



# The Predictability Power of Neural Network and Genetic Algorithm from Companies' Financial Crisis

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## ARTICLE INFO

### Article history:

Received 05 March 2019

Accepted 30 April 2019

### Keywords:

Artificial neural network

Genetic algorithm

Financial crisis

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## ABSTRACT

Organizations expose to financial risk that can lead to bankruptcy and loss of business is increased nowadays. This may leads to discontinuity in operations, increased legal fees, administrative costs and other indirect costs. Accordingly, the purpose of this study is to predict the financial crisis of Tehran Stock Exchange using neural network and genetic algorithm. This research is descriptive and practical and in order to collect data Stock Exchange database software has been used. For data analysis, artificial neural network in base form and artificial neural network mix with genetic algorithm are used. In addition, for methods comparison, determination coefficient, Mean squared error and Root-mean square error have been used. The result of study shows that the best artificial neural network is a network with a hidden layer and eight neurons in the layer. This network could predict 97.7 percent of healthy and bankrupt companies correctly for test data. Furthermore, the best-mixed neural network with genetic algorithm is a network with 400 replications and population size 50, one layer and eight neurons, which could correctly predict 100% of healthy and bankrupt companies. Finally, comparison of results of two methods shows that the best method for predicting financial crisis is mixed neural network with genetic algorithm.

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## 1 Introduction

The aim of preparing and giving financial accounting information is providing a base for economical decision making. In decision making, information has an effective role [1]. Prediction without decision making is possible, but we cannot make a small decision without prediction [2]. If predictions are more near to reality, they will become base of correct decisions. One way for helping users of financial statement, is giving useful patterns about financial situation of companies. Bankruptcy prediction patterns are one of the instruments of knowing about future of companies [3,4]. Companies' bankruptcy creates much loss for investors, creditors, managers, workers, suppliers and customers, if someone knows the reason of companies' collapse, with needed programming he saves firm from sure death [5,6]. So prediction of firm's financial crisis is a prerequisite for preventing from bankruptcy or prevention is better than cure. Technology development and huge change of environment leads to economic growth and because of daily competition of institutes, gaining profit becomes limited and desire to bankruptcy is very much, so the power of prediction financial crisis and preventing from its happening is very important and it is prevented from inappropriate allocation of scarce economic resources [7] giving exact engaged group for bankruptcy problem is very difficult, but it can be claimed that management, inves-

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tors, creditors and legal entities has the highest effect for bankruptcy phenomenon. So, financial decision making is more strategic than before. One way that with it we can help investing chances and better allocation of references are prediction of financial crisis or bankruptcy. Also high cost of bankruptcy, leads to a fundamental importance for its prediction power and prevention from its happening. It is an aspect of bankruptcy that makes it dangerous. Investors and creditors and managers and accountants with governmental institutes likes future of firm [8] financial crisis prediction pattern is one of the prediction instrument for firm future that it estimate the probability of financial crisis happening with mix group of financial ratios. The power of financial and business crisis prediction from the view point of private investor and social is very important because it is an obvious point of false giving of references. First warning of bankruptcy probability with financial crisis prediction enables management and investors to do prevention works and they recognize suitable chances from undesirable chances. Based on that for financial crisis prediction there are many methods that it is start from one variable statistical analysis and it is composed of multiple diagnosis analysis. Logit and Probit analysis, Zimsky model and Shirahata and Ohlson and other statistical models and Traditional methods of financial crisis prediction has some limited hypotheses such as being linear, being normal and independence of prediction variables or inputs. So in relation with financial data, violation from these hypotheses is imagined, these traditional methods in relation with revenue and credit are very limited. But methods of artificial intelligence and neural network and genetic algorithm have less inconsistency and violations in relation with these assumptions [9]. Based on that we come to this question that if occurrence of financial crisis in companies by using artificial intelligence and specially neural network and genetic algorithm is predictable? Can we use these methods for predicting financial crisis? And at last which of these models has the best answer? Based on up mentioned explanations, this research speaks about the possibility of firm's financial crisis prediction by using genetic algorithm network and artificial neural network.

