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# An Artificial Neural Network Method for Managing Inventory of A Fertilizer Company in Bangladesh

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**Abstract**

Business organizations are always facing uncertainties in demand, supply and inventories. For this, it is important for them to make the strategic plans to cope up with the uncertainty accordingly. To sustain, the business organizations must plan the future in such a way that the inventory cost, labor cost will be minimized and the utilization of time, financial resources and profit will be maximized. The optimum planning of resources also help the organizations to avoid wastage. A good forecasting technique can help the manager of a company to deal with the uncertainties. In this paper, we will work on such a planning fora fertilizer company in Bangladesh. To minimize the inventory cost, we will apply a new approach known as Artificial Neural Network (ANN), which is recently used for the problem of prediction and analyze the main characteristics of a system through an iterative training process. For this, we will first forecast the demand of fertilizer by using existing forecasting methods. We will then apply ANN for forecasting the demand of fertilizer of the company. We will also identify Economic Order Quantity (EOQ) to minimize total cost including inventory costs of the company. We use programming language MATLAB for analyzing different forecasting methods including ANN. Finally, we will use these results to find out the right forecasting technique for the fertilizer company with optimal inventory cost.

**Keywords:** Forecast, Inventory management, Economic order quantity, artificial neural network, Error measurement.

## I. Introduction

Bangladesh is a developing country. To be a developed one, we need improvement in all sectors such as education, health, agriculture, science and commerce etc. Economic sector plays the most important role for a country's development. To compete with globalized world, we need to improve our business sector which has to deal with many uncertainties. Forecasting is a very important tool for the modern business management. Lack of suitable forecasting or faulty forecasting are the reason for the failure of many companies. An accurate forecasting technique can help a company's managers to match capacity with demand. An appropriate forecasting system enable a company to cope up with the changing market conditions, thereby achieving high yield levels. In this Section, we will discuss about history of Artificial Neural Network (ANN), motivation, research outline and methodology.

In 1943 McCulloch and Pitts developed a simple neural network for electrical circuits [26]. In 1949, Donald Hebb presented the concept of neurons and how they work[26]. In 1959 Widrow and Hoff developed two models namelyADALINE and MADALINE which were the first neural networksmodels applied to a real life problem [26]. Rob Hyndman et. al [10], introduce a new approach focusing on point forecast equation, state space equations, estimation and model selection are discussed. Based on the data they used AMSE estimation. They calculate MAPE cross different forecast horizons [10].

Willemain et al. [24] used exponential smoothing method for forecasting the demand for inventory management. Their result showed that ES is not suitable for forecasting the entire distribution of lead time demand [24]. Rob Hyndman et. al[16] provided some formulae for calculating mean-variances of lead time demand, which depend on trends and seasonal effects. The author recommended that ANN represent an oppurtunity to effectively solve many problems including scheduling, optimization, process control and forecasting [11]. Aburto and Weber [1] combined ARIMA and Neural Networks and compared the efficiency of the hybrid model [1].

The papers we have described above are helpful to carry out our research work. That papers related to forecasting techniques give us the concept of different types of forecasting methods applied on several products in different countries. We will try to choose right forecasting method for managing the inventories with optimal cost for a fertilizer company of our country. For this, we investigate different forecasting methods as well as ANN as a new approach. We will calculate forecasting errors to identify the accurate forecasting technique. We will observe the impact of inventory cost on the total cost of company. We will use this concept in our work to control inventory costs, forecast errors, product costs and to get desired profit in our business companies. The rest of the paper is organized as follows. **In Section II**, we will discuss about basic behavior of ANN method. **In Section III,** we will study a real world problem to compare different forecasting methods with Artificial Neural Network. **In Section IV**, we will compare the forecasting methods by measuring accuracy. **In Section V**, we will focus on inventory management. **In Section VI**, we will draw a conclusion about our research work. In next section, we will introduce and discuss about the preliminaries of the new approach ANN.

## II. Artificial Neural Network (ANN)

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Artificial neural network is mostly used in forecasting the sales of a business organization. In this section, we will describe basic behavior of ANN [2, 9]. It is an information processing system and is used as mathematical models. ANN consists of many processing nodes or neurons which are connected by directed links of different weights. By using input and output arcs, the neuron accepts and release the processed values to other neurons.

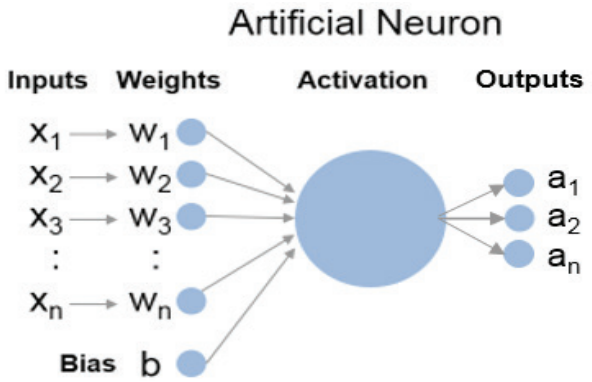


**Fig. 1.** Artificial Neuron Network (20)

In Figure 2.1, b is included to set the actual threshold of the activation function. Mathematically, $v_i = \sum_{j=1}^{d} w_{ij}\, x_j$ ,

$$o_i = \gamma(v_i) = \gamma(\sum_{j=1}^{d} w_{ij}\, x_j), \quad w = \begin{bmatrix} w_{11} & w_{12} & w_{1d} \\ w_{21} & w_{22} & w_{2d} \\ w_{m1} & w_{m2} & w_{md} \end{bmatrix}$$

where γ is the activation function, $x_j$ is the input neuron, $o_i$ is the output of hidden neuron and $w$ is the weight matrix.

