DELHI TECHNOLOGICAL UNIVERSITY

FINANCIAL ENGINEERING PROJECT REPORT

Technical Analysis Tools For Stock Price Prediction

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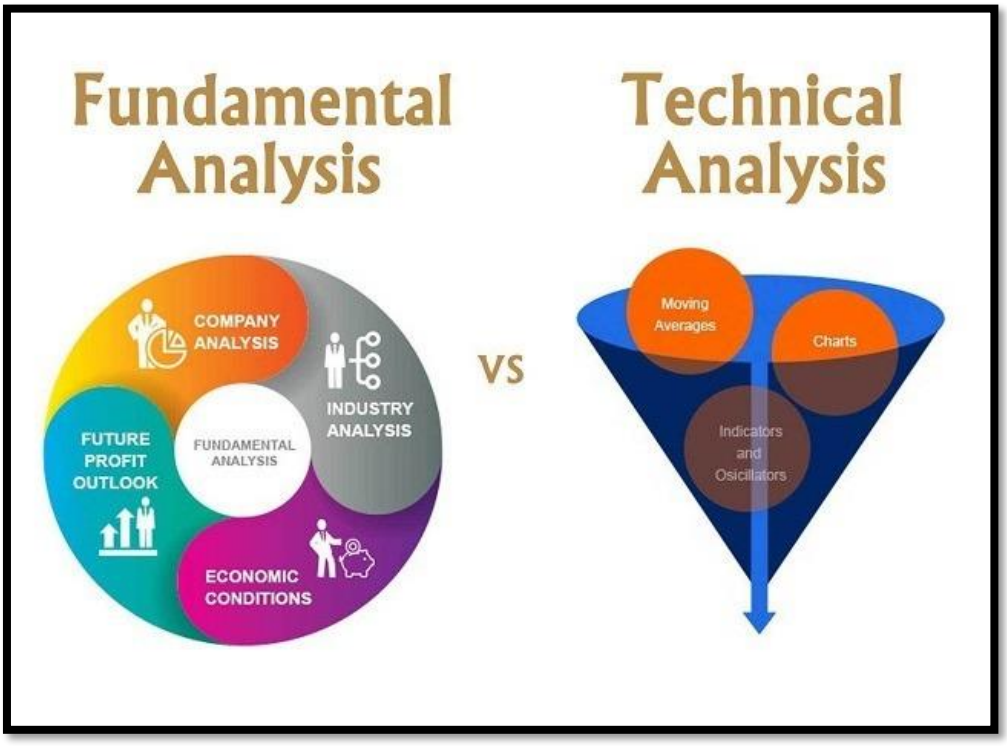
INTRODUCTION

TECHNICAL ANALYSIS

Technical analysis is a trading discipline employed to evaluate investments and identify trading opportunities by analyzing statistical trends gathered from trading activity, such as price movement and volume.

Technical analysis tools are used to scrutinize the ways supply and demand for a security will affect changes in price, volume and implied volatility. Technical analysis is often used to generate short-term trading signals from various charting tools, but can also help improve the evaluation of a security's strength or weakness relative to the broader market or one of its sectors.

There are two primary methods used to analyze securities and make investment decisions which are fundamental analysis and technical analysis. Fundamental analysis involves analyzing a company’s financial statements to determine the fair value of the business, while technical analysis assumes that a security's price already reflects all publicly-available information and instead focuses on the statistical analysis of price movements.



Technical analysis attempts to understand the market sentiment behind price trends by looking for patterns and trends rather than analyzing a security's fundamental attributes. Technical analysis as we know it today was first introduced by **Charles Dow** and the **Dow Theory** in the late 1800s. In modern day, technical analysis has evolved to include hundreds of patterns and signals developed through years of research.

Assumptions of Technical Analysis

There are typically three general assumptions for Technical Analysis.

- **The market discounts everything**

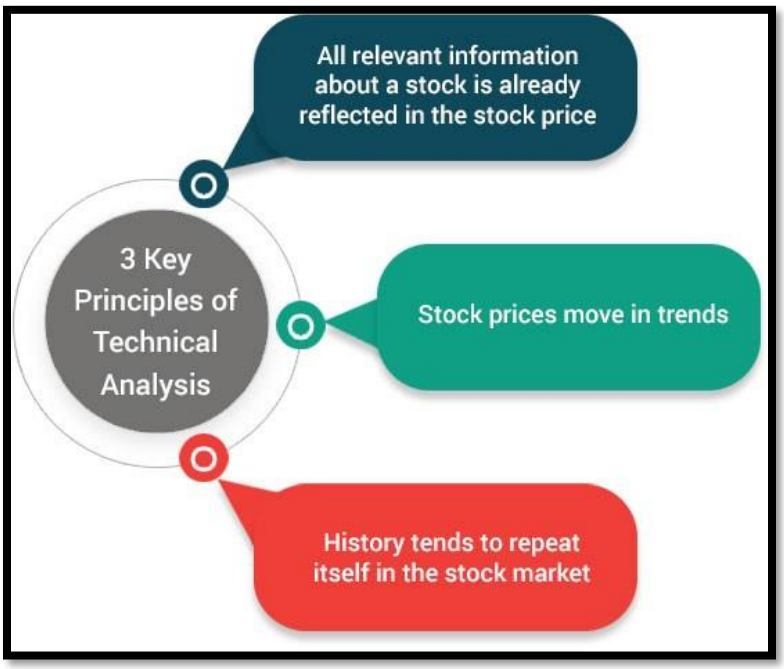
Technical analysts believe that everything from a company's fundamentals to broad market factors to market psychology are already priced into the stock. This point of view is congruent with the **Efficient Markets Hypothesis (EMH)** which assumes a similar conclusion about prices. The only thing remaining is the analysis of price movements, which technical analysts view as the product of supply and demand for a particular stock in the market.

