Chapter 2

Technical Analysis

A technical indicator is a series of data obtained by a formula applied on the price data of a security. The technical indicators are presented graphically to compare with the price chart of the security. The fundamental assumption of technical analysis is that the historical trends will be repeated. The short term market fluctuations are assumed to be more important than long term trends and the stock price movements are results of the interaction of supply and demand. Here, we discuss various technical indicators and apply them on BSE (Bombay Stock Exchange) closing price data. The main objective is to predict the trend from a given data series.

2.1 Moving Average

A moving average is a series of data, each of which is average of a subset of the underlying complete data set. It is similer to a low pass filter used in signal processing. Moving averages are most popular and easy to use tools available to the technical analyst. They smooth a data series and make it easier to spot trends, something that is especially helpful in volatile markets [Aamodt R. (2010)].

2.1.1 Simple Moving Average (SMA)

A simple moving average is formed by computing the average (mean) price of a security over a specified number of periods. While it is possible to create moving averages from the Open, the High, and the Low data points, most moving averages are created using the closing price. An N period SMA can be calculated at any given time by taking mean price of the preceedings N periods,

$$SMA_N(t) = \frac{\sum_{i=0}^{N-1}(p(t-i))}{N},$$

where, p(t) represents price at time t. The period N depends on the movement type, that is, short, intermediate or long. For example, a 5-day simple moving average can be calculated by adding the closing prices for the last 5 days and dividing the total by 5.

If the price were rising, the SMA would most likely be below the actual price. Because moving averages are lagging indicators, they fit in the category of trend following indicators. In Figure

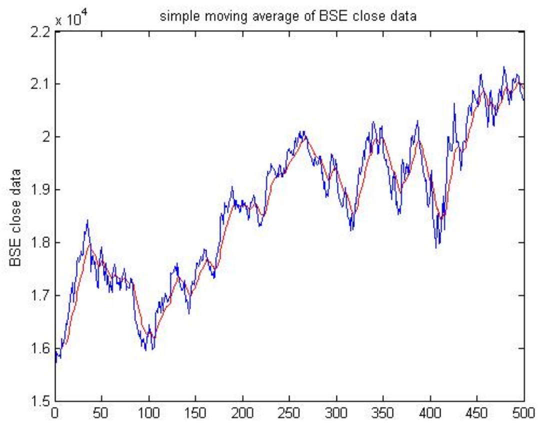

Figure 2.1: SMA of BSE daily close data from Jan 2012 to Dec 2013.

2.1, blue line shows closing price of BSE data whereas red line showing its simple moving average with window size 12. Here, SMA at last point is above the closing price which means that the price tend to decrease at next point, that is, simple moving average analysis shows downtrend of closing price.

2.1.2 Exponential Moving Average (EMA)

In order to reduce the lag in simple moving average, technicians often use exponential moving average. EMA's reduce the lag by applying more weights to recent price relative to older price. EMA is calculated by using following recursive relation [Aamodt R. (2010)],

$$EMA_N(t) = \frac{1}{N} * p(t) + \frac{N-1}{N} * EMA_N(t).$$

First, EMA value of the series is simply set to the price at that time. In Figure 2.2, blue line

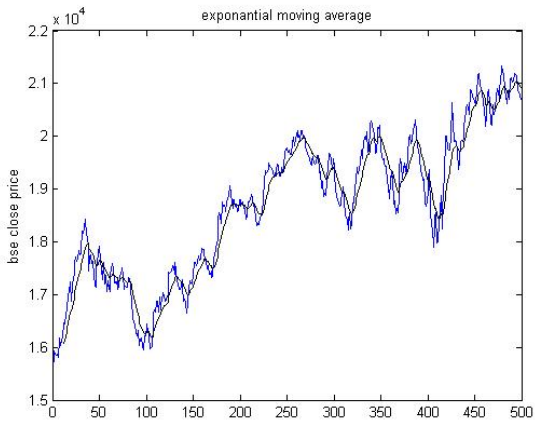

Figure 2.2: EMA of BSE daily close data from Jan 2012 to Dec 2013.

shows price of BSE data whereas black line represents exponential moving average. Here, EMA at last point is lower than closing price. It means price will decrease for next point. Similer to SMA, EMA also shows down-trend for closing price.

2.1.3 Analysing the Moving Average

Moving average can be used for making different types of observations when analyzing moving average curve.

- To determine whether the curve is in upward or downward trend.

- To determine if the curve is near support or resistance level

Support means a price level at which we expect demand of security to increase relative to supply. Resistance means opposite, price level at which supply increases relative to demand.
Figure 2.3 clearly shows that EMA is better than SMA. We can find out support and resistence at different points. Trend is downward if the lower-N moving average is below the higher-N moving average and vice versa for upward trend.

