



Research Article

Prediction planning by using the nerve network (ANN) in Pichkooban factory.Mohammad Mohammadi*¹, Meisam Mohammadi²

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The matter of production planning and prediction of request is an important and vital matter for managers and experts in different industries. Searching to find a way to reach a precise prediction has always existed. Therefore, our goal is effort to develop the methods of achieving more accurate prediction as compared with other methods. This research is about the real request of a kind of bolt from pichkooban company. Among the previous real request prediction methods, the average of previous periods, the average of simple moving, the average of swinging moving, smoothing and artificial nerve network are used. The function of predictions is evaluated by using MapE.MAD5 MSE, Variables.

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Introduction

There is often a time out between awareness of an event and occurring of that event. This time out is the main cause for planning and prediction. If the time out is equal zero or is very little, so there is need to plan but if this time is long, planning play an important role. In this condition, prediction is required to determine the happening time of the event. In order to taking necessary actions, necessary forecasting in industry activities consist of forecasting the amount of products sale and utilization of materials and spare parts. Moreover, it is necessary to forecast the products which are more desirable by customers and these products should be considered in the new product plan.[1]

If the main goal of an industrial unit consists of production and offer the products to the market, so it is clear that all unit activities will originate from programs provided for producing the production and offered to the related sections in an industrial unit. Necessary workers and personnel, volume of the machinery, needed equipment, inventory amounts of wave and parts and even unimportant factors such as the number of telephone lines required in an industrial unit are based on the production in this unit. Therefore if a long time

production plan for unit is available, the personnel section can provide necessary human force on this base.

The engineering parts and company planning in helping the production part can evaluate the volume of machinery, manufactory and equipment, and it can also plan the buying and providing the machinery.

Financial accounts investigate the necessary budgets. Based on the production plan and it's requirements and will plan inventory control sections, primary materials amounts, spare parts and used materials by other related parts. Considering this fact, the main activities of one unit are based on the production program and noticing this issue that production program is provided based on the predictions of sale part, makes clear the important of a precise and real prediction.

Forecasting in industry, contains creating relationship between market uncontrollable changes and the economic out of industry environment, with controllable change inside industry environment. So prediction, requires study and precise analysis of outside environment factors. In many cases, study of this factors with investigation of the process of their

progress in the past which is available from the past period statistics and information will be possible. But using the past statistics should be integrated with future factors and probable changes. The company inside affairs [2].

which are controllable by using done prediction consist of:

- planning and timing of production
- buying and saving materials and parts
- Investigation of necessary human force.
- Study of capitalization for completion

Equipment, and on the base of this studies, investigation of required budget to achieve these goals.

By holding proper planning of above activities, whether materials and equipment and necessary budget or human force, industrial unit can apply factors with a better efficiency and prevent inconsistency between them. The purpose of production planning is optimum use of sources to grant requirements of specified production or exploiting the potential sale chances.

These sources include machinery, work power, capital time ware house space, or primary materials which as used to produce goods and services. In Pichkooban company, production has different processes that each process is related to previous level. So that exit of each level is entrance of next level.

This succession create different states that shows development of production planning in Pichkooban industry. Noticing that to have a comprehensive and efficient production planning, a proper evaluation of request should be done. So the importance of request prediction is clear more than ever. So that achieving a comprehensive and precise planning without applying a systematic method in predicting request is not possible. We should notice that predictions can never adapt to what will happen in future completely. There will be always deviations and distances between prediction and practicable events. But using applied and experienced methods in prediction affair causes that outputs by far become more real than an identical estimate. The goal of this study is presentation of a new method for predicting request in Pichkooban company to reach a more careful forecasting.

On the other hand, the presented method should be more precise than traditional ways. In this research exact data of bolt request from Pichkooban company is used and to evaluate the predictions, four statistics criterions have been applied which contain MAPE, MAD, δ , MSE. [3]

Research literature

1. Pichkooban company : Pichkooban company has located in Savadkooh- Shirgah city with 15 years of production activities.