- **Price moves in trends**

Technical analysts expect that prices, even in random market movements, will exhibit trends regardless of the time frame being observed. In other words, a stock price is more likely to continue a past trend than move erratically. Most technical trading strategies are based on this assumption.

- **History tends to repeat itself**

The repetitive nature of price movements is often attributed to market psychology, which tends to be very predictable based on emotions like fear or excitement. Technical analysis uses chart patterns to analyze these emotions and subsequent market movements to understand trends.



Important Factors in Technical Analysis

In general, technical analysts look at the following broad types of indicators:

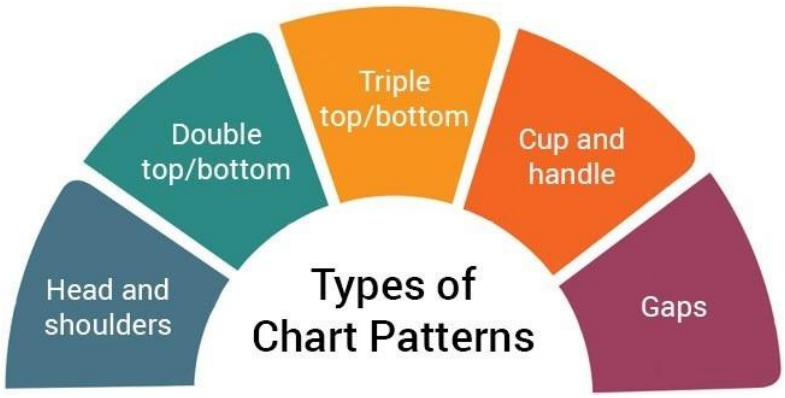
- **Price trends**

A trend is the overall direction of a market or an asset's price. In technical analysis, trends are identified by trendlines or price action that highlight when the price is making higher swing highs and higher swing lows for an uptrend, or lower swing lows and lower swing highs for a downtrend.

- **Chart patterns**

Patterns are the distinctive formations created by the movements of security prices on a chart and are the foundation of technical analysis.

A pattern is identified by a line that connects common price points, such as closing prices or highs or lows, during a specific period of time.



- **Volume and momentum indicators**

Volume indicators are those that account for the volume. For stock securities volume means the volume of executed trades (in contracts or money terms). **Momentum indicators** are tools utilized by traders to get a better understanding of the speed or rate at which the price of a security changes. Momentum indicators are best us ed with other indicators and tools because they don't work to identify the direction of movement.

TYPES OF TECHNICAL INDICATORS

Technical indicators can be divided into four categories.

TYPE	EXAMPLES
Trend	ADX, Moving Averages, MACD, Parabolic SAR
Momentum	CCI, Relative Strength Index, Stochastic
Volatility	Average True Range, Bollinger Bands, Standard Deviation
Volume	Chaikin Oscillator, On Balance Volume, Rate of Change

- **Oscillators**

An oscillator is a technical analysis tool that constructs high and low bands between two extreme values, and then builds a trend indicator that fluctuates within these bounds. Traders use the trend indicator to discover short-term overbought or oversold conditions. When the value of the oscillator approaches the upper extreme value, technical analysts interpret that information to mean that the asset is overbought, and as it approaches the lower extreme, technicians consider the asset to be oversold.

- **Moving averages**

The moving average (MA) is a simple technical analysis tool that smooths out price data by creating a constantly updated average price. The average is taken over a specific period of time, like 10 days, 20 minutes, 30 weeks or any time period the trader chooses.

- **Support and resistance levels**

Technical analysts use support and resistance levels to identify price points on a chart where the probabilities favor a pause or reversal of a prevailing trend. Support occurs where a downtrend is expected to pause due to a concentration of demand.

Resistance occurs where an uptrend is expected to pause temporarily, due to a concentration of supply.

BACKGROUND KNOWLEDGE

STATISTICAL CONCEPTS

Statistical concepts are the pillars of the Technical Tools. Some of the important statistical concepts are :

ARITHMETIC MEAN - The arithmetic mean, also known as average or arithmetic average, is a central value of a finite set of numbers.

STANDARD DEVIATION - The standard deviation is a measure of the amount of variation or dispersion of a set of values. A low standard deviation indicates that the values tend to be close to the mean (also called the expected value) of the set, while a high standard deviation indicates that the values are spread out over a wider range.

VARIANCE - Variance is the expectation of the squared deviation of a random variable from its mean. In other words, it measures how far a set of numbers is spread out from their average value.

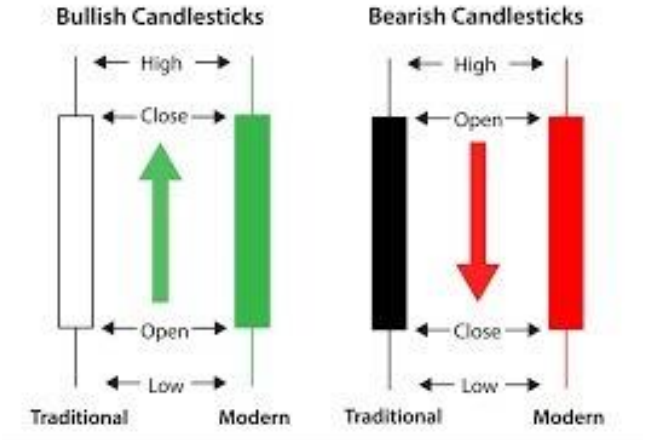
MOVING AVERAGE - A moving average is a calculation to analyze data points by creating a series of averages of different subsets of the full data set. It is also called a moving mean or rolling mean.

