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The importance of using artificial intelligence models in economic forecasting during a crisis period (Using the NARX model to predict demand for hospital health services)

Bassel Anwar Asaad

College of Human Medicine, Al-Andalus University for Medical Sciences, Tartous, Syria

Author's Mail id: basselasaadhotel@gmail.com/ba3@au.edu.sy, Tel.: +963966235490

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Abstract— Modern technical models are among the important models that must be relied upon in economic sciences, which are related to mathematical sciences and technology, The most important of these models and methods are models of economic intelligence, artificial neural networks and fuzzy logic. The study aimed to use an advanced scientific model to Forecast the demand for health services provided in hospitals in Lattakia Governorate, which is the NARX model, which is a model of artificial neural networks. In addition to how to enter data, perform analysis and forecast, and how to obtain results in the said form. The study showed the accuracy of the prediction using the artificial neural networks model. Where the results of the prediction of the values reached a trustworthiness and confidence that exceeded 98% using the artificial neural networks model. The study reached a set of results, the most important of which are: Increased reliability of prediction for government health demand in hospitals in Lattakia governorate using the neural networks model NARX compared to traditional models used to predict the demand for health services provided in hospitals.

Keywords— health services, Demand, Crisis, Models, artificial neural networks, forecast

I. INTRODUCTION

Artificial neural networks are one of the most important artificial intelligence areas that reflects an important development in the human way of thinking, the idea of artificial neural networks focuses on simulating human brain by using computer. The predictable evolution in this field might be due to many studies in neural processing, the simulation process is accomplished by resolving the problems facing it through self-learning processes that rely on experiences stored in the network that realize the best results. The artificial neural networks method has been borrowed from biological neural networks thanks to the efforts of both researchers Mc-Cultch & Pitts who introduced it to the global business service for almost 60 years. Neural networks have evolved driven by the desire to understand the human brain and simulation of its power. Although the great difficulties encountered the computer engineers in applying the neural networks on the service of the hardware as well as in the field of robotics, scientists have confirmed that these networks are able to solve many complex problems in the field of artificial intelligence and to identify samples. It is an effective tool for resolving many issues where the relationship between the variables is unknown.

Artificial neural network is defined as the system of building information that has certain similar performance properties with biological neural networks, which are credited with solving many problems in many areas including: medicine, telecommunications, banking, forecasting, economic sciences, etc [1]

RESEARCH PROBLEM: The problem of the study is determined by the following question: What is the importance of using the NARX model of neuronal artificial networks in Forecasting the demand for health services provided in hospitals.

RESEARCH Importance: Importance of the research stems from the significance of studying and applying a new model to predict the demand for government health services, so the importance of this research lies in the following:The importance of identifying the demand for health services in government agencies in accurate and modern scientific methods. The importance of identifying the real future demand using artificial neural networks model. Statement The importance of showing the difference of accurate prediction between the artificial neural network model and the traditional models adopted in Latakia Health Directorate.

RESEARCH OBJECTIVES: The current research aims at testing the efficiency of applying NARX artificial neural networks model in predicting the demand for Hospital health services, in addition to state the accuracy and credibility of prediction using artificial neural networks model compared to the traditional method of prediction adopted in Lattakia Health Directorate.

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HYPOTHESES RESEARCH: The study starts from the main hypothesis which is prediction accuracy of time series (demand for health services) using NARX artificial neural networks model, the following set of partial hypotheses emerge from th
e main hypothesis:

1. A high degree of credibility in the prediction of the number of hospitals visitors (demand for health services) using NARX artificial neural networks model.
2. A high degree of credibility with the prediction of the number of the provided services in hospitals using NARX artificial neural networks model.
3. A high proportion of prediction reliability using artificial neural networks model compared to the traditional method of prediction adopted in Lattakia Health Directorate

RESEARCH Methodology: The descriptive statistical method was used in addition to the analytical inductive method to describe data and test hypotheses, the method comprised the study of the demand for health services and the prediction of its future using NARX artificial neural networks model. The research ranges include: scientific range: the prediction of demand for health services in hospitals of Lattakia province using artificial neural networks model. Spatial range: Hospitals in Lattakia.