*Basic structure of an ANN*

There are many different structures of artificial neural network. Based on the input layers, hidden layers, output layers, neurons,and types of activation functionsetc.,the structure varies. The neurons are organized into the input layer and the the output layer. The inner layers are the hidden layers. A hidden or an output neuron recieves input signals from the incoming connections and values from its local memory [22].

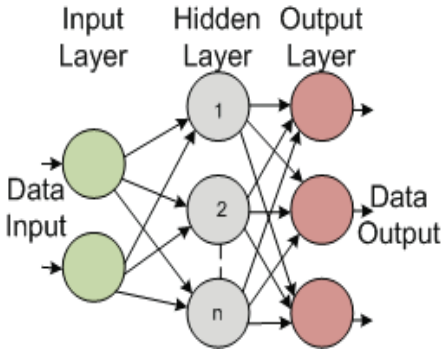


**Fig. 2.** Basic structure of a Neural Network [6]

## III. Application of ANN in Real Life Problem

In this section, we will forecast the monthly sales of fertilizer (Ammonium Sulphate) of a fertilizer company in Bangladesh. For this, we have used sample data of sales of fertilizer for two years and then forecast for the next year.

Currently, more than thirty different families of ANNs exist in literature. ANNs can be applied within the field of Marketing, in the field of Finance and Accounting, in the field of Manufacturing and Production etc.We have considered a fertilizer company in Bangladesh which produces fertilizer (Ammonium Sulphate) for using in agricultural sector. Currently the company is using intuition based production. They are not using any suitable forecasting technique for the production of fertilizer through the year. The authority provides the sample information related to the production quantity of fertilizer. But it is frequently changing over the time. So, an appropriate forecasting technique is required for this company. For this, we will first apply some relevant existing forecasting techniques to forecast the sales of fertilizer. We will then apply ANN to do the same.

Because of the confidentiality of the company, we did not use actual data. But for analyzing various forecasting techniques and Artificial Neural Network for forecasting the sales of fertilizer, we have used sample data of the monthly sales of fertilizer for last two years starting from January 2019 to December 2020 which is shown in Table 1.

**Table 1. Consolidated sales of Ammonium Sulphate**

| Month | Sales of Ammonium Sulphate |
|---|---|
| Jan.19 | 10051 |
| Feb.19 | 9640 |
| Mar.19 | 8888 |
| Apr.19 | 9581 |
| May.19 | 12796 |
| Jun.19 | 12752 |
| Jul.19 | 26201 |
| Aug.19 | 15110 |
| Sep.19 | 9545 |
| Oct.19 | 22433 |
| Nov.19 | 25360 |
| Dec.19 | 10365 |
| Jan.20 | 8992 |
| Feb. 20 | 9191 |
| Mar. 20 | 8996 |
| Apr. 20 | 4573 |
| May. 20 | 12077 |
| Jun. 20 | 10678 |
| Jul. 20 | 24896 |
| Aug. 20 | 16942 |
| Sep. 20 | 14660 |
| Oct. 20 | 26657 |
| Nov. 20 | 7275 |
| Dec. 20 | 9024 |

*Forecast using different Methods*

Forecasting is the activity of estimating the quantity of a product or services that consumers purchase. In this section, we will determine forecasted sales of fertilizer applying different forecasting methods such as m-period Moving Average (MA) method, m-period Weighted Moving Average (WMA) method, Exponential Smoothing (ES) method for different values of α, Linear Trend method and Artificial Neural Network (ANN) method [19].

*m-Period Moving Average Method*

An m-period moving average forecast, $F_{t+1}=\frac{F_t+F_{t-1}+\cdots+F_{t-m+1}}{m}$. Here, $F_{t+1}$ = Forecast for time period t+1, $F_t$=Actual value in time period t, m = Number of periods to average

*Weighted Moving Average Method*

A weighted moving average is expressed as $F_{t+1}= w_1 F_t+w_2 F_{t-1}+\ldots + w_m F_{t-m+1}$, Satisfying $\Sigma_i^m{}_{=1} w_i=1, w_1 \neq w_2 \neq w_3 \ldots \neq w_m$ and $w_1 > w_2 > \ldots > w_m$ Here. $F_t$ = Forecast for time period t and $w_m$ = Weight for the period

*Exponential smoothing Method*

Exponential smoothing method is written as $F_t = F_{t-1}+\alpha\ (A_{t-1} - F_{t-1})$. Here, $F_t$ = New forecast value for time period t, $F_{t-1}$ Forecast for the previous time period α= The smoothingconstant (0<α<1) $A_{t-1}$ Actual value in the previous period [4, 5, 8].

*Linear Trend Method*

Linear trend method is expressed as $F_t=a+bt$ here, $F_t$ is the forecast for period t is the value of $F_t$at t=0 and is the slope of the line. andare calculated as follows: b $= \frac{n\sum ty-\sum t\sum y}{n\sum t^2-(\sum t)^2}$ and $a = \frac{\sum y-b\sum t}{n}$ [14].

*Forecasting by 6-period MA method*

In the Figure 3, we have presented a comparison between actual sales and forecasting by using 6-period MA method. The forecasting errors are as follows. MAD = 133523.667/24 = 5563.486111, MSE = 1335844225/23 = 58080183.71, MAPE = 11.13980817/24 = 0.464158674. RMSE = $\sqrt{58080183.71}$ = 7621.035606

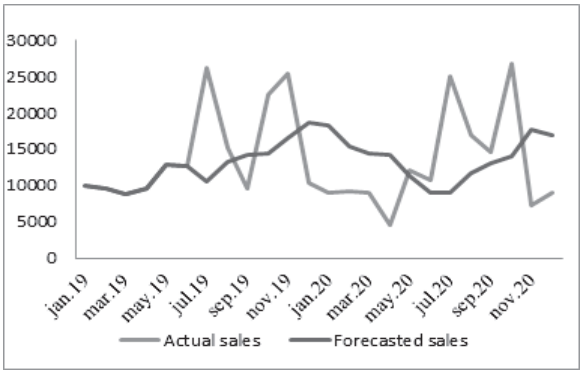


**Fig.3.** Actual sales and forecasted sales for 6-period MA method.

*Forecasting by 6-period WMA method*

For 6-period weighted moving average method we consider six weights as follows: w1 = 0.25, w2 = 0.20, w3 = 0.16, w4 = 0.15, w5 = 0.14, w6 = 0.10