EXPONENTIAL MOVING AVERAGE - An exponential moving average (EMA), also known as an exponentially weighted moving average (EWMA) applies weighting factors which decrease exponentially. The weighting for each older datum decreases exponentially, never reaching zero. The graph at right shows an example of the weight decrease.

CANDLESTICKS

Candlestick charts are used by traders to determine possible price movement based on past patterns. Candlesticks are useful when trading as they show four price points (open, close, high, and low) throughout the period of time the trader specifies.

Trading is often dictated by emotion, which can be read in candlestick charts.



APPROACH & IMPLEMENTATION WITH PYTHON CODE

In our project we are focused on 5 different Technical analysis tools for Stock Price Prediction. We implemented python code corresponding to these tools. We used the data of Apple.inc (2016-2018). The different tools are :-

Relative Strength Index (RSI)

The relative strength index (RSI) is a momentum indicator used in technical analysis that measures the magnitude of recent price changes to evaluate overbought or oversold conditions in the price of a stock or other asset. The RSI is displayed as an oscillator (a line graph that moves between two extremes) and can have a reading from 0 to 100. The indicator was originally developed by J. Welles Wilder Jr. and introduced in his seminal 1978 book, "New Concepts in Technical Trading Systems."

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

3. Calculating RSI indicator

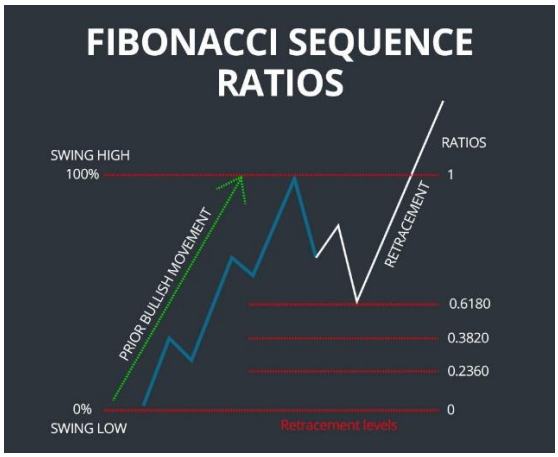
In [4]:

```
rsi_length = 14 #here define RSI lenght
next_df = df[PRICE_NAME].shift(1)
next_df[0] = 0 #change the very first array value from 'nan' to 0
change = df[PRICE_NAME] - next_df

# gain and loss array:
gain = []
loss = []
for i in change:
    if (i > 0):
        gain.append(i)
        loss.append(0)
    else:
        loss.append(i)
        gain.append(0)


# fill first avg_gain and avg_loss with None for graph
avg_gain = []
avg_loss = []
RSI = []
for i in range(rsi_length):
    RSI.append(None)
    avg_gain.append(None)
    avg_loss.append(None)


# calculate first_avg_gain and first_avg_loss, add them to avg_gain, avg_loss
first_avg_gain =  sum(gain [1:rsi_length]) / rsi_length
first_avg_loss = sum(loss [1:rsi_length]) / rsi_length

avg_gain.append(first_avg_gain)
avg_loss.append(first_avg_loss)

# calculate all other avg_gains and avg_loss
for i in range(rsi_length, df[PRICE_NAME].size):
    temp_gain = (avg_gain[i] * (rsi_length - 1) + gain[i]) / rsi_length
    avg_gain.append(temp_gain)
    temp_loss = (avg_loss[i] * (rsi_length - 1) + loss[i]) / rsi_length
    avg_loss.append(temp_loss)


# RSI calculations
for i in range (rsi_length, df[PRICE_NAME].size):
    RS = abs(avg_gain[i] / avg_loss[i])
    temp_RSI = 100 - (100 / (1 + RS))
    RSI.append(temp_RSI)


# add data to another subplot
x2 = plt.subplot(2, 1, 2, sharex = ax1)
plt.plot(RSI, color = 'blue')
plt.grid()
```

Snippet of the function used for calculating RSI from our code

Fibonacci Retracement

Fibonacci retracement levels are horizontal lines that indicate where support and resistance are likely to occur. They are based on Fibonacci numbers. Each level is associated with a percentage. The percentage is how much of a prior move the price has retraced.



The Fibonacci retracement levels are 23.6%, 38.2%, 61.8%, and 78.6%. While not officially a Fibonacci ratio, 50% is also used. Fibonacci retracement levels do not have formulas. When these indicators are applied to a chart, the user chooses two points. Once those two points are chosen, the lines are drawn at percentages of that move.