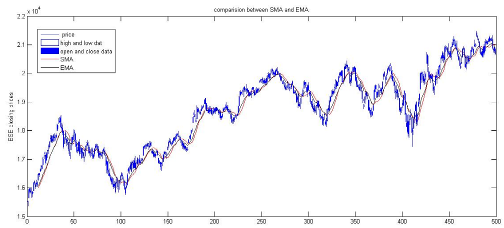

Figure 2.3: SMA and EMA comparision of BSE daily basis close data from Jan 2012 to Dec 2013.

2.2 Relative Strength Index (RSI)

RSI, developed by J. Welles Wilder, measures the velocity and magnitude of price movements. RSI is transformation of time series which is used to analyse the balance of supply and demand of the underlying security. 14 days time frame is generally used to calculate RSI.
In order to calculate RSI we need to first calculate the Relative Strength (RS) parameter. If daily changes of the price of previous N days are given, then

$$RS = \frac{average\ value\ of\ positive\ price\ changes}{average\ value\ of\ negative\ price\ changes}$$

Subsequently, we can compute the RSI using following formula

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

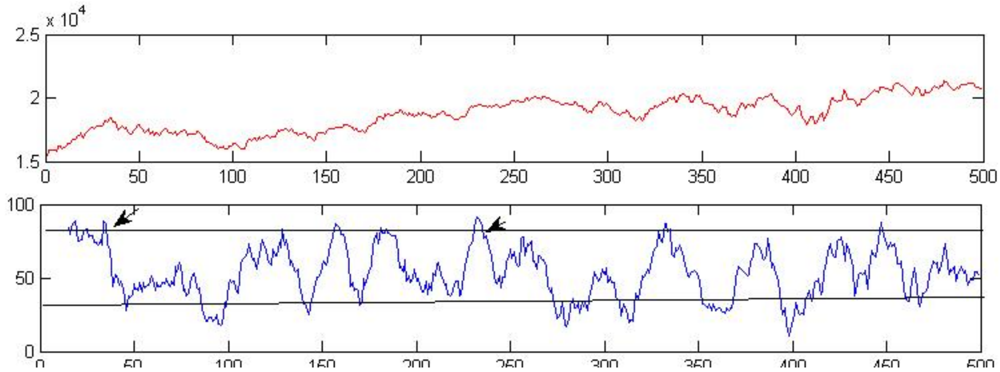

Figure 2.4: RSI of BSE daily close data from Jan 2012 to Dec 2013.

RSI should be normally between 30 to 70. Value higher than 70 indicates that period of high buying pressure has taken place. For BSE data, the RSI is shown in Figure2.4 which indicates that the stock has been overbought. Similarly RSI value lower than 30 indicates that period of high selling pressure has taken place.

2.3 Typical Price (TP)

The Typical Price indicator is calculated by adding the high, low and closing prices together, and then dividing by three. The result is the average, or typical price.

$$TP = \frac{H + L + C}{3}$$

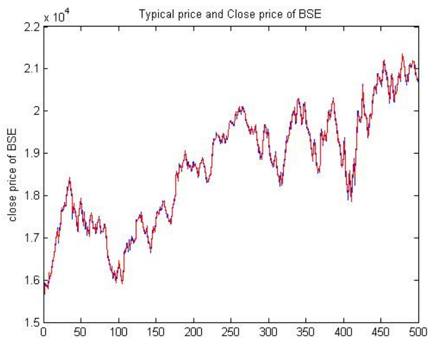

Figure 2.5: Typical price of BSE daily close data from Jan 2012 to Dec 2013.

2.4 Percentage Volume Oscillator (PVO)

It is a technical indicator which is completly computed on the basis of volume. It is configured with two exponential moving averages of volumes of different scope.

$$PVO = 100 * \frac{LongerEMA - ShorterEMA}{LongerEMA}$$

EMA with higher window size is Longer EMA. Negative PVO indicates decreasing volume and positive PVO indicates increasing volume.

PVO is used for trend confirmation. If market is in clear trend and its volume is high then there is less possibility of reverse trend. Downtrend at higher volume (positive PVO) shows clear indication of downtrend and downtrend at lower volume (negative PVO) indicates that the possibility of reversing trend (uptrend) is high. Figure 2.6 is representation of PVO for BSE data.

