A Project Report on

Forecasting the Stock Prices of Nifty Fifty Companies using a Predictive Algorithm for a good ROI

Submitted in partial fulfilment for award of degree of

Master of Business Administration

In **Business Analytics**

Submitted by

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Candidate's Declaration

I, **Gautham R** hereby declare that I have completed the project work towards the first year of Master of Business Administration in Business Analytics at, REVA University on the topic entitled "**Forecasting the Stock Prices of Nifty Fifty Companies using a Predictive Algorithm for a god ROI**" under the supervision of **Ratnakar Pandey**. This report embodies the original work done by me in partial fulfilment of the requirements for the award of degree for the academic year **2020**.

Place: Bengaluru
Date: 22.10.2020

Name of the Student: Gautham R
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Certificate

This is to Certify that the Project work entitled "**Forecasting the Stock Prices of Nifty Fifty Companies using a Predictive Algorithm for a good ROI**" carried out by **Gautham R** with **SRN R19MBA02**, is a bonafide student of REVA University, is submitting the first year project report in fulfilment for the award of **Master of Business Administration in Business Analytics** during the academic year **2020**. The Project report has been tested for plagiarism, and has passed the plagiarism test with the similarity score less than 15%. The project report has been approved as it satisfies the academic requirements in respect of PROJECT work prescribed for the said Degree.

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Place: Bengaluru

Date:

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List of Abbreviations

Sl. No	Abbreviation	Long Form
01	LSTM	Long short-term Memory
02	NSE	National Stock Exchange

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Abstract

This project presents a LSTM algorithm built on Historical prices of the stock to understand the pattern of price movement and attempts to predict the future prices of any given stock for a good Return on Investment from well sector-diversified portfolio from Nifty-Fifty companies of National Stock Exchange of India Ltd. (NSE), Which is the leading stock exchange in India and the second largest in the world.(nseindia, n.d.)

Keywords: Long Short Term Memory, Deep Learning, Stock Market Analysis

Contents

Chapter 1: Introduction

Stock market prediction is an act of trying to determine the future value of a stock(Wikipedia, n.d.) and this project aims to help the investor to predict the right stock for short-term investment and get a good Return on Investment.

“Financial markets are considered as one of the perfect choices for investors to make large profit by observing the market dynamics. Making a good decision with the lowest level of risk depends mainly on information collection and analysis”(Althelaya et al., 2018)

Indisputably, forecasting stock prices using conventional methods is very difficult because of market volatility. But still for any investor Stock Market will always be interesting with something or the other thing happening all the time, the point of this anecdote is that the investor shouldn't regard the whims of the Stock Market as a determining factor to invest in any stock in the Stock Market. One should take advantage of the market folly instead of participating in it thus the opportunity of making good profits multiply as they are seized.

The stock market works on the concept of random walk, which means that today’s value is the greatest guess you will have about the value of tomorrow, thus time series which could determine the price pattern movement from the Historical stock price data should be one of the best ways to forecast the future stock prices, But this is next to the difficulty for any Person to predict the future of the stock price but with the technical advancement in the field of AI, Algorithm’s computing power has been increased manifold to make better inferences from large quantities of data to find patterns. Machine learning and deep learning networks are the most widely used Artificial Intelligence tools for stock price prediction in today's world. In this project, we will be focusing on the technical analysis for stock price movement by making use of Deep Learning.

Stock price Forecasting using Time series poses a lot of challenges while working with a long sequence of historical stock price data, particularly for the price pattern understanding by the algorithm but Deep learning method provides a lot of support in this arena by automatic handling of the historical stock price data to identify and understand the trend to forecast the future stock prices.

Chapter 2: Literature Review

This review insisted a study in the field of financial theories related to stock market analysis, Trading Strategies and Deep Learning (Khare et al., 2017)

“None can beat the Market; instead all we can do is to learn the three important lessons

- How to minimize the odds of suffering irreversible losses
- How to maximize the chances of achieving sustainable gains
- How to Harness the emotions during Trading or Investing in Stock Market”

(Of & Counsel, 2008)

“The answer to the above question is in predictive stock forecast algorithm based on Artificial Intelligence and Machine Learning with elements of Artificial Neural Networks incorporated in it”(iknowfirst, 2020)

“The model is 100% empirical, meaning it is based on historical data and not on any human derived assumptions. The human factor is only involved in building the mathematical framework and initially presenting to the system the starting set of inputs and outputs”.(iknowfirst, 2020)

“From that point onward, the computer algorithms take over, constantly proposing theories, testing them on years of market data, then validating them on the most recent data, which prevents over-fitting. If an input does not improve the model, it is rejected and another input can be substituted.”(iknowfirst, 2020)

The study done by J. B. Heaton to solve various financial problems using Deep Learning states that the over fitting problem here could be easily eliminated and establishes the correlation with input variables at ease. (Heaton, J. B., Polson, N. G., and Witte, 2017)