II. RELATED WORK

Reference[1]The study focused on using artificial neural networks in detecting fundamental errors in financial statements. There was a difference between demand on health and demand financial statements. Reference[2]The study focused on the use of artificial neural networks for prediction from multidimensional macroeconomic model. Reference[3]The study focused on introduction to artificial neural networks and their applications in social sciences using SPSS. There was a difference between previous studies and current study

III. METHODOLOGY

FIRST: THE RELATIONSHIP BETWEEN ARTIFICIAL INTELLIGENCE AND ECONOMIC SCIENCES

ARTIFICIAL INTELLIGENCE ECONOMICS

Artificial Intelligence Economics is the study of all the basic ideas about artificial intelligence concerning economy, ranging from the expenses that finance artificial intelligence research, through the economic implications of the emergence of artificial intelligence such as its impact on prices, wages, accelerate productivity, unemployment rate and market and prediction studies, etc. and finally the conduct of applied economic research using artificial intelligence techniques. The term – artificial intelligence economics – has only been used recently, although the term has not been materialized academically yet, there are lot of studies that have already begun to address this term in research and investigation. It is possible to classify the economics of artificial intelligence within the knowledge economy which is defined as the economy of smart products, which means that these products are some of the features of knowledge economy based on the accumulation of information and then the analysis, assortment and explanation of these information. [5]

THE ECONOMIC BENEFITS OF USING ARTIFICIAL INTELLIGENCE:

There are many benefits in using artificial intelligence applications and artificial neural networks model mainly:

- Increase the quality of industrial and service products using artificial neural network techniques.
- Increase the production level of goods and services, in addition to reducing production costs.
- Savings in many of the expenses such as: health care and social security expenses.
- High degree of reliability to the use of artificial neural networks outweigh the traditional models and methods, and to the market studies, analysis of supply and demand and prediction for the future.
- Estimate of income, expenditure, investment and economic indicators (GNP and GDP, etc.) with high degree of accuracy by examining and analyzing the data of each indicator, helping to develop plans and strategies at the national level. [1]

THE MOST IMPORTANT AREAS OF THE USE OF ARTIFICIAL INTELLIGENCE AT THE ECONOMIC LEVEL: [3] [15]

Artificial neural networks model (artificial intelligence) is used in many economic areas at the global level, despite the limited use of this model in economic studies in the Arab world. Thus we can identify some areas of the use of artificial intelligence (artificial neural networks) in the following:

- Control of production of goods and services, in addition to increase the production capacity.
- Artificial neural networks are used widely in the areas of banking, stock exchanges, and in central banks.
- Artificial neural networks are used in the areas of administrative work such as: increase quality level, human resources, and decision making.
- Artificial neural networks are used in the areas of economic market studies such as: measuring and setting supply and demand, prediction of future and inflation.
- Artificial neural networks are used in the areas of financial and accounting sciences such as: the discovery of errors in the financial statements, improving the financial decision, and audit.
- Artificial neural networks are used in the areas of statistical sciences such as: time series analysis, the study of correlation relationships, and the prediction of the future.
- Artificial neural networks are used in the areas of the study and estimation of economic indicators such as: the prediction of macroeconomic models, the study of spatial relationships among economic variables, identifying the size of the investment, GDP measure,

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identifying the impact of investment on GDP, and the estimation of consumption.

The use of artificial intelligence (artificial neural networks) constitutes a significant challenge for economists today, as this model has a high accuracy and reliability helping in the study and analysis of most economic variables and phenomena. Therefore, to be able to know the working method and analysis of artificial neural networks , we have to explain most of the points associated with the analysis of this model, despite the differences between the working method of the artificial neural networks and the traditional ways of standard economic analysis.

SECOND: ARTIFICIAL INTELLIGENCE (ARTIFICIAL NEURAL NETWORKS):

BASIC CONCEPTS OF THE STRUCTURE OF ARTIFICIAL NEURAL NETWORKS: Artificial Neural Networks (ANN) are defined as mathematical techniques designed to simulate the way that the human brain carries out a certain task through a massive processing distributed in parallel, and composed of simple processing units represent mathematical elements called neurons or nodes which have nervous property where they store information and knowledge, and just as human has input units connect him with external world that are his five senses, the artificial neural networks also need input units and processing units where calculations are done to adjust weights. These input units and processing units have an appropriate reaction for each unit of the network input. Furthermore, artificial neural network resemble the human brain in gaining knowledge through training and store this knowledge using connecting powers within the neurons called the interrelation weights, therefore neural networks consist of a set of processing units called neurons. [6]

BIOLOGICAL NETWORK STRUCTURE IS COMPOSED OF THE FOLLOWING:

1- **Nerve**: it is the main part of the human brain which is a simple operating unit receiving and blending signals sent by other nerves through an internal receiver structure called dendrite.
2- **Synapse**: it is the axis of communication between the center of the neuron and the dendrites of the nerve. It is a unit of chemical nature but has an electrical aspect. Human modifies the power of synapse when he learns more as his brain contains tens of billions of these nerves related to each other by strong intensity.

It is worth mentioning that data processing of neurons is done through signal transmission by neurological links exist in the network of neurological cells – this process takes place inside the artificial neural network. Each of these links has specific value called weight which is multiplied by the signal value special to that link. There is also an activation function for every cell, which converts certain cell input signals into output signals.