Calculations for Fibonaaci Retracement

```
In [4]:  df['Close']['10/31/2016':'10/30/2018'].max()
Out[4]: 232.07

In [5]:  df['Close']['10/31/2016':'10/30/2018'].min()
Out[5]: 105.71

In [13]: df1=df['10/31/2016':'10/30/2018']

In [7]:  Price_Min =df1['Low']['10/31/2016':'10/30/2018'].min()
         Price_Min
Out[7]: 104.08

In [8]:  Price_Max =df1['High']['10/31/2016':'10/30/2018'].max()
         Price_Max
Out[8]: 233.47

In [9]:  Diff = Price_Max-Price_Min

In [10]: level1 = Price_Max - 0.236 * Diff
         level2 = Price_Max - 0.382 * Diff
         level3 = Price_Max - 0.618 * Diff

In [11]: print ("Level", " ", "PRICE")

         print ("0 ", "      " , Price_Max)
         print ("0.236", "   " ,level1)
         print ("0.382",  "   ",level2)
         print ("0.618","   ",  level3)
         print ("1 ",    "      ", Price_Min)

Level   PRICE
0         233.47
0.236     202.93396
0.382     184.04302
0.618     153.50698
1         104.08
```

Snippet of the calculations of Fibonacci Retracement from our code

Moving Average Convergence and Divergence (MACD)

Moving average convergence divergence (MACD) is a trend-following momentum indicator that shows the relationship between two moving averages of a security's price. The MACD is calculated by subtracting the 26-period exponential moving average (EMA) from the 12-period EMA.

The result of that calculation is the MACD line. A nine-day EMA of the MACD called the "signal line," is then plotted on top of the MACD line, which can function as a trigger for buy and sell signals. Traders may buy the security when the MACD crosses above its signal line and sell—or short—the security when the MACD crosses below the signal line. Moving average convergence divergence (MACD) indicators can be interpreted in several ways, but the more common methods are crossovers, divergences, and rapid rises/falls.

MACD helps investors understand whether the bullish or bearish movement in the price is strengthening or weakening.

The Formula for MACD Is:

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

3. Calculate MACD indicator and add it to subplot

In [4]:
```
def calculate_macd(df, PRICE_NAME, period1, period2, period3): # default
    EMA_1 = df[PRICE_NAME].ewm(span=period1, adjust=False).mean()
    EMA_2 = df[PRICE_NAME].ewm(span=period2, adjust=False).mean()
    MACD_line = EMA_2 - EMA_1
    MACD_Signal_line = MACD_line.ewm(span=period3, adjust=False).mean()
    MACD_Histogram = MACD_line - MACD_Signal_line
    return MACD_line, MACD_Signal_line, MACD_Histogram
```

Snippet of the function used for calculating MACD from our code

AROON

The Aroon indicator is a technical indicator that is used to identify trend changes in the price of an asset, as well as the strength of that trend. In essence, the indicator measures the time between highs and the time between lows over a time period. The idea is that strong uptrends will regularly see new highs, and strong downtrends will regularly see new lows. The indicator signals when this is happening, and when it isn't.

The indicator consists of the "Aroon up" line, which measures the strength of the uptrend, and the "Aroon down" line, which measures the strength of the downtrend.

The Aroon indicator was developed by Tushar Chande in 1995.

Formulas for the Aroon Indicator

$$\text{Aroon Up} = \frac{25 - \text{Periods Since 25 period High}}{25} * 100$$

$$\text{Aroon Down} = \frac{25 - \text{Periods Since 25 period Low}}{25} * 100$$

3. Calculating AROON indicator

In [4]:

```
aroon_lenght = 25
aroon_up = []
aroon_down = []

highest = 0 # starting values
lowest = sys.maxsize # maximum size for float

lengh_since_last_high = 0
lengh_since_last_low = 0

period_values = [None] * aroon_lenght


itterator = 0
for i in df[PRICE_NAME]:
    #find highest and lowest values in a aroon period
    if itterator > 0: # ignore the very first itteration when 'period_values' consist of 'None' only
        highest = max(x for x in period_values if x is not None) # ignoring 'None'
        lowest = min(x for x in period_values if x is not None) # ignoring 'None'
        lengh_since_last_high = aroon_lenght - period_values.index(highest)
        lengh_since_last_low = aroon_lenght - period_values.index(lowest)

    if (i > highest): # new highest value
        highest = i
        aroon_up.append(100)
    elif (i < highest):
        high_value = ((aroon_lenght - lengh_since_last_high) / aroon_lenght) * 100
        aroon_up.append(high_value)

    if (i < lowest): # new lowest value
        lowest = i
        aroon_down.append(100)
    elif (i > lowest):
        low_value = ((aroon_lenght - lengh_since_last_low) / aroon_lenght) * 100
        aroon_down.append(low_value)

    period_values.append(i)
    period_values.pop(0)
    itterator += 1

# add data to subplot
x2 = plt.subplot(2, 1, 2, sharex = ax1)
plt.plot(aroon_up, color = 'green')
plt.plot(aroon_down, color = 'red')
plt.grid()
```

Snippet of the function used for calculating AROON from our code

Bollinger Band

A Bollinger Band is a technical analysis tool defined by a set of trendlines plotted two standard deviations (positively and negatively) away from a simple moving average (SMA) of a security's price, but which can be adjusted to user preferences.