## 2 Literature Review

Organization financial crisis is a popular problem in different industries [10] and it is an important subject in financial management. Survey about reasons for financial crisis and bankruptcy from financial point of view and recognition of financial basic and the most important thing evaluation of bankruptcy and prediction of financial crisis based on popular methods is very important. Financial crisis that makes companies weak when they want give their debts is before bankruptcy level does by on time prediction of that we can have enough time to answer investors. Bankruptcy happens when a firm couldn't pay debts, so they can't be active [11]. By regarding the importance of financial crisis prediction, there are many researches about that. Because prediction of future is very important in decision making so prediction is very important for organizations and each organization for correct decision making could predict. It should be said that financial ration as independent variable is an instrument for prediction of financial crisis in companies in inside and outside of country and framework of research is taken from them [12]. Table 1 is some of these researches. Nazemi et al. [13] in their research determined prediction pattern for car industry and piece making, chemical products and food products except sugar. This pattern uses decision tree for prediction, for determining companies bankruptcy it uses article 141 of business rule. Time of this research is from year 2002 to 2013. Results show that designed pattern for car industry, piece making, chemical products and food products except sugar is 95.95, 96.83, 97.83 percent that they show high accuracy for designed pattern in these 3 industries.

**Table 1:** Researches about Designing Prediction Patterns of Financial Crisis and Bankruptcy

Research/re-searchers	Studied variables	Results
William Biur	Ratio of cash flow to total property, net profit to total property, total debt to total property, working capital to total property, current ratio, ratio of doesn't having credit distance	The best ratio between studied ratios for prediction of bankruptcy of cash to total property.
William Biur	Ratio of cash flow to total property, net profit to total property, total debt to total property, working capital to total property, current ratio, ratio of doesn't having credit distance	The best ratio between studied ratios for prediction of bankruptcy of cash to total property.
Altman	Ratio of investing flow to total property, accumulated profit to total property, income before profit and tax to total property, market value, salary of stock holders to book value of debts, sale to whole property	If calculated ratio based on studied variables is less than 1.81, firm is bankrupt, if it is between 1.81 and 2.61 firm is near bankruptcy and if it is more than 2.61 probability of bankruptcy is very low.
Springate	Ratio of flow property to all property, profit before interest and tax to all properties, profit before tax to current liabilities, sale to whole properties	If calculated ratio based on studied variable is less than 0.862 that firm is bankrupt and if it is more than 0.862 it that firm is healthy.
Zavgin	Medium ratio of properties to sale, medium of accounts to properties (short term investment with cash, to total property, future property to current liabilities, function profit to current liability, total property, long term debt to current liability, total property, sale to net working capital with constant properties	Model output that is bankruptcy probability is a number between zero and 1, whatever this number becomes bigger and near 0, firm's bankruptcy is more and if it is 0 probability is less
Ohlson	The total assets' logarithmic ratios to the GNP index, total liabilities to total assets, working capital in total assets, current liabilities to current assets, if the debts are greater than or equal to the assets, 1 and otherwise zero, if the profit for the last two years is negative, 1 and the other, the number zero, net profit to total assets, funds from operations to total debts, the amount of net change over the past year.	If ratio based on studied variable is less than 0, the firm is bankrupt, other ways healthy.
Tofler	Return on investment, working capital, (financial risk, debt-to-equity ratio), liquidity.	The share of each of these variables was evaluated in the prediction of bankruptcy of 0.53, 0.13, 0.18 and 0.16, respectively.
Zimsky	Net profit ratio to total property, total debt to total property, current property to debt	If calculated ratio less than 0 firm is bankrupt, no is healthy.
Foulmer	Profit ratio to total property, profit before tax, liquidity to total debt, debt to total property, current liability to total property, whole logarithm, current liquidity to total debt, profit logarithm before interest and tax	If ratio is less than 0 firm is bankrupt, no is healthy.
CA-SCORE	Stock holders fund ratio to total property (profit before tax and financial costs) to total property	Based on model when ratio is less than -0.3 companies are healthy.
Griss	Ratio of net profit to total property liquidity total debt to total property, difference of net profit and liquidity from operations	Companies that according to the calculated ratios in the variable and based on the Logit model, their probability of bankruptcy is less than 0.5. Non-corrupt companies and if they are more than 0.5, they become bankrupt.
Shirata	Accumulated profit to total property, decrease cost to loan, papers and accounts 1, to total sale, gross capital of this year to last year	Companies that value is more than 0.38, bankruptcy is little and vice versa.

