# Predict the success of students in math's course in final exams in Arak city with neural networks

**Maryam Sadat**
Department of Information Technology Management, Electronic Branch, Islamic Azad University
Tehran, Iran
Maryam77.s77@gmail.com

**Abbas Toloie Ashlaghi**
Prof. of Islamic Azad University, Science & Research Branch
Tehran, Iran
Toloie@gmail.com

**Reza Radfar**
Associate Prof. of Islamic Azad University, Science & Research Branch Tehran, Iran
Radfar@gmail.com

## ABSTRACT

One very significant issues in most educational systems, the question is educational achievement levels of students in exams. The educational system is one of the most important indicators of education performance and evaluation of teaching and the learning is the fact that the performance of the system output in each year. The method of the research is descriptive-survey. The research community of the study is the third grade secondary school' students of Arak city. The study sample was 192 students in the 1389-1392 timeframe. The factors affecting the success of students in the final exams at the high school was identified and then offered the artificial neural network model to predict the success of students in examinations. The results showed the selective model of MLP with three layers (input, hidden and output) respectively with (6-3-1) neurons and the estimated accuracy was (95.249).

## Keywords

Success, Educational achievement, Final exam, artificial neural networks

## 1. INTRODUCTION

Education institutions, play a significant role in the development of personal and social change which leads to the development of society. Success or achievement is discussed as a key concept in sociology of education, influence the economic, social, cultural variety.[4].

Factors affecting the development and progress of developed countries shows that all these countries have had education qualifications. Therefore, more attention to education is the most important factor in the development of cultural, social, economic and community impact it poses to society and the family.

Here's the problem that we have mentioned, is the fact, success or failure of students in exams depends on what factors? How much influences each of these factors in success of students in final exams at high school in Arak city?

Studies show that students' success or failure in examinations depends on many factors. These factors are not isolated from each other, they link together like a chain and lack of attention and expertise to the cause have irreparable harm to the individual and society.

To find the cause of a social problem, there is not a sufficient reason, because the individual and society factors of educational success or failure are very much. So in order to identify the factors that have multiple issues, should be considered physiological factors, psychological factors and environmental factors, covering external factors, including social and economic base, such as income, education, place of residence and family-related variables such as number of children, family and cultural values of the variables the school environment, such as school management, teachers characteristics and school atmosphere.[2]

### 1.1. Expression of the Problem and the Necessity of Doing Research

In addition to the social effects education has an economic impact. Adam Smith's famous classical economists believed that education is an investment in their people. They will be capable of learning and development capabilities and cause them not only to meet the higher income but also the society is their investment to benefit. So there is need to study

and research about education and challenges of students, particularly in the course requires a lot of success in curriculum tests and due to various factors affecting their social, cultural, economic and psychological, on the other hand the rapid changes taking place in Arak city as part of society, the need for research and new research is necessary.

## 1.2. Conceptual model

This will be followed in this study to select the most effective agents to make prediction model using neural networks and go. The design features a number of important steps:

1) Select the type of network
2) Determine the data model must be designed (the need for the data model, the input data is collected)
3) The placement of data and preparation of data for analysis
4) Model to the data
5) Training model
6) Evaluation model based on the data
7) Calculate the model output

