Stocks Analysis and Trading Strategies

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02/2023

PROBLEM STATEMENT

How can Data Science be leveraged to evaluate and develop trading strategies, which can outperform the market returns for year 2022 for selected US Stocks and ETFs in 3 months

Scope:
Daily closing price data for stocks and etfs available at Yahoo Finance API will be used for developing and back testing different models

Constraints:
- Fluctuation of stock price within day could not be considered
- Stock prices are affected by economic factors like inflation, bond prices and federal interest rates and may adversely impact the trading models.

Criteria for Success:
Successfully develop models based on Bollinger bands, MACD, Relative Strength index, neural network in 3 months

Stakeholders
Stock Analysts, Economists, Financial Advisors and Data Scientists

Key data sources
- https://pypi.org/project/yfinance/Metadata

Bollinger Bands

- Bollinger Bands® are composed of three lines.

- One of the more common calculations uses a 20-day simple moving average (SMA) for the middle band.

- The upper band is calculated by taking the middle band and adding twice the daily standard deviation to that amount.

- The lower band is calculated by taking the middle band minus two times the daily standard deviation

Bollinger Bands (Up trending Scenario)

▶ QQQ(2010-01-04 TO 2022-12-07)
Profit% One Time Investment-
584.23%
Profit% BB- 2.23%

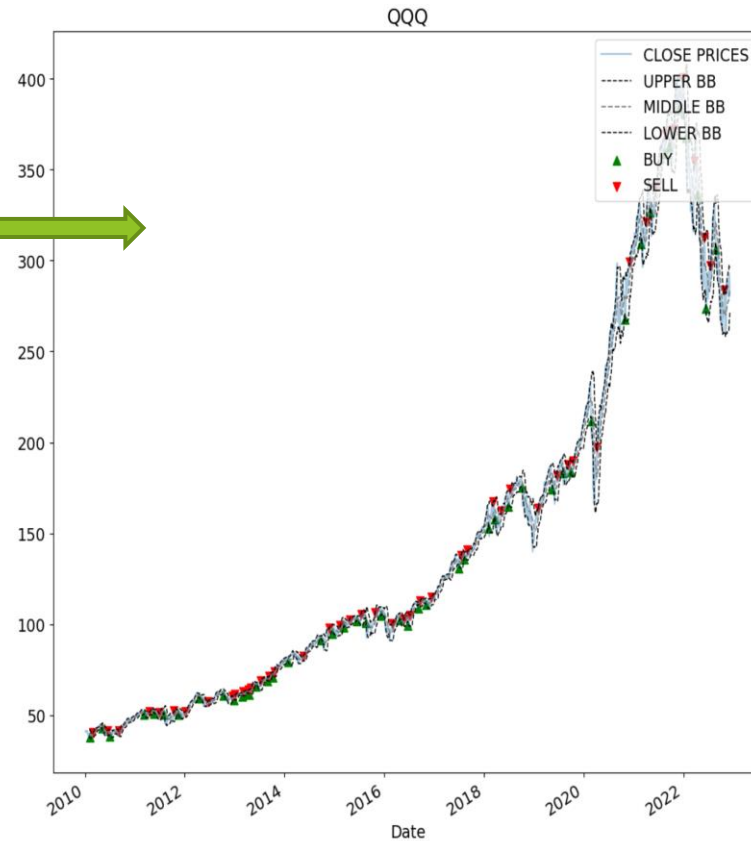▶ SPY(2010-01-04 TO 2022-12-07)
Profit% One Time Investment-343.2%
Profit% BB- 1.93%