Ghazanfari et al. [14] by implementation of a coherent and intelligent system based on neural networks, vector support machine and training and using optimization algorithms, cultural algorithm and harmony they want to eliminate flaws of before models. Amount of samples in food and textile industry were 5825 and 4089. That by applying legal criteria of financial bankruptcy it was 999 and 848 samples in 2 years. Results shows excellence function of mixing backup vector machine with harmonic search of optimization and colonial competition without data delete. Saeidi [15] surveyed about financial crisis of companies by using Bayes networks and for this reason they give two models with Bizz networks and logistic regression. The first model of simple Bayes network that was based on correlation is a condition that can predict healthy and non-healthy companies with 90 percent accuracy. The second model with 93 percent accuracy comes to this result that is based on condition at last logistic regression model can have 90 percent accuracy. Saruei [16] in his research surveyed about revenue of Springate, Zimsky and Ohlson model in two industries of pharmacy and textile and results shows that in 3 years, sporting model has a better result. Asgari [17] in his research surveyed about revenue of Springate, Zavgin and Foolmer patterns in prediction of bankruptcy of accepted companies in Tehran stock exchange and come to this conclusion that n 90 percent of confidence level, Springate pattern is better than others. Ghadiri et al. [18] with a sample of 40 companies in exchange and 13 financial ratios to model estimate and prediction of bankruptcy for 1 to 3 year before financial crisis based on multi variable regression and logistic and his aim in this research, first was comparison of two prediction model of bankruptcy of Altman and Ohlson and secondly was giving useful statistic model for prediction of firm's bankruptcy in 1, 2 or 3 years before financial crisis. Results shows models given by Ohlson and model with logistic regression, have higher accuracy in bankruptcy prediction in companies. Raei [19] in his research surveys about revenue of using support vector machine (SVM) in prediction of financial crisis of companies. A result of SVM model is in comparison with statistical model of logistic regression has been surveyed. And results show that SVM model has a better accuracy than logistic regression and has a more power. In another research that has been done by Shariatpanahi and Araghi [20], they predict bankruptcy of inside companies by using 21 financial ratio with multi analysis method. These companies were 460 companies that were accepted in stock exchange. Farajzadeh, [21] in his research wants to make a model for bankruptcy prediction of companies accepted in Tehran stock exchange by using genetic algorithm technique. This sample was 72 bankrupt companies and 72 healthy companies in 8 years from 1995 to 1998. That these companies divided in 2 trial collections accidentally (51 bankrupt firm and 53 healthy firm) for creating models and trial collection (21 bankrupt firm and 19 healthy firm) for models validity test. For making models at first we need to determine variables that predict bankruptcy. For this reason they research very much and they prepare a complete index of financial ration. Then by searching and survey in this collection for ratios and using SDA technique, 5 financial ratios for making bankruptcy pre model chose. By using two techniques of genetic programming and multi recognition analysis and using 5 financial ratios, 2 models extracted and for result comparison was made. Genetic programming model classifies 94 percent of training firm and 90 percent of Trial Firm before bankruptcy in bankrupt and healthy group in correct way. Model accuracy in recognition of bankrupt firm in training and trial sample was 96 and 90 percent. Also analysis model could classify 77 percent of training sample and 73 percent of trial sample correctly one year before bankruptcy. McNamara test shows that genetic model is better than recognition model. Ahadidolatsara [22] in M.A. thesis surveyed about revenue of patterns for financial crisis prediction and for this reason he surveyed about the power of prediction of activity in companies by using Zimsky, Springate and Altman patterns and results shows that this patterns can predict activity stop in companies who are accepted in Tehran stock exchange, but there is a meaningful difference between their results. Poormehr [23] in his research