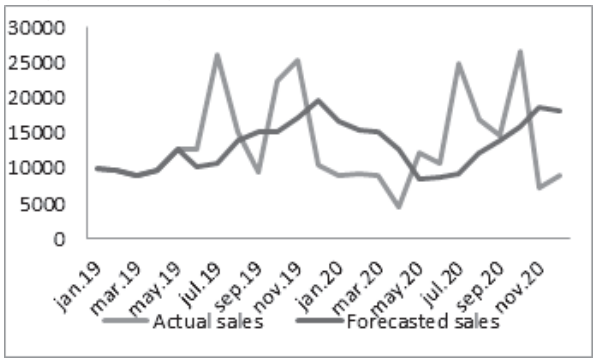


**Fig. 4.** Actual sales and forecasted sales for 6-period WMA method

Figure 4. illustrates that there has no vast difference between 5 and 6 periods WMA forecast. Therefore more weighted will give smoother graph.

*Forecasting by Exponential Smoothing method for different α*

Here, we will forecast sales of fertilizer by Exponential Smoothing method for different α. Figure 5. and 6. represent the forecasted sales of fertilizer by ES with α=0.2 and 0.4.

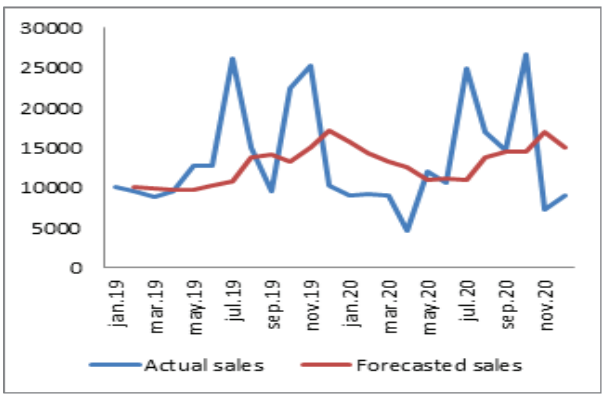


**Fig. 5.** Actual demand and forecasting demand for ES method (α=0.2)

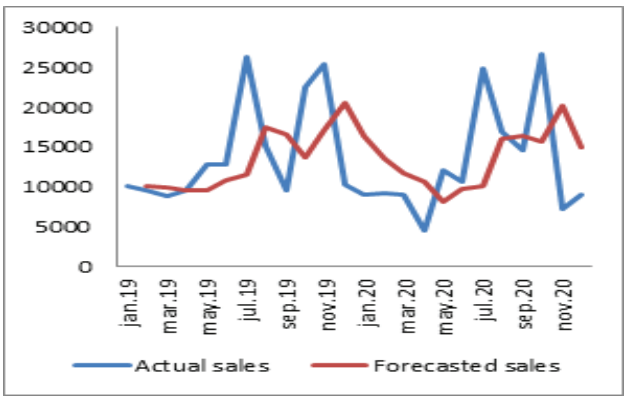


**Fig. 6.** Actual demand and forecasting demand for ES method (α=0.4)

*Forecasting by Linear Trend method*

Figure .5 and .6 represents long term upward movement. So a linear trend method is applicable.

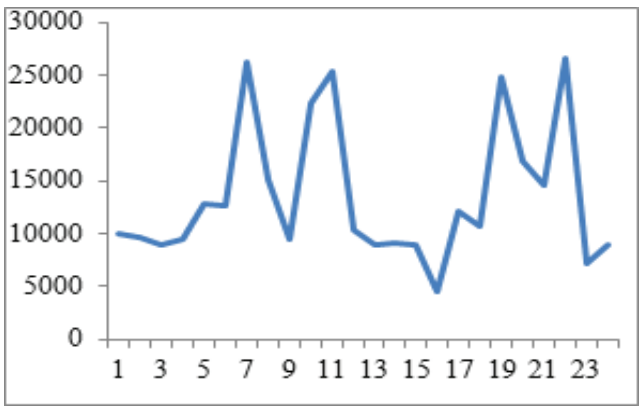


**Fig.7.** Monthly Actual sales of the fertilizer company.

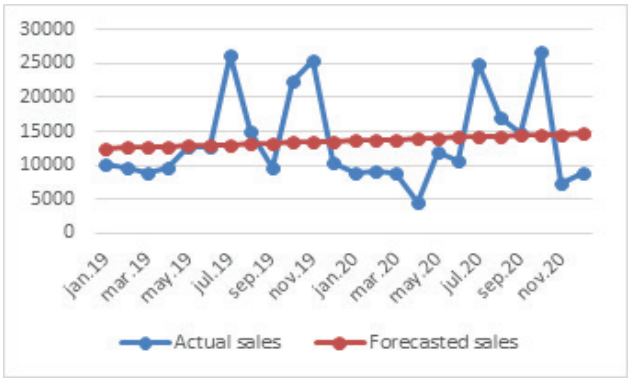


**Fig. 8.** Actual sales and forecastedsales of Linear Trend method.

*Forecasting by ANN*

In this section, we will forecast the sales for the company by using ANN method. For this, we use the data of January 2019 to December 2020 and forecast for next year 2021.

*Methodology for ANN*

The follow the following four steps are required for ANN.

**Step 1:** We used the sample data of monthly sales of fertilizer for two year from January 2019 to December 2020.

**Step 2:** Data preprocessing is used for data cleaning or enrichment.

**Step 3:** Transformation steps. Our data contains numerical values therefore no transformation are required.

**Step 4:** For forecasting for the next year 2021, a NARX network is used.

We use MATLAB for implementing ANN to forecast the demand of the fertilizer. Lastly we calculate the forecasting accuracy using actual sales of year 2021 and for comparison we use actual sales of fertilizer of year 2021.

