

Predicting the Social Structure of Educational Services Using Artificial Neural Networks: Application on Turkish Higher Education Institutions According to Gender

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Abstract

The study aimed to: Clarify the concept and importance of artificial neural networks and their importance in the prediction process, measure the validity of prediction results using artificial neural networks in the social structure of educational services according to gender in THEIs Turkish Higher Education Institutions (THEIs), and predict the development of male and female demand for educational services in THEIs. The descriptive analysis method has been used in the study, as well as the MATLAB program has been relied on in data analysis and network training. The study has reached a set of findings results, the most important of which are the following: It is expected that the total number of students in THEIs will grow during the next 9 years by 25.53%. Moreover, there is a high degree of credibility and confidence in the prediction for the years 2017 and 2018, concerning the total demand for educational services in THEIs, and an increasing number of males and females in THEIs, using the artificial neural networks model.

Keywords: Social structure, demand for educational services, artificial neural networks, network training, THEIs

1. Introduction

Big data represents an important stage in the development of information and communication systems, as the analysis of this data allows the existence of correlations between a set of independent data to reveal many aspects, including, for example, forecasting by economic and social indicators...etc. These forecasts also provide decision makers with innovative tools to have better understanding of conditions, and thus make the right decisions that achieve the desired goals.

There has been an increasing interest in the sciences of numbers and data recently. Data science and numbers have witnessed a remarkable development in many areas, the most important of which are (data mining, big data, data analysis by a variety of statistical and mathematical methods, such as artificial intelligence methods and models). Data science has become one of the most important sciences that is related to various fields of science and business. So, there is no longer a role for guesswork and personal opinions in a world depends on modern methods of decision-making. (Hutajulu *et al*, 2019) [14].

The increasing population was accompanied by a raise of demand for educational services, on the one hand, in addition to the societal openness changes, which resulted in an increase in the number of females in educational levels during the past decades. The indicator of female education level has become one of the important indicators that judge the degree of society openness and development. Many countries resort to predicting the demand for educational services in our time, linking supply to demand. Depending on the high demand for educational services, governments amend their laws and

regulations and grant investment facilities in education to accommodate the increasing demand for educational services. Hence, the importance of the study comes since it focuses on studying, analyzing, and predicting the evolution of the social structure of the demand for educational services in THEIs according to gender.

2. Turkish Higher Education Institutions (THEIs)

The widespread use of mass media in the globalizing world and the increasing need for services in many areas are factors that accelerate the competition of institutions that provide different types of services in domestic and foreign markets. The said competitive race brings with it many revisions that institutions need to make on their internal and external dynamics and structural essences (Sakar, 2021) [22]. This situation provides a high-level scientific research environment, contributing to the academic development of individuals in the target area, etc. This also applies to higher education institutions that pursue goals. It is seen that students, researchers, and individuals who are interested in different fields of education tend to turn to countries and universities that stand out in terms of development among their stakeholders, especially with the influence of mass media such as the internet (Saka & Yaman, 2011) [21]. Today, higher education institutions are expected to constantly improve themselves within the framework of the visionary plans they have determined, to serve science by conducting more qualified studies in the light of academic principles, and to meet the educational and social needs of their current and potential students. It is important for universities to tend to be

preferred more than their stakeholders in an increasingly competitive environment, by constantly updating themselves and acquiring a brand image in line with the wishes of the students (Özalp, Tonus & Geylan, 2010) [20]. For this reason, universities have an international perspective by following current developments, they can improve themselves academically, physically, socially, etc. Their continuous improvement in all aspects can be considered as a factor that will bring them to the fore among their stakeholders (Sakar, 2021) [22].

The fact that higher education institutions are in a certain ranking on a global basis is an indicator in terms of gaining an academically more successful and prestigious appearance, especially in the national context (Marginson & Wende, 2007) [19]. The ranking of higher education institutions by considering many sub-dimensions and their positions because of this ranking can be evaluated as a set of features that reflect the academic, social, and physical conditions of the institutions in question in terms of quantity and quality. According to Hazelkorn (2013) [11], worldwide higher education rankings play a critical role in understanding the importance of quality and increasing the competitive environment among universities. Similarly, it is emphasized that these rankings reduce the importance of universities having qualifications only at the national level (Hazelkorn, 2014) [12]. In this context, international ranking indexes on behalf of universities can be considered as an important factor in proving academic competence and increasing recognition (Hou & Jacob, 2017) [13]. The ranking-based achievements of higher education institutions are not only an indication of their international competitiveness but also an introductory tool that brings them to the fore in terms of academic development and the power to conduct qualified scientific research (Aguillo, Bar-Ilan, Levene & Ortega, 2010) [1]. In this context, many situations are effective in higher education institutions' desire to rank higher among their peers. The desire to be preferred by bright students, and the need to obtain internal and external grant support are the factors that make higher education institutions want to be in a certain ranking and to preserve this ranking as much as possible (Altbach, 2006; Sakar, 2021) [3, 22].

