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Using Data Mining Methods (Neural Network) in Tehran Fuel Consumption Analysis in Public Transportation

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Review:

To predict demand for oil products using statistical methods such as regression models, auto regression and moving average, from the beginning, the form of the functional relationship between the dependent variable (consumption of the product) and the independent variables (total population, urban population Rural population, gross national product, value added of industries and mines, road and rail transportation section, agricultural sector, product prices, number of diesel fuel buses, number of mini- buses and capacity of power plants) Be clear. In most cases, for simplicity, linear, quadratic or logarithmic relationships are assumed, although this simplification may lead to false results. Determining the functional relationship between the consumption of the product and the factors affecting it is a very complicated problem and it is simply not possible. Therefore, the use of intelligent systems such as neural networks, which in recent years has been considered by many experts, is reasonable. In this study, multi-layer neural networks with retro-reflection learning were used to predict Tehran's gas consumption. In this study, in order to find the predicted values closer to the desired output values and to select the best solution with the lowest MSE, the network problem Neural networks were solved for various values of the secret layer neurons and educational, evaluation and experimental sets. Since manual selection of numbers in addition to being time-consuming is a possible mistake due to the fact that some values are not selected, in order to avoid this problem, the optimal number of secret layer neurons, the percentage of data related to the training, evaluation and testing sets It was found by MATLAB software and the problem was solved for each of the MLP, MLFF, and MLCF states, which ultimately was the best answer with the lowest MSE of MLFF mode with 8 neurons in the hidden layer, and taking 65 % Of the data for the training set, 16% for evaluation and 19% for the test. Eventually, by the time series of the network, it was trained to predict the next seven courses, and the gasoline consumption rate was projected until 1400.

Key words: Neural network, prediction, energy consumption

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Introduction

Growth and even the survival of most economic activities in developing countries depend on energy supply. Hence, the statesmen try to

control energy supply and demand indicators more accurately, with more accurate energy consumption planning and proper planning in the direction of consumption. Given the special position of Iran in the field of energy in the Middle East and the world as well as the strategic importance of hydrocarbon resources, the proper management of these resources in the process of production to consumption in the country is of particular importance. The increasing growth of the road fleet has led to a significant portion of the country's energy consumption in the transport sector, and consequently the greenhouse gas and pollutant emissions are also a major cause. Basically, energy consumption in the consumer sector, including the transportation sector, is not a good model, and the reform of the energy consumption pattern in all sectors is indispensable. In Iran, gasoline accounts for a major part of the energy carrier, and its increasing consumption has led many professionals to take major steps in this regard. Due to its widespread use in the national transport network, this fuel has a very important role in the country's economic cycle, and any changes in its production situation and its decline are effective on the country's economic situation.

To predict demand for oil products using statistical methods such as regression models, autoregression and moving average, from the beginning, the form of the functional relationship between the dependent variable (consumption of the product) and the independent variables (total population, urban population Rural population, gross national product, value added of industries and mines, road and rail sectors, agricultural sector, product prices, number of bus and coach buses, number of minivans and capacity of power plants) . In most cases, for simplicity, linear, quadratic or logarithmic relationships are assumed, although this simplification may lead to false results. Determining the functional relationship between the consumption of the product and the factors affecting it is a very complicated problem and it is simply not possible. Therefore, the use of intelligent systems such as neural networks, which has attracted many experts in recent years, seems reasonable.

Express the issue

Given the special position of Iran in the field of energy in the Middle East and the world as well as the strategic importance of hydrocarbon resources, the proper management of these resources in the process of production to consumption is of particular importance. The increasing growth of the road fleet has led to a significant portion of the country's energy consumption in the transport sector, and consequently the greenhouse gas and pollutant emissions are also a major cause. Basically, energy consumption in all consumer sectors, including the transportation sector, is not a good model, and reforming the energy consumption pattern in all sectors is indispensable. In Iran, gasoline accounts for a major part of the energy carrier, and its increasing consumption has led many professionals to take major steps in this regard. Due to its widespread use in the country's transportation network, this fuel has a very important role in the country's economic cycle, and any changes in the state of production and

its decline will affect the country's economic situation. Therefore, the necessity of providing a model for predicting consumption of this product is very important for future decision making and macro policy of the country.

Nowadays, the use of intelligent technologies has been of great interest in solving complex practical problems in various industrial sectors. These systems collect general rules by computing empirical data. Hence, they are called smart systems. Neural networks are part of a group of intelligent systems that transfer knowledge beyond the data by processing empirical data into the network structure. The greatest advantage of neural networks is their ability to model complex nonlinear relationships, regardless of previous assumptions. Artificial neural networks have features that distinguish them in some applications such as pattern recognition and model in nonlinear and complex systems of other methods. Among these features are:

•Learning capability: the ability to adjust network weights using educational data.

•Generalization: After training the network using training data and setting network weights, the network can accept an untrained input and provide an appropriate output.

