

“Time Series Data Prediction Using Deep Learning”

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In the present scenario, Time Series data analysis is crucial for Decision Makers. In various fields varying from medicine to finance. These diversified and critical utility Time-series data analysis motivates researchers to perform it in a more precise and accurate manner, especially the future value prediction. As the data involved are usually huge in the volume. Therefore, the implementation of Deep learning will provide more meaningful insides. For doing this the identification of impacting Hyper parameters and related algorithms is to be done. So, the value predicted from former specified hyper parameters and an algorithm should be effective and efficient.

Keywords: - Time Series, Deep Learning, Machine Learning, Hyper Parameters.

1. INTRODUCTION:

In the Current era of Technology, each and every field of Humanity like Business, Medicine, Entertainment, etc are affected by data. Mostly this data is time series in nature. Organizations may better comprehend systemic patterns across time by using time series analysis. Business users may examine seasonal trends and learn more about their causes using data visualizations. These visualizations can do much more than just display line graphs using today's analytics solutions. Organizations may use time series forecasting to estimate the likelihood of future occurrences when they study data at regular intervals. Predictive analytics includes the prediction of time series data. It can indicate expected data changes, such as seasonality or cyclical behavior, which improves forecasting and gives a better understanding of data factors.

For the above-specified issue, computer science can play a vital role in solving the case, since by using the machine learning branch of Computer Science this problem can be tackled. For better understanding, we took the problem of Stock Price Prediction where the use of computer science for time series data analysis can be done easily. Since this problem relies on times series data where the current value of the stock depends on the previous value of the Stock. Therefore, it can be solved using Deep Learning, more specifically RNN (Recurrent

Neural Network) will be required to solve the problem. Here we are going to use the LSTM Algorithm i.e. Long Short Term Memory Algorithm which is a special case of Recurrent Neural Network. In the next section the available literature is reviewed for determine the step-by-step solution for the Stock Market prediction problem.

2. RELETED WORK:

In this section the previous work done in the field of stock prediction are reviewed in details. And then observed points are listed which lays the foundation of this experiment. Here the using of the Machine learning in Financial data is determined and what different algorithms available analyzed previously.

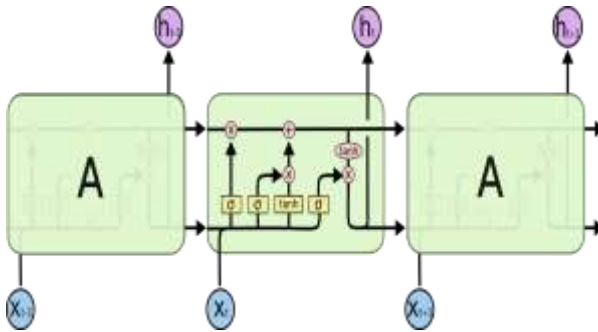
In [3] the author specified the use of a Deep learning framework for forecasting financial data. Here the deep learning framework is used for training the neural networks. Then the results observed by using Neural Networks were compared with the traditional benchmark methods of forecasting financial data. The Neural network results are found to be more stable than the traditional method.

In [5] the author has focused on the application of Machine learning Algorithms in the field of finance. With the introduction of machine learning algorithms in finance many crucial tasks such as Portfolio Designing, Risk Modeling, Forecasting and Decision making can be done at much higher efficiency

In this paper [6] the authors have described the deep learning-based methods and the process of applying those methods for stock prediction. The collection of data from Chinese stock market is done and followed by the data preprocessing step and at last subject to the deep learning models for value prediction.

In this paper [7] authors have thrown light on the use of ANN and Random Forest method in Stock Prediction problem here data of 5 different companies are taken. Prediction is done using ANN and RF methods. Then consider RSME and MAPE as indicator for evaluation ANN methods are found to be more satisfactory when used for predicting the value.

Here in [9] author has illustrated the complete information regarding LSTM (Long Short-Term Memory Networks). Author has described it as a special kind of RNN with capacity of learning long term dependencies. The core reason for the development of LSTM is the avoidance of the long-term dependency problem. It usually consists of multiple layers as demonstrated in Figure 1. These layers consist on multiple cell where in each multiple functions are working as elaborated in figure 2



1. Cell Structure of LSTM

O_t : Output gate activation vector

$$f = \sigma_g(w_f x_t + U_f C_{t-1} + B_f)$$

$$i_t = \sigma_g(w_i x_t + U_i C_{t-1} + B_i)$$

$$O_t = \sigma_g(w_o x_t + U_o C_{t-1} + B_o)$$

$$C_t = f \circ C_{t-1} + i_t \circ \sigma_c(w_c x_t + B_c)$$

$$h_t = \sigma_h(O_t \circ C_t)$$

x_t : input vector to the LSTM

2. Functions in LSTM

The Internet of Things for the first time was used in 1999 which described the world where anything, including people, animals, plants, and even inanimate objects (such as cars), being able to have their digital identity which is allowing the computers to organize and manage them

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3. METHODOLOGY:

In this section the process, dataset and the experimental setup is defined which will be used in prediction the value of a stock. For this experiment we have used the dataset available at kaggle [2]. This data contains the daily records of all Nifty 50 companies in the Indian Stock Market. Here the records of CIPLA are taken into consideration. The Duration of data considered in this experiment is from 2017 to 2021 i.e. 5 years. Where the five year tenure is divided into two parts one of four and half years and another of half year.