The company activities consist producing all kinds of bolts proper to use in car industries (specifically) and other bolts proper to use in home appliance, electronic industry. [4]

Pichkooban company having experienced engineering staff and laboratory facilities and spread production, is capable to produce all kinds of special bolts. Pichkooban company has grade (p) Supco, TS / ISO 16949, QS9000 , ISO 9000 certification from RW TUV company and it is now preforming the projects of grade a Supco and six sigma. Pichkooban company also has graded in phase one to accomplish OEE project in accompany with five other companies among saze gostar company providers. [5]

Pichkooban company products are produced according to

the customers needs and international standards such as BS, JIS, DIN and etc... and also standards of car manufacturing like kiamotor, Nissan, Renault, ...

2. Methods of request prediction

In this part we investigate some of request prediction ways.

The most common classification of prediction methods consists of two ways as below:

- Theoretical methods
- Statistic and accounting methods. [6]

Theoretical methods : it's evident that each kind of prediction statistically are not accomplished. Different factors like social changes, outside and inside politics of country, people expectations, production possibility of new products and with better conditions by competitors and many other factors. Surly affect the amount of people request of a special product. [7]

To have possibility of theoretical prediction. It's necessary to measure changings of consumption under effect of price changes. Maybe a company examines it's products in definite areas for limited time and by raising and lowering prices and evaluates the request changes. Generally theoretical predictions accuracy depends on predictor's skill in judgment and guessing future problems.

It's obvious that whatever individuals information in economic, social and politic fields increase, the prediction skill will be developed. Because theoretical predictions are not based on the recorded statistics and information, generally they can't be very important, but anyway in many affairs, the only way of prediction is theoretical predictions. [8]

Statistic and calculative methods:

In this method, fulfilled calculations are based on the past numbers and statistic. Therefore in all these methods, general assumption is that whatever will happen in future correspond with whatever happened in the past in statistics methods, as it said before, future prediction will we can act in two main ways. these two ways contains:

- continuation of the past procedure
- Communal methods
- Judgment methods
- statistical methods

In the continuation of the past procedure, by having a time chart of a factor, it is attempted to draw the same chart in future. communal method is based on this fact that, a proper factor correspondent with another factor that has been predicted and it's prediction chart is available will progress.

classification of request prediction naturally. [9] totally, performance of request prediction methods naturally classifies as below:

- qualitative ways
- quantitative ways.

In qualitative ways, don't use the quantitative and mathematical models to predict the request. all kinds of qualitative ways consist of :

- Getting seller's opinion
- Communal agreement method
- Consumers expectations
- Delphi method

The quantitative methods can be classified in two kind : time series and causal methods. [10]

In causal ways, the linear regression and non regression can be named. In methods of time service that amount of

read selling in the past periods depends on time independent variable(t). (f(t)y=), the below methods can be stated:

- Naive method (previous real periods)
- Simple average method (previous periods)
- Simple moving average method
- Harmonic moving average method
- Simple smooth increment method
- Adjusted smooth increment method
- Method of least squares
- Seasonal vacillations method

In this study, among the traditional methods of request prediction, five kinds of time series methods will be used that their function will be compared with functions of modern method of using (MIP) nerve networks. This comparison will be done by applying statistical indicators. Selection of a proper prediction method is affected by below factors :

- Prediction horizon (short time, middle time, long time)
- Availability of data
- Necessary carefulness
- behavior of process of prediction case
- development expense
- simplicity and facilitation of function

To create a prediction system, performing 8 process is necessary

- characterize the goal
- select the items for prediction
- select the horizon and prediction period (long time, middle time, short time)
- select the prediction model
- gather the needed data
- validate the prediction model
- accomplish the prediction
- investigate the results

Method of artificial neural network.

Techniques of machine learning, attempt to solve the most complex problems with much more speed than computers. They achieve this goal by imitation of human brain and using the calculative methods to automatize the process of knowledge acquisition of models. artificial neural networks are those part of dynamic systems which by processing on experimental data transfer hidden knowledge behind the data to the network structure. Because these systems learn general laws based on accounts on numerical data or examples, so they are called intelligent systems. these systems based on calculative intelligence try to model structure of human brain neural network systems can come to help us when :

-There is not possibility to formulate an algorithm solution for the problem.

- Can gain a lot of behaviors that we want to model them
- Require the extraction of structure from existent data.