According to the presentations in this research, it has been attempted to draw a model of neural networks for predicting gas consumption in Tehran's public transport sector.

Research variables

The inputs used in this study are the number of buses, the gross domestic product and population of Tehran, and the number of passengers displaced and the output of research on the amount of gasoline consumed in the public transport sector are as follows:

Number of buses: The number of buses and minivans from 1991 to 2014, which are used for the movement of passengers in the city of Tehran.

GDP: GDP or GDP is the sum of the total value of goods and services produced from 1370 to 1393.

Population of Tehran: The number of people living in Tehran from 1991 to 2014

Number of Passengers Passed: The number of people who used buses and minibuses from 1370 to 1393.

Gasoline consumption: Gasoline consumed by buses and minibuses for passenger transportation from 1991 to 2014

data analysis methods

Artificial Neural Networks

Neural networks have been used in recent decades as a powerful tool for prediction in various areas. In this research, multi-layer neural networks with retro-reflective learning are used to predict the demand for subsequent periods.

In this research, MATLAB software is used to predict future demand. The results show that in relation to demand forecasting, the multi-layer

MLP progressive model with backward or post-propagation pattern of BP with three layers with the highest value of R2-value, minimum value of MSE and minimum value of MAD And is more powerful compared to classical methods, and this demonstrates the superiority of neural networks compared to the old ones.

Collect information

Data on GDP and energy from the Ministry of Energy and the Statistics Center of Iran, Population Information from the Ministry of Industries, Mines and Commerce, and the Statistics Center of Iran, Information on the number of passengers displaced from the bus and data organization The number of Auto waves from the Ministry of Industry, Mining, and Commerce and the Bus Company has been collected.

Table 4-1: Input and Output data of the model

Gasoline Consumption	Gross Domestic Product	Number of Passengers	City Population	Number of Buses	year
29766204	245036	456890531	6245596	2487	1370
33512413	254823	514392234	6341524	2800	1371
37246653	258601	571710226	6657423	3112	1372
42273515	259876	648869061	6749621	3532	1373
45169945	267534	693327247	6832657	3774	1374
52243458	283807	801900751	6946111	4365	1375
54361921	291769	834417689	7196452	4542	1376
56887321	300140	873180818	7304284	4753	1377
59364846	304941	911209101	7484167	4960	1378
62081745	320069	952911614	7646953	5187	1379
62644275	330656	961546056	7784632	5234	1380
64056584	355554	983224014	7894553	5352	1381
65121800	379838	999574339	8167052	5441	1382
66570015	398234	1021803432	8216745	5562	1383
68066105	420928	1044767371	8317101	5687	1384
69969131	446880	1073977502	8536624	5846	1385
72470593	499071	1112373208	8586333	6055	1386
74265901	501000	1139929935	8658254	6205	1387
76970832	514826	1181448736	8732375	6431	1388
79699700	536475	1223334961	8876543	6659	1389
84519300	546357	1243359516	8993133	6768	1390
79420385	558945	1220763120	9106548	6645	1391
77277985	571032	1439763401	9189546	6806	1392

Prediction using neural networks

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To predict gas demand using statistical methods such as regression, autoregressive and moving average models, the functional relationship between the dependent variable (diesel consumption) and the independent variables (bus number, GDP, population Tehran and the number of passengers displaced). In most cases, for simplicity, linear relations are assumed to be second or logarithmic, and this simplification may lead to inaccurate results. Determining the functional relationship between gasoline consumption and the factors affecting it is a very complicated problem and is not easily feasible. The use of intelligent systems such as neural networks, which in recent years has been considered by many experts, seems reasonable. In this section, how to predict gas consumption using the neural network and software maklet.

Figure 2 shows the network performance diagram in terms of least squares error (MSE). The definition of the MSE function is given in the following equation:

$$MSE = \sqrt{\frac{1}{m}\sum_{j=1}^{m}(Q(E)_i^{ANN} - N(E)_i^{ORIGINAL})^2}$$

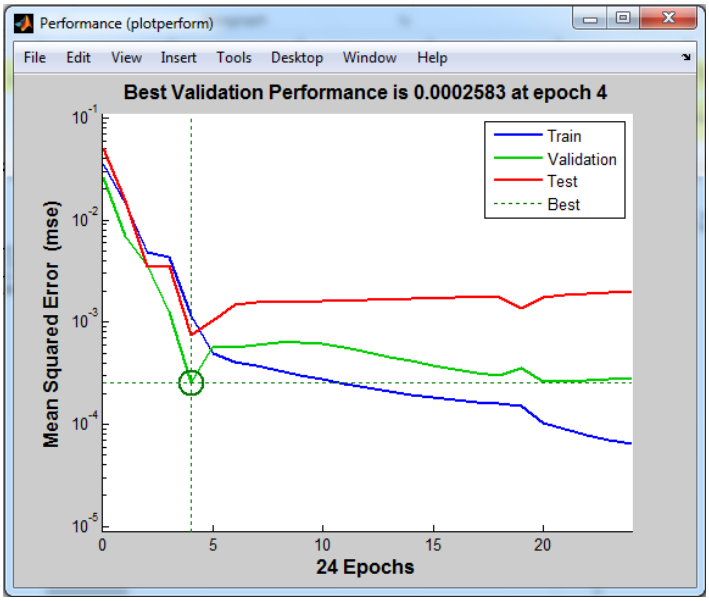

Figure 1 Performance diagram in MSE has three training curves, validation and test

