Testing Reliability of Stock Analysis Indicators Using R

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1 Introduction

The stock market is a wild ordeal. It has the notoriety of being very unreliable by seeming to be on a definite rise but then catapulting downwards because of huge buyer pressure or some false rumor buzzing around town. Although the idea of the stock market is simple, since so many factors come into play when with the real world including current affairs/events, company decisions, and public sentiment(which can be said to play the biggest part in it all), mathematical tools sometimes can't predict changes in prices no matter how much effort is put into creating them to perfection. Math just doesn't seem to able to capture the uncertainty that the stock market represents.

But probability comes in handy and forces us not to throw up our hands in defeat. Creating approximation of trends by using current and past data is enormously helpful in predicting future states. Over the past centuries, numerous indicators have been developed and it is a traders job to use a variety of them to ensure that predictions are accurate. If a prediction is justified by many different indicators that there is better probability of its truth. A beginners course would be to provide an introduction to these indicators and use them to remark on past data.

Past data is a very good way to learn how trend in the stock market act, where they seem to follow the general "rule" and where they stray. It is often said that looking back on data and justifying price movements is exponentially easier that having to predict the price at a later date. But if you can understand past data, you're half way there to becoming a smart trader.

2 Trends

Trendlines measure the ups and downs that are seen in prices or volume or any other desired variable of the stock. We'll stick to prices for now. In simple terms, we can consider the stock prices portraying a competition between buyers and sellers. When the price goes down, that means the buyers have the upper hand in the market while if the price rallies the buyers are dominating the market. There are three basic trends in price levels of stocks:

1. Primary trends (9 months to 2 years)

2. Intermediate Trends (6 weeks to 9 months)

3. Short Term trends (2 to 4 weeks)

An primary uptrend signifies what's called a "bull" market while during a primary down trend, the current state is a "bear" market. With the advent of day trading, these trends have become much less important but for pledging amounts long term studying these trends are a good base point. Generally, a local maxima in the data is considered a peak or a trough if it retraces at least one-third of its initial height. An economy rarely stagnates and when it does it indicates investors to be prepared for a rocky and highly unpredictable future.

Different sectors of the market have different correlations and it can be an interesting and very misleading exercise to find the correlation between them at a particular time. In the past, there was a serially staggered correlation in sectors with bond leading the up/down trend, followed by stocks then commodities. Now, things are less simple and correlations are more complicated because of large swings in sentiment over rapid spreading of false rumors through media for example.

Figure 1: Closing Prices of Nestle India from 2019 to 2021 with hand drawn up trend lines

2.1 How to draw and read Trend lines

Trend lines MUST NOT be drawn in thin air. They must be tangent to the graph at multiple points or give as good an approximation of a tangent as possible. They must be drawn supporting an uptrend and resisting a downtrend. Usually, a trend reversal is indicated when a support line becomes a resistance or vice verse(seen in the first trend line for the Nestle data above). The graph also shows a good example of investor sentiment drastically affecting the prices of the commodity around March 2020. This sudden dip indicates panic that was proven to be unjustified as the primary uptrend was not affected at all.

Closing prices are usually taken as 'the' variable to be plotted if no formulas are being applied. They are a good indication of the day's sentiment especially when entering into weekends when the market is closed. The third figure shows how companies under the same sector (Energy) can completely fail to mirror each other. The graph shows the closing prices of Coal India, BPCL, and Power Grid over little over a decade. Coal prices due to the current society's change of perspective to more renewable forms of energy has been on a continuous and uninterrupted decline. BPCL and Power Grid on the other hand seem to show a similar rally in the beginning years. After a slight falter during the COVID onset, Power Grid has gotten back on it feet to a bigger rally while petroleum prices seem to be on a downtrend. Now, looking a few years forward, natural gas and oil prices after the start of the Ukraine-Russia war have increased dramatically because of disruption in its international trade. On the other hand focusing in around the time of the COVID pandemic tends to show an identical down trend in almost all companies. (Of course companies like Nestle were not affected at all and price stayed on the general uptrend,) This down trend is common to all companies because market sentiment permeated to all sectors during the start of the pandemic when people were unsure how to assess such a weird situation.

But it's also important to note that first intuition is not always right when it comes to trends. Lockdown forced people to stay inside which meant that TV consumption increased during this time. But ZEE Entertainment was unable to get up from that initial drop during the first scare. This is because of the start of a legal dispute and not because of the lack of quality of the shows or views by audience. You would also imagine that automobile prices went down because of a lack of travel at the time, but COVID worked in favor of luxury items and motorbikes and cars seem to fall under that category. Therefore Hero Motor Company and Titan showed a huge rise after the initial fall almost mirroring the extent of rise of Pharmaceutical companies such as Dr Reddy.