Neural networks in recent decades, as an useful and reliable tool for modeling the complex writings between different variables has been identified and considered. Neural networks by using the input and output sets, educate and estimate the relationship between them, so that, after that in exchange of a new member of input set, approximate it's corresponding output. Neural networks has been used to predict in engineering, management and financial fields. Considerable capability of human brain in learning different issues is of special characteristics that it's similar making a has been al-

ways tempting. Scientist's efforts in this direction led to appearance of a branch of science named calculating intelligence. People often know calculating intelligence by it's three components namely phase logic, genetic algorithm. And artificial neural networks are part of dynamic systems which by processing on experiment data, transfer the hidden knowledge or law above the data to the network structure and on the basis of calculating on numerical data, learn general laws. Artificial intelligence methods and neural network systems can be applied even in problems that :

-Presentation of an algorithmic or analytic solution for a problem is impossible

- only can gain many types of modeling behavior
- It's need to extraction of data structure and knowledge[11]

Artificial neural networks by analyzing information, can extract the relationship between them. And by applying it in exchange of a set of new information, estimate it's corresponding amounts so, the main application of artificial neural networks can be appropriate in estimating non linear functions. General structure of artificial neural networks has been inspired from human Biological neural networks. [12]

Researches, about neural networks have been accompanied with identification and investigation of human brain learning. Artificial neural networks are systems that are capable of doing actions similar to neural natural systems. Or on the other hand they can imitate characteristics similar to human brain function. When there is proper and careful description and identification of a problem, then applying laws and identified connections related to the problem, helps to solve the problems and it is the best way. But on the condition that there are not necessary set of laws to solve the problems or if cognition of phenomenon is very complex and accurate description of problem doesn't exist, using this method may not be very useful.[13]

So scientist thought about the function of an artificial intelligence system that have the ability of learning, creativity and flexibility of human and in this direction presented calculation neural methods.

In this methods, there is no need to the identification of a set of specific laws to solve the problems. And action base is gradual training of system. Artificial neural networks transfer hidden knowledge above the data to the model by processing on experimental data. Therefore they are called intelligent systems. For the first time Rosenblatt published a book named dynamisms of networks. He introduced a learning algorithm which scales could adapted themselves in order to reach the goal. In 1960 Minsky showed that some of simple calculations can not be preformed with a one layer neural network and suspect the performance of calculations with the help of a multi layer neural network and this happened when most of the scientists left working on artificial neural networks.[14]

In 1980, some of experts found a learning algorithm named returnable (regressive). In this algorithm scales can adapt themselves in a multiple layer network. In that time a new kind of artificial networks with dynamical behavior was introduced that named hop field neural network and (Kohnonen) organization network. [15]

Research history

Kohodan in 2001, introduced genetic algorithm and neural networks as calculating methods and then proceeded to predict the monthly price of petroleum and compared the results. He used received networks in the neural network model. The comparison criterion of the models has been considered MSE. The researcher believes that petroleum prices, follow the cyclic patterns along a period of time and tend to increase widely in a period and then reverse their directions and maybe increase again.[16]

Alternation in these samples are not stable and generally, deviations accompany with a period of increasing or decreasing. Therefore including of related data to this period, Causes the production of models and unreliable predictions. Kabudan either in neural network model or genetic algorithm model used different variables. For example we can point the delayed price of petroleum, the petroleum consumption in OECD countries and monthly changes in America known stock. In 2001 Tekaz used neural networks to predict the growth rate of impure production inside Canada neural networks statistically have less prediction errors than linear models. This researcher has used MAE, MSE variables to compare models. And believes that MSE is a logical standard for comparison, because whatever it is great, economical predictions bear more losses.

In 2002, Rech, compared the prediction function of neural network models with linear models. Different techniques have been used for neural network models, such as early stop pruning and adjustment. To compare foresaid models with linear models, function criterions MAE, nRMSE have been used. [17]

Rech believes that in the next prediction, all neural networks lay aside rival methods. Nasr and his coworkers has used neural networks to predict gas consumption in Lebanon. In this study, four different models has been used and function criterions MAD, MSE is used to compare the results. Hill investigated the existent literatures in comparison of artificial neural networks and statistical models which statistical models contained decision models, prediction of time series and prediction based on regression. As a result, their research can compare artificial neural networks with statistical prediction models.