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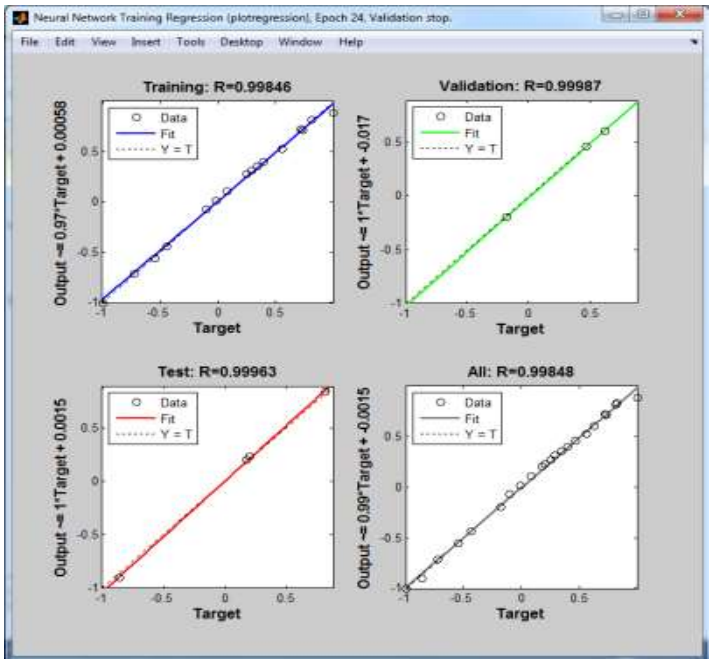

Figure 2 shows the regression results

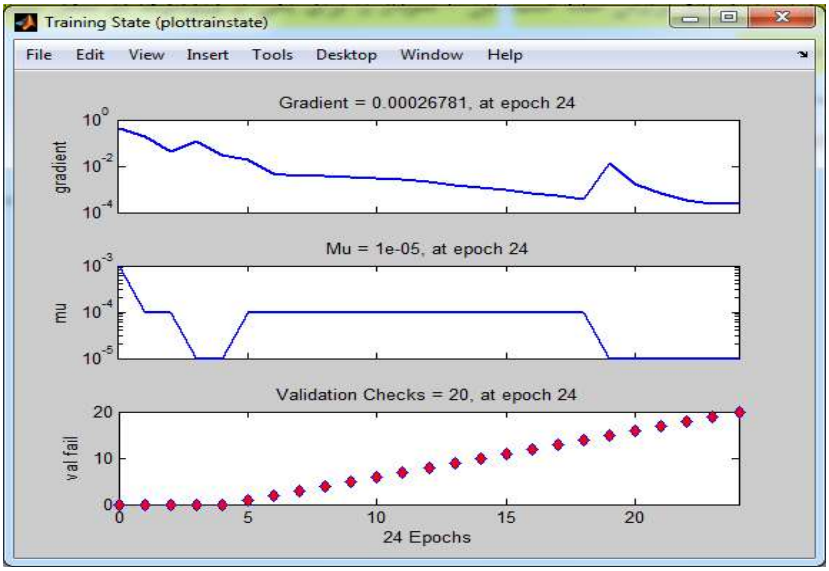

Fig. 3 Graph of training data

Solving the problem of the neural network by MLP

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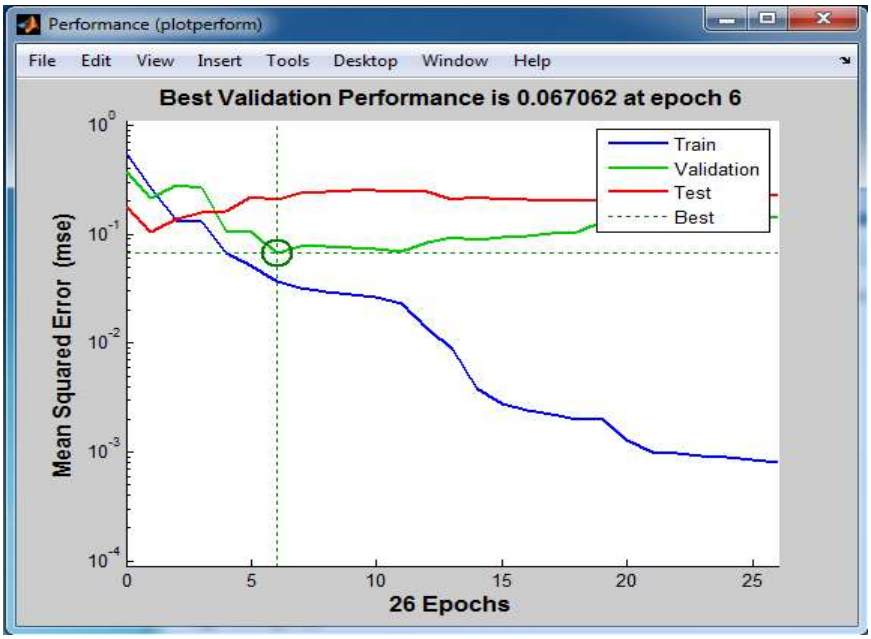