Hengjian Jia discovered that LSTMs are efficient to forecast the stock prices and he achieved a decent RMSEs using LSTM, This study helped us to analyse the stock forecasting as univariate time series problem with a sliding window approach. (Jia, 2016)

Pradeep Mahato, in his work has proposed ensemble models to forecast the next day's stock price.(Mahato & Attar, 2014)

"In this project we will discover the promise of deep learning methods for time series forecasting on Stock Prices Historical data."(Jason, 2018)

"Time series forecasting is challenging, especially when working with long sequences, noisy data, multi-step forecasts and multiple input and output variables. Deep learning methods offer a lot of promise for time series forecasting, such as the automatic learning of temporal dependence and the automatic handling of temporal structures like trends and seasonality"(Jason, 2018)

"Artificial Neural Network or Deep Learning provides capabilities that are offered by few algorithms, such as:

- **Robust to Noise**. Neural networks are robust to noise in input data and in the mapping function and can even support learning and prediction in the presence of missing values.

- **Nonlinear.** Neural networks do not make strong assumptions about the mapping function and readily learn linear and nonlinear relationships. ˆ

- **Multivariate Inputs**. An arbitrary number of input features can be specified, providing direct support for multivariate forecasting. ˆ

- **Multi-step Forecasts**. An arbitrary number of output values can be specified, providing direct support for multi-step and even multivariate forecasting"(Jason, 2018)

"It has been observed that deep neural network architecture like LSTM is competent enough to capture the dynamics hidden in the Historical Stock Price Data and understand the price

pattern movement. The analysis of these type of trends and cycles will give more profit for the investors" (Selvin et al., 2017)

> "This project aims to develop a Long Short-Term Memory Neural Network model or LSTM for univariate time series forecasting on Historical stock price data, LSTM model expects three-dimensional input with the shape [samples, time steps, features]. We will define the data in the form [samples, time steps] and reshape it accordingly".(Jason, 2018)

This kind of three dimensional inputs is very much essential for the price pattern understanding by the model to forecast the future stock prices.

Chapter 3: Problem Statement

In today's Financial Stock Market, the real challenge is to identify the best stock for Short Term or Long Term investment and gain profit for any individual or a firm. Though Long term investments in good fundamentally strong companies are still one of the major investment decisions, we do have few instances of companies such as RCOM, Reliance Capital, Reliance Infrastructure, etc.… which had good fundamental numbers but the price of the shares surprisingly declined and we have concluded now that those companies are not worth investing.

Henceforth whether we prefer to own the stock for Short Term or Long Term the visualization of the price movements in the future or the future prices of the company stock would be very much essential to buy and own stock.

But to identify the future trend of any particular stock we need to be aware of the fact that random event always occurs, a stock with a 1% drop in stock price doesn't have to have a cause as they go up and down on a daily basis, trying to understand the reason behind the 1% drop is meaningless, even when there is a reason it could be easily identified at the earliest from the price pattern, But to identify the future trend it is very much essential to have a good knowledge and understanding of the Historical price movements of that particular stock, This is because the History always repeats itself so by looking into the past, we can always look into the future but is next to impossible for any human being to do it precisely without the aid of latest technologies.

Chapter 4: Objectives of the Study

The stock market prediction aims at forecasting the future value of the stock and accurate prediction of a stock price in future should fetch a good returns for the investor, this project aims at devising an automated prediction system and is highly essential for stock forecasting using Technical Analysis

This paper demonstrates the applicability of Deep Learning algorithms for technical analysis of Stock Price to determine the future prices and advise a Buy Call or No Buy Call to the investors of any given stock from well sector-diversified portfolio from Nifty-Fifty companies of National Stock Exchange of India Ltd. (NSE), Which is the leading stock exchange in India and the second largest in the world(nseindia, n.d.)

Nifty Fifty Stocks-Future 30 days price Prediction, Date- 3rd August

S/n	Stock	S/n	Stock	S/n	Stock	S/n	Stock	S/n	Stock
1	ADANIPORTS	11	COALINDIA	21	HINDALCO	31	LT	41	SUNPHARMA
2	ASIANPAINT	12	DRREDDY	22	HINDUNILVR	32	M&M	42	TATAMOTORS
3	AXISBANK	13	EICHERMOT	23	ICICIBANK	33	MARUTI	43	TATASTEEL
4	BAJAJ-AUTO	14	GAIL	24	INDUSINDBK	34	NESTLEIND	44	TCS
5	BAJAJFINSV	15	GRASIM	25	INFRATEL	35	NTPC	45	TECHM
6	BAJFINANCE	16	HCLTECH	26	INFY	36	ONGC	46	TITAN
7	BHARTIARTL	17	HDFC	27	IOC	37	POWERGRID	47	ULTRACEMCO
8	BPCL	18	HDFCBANK	28	ITC	38	RELIANCE	48	UPL
9	BRITANNIA	19	HDFCLIFE	29	JSWSTEEL	39	SBIN	49	WIPRO
10	CIPLA	20	HEROMOTOCO	30	KOTAKBANK	40	SHREECEM	50	ZEEL

Colour	Prediction
	Buy Call
	No Buy Call

Figure. 4.1. Proposed Report – Nifty Fifty Companies Buy/No Buy Signals

The Fig.1. shown above is the proposed report of this project, which should benefit the investor to understand on which stocks the investor should invest for a specific time frame, such as 30 days to get good returns on his investment.