Very standard trend lines are complimented by highly unpredictable ones like when looking at
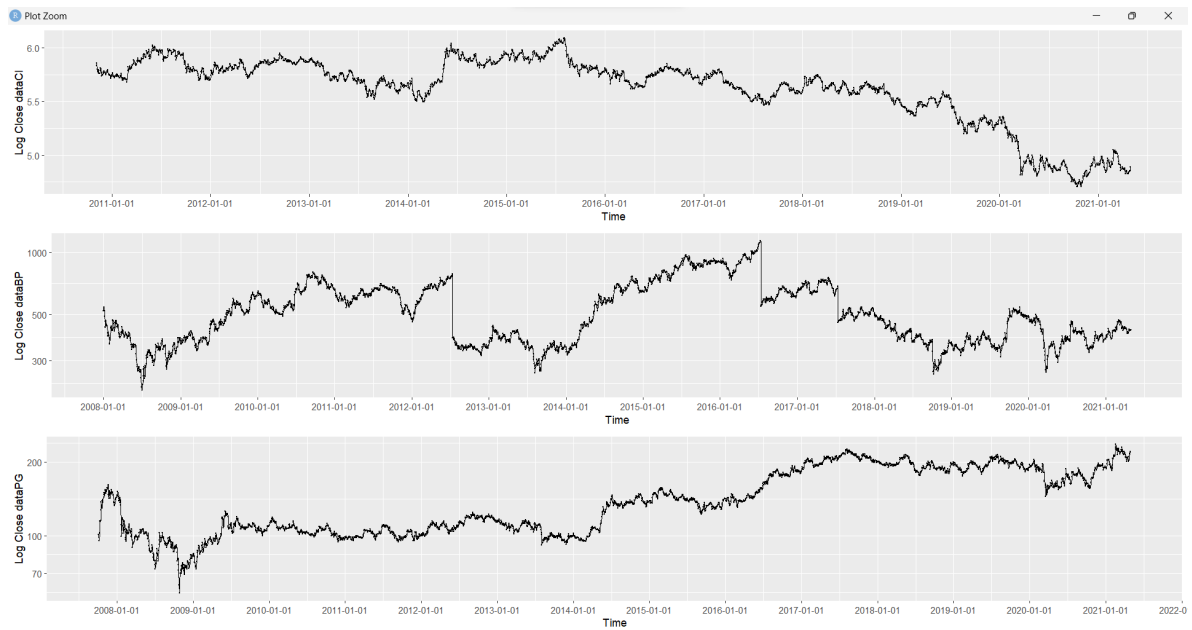
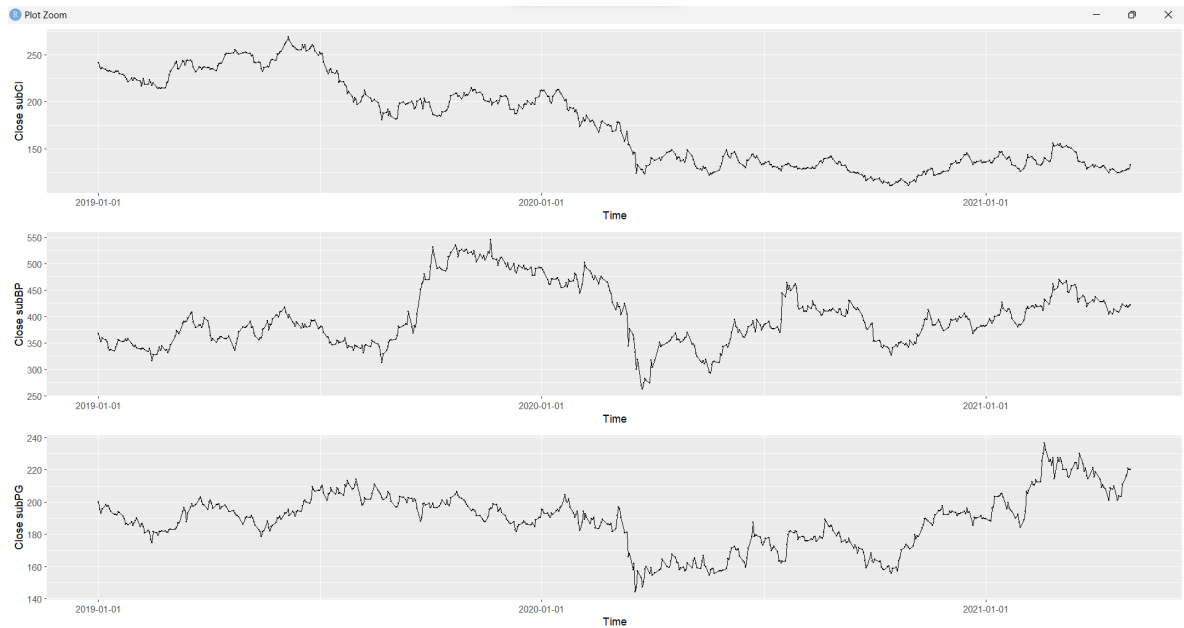Figure 2: Closing Prices of Coal India, BPCL, and Power Grid from 2008 to 2021