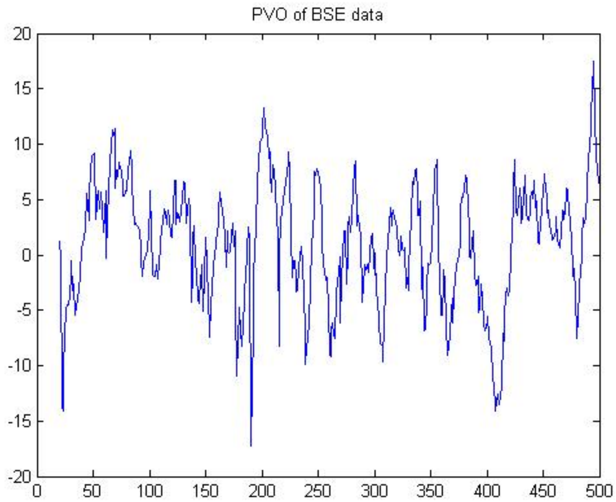

Figure 2.6: PVO of BSE daily close data from Jan 2012 to Dec 2013.

2.5 Trading Bands

These are trends based on historical price. We analyse the BSE data by using Bollinger band and a new generalized band. These bands further define technical indicators.

2.5.1 Bollinger Band

Bollinger bands are developed by John Bollinger in 1989. Bollinger bands are based upon a simple moving average and the volatility of stock. Middle one is moving average itself. Lower band is D standard deviation below the moving average. The upper band is D standard deviation above the moving average. When market is more volatile, space between these lines widens and for less volatility, lines come closer together. If prices move closer to the lower band it indicates that stock is oversold and prices should soon rise. If prices rise to higher band the stock becomes overbought and prices are expected to fall. Bollinger band derives two indicators, % b and bandwidth.

%b is defined by

$$\%b = \frac{Last\ Bollinger\ band - Lower\ Bollinger\ band}{Upper\ Bollinger\ band - Lower\ Bollinger\ band}$$

Bandwidth is defined as

$$BW = \frac{Upper\ Bollinger\ band - Lower\ Bollinger\ band}{Middle\ Bollinger\ band}$$

If current price breaks lower bollinger band it is considered a buy signal.

$$StdDev = \sqrt{\frac{\sum_{i=1}^{N}(p(i) - MA(N))^2}{N}}$$

$$Upperband = MA + D\sqrt{\frac{\sum_{i=1}^{N}(p(i) - MA(N))^2}{N}}$$

$$Lowerband = MA - D\sqrt{\frac{\sum_{i=1}^{N}(p(i) - MA(N))^2}{N}}$$

where, p(i)=price, D= multiple of standard deviation.

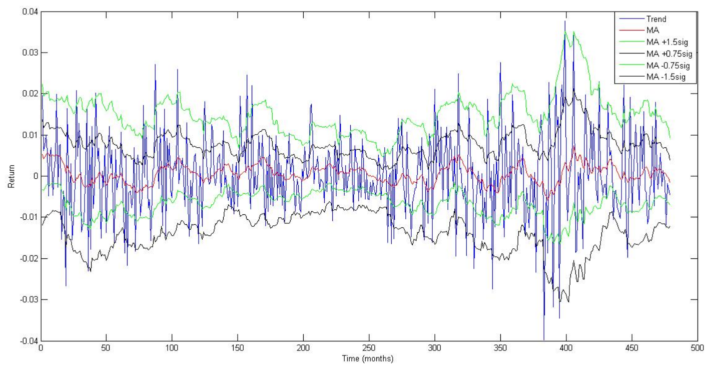

Figure 2.7: Bollinger band of BSE daily close data from Jan 2012 to Dec 2013.

A representation of Bollinger band, with D= ± 0.75 and ± 1.5 is given in Figure 2.8.
When band is analysed, it aids in pattern recognition as well as price action comparison which can be viewed simultaneously to other indicators in order to come to a conclusion as to the movements of the market at that time.

Buy and Sell

If stock price hits the lower band, many traders usually buy or vice versa. If price tend to stick on the middle moving average band, it is a sign of less volatile market.

Band Width

While calculating bandwidth, the first step is to subtract the value of the lower band from the value of the upper band. This shows the absolute difference. This difference is then divided by the middle band, which normalizes the value. This normalized bandwidth can then be compared across different time frames or with the bandwidth values for other securities.

Narrowness

Narrow bandwidth always defined relative with other. Bandwidth values should be very near to prior bandwidth values for particular time period. It is important to get very near value look-back period to define bandwidth range for a particular stock. Bandwidth is considered narrow as it approaches to lower side and wide as it approaches the high end.