[4]**ARTIFICIAL NEURAL NETWORK STRUCTURE:**

it is a system of information processing that has certain features in a style simulating biological neural network. The components of artificial neural network and the way of processing information are displayed bellow: [7]

A. Processing takes place through simple elements of processing called neurons.
B. Signals pass between neurons via links.
C. Each line is enclosed with a certain weight (numeric value) which is multiplied by the signals entering the neuron.
D. Every neuron is subject to activation function (usually a non-linear) to the network input to determine the resulting output signal.

Neural networks are described as follows: a form of linkage between neurons, the way in which these linkages are weighted (training or education), the type of the used activation function. Every neuron has its own internal state called effectiveness obtained from applying a specific mathematical function on input data, the result of which is received by the neuron. Every neuron also sends effectiveness as an input signal to many other neurons associated with it; however, it should be noticed that the neuron sends only one signal in the same moment but can send this signal to many other neurons.[8]. he following figure shows a simple model of artificial neuron network composed of three layers

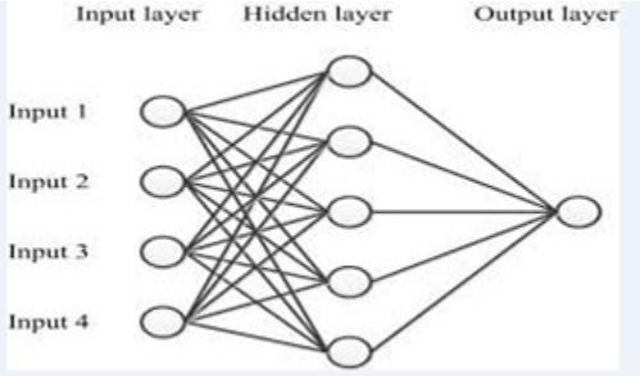

Figure (1) artificial neuron network composed of three layers [8]

The previous figure shows that neural network consists of three layers as follows:

a. Input Layer. (health data in this paper).
b. Hidden Layer. (Layer in which data are processed to predict the future while hidden)
c. Output Layer. (Health data values predicted from 2018 until 2028)

THE CONCEPTS OF ARTIFICIAL NEURAL NETWORKS TECHNIQUES: [9]

- Layers: they are the total number of neural network layers, which are the input layer, the output layer, and one hidden layer or a number of hidden layers.
- Layer size: it is related to the number of nodes in each layer and is determined by the amount of memory

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specified by the program that operates the artificial neural network.

- Neural function used: it is called activation function, which can take several forms, the following figure shows some forms of activation function:

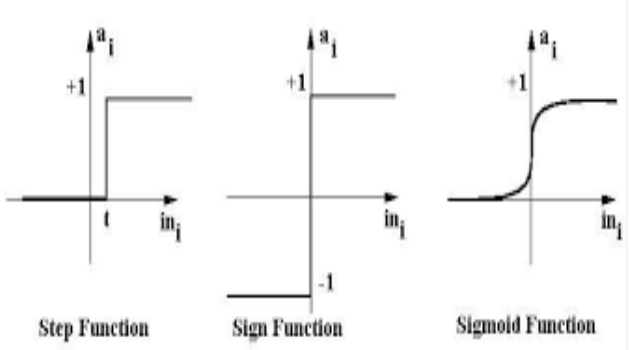

Figure (2) some forms of activation function [9]

CHARACTERISTICS OF ARTIFICIAL NEURAL NETWORKS: the most important characteristics of neural networks [10]

- Depend on a strong mathematical basis of the data analysis.
- Represent one of the smart operating information technology applications that simulate the human mind.
- Accept any type of quantity or quality data.
- Ability to store knowledge acquired through instances that are running on the network
- Applicable in many different scientific fields, including the economic and demand prediction.

THE TYPES AND MODELS OF ARTIFICIAL NEURAL NETWORKS: [2].

1- **Feed forward Neural Networks:** they are the networks that their structure is devoid of closed circle of linkages between its constituent units. Such networks are more commonly used, these types of networks consist of two layers at least, hidden layers also exist between input and output layers, the calculation processes move in one direction that is forward from input to output layers through hidden layers.