Chapter 5: Project Methodology

The CRISP-DM framework has been used here for the project.

"Cross-industry standard process for data mining, known as CRISP-DM, is an open standard process model that describes common approaches used by data mining experts. It is the most widely-used analytics model"(Wikipedia, 2020)
It comprises of the following six phases: Business Understanding, Data Understanding, Data Preparation, Modeling, Evaluation and Deployment. The project will be explained in these 6 phases in the following pages.

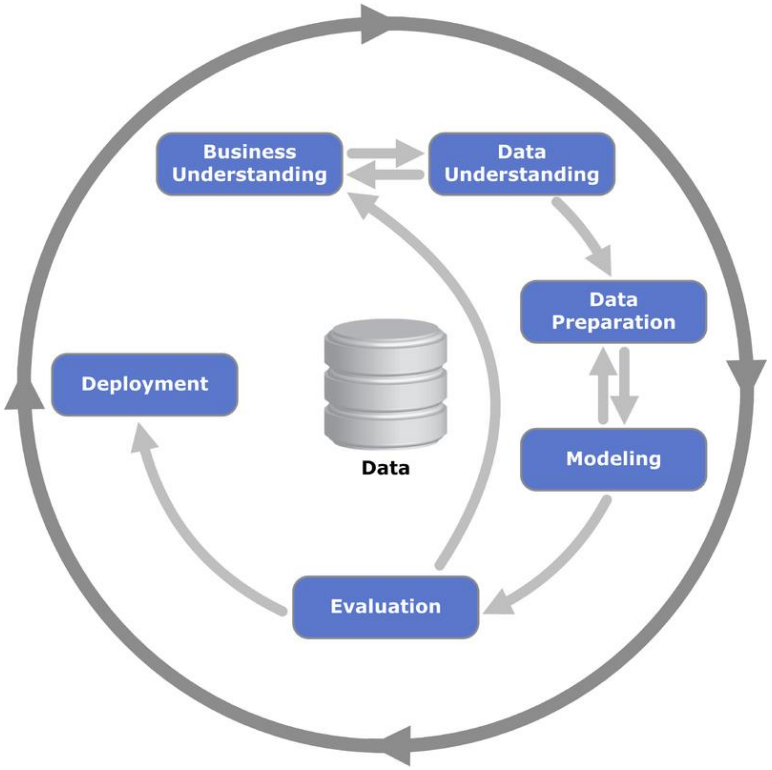


Figure 5.1 "CRISP-DM Framework "(Wikipedia, 2020)

Chapter 6: Business Understanding

“The stock selection should not be based on any human derived assumption, The person should only be involved in building the framework which makes use of historical data to build a 100% empirical Model”.(iknowfirst, 2020)

In short this project aims to provide algorithmic solutions to investors in predicting the right stock based on their time frame of investment.