Figure 3: Closing Prices of Coal India, BPCL, and Power Grid from 2019 to 2021 showing a common down trend around March of 2020
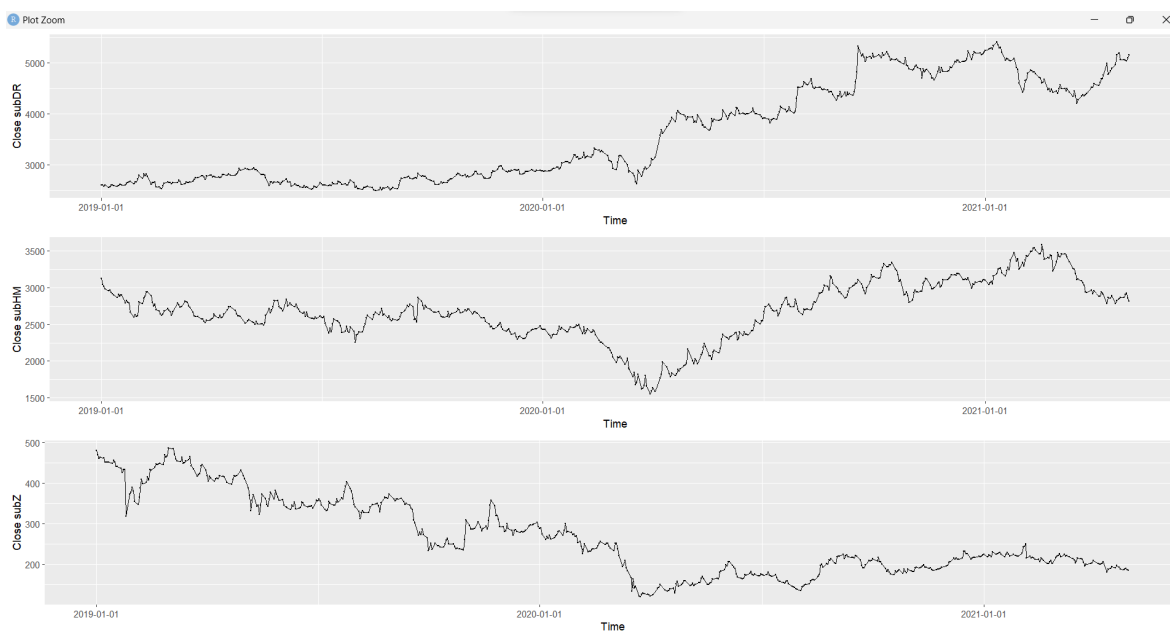
Figure 4: Closing Prices of Dr Reddy, Hero Motors COmpany, and ZEE Entertainment Enterprises from 2019 to 2021 showing a large after the fall in March 2020 uptrend

Bharat Petroleum which had wild over night plummeting prices multiple times over a 15 year time period.

3   Using Volume Data

One of the best ways traders get tipped about trends is through trading volume. It is a technical indicator (One of the many. More will be introduced later.) that can be interpreted as the "true" market sentiment. Unlike prices, volume shows more drastic changes (up to a few lakhs a day) in short amounts of time. Trading volume usually leads a trend. If volume is up, the prices re up too. It can also show when prices are not exactly reflecting reality. If prices are up but volume has decreased, it is a sure indicator that prices should decrease as well. As a general rule of thumb, any breakout or indication of trend reversal increase in probability of there is a sudden change in volume in the expected direction.

4   Averages and True Averages

Plotting daily closing prices in a line graph over more than a decade can make the graph look very cluttered. Smoothing out the curve to a rough estimate can be done in multiple ways. Alternate substitutes for y variables of graphs instead of closing prices were developed for this reason. I've provided a brief introduction of a few.

4.1   Averages

This the elementary school approach of rounding the data. An average of the high and low prices of a particular day are taken.

4.2   True Average

This a step higher than simple averages. Here we use the current day's high price, the current day's low price, and the previous day's closing price. The formula for calculation of true average is

