

Investigating the risk of international construction projects using artificial-fuzzy neural networks technique

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Abstract. The purpose of implementing the risk management process is to identify and root the causes of each risk, analyze it, plan response methods and assign risks to appropriate factors, in order to effectively control the preferred risks. This article aims to analyze risk management in construction projects using fuzzy artificial neural networks in the form of a descriptive-survey study and in the category of applied research. Data analysis was done using MATLAB software using MATLAB software to ensure the soundness of the method and to implement project risk management in international construction projects, and the results indicate success in terms of risk.

key words: risk, artificial-fuzzy, construction projects, neural network

Introduction:

Project risk management is a systematic process of identifying, analyzing and responding to project risks in order to maximize the results of positive events and minimize the consequences of unfortunate and negative events that can affect the main goals of the project. In this process, the phase of responding to risks is a phase. It is very important because the effectiveness of responses directly determines the increase or decrease of project risk. Risk response planning is the process of determining various options and measures to reduce or eliminate threats and increase or exploit opportunities related to project goals. . Birganal (2004) sought to design a neural network-based model for quantifying the risks in international construction projects by using a hierarchical analysis approach to compare options, which ultimately resulted in a DSS decision support system for ranking project risks. designed the international Ardbati (2005) in his research entitled "Risk management due to contractor's default for the employer" has predicted the probability of contractor's default by using artificial neural network and genetic algorithm and according to historical data. Ok" et al. (2009) in a study have paid attention to how to respond to some risks and risk response and control strategies in the supply chain. Tan and Honik (2011) in their study, supply chain risk to The product of the probability of an event has been calculated and two indicators "impact rate" and "risk occurrence probability" have been used in the form of risk-air probability matrix. Gianakis and Lewis (2011) in their research discussed modeling and simulation of risk in the supply chain. In this research, the identification of risks is very limited, and on the other hand, the magnitude of risks is not expressed based on different indicators, and therefore the degree of criticality of risks is not determined relative to each other. Tailan and others (2015) in their research called the selection of construction projects and risk assessment by fuzzy AHP and fuzzy Topsis method, their goal was to use a new analytical tool to evaluate construction projects and their overall risks under imprecise conditions. They used the fuzzy analytical hierarchical process. They used appropriate weights for five main criteria namely time, cost, quality and safety and sustainability

environment, and then used the fuzzy technique to rank priorities based on similarity in the ideal solution to rank 40 construction projects based on the opinions of seven decision makers in different parts of Saudi Arabia. Zhao et al., (2016) in the research on risk assessment and safety management of the highway maintenance project stated that in order to evaluate the highway maintenance company in a traditional and quantitative way, a safety evaluation index was created according to the effect of production and maintenance safety factors in this study. This can help maintenance organizations stay informed about highway company safety production dynamics and take targeted safety measures. Khamene et al. (2016) presented a framework for evaluating the performance of the project risk management system and mentioned that risk management is an important function in project-based organizations and its ultimate goal is to create value for the company. Fontin (2016) evaluated project risk management and stated that a project is a temporary action in which the competing demands of the project, i.e., schedule, cost, and scope of work, must be adjusted in such a way that it is best in line with the goals.

research method:

Since the final goal of this research can be considered in determining the effective factors and predicting the risk of construction, which should have the necessary flexibility, and in this case, it seems the necessity of an integrated approach to the investigated variables. As can be seen from the review of the research literature, many variables are involved depending on the different stages of the construction process. But what is intended in the present research is the variables related to the comprehensive evaluation of the plan in order to predict the amount of investment risk in the construction of international projects as well as its acceptance or rejection before investment. These variables have been divided and used in 4 groups, namely geotechnical risks, economic risks, technical risks, and political and environmental risks. To determine the effective factors in this field, by studying the articles on price and profitability determinants, technical specifications and geotechnical factors in road construction and input variables should be extracted. Therefore, it is necessary to provide the experts in this field with the considered important factors in the form of a questionnaire so that the most effective factors can be determined. The data is collected in the form of a questionnaire and randomly divided into the three mentioned categories. To enter data into the MATLAB software, the data must be converted into dat format, which is easily possible using software such as Excel and Notepad. The data input to the system can be related to several variables. But the output includes a variable, which is the success rate in estimating the risk of risky investment.

Data and results:

The training process is such that first the system is trained with the help of training data with the type of data and during training, the outputs automatically contribute to the validation data to maintain the internal validity of the model through several indicators. Figure 1 shows the matching of training data with the output of the system designed by the programming code, and two figures 1 and 2 are related to the error values and the average error, which is equal to 0.14816.

