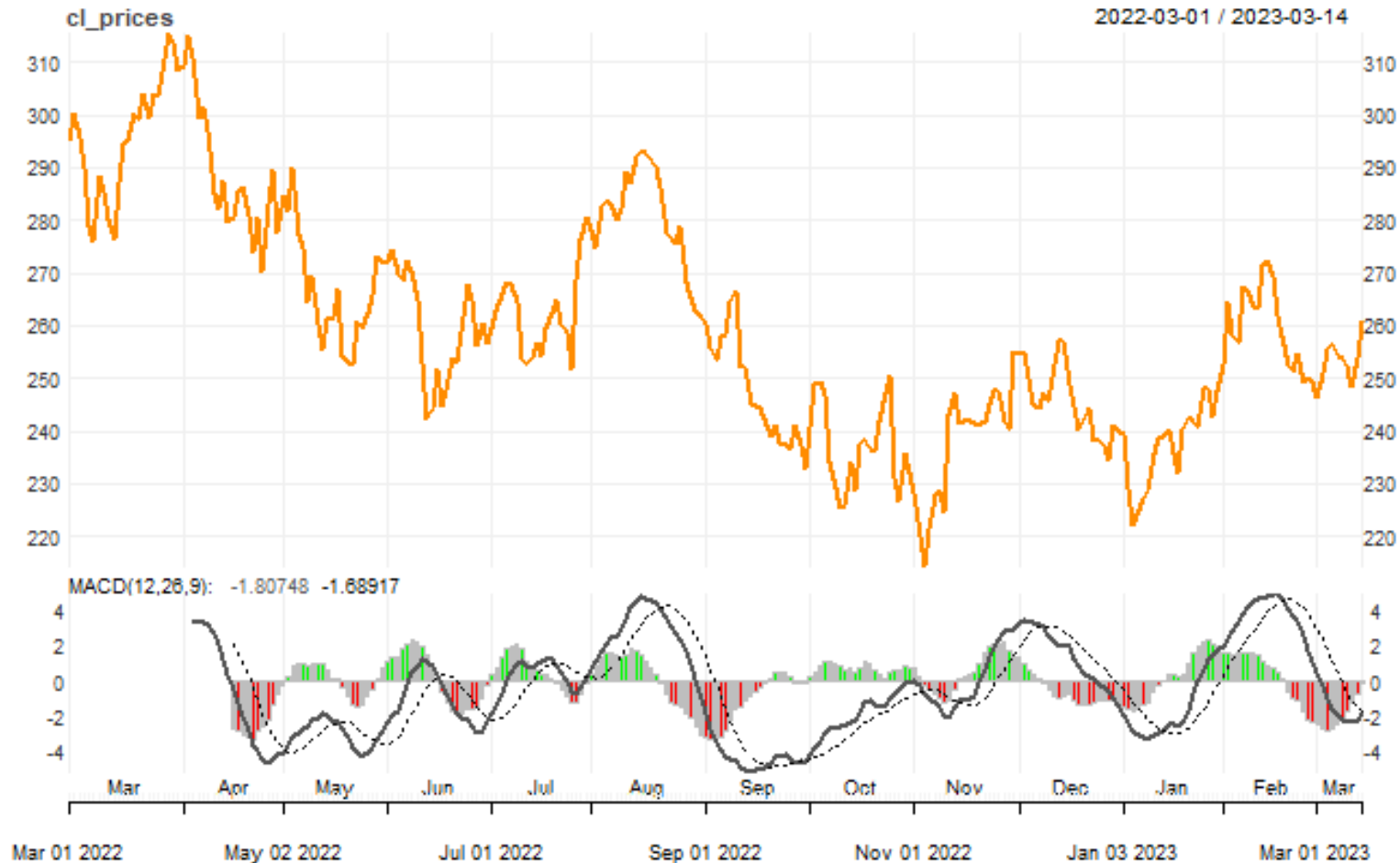
***sd***: The number of standard deviations to use for the upper and lower bands. The default value is 1, but you can choose any positive value.

***on***: An integer that specifies which plot pane to draw the Bollinger Bands on. The default value is -1, which means the Bollinger Bands are drawn on the same plot pane as the price chart.