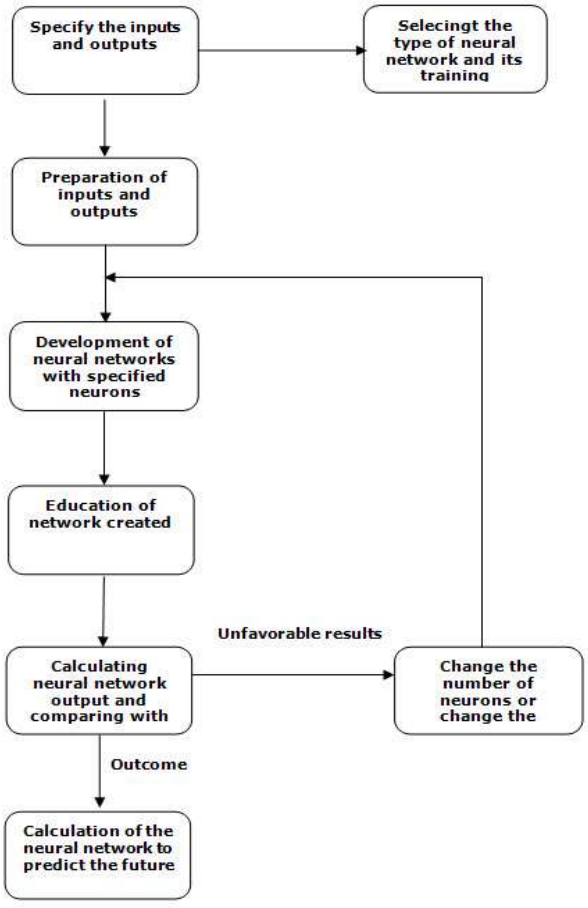


**Figure 1. Conceptual model**

## 2. REVIEW OF RESEARCH LITERATURE

The problem of educational success and failure is a long and uncertain. It coincides with the beginning of the reading and writing of human history, the pace of industrial development and the need for trained personnel and specialists, opinion leaders and practitioners education has been paid to the issue of development and educational failure, thus to find success factors should be considered various issues and impacts to be evaluated.[2]

Arjmand Syahpush and colleagues in their study entitled "Evaluation of social and cultural factors affecting the education achievement of high school students in the city of Susa Daniel", confirmed that the effects of gender, parental social class and educational level of self-esteem education achievement. However, the hypothesis that the effect of independent variables on education achievement rejected the family while in previous studies was confirmed. The results of this study compared with previous studies suggested that such effects of gender, social class and parental self-esteem and education achievement. This is also related to the study of traditional texture and rural areas and yet family environment failed to provide favorable conditions in the education achievement of students.[1]

The results of Zare and Shafiee research indicate that the cultural capital and its aspects and type of school has a significant relationship with education performance of students, while economic capital performance has very low significant relationship.[3]

Research on the effect of cultural and economic, social and cultural capital on success in university entrance examination was done by Noghani and colleagues. The findings indicated that the cultural capital and its aspects and the type of school has a significant relationship with education performance of students while economic capital have very little relationship with education performance of students.[6]

In another study, Moein Poor and Colleagues showed that although there is no meaningful relationship between the physical and academic achievement, but these variables affect Persons' Attitude teacher and academic achievement of students. It also became clear that our current school educational facilities for children and adolescents with psychotic features are not compatible. Therefore, it will be considered in the context of reform.

Mohseni Kouchesfahani in her research concerned with educational failure, were asked students to name the most important factors that led to their educational failure, the results indicated that the family is the most important factor in student achievement.[7]

Livieris and colleagues in their study, indicated to using implementation of a software tool for predicting the students' performance in the course of “Mathematics” which is based on a neural network classifier. They applied 4 algorithms

(BFGS, LM, Rprop and MSP) and for recognition of poor students, they used information and specifications relating to the progress of students in two different ways to classify students based on test scores and final.[5]

Chun-Teck Lye and colleagues entitled "Predicting Pre-university Students' Mathematics Achievement," Used a three methods, the Back-propagation Neural Network (BPNN), Classification and Regression Tree (CART), and Generalized Regression Neural Network (GRNN) in predicting the students' mathematics achievement. The findings reveal that BPNN outperforms to other models in predicting the mid-semester evaluation result and respectively to final examination result and that was a alert tool in predicting the preuniversity students' mathematics achievement. This model was anticipated to show improvement in its predictive accuracy with the inclusion of closely correlated attributes and a larger sample size. Consequently, enhanced model can be implemented and it will be beneficial to both lecturers and students definitely.[3]

## 3. RESEARCH QUESTIONS

This study seeks to answer the questions that arises is the following:

1) What is the relationship between parental education and success in final exams at high school in Arak city?
2) What is the relationship between parental occupation and student success in final exams at high school in Arak city?
3) What is the relationship between family economic status and student success in final exams at high school in Arak city?
4) What is the appropriate model of success factors in final exams at high school Arak city based on artificial neural network?