Bollinger Bands were developed and copyrighted by famous technical trader John Bollinger, designed to discover opportunities that give investors a higher probability of properly identifying when an asset is oversold or overbought.

$$Middle\ Band = 20\ day\ Simple\ Moving\ Average\ (SMA)$$

$$Upper\ Band = 20\ day\ SMA + (20\ day\ standard\ deviation\ of\ price * 2)$$

$$Lower\ Band = 20\ day\ SMA - (20\ day\ standard\ deviation\ of\ price * 2)$$

Finding Middle Band with Bperiods

In [2]:
```
Bperiods=19
y=0
array_Middleband=[None,None,None,None,None,None,None,None,None,None,None,None,None,None,None,None,None,None,None,None]
for x in range(0,array_close.size-Bperiods):
    sum=0
    for j in range(0,Bperiods+1): #upto 20 periods value
        z=array_close[y]
        sum=sum+z
        y=y+1
    sum=sum/20
    array_Middleband.append(sum)
    y=y-(Bperiods)
```

Finding Standard Deviation

In [3]:
```
stndrd_deviation=[None,None,None,None,None,None,None,None,None,None,None,None,None,None,None,None,None,None,None,None]
y=0
z=0
for x in range(0,array_close.size-Bperiods):
    sum=0
    for j in range(0,Bperiods+1): #upto 20 periods value
        z=array_Middleband[x+Bperiods]
        sum=sum+((z-array_close[y])*(z-array_close[y]))
        y=y+1
    sum=sum/19
    sum=math.sqrt(sum)
    stndrd_deviation.append(sum)
    y=y-(Bperiods)
```

Finding Upper and Lower Bands

In [4]:
```
upper_band=[None,None,None,None,None,None,None,None,None,None,None,None,None,None,None,None,None,None,None,None]
lower_band=[None,None,None,None,None,None,None,None,None,None,None,None,None,None,None,None,None,None,None,None]
for x in range(Bperiods,len(stndrd_deviation)-1):
    upper_band.append(array_Middleband[x]+(2*stndrd_deviation[x]))
    lower_band.append(array_Middleband[x]-(2*stndrd_deviation[x]))
```

Snippet of the functions used for calculating Bollinger Band from our code

RESULT AND ANALYSIS

We have implemented the code of all the 5 technical tools and below we have discussed the result which we got from our code and analyzed it along with the output from our code.

Relative Strength Index (RSI)

Trading Strategy with RSI

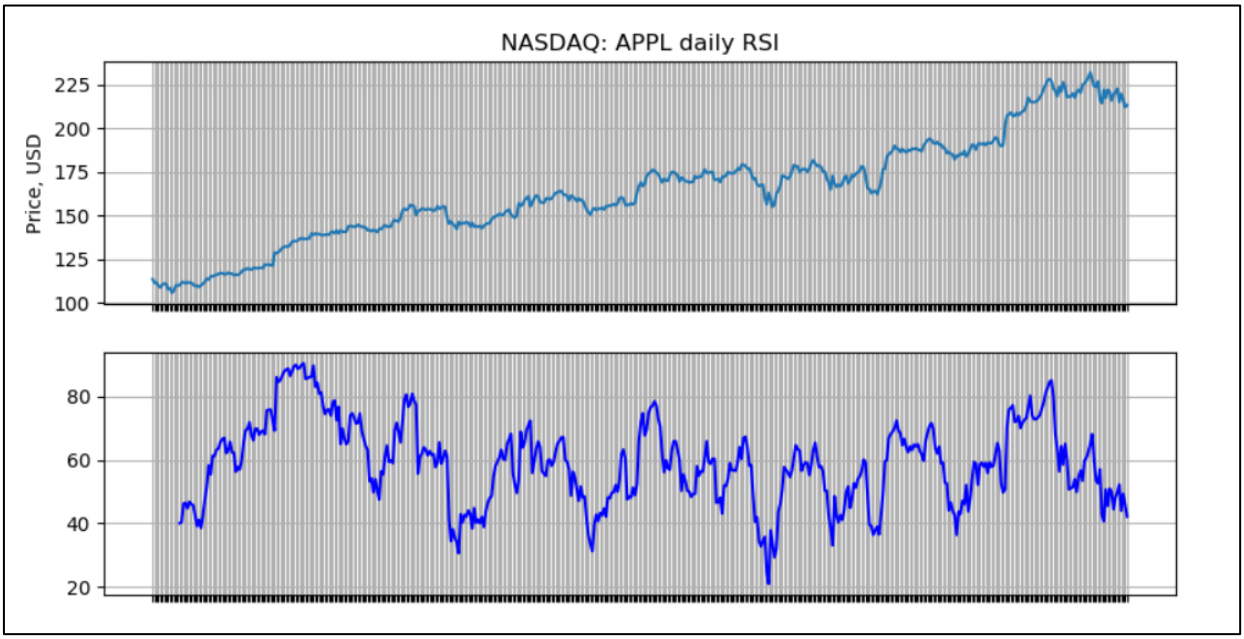
Buy Signal - When RSI moves above 50 with combination of another indicator like rise in volume and Moving average crossover of EMA (8) & EMA (21) and prices are trading above EMA (50).

1. **Profit Booking -** Whenever price candle is closed below EMA (8) or bearish crossover of EMA(8) & EMA(21).
2. **Stop Loss -** Low of Previous candle, i.e. one candle prior to 'Buy Signal candle'.

Example Indicating Buy signal in SunPharma on daily chart.

Sell- When RSI moves below 50 with combination of moving average crossover of EMA (8) & EMA(21) and prices are trading below EMA(5).