# Add MACD to the Plot

```
# Add MACD indicator  
add_MACD(fast = 12, slow = 26, signal = 9, maType = "SMA", histogram = TRUE)
```



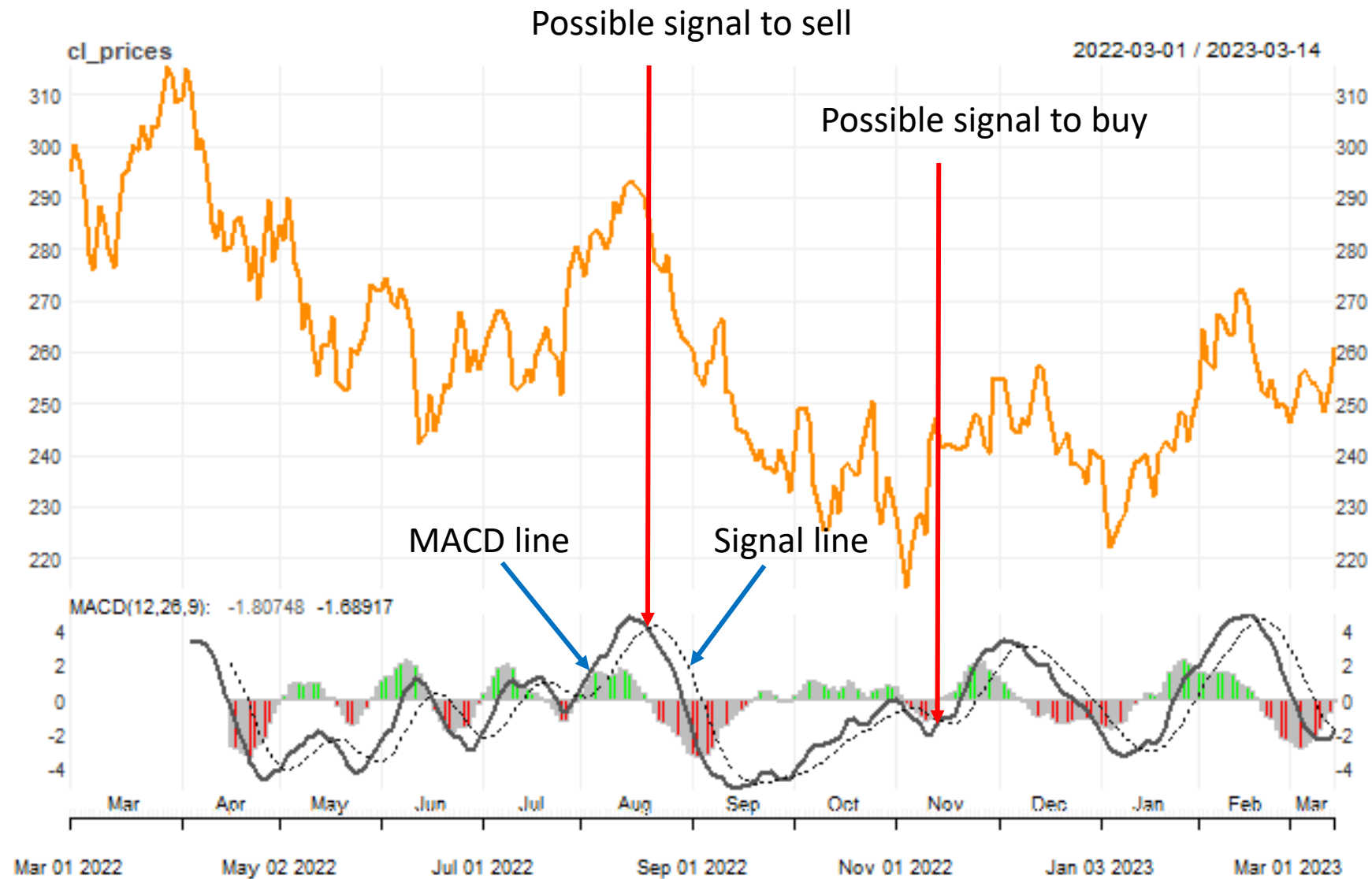
**fast:** the number of days used to calculate the fast moving average.