**Table 2. Forecasting for sales by Artificial Neural Network**

| Month | Actual sales | Forecasted sales | Error | Abs Error | Square Error | Abs Per Error |
|---|---|---|---|---|---|---|
| Jan.21 | 9837 | 10996.43 | -1159.43 | 1159.43 | 1344277.925 | 0.117864186 |
| Feb.21 | 11058 | 10102.51 | 955.49 | 955.49 | 912961.1401 | 0.086407126 |
| Mar.21 | 9998 | 10167.29 | -169.29 | 169.29 | 28659.1041 | 0.016932386 |
| Apr.21 | 11359 | 13682.19 | -2323.19 | 2323.19 | 5397211.776 | 0.204524166 |
| May.21 | 12531 | 15074.65 | -2543.65 | 2543.65 | 6470155.323 | 0.202988588 |
| Jun.21 | 12307 | 9971.99 | 2335.01 | 2335.01 | 5452271.7 | 0.189730235 |
| Jul.21 | 23855 | 14261.42 | 9593.58 | 9593.58 | 92036777.22 | 0.40216223 |
| Aug.21 | 16835 | 9512.06 | 7322.94 | 7322.94 | 53625450.24 | 0.434983071 |
| Sep.21 | 6679 | 4558.08 | 2120.92 | 2120.92 | 4498301.646 | 0.317550532 |
| Oct.21 | 20547 | 8986.31 | 11560.69 | 11560.69 | 133649553.3 | 0.562646128 |
| Nov.21 | 7393 | 8874.02 | -1481.02 | 1481.02 | 2193420.24 | 0.200327337 |
| Dec.21 | 7588 | 8998.63 | -1410.63 | 1410.63 | 1989876.997 | 0.185902741 |
| | | | Sum | 42975.84 | 307598916.6 | 2.922018727 |

The forecasting errors are:MAD = 3581.32, MSE = 23963537.87, MAPE = 0.243501561, RMSE = 5288.056152

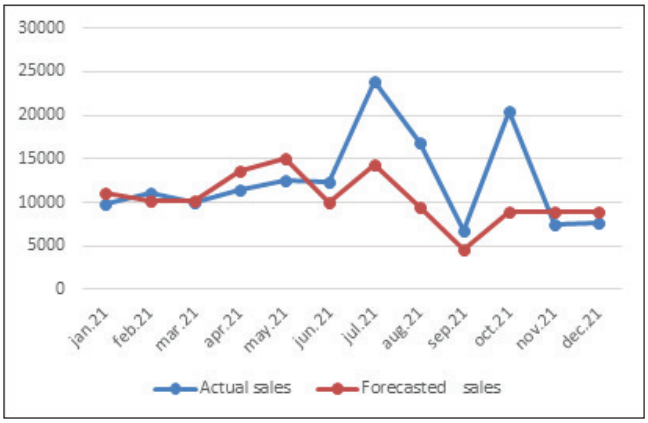


**Fig. 9.** Actual sales and forecasted sales for Artificial Neural Network method.

## IV. Result and Discussion

*Performance*

Performance function is used to evaluate the performance [25]. The more the number of iterations the less the error. In the default setup, the process is stopped after six consecutive increases in validation error and the iteration with lowest validation error gives the best performance [6, 7]. For this company the performance is evaluated as follows:

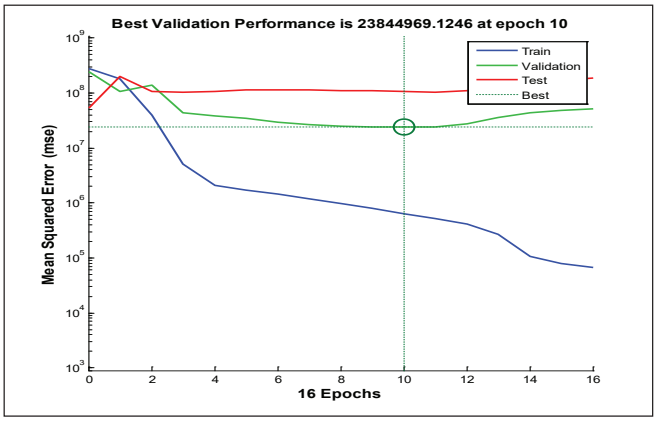


**Fig. 10.** Performance analyses for Neural Network of the data.

In Figure [10], best performance occurs at 10 epochs. Even though the inputs during training process are not large, ANN is able to identify the pattern of the data.

*Training state*

In our problem, we have trained the input and target data. By the training state, we can find the value of R in this case [20]. The data used for input to train, validate and test the parameters is showed in the Figure 9.