Hosseini by studying in Mazda Yadak company found that MSE values gained from nonlinear series are completely better than MSE values gained from linear series. And despite that (R) value was not comparison base and when needed, it was used. (R) values of non linear series also are more favorable than linear series. He stated that. Each neural network with a latent layer, is more efficient if contains enough neuron to recognize being nonlinear process of data. [18]

Research procedure:

In this research two methods has been used: document and library first issues related to information technique has been studied and then by studying documents to collect data and information in order to relationship between these variables, prediction of request and planning for production has been done in Pichkooban company.

To gather information after primary plan and signification of theories, we have used library method of production section, commercial and planning reports. Information analysis software excel and neuro intelligence have been used, to describe gathered statistical information, the criterion devia-

tion, absolute error average (MAPE) and MAD and MSE have been used.[19]

Way of collecting information: Pichkooban company produces many various bolts for automobile industry and another industries this company has been selected to predict request by using neural network. In this study, on bolt with technical number (K99796-0612), has been used. The reason of selecting this bolt is the existence of information registered in computer in 270 periods that such an information has not existed for another bolts. [20]

In Pichkooban company, a lot of bolts are produced for markets and automobile makers. But there is not previous request data regularly for all of them. Therefore we concentrate on one item in order to investigate and analyze their time series in selecting the related piece to analyze, 2 criterions are considered:

- Existence of previous request data

- Request value should not be zero in needed periods of time in this research, information has been collected by documentary procedures. That has been existed in data management systems in Pichkooban company (MIS).[21]

Data analysis:

Used network structure: in this study it's been used a neural artificial network with multi-receiving layer and learning algorithm and 2-5-1 structure.

Numbers of input nodes: the number of input nodes are related to number of input variables used for prediction of future request values. The number of input nodes are the most important decision variables in prediction of time series. Because this noses consist of important information about investigating problems input vector dimensions depend on defined variables for problem. And these variables are defined with attention to the problem's nature.[22]

In this research to predict the request, the below variables have been defined for each period of goal time series of request, these variables have been extracted only from time series of request and don't contain output variables.

These variables consist of :

- Request amount in a period before goal (lag1)

- Request average for previous periods of goal period

- Simple moving average. Four continuous periods before goal period

- Weight moving average. Four continuous periods before goal period with weights (0/1,0/2,0/3,0/4)

- Maximum request of periods before goal period

- Maximum request of four continuous period and before goal period

However all of these variables was defined for total time series of request and are extract for all goal periods of these inputs, but it is not necessary to use all of these defined variables as the network input. On the other hand, maybe some of inputs don't influence the problem output greatly. So inputs affecting the problem output should be identified and inputs that don't affect the problem output should exit from input set. So effective input set should be performed in order to doing prediction.[23]

By regarding above inputs, the network with different architectures and different learning algorithms, has been analyzed.

The number of output nodes: network output contains values which should be checked. The number of output nodes

also depends directly on the type of problem and problem characteristics that specifies the number of network outputs. In this study, a node is used in output layer of network. This node consists of the request values in future period. Output values of network can be each non negative number and outputs with negative values was not acceptable for the problem.

Normalization of data:

Before presenting input samples to the works, it's better to do process on them. Preparing input data to the network is one of the important point in using neural networks. This preprocess includes the conversion of data from it's real change domain to the domain in which the neural network has a better efficiency. The following relation is applied in order to changing data scale.[24]

$$S_i \text{ (scaled)} = \left[\frac{S_i - \min(s)}{\max(s) - \min(s)} \right]$$

In the above relation, (S) is variable time series, S1 is the component of (1M) of this series and SI (scaled) shows the converted values of component. In this research, the neuro intelligence software, by activating preprocessing, transfers input data to the specified range.

Conversion function: the latent layers, produce outputs based on a total weight values. Then output layer of network, specified the last output if problem. Generally the latent layers and output of the network produce their outputs by executing the function of conversion to the total weight input values.[25]

There are different functions of conversion in different layers of network. By in the view of the fact that, outputs of the problem should be negative, a combination of different conversion function has been examined to reach the responses. And at last the conversion function of sigmoid logistic was used in output layer.

Instruction and examination data: to create a predictor neural network model, instruction and examination data are required.