with title of survey about feasibility of using Springate and Zimsky patterns in prediction of accepted companies in Tehran stock exchange wants to design a pattern for prediction of bankruptcy of accepted companies in exchange. The base of patterns in this research is Springate and Zimsky patterns. Sample was 40 bankrupt companies from different industries that were bankrupt for 2 consecutive 66years from exchange statistics and also 54 healthy companies in pharmacy and chemical industries. In this study, at first one survey about using Springate and Zimsky models in bankruptcy prediction and then by using logistic regression technique and pattern analysis, adjustment patterns given. At last, patterns validity test done by data of year 2007. Results show that accuracy of Springate pattern is 94.5 and Zimsky is 95.9. Hosaka [24] applied convolutional neural networks to financial analyses. Hence, in the research, convolutional neural network applied to the prediction of corporate bankruptcy. He used the financial statements of 102 companies delisted from the Japanese stock market due to de facto bankruptcy also the financial statements of 2062 at present listed companies over four financial periods. A set of financial ratios are resulting from the financial statements and are as a grayscale image. The image is utilized for train and test of convolutional neural network. A total of 7520 images of bankrupt and ongoing enterprises classes are used based on GoogLeNet. Bankruptcy predictions by the trained network are revealed to have a better performance compared to methods by means of support vector machines, decision trees, multi-layer perception, linear discriminate analysis, AdaBoost, or Altman's  $Z''$ -score. Feng et al. [25] introduced deep learning models for bankruptcy forecasting using textual disclosures. Deep learning employs layers of neural networks to mine features from textual data for prediction. They construct a broad bankruptcy database of 11,827 U.S. companies and illustrate that deep learning models give up superior prediction in forecasting bankruptcy. They also examine the effectiveness of two deep learning architectures. Their empirical results explain that simpler models are more effective than convolutional neural networks. Chen [26] in his research explained three different techniques for approaching the categorization problem in bankruptcy prediction: single, hybrid, and classifier ensembles. His approach has enhanced the accuracy of bankruptcy prediction models. Greater accuracy promotes external processes of banks by minimizing credit risk and by facilitating regulatory compliance. Zieba et al. [27] surveys about power of four prediction models that used very much in Taiwan companies with multiple analyses, Logit and Probit and artificial neural network was their methods. In this survey 20 models used for financial crisis prediction. Results show that Logit and Probit and ANN have much accuracy. Cho et al. [28] mixed coherent strategy about how use artificial intelligence and statistical techniques. By mixing multi analysis, logistic regression, neural network and decision tree they introduce a coherent model by subject of training of neural networks for bankruptcy prediction. Their model power was from different of reference method for each subject. Results shows that proposed model can increase the accuracy of prediction in comparison with reference methods. Hyun-Jung et al. [29] in his research developed one layer perception based on Electra for classification of multi variable based on Electra method. In this research, they used these variables: liquidity to total properties profit to total property, profit before interest and tax to total property, value of stock holders market to total property and sale to total property. Results show that proposed model is better than popular classifying methods such as statistical method and machinery learning. Chandra et al. [30] in their research introduced data analysis as an instrument for evaluating of firm's bankruptcy in comparison with logistic regression. Their statistical society was 50 bankrupt companies and 910 healthy companies between years 1991 to 2004. They used 9 variables (2 outputs and 7 inputs) in their studies. Results show that logistic regression in inside sample works good, but data analysis is better in outside sample. Also data analysis is better in recognition of bankruptcy companies but logistic regression model is better in recognition of healthy companies than DEA. Woo et al. [31] proposed probabilistic neural network method in their

researches. They compare this method with multiple analyses. In this research they used 48 Chinese companies and 7 financial ratios that are: profit making ratio, total debt to total property, ratio of goods, and ratio of accounts, whole liquidity flow, profit index and liquidity flow index. Results show that probabilistic neural network and multiple and multiple analysis method give good classification but towards multiple analyses neural network method has more accuracy. Chuang [32] in his study mix multi-layer prospect and use it for financial crisis analysis. He used 129 samples that 65 are bankrupt. 5 variables that he used investment to total property, profit to total property, profit before interest and tax to total property, market value of stock holders to total debt and sale to total property. Results show that this model is better. Cochran et al. [33] by using Cox PH technique survey about bankruptcy in internet companies. Result show that parameters of net profit, liquidity to total debt and total property are keywords I bankruptcy prediction. Also they know that for one year before bankruptcy, liquidity is the most important index for prediction but for three years before bankruptcy revenue is more important. Also they use market value and accounting ration for their model. Tesakonon et al. [34] in their research shows useful use of mix intelligent system for problems of bankruptcy prediction. In this research use of neural logical network is given by a genetic program. Programming process is by freed subject and non-direct of neural logical network inside of genetic programming. Results show that their proposed methodology is better than other methods. Wallace [35] designed a pattern by using neural network in his researches. He uses main financial ratio in studies about bankruptcy as the best ratios. Wallace pattern has 94 percent total accuracy and studied 65 different financial ratios in studies.