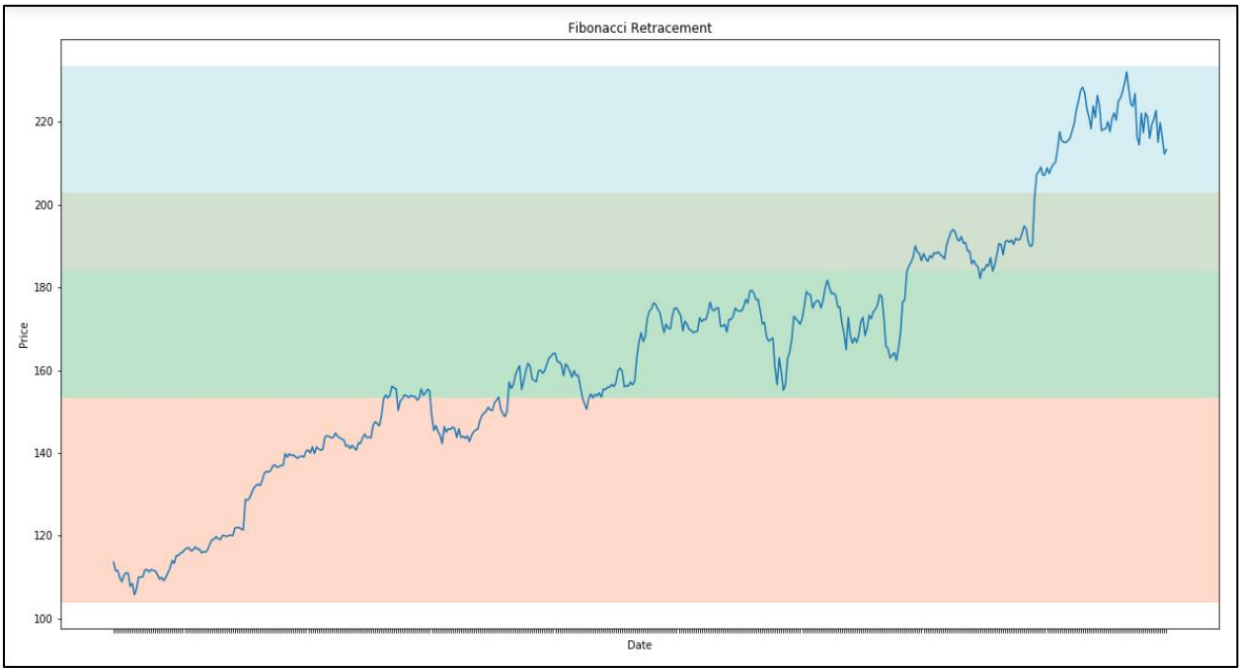
1. **Profit Booking -** Whenever Price Candle closes above EMA (8) or bullish crossover of EMA(8) & EMA(21).
2. **Stop Loss -** High of Previous candle. i.e. one candle prior to 'Sell Signal candle'.



Output from our code for RSI

Fibonacci Retracement

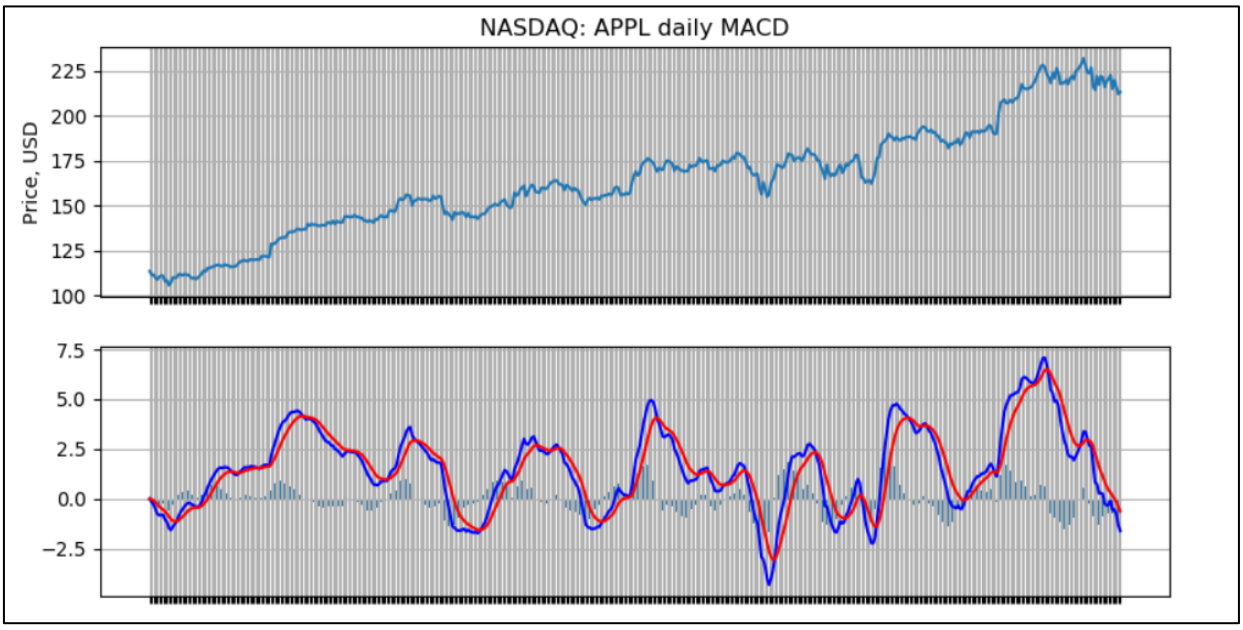
When a stock is trending very strongly in one direction, the belief is that the pullback will amount to one of the percentages included within the Fibonacci retracement levels: 23.6%, 38.2%, 61.8%, or 76.4%.