Figure 4: Performance diagram in terms of MSE for solving the problem of the neural network by MLP

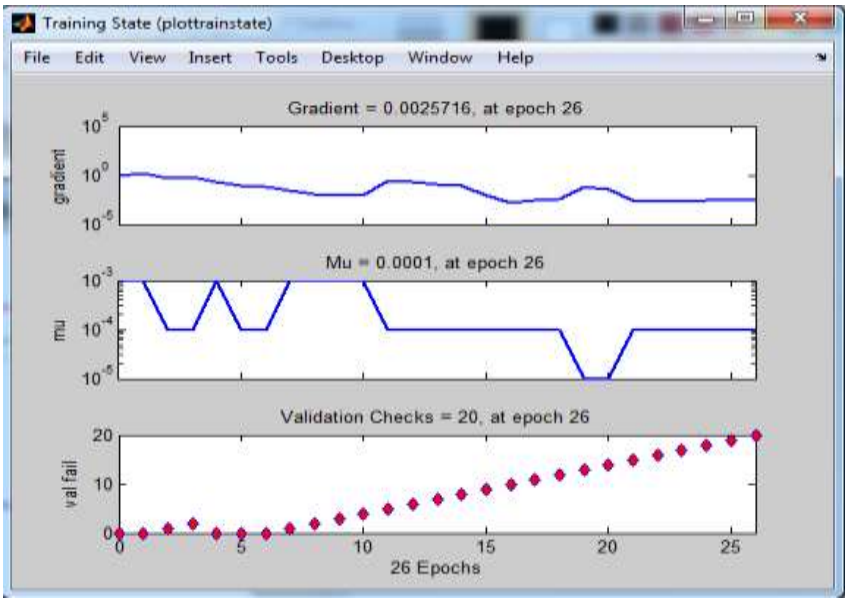

Figure 5: Diagram of data training in solving the problem of the neural network by MLP

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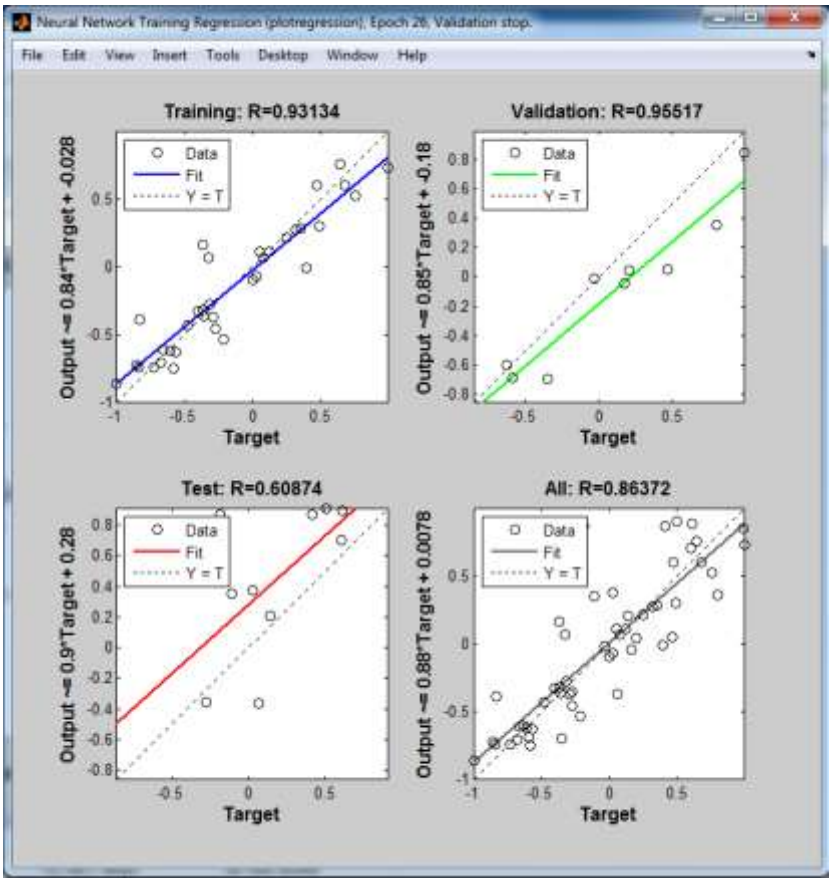