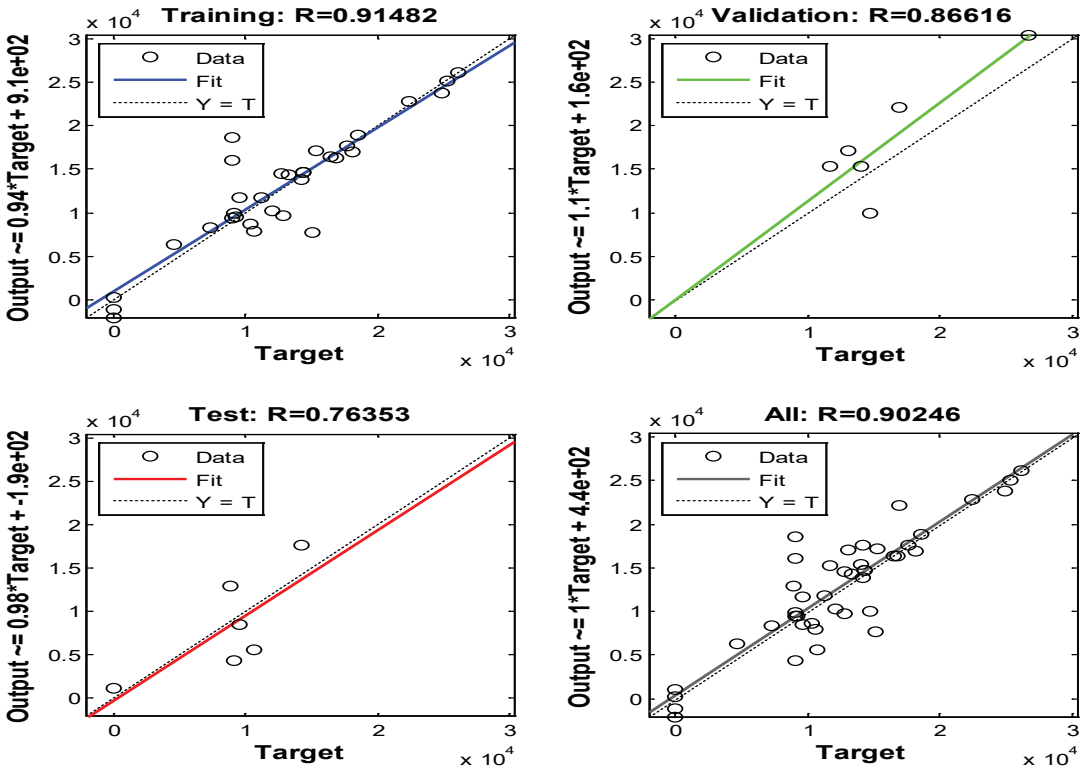


**Fig. 11.** Analysis of training state for NN of the data.

In Figure 11, we analyzed the training state for ANN of the data.We observe that the R values are less than 0.9. The scattered plot shows that certain data points have poor fits. Combining training, validation and test we get R=0.90246, which is close to 1, so we can say for this data there has a linear relationship between output and target.Error histogram represents the error occurs in the output and targets which is presented in Figure 10.

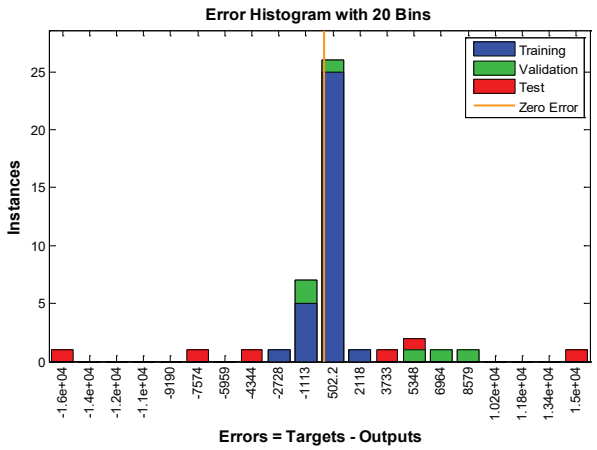


**Fig.12.** Error Histogram in Artificial Neural Network [2]

From Figure 12, we have observe that the error from ANN is much adoptable.We begin with sales of fertilizer and designing the forecasting system. We have noticed that the forecasted sales find by ANN is more reliable than other methods. In the following section, we will compare the forecasting methods by calculating errors in order to select the most suitable method for the fertilizer company.

## V. Comparison of Forecasting Methods by Measuring Accuracy

The forecast technique which sometimes produces good forecasts and sometimes bad forecasts keeps the manager in dark. So to find out a reliable forecasting technique the error measurement is very important. In previous section, we presented forecasts obtained by using different forecasting techniques such as MA, WMA, ES, LT and ANN. We also calculated the forecasting errors of these methods by using error measurement techniques such Mean Absolute Deviation (MAD), Mean Squared Error (MSE) and Mean Absolute Percent Error (MAPE) and Root Mean Square Error (RMSE) [17, 21, 23]. In this section, we will compare forecasting errors of different methods by using these methods to find which method is suitable for forecasting the sales of the fertilizer factory.

*Comparison by using MAD*

The forecasting errors measured by Mean Absolute Deviation (MAD) for each forecasting methods are compared by using graphical presentation in Figure 1.

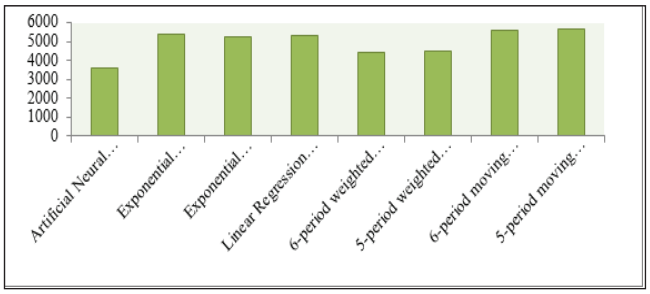


**Fig. 13.** Comparison of forecasting errors of all Forecasting methods obtained from MAD

From Figure 13, we have observe that the forecasting error obtained from Artificial Neural Network method by using error measurement method MAD is the lowest among all other forecasting methods.

*Comparison by using MSE*

The forecasting errors measured by MSE for each forecasting methods are compared by using graphical presentation in Figure 12.

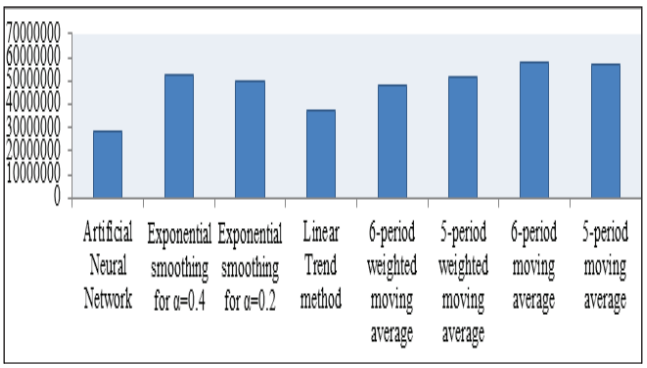


**Fig. 14.** Comparison of MSE for all Forecasting methods

From Figure 14, we have observe that the forecasting error obtained from Artificial Neural Network method by using error measurement method MSE is the lowest among all other forecasting methods.