2.5.2 Generalized band

[Paul and Vijay (2014)] defined a new band in which each point is a combination of global extrema and local extrema. This band uses a linear function of extreme values (both absolute and local) in which the parameters are estimated by simple optimization techniques. We always face the problem that, at which time tick should we buy or sell the assets. Here, we address this problem using Generalized Band. This may be considered as an alternative to Bollinger band. Consider the returns $X_1, X_2, ..., X_n$ and define

$$\alpha(AbsoluteMax) = Max(X_1, X_2, ..., X_n)$$

$$\beta_p(LocalMax) = Max(X_p, X_{p+1}, ..., X_q)$$

$$\gamma_p(LocalMin) = Min(X_p, X_{p+1}, ..., X_q)$$

$$\delta(AbsoluteMin) = Min(X_1, X_2, ..., X_n)$$

$$(1 \leq p < q \leq r)$$

Based on the different conditions on $\alpha, \beta_p, \gamma_p$ and δ, different levels of the optimal band are defined with the help of a linear function f of α, $\bar{\beta}$, $\bar{\gamma}$, and δ,

$$f(\alpha, \bar{\beta}, \bar{\gamma}, \delta) = a * \alpha + b * \overline{\beta} + c * \overline{\gamma} + d * \delta,$$

where $\overline{\beta}$ $is\ mean\ of\ all\ \beta_p$, $\overline{\gamma}$ $is\ mean\ of\ all\ \gamma_p$ and a, b, c, d are parameters.

Upper Band$[UB_1] = \beta_p + f(\alpha, \bar{\beta}, \bar{\gamma}, \delta)$

Upper Band$[UB_2] = \beta_p - f(\alpha, \bar{\beta}, \bar{\gamma}, \delta)$

Middle Layer$[ML] = f(\alpha, \bar{\beta}, \bar{\gamma}, \delta)$

Lower Band$[LB_1] = \gamma_p + f(\alpha, \bar{\beta}, \bar{\gamma}, \delta)$

Lower Band$[LB_2] = \gamma_p - f(\alpha, \bar{\beta}, \bar{\gamma}, \delta)$

Parameters a, b, c and d are estimated by using following constraints which ensure that whole data is covered by the bands.
The optimization problem is :

$$\underbrace{Max}_{\text{a b c d}} f(\alpha, \beta, \gamma, \delta) = a * \alpha + b * \overline{\beta} + c * \overline{\gamma} + d * \delta$$

S.t

$$f(\alpha, \beta, \gamma, \delta) \ \leqslant Min((\beta_i - \gamma_i)/2, (\alpha - \beta_i))$$

$$(1 \leq i \leq N - n)$$

$$f(\alpha, \beta, \gamma, \delta) \geqslant 0$$

We then use Solver in MS excel to solve the optimization problem.

Example

For BSE data, we obtain

$$\alpha = 0.0377, \bar{\beta} = 0.0123,$$

$$\bar{\gamma} = -0.0109, \delta = -0.0397.$$

The initial values of the parameters are chosen as

$$a = 0.5, b = 0.7, c = 1, d = 1.$$

Based on the constraints given earlier, the estimated values are

$$a = 1, b = 1, c = 1, d = 0.93.$$

We get $f(\alpha, \bar{\beta}, \bar{\gamma}, \delta) = 0.0363$.
Note that for different initial values of a, b, c and d, the estimated values may differ but the value of function f will remain same.
Now we define the following bands.

Upper Band$[UB_1] = \beta_p + 0.0363$

Upper Band$[UB_2] = \beta_p - 0.0363$

Middle Layer$[MB] = 0.0363$

Lower Band$[LB_1] = \gamma_p + 0.0363$

Lower Band$[LB_2] = \gamma_p - 0.0363$

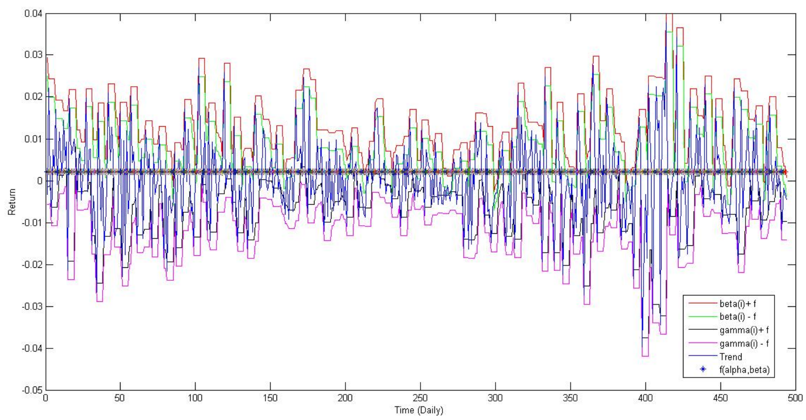

Figure 2.8: Generalized band of BSE close data of daily from Jan 2012 to Dec 2013.

Clearly, The generalized band covers the whole data set and due to its constant value for a few time ticks, it gives more decision time.