## 4. RESEARCH METHOD

In terms of the goal this research is an applied research and regarding methodology is a descriptive- survey. This research is going to predict the success of students in maths course in final exams in Arak city with neural networks. Required data were collected from the registers annual grades list and vice-school disciplinary list and, school counselors and Reporting System Office of Education, Markazi Province. Information of the factors affecting on student achievement in final exam included the information of students, the parents' education, parents' occupation and family economic status.

Information saved in Excel file format ready to enter the Clementine Software. Clementine incorporates several features to avoid some of the common pitfalls of neural networks, including sensitivity analysis (as indicated in the variable importance chart) to aid in interpretation of the network, pruning and validation to prevent overtraining, and dynamic networks to automatically find an appropriate network architecture.

### 4.1. Research Community

The research community of the study is the third grade high school students of Arak city. The study sample is 192 students in the 1389-1392 timeframe.

## 5. DATA ANALYSIS METHOD

In this study, to simulate the nonlinear model in designing is used from neural modeling by CLEMENTINE 12.0 software in the field of data mining.

### 5.1. Neural Networks

The first practical application of neural networks in the late 50s twentieth centuries, when Frank Ruznblt perceptron introduced in 1958. Neural networks are simple models of the way the nervous system operates. The basic units are neurons, which are typically organized into layers, as shown in the following figure. A neural network, sometimes called a multilayer perceptron, is basically a simplified model of the way the human brain processes information. It works by simulating a large number of interconnected simple processing units that resemble abstract versions of neurons. The processing units are arranged in layers. There are typically three parts in a neural network:

An input layer, with units representing the input fields; one or more hidden layers; and an output layer, with a unit or units representing the output field(s). The units are connected with varying connection strengths (or weights). Input data are presented to the first layer, and values are propagated from each neuron to every neuron in the next layer. Eventually, a result is delivered from the output layer. The network learns by examining individual records, generating a prediction for each record, and making adjustments to the weights whenever it makes an incorrect prediction. This process is repeated many times, and the network continues to improve its predictions until one or more of the stopping criteria have been met. Initially, all weights are random, and the answers that come out of the net are probably nonsensical. The network learns through training. Examples for which the output is known are repeatedly presented to the network, and the answers it gives are compared to the known outcomes. Information from this comparison is passed back through the network, gradually changing the weights. As training progresses, the network becomes increasingly accurate in replicating the known outcomes.

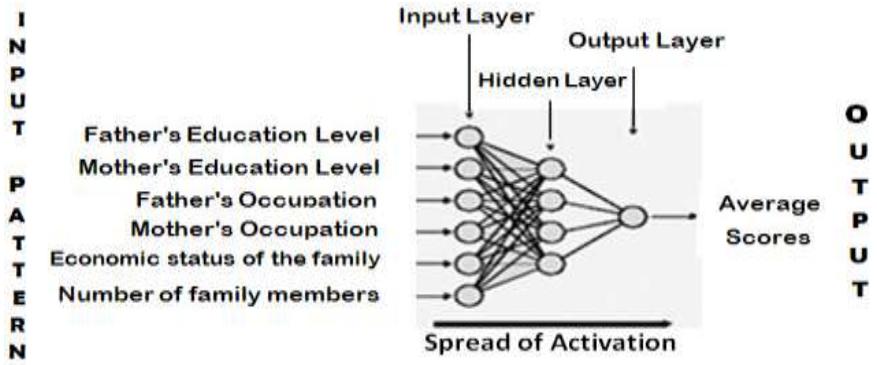


**Figure 2. Structure of a neural network**

Neural networks are very complex and cannot easily tell which variable does not affect the model and adding that reduces accuracy of network that is trained. Since we cannot generally predict an ideal set of variables affecting the predicted model in practical applications of artificial networks. This is restricted the use of networks. So before creating and training the network, depending on the issue, a number of variables is identified. In some respects, the number of input features influences on neural networks. First the more input characteristics of the network will grow the network, and this increases the risk of over-fitting of the training set size. Another is to increase the time for converging networks. If there are too many parameters, the probability of optimal weights are reduced.

