**4. Experimental Result & Discussion**

In the course of the experiment, the proposed meta model has been experimented with the open access data from Stock Bangladesh [1]. This experimental design was employed to evaluate proposed meta model.

**4.1. Experimental Setup**

To experiment the overall model the following materials are required.

**Python:** Python is the fastest-growing well-known programming language for built-in support for scientific computing as well as in the field of research and development works. Python has a wide variety of libraries like NumPy, SciPy, Pandas, and matplotlib which are extremely optimized, well documented and easy to compute. Most importantly it has strong support for data preprocessing and to better handle the data deluge.

**Jupyter Notebook** :To work with python, we used Jupyter Notebook as an IDE which is an open-source web application. It is extremely useful for data cleaning, transformation, numerical simulation, statistical modeling and data visualization. Alongside it allows us to write expressive code, present our findings and embed results/graphs in the same document as with code.

**Workstation**: In the time of experiment the workstation configuration was:

* Operating System: Windows 10 Enterprise
* Processor: Intel(R) Core (TM) i5-7200U CPU @ 2.50GHz
* Memory: 8 GB DDR3
* Secondary Storage: SSD 224GB (Flash Storage)
* Graphics: Intel(R) HD Graphics 620 8073 MB

**4.2. Dataset**

We collected the stock price data form an open source website Stock Bangladesh[1]. This website contains the historical stock price data of all the companies listed in Dhaka Stock Exchange. This historical data includes financial statements of different sectors like: Insurance, Telecommunication, Ceramics, Engineering, Cement, Tannery, Textiles, Travel etc.

We have collected the price data of many popular Bangladeshi company like: Prime Bank, Saif Power, South East, BBS Cables, Nploymar, Aramit Cement, Linde Bangladesh Limited, Grameenphone, Dutch Bangla Bank Limited (DBBL), Rahim Textile Company, Ibn Sina etc from 1st December 2018 to 25 December 2020.Because of covid-19 pandemic the year 2019-2020 had been very challenging year for Bangladesh share market.

After collecting dataset, we have considered the close value as an indicator for divide the whole dataset into multiple ranges single dataset. Then from each single dataset we have extracted 10 companies’ data and convert it into individual single dataset. Later for each company, data from December 2018 to October 2020 used as the training dataset and November 2020 used as the test dataset.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **DATE** | **OPEN** | **HIGH** | **LOW** | **CLOSE** | **VOLUME** |
| 1-10-19 | 72.36 | 73.36 | 71.27 | 72.45 | 246105 |
| 2-10-19 | 72.82 | 72.91 | 71.91 | 72.18 | 182444 |
| 3-10-19 | 72.45 | 72.64 | 71.55 | 71.82 | 179627 |
| 6-10-19 | 72 | 72 | 71.09 | 71.36 | 155922 |
| 7-10-19 | 71.64 | 71.64 | 69.45 | 69.64 | 256857 |
| 9-10-19 | 69.73 | 69.73 | 65.36 | 65.91 | 490989 |
| 10-10-19 | 67.09 | 67.09 | 63.55 | 63.91 | 427414 |
| 13-10-19 | 64.64 | 65.64 | 63.36 | 63.82 | 297580 |
| 14-10-19 | 64 | 65.18 | 63.27 | 64.36 | 292522 |
| 15-10-19 | 64.82 | 70.82 | 64.82 | 70.82 | 806610 |
| 16-10-19 | 71.55 | 72.64 | 67.64 | 68.55 | 767654 |
| 17-10-19 | 68.55 | 68.55 | 66.18 | 66.55 | 373765 |
| 20-10-19 | 66.64 | 68.09 | 66.55 | 67 | 276455 |

A sample used data of BBS Cables Company has been displayed in **Table 3**. It represents several important attributes of stock market along with companies information and their stock prices. The details of those attributes are given below.

Table 3 Sample Data (BBS Cables Stock Value)

**Open:** In the financial markets the term "open" has several usages. Basically, opening price is price which the financial security opens in the market when trading begins or other words first trade for any listed stock. Moreover, for day's trading activity the opening price is an important marker as well as for those whose interested in measuring short-term results such as day traders.

**Close:** The term "Close" refers to a security’s trading price at the end of a day’s business in a financial market. It can also refer to last price at which a stock trades during a regular trading session. This term helps investors to analyzing historical returns on an investment and understand changes in the value of a security over a certain time frame.