$$\max\left(High - Low, High - PrevClose, PrevClose - Low\right)$$
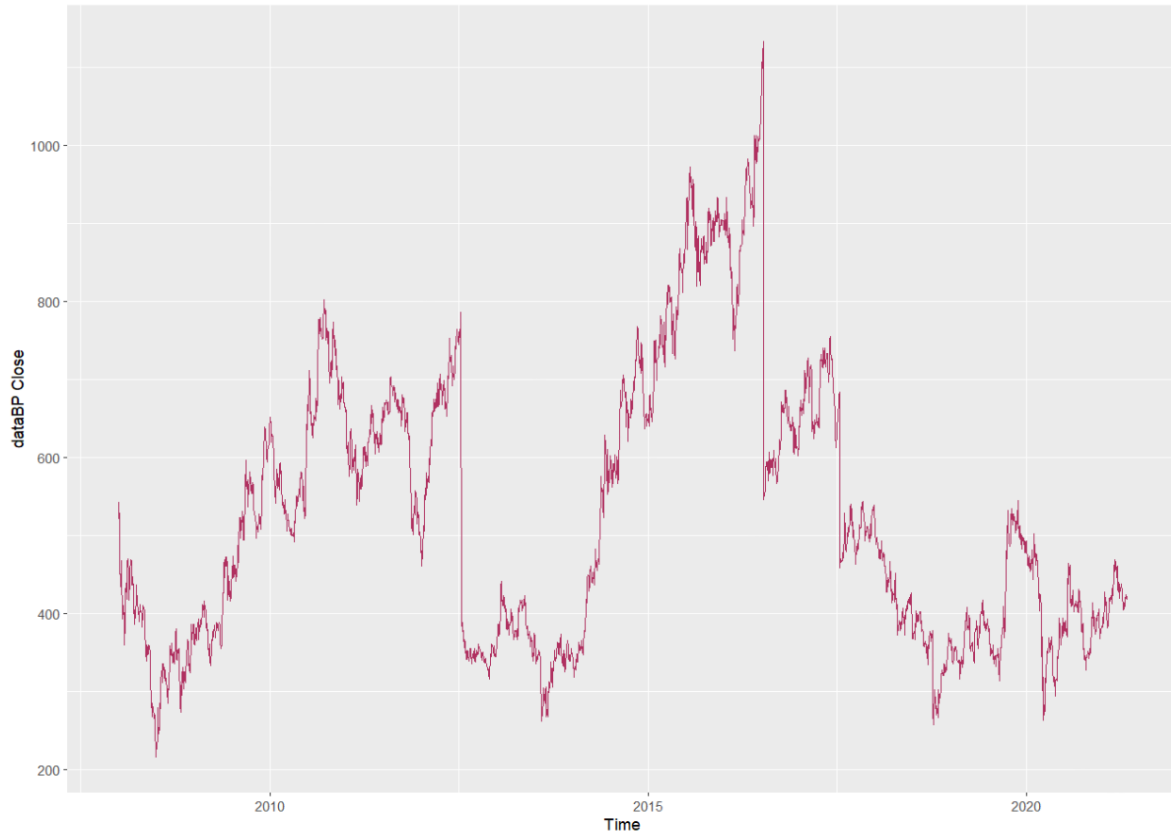
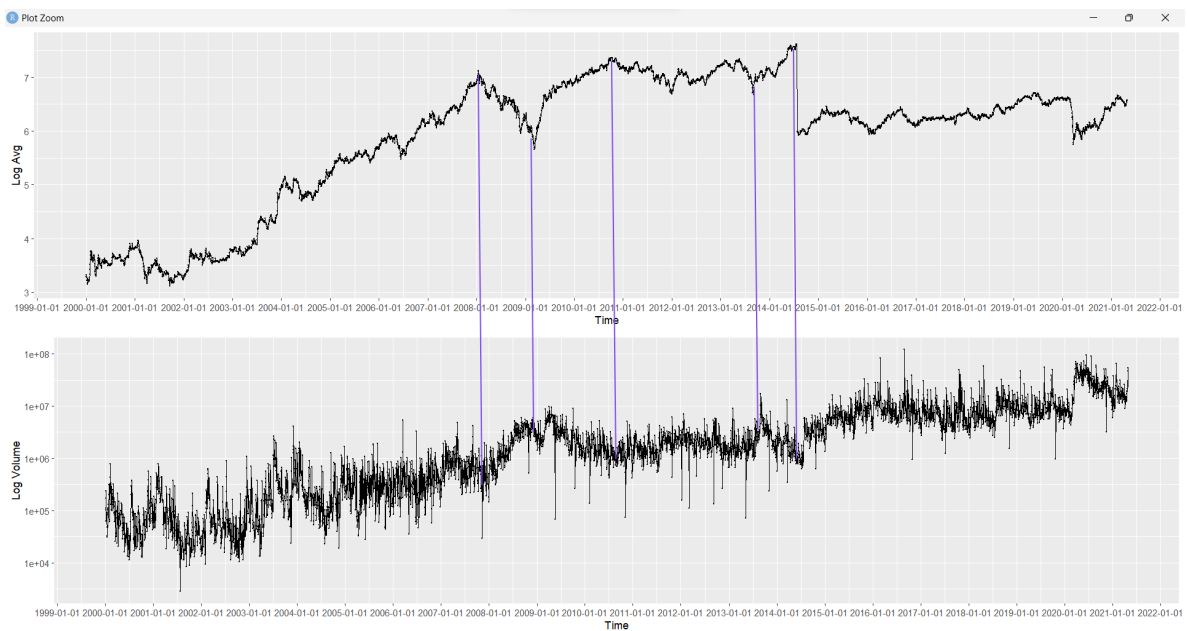Figure 5: Closing Prices of Bharat Petroleum Corporation Ltd. from 2008 to 2021 showing wild fluctuations

