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Demand Forecasting For Economic Order Quantity in Inventory Management

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***Abstract*-**With today's uncertain economy,companies are searching for alternative methods to keep ahead of their competitors.Forecasts of future demand will determine the quantities that should be purchased,produced and shipped.In this work α,two data mining methods,artificial neural network(ANN) and exponential smoothing(ES) were utilized to predict the demand of the fertilizer(Ammonium Sulphate).The training data used was the sales data of fertilizer of the previous 3 years.Demand forecasted by artificial neural network is more accurate and have less inventory costs than exponential smoothing method.

Index Terms- Artificial neural network(ANN),Economic Order Quantity(EOQ), Exponential smoothing(ES),Inventory Costs

I. INTRODUCTION

Forecasting in general is prediction of some future event.Businesses use a variety of forecasts such as forecasts of technology,economy and sales of product or service.As a result,theaccuracy of demand forecasts will significantly improve the production schedulingcapacity planning,material requirement planning and inventory management.Although having accurate forecasts have never been easy,it has become more difficult in recent years due to increased uncertainty,complexity of business and reduced product life cycle.Traditionally,statistical methods such as time series analysis like exponential smoothing,weighted average,weighted moving averages,holt's model,winter's model etc are used for quantitative forecasting.General problems with the time series approach include the inaccuracy of prediction and numerical instability.Most of the traditional timeseriesmethods are model based which are more difficult to develop.Recently,applications of artificial neural networks have been increasing in business.One of the important applications of ANN is in the area of sales forecasting.Several distinguishing features of artificial neural networks make them valuable and attractive for forecasting tasks,artificial neural networks are data driven self adaptive method.There are a few a priori assumptions about the models for problem under study.After learning the data presented to them(a sample)ANNs can correctly infer the unseen part of the population.

II. METHODOLGY

Two methods used in this study were Artificial neural network method and Exponential smoothing method:

A. Exponential smoothing method

It calculates the smoothed series as a damping coefficient times the actual series plus 1 minus the damping coefficient times the lagged value of the smoothed series. The extrapolated smoothed series is a constant, equal to the last value of the smoothed series during the period when actual data on the underlying series are available. While the simple Moving Average method is a special case of the ES, the ES is more parsimonious in its data usage.

$$F_{t+1} = \alpha D_t + (1 - \alpha) F_t$$

where:

- D_t is the actual value
- F_t is the forecasted value
- α is the weighting factor, which ranges from 0 to 1
- t is the current time period.

Notice that the smoothed value becomes the forecast for period t + 1.

B. ANN METHOD

Neural networks are computing models for informationprocessing. The most popularly used neural network modelin practice for retail sales is the feedforward multi-layer network. It is composed of several layers of basic processingunits called neurons or nodes. Before it can be used for forecasting, the NN modelmust be built first. Neural network model building (training)involves determining the order of the network (the architecture)as well as the parameters (weights) of the model. NNtraining typically requires that thesample data be splitinto a training set and a validation set. The training set isused to estimate the parameters of some candidate models,among which the one that performs the best on the validationset is selected. The out-of-sample observations can beused to further test the performance of the selected modelto simulate the real forecasting situations.

Advantages Of Using Artificial Neural Network
Adaptive learning, Self-Organisation, .Real Time Operation, and Fault Tolerance via Redundant Information Coding.

III. RESEARCH ELABORATIONS

Production of Ammonium sulphate include

$H_2SO_4+2NH_3 \longrightarrow (NH_3)_2SO_4$

One ton of Ammonium sulphate requires 0.6 ton of sulphur rock.

Data collection:The first and foremost step of the model is collection of data.

For implementation of exponential smoothing and Artificial neural networks for sale forecasting ,the monthly sales of fertilizer for last three year starting from March 2010 to march 2013 were collected.(Table.1)

Forecasting of demand by Exponential Smoothing:

$L_{t+1}= \alpha D_{t+1}+(1-\alpha)L_t$

α = 0.2

Demand forecasted by Exponential smoothing is given in the table.2

Total demand of Ammonium sulphate for a period from April 2013 to March 2014=165601 tons

Raw material(sulphur rock) required = 0.6*165601=99360 tons.

