



Using artificial neural network in demand prediction in Pichkooban company

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ABSTRACT

Prediction term base an its word meaning is imagination of a situation in future. Demand prediction is the most important issue about inventory management and for effective decision in inventory management, demand prediction for future periods are necessary. More over applying methods which results in increasing prediction precision were interested by management, economy and engineering fields. Neural networks were used as a powerful tool for predication in different fields in recent years. In this research demand prediction were considered by using neural networks. Neural network approach, multi-layered perceptron (MLP) with post-propagation learning were studied. Regarding to little information in network learning, adaptive calibration Algorithm were used. This technique has increased adaption capability of network and to some extent eliminated disadvantage of applied data loss. By using real data 1 production page type , Pichkooban company, prediction with real values compared and performance of real value methods in past period, past period mean, simple movable mean, balanced movable mean and profile smoothing with result of using.3-layer perceptron neural network were compared. In general, results show preference of MLP neural network model over other methods base on statistical performance criteria of MSE,MAD,MAPE.

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Introduction

Future events prediction is one of key decision elements and final effect of any decision depends on final effect of any decision depends on its results .prediction capability, uncontrollable aspects of these events before decision results in better selection so management system use prediction performance for planning and organization operation control prediction is inseparable part of decision in management .At first goals are set in organization then predict effective environment factors at last actions are done which results in gaining considered goals. By managers effort to decrease dependency to chance in making decision and scientific exposure with issues in front of their environment, prediction necessity increase.[1]

For competition and reaching to permanent development, it is necessary to have exact schedule base on prediction methods that results in precision increase has attracted engineering, economic and management areas attention.

Regarding to relationship among different areas of an organization ,a good or bad prediction can affect on organization activities .For effective decision in inventory manage-

ment and production planning and schedule, demand prediction is necessary for future periods.[2]

Prediction use for forecasting indefinite event since future to help managers of supply chain I order to make better decision. Demand prediction is widespread prediction form in supply chain management. Demand prediction is a process to help managers and participant individuals in supply chain to determine necessary production and services, space, time and amount. This process play main role in organization schedule, budgetary and supervision process performance and related to organization activities. Exact prediction can be effective in production management, logistic, service and equipment management.[3]

Supply prediction

There is a temporal gap between need awareness and doing an event. This gap is the main reason for prediction and schedule. If this gap equals zero or is very little, schedule play important role. In these conditions, prediction is necessary for time determination and event happening in order to do appropriate actions.

Among necessary prediction in industrial activities is prediction of production sale value and spare parts consumption. more over it is necessary to predict properties of interested production and account for new production plan. If the main goal of an industrial unite is production and supply for market, so it is clear all unite activities arise from programs for production and following sections. Necessary human force, machines, necessary equipment, inventory values, spare part and even telephone line depend on production values in unit.[4]

Therefor if long-term and medium-term production program for unit were available, employment recruitment section can provide necessary human force program.

Engineering and planning parts of factory with help of production section can estimate the amount of machines, workshop and equipment and schedule machines purchase. Finance affair consider and predict necessary budgets base on production program and its necessities and schedule inventory control sections, primary material values, spare parts and consumer material with aid of others following sections.

Regarding to this reality that main activities of a unit depend on production program and regarding to this issue that production program mainly provide base of sale part predictions so it will show importance of an exact prediction and approximately reality.[5]

In summary we can say prediction in industry is relation between uncontrollable equipment of market and economy outer of industry with controllable changes in industry. Therefore prediction necessitate exact study and analysis of outer environment. In many cases, these factors consideration regarding to their movement process in past which are available from past periods statistics, figures and information is possible. But in using past statistics, future factors and possible change should be integrated.

Company inner affairs which can be schedule and control by using done predictions are:

- production planning and schedule.
- spare parts and material purchase and saving .
- necessary human force consideration.
- necessary investment consideration for completing equipment and base on these considerations, necessary budget consideration to gain these goals.

With suitable schedule from above activities whether with equipment, material and necessary budget or human force, industrial unite can apply factors with better yield and prevent incompatibility and incompatibility and imbalance among them production planning goal is optimized usage from resources to meet determined production needs or exploit sale potential opportunities. These resources include machines, work force, investment, time, storage space or primary materials for goods production and consumption services. In Pichkooban company, production has several stages and each stage relate to previous stage in a way that output of each stage is input of next stage. This sequence brings about different manners that shows production schedules expanding in Pichkooban industry. since for effective and comprehensive planning, appropriate estimation of demand is vital so importance of demand prediction become clear therefor without systemic procedure in demand prediction we can not get exact and comprehensive planning.[6]

It should be paid attention prediction can not never correspond with anything that happen in practice. There is always distance and deviation between prediction and practical events but using practical and experienced methods in prediction cause obtained results approach reality more than identical estimation.[7]

This article has been gathered about research is in Pichkooban company about using artificial neural network in demand prediction for using in production planning.