Output from our code for Fibonacci Retracement Tool

Moving Average Convergence and Divergence (MACD)

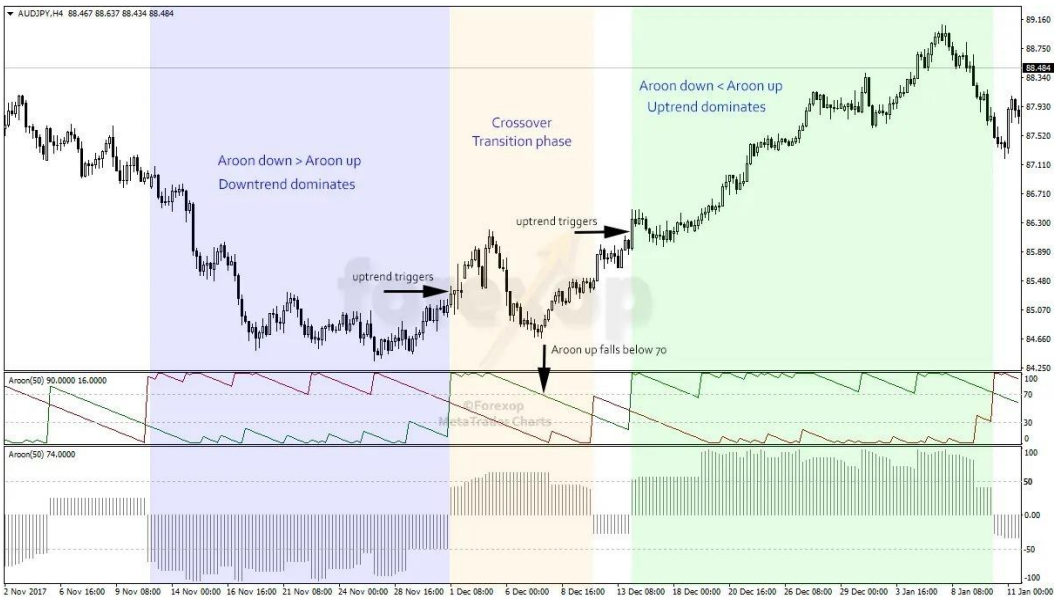
It works using three components: two moving averages and a histogram. If the two moving averages come together, they are said to be 'converging' and if they move away from each other they are 'diverging'. The difference between the lines is represented on the histogram. There are three common MACD strategies: crossovers, histogram reversals and zero crosses.



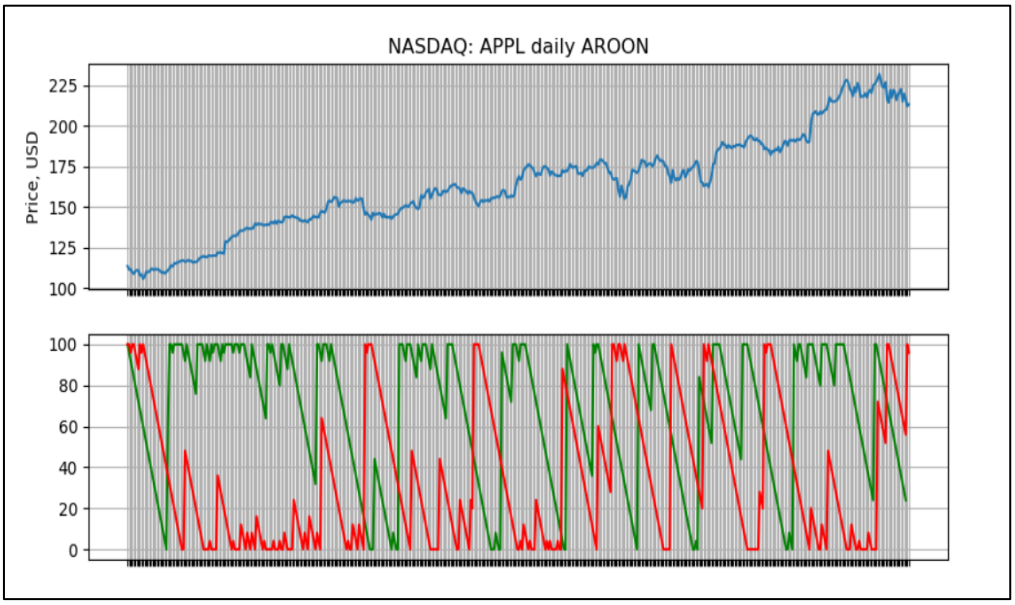
Output from our code for MACD Tool

AROON

- **Bearish trend** – In the below diagram the blue section initially shows AUDJPY in a bearish trend. During this phase if you check the Aroon down, which is the red line, it doesn't dip below the key 70 level. The Aroon up does not rise above the 30 level.