Instruction data are used to develop artificial neural network and examination data are used to evaluate the ability of predicting the model. Important point is division manner of time series data into the discussed problem, type of data and measure of available data should be considered. In this research we have allocated 70% of data for instruction set, and 15% for exam and 15% for authenticating.

Learning rat : In this research with regarding to the algorithm used in instructing networks, learning rate a=0/1 has been used that has been selected from comparative learning rate. It means that the network is allowed to adapt itself to the new condition and change of learning rate.

Primary weight : In this research, before instruction of the network accidentally was selected for the first time. But in order to reduce the sensibility of network to primary parameters values in every case, they were performed ten times and the best answers were selected.[26]

Stop criterion : function of network operation usually is considered as average of total error squares (MSE) on set of instruction data collection. In the course of instruction,

network tries to minimize this function. In this study, this criterion has been used the instruction process stops when no improvement in result error happens or the number of repetitions is more than the number defined for iteration.

In this study, the number of iteration that includes input actions of network and evaluating of its outputs. Has been considered 10000[27]

Comparative calibration algorithm :

In this algorithm, necessary information to instruct the model is limited to the last observed data before prediction time.

On the other hand, in this method, set of input and output separately is presented to the network and after each stage, weights are updated. With regarding to this property, it is obvious that this technique does not need much information. In this way, the model by observing data of every step, adapt itself to the new condition and so it is called comparative calibration.

In every step , standard error algorithm is used to adjust the parameters of network.[28]

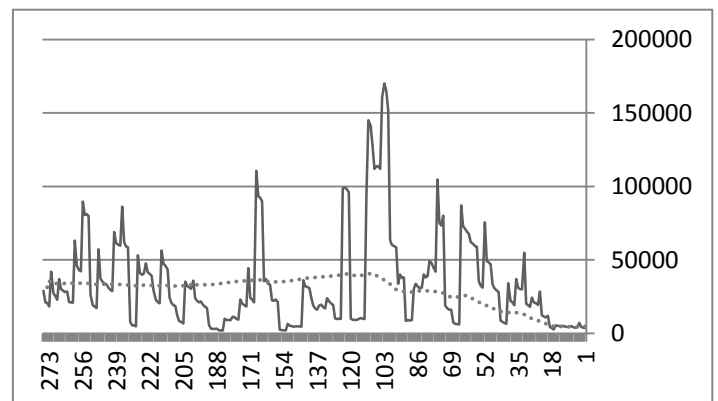
The results of used theory prediction: in presenting results for each way. first it is created a table containing numeral and statistical results. then the results of theory prediction presented in this research have been compared by graphs with real values of request.

Results of real request method of the past period

E bar	-202 /68767
MSE	968693338
MAD	19599
MAPE	92.4%
σ	31180
CORRELATION	53%

Table (1):results up real request method of the post period
With regarding to table (1), its observed that MAPE , MAD , MSE and CORRELATION , in using the real request method of previous period consist of : %53 and 31180 , %92/4 , 19599 , 968693338

The graph of predicted request by naive method and real values is according to figure (1)



The results of average of request values method in previous period

E bar	4863/78096
MSE	975564017
MAD	22018
MAPE	150%
σ	30909
CORRELATION	27%

Table (2) : The results of average of request values method in previous period

With regarding to table (2). It is observed that values of CORRELATION and σ , MAPE, MAD, MSE, in using average of request values method of previous period, respectively equals with : %27, 30909, %150, 22018, 975564017.

The graph of predicted request by way if request values average of previous period

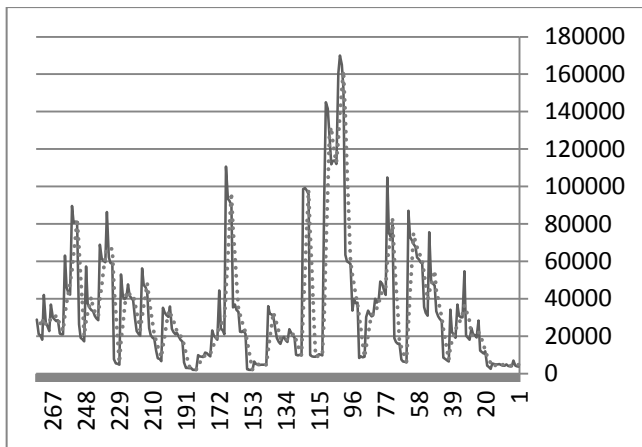


Figure (2)

results of simple moving average method, 3 periods before goal period are correspondent with (3) table

E bar	-146/20096
MSE	287409806
MAD	9698
MAPE	% 44/8
σ	16983
CORRELATION	85%

Values of MAD, MAPE, MSE, and CORRELLATION in using simple moving average are: %85 and 16983, %48/8, 9698, 2874, 287409806.