▶ DIA(2010-01-04 TO 2022-12-07)
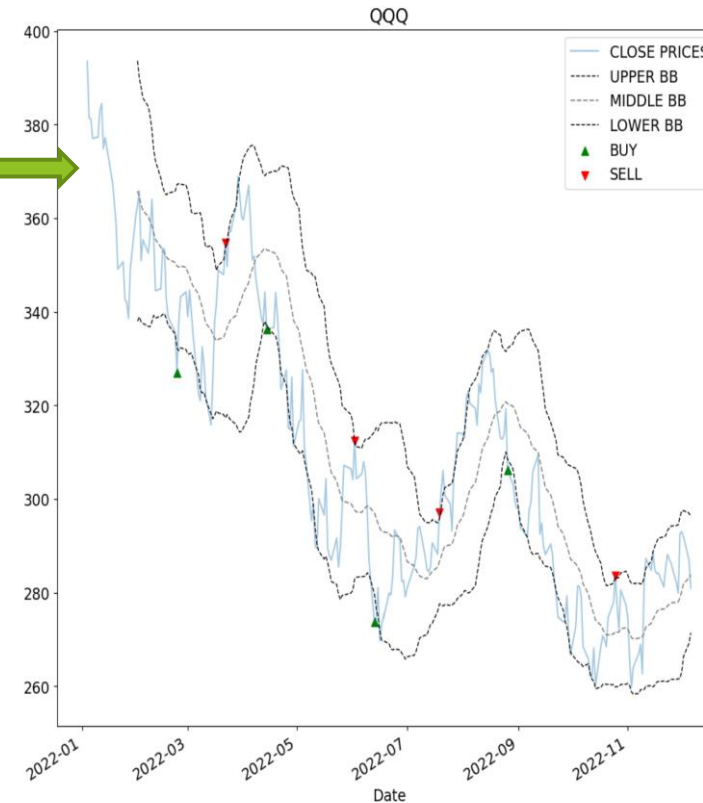Profit% One Time Investment-
325.03%
Profit% BB- 1.86%

QQQ

CLOSE PRICES
UPPER BB
MIDDLE BB
LOWER BB
▲ BUY
▼ SELL

Bollinger Bands (Down trending Scenario)

- QQQ(2022-01-04 TO 2022-12-07)
  Profit% One Time Investment 28.6%
  Profit% BB 0.37%
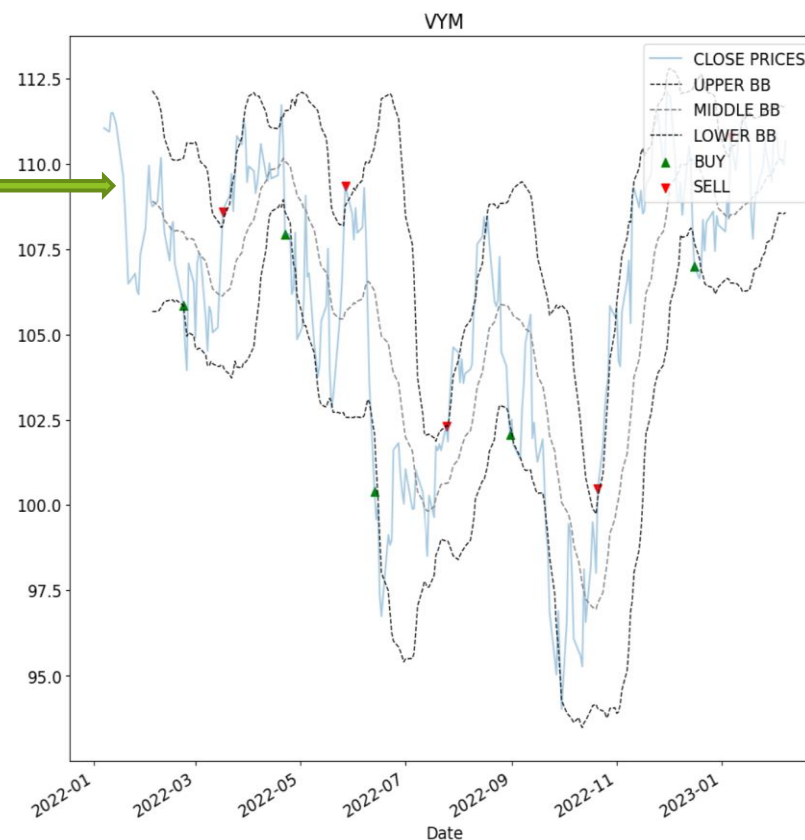
- SPY(2022-01-04 TO 2022-12-07)
  Profit% One Time Investment 2.44%
  Profit% BB- 16.58%

- DIA(2022-01-04 TO 2022-12-07)
  Profit% One Time Investment 2.11%
  Profit% BB 6.95%

Bollinger Bands (No trend Scenario)

- VYM(2022-01-07 TO 2023-02-08)
  Profit% One Time Investment 0.33%
  Profit% BB 1.58%

Relative Strength Index

▶ [Relative Strength Index](#) measures the momentum and is a oscillator which moves between 0 and 100.