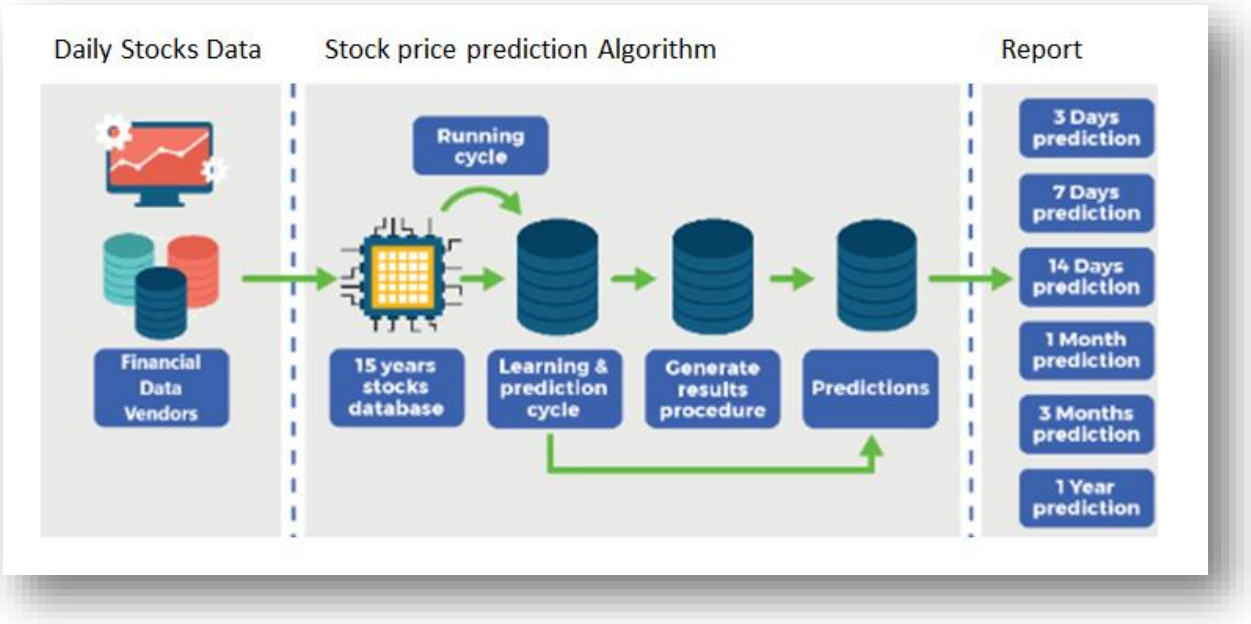


Figure 6.1 – Algorithmic Solution for Stock Price Prediction

Chapter 7: Data Understanding

Business Understanding of this project is to provide the Algorithmic Solution for Stock Price Prediction and for this to happen the Algorithm has to be trained to understand the pattern of the stock price movement in order to predict the future prices of the stock.

Thus we need the Historical prices of any stock listed in Nifty Fifty companies to understand the pattern of price movements of that particular stock.

Five Years Historical day closing prices on all working days are collected from Yahoo Finance, which is a well-known financial website.

Date	High	Low	Open	Close	Volume	Adj Close
2015-05-27	375.500000	366.899994	368.049988	372.200012	215459.0	357.987213
2015-05-28	385.799988	365.500000	375.000000	380.250000	1467589.0	365.729797
2015-05-29	381.000000	372.200012	381.000000	378.299988	312544.0	363.854248
2015-06-01	379.600006	373.049988	375.100006	376.299988	232939.0	361.930603
2015-06-02	378.450012	367.200012	378.450012	368.950012	322834.0	354.861298
...	...	...	...	...	...	...
2020-07-29	1066.750000	1036.199951	1056.800049	1040.449951	2332468.0	1032.612427
2020-07-30	1057.699951	1039.949951	1042.000000	1041.849976	2297977.0	1034.001953
2020-07-31	1051.099976	1032.699951	1045.500000	1043.250000	1786573.0	1035.391479
2020-08-03	1094.650024	1043.000000	1047.000000	1077.349976	7646498.0	1073.349976
2020-08-04	1089.199951	1065.250000	1088.949951	1075.199951	3357481.0	1075.199951

Figure 7.1 – Historical Price Data of Stock

Chapter 8: Data Preparation

In this phase the Historical stock price data extracted will be preprocessed to a format that can be fed to the model to provide an output.

Data Preparation steps

- **Closing prices on each date is extracted from the Historical prices of the stock, to form a Univariate Time series Data.**
- **The Data is scaled to transform features within the range of 0 to1**
- **The entire 5 Years data is Split into Train Data and Test Data**
- **Transform the Train Data and Test Data into a Supervised Learning Format**.

"Supervised learning is where you have input variables (X) and an output variable (y) and you use an algorithm to learn the mapping function from the input to the output. The goal is to approximate the real underlying mapping so well that when you have new input data, you can predict the output variables for that data. Time series data can be phrased as supervised learning. Given a sequence of numbers for a time series dataset, we can restructure the data to look like a supervised learning problem. We can do this by using previous time steps as input variables and use the next time step as the output variable. For example, the series"(Jason, 2018)

Figure 8.1 – "Univariate Time series Example"(Jason, 2018)

"The above discussed Univariate time series should be transformed into samples with input and output components that can be used as part of training set to train a supervised learning model like a deep learning neural network"(Jason, 2018)

Figure 8.2 – "Example of a time series transformation into samples"(Jason, 2018)

In the above example time step is 3 where as in our project time step will be 100, means 100 days historical prices will be used to determine the stock price on 101^{th} day.
The above discussed process is performed both for Train and Test data of the scaled data.

Chapter 9: Data Modeling

The preprocessed data discussed in the previous phase is fed in to the Stacked LSTM Model, to get the future stock prices as an output.