*Comparison by using MAPE*

The forecasting errors measured by MAPE for each forecasting methods are compared by using graphical presentation in Figure 15.

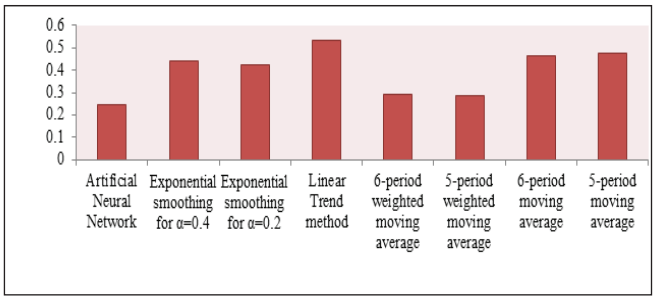


**Fig. 15.** Comparison of MAPE for all Forecasting methods

From Figure 15, we have observe that the forecasting error obtained from Artificial Neural Network method by using error measurement method MAPE is the lowest among all other forecasting methods.

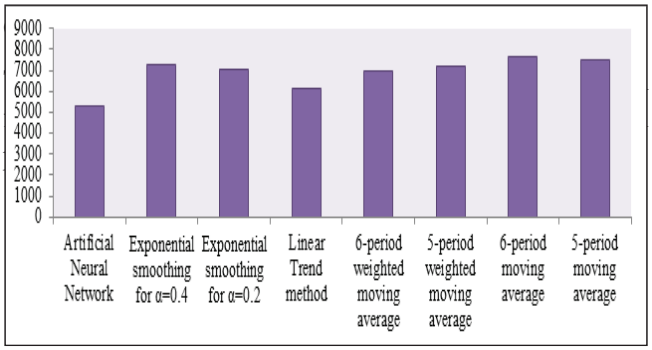


**Fig. 16.** Comparison of RMSE for all Forecasting methods

From Figure 16, we have observe that the forecasting error obtained from Artificial Neural Network method by using error measurement method RMSE is the lowest among all other forecasting methods.

Our concern was to select best forecasting technique for the fertilizer company. To find which forecasting method is suitable for this fertilizer company we have compared MAD, MSE, MAPE and RMSE for all methods, given forecasting errors in previous section. We have identified that our recommended Artificial Neural Network (ANN) method has lowest forecasting error. So, Artificial Neural Network provided the best forecasting results. Thus, we can suggest that the company can use ANN as their forecasting technique.In next section, we will compare the inventory costs of each forecasting methods to see which method minimizes the inventory cost.

## VI. Analysis of Inventory Management

Inventory is amount of product which is kept in the store as safety stock. Business organizations keep to cope up with unevenness in the demand. In this section, we will analyze the impact of inventory management on the fertilizer company.

*Inventory costs*

The objective of inventory management is to minimize the total cost and maximize the utilization of resources. These costs are as follows inventory holding or carrying costs, Ordering costs, Shortage costs, production or purchase costs, Setup costetc [15].

Inventory holding or carrying cost includesinterest, insurance, taxes, depreciation, obsolescence, deterioration, spoilage, pilferage, breakage and warehousing costfor some examples of holding cost [3, 13]. Ordering costs are the costs of ordering and receiving inventory. It includesshipping cost, invoices, inspection cost and transportation cost. Setup cost includes labor and time to make the changeover, cleaning and sometimes new tools or equipment.

*Economic Order Quantity (EOQ):*

The fertilizer company needs to decide how much to order or produce. The economic order quantity (EOQ) model can help the company by determining the optimal quantity to be kept as inventory so that cost will be minimum. Many organizations are using this model because it is user friendly.

The EOQ model minimizes the total costs and maximizes the ability of the company to satisfy the customer with right product in right time. We assume that the ordering cost and the carrying cost or holding cost are variables. And other costssuch as the purchase cost are constant. It is also assumed that the average inventory will be one –half of the order quantity [12, 16]. The mathematical expressions for the annual ordering and carrying costs are as follows:

Q = Amount of quantity per order, EOQ = = Optimal order quantity per order, D = Annual demand, S = Ordering cost per order, H = inventory holding or carrying cost per unit per year. Then, ordering cost = (No. of orders per year) $\times$ (Ordering cost per order) = $\frac{\text{Actual Demand}}{\text{Number of units in each order}}$

(Ordering cost per order) = $\frac{D}{Q}$ S.

Annual holding cost = (Average inventory) $\times$ (Carrying cost per year) = $\frac{Q}{2}$ H.

All of the above costs are presented in the Figure 17. If the ordering cost = the carrying cost, the total cost is minimum.