The rise of higher education institutions in terms of quantity and quality in Turkey can be interpreted as an indicator of the importance given to the gradual development of higher education (Sakar, 2021) [22]. The University Reform implemented in 1933 and the higher schools, universities and institutes opened within the scope of this reform, in a sense, are the basis of the modern and dynamic higher education understanding in Turkey (Namal & Karakök, 2011). The evolutionary process of the Turkish higher education system continued with the laws of 1946 and 1973 and took its final form with the law numbered 2547 of 1981 (Baskan, 2001) [5]. Turkish higher education institutions, which gradually increased in terms of quantity and quality with this law, reached a total of 209, 129 state universities, 75 foundation universities, and 5 foundation vocational schools, within the scope of the 2019-2020 Academic Year Higher Education Statistics (YÖK, 2020) [27]. Scientific studies carried out by Turkish higher education institutions in many priority areas determined by YÖK for the development of our country, steps taken to train qualified scientists with high-level research skills within the scope of "YÖK-Future Project" (YÖK, 2020) [27], BOLOGNA followed within the scope of internationalization of higher education, Innovations such as TURQUAS Project, International Labor Law, joint education

and training programs, foreign academician information system, diploma equivalency, and European higher education field (YÖK, 2017; Çetinsaya, 2014) [26, 8], increasing academically through Turkish higher education institutions that increase in quantitative terms can be considered as indicators of success. In this context, it is important for Turkish higher education institutions to achieve success through qualified studies and actions within the scope of priority areas and basic areas, in terms of gaining a leading position among their stakeholders at the international level (Sakar, 2021) [22]. To meet the growing demand for educational services for both males and females of all levels.

3. The Problem of the Study

The use of artificial intelligence and neural networks is not a new topic, but what is new is its use in the field of economic and social sciences in recent decades, as many studies, with the development of data science around the world, have focused on the use of modern models and techniques in data analysis and prediction that are characterized by higher accuracy and credibility than traditional models. From above, the research problem can be formulated through the following main question: Is the social structure of educational services according to gender in THEIs predicted appropriately? Thus, the main problem can be divided into the following sub-questions:

- To what extent can the artificial neural network model be used in predicting the social structure of educational services according to type in THEIs?
- What is the degree of predicting accuracy in the social structure of educational services according to type in THEIs by using the artificial neural network model?

4. Research Objectives

The research aims to achieve the following:

- Explaining the concept and importance of artificial neural networks and their importance in the prediction process.
- Measuring the credibility of prediction results by using artificial neural networks in the social structure of educational services according to type in THEIs?
- Forecasting the development of males' and females' demand for educational services in THEIs.
- Reaching to some results and recommendations that could help in adopting modern models to predict the social structure according to gender on educational services in THEIs.

5. Research Importance

Scientific Importance: The scientific importance of the study lies in relying on modern methods and models in predicting the social structure of the demand for educational services, in addition to using artificial intelligence models in the prediction process that depends on advanced mathematical sciences. That is, relying on technical scientific developments and using them to serve economic and social goals.

Practical Importance: The practical importance of the study lies in measuring and testing the credibility and efficiency of the artificial neural networks model in predicting the social structure of the demand for educational services, in addition to reaching a modern forecasting method that can be measured and applied to predict the diverse demand for future educational services in universities.

This study also constitutes a scientific theoretical contribution by studying and analyzing the prediction of the reality of

educational services using a modern model. This study also forms a practical addition that offers tangible empirical evidence on the reliable and accurate prediction for demand by using the artificial neural network model.

6. Research Hypotheses

The main hypothesis: There is high accuracy and credibility in predicting the social structure according to gender of educational services in THEIs using the artificial neural network model. It is divided into the following two hypotheses:

- i) **First Sub-Hypothesis:** There is high accuracy and credibility in predicting males' demand for educational services in THEIs using the artificial neural network model.
- ii) **Second Sub-Hypothesis:** There is high accuracy and credibility in predicting females' demand for educational services in THEIs using the artificial neural network model.

7. Research Methodology

The descriptive analytical method has been used in the research. Also, the secondary data represented by the social demand according to gender for educational services in THEIs from the Turkish Higher Education Council has been applied.