Figure 6: Regression results graph in solving the problem of the neural network by MLP

Solve the problem of the neural network by MLCF

In the MLCF networks, it also uses the BP algorithm to update the weights as a progressive forward-looking network, but the main features of the network are that the neurons of each layer are connected to all the neurons of the previous layers (Mohammad HadiTakayda ,GholamaliMontazar and Saeed Minaei, 2009). In order to make the predicted values closer to the desired output values and to select the best solution with the lowest value of MSE, the optimal number of hidden layer neurons, the percentage of data for the collection Training, evaluation and testing

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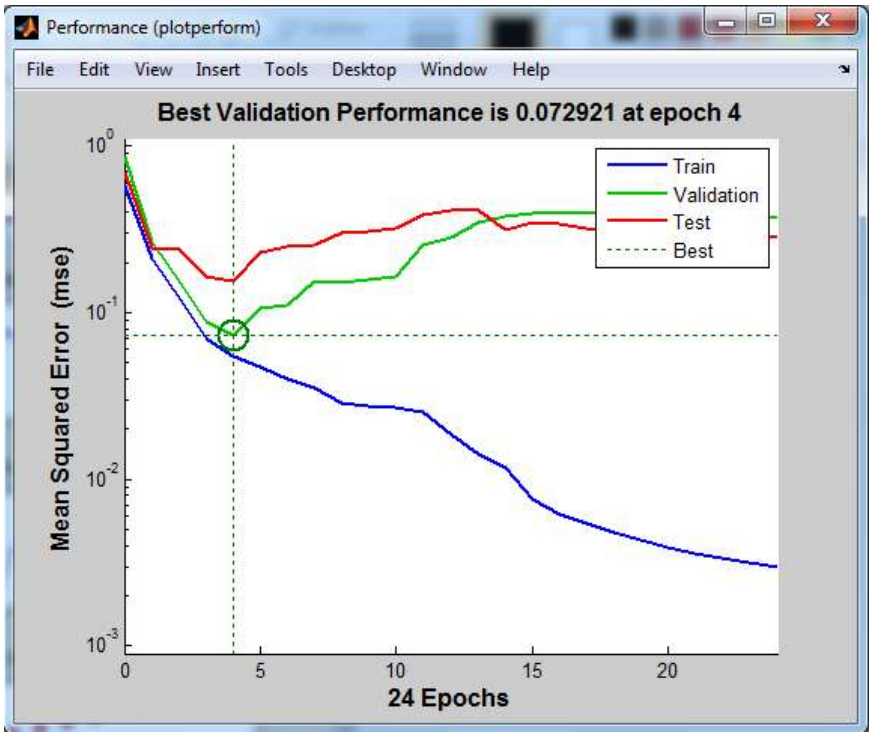

Figure 7: Performance diagram in terms of MSE for solving the problem of the neural network by MLCF