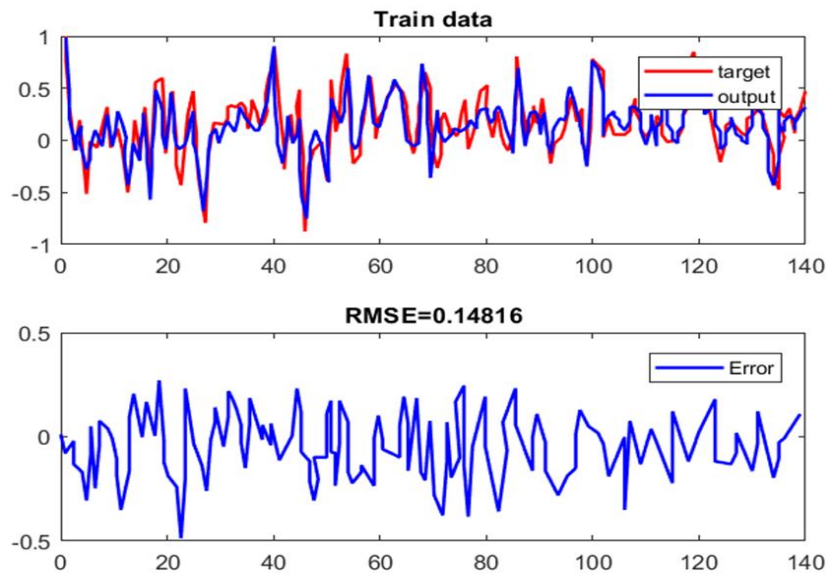


Figure 1-Output of fuzzy inference system based on training data

In Figure 2, we see the same outputs based on validation data. It can be seen that the average error value in the test data is equal to 0.1987.

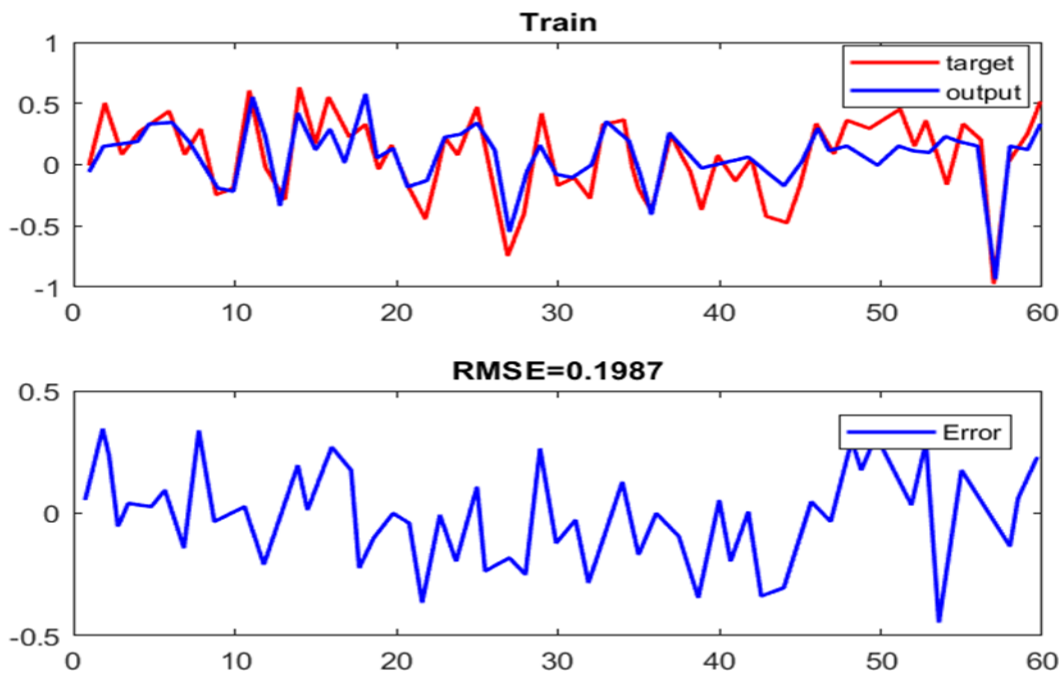


Figure 2-Output of fuzzy inference system based on validation data

The research method is that the software puts the educational data in this chart and then gives the same data to the system. The fuzzy inference system estimates the output based on these data and displays it on the same graph to be comparable with the training data. In the bottom diagram of the figure above, the same mechanism has been implemented for the validation data, and at each training stage, at the same time as the comparison of the training data with the data estimated by the system, this process is also performed separately with the validation data. It is possible that the result is presented in the bottom diagram of the above figure. In fact, the system performs the learning process one time according to the training data, the output of which is mentioned in the first diagram, and then based on the validation data, it checks the accuracy and reliability of the system, the output of which is shown in the diagram The second is displayed. In the second chart, the validation data is displayed along with the system estimate for each.