Study Community: the total number of male and female university students in THEIs between the years 1984-2021.

Scientific Limits: Predicting social structure according to gender on educational services in THEIs using artificial neural networks model.

Spatial Limits: THEIs.

Time Limits: The study and data analysis were conducted in 2022.

Theoretical Framework

i) The Concept and Emergence of Demography

Demography is the study of population in terms of size, structure, distribution, and the causes and results of changes in those characteristics. Thus, it consists of two main areas, the first is concerned with the population structure, which is interested in describing the population using measures such as size, age distribution, geography, gender, religion, and the level of human capital distribution. The second field includes population dynamics, i.e., changes that occur in the population structure during a certain period. These changes occur either because of natural increase (births, deaths), or abnormal increase, (migration). Some sociologists believe that demography is the interest of statistics in the population study, since it studies population phenomena as a quantitative statistical study (Al-Sayed, 2001) [31].

During its inception and development, demography had many names, so some called it biostatistics. Émile Durkheim called it "social morphology", affecting by social philosophy, to refer socially to the study of population and their conditions. Then, this concept had the term "demography". However, It was used for the first time by the Belgian scientist Asil Guillard, in the book issued in 1855 with the title "The Principles of Human Statistics or Comparative Demography", a term that was derived from two Greek words, namely (DEMOS), meaning people or population, and (GRAPHY), which means and refers to the descriptive science or study. Thus, the phrase in its total connotation means the science which is concerned with describing the population and studying it as a statistical study (1976 Louis Henry) [18].

Population statistics are one of the most important statistics that have attracted the attention of statisticians in various countries for many centuries. This importance is due to the fact that these statistics from the main introduction to economic and social planning through which the political, economic and social objectives of the state can be achieved. Therefore, population projections are important in planning the labor market, as well as to know the society's needs for educational services and electric power. In addition, through which it is possible to detect environmental, economic, and social problems in the concerned country, which forms the basis for decision-makers to prepare appropriate policies and procedures to avoid such problems and find appropriate solutions to them. (Bait, 2021) [28]

The social importance of the gender and age structure appears in the knowledge of the population of educational age to determine their need for schools and universities, for example, and the future demand for their services. Thus, providing data about the population according to gender (male, female) has a great importance in the planning process of various economic, social, and political activities in the state. Although there is a large overlap between the qualitative and age structure, it is preferable to study each of them separately. (Shoaib, 2010) [32]

ii) The Social Structure of Educational Services According to Type and the Importance of Predicting it:

Any population group consists of males and females, and the ratio between them is calculated by knowing the number of males for every (100) females. This ratio is called the gender ratio or the sex ratio. This ratio is important as it affects the rates of births, deaths, migration, and the economic structure of population, including employment and its occupational structure (Al-Hadithi, 1988) [30].

Social structure according to gender means the learning of the number of males and females in schools and universities. Countries usually resort to measuring the percentage of male and female education in order to develop future plans and strategies that they aim at. The greater the number of educated males in schools, for example, this means that the demand for educational services in universities soon will be in favor of males more than females. It is known that there are preferences in some university disciplines that are preferable by males and some by females. For example, females want to study languages, education, kindergartens, etc. more than males.) (Bait, 2021) [28].

The importance of studying the analysis of the social structure according to gender in educational services and predicting the future can be determined as follows:

- Stating the percentage of male and female learners at schools and universities in a country and the degree of its future development.
- Setting employment plans and policies for future governments according to the males' and females' different specializations and desires to some extent.
- Providing the necessary offer of future educational services (universities, specializations, and departments), depending on the females' and males' desires and orientations for future education.
- Directing and motivating investment for the education sector in the case that the public sector is unable to absorb the increasing demand for future educational services.
- Stimulating creativity and future talents by providing the future and desired educational opportunities, not the desires imposed on them.

Forecasting according to gender shows the future development of the demand for educational services for males and females, and the expansion of specializations that must be increased in connection with the desires according to gender. For example, if the number of universities increases by 40%, the expansion of specializations must be re-examined in accordance with female desires to education, and this leads to creativity and the spread of future talents.

iii) The Concept of Artificial Neural Networks

Artificial neural networks are considered one of the artificial intelligence techniques. They are defined as information processing systems that have certain performance advantages in a way that simulates biological neural networks. (Fri, 2012) The artificial neural network is defined as a system for building information that has certain characteristics of performance like biological neural networks, which is thanked to for solving many problems. It has many fields, the most important of which are: (medicine, telecommunications, banking affairs, Forecasting, economic sciences, etc. (Singh and Banerjee, 2019) [23].