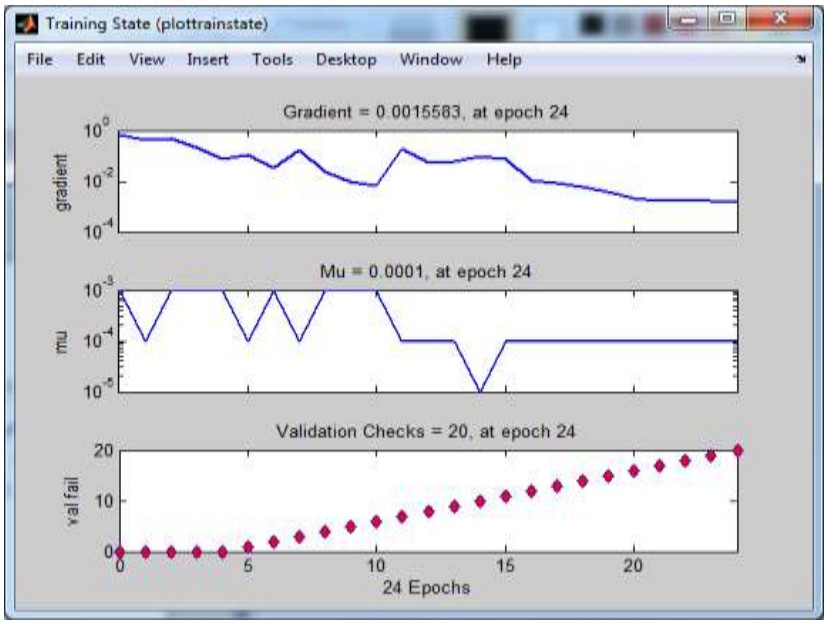

Figure 8: Data flow diagram in solving the problem of the neural network by MLCF

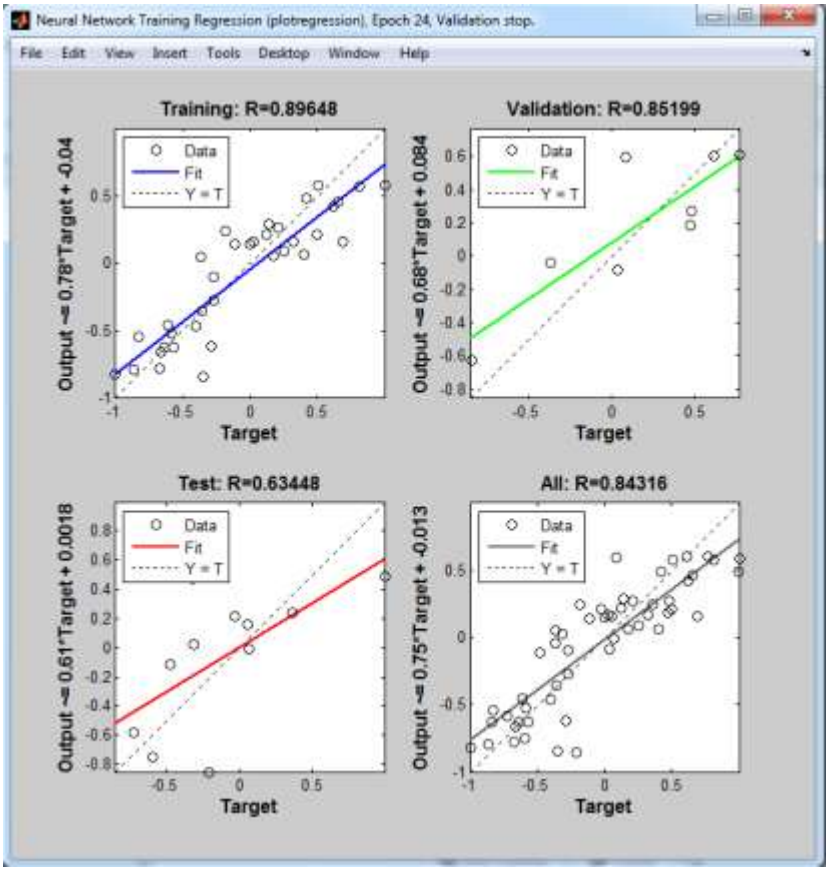

Figure 9: Regression results graph for solving the problem of the neural network by MLCP

Solving the Neural Network Problem by MLFF

In laminar networks with back propagation algorithm in progressive multi-layer structures In order to get the predicted values closer to the desired output values and to select the best answer with the lowest value of MSE, the optimal number of hidden layer neurons, Percentage of data for training, evaluation and testing sets

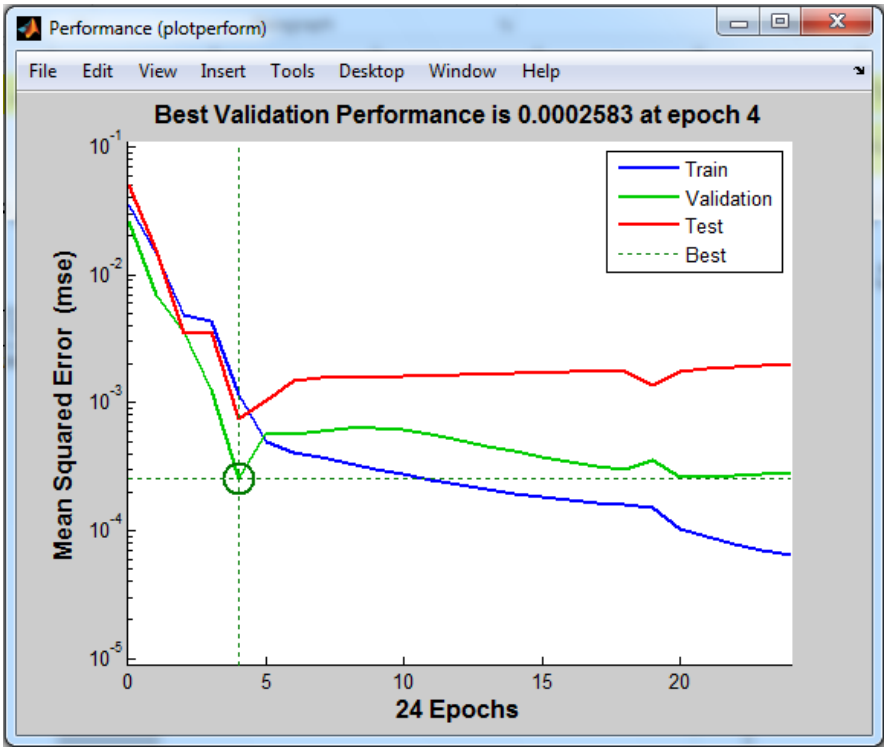

Figure 10: Performance diagram in terms of MSE in solving the problem of the neural network by MLFF