The former part is taken as the training set and the latter part is taken as the testing set for our Machine Learning Algorithm. Dataset consists of 7 columns their description is given in the table

Table 1. Dataset field Description

Dataset Field Name	Specification
Date	Date specifies the Date of record for the Stock
High	Highest Value of the Stock
Low	Lowest Value of the Stock

Open	Opening Value of the Stock
Close	Closing Value of the Stock on the Date of Record
Volume	Volume of the Stock
Adj Close	Adjusted Closing Price of the Stock

The experimental setup used here works on Intel® core™ i5-9500U CPU @ 2.70GHz (4 CPU's) with a memory size of 8GB. Python is used as the scripting language for the development of LSTM and other automation. Pandas, Matplotlib, NumPy and keras are some crucial libraries used here.

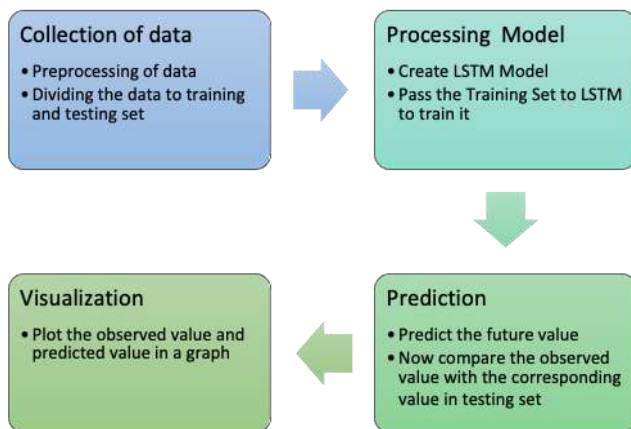
For starting the experiment, the data of the stock is required then only further process can be done. Here the kaggle dataset of Nifty 50 is taken. As formerly specified in this section the Records of CIPLA is chosen for the experiment. Once the common separated value file of the data is uploaded in Python for construction of Data frame, its processing is started since LSTM (Long Short Term Memory) Algorithm is extremely sensitive towards data value to the value is to be normalized in a range of 0 to 1.

After the preprocessing data is divided done it is into training set and testing set. Then a LSTM Models is created with different layers on the basis on the methodology that close price depends upon the previous closing price. Here the number of layer considered to be 100. Once this Model is established then the Training is provided to this model so that it can train itself on the basis of Training set and Testing set.

After this future value is predicted on a specified training set and then the results is validated by comparing it to the corresponding value in Testing Test to find the accuracy. Now the Model is ready for predicting further more future values.

On the observed value and the predicted value can be plotted on a graph for determining the pattern and assistance in decision making by the Investors

1. Collection of data in CSV format
2. Preprocessing of data
3. Dividing the data to training and testing set
4. Create LSTM Model
5. Pass the Training Set to LSTM to train it
6. Predict the future value
7. Now compare the observed value with the corresponding value in testing set
8. Plot the observed value and predicted value in a graph



3. Process for LSTM Implementation

4. RESULT AND DISCUSSION:

In this section the results generated by using the algorithm demonstrated in the methodology section are recorded and analyzed. The figure specifies the graph plotted for the closing prices of CIPLA stock. And then in the figure specify the graph plotted for the prediction made and Actual Value observed



4. Closing Price Chart (INR)

In this figure closing price of the stock is plotted with respect to the time. It is the entire dataset considered for this experiment. From the very dataset the training and the testing data set are generated .



5. Example of a figure caption. (figure caption)

In Figure 5 closing price of stock is plotted here the blue color plot specifies that it is training set, Yellow is Prediction from LSTM model and Red is the actual value observed.

Table 2. sample of Results Generated on Prediction

Date	Actual Value	Predicted Value
2021-04-16	938.05	939.05
2021-04-19	946.3	944.3
2021-04-20	949.3	950.3
2021-04-22	944.35	948.35
2021-04-23	935.6	926.6
2021-04-26	905.4	895.4
2021-04-27	912.4	905.4
2021-04-28	910.2	906.2
2021-04-29	906.5	909.5
2021-04-30	910.35	900.35

In order to test the accuracy of our model, the predicted values are subjected to RSME (Root Square Mean Error) Method using the formula

$$RSME = \sqrt{\frac{\sum_{i=1}^n (Y_i - P_i)^2}{n}} \quad (1)$$

Where Y_i is the Actual Value of the Stock, P_i is the Predicted Value of the stock, n is the No. of Iterations for Date. After subjecting 150 Different rows of Data consisting of the above specified values The Calculations were made and the RSME value is found to be 5.7652.

5.CONCLUSION AND FUTURE SCOPE:

Stock Market Prediction is usually a difficult task since the factors affecting it are large in number. Moreover, these factors are not controllable many times. Here, in this paper we have taken the closing price as a parameter for determining the future value of the stock. The results were found to be satisfactory since around 57% accuracy was achieved. And, with a RSME value 5.7652 variation in prediction was also found to be comparatively low. But, then also there is a future scope of betterment in accuracy by involving other crucial factors such as volume, P/E Statement, Impact of social events etc.

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