2- **Feedback Neural Networks:** in this type of networks output of some neurons are related to the same neurons results in previous time moment or other neurons output. So, the signal in this pattern of neural networks are moving forward towards the output layer and also in the opposite direction so that it can be an input to other neurons at the same time. This type of networks is called dynamic networks because the output in a moment is related to the input in the same moment and in previous moments meaning they have memory, and some examples of them are Hopfield & Elman & Jordan & NARX. A network of the NARX model has been used in this paper as shown in Figure 3 below:

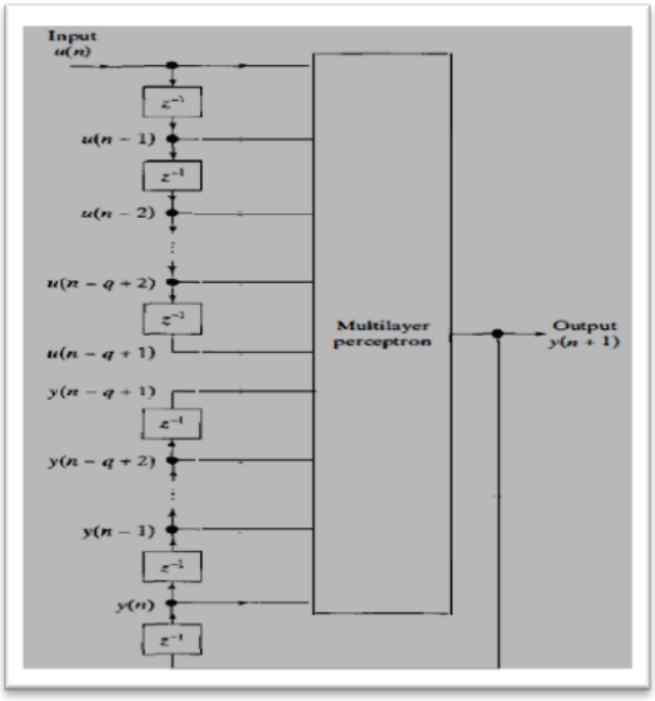

Figure (3) shows a network of the NARX model

NARX model can be used in many forms, but the simplest is by using feedforward neural network with memory has a time delay, the above figure shows the input and output frequent model with a design shows multiple layers neural network of MLP style. It can be noticed that the model used has a single input uses time delay memory composed of q component.**[u(n) represents the current value of input model. y(n+1) represents the value of the output model. F represents non linear function]**.

$$y(n+1) = F(y(n), \dots, y(n-q+1), u(n), \dots, u(n-q+1))$$

3- **Auto Associative Neural Networks:** they are the networks that all its constituent elements play typical role receiving input and transmitting output at the same time.

ARTIFICIAL NEURAL NETWORK DESIGN STEPS: [11]

First step	Data are collected then will be used in training or selecting the network.
Second step	Data of the network training are defined, and a plan for training and learning is developed.
Third step	Building a network structure and specifying the network installation in the number of inputs, the layers and the type of network.
Fourth step	Selecting the method of learning according to the availability of tools, network development or decisions.
Fifth step	Setting the values of the weights and variables, then modifying the values of the weights through the feedforward and feedback.
Sixth step	Converting data to appropriate type of network by writing the equation for the preparation of data and ready-made programs.
7^{th} and 8^{th} step	In these two steps the processes of training and testing by repeating the display of input and output desired to the network, including the comparison of actual values (desired values) with the calculated values, and then calculate

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	the difference between the previous two values (the error), then adjust the weights to reduce the difference until it becomes acceptable.
Last step	Here, the network can access the desired results through the use of training inputs, and thus we can rely on the network for use as an independent system or as part of the system.

LEARNING ALGORITHMS IN THE ARTIFICIAL NEURAL NETWORKS

Learning algorithms in artificial neural networks aims at determining the value of the weights through training the network in one of the following three methods: [12]

1. **Supervised Learning:** Supervised Learning of artificial neural networks depends on the idea that displaying training data in the form of a pair of patterns called Input Pattern and Output Pattern, both of them are linked to a targeted output beam. The network uses the difference between the calculated network output and the real desired output in calculating error function, which is then used to modify the weights to reduce the difference between the calculated outputs and desired output of the network. The weights are then adjusted to find the best results by using the weights update function or learning Function. The current paper adopted this type of learning techniques.
2. **Unsupervised Learning:** The self-learning methods of artificial neural networks are based on their ability to detect distinctive features of the form of inputs through a set of data which are generalized to the rest of the output without prior knowledge and without displaying examples of what should be produced, so in contrast to the principle adopted in supervised learning style in the sense that the neural networks have the ability to self-regulation of interrelation weights according to the nature of what is being displayed of patterns.
3. **Reinforcement Learning:** The Reinforcement Learning process is based on combining between supervised and unsupervised learning methods, where the true values of the outputs are hidden from the neural network as in the case of unsupervised learning method, but the network is referred to with the validity or invalidity of its results as in the case of supervised learning method.

Error Back Propagation Learning is the most important method of learning oriented towards neural networks with feedforward , this phase is performed via the following three phases:

1- **Forward Phase:** the training patterns of neural network are displayed in this phase, where every input is allocated an output with expected value, the error is then calculated between the desired and calculated values.