Figure 9.1 – Deep Learning Architecture

Long Short Term Memory

"It was introduced by Hochreiter and Schmidhuber in 1997. These networks are clearly designed to evade the long- term dependency problem, but remembering information for a long time period back is their normal behavior."(Hiransha et al., 2018)

"The Long Short-Term Memory network, or LSTM for short, is a type of recurrent neural network that achieves state-of-the-art results on challenging prediction problems"(Jason, 2020b)

In our case we are making use of Historical closing prices of the stock which is fed into the LSTM model, ours is a Sequence Prediction problem where the LSTM learns the price pattern movement of any stock and attempts to predict the future stock price

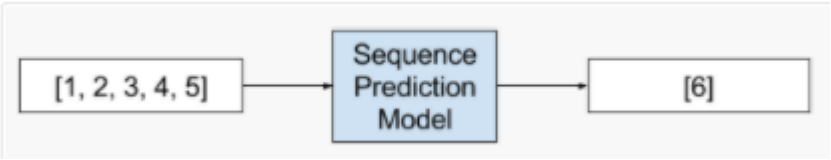


Figure 9.2 – Example of a Sequence prediction problem(Jason, 2020b)

"The LSTM model will learn a function that maps a sequence of past observations as input to an output observation. As such, the sequence of observations must be transformed into multiple examples from which the LSTM can learn".(Jason, 2020a)

```
[ ]  ### Create the Stacked LSTM model
     from tensorflow.keras.models import Sequential
     from tensorflow.keras.layers import Dense
     from tensorflow.keras.layers import LSTM
```

```
[ ]  model=Sequential()
     model.add(LSTM(50,return_sequences=True,input_shape=(100,1)))
     model.add(LSTM(50,return_sequences=True))
     model.add(LSTM(50))
     model.add(Dense(1))
     model.compile(loss='mean_squared_error',optimizer='adam')
```

```
[ ]  model.summary()
```

```
Model: "sequential_4"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_12 (LSTM)               (None, 100, 50)           10400
_________________________________________________________________
lstm_13 (LSTM)               (None, 100, 50)           20200
_________________________________________________________________
lstm_14 (LSTM)               (None, 50)                20200
_________________________________________________________________
dense_4 (Dense)              (None, 1)                 51
=================================================================
Total params: 50,851
Trainable params: 50,851
Non-trainable params: 0
_________________________________________________________________
```

```
[ ]  model.fit(X_train,y_train,validation_data=(X_test,ytest),epochs=100,batch_size=64,verbose=1)
```

Figure 9.3 – Stacked LSTM Model

Chapter 10: Data Evaluation

Once the Model is built, the scaled output data of the model has to be retransformed Predict the output for both Train and Test Data and Plot the results.

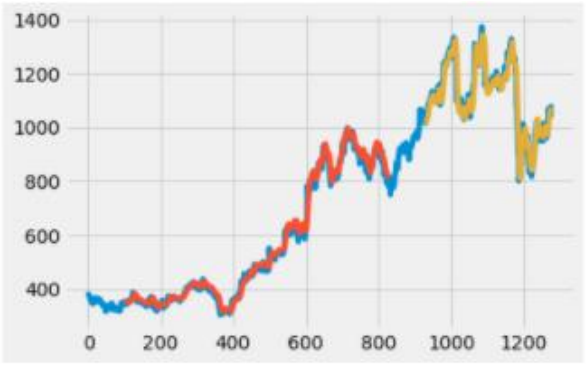
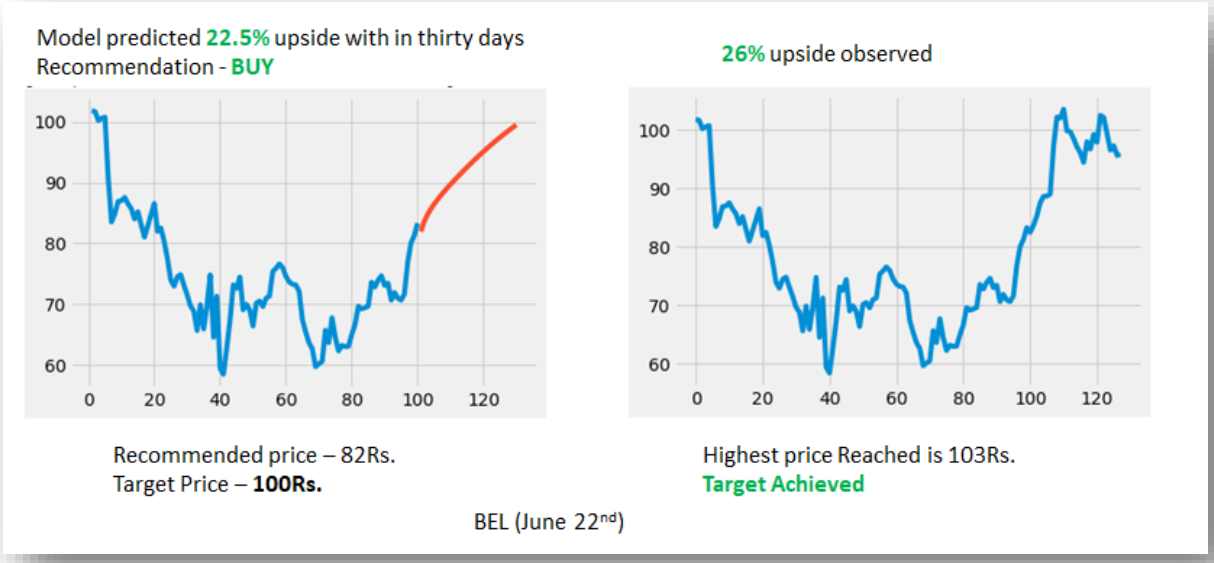


Figure 10.1– Output Plot of Train and Test Data v/s Actual Data

Now the model should be evaluated for all the stock listed in NSE Nifty Fifty companies.