▶ When the RSI drops below 30, it indicates the market is oversold and when it goes above 70 it indicates overbought level.

▶ RSI calcuation is done in two steps. Initial 14 days RSI is calculated in step 1 and later period RSI is calculated in Step 2

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

$$RSI_{\text{step two}} = 100 - \left[\frac{100}{1 + \frac{(\text{Previous Average Gain} \times 13) + \text{Current Gain}}{((\text{Previous Average Loss} \times 13) + \text{Current Loss})}} \right]$$

RSI (Up trending Scenario)

- QQQ(2010-01-04 TO 2022-12-07)
  Profit% One Time Investment-
  584.23%
  Profit% RSI- 6.0%

- SPY(2010-01-04 TO 2022-12-07)
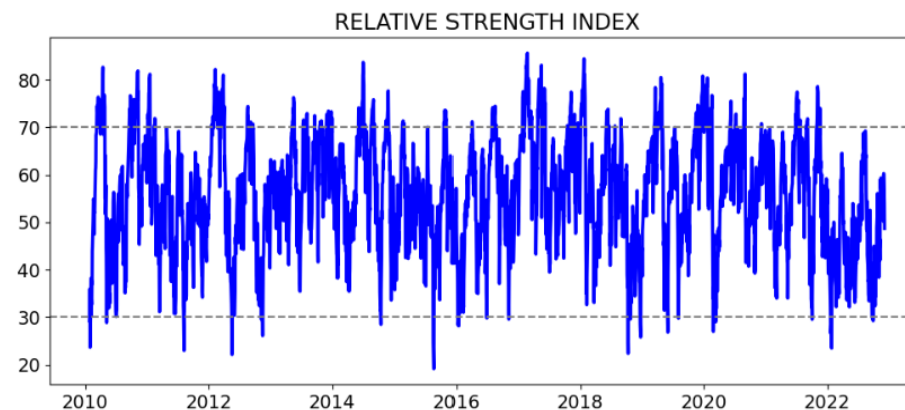 Profit% One Time Investment-343.2%
  Profit% RSI- 5.58%

- DIA(2010-01-04 TO 2022-12-07)
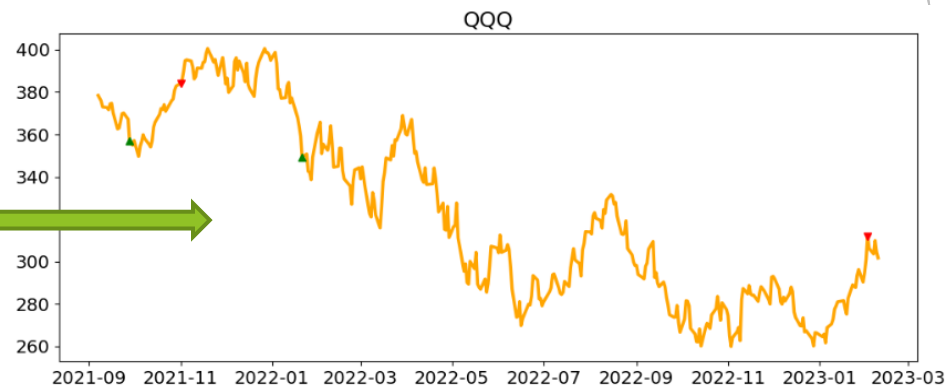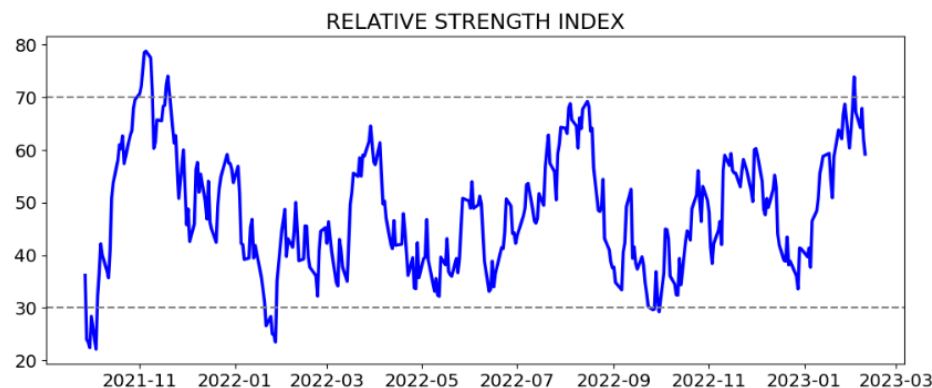 Profit% One Time Investment-
  325.03%
  Profit% RSI- 6.92%