Neural networks are powerful general function estimators. They usually perform prediction tasks at least as well as the other techniques and sometimes perform significantly better. They also require minimal statistical or mathematical knowledge to train or apply. Due to predict educational success and knowledge of the factors affecting the final exam 70% for training data and 30% for evaluation and testing will be used. We will consider the structure of the neural network, Multi-layer Perceptron. The difference between the number of layers of the multilayer perceptron networks as well as the number of neurons in each layer is determined. In using this type of neural network structure should be noted that increasing the number of neurons in the middle layer, or even increasing the number of layers cannot ensure better response. For this purpose, 6 model was created using a 6 method (Quick, Dynamic, Multiple, Prune, RBFN, Exhaustive prune) of the neural network by Clementine 12.0 and each of these topologies, was trained and tested with available data., The number of input layer is equal to the number of predictive variables or independent. Therefore, in this study, the number of neurons in the input layer is 6 and the number of neurons in the output layer is also one (Table 1.).

**Table 1. Data Input and Output**

| Input | Output |
|---|---|
| Father's Education Level<br>Mother's Education Level<br>Fathers Occupation<br>Mother Occupation<br>Economic status of the family<br>Number of family members | Average Scores<br>(Religion and the Quran<br>Persian Language<br>Persian Literature<br>Arabic<br>Foreign Language<br>physics & Lab<br>Chemistry Lab<br>Algebra and probability Geometry<br>Calculus) |

In order to answer the research questions, different models of artificial neural network is trained using data to fit the model with the highest estimated accuracy and lowest error to be obtained.The final exam average scores were considered as success. So here is to assess the final exam average scores will target variable.

The results is shown that the Multiple Neural Network model with 6 neurons in the input layer, and 3 neurons in the hidden layer and 1 output neuron layers, has the highest index prediction accuracy in average scores than others. The highest estimated accuracy's model of average scores in final exam is 95.138 (Table 2).

**Table 2. the index prediction accuracy average scores in final exam with six methods in math course.**

| ANN Model | | | | | | |
|---|---|---|---|---|---|---|
| **Exhaustive prune** | **RBFN** | **Prune** | **Multiple** | **Dynamic** | **Quick** | **Method** |
| 93.22 | 90.506 | 93.842 | 95.138 | 95.44 | 94.915 | **Average scores** |
| 2-1-1-1 | 6-20-1 | 6-9-1 | 6-3-1 | 6-2-2-1 | 6-3-1 | |

The relative importance of each variable in the model is showm (diagram1.). In this diagram, father's occupation with 0.223, father's education level with 0,193, mother's education level, 0.189, mother's occupation with 0.167, family size with 0.115 and economic situation with 0.110 are of paramount importance. The variables specified in this diagram is the effective variable on student achievement in final exams.

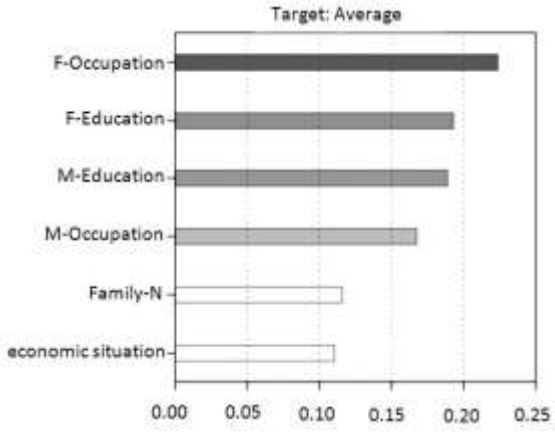


**diagram 1. Variable importance chart**

## 5.2. Research Findings Regarding the 1st Question

In answer to the first question of what is the relationship between parents' education level and success in final exams at high school? It must be said based on the findings in (Table2), the accuracy of the estimation model of final exam average scores that was 95.138 and according to (diagram1), the significance of father's education level with 0.193, mother's education level with 0.189 are the paramount importance. According to experts, theoretical studies have suggested that parental education is a contributing factor in the development and academic success and previous research indicates that there is a positive correlation between the two variables has been proposed, so we can conclude that the father's education can be effective in creating a model to predict the success of students in final exams using average scores.