**High:** The term "High" means the highest price in a given period of time. Broadly high refers to a security's intraday high trading price during the course of the trading day. Sometimes it’s may or may not be higher than the closing or opening price.

**Low:** Today’s low is lowest price in a given period of time which a stock trades over the course of a trading day. It is typically lower than the opening or closing price.

**Volume:** Volume is the amounts of shares bought or sold of a stock in a given period of time. In the larger sense volume is the total number of shares that are actually traded during the trading day. It is important because the more volume the more people agree with the price of the stock and also an important indicator in technical analysis.

We have used the Close column of our dataset as the Actual value of the stock and train our system in that way for trend estimation. Then use some auxiliary columns for improve prediction accuracy.

**4.3. Forecasting Performance Evaluation**

It is mandatory for every forecasting model to evaluate its forecast accuracy without which it is difficult to determine how well a model performs on new data set. Further, the residual’s size is not a true dependable indication of how large true forecast errors are likely to be. For which the accuracy of forecasts can only be estimated by considering the size of error rather than size of the residuals. There are many forecasting performance measures used to evaluate the size of the error, while considering the size of the error, different dimensions may be addressed.

**Root Mean Square Error (RMSE):**

The Mean Square Error (MSE) value measures the amount of dispersion of the errors. The MSE is calculated as the average of the sum of the squares of forecast errors. The square root of the MSE results in the standard deviation [2]. Root Mean Square Error (RMSE) is nothing but the standard deviation of the residuals (prediction errors). Residuals are the quantity of how far from the regression line data points are. RMSE could be denoted as:

where t = time period; n = number of periods predicted; Yt = actual value in time period t; Ft = predicted value in time period t. RMSE is a process of measurement to check how wide out these residuals are. In other words, it gives an account of how centralize the data is around the line of best fit.

**Mean Absolute Percentage Error (MAPE):**

Mean Absolute Percentage Error is a widely used evaluation of forecasting methods, which is actually a statistical measure of how accurate a forecast system is and computes error as a percentage. The average absolute percentage error for each time period minus actual values divided by actual values is equal value to this method [2]. The MAPE is calculated as:

where, Yt is the actual value and Ft is the predicted value. One of the best advantage of MAPE is being unit-free, and therefore is frequently used to compare forecast performances between many data sets. A scale to judge the accuracy of the model based on the MAPE measure was developed by Lewis [3] where less than 10% is considered as High Accuracy, between 11% and 20% (inclusive) is Good forecast, between 21% to 50% (inclusive) is reasonable forecasting and more than 50% MAPE value represents inaccurate forecasting.

**Percentage Forecast Error (PFE):**

The conventional forecast performance measures have no real world or business meaning or context that motivates to develop a measure call the Percentage Forecast Error (PFE). It is a new forecasting alternative that offers a practical and accurate measurement as well as forecasters confidence. The PFE is calculated as,

where s e is the standard error and Ŷt+1 is the forecasted value for the next time period, t+1. The PFE is somewhat almost like to the coefficient of variation (CV) in which one measures the relative dispersion around the mean. With the PFE, there is a similar ratio except that in the numerator of the PFE measure the standard error, which is multiplied by 2. As a result, the resulting measure is 2 standard deviates far away from the mean in conjunction with the Empirical Rule. Accordingly, using the PFE value with a high level of certainty which is almost 95% and it allows one to say that the forecast for the next time period will be within PFE% of the actual value. In other words, one is highly certain that the forecast will be within 20% of the actual value [4].

References:

[1]. Stock Bangladesh, Available: https://stockbangladesh.com, Last Accessed on 28th December, 2020

[2]. R. K. Klimberg, G. P. Sillup, K. J. Boyle, and V. Tavva, “Forecasting performance measures—what are their practical meaning?” Advances in business and management forecasting, vol. 7, pp. 137–147,2010.

[3]. M. Tirea and V. Negru, “Stock market analysis-strongest performing stocks influence on an evolutionary market,” in Proceedings of the ITI 2013 35th International Conference on Information Technology Interfaces. IEEE, 2013, pp. 263–270.

[4]. R. Klimberg and S. Ratick, “A new measure of relative forecast error,” in INFORMS Fall Meeting, 2000.