### 3 Research Methods

Figure 1 shows variables in a conceptual model and description of survey and variable evaluation.

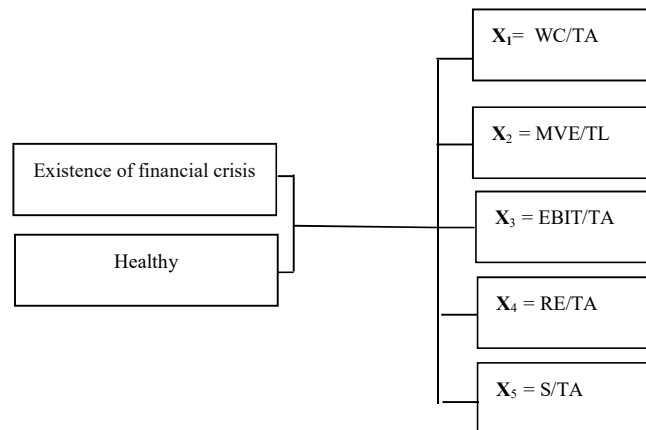


Fig. 1: Research Conceptual Model

Altman pattern

$$z = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5$$

Based on this if

$$Z < 1.33$$

Bankruptcy probability is high

If it is  $1.33 < Z < 2.9$  firm is in bankruptcy era and if it is  $Z > 2.9$  bankruptcy probability is very low. Statistical society of this research is all accepted companies in Tehran stock exchange. In this research for evaluating pattern we need information of two groups of companies with financial crisis and without it. For choosing a sample firm should have these situations:

1. Firm should be productive
2. Before 2006 were accepted in Tehran stock exchange
3. Their financial year ends in 12/29
4. About unhealthy companies: they should have article 141 on time (article 141: if because of loss, firm's fund deleted management should invite stock holders to speak about firm).
5. Their information should be available.
6. They shouldn't be holding investment firm.

By regarding them, sampling is systematic with 49 companies that has financial crisis and 58 healthy system that totally 107 firm. In this research for data analysis and answer to questions we used these methods:

1. They use artificial neural network for prediction of companies' financial crisis.
2. They use genetic algorithm for training artificial neural network.
3. For comparison of two systems they use MSE medium square error, RMSE medium square error root and  $R^2$  determine coefficient.

There are different artificial neural network that in this research we use MLP (multi-layer perception) network for matching it with research problem. Training algorithm in this research is Levenberg-Marquardt algorithm for updating of artificial neural network weight that as many usage. It does training very fast. In reality this algorithm is designed for increase of network speed. That is based on Hsien matrix. In this research we use perception network with an input layer, a hidden layer and an output layer. Number of neurons of hidden layer in each execution increased and at last we choose a network with fewer faults.

## 4 Research Results

Financial crisis prediction by using artificial neural network by regarding 5 input variable (here they use Altman model for financial crisis prediction and output variable, artificial neural network for financial crisis with 5 variables, 5 neuron in hidden layer as an assumption and a variable that show healthy or bankruptcy of companies and it is as a code 1 for bankruptcy and code 2 for healthy firm in output layer. Designed artificial neural network is shown in Fig. 2. For training in network, 70 percent of data was training data and 30 percent for network testing. Results show that for network training data correlation coefficient between aimed data and output data of model is 97.61. Determine coefficient for training data is 0.953. Neural network could predict 95.6 cases correctly with training data. For work test correlation coefficient was 91.71. Determine coefficient for test data was 0.841. Neural network can predict in 84.1 cases correctly.