- Predict the future 30 days stock price movement by feeding 100 days historical price data

- Compare the predicted price plot with the actual price plot



. Figure 10.2 – Model Prediction Plot V/s Actual Stock Price Plot

Chapter 11: Deployment

Identification of BUY CALL and NO BUY CALL of any given stock of NIFTY FIFTY Companies, from the future 30 days price movement as shown below

Figure 11.1 – Classification of Buy Call and No Buy Call from Predicted Plots

The above discussed Classification test is conducted on all Companies listed in Nifty Fifty Companies to identify the stocks worth investing for a specific time interval to get good returns on investment.

Nifty Fifty Stocks-Future 30 days price Prediction, Date- 3rd August											
S/n	Stock	S/n	Stock	S/n	Stock	S/n	Stock	S/n	Stock		
1	ADANIPORTS	11	COALINDIA	21	HINDALCO	31	LT	41	SUNPHARMA		
2	ASIANPAINT	12	DRREDDY	22	HINDUNILVR	32	M&M	42	TATAMOTORS		
3	AXISBANK	13	EICHERMOT	23	ICICIBANK	33	MARUTI	43	TATASTEEL		
4	BAJAJ-AUTO	14	GAIL	24	INDUSINDBK	34	NESTLEIND	44	TCS		
5	BAJAJFINSV	15	GRASIM	25	INFRATEL	35	NTPC	45	TECHM		
6	BAJFINANCE	16	HCLTECH	26	INFY	36	ONGC	46	TITAN		
7	BHARTIARTL	17	HDFC	27	IOC	37	POWERGRID	47	ULTRACEMCO		
8	BPCL	18	HDFCBANK	28	ITC	38	RELIANCE	48	UPL	Colour	Prediction
9	BRITANNIA	19	HDFCLIFE	29	JSWSTEEL	39	SBIN	49	WIPRO		Buy Call
10	CIPLA	20	HEROMOTOCO	30	KOTAKBANK	40	SHREECEM	50	ZEEL		No Buy Call

Figure 11.2 – Report – Buy Call / No Buy Call of Nifty Fifty Companies

Chapter 12: Analysis and Results

"A confusion matrix is a table that is often used to **describe the performance of a classification model** on a set of test data for which the true values are known."(Kevin Markham, 2014)

The performance of the Buy call / No Buy call of the Nifty Fifty Companies classification is verified by using a Confusion Matrix.

	Prediction	Buy-Actual	Neutral-Actual	Sell-Actual
Buy Call	13	13	0	0
Neutral Call	14	5	8	1
Sell Call	23	10	3	10

	Predicted No Buy	predicted Buy	
Actual No Buy	22	0	22
Actual Buy	15	13	28
	37	13	

Table 12.1 – Confusion Matrix

"Precision → When the Model predicted Buy, How often it is Actual Buy?"(Kevin Markham, 2014) 13/13 =100%

Average Returns per month – Predicted is 18%, Actual is 15%

Buy Calls		
Stocks	Predicted Returns	Actual Returns
ZEEL	55%	55%
COALINDIA	46%	8%
ONGC	24%	9%
EICHERMOT	19%	6%
GAIL	15%	8%
NTPC	13%	23%
TATASTEEL	13%	13%
AXISBANK	12%	18%
POWERGRID	11%	6%
INDUSINDBK	10%	20%
MARUTI	10%	10%
GRASIM	7%	14%
HEROMOTOCO	3%	11%
Average Returns - Aug Month		15%