2- **Backward Phase:** in this phase the difference between the desired and calculated values in the previous phase are recovered and retrieved.

3- **Adaptation of Weight Phase:** in this phase the difference between the desired and calculated values is reduced.

CHANGE THE RELATIVE WEIGHTS

Neural networks method is based on the changing relative weights of the connection nodes. Therefore, it has the ability to create a learning rules which are made of the following phases: [13]

Phase I: in this phase, a preliminary selection of the initial values of relative weights or a random selection of initial values of the weights between network connection nodes is made; this selection is done with the help of (MATLAB) program. The development of weights has effective role in the development of learning in calculating the output of the input data, then comes the process of comparing calculated outputs by the network with the desired output.

Phase II: in this phase, the error resulted from the comparison between the calculated and desired outputs by calculating the lower aggregate of the error squares average as in the following equation:

$$E = \frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{k}\left(x_{ij} - y_{ij}\right)^2 \quad , \; i = 1,2,\ldots, n \; , \; j = 1,2,\ldots, k \qquad (2)$$

Where: ***n*** is for the sample size, ***k*** is for the number of samples, ***i*** is for the number of processed elements in the output layer, ***x*** is for the desired output, ***y*** is for the network outputs which represents the aggregate of the outputs of the processed elements in the output layer.

THE ADVANTAGES OF USING ARTIFICIAL NEURAL NETWORK MODEL:

The model is characterized by the following:[14]

1. Once the network starts to receive the data, its performance is not much affected when introducing any additional set of new data, which were not available at the beginning.
2. The use of artificial neural networks does not require the presence of a strong assumptions between the quality of the data and the relationship between variables, as in other statistical methods, nor does it require the availability of a large number of experimental data.
3. There is no need to arrange the variables according to their importance, the network is automatically put their special weights depending on the nature of the input data.
4. The use of artificial neural networks gives clear decisions in the well-known models, and can address the problems and make decisions that are characterized by unclear inputs.

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IV. RESULTS AND DISCUSSION

DEMAND PREDICTION ON HEALTH SERVICES IN LATTAKIA HEALTH DIRECTORATE

Lattakia Health Directorate

It includes 117 health centers within the urban and rural areas of the city. In addition to seven public hospitals affiliated to the Department (National Hospital, Al-haffeh hospital, Qardaha hospital, the National Hospital in Jableh, Al-Basel cardiac surgery Hospital, children's hospital, and the hospital of diabetes). The Health Directorate offers a wide range of services to citizens in Lattakia province and the displaced people in the current period.

Syria has been suffering from a war for ten years. This war affected all aspects and areas of the Syrian economy and the health sector was one of the most affected sectors during this war. Although there are no military operations in Lattakia Governorate, many citizens from other governorates have migrated to Lattakia Governorate, which has increased the population by three times, and this has put great pressure on the services provided in government hospitals and their ability to receive large numbers of patients, in The absence of scientific forecasting methods for hospital needs in light of this significant change in the demand for services provided in hospitals. Hence the importance of forecasting to reach the actual need of hospitals, including supplies and equipment and work to secure the necessary financial credits.

How to predict the demand for health services and the working mechanism of the used artificial neural network:

MATLAB program was used in the prediction process using artificial neural network due to its importance and its wide range applications in many vital areas including prediction.

Stages of prediction the demand for health services:

Using Matlab program and by the tool (nntool) we can follow these steps:

Data entry: data is entered in the form of input beam (X) Input Data as described in the previous interface.

Entering desired output beam (T) Target Data

Selecting the type of artificial neural network used in the prediction from the list (networks). In this step several types of artificial neural networks have been tested and the number of hidden layers in these networks has been changed (one hidden layer, two hidden layers, etc.) the number of neurons in these layers has also been changed. Eventually, a feedback artificial neural network feedback of the type (Nonlinear Autoregressive with eXogenous, NARX) has been used with one hidden layer and a number of neurons in this layer that is equal to 10 neurons. This layer uses (TRAINLM)training algorithm, [training Levenberg Marguardt Backpropagation (TRAINLM): a neural network training function, designed to modify the weights of neurons values], and MSE error scale, and (TANSIG) activation function [(TANSIG) Tan-Sigmoid activation function: is generally used with multilayers neural networks which gives valules confined within the domain (-1, +1)].