RSI (Down trending Scenario)

▶ QQQ(2021-09-04 TO 2023-02-10)
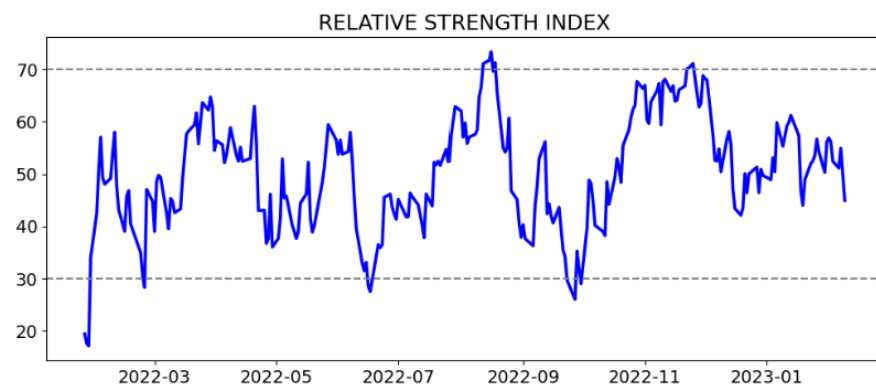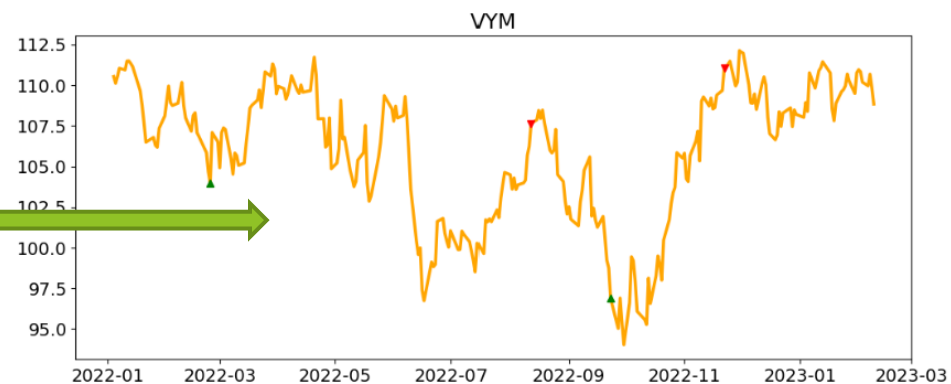Profit% One Time Investment 15.44%
Profit% RSI 1.43%

▶ SPY(2021-09-04 TO 2023-02-10)
Profit% One Time Investment 3.26%
Profit% RSI 5.37%

▶ DIA(2022-01-04 TO 2022-12-07)
Profit% One Time Investment 1.22%
Profit% RSI 5.43%

RSI (No trend Scenario)

▶ VYM(2022-01-04 TO 2023-02-10)
Profit% One Time Investment 4.69%
Profit% RSI 8.9%

Moving Average Convergence Divergence ([MACD](#))

- [MACD](#) is a momentum-based trend indicator and is based on the convergence and divergence of 12 and 26 period exponential moving average(EMA).