Table 12.2 – Predicted Returns V/s Actual Returns

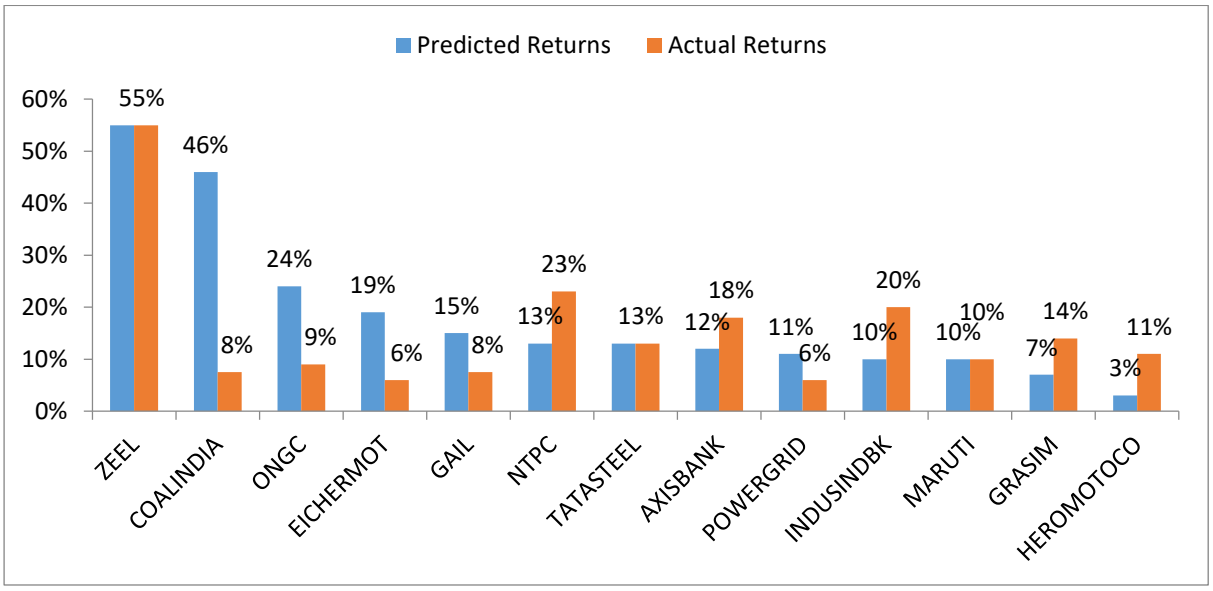


Figure 12.1 – Predicted Returns V/s Actual Returns

Chapter 13: Conclusions and Recommendations for future work

Conclusion:

This project solely focus on the technical analysis of the stocks using Time Series Deep Learning, where the model studies the price pattern from the historical data and predicts the future prices, Based on which the Fifty Companies listed in the Nifty Fifty are classified into Buy Call or No Buy Call signals.

Recommendations for Future Work:

This project does not cover the News analysis, so the recommendation for the future work would be to analyze the stock based on the news where the algorithm web scrapes the data from the Financial websites using NLP and analyzes the stock to be bought or not.
Thus the combination of Technical analysis and News analysis should give a more accurate forecast of stock prices

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Appendix

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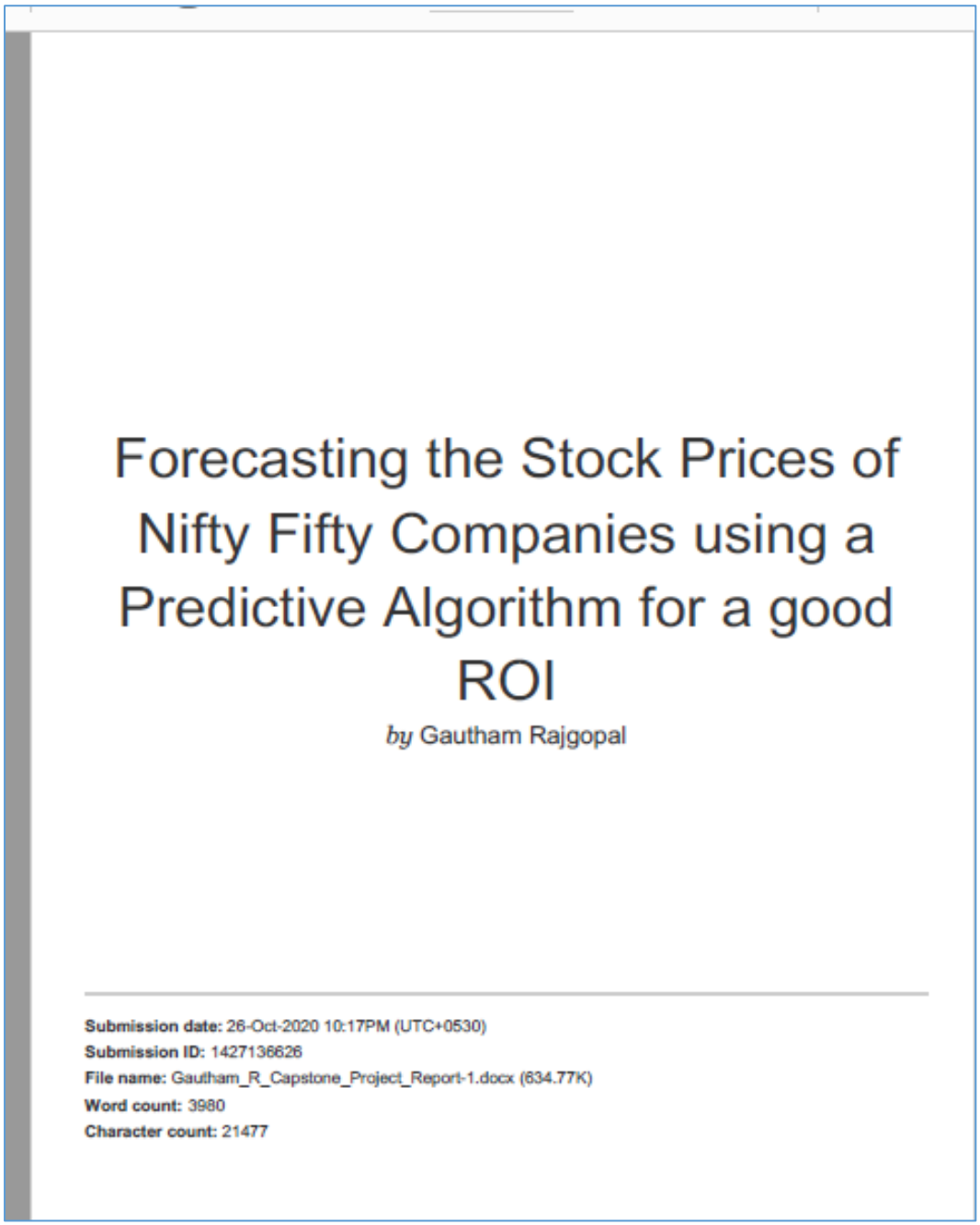