Dividing input data (health department data) into three parts:

The first part is the training stage: it is 70% of the sample size (training group), in order to train the network until it reaches the stage of stability as network requires larger size of the sample for the training, stability stage means - setting network according to the error - scale error reduction (Mean Square Error (MSE)) to a specific value of significance level 0.05. By the end of the process the network will be stable and ready for testing stage.

$$MSE = \frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{k}\left(x_{ij} - y_{ij}\right)^2 \quad , \quad i = 1,2,..,n \quad , \quad j = 1,2,...,k$$

The second part is the test stage: it is 15% of the sample size (he test group), it gives the result of output calculated by the network.

The third part is the check or stop stage: it is 15% of the sample size (this stage helps the network to check the stop condition that ends the work of the network so as not to continue repeating indefinitely as the required error scale has been reached).

The previous percentages can be adjusted between one network and another provided that the proportion of the training group data should be high.

Selecting the error scale and using the training algorithm for the used network:

a. MSE error scale has been selected which is a standard error scale used in most types of artificial neural networks. Other error scales can be used such as RMSE, etc.
b. Network training algorithm, where (TRAINLM) has been selected from the options of MATLAB program. This option represents a training algorithm (Levenberg-Marquardt backpropagation), which is an algorithm depends on the method of Error Back Propagation, BP and modifies the weights and thev alignment according to Levenberg-Marquardt technique.

The stage of getting results:

a. Calculated output.
b. The value of error scale that can be assigned before the network training process, this value can be increased or decreased according to the application used.

The application of artificial neural network:

Figure (4) illustrates the artificial neural network that has been used, it is a feedback neural network of (NARX)

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model, this network of the NARX model has been selected in three different mechanisms, the network in the middle has been adopted and applied on among the existing three networks.

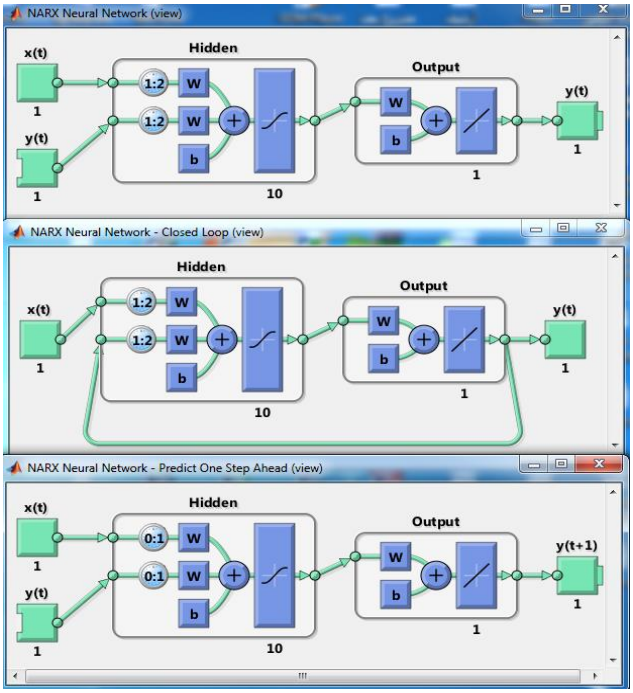

Figure (4) three artificial neural network of NARX model (source: prepared by the researcher)

The network consists of three parts that are:
First part (input layer): input beam (X)

Second part (hidden layer): it includes the following:

1) 1· : Which means the delay of a time amounts to 2, where the network is trained to previous input beam, except for the first two values stored in memory, which means ignoring the first two values of the data (ignoring the values of 1997-1998) according to the type of network that was used and two values at least should be stored, this value differs from a network to another.
2) W: weight beam.
3) b: alignment weight which takes the value (1).
4) + :this signal symbolizes the following applied equation: Y=£ X.W+b
5) + :this signal symbolizes activation function.

Third part (output layer): calculated output beam (Y), results are sent from hidden layer to output layer which might not have the same activation function.

HEALTH DATA UNDER ANALYSIS AND FORECASTING USING ARTIFICIAL NEURAL NETWORK MODELS:

the process of accurate prediction has a great importance in all fields, particularly that of the public health services, as the prediction accuracy contributes significantly to the provision of appropriate funds for hospitals of the Health Department. It also helps in securing the appropriate medical staff, where it was noticed that the process of prediction **in the Department of Health** has not been given the necessary importance through the adoption of a simpler traditional models in the prediction of the future, which would affect the work of **the Department of Health**, especially during a crisis period. The method of demand prediction (the number of visitors to hospitals) for health services provided in the **department of health**, for example, based on the arithmetic mean calculation for the previous five years, the resulting value is considered the value predicted for the coming year.