- Fast Line : This line represents short term exponential moving average, which is 12 period EMA

- Slow Line : This line represents long term exponential moving average, which is 26 period EMA

- MACD Line : 12 period EMA- 26 period EMA

- Signal Line: This line is the 9 period EMA of MACD

- MACD histogram : MACD Line -Signal Line

- Zero Line : It's the base line with value of zero, and on this line MACD histogram is plotted. Generally, positive values of MACD bars are shown as Green ans negative values are shown as Red
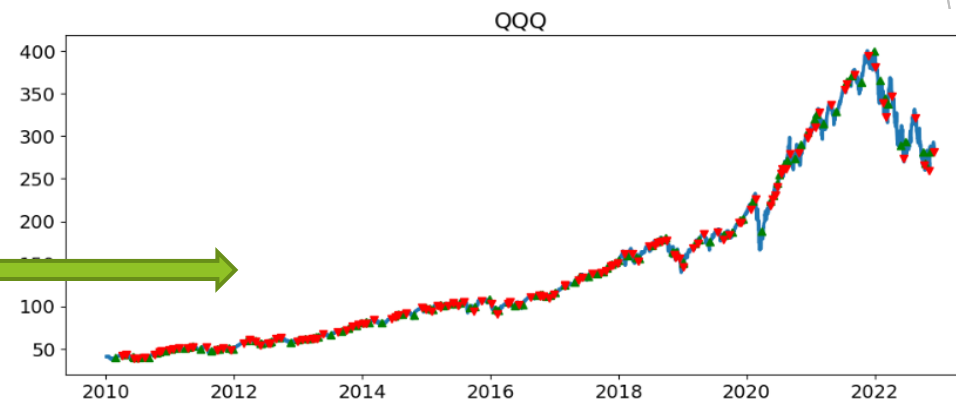
MACD (Up trending Scenario)

- QQQ(2010-01-04 TO 2022-12-07)
  Profit% One Time Investment
  584.23%
  Profit% MACD 0.73%

- SPY(2010-01-04 TO 2022-12-07)
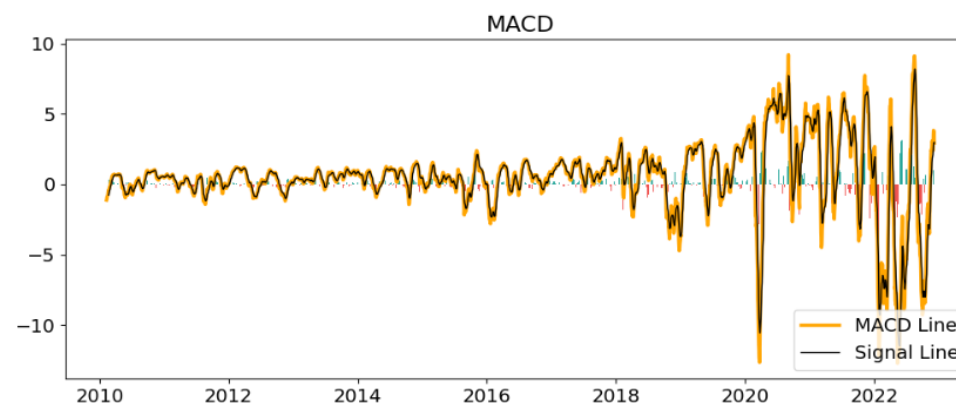 Profit% One Time Investment 343.2%
  Profit% MACD 0.6%

- DIA(2010-01-04 TO 2022-12-07)
  Profit% One Time Investment-
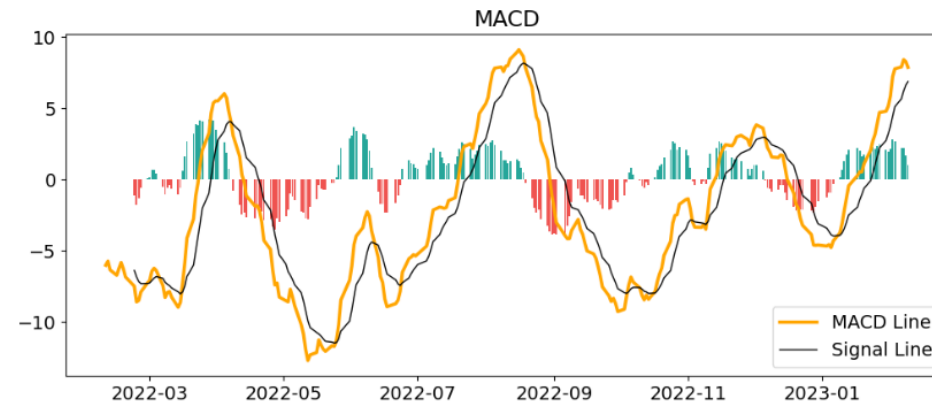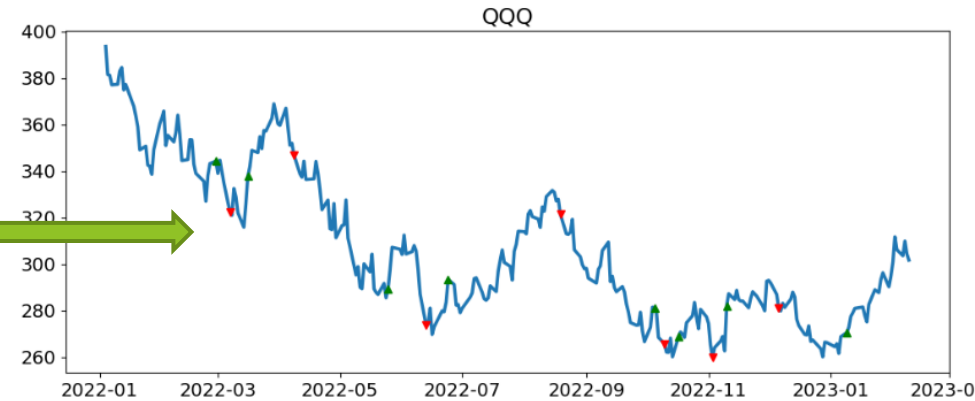 325.03%
  Profit% MACD 0.81%