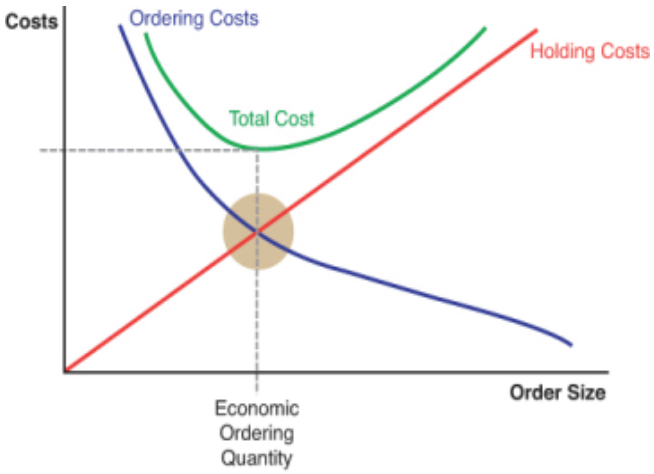


**Fig.17.** Total cost of a function of order quantity [15]

*Finding EOQ*

We set, annual holding cost = Annual ordering cost => $\frac{Q}{2}$ H = $\frac{D}{Q}$ S. Solving this for Q gives the optimal order quantity =>$Q^2H = 2DS$ =>$Q = \sqrt{\frac{2DS}{H}}$

The optimal order quantity is denoted by Q* and is defined as EOQ = Q* = $\sqrt{\frac{2DS}{H}}$ . Thus, Total cost = annual holding cost + annual ordering cost =>TC = H + . Replacing Q by , one can find theoptimal cost.

*EOQ and inventory costs for the fertilizer company*

For proper inventory management, accurate demand forecasting is very important. To minimize the inventory costs the manager needs to find optimal order quantity or production quantity. For this the company needs to estimate demand of fertilizer. This demand must be forecasted appropriately. If the variability of demand is high then the company need to keep additional stock as inventory to satisfy customer demand.

The fertilizer companyneedsSulphur rock for the production of Ammonium Sulphate. In this case, the inventory is Sulphur rocks. So, EOQ of Sulphur rocks can optimize the order quantity when an order is placed. In this section, we will determine EOQ with the help of forecasted demand for the sales of Ammonium Sulphate of the fertilizer factory. To find the demand of raw materials, we determine the reaction of the production of Ammonium Sulphate as $H_2SO_4+2NH_3 \rightarrow (NH_3)_2SO_4$.So, one ton of Ammonium Sulphate requires 0.6 ton of Sulphur rock.We have determined forecasted sales of Ammonium Sulphate for traditional forecasting methods along with our recommended Artificial Neural Network method. We will also calculate EOQ for each of these forecasting methods.

*Calculations of Inventory costs*

Total demand of Ammonium Sulphate for the period from January 2019 to December 2020 is 315833.67 tons

Number of orders per year = 3, Demand of raw materials, D = 0.6* 315833.67 tons =189500.202 tons, Ordering cost per unit, S = Tk.1320000/3 = Tk.440000, Holding cost per unit, H = Tk.8486944/3 = Tk.2828981.333.

Economic order quantity, EOQ = $\sqrt{\frac{2DS}{H}}$ 242.7901893 tons ≈243 tons. Thus, Total cost, TC = $\frac{Q}{2}$ + $\frac{D}{Q}$ S = Tk. 686848913.5. Inventory costs are as follows. Ordering cost = Tk.440000, Storage cost= Tk. 530000, Holding cost = Tk. 2828981.333, Transportation cost = Tk.520000.