Artificial neural networks have developed as mathematical examples based on the way of human thinking and have become more advanced than traditional methods. They are considered the ideal method for representing the relationships between variables. The following steps show the components of the artificial neural network and how it processes information: (Son, *et al.*, 2016) [24].

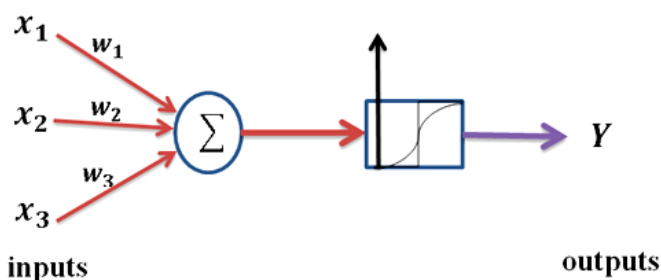
1. Information is processed in simple processing elements called neurons.
2. Signals between neurons pass through connecting lines.
3. Each connection line is attached to a specific weight (a numerical value) which is multiplied by the signals entering to the neuron.
4. An activation function is applied on each neuron (usually non-linear) to the network input (the sum of the weighted input signals) to determine the output signal from it.

Artificial Neural Networks are described as

1. The form of interconnection among neurons (which is called architecture).
2. The method that determines the weights of these connections (which is called training, education, and algorithm).
3. The type of activation function used. (Da Silva, *et al.*, 2017) [9].

iv) Neural Networks Components

According to the used neural network architecture, the components of the neural network can be displayed as follows: (Kapanova, *et al.*, 2018; Khalil, *et al.*, 2018; Berry, *et al.*, 2020) [15, 16, 7].



Source: Prepared by the researcher based on (Berry, *et al.*, 2020) [7]

Fig 1: The simple structure of a neural network

- **Input Layer:** It is the first layer in neural networks. This layer receives data of independent variables from different sources. It contains many neurons or processing elements whose number is correspondent to the number of independent variables of the inputs to be measured.
- **Hidden Layer:** The hidden layer is the layer that follows the input layer, and the neural network may contain one or more hidden layers. It classifies, distinguishes, and analyses inputs by making each one has a relative weight. Then, analytical functions are used to modify these relative weights, after making a comparison between the current results and target ones to reduce errors and achieve the best results.
- **Output Layer:** It is the final layer of the neural networks. It contains a number of processing elements whose number is correspondent to the number of response variables. This layer displays the results of the neural networks that reached from the previous layer.
- **Relative Weights:** These weights determine the relative importance of each input, and thus determine the strength of the relationship between the elements and units of treatment and the effectiveness of the communication contract. The relative weights can be modified through training and learning.
- **Summation Function:** This function is the internal activator or stimulator of the neural network, as it calculates the relative weights of the inputs, by multiplying each input by its relative weight to get the sum.
- **Transfer Function:** It is also called activation function, as it performs mathematical equations on the values outside the summation function, constantly adjusting relative weights during the training period of the network. However, the most popular neural network activation functions are the linear function, the boundary function, the sigmoid function, and the binary sigmoid function. (Singh, and Banerjee, 2019) [23].

Artificial neural networks can be used to solve many problems, such as ordering and reordering data or samples, classifying samples, accomplishing the learning process for many input samples to obtain output samples or a group of similar samples in the output, and finding optimal solutions for constrained problems.

Each neuron has its own internal state called activity, which is obtained by applying a certain mathematical function on the input data, and its result is received by the neuron. Barboza, *et al.*, 2017) [4].

Each neuron sends its activity as an input signal to many other related neurons, and we should note that the neuron sends only one signal at the same moment, but it can transmit this signal to many neurons X_1, X_2, X_3 , whose activities (output signals) are x_1, x_2, x_3 respectively, in Figure (1). Furthermore, let's denote by w_1, w_2, w_3 for the weights of the connections coming from neurons X_1, X_2, X_3 to neuron Y, respectively. The input of the neuron Y is (Y-in) which is the sum of each input signal plus the weight attached to it and as a relationship illustrating this:

$$Y - \text{in} = w_1 \cdot x_1 + w_2 \cdot x_2 + w_3 \cdot x_3$$

While the efficiency (output signal) of the neuron Y is given in the following relationship:

$$Y = f(Y - \text{in})$$

Where f is a specific mathematical function presented to its input. An example of these functions is the Binary Sigmoid Function: (the function used in the study)

$$f(x) = \frac{1}{1 + e^{-x}}$$

v) Classification of Neural Networks

Many previous studies and scientific literature and writings have divided neural networks into many classifications. Neural networks can be classified, according to the number of their layers, into single-layer networks and multi-layer networks, as well as according to their spread methods into feed-forward networks, feed-back networks, competitive networks, and repetitive networks. (Xin, *et al.*, 2020) [25].