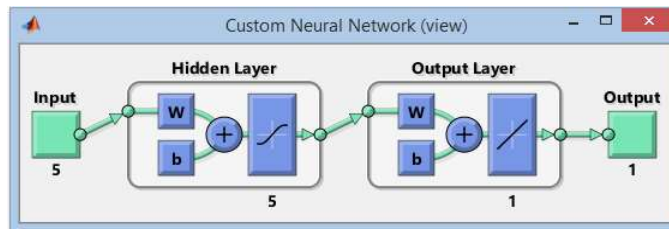


Fig. 2: Designed Neural Network for Prediction

For gaining a better model for financial crisis prediction, number of neurons increased and the network has been evaluated to achieve appropriate convergence with different neurons. Results of determining coefficient medium square error and it roots are in Table 2.

Table 2: Results of Artificial Neural Network with Different Neuron Number

RMSE	MSE	Determine coefficient	Data type	Neuron number
0.15610	0.02437	0.953	Training	5
0.21566	0.04651	0.841	Test	
0.20466	0.04188	0.944	Training	6
0.20621	0.04252	0.910	Test	
0.11747	0.01380	0.960	Training	7
0.17281	0.02986	0.888	Test	
0.12912	0.01667	0.952	Training	8
0.10673	0.01139	0.977	Test	
0.13174	0.01735	0.958	Training	9
0.17004	0.02891	0.917	Test	
0.16257	0.02643	0.905	Training	10
0.19390	0.03759	0.869	Test	

Based on Table 2 of results the best function of artificial neural network is in 8 neurons and neural network has little function. Neural network after that is not better and has many faults. Results shows that for network training data and artificial neural network test with 8 neuron in hidden layer, correlation coefficient between aim data and output data is 97.58. For data, correlation coefficient is 97.87. Determine coefficient for test data and network training are 0.951 and 0.977.

#### 4.1 Financial Crisis Prediction

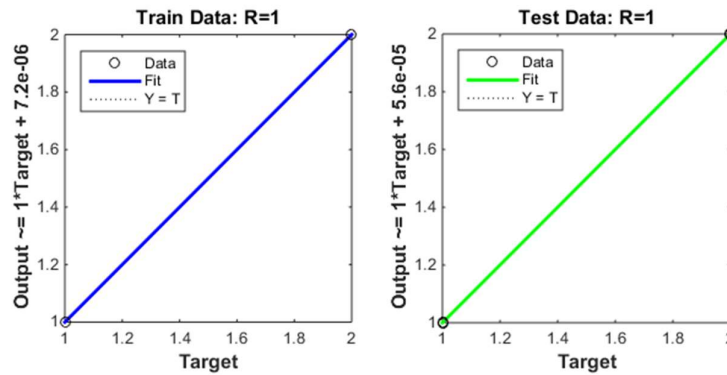
By regarding artificial neural network designing and choosing the best neural network with eight neurons in this part for surveying multi-layer neural network better, one use genetic algorithm in training. In mix of neural network with algorithm, network education is with ultra-innovative. First genetic algorithm with 100 repetitions and 50 person leap percent 2 percent, interest percent 0.2 percnt and choose pressure is 8 and then, number of repetition was 400. It should be explained that neural network was in last art, the best artificial neural network is with 8 neurons, and so in mix neural network with genetic algorithm there are 8 neurons in hidden layer.

Based on Table 3 you see that the best function of artificial neural networks in repeat 400 and population of 20-50. Genetic algorithm could reach to convergence and population hasn't effect. Increase of repeat and size of people isn't effective because 100 percent learning happens and network predicted all companies correctly. Results of convergence between aimed data with output data of system is in Fig. 3.