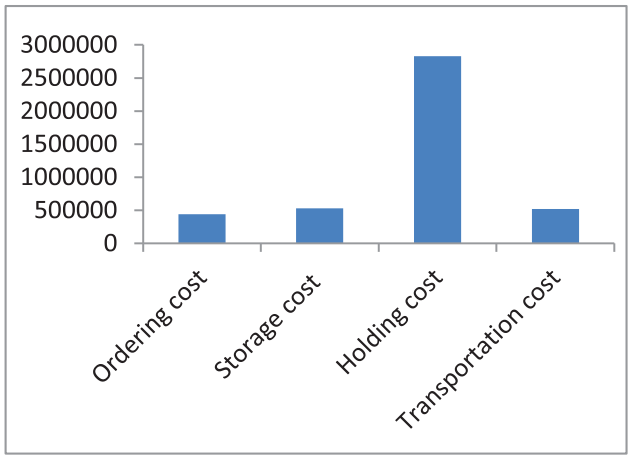


**Fig. 18.** Inventory costs of Sulphur rock for 6-period MA method.

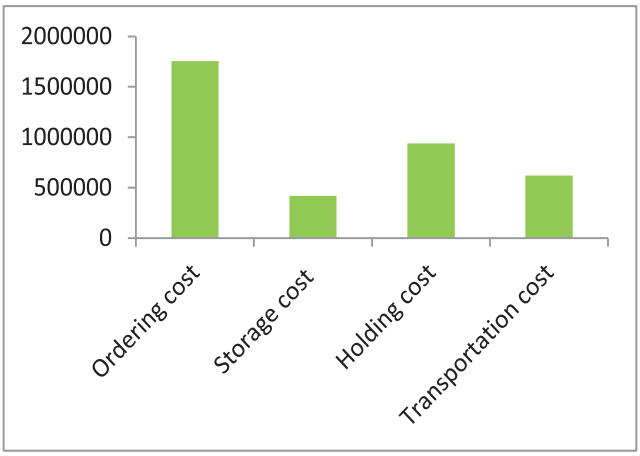


**Fig.19.** Inventory costs of Sulphur rock for 6-period WMA method.

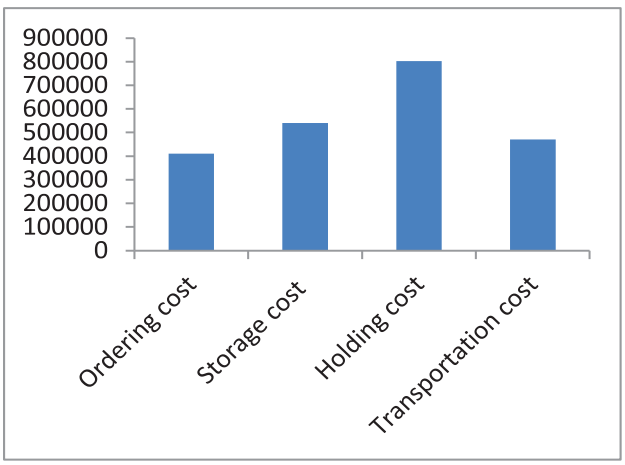


**Fig. 20.** Inventory costs of Sulphur rock of ES method for α =0.4

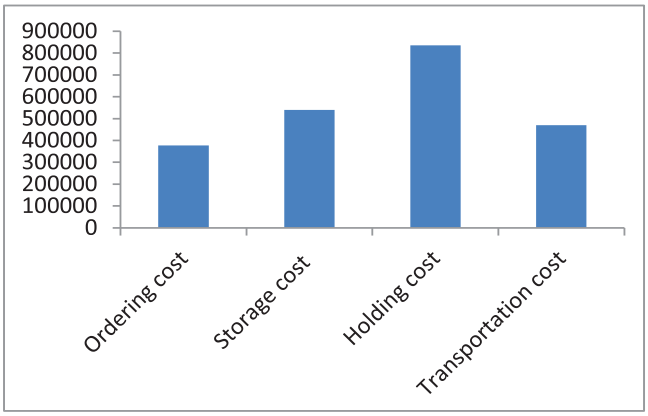


**Fig. 21.** Inventory costs of Sulphur rock for Linear Trend method.

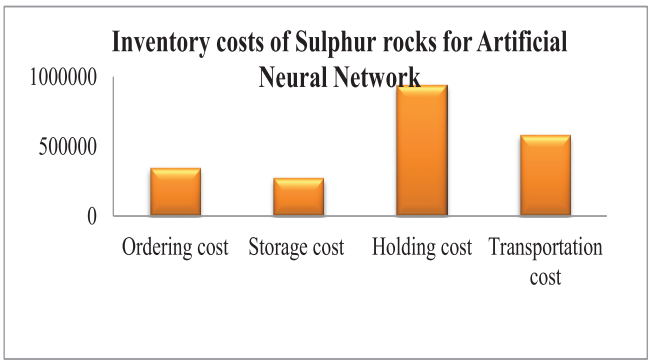


**Fig. 5.6.** Inventory costs of Sulphur rock for Artificial Neural Network method.

*Comparison of EOQ*

For managing the inventory of the fertilizer company, we compare EOQ for each forecasting method. The comparison is made with the help of graph to find which forecasting method has the lowest EOQ and is presented in Figure 22. From the figure, we observe that Economic Order Quantity (EOQ) is smaller for Artificial Neural Network method than any other forecasting methods. This means if the company's order size is 235 tons that will be helpful to minimize the total annual costs as well as the inventory costs.

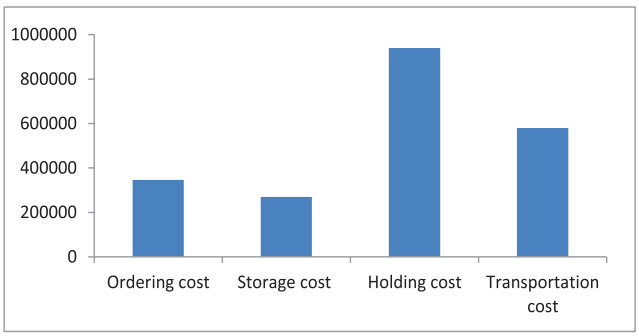


**Fig. 22.** Comparison of EOQ for all Forecasting methods

*Comparison of Total Cost*

In Figure 23, we graphically compare the total inventory cost which is the sum of inventory holding cost and ordering cost obtained from different forecasting methods. We observe that, by reducing holding cost and increasing ordering cost EOQ model makes a balance in total cost. We also observe that the inventory cost for Artificial Neural Network is lower than the other forecasting methods. Thus, Forecasting by ANN would be suitable method for forecasting the demand of the fertilizer company.

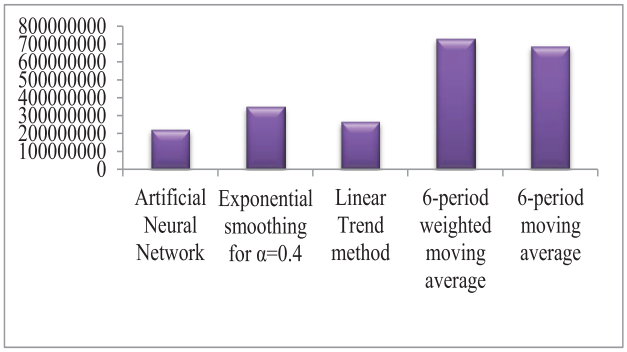


**Fig. 23.** Comparison of total costs for all Forecasting methods

Since the company is currently using intuition based forecasting method which results into inaccurate inventory level. But if the manager of the fertilizer company uses ANN for forecasting the demand of fertilizer, he will be able to keep inventories low enough to avoid excess inventory holding cost. So we recommend that the company can adopt ANN as a forecasting tool. From our analysis, we can say that, the ANN method will ensure the optimum inventory level of fertilizer in stock which will enable the company to satisfy the demand of fertilizer with right amount and right time.

## VII. Conclusion

In our project, our goal was to help a fertilizer company in Bangladesh to make profit by minimizing total cost including inventory cost. We recommended a new approach for forecasting the demand of fertilizer known as Artificial Neural Network (ANN).We use sample data for our analysis. We first forecasted sales (demand) of fertilizer by using different existing methods and ANN approach. The accuracy of the forecasts was measured using four different accuracy measurement techniques. Since inventory cost has a big impact on the total cost, we found out optimal inventory cost by calculating EOQ of fertilizer. We then calculated total costs of different forecasting methods and compare them to get right forecasting methods. We observed that, the forecastsobtained from ANN is more reliable than the other forecasting methods. The fertilizer company was running through the intuition based forecasts which created problems due to ineffective forecasting's.So we recommend ANN as a suitable method for the company because it produces

optimal economic order quantity and optimal cost. We can apply this approach to other similar business industries in our country. Hopefully it will solve many problems occurred in the business organizations in our country.

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