MAE, MSE, and RMSE indices are used to detect the accuracy of the system and the closeness of the estimates to the real values. These values are used in comparison with each other and in the case of the systems designed in this research, the lower the number provided for these indicators in a design and training method, the more optimal the system designed by that method will be. and estimates will be closer to the actual holidays. The indicators of the detection coefficient and modified detection coefficient are also used for the accuracy of the system outputs in estimating the real values. The modified detection coefficient index is a better criterion for measuring the estimation power of the system than the detection coefficient index. To determine the three validation criteria (R^2 , Adjusted R^2 and RMSE), you can use the program code or the curve fitting toolbox. The calculation method is that the actual output obtained from the organization is compared with the output of the system. The software is able to present all validation criteria separately for both categories of data. The software code is also used to calculate the MSE and MAE criteria. Among the presented indicators, the RMSE index is considered the most important index and is calculated automatically by the software along with training. Therefore, this index is the most important criterion to identify the optimal system. Along with the RMSE index and the Adjusted R^2 index, it is also a suitable measure to detect the system power in accurate estimation of the output values, and usually these two indicators together show the system power in accurate estimation and far from error. We used linear regression to check the regression criteria in this research. As you can see in the figures, the higher the matching value of the points and the line, the better the regression is and the lower the estimation error.

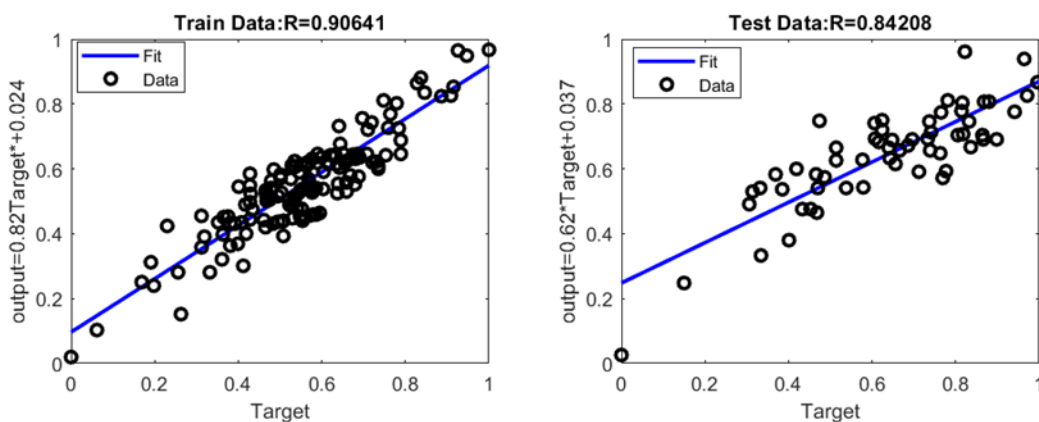


Figure 3- Fitting the regression diagram on fitting the data of a) training b) test

Table 1 shows the graph fitting on the outputs and validation values for the training data. The same values are calculated for validation data;

Table 1- The output of the results

R^2	MSE	RMSE	
0.90648	4.44×10^{-8}	0.13813	VALIDATION DATA
0.84204	0.012241	0.1931	TEST DATA

Conclusion:

The present proposed research aims to implement project risk management in construction projects using fuzzy artificial neural networks (case study: the international road and highway network was studied and the research objectives were investigated. The use of fuzzy neural network represents The recommended average is the user's risk rate. Generally, neural-fuzzy network provides very interesting results in the field of risk management. Artificial neural networks cannot replace traditional deterministic methods in any way, but they can be used as a decision support tool. taking part in the process, especially since other methods fail, it should be said that by using the fuzzy adaptive neural method, the obtained results show the success of the risk level, which shows the superiority of the fuzzy adaptive neural method in risk estimation. Therefore, this type of system, by using the power of training neural networks and the advantage of fuzzy systems (ANFIS), has been able to use the advantages of these two models to analyze complex processes very powerfully. Today, fuzzy systems based on adaptive neural networks are one From efficient methods in the field of It is evening and modeling.

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