**Table 3:** Genetic-Neuron Network Results with Population Size and Different Repeat Number

RMSE	MSE	Determine coefficient	Data kind	Population	Repetition number
0.0663	0.0043	0.985	Training	20	100
0.0638	0.0040	0.986	Test		
0.0202	0.0004	0.999	Training	50	
0.0391	0.0015	0.996	Test		
0.0748	0.0056	0.984	Training	20	200
0.0487	0.0023	0.995	Test		
0.0551	0.0030	0.990	Training	50	
0.0376	0.0014	0.996	Test		
0.0000	0.0000	1.000	Training	20	300
0.0115	0.0001	0.999	Test		
0.0000	0.0000	1.000	Training	50	
0.0006	0.0000	0.999	Test		
0.0000	0.0000	1.000	Training	20	400
0.0000	0.0000	1.000	Test		
0.0000	0.0000	1.000	Training	50	
0.0000	0.0000	1.000	Test		



**Fig. 3:** Correlation Between Real Data and Output Data from Ultimate Neural Genetic Network

Results of Fig 3 shows for network training data, correlation coefficient between aimed data and output were 100 percent. Determine coefficient for training data was 1000. Neural network could predict in 100 percent firm’s financial crisis. For network test data correlation coefficient was 100 percent. Determine coefficient for test data is 1000. Mixing neural network with genetic algorithm could predict 100 percent by using test data. Error, medium square error and root for test data, training and neural network mixed with genetic algorithm are shown in Fig 3, 4 and 5.

Based on results, training artificial neural network with genetic algorithm becomes better in error index. Also done improvement is not very much. For more confidence, there was a comparison between training artificial neural network with genetic algorithm and lonberg algorithm. For this comparison it was data as accident and error of two methods calculated. Results shows that mix artificial neural network with genetic algorithm has less faults and function of this network in comparison with neural network without genetic algorithm is very high. Also Results of comparison shows that different results exists without training with genetic algorithm towards training neural network and genetic algorithm.

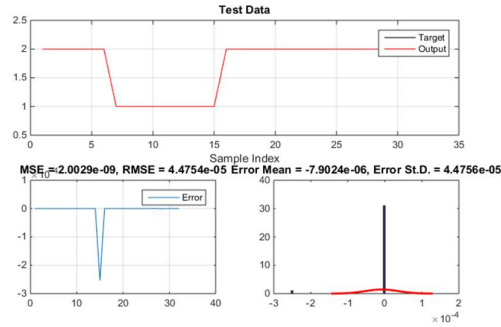


Fig. 3: Results for Test Data of Ultimate Genetic-Neural Network

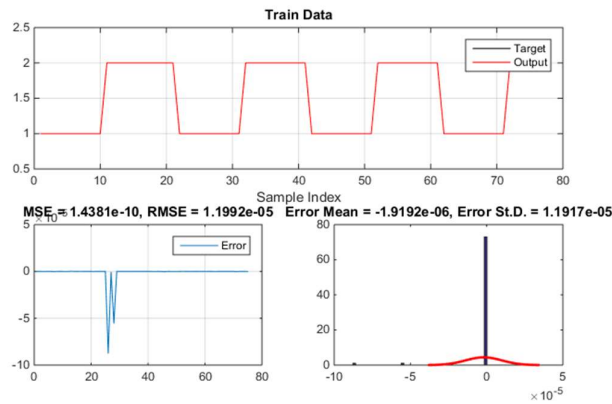


Fig. 4: Results for Training Data of Ultimate Genetic-Neural Network

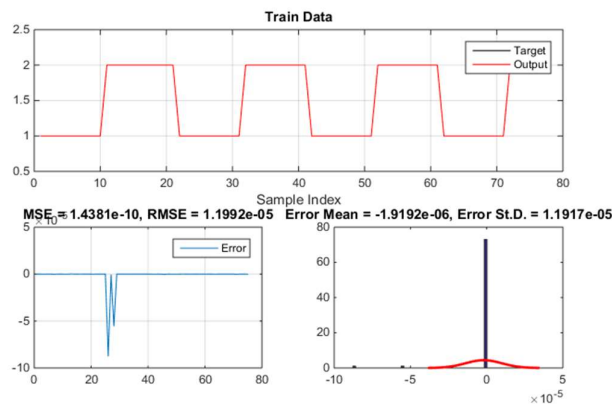


Fig. 5: Results for Total Data of Ultimate Genetic-Neural Network

## 4.2 Choosing the Best Method

At last the best artificial neural network in prediction of financial crisis can be choosing by using MSE, RMSE, R2 indexes. Based on it the best one from each method chosen and results is in table 4.