Figure 6: Avg Price and Volume Graphs of Axis Bank from 2000 to 2021 showing opposing trends indicted with purple vertical lines
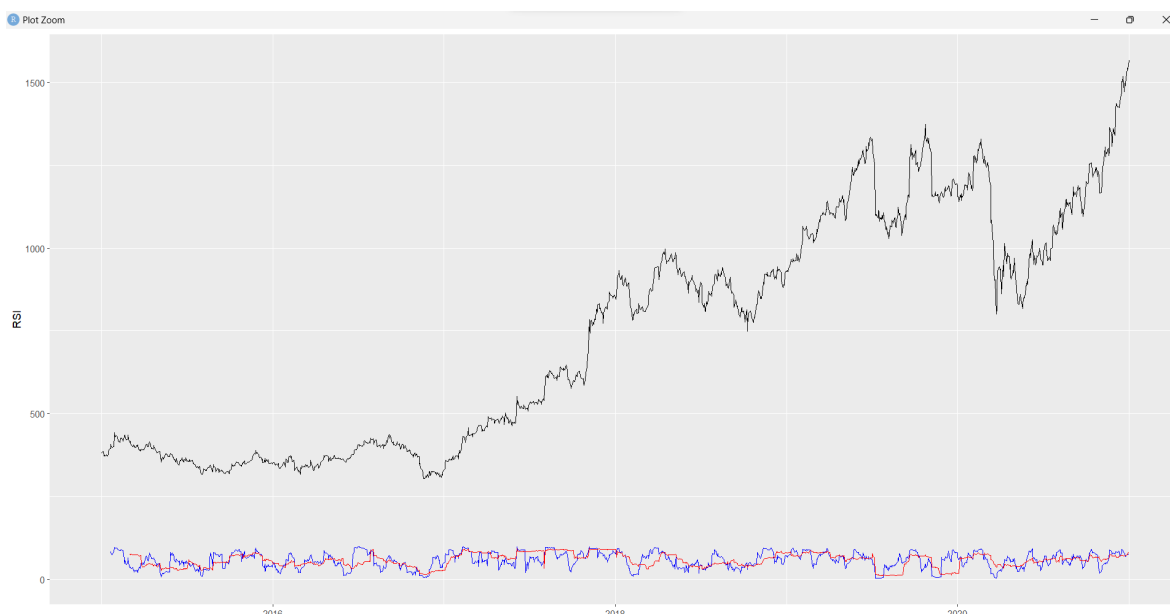
Figure 7: Titan RSI values for 14(blue) and 41(red) day periods during the years 2015 to 2010

4.3 Moving or Rolling Averages

A moving or rolling average takes the average of the closing values of the previous n (usually 41) days. The first n-1 (40) days are left blank (without any y values) and the rest of the dates are plotted against the average calculated within the n (41) day window. An alternative is to shift the window to the middle, i.e. in the 41 day case, the window where average is to be taken would be 20 days on either side of the day considered. In this altered form, the first 20 and last 20 x values would be left blank. It's an interesting exercise to toggle the offset of the windows where average is taken and also the width of the window and see where optimal interpretation of the data can be attained.

4.4 ROC Ratio

The Rate of Change or ROC ratio is another indicator that uses the ratio of the current closing price to the closing price n days ago. ROC indicators are helpful to spot overbought or oversold instances. While drawing the ROC graph it's common to replace the first value as the origin and calculate all other values as being above or below it. When the line graph for the price crosses the ROC graph, it may signal a trend reversal. ROC is a common type of momentum indicator. A momentum indicator is one which signals the rate of rise and fall of price. (A rally over the the period of two years and a rally over 2 weeks should be considered with different mindsets and momentum indicators help in this regard.)

4.5 Relative Stability Index (RSI)

RSI goes one step further than ROC. It is not only able to tell the rate but also the time at which trend reversal will most likely occur. Note that RSI looms around the lower values as compared to the actual prices. Calculation of RSI uses the formula

$$RSI = 100 - \frac{100}{1 + RS} \qquad \text{where} \qquad RS = \frac{\text{average of x days up closes}}{\text{average of x days down closes}}$$

Usually, RSI's are calculated by also included the trading weight of each day which makes it more accurate in predicting trends than using an unweighted formula.
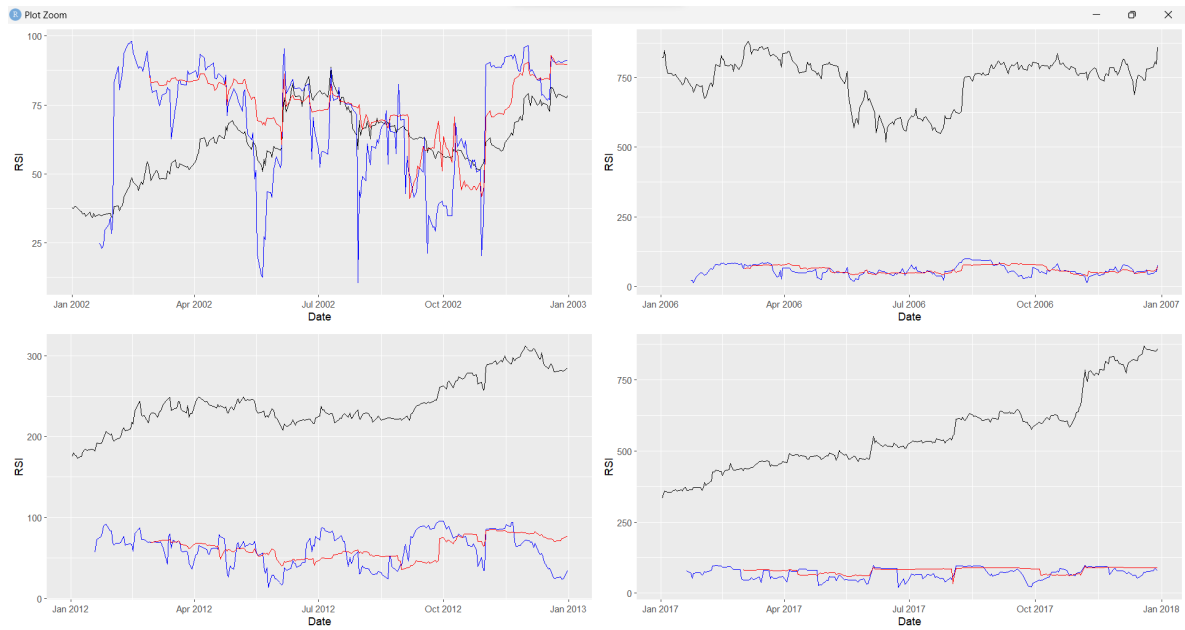
Figure 8: Titan RSI values for 14(blue) and 41(red) day periods during 4 different years