First: **the forecasting of demand for health services in public and private hospitals** Data had been entered with the help of MATLAB program, the results are illustrated in the following table:

Table No. (1) shows the forecasting of demand for health services in hospitals using a neural network model

Years	Demand in hospitals	predicting the demand using neural networks model	The credibility proportion of prediction using neural networks
1996	947123	displacement of periods of time for the prediction until 2028	The Credibility proportion of the prediction of the known value of 2018 and 2019 amounted for 99.6% and 98.3% respectively
1997	950045		
1998	965841		
1999	981754		
2000	985743		
2001	1033547		
2002	1078451		
2003	1180754		
2004	1195343	1092324	
2005	1237065	1211123	
2006	1282365	1434200	
2007	1346892	1410087	
2008	1390100	1502276	
2009	1431932	1518644	
2010	1422401	1522457	
2011	1553290	1604388	
2012	1531508	1580576	
2013	1626358	1642587	
2014	1594780	1580122	
2015	1577236	1714688	
2016	2086472	1739976	
2017	2409802	1902208	
2018	**2942236**	**2954301**	**99.6%**
2019	**2745160**	**2790776**	**98.3%**
2020	Non-existed values that will be predicted	2931900	
2021		2955100	
2022		2883400	
2023		3038100	
2024		3084200	
2025		3168500	
2026		3360400	
2027		3533400	
2028		4044200	

Source: prepared by researcher depending on MATLAB And Health department in Lattakia 2020

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Table No. (2) shows the forecasting of demand for health services in hospitals using the traditional prediction models

Years	Demand in hospitals	Prediction according to the method adopted in the **Department of health**	The credibility proportion of prediction using traditional method
1996	947123	The prediction method depends on the arithmetic mean of the total values of the previous five years according to the **Department of Health**	The Credibility proportion of the prediction of the known value of 2018 and 2019 amounted for 63% and 69.4% respectively
1997	950045		
1998	965841		
1999	981754		
2000	985743		
2001	1033547		
2002	1078451		
2003	1180754		
2004	1195343		
2005	1237065		
2006	1282365		
2007	1346892		
2008	1390100		
2009	1431932		
2010	1422401		
2011	1553290		
2012	1531508		
2013	1626358		
2014	1594780		
2015	1577236		
2016	2086472		
2017	2409802		
2018	**2942236**	**1858930**	**63%**
2019	**2745160**	**1905284**	**69.4**
2020	Non-existed values that will be predicted	1967545	
2021		2045607	
2022		2037434	
2023		1962960	
2024		1983766	
2025		1999462	
2026		2005846	
2027		1997894	
2028		1989986	

Source: prepared by researcher depending on MATLAB And Health department in Lattakia 2020

From the above table we can notice the following: The values from 1996 until 2017 had been entered in order to predict future demand for health services provided in hospitals for a period of eleven future years (from 2018 until 2028), the results were as shown in the previous table, and in order to verify the credibility of artificial neural networks model the known values of the 2018 and 2018 were predicted, the prediction value for 2018 using artificial neural networks model was 2954301, a 99.6% of the known value (high value of credibility in predicting) of the demand for health services provided in the hospitals in 2014 which amounted for 2942236, whereas the percentage of 2019 was 98.3%.

Which is high as well. It was also noticed that the prediction for the future using traditional models adopted in the **Department of Health** stood at 63% in 2018 and 69.4% in 2019, a low value when compared to the prediction using neural artificial networks model. The unknown values of the years 2020 until 2028 were predicted using the artificial model and traditional model; it is noticed that there are substantial differences between the predicted values for the mentioned years using the two methods amounted for an average percentage estimated at 35%, where the prediction data for the years between 2020 and 2028 was more precise and logical than the traditional prediction method.

THE FINDINGS OF THE RESEARCH:

- A high degree of credibility and confidence in the prediction of 2018 and 2019 for the number of health services provided in hospitals using the artificial neural network model, higher than the traditional prediction models.
- A high degree of credibility and confidence in the prediction of 2018 and 2019 for the number of health services provided in health centers using the artificial neural network model, higher than the traditional prediction models.
- A low degree of credibility of predicting the future based on the traditional method adopted in the **Health Department** in Lattakia.
- The existence of substantial differences in the prediction of 2018 and 2019 between the traditional artificial neural networks model and the traditional prediction model amounted for 55%
- The existence of a basic and fundamental differences of predicting the future of health services between the artificial neural network model and the traditional models applied in the **Health Department** of Latakia for the years 2020 until 2028, where the prediction method using artificial neural network model was more logical and simulating the current reality.
- The emergence of many negative economic effects in health sector as a result of the convergence of the values of predicting the demand for health services to be provided, as well as the multiplicity of economic pros of using artificial intelligence model.
- The need for simple capabilities for the use of artificial intelligence model in the **Health Departmen**t in Latakia.