The graph of predicted request by way of simple moving average of 4 periods before goal period and real value is shown in figure (3)

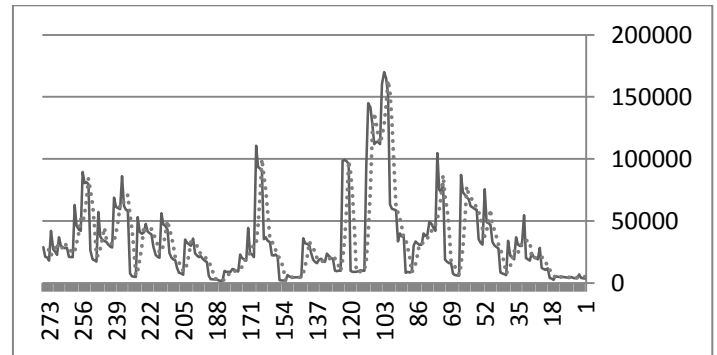


figure (3) results of harmonic moving average of 4 previous period. These result are shown in table (4)

E bar	152/883548
MSE	475422095
MAD	12843
MAPE	59.8%
σ	21843
CORRELATION	75%

By regarding to table (4). It is observed that values of MSE, MAPE, CORRELATION and σ in using harmonic moving average 4 previous periods respectively are: %75 and 21843, %59/8 12843, 475422095.

The results of harmonic moving average method, 4 period before goal and real values period is shown in figure (4)

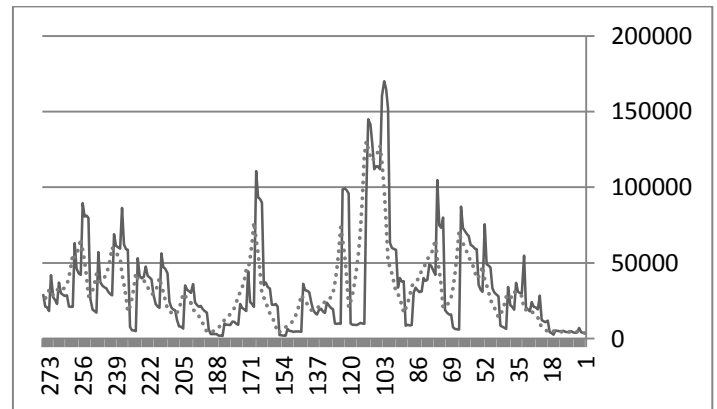


Figure (4)

The results of simple smooth growth method are shown in (5) table.

E bar	326/208324
MSE	563187323

MAD	15882
MAPE	%91/6
σ	23772
CORRELATION	%67

Table (5)

By regarding to table (5), it's observed that values of MSE, MAD, CORRELATION and \hat{O} , in using simple smooth growth method are: %67 and 23772, %91/6, 15882, 563187323.

The graph of predicted request by way of simple smooth growth and real values are shown in figure (5)

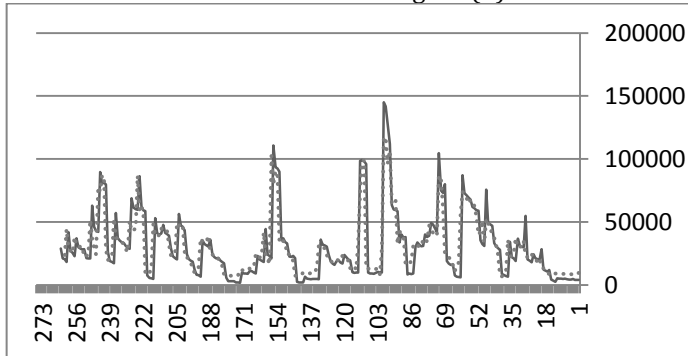


Figure (5)