**Table 4:** Choosing The Best Method and Prediction of Financial Crisis Between Different Methods of Ann and Ga-Ann

<i>MSE</i>	<i>RMSE</i>	<i>R</i> <sup>2</sup>	Prediction method
0.10673	0.01139	0.977	Artificial neural network)ANN(
0.0000	0.0000	1.000	Genetic-artificial neural network)GA-ANN(

Table 4 results show that the best model for financial crisis prediction is training neural network with genetic algorithm. At last prediction table for each method are in table 5 and 6.

**Table 5:** Prediction of Healthy and Bankruptcy Firm by Using Artificial Neural Network Without Mixing with Genetic Algorithm

Data	Firm type	Total companies	Data kind
58	Healthy firm number	107	Real data
49	Bankruptcy firm number		
57	Healthy firm prediction	107	Neural network prediction
47	Bankruptcy firm prediction		
98.4%	Correct prediction of healthy firm		
96%	Correct prediction of bankruptcy firm		
1.7%	False prediction of healthy firm		
4.00%	false prediction of bankruptcy firm		
97.7%	Total correct prediction		

**Table 6:** Prediction Network Mixed with Genetic Algorithm

Data	Firm type	Total companies	Data kind
58	Healthy firm number	107	Real data
49	Bankruptcy firm number		
58	Healthy firm prediction	107	Neural network prediction
49	Bankruptcy firm prediction		
100%	Correct prediction of healthy firm		
100%	Correct prediction of bankruptcy firm		
0%	False prediction of healthy firm		
0%	also prediction of bankruptcy firm		
100%	Total correct prediction		

## 5 Conclusions

Financial crisis results leads to financial problem such as accounting risk, property risk, and strategic risk. Effects can be catastrophic. Mazomder and Miller [36] explain that by bad effect of financial crisis in companies, market effects too. So it is necessary to estimate financial situation of a firm several times. Prediction of job fault help management to do prevention work such as change in functional ways, again organization of firm's financial organization, has good methods for management, strategic programming, customer satisfaction and continuing of training and growth can power firm value and decrease financial crisis in different industries. For prevention from financial crisis, there are many

researches about prediction of this phenomenon. In this research, researcher wants to answer to this question that:

How is prediction of financial crisis of companies of Tehran stock exchange by using neural network and genetic algorithm?

For designing neural network with regarding input and output variable, artificial neural network with 5 variable input layer, 5 neurons in hidden layer chose and one variable for health or bankrupt firm. For gaining a better model for prediction financial crisis of companies, number of artificial neural network increased each time and network evaluated sometimes. Results of determining coefficient, medium fault square and root each time increases and at last 8 neurons has the best function. To survey about possibility of best multi-layer neural network, we use genetic algorithm for training artificial neural network. In mixing neural network with ultra-innovative algorithms, usually network training part is in ultra-part .first genetic algorithm with 100 repeat and 20 person, 0.2 percent leap, 20 percent intersection and then number of repeat and number of persons, also by regarding neural network result in previous part it has shown that the best artificial neuron network is with 8 neurons in mix with genetic algorithm and there exists 8 neurons in hidden layer. For increase of improvement of network function, population increased accidentally. At last after increase the best function was for repeat 400 with 20-50 people. Genetic algorithm can reach to convergence in 400 and number of people hasn't any effect. Increase of repeat and population didn't improve network because training was 100% and network predicted healthy and bankruptcy correctly. So the best natural network mix with genetic algorithm is a network with 400 repeat, 50 people, 0.2 percent, leap 0.2 percent mix with 8 neurons in hidden layer. At last by comparing best function of each model in base and training neural network with genetic algorithm the best method in financial crisis prediction surveyed with MSE, RMSE, R2 indexes that results shows that training neural network with genetic algorithm has the best function from less fault. MSE and RMSE were 0 for raining neural network with genetic algorithm that has the best function. By regarding result that mixed neural network with genetic algorithm has the best function so we advise managers that predict financial crisis and preventing from negative effects in different parts. Also for stock exchange it is said that before entering stock, they should estimate existing financial crisis in these companies that is based on proposed method. It means that they predict first from financial crisis in these companies.

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