**slow:** the number of days used to calculate the slow moving average.

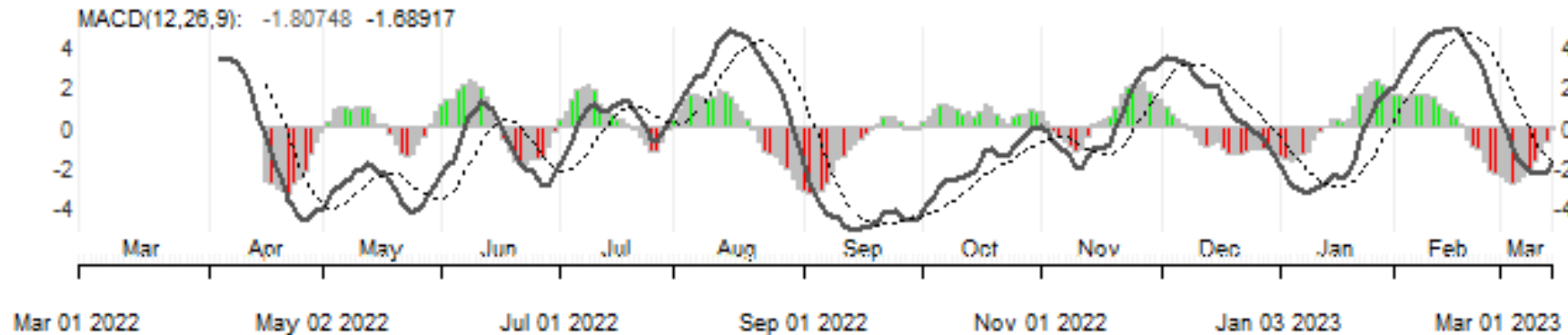
**signal:** the number of days used to calculate the signal line, which is a moving average of the MACD line.

**maType:** the type of moving average used to calculate the MACD and signal lines.

# MACD and Signal Line



# *Histogram at MACD plot*



***Histogram*** shows the difference between the MACD and signal lines.

When the histogram bars are increasing, it suggests that the market momentum is becoming stronger in the direction of the trend, while when the bars are decreasing, it suggests that the market momentum may be slowing down or reversing.

The histogram can also indicate whether bullish (increasing market) or bearish(falling market) momentum is dominant, based on whether the bars are above or below the zero line

## 4. Strategy Development

# *Install and Load PerformanceAnalytics package*

```
# Load PerformanceAnalytics library  
library(PerformanceAnalytics)
```

*PerformanceAnalytics* is R package of econometric functions for performance and risk analysis of financial instruments or portfolios.

Herein we will consider the development of strategy basing on MACD indicator.

But in a real world, to improve the strategy, you can add more technical indicators we were talking about and use them in combination with other indicators.

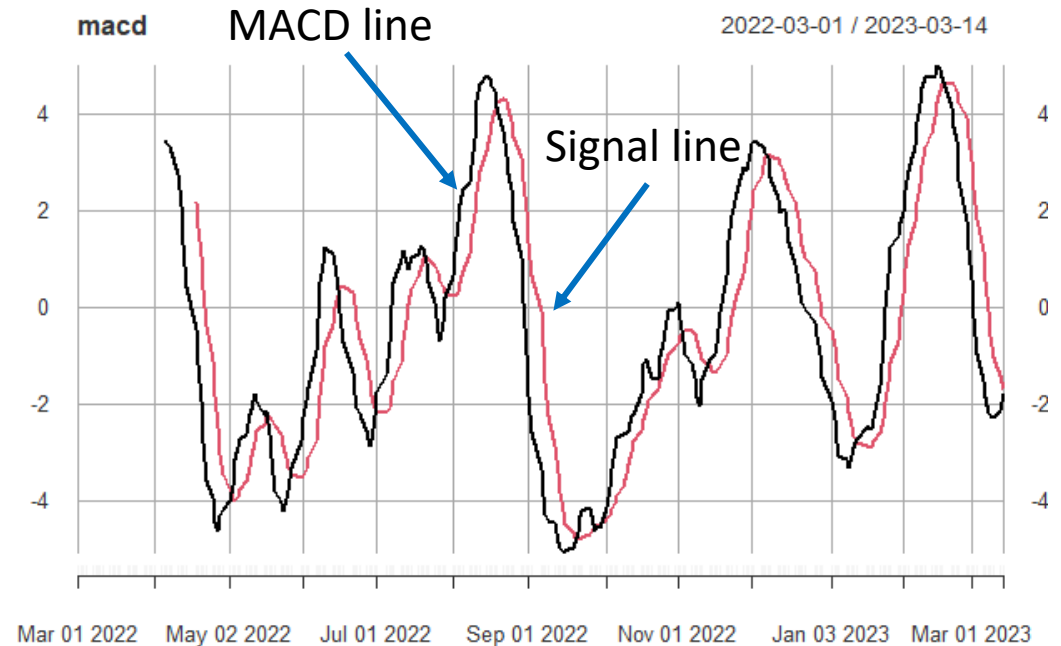
# Calculate MACD and Signal line

```
# Calculate the trading signal based on the MACD indicator  
macd <- MACD(cl_prices, maType = "SMA")  
tail(macd)
```

```
> tail(macd)
```