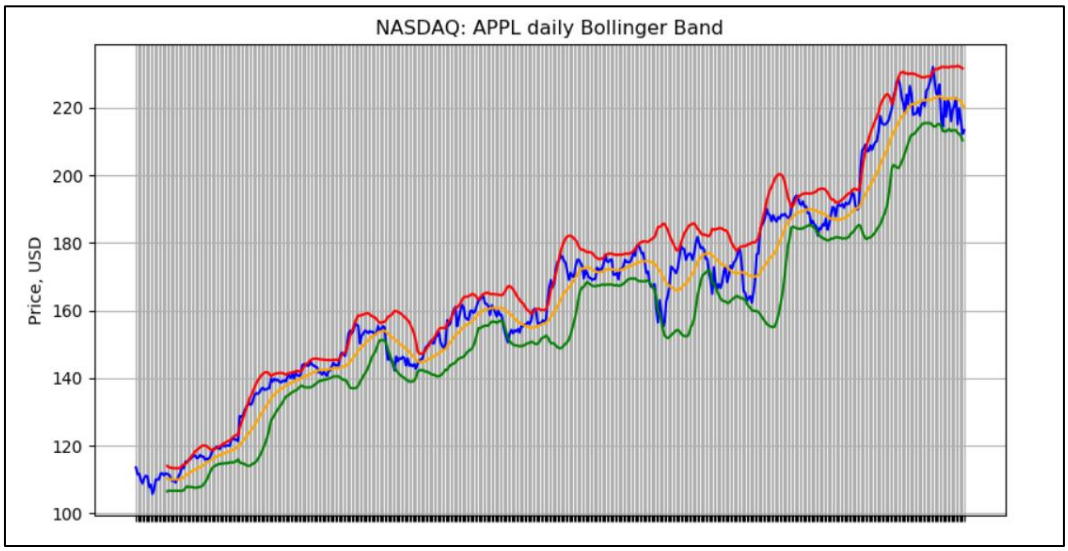
- **Transition** - The market appears to be shifting direction and this is marked in the orange box. First the Aroon down falls beneath 70 for the first time. And this happens before the Aroon up begins to rise.
- **Bullish trend** - The green box shows where the bullish trend becomes established. This is defined by the Aroon up line remaining clearly above 70, and the bearish, down line remaining below the significant 30 level.



Output from our code for AROON Tool

Bollinger Band

While every strategy has its drawbacks, Bollinger Bands have become one of the most useful and commonly used tools in spotlighting extreme short-term prices in a security. Buying when stock prices cross below the lower Bollinger Band often helps traders take advantage of oversold conditions and profit when the stock price moves back up toward the center moving-average line.



Output from our code for Bollinger Band Tool

OBSERVATIONS AND LEARNING

Some key findings which we observed while working on this topic are :-

Lagging and Leading Indicator

Lagging indicators are those which tell us about an event after it has happened whereas leading indicators are predictive in nature — they signal what is likely to happen.

1. Lagging indicators provide fewer false signals which might mean a smaller probability of stop-out losses.
2. Another key difference between leading and lagging indicators is that the latter is generally more accurate by virtue of the fact that it is the result of post facto data gathering and calculations.
3. Given the slow nature of lagging indicators, the signals might not come in early enough to book large gains by capturing a bigger part of the move.
4. Another major difference between leading and lagging indicators is that the former kind is generally more useful in day trading whereas the latter would be more helpful in swing trading.

   Examples of Lagging Indicator – MACD, EMA, ADX.
   Examples of Leading Indicator - RSI , Stochastic Oscillator,William %r.

Comparison between MACD and RSI

- Even though both, MACD and RSI, are momentum indicators that measure the strength of a trend, there are some striking differences in how advanced traders use these indicators in their trading strategy.
- There are scenarios in which RSI (Relative Strength Index) has been found to deliver better trading results than MACD (Moving Average Convergence Divergence) and vice versa.
- MACD Provides Trading Signals with 80% Accuracy in Trending Markets.
- If one is trading in a trending market, one can have MACD as his indicator of choice. However, in a choppy sideways movement, it is likely to get better trading results using RSI.
- MACD is More Versatile, Providing Reliable Trading Signals on All Time-Frames and in a Variety of Market Conditions.
- RSI Gives Less Frequent, But More Accurate Trade Signals.

Observations on AROON Indicator

- The Aroon Oscillator does a good job of keeping a trader in a trade when a long-term trend develops. This is because during an uptrend, for example, the price tends to keep making new highs which keeps the oscillator above zero.
- During choppy market conditions, the indicator will provide poor trade signals, as the price and the oscillator whipsaw back and forth.
- The indicator may also sometimes provide trade signals too late to be of use. The price may have already run a significant distance before the trade signal develops. The price may be due for a retracement when the trade signal is appearing.

Observation on Fibonacci Retracement and Bollinger Bands

Fibonacci retracements are used to indicate levels of support and resistance for a stock's price.

Bollinger Bands is a powerful breakout indicator. If the price has crossed the upper or lower Bollinger Band at the same time when key Fibonacci Levels have been crossed, then the likelihood of a breakout is confirmed.

On the other hand, if the price has reversed after touching the upper or lower Bollinger Band and at the same time when key Fibonacci Levels have been reached, then the likelihood of a reversal is confirmed.

Fibonacci Retracement with Moving Averages

- In shorter time frames, longer Fibonacci MAs are more reliable. For example, if we apply the 5-Period SMA on the M5 timeframe the results are basically irrelevant. In these shorter time frames, we should focus on 55-Period or higher MAs.
- On the other hand, in longer timeframes (H4, D1) we can use shorter MAs (i.e. 5, 8, 13).
- In most time frames, we can focus on the price crossovers above or below MA(55), MA(144), or MA(233).

REFERENCES

- https://www.moneycontrol.com/stocksmarketsindia/
- https://www.businesstoday.in/moneytoday/stocks/technical-analysis-tools/story/21155.html#:~:text=These%20include%20200%2Dday%20moving,nowadays%20makes%20technical%20analysis%20easy.&text=One%20of%20the%20widely%20used,the%20200%2Dday%20moving%20average.
- https://groww.in/blog/top-5-technical-analysis-tools-for-stock-market/
- https://en.wikipedia.org/wiki/Stock_market_prediction
- https://www.businesstoday.in/moneytoday/stocks/technical-analysis-tools/story/21155.html#:~:text=The%20most%20used%20are%20available,nowadays%20makes%20technical%20analysis%20easy.