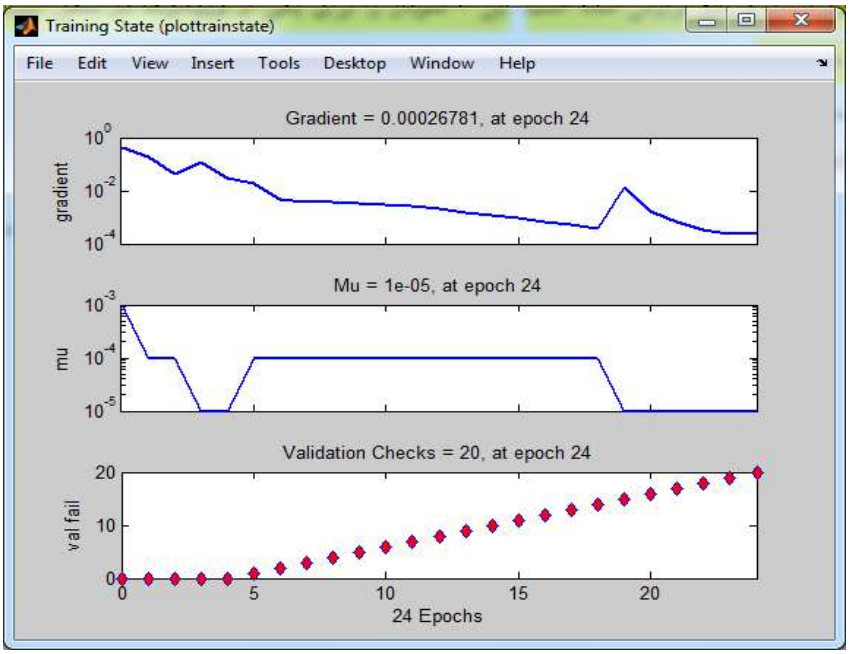

Figure 11: Data flow diagram in solving the problem of the neural network by MLFF

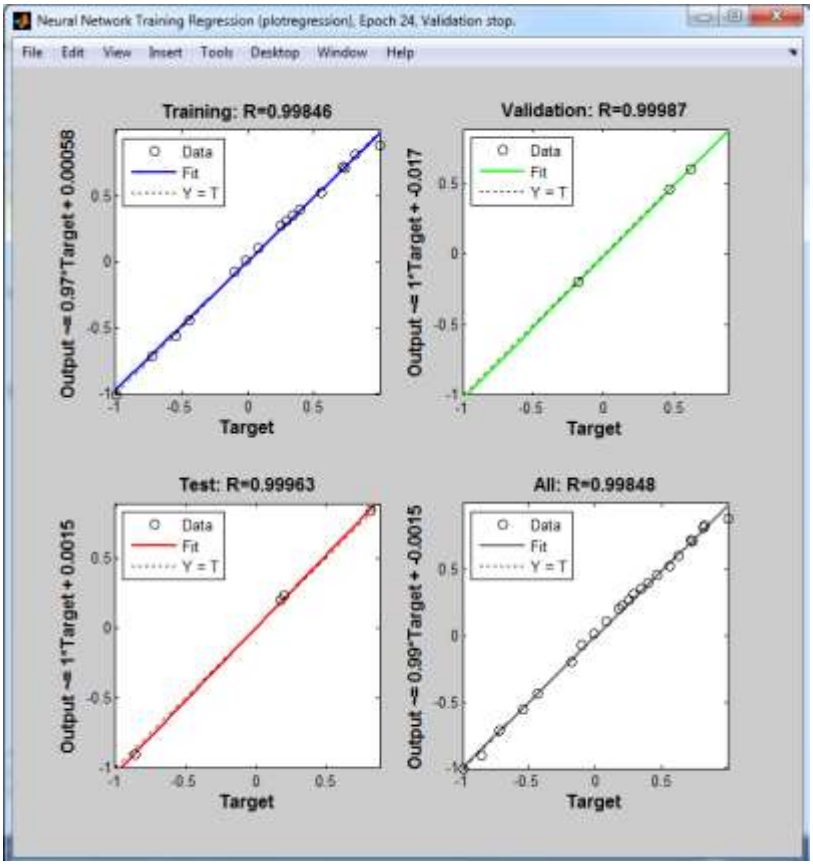

Figure 12: Regression results graph in solving the problem of the neural network by MLFF

As is clear from the results, the MLFF has the lowest error and the highest value of R, in this case, the predicted values are closer to the optimal output values and the best answer with the lowest MSE value is the calculation criterion.