Research purposes

One of purposes of this research to present new approach to predict demand in Pichkooban company to obtain more precision prediction in other words presented approach should have higher prediction precision compared to traditional methods. In this research test data of page demand from Pichkooban company will use .In this research for prediction graduation 4 statistical performance criteria have used including MAD,MAPE,MSE:

-To present suitable structure in artificial neural networks in order to predict in Pichkooban company

-comparison of efficiency of artificial neural networks in demand prediction with classic methods.

- Pichkooban managers awareness with new procedures of demand prediction and production schedule and the way of its application in mentioned pages.

Main purpose of this research is using artificial neural networks in demand prediction for production planning in Pichkooban company.[8]

We can consider this research in other organization and industries and compare its results in this research with other results in this field, and select the best results and apply them to improve performance and development process and increase capabilities, efficiency and their effect in little and great levels.

Research Method

Current research is case study in Pichkooban company.

In this research has used both field(document) method and library (books and interest). firstly study issues and aspects about information technology and different levels has been considered in format of research subject literature then by using field studies, data and information gathered in order networks in demand prediction and production planning in Pichkooban company.[9]

For information gathering in this research after initial plan and hypo thesis determination, library study method reports from commercial, planning and production parts were used .In this research, information gathered in field (document) method which is present in management information systems(MIS) in Pichkooban company.

Information analysis software has used Excel ,and neural intelligence, software. For statistical description of gathered information, standard deviation, mean abstract percent error (MAPE),mean abstract error (MAD) and mean square error (MSE).[10]

Society and statistical sample

production pages in Pichkooban are statistical society in this research. In this research from mentioned static society to one page with technical number 0612-99796 K is as a

statistical sample. The reason of above page selection as statistical sample is registered computer information in 270 periods (week) that there are not such information for other pages.[11]

Research Success

The most important success in this research is success in determined and effective method compared to traditional methods of supply prediction in Pichkooban company and develop it in similar companies. Other success of Pichkooban company is to reach special architecture of neural network regarding input and output nodes and necessary layers and also the number of necessary Neurons of each layer for responding to demand prediction of Pichkooban company.[12]

Demand prediction grouping from view point of nature

in general, demand prediction methods from view point of nature divide as follows:

- quality methods
- quantity methods in quality methods, quantity and mathematics models are used for demand prediction.

Quality methods types are:

- seller polling
 - group agreement method
 - consumer expectation
 - Delphi method
- quantitative methods divide into both time series type and causative methods.

In causative methods, we introduce line regression methods and non-line regression.

In time series methods that real sale values of previous periods depends on independent variable of time ($y=f(t)$), we introduce following methods:

- Nao method (real value of previous period)
- simple mean method(previous periods)
- simple movable mean method
- balanced movable mean method
- simple smooth development method
- adjusted smooth development method
- least squared method
- monthly function method

In this research. Among traditional methods of demand prediction ,first five types of time series methods used which their performance will be compared with modern method performance by using MLP neural network by statistical index.

Machine learning technique try to solve great and complicated issues faster than fastest computers through imitation from than fastest computers through imitation from human thought by calculation methods for automation of knowledge acquisition.[13]

Artificial neural networks belong to dynamic systems than by process on experimental data, knowledge and hidden rule in data transfer to network structure .since these systems are base of calculation in numerical data or examples and general rules, they call intelligent. These systems base on calculation intelligence try to model structure of human brain Norvosynaptiky.

Neural network systems help us when:

- there is no Algorithm resolve formulation for an issue.
- to obtain many samples from behaviors we want to model.
- it needs to get structure from available data.

In recent years neural networks have recognized as an useful tools to model current modeling between different variables .neural networks by input and output sets have estimated current relation and output sets have estimated current relation between them in a way that they approximate output by new number from input set .neural networks use for prediction in various fields such as engineering, financial management and etc.

Remarkable ability of human brain to learn different issues is special properties that its stimulation is tempting. Scientists effort caused to present a branch of knowledge called" accounting intelligence". Accounting intelligence is recognized by its three main branches: phase logical, gentic Algorithm and artificial neural networks. neural networks belong to dynamic systems that with process on empirical data, hidden rule or knowledge transfer data to network structure and base on sample learn general rules.[14]

artificial intelligence methods and neural network systems can be applied in:

- there is no Algorithm resolve or analysis for issue.
- we can obtain several sample from models behavior.
- there is a need to get structure and Knowledge from data.