MACD (Down trending Scenario)

- QQQ(2022-01-04 TO 2023-02-10)
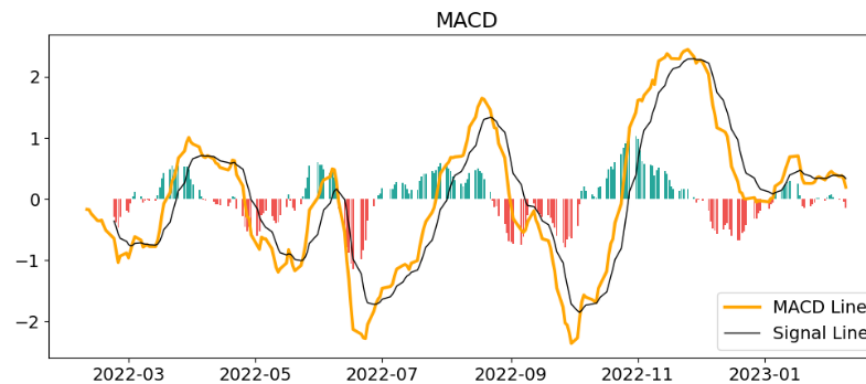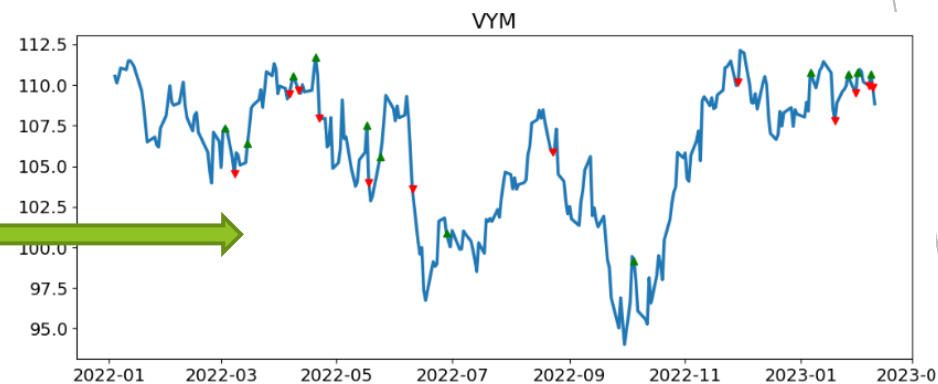 Profit% One Time Investment 23.35%
  Profit% MACD 1.22%

- SPY(2021-09-04 TO 2023-02-10)
  Profit% One Time Investment 7.75%
  Profit% MACD 0.15%

- DIA(2021-09-04 TO 2023-02-10)
  Profit% One Time Investment 1.51%
  Profit% MACD 0.68%

MACD (No trend Scenario)

▶ VYM(2022-01-04 TO 2023-02-10)
Profit% One Time Investment 1.53%
Profit% MACD 0.01%

Long Short-Term Memory (LSTM) Neural Network

- **LSTM** is a type of artificial recurrent neural network, which is used in field of deep learning. It has feed back connections and can process sequence of data points.