vi) Training and Learning Neural Networks:

Hebb's study in 1949 is one of the first early studies that proposed the basic basis for the learning way of the neuron in the human mind. It was one of the first studies to reach the connectivity structure of neurons and how knowledge is represented. Then, many researchers applied Hebb's rule to neural networks, and found that training and learning determine the values of relative weights. The relative weight expresses the relative importance of the input data. The neural networks are not programmed, but they only do training and learning. They are trained on a set of stored data in previous periods of time, which contributes to the fast learning of those neural networks that have been trained, thus adjusting the

relative weights, and achieving the best results. Liang, and Cai, 2020) [17].

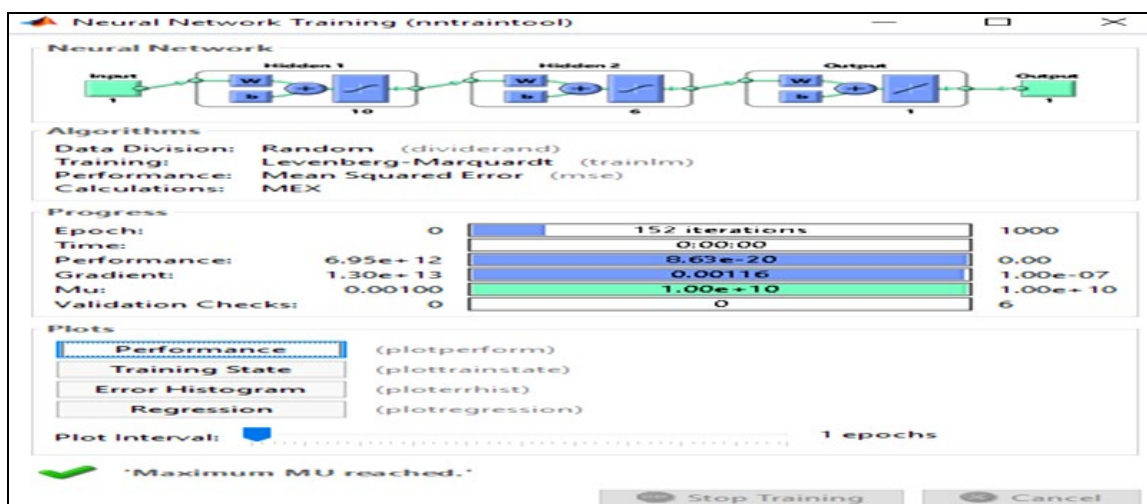
In the beginning, the neural networks determine the initial values of these relative weights, or randomly choose the initial values of the relative weights. The importance of the initial values of the relative weights is because of determining the effectiveness and period of learning. There are two ways of neural networks training: supervisory training or non-supervisory training. (Da Silva, *et al.*, 2017; Alloghani, *et al.*, 2020) [9, 2].

Practical Study

i) The Predicting Method of the Social Structure of Educational Services According to Type in THEIs

The MATLAB program has been used in the prediction process by using the artificial neural network, due to the importance of this program and its wide applications in many vital areas, including prediction. Figures (2, 3) show the illustrated interface for all the followed steps of using MATLAB and testing the network by the artificial neural network, as follows:

The accurate forecasting process has a great importance in all fields, especially in the field of educational services. The accuracy of forecasting will greatly contribute to the setting of future educational plans and strategies related to the desires of both genders and the community's needs of specializations on the one hand. In addition, it will provide financial credits for future expansions in public universities and stimulating the private sector to invest in education to assimilate the future increasing demand for educational services and reduce students' dropouts of outside study, in light of the availability of high-quality educational services parallel to the external one. (Asaad, 2020) [6].



Source: Prepared by the researcher depending on Matlab

Fig 2: The MATLAB interface used to implement the artificial neural network

The ascertaining method of the credibility and reliability of artificial neural networks and predicting the social structure of educational services according to type in THEIs has been done according to the following sequence:

- Compiling and arranging data according to the evolution of the social distribution by gender for demand for educational services in THEIs between the years 1984-2021. (Table 1).
- Data entry: The data is entered in the form of an Input Data (X) ray as shown in the previous interface. (Figure 2).
- Input the desired output ray (Target Data). (Fig. 3).