Artificial neural network can get relationship among them through information analysis, and by applying them within a series of new information estimate similar values. Therefore main usage of artificial neural networks is non-linear functions estimation with suitable precision. general structure of artificial neural networks has gotten from human biological neural network. Researches about artificial neural network are systems that can operate similar to natural neural systems or in other words they can imitate properties similar to human brain performance.[15]

When there is explain and exact description and recognition from an issue, using recognized rules and relations about issue can help to resolve it and it is the best way. but when there is not necessary rules to resolve problem using this method may not be useful. Therefor scientist that present capabilities of neural calculation learning. In accounting method It is not necessary to recognize special rules to resolve problem and basis is on gradual order system . artificial neural networks withe process Process on empirical data, knowledge or hidden rules transfer data to model. Therefor they call intelligence system.

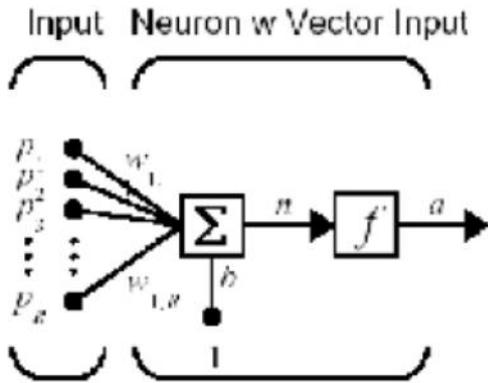
Since base on calculation in numerical data or example , learn general rules. Learning in neural networks presented in Rosenblatt, book entitled networks dynamic for the first time that weight could correspond itself to gain considered goal.[16]

Any artificial network has consist of process elements that are artificial Neurons. These Neurons can organize in different ways to form network structure. Each of these artificial Neurons receive inputs and processes them and deliver output signal. Input can be raw data or process element out put. Output can be final product or applied as input to other Neurons.

And artificial Neurons consist of these basic factors: weight, bias, and stimulant function. Figure 1 shows artificial Neuron presentation.

P and a are Neuron input and output respectively, weight and bias consist Neuron parameter and show with w and b and f is Neuron stimulant function.

Figure 1: one Neuron with input r and one output



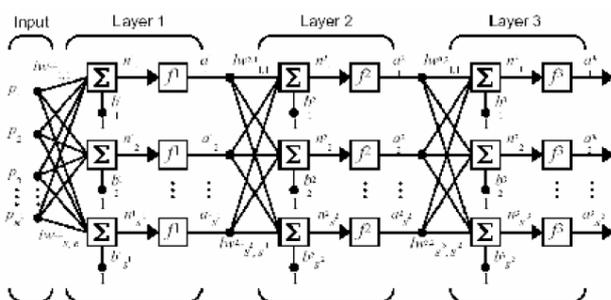
parameter n called Neurons net input, in fact it is input to stimulant function and make base on input p and Neuron parameter. by integrating some artificial Neuron, an one-layered neural network will make.

Neural network contain more than one layer so it is called multiple-layer network. Neurons numbers and conversion function in any layer can be different from other layers. Multiple layer neural network has more power in pattern recognition and data process compared to one layer networks.

In multiple layer network, the layer that is input of network call input layer and output of final layer is network call output layer. Any artificial neural network consist of a series of Neuron that group in layers. Placing these Neurons in different layers and their connection to each other determine Neuron number in any layer and number of hidden layers of neural network architecture.

A neural network with hidden multiple show in figure 2. As soon as network architecture determined process will begin.

Figure 2: multiple layer neural network



multiple layer Perceptron network (MLP)

multiple layer Perceptron network (MLP) is widespread type of neural network since their network power in

estimation of complicated of complicated linear and non-linear readings.

In this network the number of input curve factor equals R , the number of hidden layer Neuron s_1 , the number of output layer Neuron or the number of network output S_2 .

Structure of used network

in this research, artificial neural network of multiple layer perceptron (MLP) WITH post propagation learning Algorithm and structure of 2-5-1 has used

The number of input nodes

The number of input nodes relate to number of input curve variable for time valve prediction the number of input nodes is the most important decision variable about prediction of time series. Since these nodes contain of time series. Since these nodes contain important information about considered issue data.

the number of output layer of network

Network output value or values that shall predicted by the network. In this study, using a network of nodes in the output layer is used. This node contains the demand in future periods. Network output value can be any non-negative number, and the output of negative values is not acceptable and have no real justification.[17]

Data normalization.