EOQ of sulphur rock = 92634 tons.

No of orders per year = 3

Inventory costs of sulphur rock

Ordering costs = Rs 1320000

Holding costs = Rs8486944

Forecasting of demand byArtificial neural network:

MATLAB contains inbuilt NEURAL NETWORK tool box, which contains neural time series tool (ntstool). Time series tool helps in forecasting the demand of the fertilizer.

Demand forecasted by ANN is given in the table.3

Total demand of Ammonium sulphate for a period from April 2013 to March 2014=265217 tons

Raw material(sulphur rock) required = 0.6*265217 =99360 tons.

EOQ of sulphur rock = 33153 tons.

No of orders per year = 8

Inventory costs of sulphur rock

Ordering costs = Rs 5280000

Holding costs = Rs 2817929

IV. RESULTS

In this work demand of Ammonium sulphate is forecasted by Exponential smoothing and Artificial neural network methods.EOQ and no of orders of sulphur rock is calculated with the help of forecasted demand.Number of orders per year by Exponential smoothing is three.Number of orders per year by ANN is eight.Inventory costs,raw material holding costs and ordering costs of sulphur rock for the coming year is obtained.A comparison is made with the help of charts.By comparing two methods a savings of 17.42% is obtained in the case of ANN method.

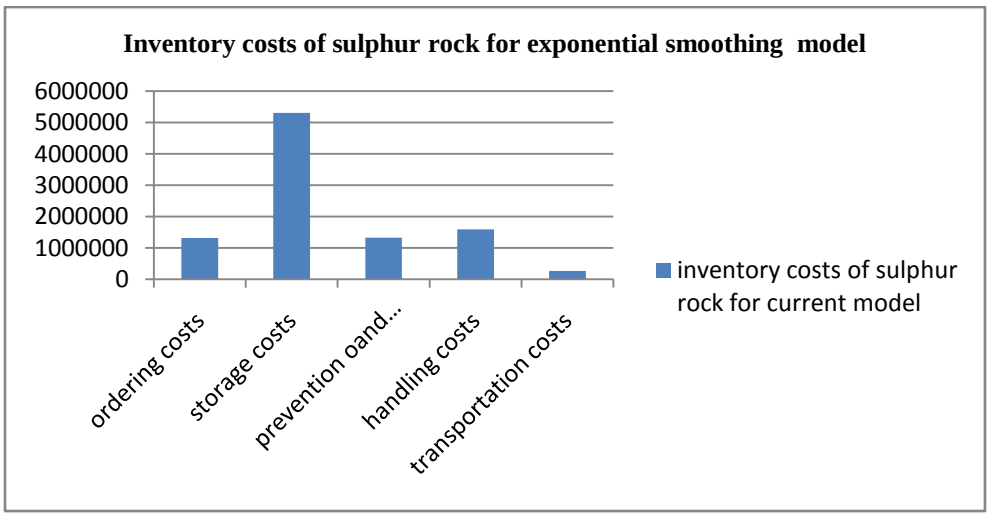

Figure 1:Inventory costs of sulphur rock for exponential smoothing.