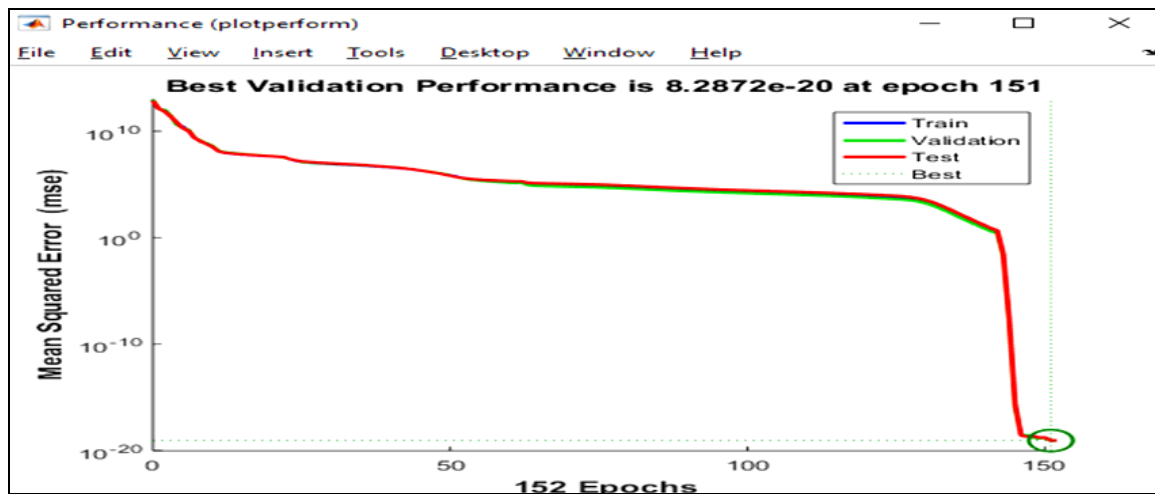
- Choosing the type of artificial neural network used in prediction.
- Choosing the MSE Error Scale.
- The use of the training algorithm for the used network: This option represents a training algorithm (Levenberg-Marquardt backpropagation), which is an algorithm that depends on learning in the method of backward progression of error and adjusts the weights and bias weights based on the Levenberg-Marquardt technique.

Obtaining the test results, which are divided into two parts as follows:

a) **The First Stage: Testing the Credibility and Reliability of Artificial Neural Networks:** The data were entered into the MATLAB program between the years 1984-2016, then the values were predicted for the known years (2017-2018-2019-2020-2021), in order to compare the predicted values using the neural networks

and the known actual information and illustrating the reliability degree of prediction.

b) **The Second Stage:** After confirming the accuracy of prediction and that all values were at rates exceeding 93%, which are very high values, the future of these years (2022-2023-2024-2025-2026-2027-2028) was predicted.



Source: Prepared by the researcher depending on Matlab

Fig 3: The best performance after network training

ii) **The Distribution of the Social Structure of Educational Services According to Type in THEIs:**

Before doing the prediction process, the distribution of the social structure according to gender and its development

during the years of study was studied and clarified as in the following table:

Table 1: Social structure data according to gender on demand for educational services in Turkey.

Academic Year	Males' Number M	Males' Percentage	Females' Number F	Females' Percentage	Students' Known Sum T
1984	222566	66	112599	34	335165
1985	283547	69	128983	31	412530
1986	314981	68	149801	32	464782
1987	334195	67	168185	33	502380
1988	343440	66	176357	34	519797
1989	380989	66	197787	34	578776
1990	441145	66	227733	34	668878
1991	482788	66	249633	34	732421
1992	517242	60	272570	40	789812
1993	555289	62	371962	38	927251
1994	699908	61	422953	39	1122861
1995	708476	61	444631	39	1153107
1996	741558	61	478145	39	1219703
1997	778700	60	505212	40	1283912
1998	838636	60	552828	40	1391464
1999	869978	60	575825	41	1445803
2000	884892	59	600446	42	1485338
2001	936721	58	650317	42	1587038
2002	968169	58	687849	42	1656018
2003	1098565	58	784065	42	1882630
2004	1128186	58	807700	42	1935886
2005	1190046	58	872850	42	2062896
2006	1316060	57	983361	43	2299421
2007	1372583	57	1034747	43	2407330
2008	1404450	57	1080344	43	2484794
2009	1612713	56	1264065	44	2876778

2010	1924792	55	1555451	45	3480243
2011	2055336	55	1712876	45	3768212
2012	2335804	54	1967746	46	4303550
2013	2666039	55	2257901	45	4923940
2014	3075444	55	2543635	45	5619079
2015	3276658	54	2786228	46	6062886
2016	3621517	54	3067668	46	6689185
2017	3886107	54	3312880	46	7198987
2018	4047302	54	3513069	46	7560371
2019	4064516	53	3675986	47	7740502
2020	4108571	52	3831562	48	7940133
2021	4191572	51	4049425	49	8240997

Source: Compiled by the researcher depending on the data of the Higher Education Council (YÖK) in Turkey.