Figure 9: Moving averages with periods 50-day(in blue) , 120-day(in purple), and 300-day(in red) for Reliance from 2005 to 2015
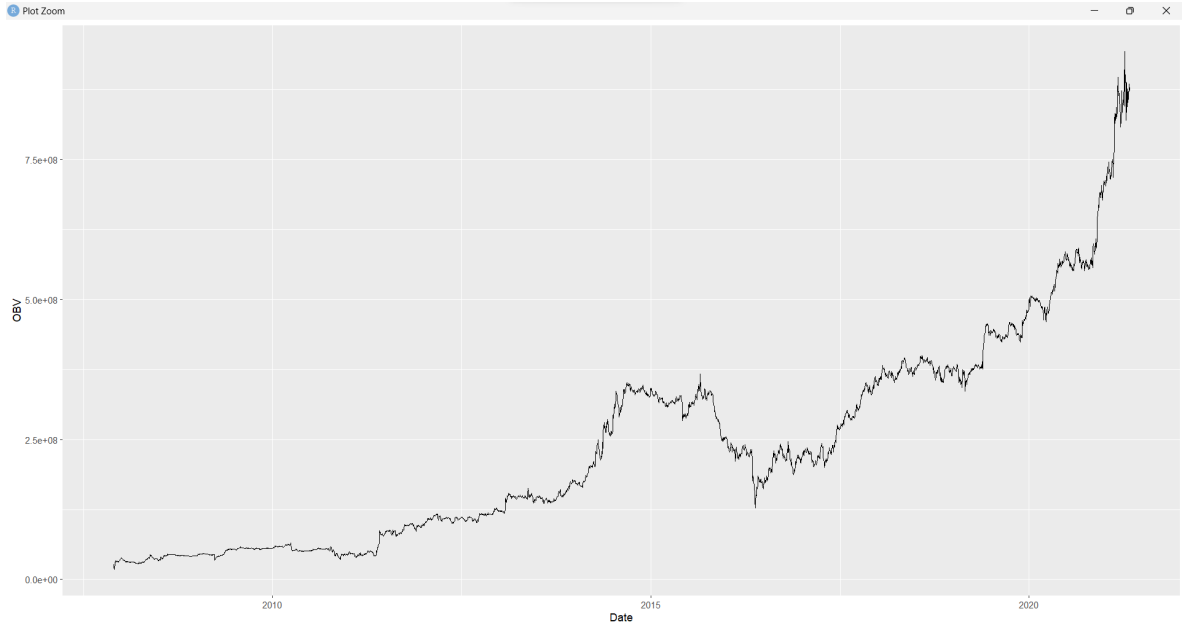
Figure 10: On-Balance Volume values for Adani Port Data from 2008 to 2021

4.6 On-Balance Volume Indicator

This momentum indicator emphasizes on trading volume to predict the trends. It is based on the principle that if there is a large volume change without a corresponding change in price, there is a high probability of a sudden increase or decrease in price. (The indicator cannot decide which direction the rate will increase in.) The on balance volume is calculated as:

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

In other words, if the current day's price is greater than the previous day's closing price, the current day's volume is cumulatively added. If the current day's price is less than the previous day's closing price, the current day's volume is subtracted from the OBV calculated thus far. IF the closing prices are the same, the OBV does not change either. Since it is an almost cumulative value, it will always plot an almost increasing graph.