Output indicator forecast

The network was hidden with 8 layers and was trained to predict 7 future periods, and the predicted results of gas consumption by 1400 by the time series are as follows:

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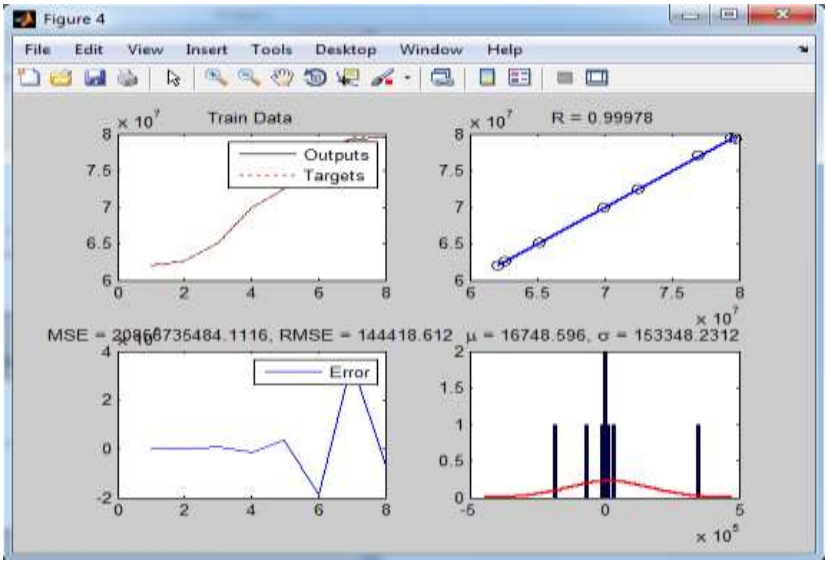

Figure 13: Graph of training data in predicting gas consumption by time series

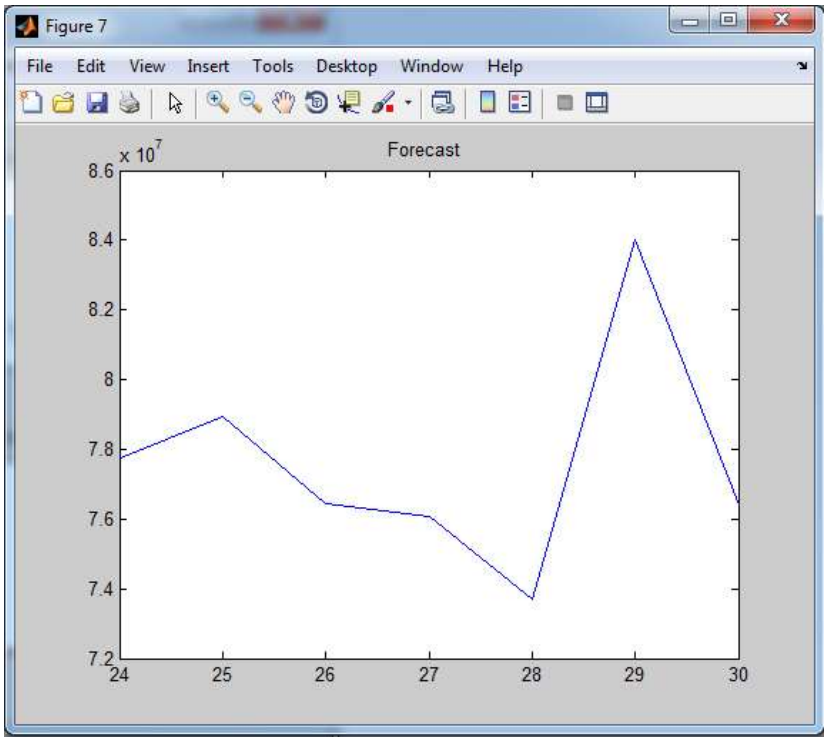

Figure 17: Gas consumption prediction graph by time series

Conclusion

Despite the fact that the Islamic Republic of Iran has many potential for the development of the oil industry and gasoline and gas production, the development of the country's oil industry is slowly taking place. According to the existing literature, the most fundamental obstacle to the development of Iran's oil and gas industry is the lack of effective policies and the imposition of international sanctions. Indeed, the absence of a well-defined framework of factors and indicators of gas consumption in Iran and its constituent parts has led policy makers to have no clear basis for formulating the policies required by the industry and are more based on non- Bachelor, decide. In this research, which seems to have addressed a flow of relationships between the determinants of gas consumption with an appropriate approach, it was attempted to use a system knowledge and knowledge of effective indicators of gasoline consumption to predict consumption Gasoline in Tehran to plan for the future. This template represents the effective indicators of gas consumption in Tehran and the most general relations of accelerating or limiting its development, and by completing and clarifying it, it is possible to adjust the policies of gas consumption in the coming years with the proper precision of the program Made.

In general, energy policy makers in the country, based on this model and the knowledge of the effective indicators of energy consumption and this fuel, as well as the logical relations between them, can develop more effective policies for development. The energy sector and this fuel will be compiled.

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