RECOMMENDATIONS

Based on the findings of the research, we find it necessary to:

- The development and modernization of traditional methods of predicting the health data held by the **Department of Health** in the province of Latakia, because of the importance of prediction to know the future real demand for health services.
- The use and application of artificial neural network model in predicting the future of health data and its analysis, because of the importance and the increased proportion of the credibility of this model in predicting future values compared to other models.

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- Providing the requirements of the use of artificial intelligence model of human resources and other equipment.
- Estimating future need for health services to be provided to patients and the expenditures and the size of investment, etc. by adopting the artificial intelligence model in analysing and predicting the supply and demand for health services.
- Activating the role of the division of Statistics at the **Department of Health** and increasing the skills of its cadres by conducting training courses necessary for the development of statistical work as an integral part in the development of future health plans and strategies.
- Minimize the negative effects resulting from poor service due to increased demand and the whereas the offer is constant, through working to find suitable and affordable alternatives for the patients.

V. CONCLUSION AND FUTURE SCOPE

THE ECONOMIC IMPACT OF DIVERGENCE OF THE VALUES OF THE PREDICTION OF DEMAND FOR HEALTH SERVICES:

The prediction of demand for health services plays an important role in estimating the number of services to be provided to the patients in the future, the more the prediction is realistic the more it helps the administration to provide the appropriate funds to cover the need for visitors of hospitals and health centers of the **Department of Health**. Thus we can say that the lack of credibility of predicting health services in the **Health Department** in Latakia has led to the emergence of many negatives in the way of providing services, especially with the significant increase of the number of population in the province.

THE NEGATIVE SOCIO-ECONOMIC IMPACTS OF DIVERGENCE OF THE VALUES OF THE PREDICTION OF DEMAND FOR HEALTH SERVICES IN DEPARTMENT OF HEALTH IN LATTAKIAE:

- Insufficient funds available in the **Department of Health** to cover patients need services.
- Inability to provide many of the medicines and tests and X-rays for patients in hospitals and health centers.
- Inability to receive many of the patients in government hospitals as a result of the lack of places, especially with the increasing number of injured military personnel.
- Inability to invest and build new hospitals, or the expansion of existing ones during the crisis period (with exception of the opening portions of the paid Tishreen University Hospital 2015).
- Converting many hospitals to paid public bodies during the period of the crisis has negatively affected the medication of many citizens as a result of the lack of material resources.
- High rate of failures in medical equipment as a result of lack of maintenance capabilities, and the exhaustion of medical devices as a result of increased number of visitors.
- The incompetence of the existing medical staff to heal the sick and visitors as a result of great pressure on public hospitals.
- Failure to pay the dues of the **Department of Health** for many traders and companies as a result of lack of funds.

THE POSITIVE SOCIO-ECONOMIC IMPACTS OF THE USE OF ARTIFICIAL INTELLIGENCE MODEL IN PREDICTING THE FUTURE DEMAND FOR HEALTH SERVICES:

- Estimating the volume of services to be provided to future patients in a high degree of confidence and credibility.
- The estimation of the real volume of demand leads to the development of appropriate financial plans, and trying to provide the necessary funds to cover the expenses.
- The correct prediction demand for health services helps guiding the future health investments, and investment spending, in particular through working to develop the investment plans appropriate the expected increase in health demand for hospitals and health centers.
- Estimating the size of medicines, tests and X-rays accurately, helping to provide the necessary requirements.
- Securing various funding sources (associations, international bodies, fees), in the event of unavailability of funds during the current crisis.
- Estimating the real needs of required human resources to meet the provision of appropriate health service for patients.

REQUIREMENTS OF THE USE OF ARTIFICIAL INTELLIGENCE MODEL IN THE HEALTH DIRECTORATE IN LATTAKIA:

The Requirements of the use of artificial intelligence model to estimate the prediction of demand for health services and to study the relation between other variables are very simple and are as in the following:

- Qualified and trained human cadres capable of data analysis using artificial intelligence model.
- Equipment and computer programs with the possibility of accessing data and using it.
- The presence of a real willingness by the administration to adopt a sophisticated scientific models to determine the demand and supply of health and other health indicators.

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AUTHORS PROFILE

Dr. Bassel Anwar Asaad PhD, in 2017, in the health services sector. The Faculty of Economics, Tishreen University, Syria. Master degree in tourism economics, Tishreen University, Syria in 2012. Master's degree in tourism management in India, NITHM Hyderabad in 2007. Diploma of translation from CIEFL in 2007, India, Ottoman university. Postgraduate diploma from Tishreen University, College of Economics.

I published many scientific articles in Syria and outside Syria for the last ten years, participating in many international and local conferences, workshops and scientific forums. Teaching experience for 13 Years at Tishreen University and Al-Andalus University for Private Medical Sciences. General manager of a four-star hotel, many economic and management positions in various private companies in Syria.

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