|            | macd      | signal      |
|------------|-----------|-------------|
| 2023-03-07 | -1.862064 | 0.55879409  |
| 2023-03-08 | -2.164059 | -0.06205179 |
| 2023-03-09 | -2.241188 | -0.60147760 |
| 2023-03-10 | -2.274919 | -1.05323030 |
| 2023-03-13 | -2.146421 | -1.42361340 |
| 2023-03-14 | -1.807476 | -1.68916849 |

```
plot(macd)
```



# Determine the direction of the trade based on the MACD indicator

```
# Calculate the difference between the MACD and Signal lines  
macd$diff <- macd$macd - macd$signal
```

When MACD line crosses above signal line, the market is probably going to increase.

When MACD line crosses below signal line, the market is probably going to decrease.

```
> tail(macd,20)
```

|            | macd    | signal   | diff    |
|------------|---------|----------|---------|
| 2023-02-14 | 4.7870  | 3.93550  | 0.8515  |
| 2023-02-15 | 4.9934  | 4.22451  | 0.7689  |
| 2023-02-16 | 4.9339  | 4.45893  | 0.4750  |
| 2023-02-17 | 4.7528  | 4.61828  | 0.1346  |
| 2023-02-21 | 4.1345  | 4.65270  | -0.5182 |
| 2023-02-22 | 3.7156  | 4.59765  | -0.8821 |
| 2023-02-23 | 3.4236  | 4.47209  | -1.0485 |
| 2023-02-24 | 2.6136  | 4.23356  | -1.6199 |
| 2023-02-27 | 1.7909  | 3.90502  | -2.1142 |
| 2023-02-28 | 1.1870  | 3.50503  | -2.3180 |
| 2023-03-01 | 0.5825  | 3.01493  | -2.4324 |
| 2023-03-02 | -0.2121 | 2.44316  | -2.6552 |
| 2023-03-03 | -0.9796 | 1.80622  | -2.7858 |
| 2023-03-06 | -1.5147 | 1.17853  | -2.6932 |
| 2023-03-07 | -1.8621 | 0.55879  | -2.4209 |
| 2023-03-08 | -2.1641 | -0.06205 | -2.1020 |
| 2023-03-09 | -2.2412 | -0.60148 | -1.6397 |
| 2023-03-10 | -2.2749 | -1.05323 | -1.2217 |
| 2023-03-13 | -2.1464 | -1.42361 | -0.7228 |
| 2023-03-14 | -1.8075 | -1.68917 | -0.1183 |

## 5. In-class Assignment



The data set “**mtcars**” you’ll be working with contains information on fuel consumption and performance of various car models. The dataset contains 11 columns:

mpg: Miles/(US) gallon

cyl: Number of cylinders

disp: Displacement (cu.in.)

hp: Gross horsepower

drat: Rear axle ratio

wt: Weight (lb/1000)

qsec: 1/4 mile time

vs: V/S (0 = V-shaped, 1 = straight)

am: Transmission (0 = automatic, 1 = manual)

gear: Number of forward gears

carb: Number of carburetors

```
> head(mtcars)
```

|                   | mpg  | cyl | disp | hp  | drat | wt    | qsec  | vs | am | gear | carb |
|-------------------|------|-----|------|-----|------|-------|-------|----|----|------|------|
| Mazda RX4         | 21.0 | 6   | 160  | 110 | 3.90 | 2.620 | 16.46 | 0  | 1  | 4    | 4    |
| Mazda RX4 Wag     | 21.0 | 6   | 160  | 110 | 3.90 | 2.875 | 17.02 | 0  | 1  | 4    | 4    |
| Datsun 710        | 22.8 | 4   | 108  | 93  | 3.85 | 2.320 | 18.61 | 1  | 1  | 4    | 1    |
| Hornet 4 Drive    | 21.4 | 6   | 258  | 110 | 3.08 | 3.215 | 19.44 | 1  | 0  | 3    | 1    |
| Hornet Sportabout | 18.7 | 8   | 360  | 175 | 3.15 | 3.440 | 17.02 | 0  | 0  | 3    | 2    |
| Valiant           | 18.1 | 6   | 225  | 105 | 2.76 | 3.460 | 20.22 | 1  | 0  | 3    | 1    |