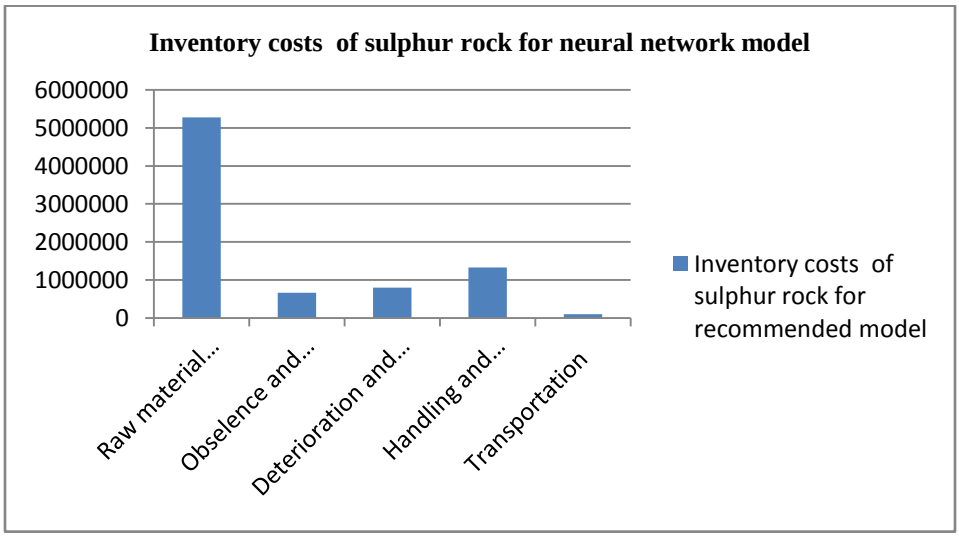

Figure 2:Inventory costs of sulphur rock for artificial neural network.

V. CONCLUSION

The current forecasting model in place at Company has brought problems due to ineffective forecasting that resulted in inaccurate inventory level. In order to help them reduce their stock outs, a forecasting model was provided along with an economic order quantity. Finally, the economic order quantity is, optimized the order quantity for each product when an order is placed, reducing the companies product stock out issue. By providing and recommending the inventory control model, the results have shown improvements in forecasting as well as in cost reduction. So, if the company follows through and implements the recommended inventory model, they would be able to reduce the total cost by approximately 20%which is a cost reduction of for top selling products. In the end, the issues the company faces would be reduced by implementing the recommended inventory model. The model will ensure the product is in stock, which would drive product sales and would allow the company to increase profit by forecasting accordingly. The recommended analysis showed that simple, yet complex techniques are the key for retail success which could give them the competitive edge.

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Table1.Consolidated sales data of four states.

Consolidated sales of four states	
Month	AMMONIUM SULPHATE
Mar-10	10051
Apr-10	9640
May-10	8888
Jun-10	9581
Jul-10	12796
Aug-10	12752
Sep-10	26201
Oct-10	15110
Nov-10	9545

Dec-10	22433
Jan-11	25360
Feb-11	10365
Mar-11	8992
Apr-11	9191
May-11	8996
Jun-11	4573
Jul-11	12077
Aug-11	10678
Sep-11	24896
Oct-11	16942
Nov-11	14660
Dec-11	26657
Jan-12	7275
Feb-12	9024
Mar-12	9837
Apr-12	11058
May-12	9998
Jun-12	11359
Jul-12	12531
Aug-12	12307
Sep-12	23855
Oct-12	16835
Nov-12	6679
Dec-12	20547
Jan-13	7393
Feb-13	7588
Mar-13	8558

Table 2. Demand forecasted by Exponential smoothing

MONTH	AMMONIUM SULPHATE
Apr-13	12419
May-13	11712
Jun-13	11285
Jul-13	11587

Aug-13	11820
Sep-13	14696
Oct-13	14778
Nov-13	13731
Dec-13	15471
Jan-14	17448
Feb-14	16031
Mar-14	14623

Table 3. Demand forecasted by Artificial neural network.

FORECASTED DEMAND OF AMMONIUM SULPHATE FROM APRIL 2013 TO MARCH 2014	
All units are in metric tons	
MONTH	AMMONIUM SULPHATE
Apr-13	9963
May-13	9294
Jun-13	8504.333333
Jul-13	12468
Aug-13	11912.33333
Sep-13	24984
Oct-13	16295.66667
Nov-13	10294.66667
Dec-13	23212.33333
Jan-14	13342.66667
Feb-14	8992.333333
Mar-14	9129