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by Gautham Rajgopal

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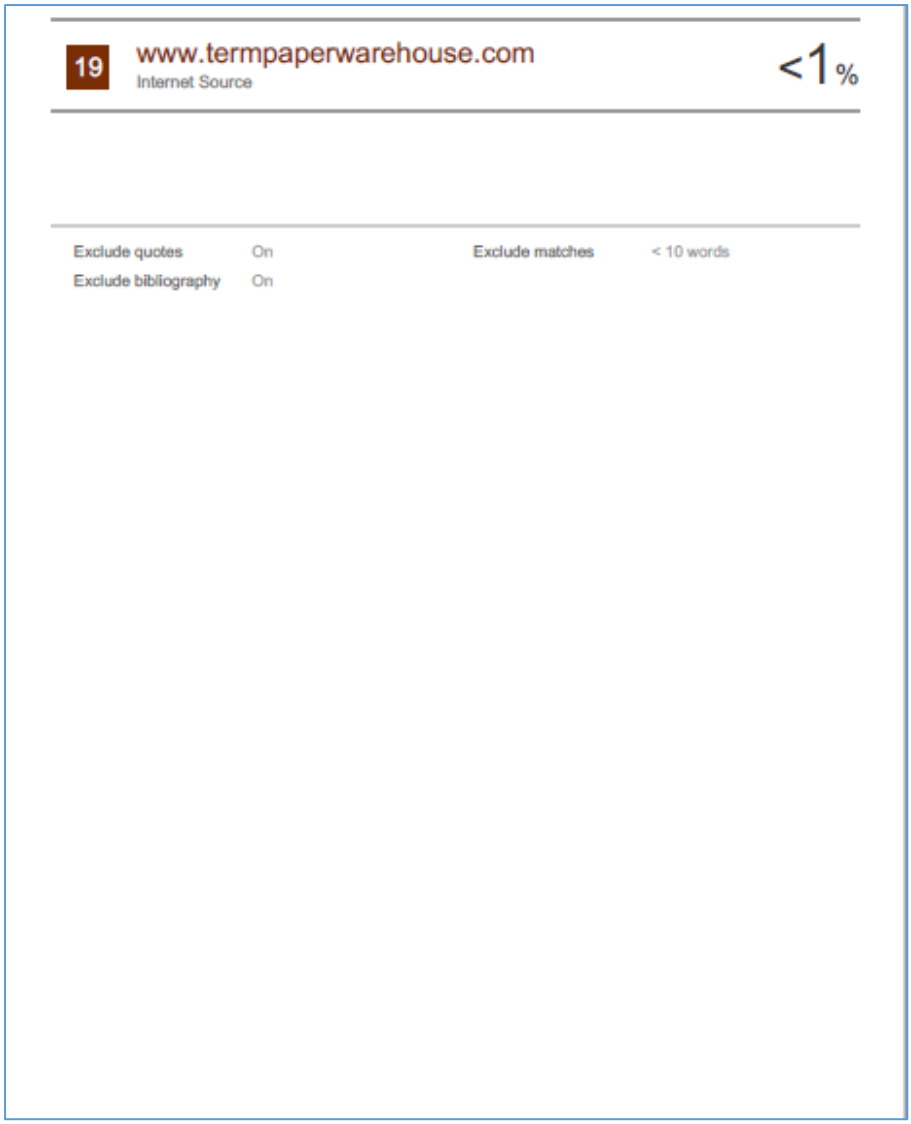
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