- LSTM neural network can be used for short term movement of stocks over a long period of time

- Optimizer- Adam

- Loss Function-'Mean Squared Error

LSTM Model

- No. of epochs used :50
- Trained on 3060 days of closing prices
- Loss after first epoch:

  - 1s 460us/sample - loss: 0.0203

- Loss after last epoch:

  0s 160us/sample - loss: 7.8101e-04
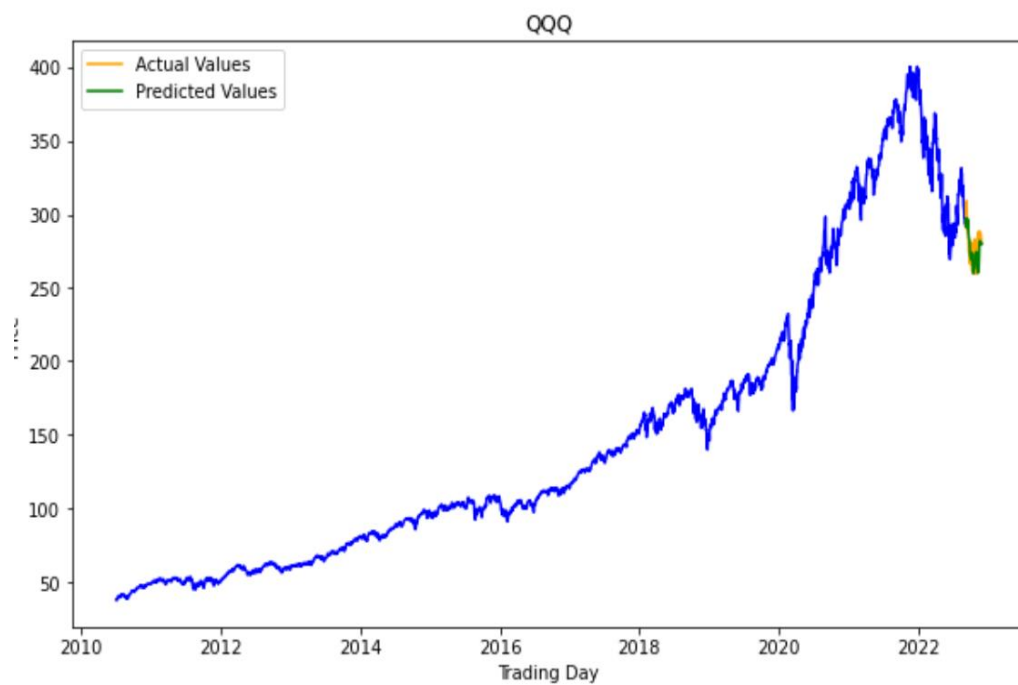
```
Model: "sequential"
_____
Layer (type)                 Output Shape              Param #
=================================================================
lstm (LSTM)                  (None, 5, 50)             10400

dropout (Dropout)            (None, 5, 50)             0

lstm_1 (LSTM)                (None, 5, 50)             20200

dropout_1 (Dropout)          (None, 5, 50)             0

lstm_2 (LSTM)                (None, 50)                20200

dropout_2 (Dropout)          (None, 50)                0

dense (Dense)                (None, 1)                 51

=================================================================
Total params: 50,851
Trainable params: 50,851
Non-trainable params: 0
_____
```

LSTM Model Forecast for ETF "QQQ"

- ▶ Predicted Value for 60 periods

Conclusion

Bollinger Band Strategy, Relative Strength Strategy and MACD did not perform well on up trending market, compared to buy and hold strategy.

Bollinger Band Strategy, Relative Strength Strategy and MACD outperformed the buy and hold strategy for both down trending and non-trending stocks.

Relative Strength Index Strategy performed far better than Bollinger Band and MACD strategy for all three price trend scenarios

LSTM neural network did show good predictability for exchange traded fund "QQQ"

Macro-economic conditions should be considered along with fundamental of stocks in making investment decisions.

In general, all 3 exchange traded funds performed very well over long horizon, and it would be worth while to do recurring investment over a long period of time

THANK YOU