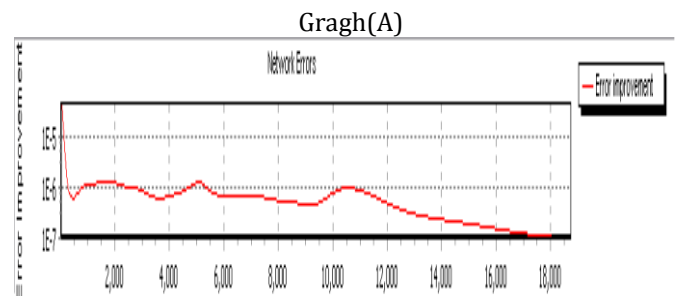
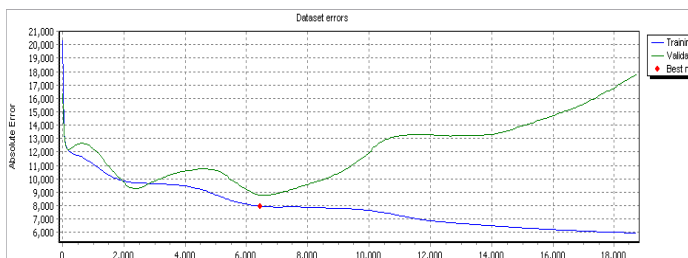
The results of artificial neural network method are shown in table (6)

E bar	231/131322
MSE	221244477
MAD	8595
MAPE	57/7%
σ	14572
CORRELATION	86%

By regarding to table (6), it is observed that values of MSE, MAD, MAPE, CORRELATION and \hat{O} , respectively are equal with : %86 and 14572, %57/7, 8595, 221244477.

The results of artificial neural network method are according to the attachment number 6.

The graph of instruction and improvement of artificial neural network error is according to figure (7)



Graph(B)

Figure (7) :graph (A) instruction and graph (B) improvement of artificial neural network error (MLP).

The comparison of prediction of applied theory : in table (8-4), the results of prediction of applied theory have been compared based on statistical criterion MSE, MAD, MAPE.

The results of prediction of applied theory in study

Table8:The results of the forecasting of the approaches used in the study

Statistical criterions of standpoint	MSE	\hat{O}	MAD	MAP E	CORRELATIO
Real request values of pervious period	9686933338	31179	19599	%92/4	%53
The average rage of requests related to previous periods	975564017	30909	22018	%150/2	%27
Simple moving average of previous periods	287409806	16983	9698	%44/8	%85
Harmonic moving average of 4 periods before the goal period	475422095	21843	12843	%59/8	%75
The method of simple smooth growth	583187323	23772	15882	%91/6	%67
Artificial neural network method MLP	221244477	14572	8595	%57/7	%86

With regarding to table(8), it is observed that, based on MSE and MSE criterion, techniques of neural network, simple moving average, harmonic moving average, simple smooth method, average of previous periods requests and average of previous period request perform in the best way.

Based on criterion (\hat{O}), techniques of neural network, simple moving average, harmonic moving average, method of simple smooth growth. Real request values of previous periods and perform better.

Table (8) shows that based on MAPE, techniques of simple moving average, neural network, harmonic moving average, simple smooth growth, real request values of previous period and average of previous period request perform better.

Table (8) shows that correlation in neural network and simple moving average are better than other methods.

According to above result, it's observed that neural network based on 4 criterion response better than other techniques using in this study.

Conclusion : in this study, prediction of request has been used. Theories based on traditional methods and artificial neural network, has been presented. The main goal is technical recognition with more accuracy, so these criterions,

MAPE, \hat{O} , MAD, MSE has been considered to evaluate the predictions.

The results of prediction based on MAD, MSE, indicates the superiority of artificial neural network as compared with methods of simple moving average, harmonic moving average, simple smooth growth, real request values of previous period and average of previous period request.

The comparison of predictions by represented methods in this study are based on the statistical criterion \hat{O} , MAPE, also according to the correlation value indicating the priority of neural net work and simple moving average. In spite of the low volume of data used in this study. Acceptable accuracy of artificial neural network model is because of using the calibration algorithm that in this situation, the model efficiency is greatly increase. The results of gained investigations by researchers, adapted to results of this study and confirm the results of the research.

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