From Table (1) we note the following:

- A decrease in the number of male students during school years by 15%. This increase in the number of females has affected the social structure of educational services in THEIs according to gender during the past several decades.
- A noticeable increase in the demand for educational services in THEIs during the years of study, especially after 2005. This is because of the increase in the number of universities in Turkey on the one hand, the increase of external demand for THEIs from several countries, and the population increase in Turkey.
- It is certain that the increase of the student's number in THEIs has been accompanied by the presence of several educational systems (distance education, formal education, etc.). All these have contributed for many

students to have a desire to develop their educational performance during the working period.

- The increasing number of students and universities was accompanied by the increasing number of specializations and educational programs in THEIs, which is proportional to the desires of females in education.

iii) Testing the Reliability of Neural Networks in Predicting the Social Structure of educational Services According to Type in THEIs:

To measure the reliability of neural networks, the known years have been predicted, and the results were as shown in the following table:

Table 2: Reliability of neural networks in prediction.

Academic Year	Males' Known Number M	Prediction of Males' Number M	Credibility Percentage %	Females' Known Number F	Prediction of Females' Number F	Credibility Percentage %	Students' Known Sum T	Prediction of Students' Sum T	Credibility Percentage %
2017	3886107	4022265	96.61	3312880	3144807	94.93	7198987	7390374	97.41
2018	4047302	4186647	96.67	3513069	3359067	95.61	7560371	7692512	98.28
2019	4064516	4284734	94.86	3675986	3399004	92.47	7740502	7976154	97.60
2020	4108571	4592954	89.54	3831562	3518961	91.84	7940133	8497823	93.44
2021	4191572	4594414	91.23	4049425	3568952	88.13	8240997	8899925	92.59

Source: Prepared by the researcher depending on MATLAB program.

From the previous table (2) we note the following:

Regarding the credibility and reliability of predicting the social structure and the total number of students in THEIs between the years (2017, 2018), the years during which the Corona pandemic had not spread yet, it was noted:

- **For Males:** the reliability of the predicted number through using neural networks reached a very high rate that exceeded 96% of the known real number. This indicates to the high strength and credibility of using neural networks in predicting the demand for education in THEIs by males.
- **For Females:** the reliability of the predicted number using neural networks reached a very high rate, close to 95% of the known real number. This indicates to the high strength and credibility of using neural networks in predicting the demand for education in THEIs by females.
- **For the Total Students:** The reliability of the predicted

number using neural networks reached a very high rate, exceeding 97% of the known real number. This indicates to the high strength and credibility of using neural networks in predicting the demand for education in THEIs for total students by social type.

Regarding the credibility and reliability of predicting the social structure and the total number of students in THEIs between the years (2019, 2020, and 2021), the years in which the Corona pandemic spread, it was noted:

- **For Males:** The reliability of the predicted number using neural networks ranged between 89% and 94% of the known real number. This indicates to the high strength and credibility of the use of neural networks in predicting the demand for education in THEIs by males. It is a high percentage despite the anxiety, quarantine laws and difficulty of movement imposed by countries.

- **For Females:** The reliability of the predicted number using neural networks ranged between 88% and 92% of the known real number. This indicates to the high strength and credibility of using neural networks in predicting the demand for education in THEIs by females.
- **For the Total Number of Students:** The reliability of the predicted number using neural networks ranged between 92% and 97% of the known real number. This indicates to the high strength and credibility of using neural networks in predicting the demand for education in THEIs.

We note that there is high credibility in prediction using the neural network model in the case there are complementary time sequences for long periods. Moreover, the network training and results were satisfactory and very high even during the period of the Corona pandemic crisis.

Based on the results and analysis of Table (2), all three hypotheses of the study are correct as follows:

- **The Main Hypothesis:** There is high accuracy and credibility in predicting the social structure according to type for educational services in THEIs using the artificial neural network model, based on the results of Table (2).
- **First Sub-Hypothesis:** There is high accuracy and credibility in predicting male demand for educational services in THEIs using the artificial neural network model, based on the results of Table (2).
- **Second Sub-Hypothesis:** There is high accuracy and credibility in predicting female demand for educational services in THEIs using the artificial neural network model, based on the results of Table (2).