Before presenting input pattern to network, it is better to do process on it. In put data preparation in network is one of the most important in neural network. This pre-process include data conversion from real changes domain to a domain that neural network has better efficiency.

Base on conversion function in network, 2 types of number domain act on input, zero to one domain (0.1) and -1 to 1 domain. Regarding to stimulant function in hidden layer of all network and form of these function, it is better to change input data scale to network. function gradient is remarkable from real value in $(-1, 1)$ and out of this has little changes. so because of preventing network crowd, all input and output data transferred. Network education has done with this information and after ending operation, predicted values return to real dome in.

Below relation us to change data scale

$$S_i (\text{scaled}) = \frac{S_i - \min(s)}{\max(s) - \min(s)}$$

In the above equation s , the time-series variables, S_i i-the component of the series of (scaled) S_i , become a component of the show.

In this research, Neuro intelligence soft ware transfer input data with activating range and time

Conversion function

Hidden layer produce output base on referred weighted value the network out put layer determine final output. In general hidden and out put network layer produce output through conversion function to input weighted values.

There is various conversion function. Regarding issue and its application, each of function use any where that has efficiency. using logistic conversion function and sigmoid

Tanzant in hidden layer cause to stabilize Neuron output of this layer in 0, 1 and -1, 1 range , consequently by preventing produce too much valves that causes network become unserviceable , prevent learning process failure. Most of article has used sigmoid logistic conversion function and sigmoid Tanzant. In this research, architecture 2-5-7 has used.

Learning and test data

To make a predicted neural network model, we need learning and test – data. Learning data is used for developing artificial neural network model and test data is used to evaluate model prediction capability . it is important how to divide time seri data into learning and test data. Although there is no general resolve, factors such as discussed issue properties, data type and available data range must be considered . there is various suggestion to select test and learning data. Most of authors select patterns base on 90% learning data against 10% test data, 80% learning Data against 20% test data or 70% learning data against 30% test data. we use rule of 70% against 30% in this research and of course from 30% , 15% belong to credibility and 15% to test.

The number of hidden layers

When learning a neural network, we begin with a set of data. First stage is to divide this set of data to two sets of learning and test. firstly by learning set, present learning network then by using test set, network will be evaluated the number of Neuron in hidden layer it is not difficult to determine the number of hidden layer. For estimation of any function, a hidden layer is enough, although in some cases more layer are used.in this research considered network has one or two hidden layer, finally one hidden layer selected.

Since layer increase has no effect in response optimization, so for presenting network crowd one hidden layer were used.

In post-propagation network ,hidden-layer Neuron determine how much data pattern can be learned.it too much Neuron were used, network will reserve issue, therefor it is not generalized. if little Neuron select, generalization capability of network is more suitable but it doesn't have enough power to learn pattern.

In this research for determination of hidden layer Neuron we used effort and error method, and number of hidden layer Neurons considered 2 to 20 by effort and error, the best choice were selected. another point in selection of hidden layer Neuron is simplicity of network.

In other words, between two similar choices, little Neuron choice were selected.

Comparison of prediction results of used approaches

Table (1) compare prediction results of used approaches base on statistical criteria MSE,MAD,MAPE.

Table 1: prediction results of used approaches in research

Approach statistical criteria	MSE	δ	MA D	MAPE	COR REL ATION
Real demand value of previous period	9686933338	31179	19599	%92/4	%53
Demand mean of previous period	975564017	30909	22018	%150/2	%27
Simple moveable mean of 4 previous periods ,goal period	287409806	16983	9698	%44/8	%85
Balanced more able mean of 4 previous period , goal period	475422095	21843	12843	%59/8	%75
Simple smooth development method	583187323	23772	15882	%91/6	%67
Artificial neural network method (MLP)	221244477	14572	8595	%57/7	%86

Table (1) shows base on MSE criteria, MAD by neural network technique, simple moveable mean, balanced moveable mean simple smooth development method, real demand value of previous period and demand mean of previous period act better.

Regarding table (1) , base on MAPE criteria techniques of simple moveable mean , neural network , balanced more able mean , simple smooth development method , real demand values on previous period and demand mean of previous period act better.

Regarding table, (1), correlation in neural network , simple moveable mean compared to other method is better

Regarding to above results , neural net word with 4 criteria compared to applied techniques in this research respond better

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