4.7 Polynomial Approximation

Approximating data using polynomials is a good way to see the general peaks and troughs in the line graph. The figure show polynomial approximations of various degrees fitting the data of Britannia's closing prices from 2019 to 2021. The higher the degree of the polynomial the better the approximation since we are working with a large set of data but the degree can only be taken as high as is mathematically calculable. If a singular matrix is formed in the calculation, the polynomial degree is infeasible and a lower degree must be used. For 15 years of data an average of degree 15-20 polynomial marks the most precise fitting possible/allowed,

5 The Candlestick Graph

This deserves a separate section because of the iconic representation that it has become. Each day in this graph is represented by a rectangular candles with wicks sticking out at both ends as straight vertical lines. The tip of the upper vertical line represents the highest price of the day and the tip at the bottom wick represents the lowest. So the entire "candle" ranges over the values that the price
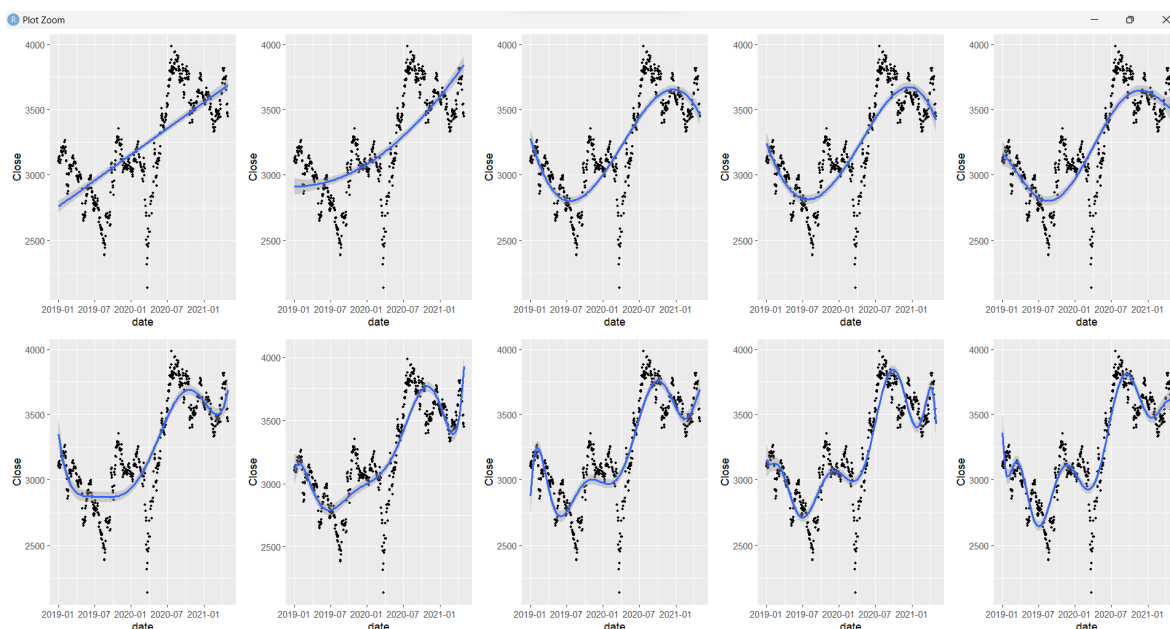
Figure 11: Polynomial approximations of degrees increasing from 1 to 10 are shown for the closing price data of Britannia from 2019 to 2021

took on that day. The body of the candle represents the opening and closing prices. If the closing price was higher than the opening price it is colored green while if the closing price fell below the opening price, it is colored red. There are many intricate analyses like checking if wicks of a previous candle encompasses the body of the next, etc. to predict trends.

6 Price Patterns

6.1 Shoulder-Head-Shoulder Pattern

The SHS pattern or it similar variants (SSHSS,SSSHSSS, etc.) is named so because of how it looks. It consists of three peaks, the middle one taller than the ones on the side. If three consecutive SHS patterns are seen it is usually indicative of an upcoming trend reversal. A good example of this was found in the data of Hindalco in the year 2011. The SHS pattern on the left was the initiator of a downtrend and after the next two SHS pattern, the graph seems to begin a primary rally.

6.2 Break outs

Breakouts occur when the price graph extends beyond the current trendline. In other words, the price exceeds a resistance or falls below the support. Breakouts are the simplest pattern to notice but since drawing trendlines in still an inexact art, they have high probability of deception into wrong predictions. False breakouts are found so often that they have been coined by their own term "whipsaws". The first time a breakout occurs, investors are put on high alert of a possible change in trend, if a second breakout occurs closely afterward, the trend reversal has a higher probability of being true.

6.3 Wedges

These patterns occur when trend lines drawn in both a supportive and resisting manner converge when extended to form something resembling a wedge. All wedges are usually accompanied by decreasing volume. There are three main types of wedges:

- Right angled Wedge

- Rising Wedge

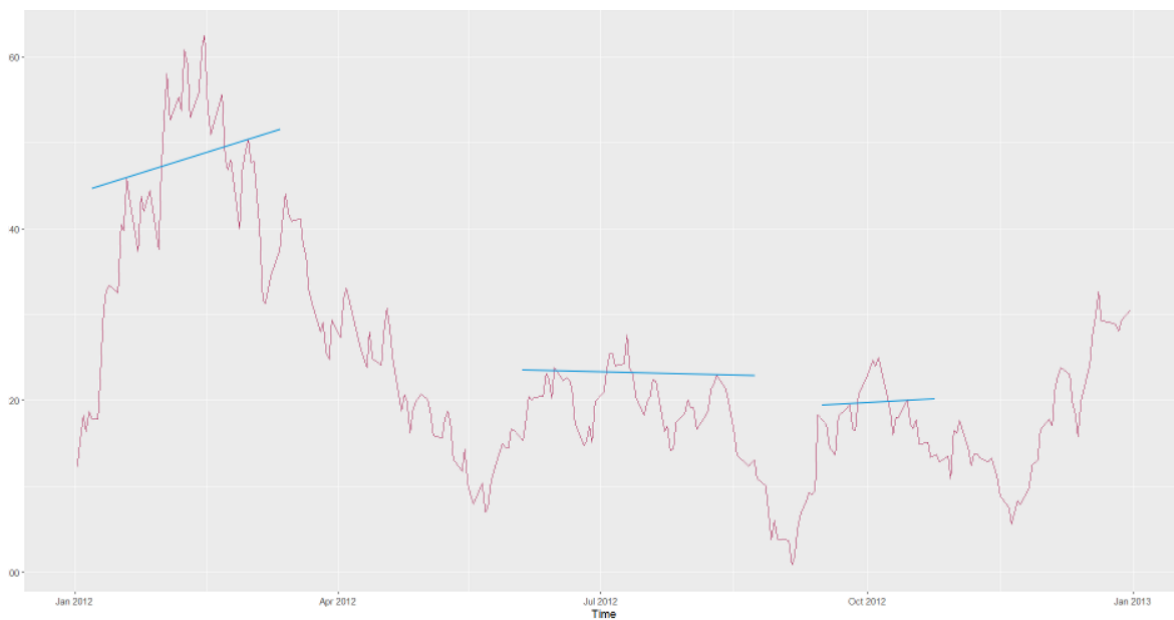Figure 12:   Interactive Candlestick Graph of Coal India for the year 2015

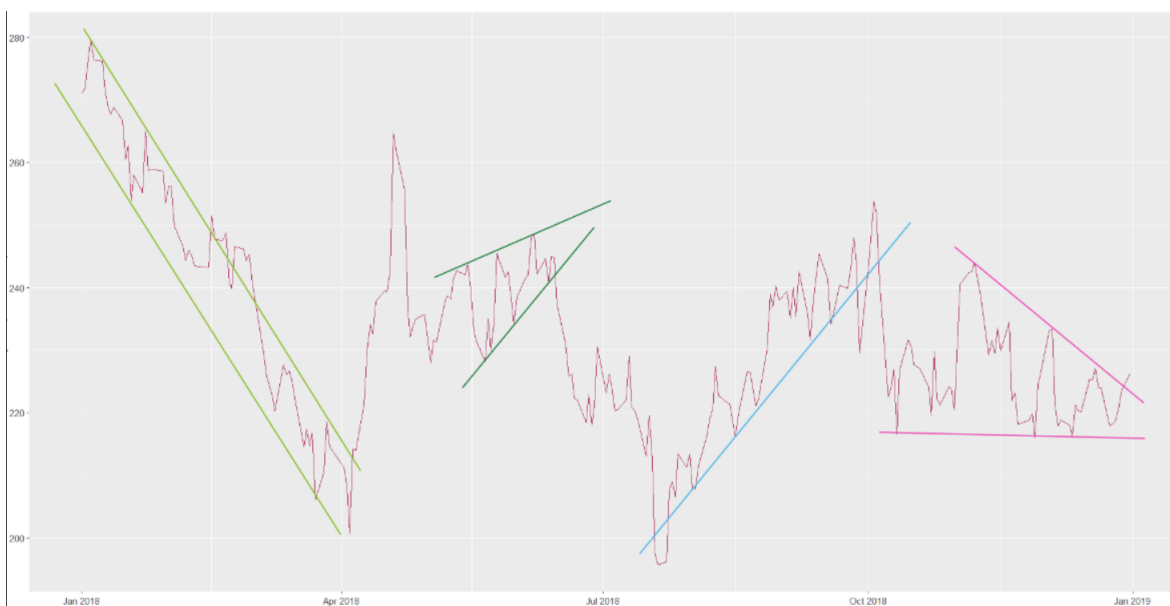Figure 13: Three SHS patterns in the 2011 closing prices of Hindalco

Figure 14: 2028 closing prices of Hindalco showing from left to right: descending channel(yellow), rising wedge(green), breakout from support(blue), right angled wedge(pink)

- Falling wedge

Unfortunately, rising and falling wedges by themselves do not indicate any particular trend reversal only that a reversal may occur.

6.4 Channels

Channels occur when supporting and resisting trend lines to a price chart appear parallel to each other. Depending in the direction of the primary trend, channels are classified as ascending or descending.

7 Observations

Trends in the stock market depend on both price and volume. Different indicators involve the development of different formulas using the highs, lows, and closing prices in order to better predict future changes. Price patterns take practice to notice but even if they are detected it is not a sure sign that what they imply will actually occur. An array of various indicators should be used together and if they all point to the same conclusion, a higher chance of trend reversal is obtained. The market is subject to a huge amount of factors and all of them need to taken into account and risks weighed. This guide hopefully gave a brief but wholesome introduction to the stock market and technical analysis. The R code is provided and the user is encouraged to try plotting as many graphs and gleaning as many observations as possible to create a repository of stock price and volume indicators that will guide them to better predictions.