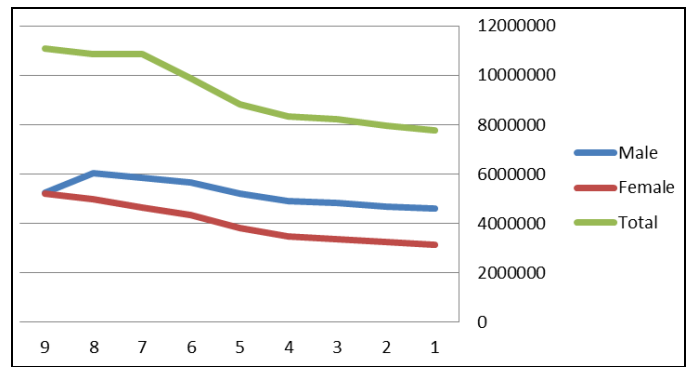
Fourth: Predicting the Social Structure of Educational Services According to Gender in THEIs:

After testing the validity of the artificial neural network model in predicting the social structure, the social structure of educational services according to gender in THEIs was predicted for 9 future years as follows:

Table 3: Predicting the social structure of educational services according to gender in THEIs.

Academic Year	Predicting Males' number M	Predicting Females' number F	Predicting Students Number T
2022	4594676	3148950	7770302
2023	4694723	3248950	7970370
2024	4824731	3367589	8226953
2025	4913625	3476692	8341251
2026	5221362	3826921	8812652
2027	5669251	4352812	9868591
2028	5863392	4635829	10853491
2029	6055523	4978519	10855159
2030	5263281	5224221	11066291

Source: Prepared by the researcher depending on Matlab program



Source: Prepared by the researcher depending on Excel.

Fig 4: Forecasting the social structure and total demand for educational services.

From the previous table (3) and Figure (4), we note the following:

- It is expected that the number of male students in THEIs will grow during the next 9 years by 19.37%.
- It is expected that the number of female students in THEIs will grow during the next 9 years by 22.50%.
- It is expected that the total number of students in THEIs will grow during the next 9 years by 25.53%.
- The reason of the difference is that each function (males, females, total, were treated and trained in the program separately). In addition, the development of the whole series of the total students was more regular than the development of males and females, but the results were approximate and indicate to the increase of structure on demand for educational services in THEIs ranges between 19-25%.
- By following the two predicted numbers in 2030 for the number of males, it is expected that the number of males and females in THEIs will approximate significantly in 2030, under the conditions of the current forecast.

The Findings of the Study

- There is a high degree of credibility and confidence in the predictions for the years 2017-2018 in relation to the total demand for educational services in THEIs, and the increase of the males' and females' number in THEIs, using the artificial neural networks model.
- There is a high degree of credibility and confidence in the prediction for the years 2019, 2020, 2021 during the period of the Corona pandemic spread in relation to the total demand for educational services in THEIs, and the increase of males' and females' number in THEIs, using the artificial neural networks model.
- It is expected that the number of male students in THEIs will grow during the next 9 years by 19.37%.
- It is expected that the number of female students in THEIs will grow during the next 9 years by 22.50%.
- It is expected that the total number of students in THEIs will grow over the next 9 years by 25.53%.
- It is expected that the number of males and females in THEIs will be approximate significantly in 2030, under the current forecast conditions.

Recommendations

- Relying on different artificial intelligence models (artificial neural networks, fuzzy logic) in predicting the social structure on educational services in THEIs.
- Linking forecast values according to social type or specialization with the future expansion of investment in specializations field, academic programs, and universities to meet the needs of students according to gender.
- Using and applying the artificial neural network model in predicting and analyzing all future educational data, due to the importance and high percentage of this model credibility in predicting future values compared to other models.
- Provide the requirements of the use of the artificial intelligence model such as human cadres and other supplies and provide them.

Conclusion

In the end, the study of the development of students number in universities and institutes of higher education is one of the important topics, because of its impact on the expansion and future foresight of demand for educational services in those universities, and the need for investment and future expansion to meet the increasing demand, in addition to distinguishing between the desires of males and females to study. And work on geographical expansion in proportion to the places of student increase, hence the importance of artificial intelligence models in accurately predicting the future demand for educational services, knowing the percentages of increase in the total number of students and their distribution between males and females, and estimating the demand for universities and higher education institutes in Turkey.

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