## 5.3. Research Findings Regarding the 2st Question

The answer to the second research question, what is the relationship between parent's occupation and success in final exams at high school? It must be said based on the findings in (Table2), the accuracy of the estimation model of the final exam average scores that was 95.138 and according to (diagram1), the significance of father's occupation with 0.223, mother's occupation with 0.167 are the paramount importance. According to experts, theoretical studies have suggested that father's occupation is a contributing factor in the development and education success and previous research indicates that there is a positive correlation between the two variables has been proposed, so we can conclude that parents' occupation, specially father's occupation can be effective in creating a model to predict the success of students in the final exams using average scores.

## 5.4. Research Findings Regarding the 3st Question

What is the relationship between family economic status and success in final exams at high school? It should be noted, based on the findings in (Table2) the accuracy of the estimation model in final exam average scores was 95.138. As well to (diagram 1), it can be concluded that the economic situation of the family can be effective in creating a model to predict the success of students in final exams average scores, as Arjmand Syahpush and colleagues in their study about social and cultural factors affecting the students' education achievement in Susa Daniel, confirmed assumptions such as impact of the social class of parents on students' achievement, they noted that if the increase in family income or enhance socio-economic status or social class, level of education achievement and average scores of students are added and vice versa.

## 5.5. Research Findings Regarding the 4st Question

In response to what is the appropriate model of success factors in final exams at high school Arak city based on artificial neural network? It should be said as well as different artificial neural network models trained and modeled using the available data and determined the accuracy's predictions of the output with the highest estimated accuracy and low error, to be achieved appropriate model. Finally, among several algorithms of training neural network MLP, the Quick method with 6 neurons in the input layer, and 3 neurons in the hidden layer and 1 neuron in the output layer, was the highest estimated accuracy of prediction in output of the average scores final exams in Math course than other methods, so the model was selected.

## 6. RESULTS AND DISCUTION

In this study, 6 input variables affecting (parents' education level, parent's occupation, family size, and family economic status) and the average final exam scores were used as output. To test the validity of the study, the data were divided into two sets of training data and test data for the neural network techniques and the final outputs are checked and confirmed the validity of research. Results 70 to 30 % for training and testing data were partitioned. The accuracy of the model (95.249) was extracted. The accuracy of the model, the percentage of times that the samples tested successfully classified. The results show the accuracy of models, numerical values obtained from calculations performed by Clementine and final analysis.

Finally the ANN model using 6 neurons in the input layer, and 3 neurons in the hidden layer and 1 neuron in the output layer, was the highest prediction accuracy's output of the average final exams in maths than other methods, and as the selected model was determined.

# REFERENCES


1) Arjmand, Syahpush. Isaac., Moghaddas, Jafari. Mohammad. Hassan. Farboghlani, Mohammad. (1390). Evaluation of Social and Cultural Factors Affecting the Education Achievement of High School Students in Susa Daniel. Sociology of Education Youth, (Periodical style), no. 2, pp. 7-20.
2) Biabangard, Ishmael. (1387). Fall prevention techniques. (Book style). Tehran, parents and educators Press.
3) Chun-Teck, Lye., et al. (2010). Predicting Pre-university Students' Mathematics Achievement( Published Conference Proceedings style). International Conf. on Mathematics Education Research, Multimedia University, Malaysia, pp 299-306.
4) Zare, Bijan., Shafie, farzaneh. (1390). Cultural and Economic Capitals of Family and the Type of School in Students Achivement in the District 14 of Tehran. (Periodical style), no. 1, pp. 37-70.
5) Ioannis, E. Livieris., Konstantina, Drakopoulou. & Panagiotis, Pintelas. (2012). Predicting Students' Performance Using Artificial Neural Networks, University of Patras, Greece, pp 1-8.
6) Noghani, Mohsen., Ahanchian, Mohammad. Reza., and Rafiei, Mohammad. Tagh. (1390). The Effect of Cultural and Economic, Social and Cultural Capital on Success in University Entrance Examination. Sociology of Education, (Periodical style), no. 1, pp. 191-218.
7) Mohseni. Kouchesfahani, Nahid..(1367) . Reviews of How Public Relations Parents on Education Achievement of Students Daughter Saadat Abad. Thesis. Tehran.