

The Investigation of Possibility of the Use of Genetic Algorithm in Predicting Companies' Bankruptcy

(Experienced Evidence in Iran)

Mansour Garkaz

Accounting dept; Islamic Azad University;
Aliabad Katoul Branch, Golestan Province,
IRAN

Ahmad Abdollahi

Accounting dept; Golestan Non- Governmental Non for
Profit Institute of Higher Education; Golestan Province,
IRAN

Abstract-The purpose of this paper is to predict the bankruptcy using genetic algorithm. So doing, having read the review of literature, the researchers found a complete list of financial proportions that showed high capabilities the predicting bankruptcy. These proportions include the ratio of operational income to sale, ratio of total debts of total assets; current assets to current debts; sale to current assets and interest cost to gross profit. Then the possibility of the use of the genetic algorithm in predicting the bankruptcy of the accepted companies in Tehran Stock Exchange was investigated. The independent t-test showed that there was a meaningful difference between the average of these ratios of bankrupted group with that of non-bankrupt one. The results of the statistical tests indicate that the genetic algorithm can be used of predict bankruptcy in Iran.

Key words: predicting bankruptcy; genetic algorithm, Tehran Stock Exchange; type 1 and 2 Error.

I. INTRODUCTION

The economic crisis of the 1930s necessarily led financial studies to final saving aspects for the companies and the issues such as liquidity, bankruptcy, liquidation and refunding the companies [7]. The world economy has become aware of the risk within the capital structure of the companies especially after the bankruptcy of some huge companies such as WorldCom and Enron. If we can cull information pertaining to the possibility of bankruptcy after the real occurrence, we can decrease an even prevent its economic and social consequences. Thus the correct predicting of bankruptcy in the financial world is of vital importance [2]. By the way models to predict bankruptcy, we means these models that are able to predict the bankruptcy and decrease investing risk using financial information released by accounting [8]. Bankruptcy predicting models can be divided into two main groups. The first group is those models that predict bankruptcy using information of the market and analyzing them and the 2nd group refers to these ones that predict bankruptcy using accounting information (financial ratios). The 2nd group models can be divided using modeling method into statistical models, models based on artificial intelligence and

theoretical models. Table 1 shows different predicting paradigms. In all the models in use, the suitable model should be capable enough to classify the companies correctly [4]. The recent studies pertaining to the genetic algorithm rarifies the fact that this algorithm due to nonlinear nonparametric qualities and comparative learning is a powerful tool to identify and classify the models [10]. That is why this kind of algorithm has been used in this study.

In a research entitled "The application genetic algorithm in the analysis of bankruptcy danger", Varetto f. (1998) has made use of the genetic algorithm in predicting bankruptcy. The studies included 500 companies consisting of 236 bankrupted and 264 not bankrupted ones. The findings indicated the 93% predicting accuracy one year before bankruptcy and 91.6% accuracy two years before bankruptcy [1].

Shin and Lee (2002) also presented a model beside on genetic algorithm that showed how this algorithm could be used in modeling predicting the bankruptcy. They investigated 528 producing comprised of 264 bankrupted and 265 not bankrupted from 1995 to 1997. Their results showed that the designed model could predict bankruptcy one year in advance its occurrence with the accuracy of 80% [6]. Min and Jong (2008) suggested a new classification based on the genetic algorithm to predict bankruptcy. The proposed method was also flexible and was able to be applied in other fields such as predicting the purchase of the products or risk management of the project. The financial ratios of 2542 small and middle audited producing companies and the same number not bankrupted one were used as the data of this research [5]. Considering all the research done, it can be understood that although the statistical models could predict the bankruptcy well, some limiting assumptions such as linearity. Normality and independent relation among the variables could affect the efficiency of these models. Therefore, other methods have been introduced to overcome some or even all of these limitations to improve the predicting performance

The research hypothesis is as follows:

The genetic algorithm is able to predict bankruptcy of the companies in Iran Stock Exchange.

II. METHOD

This research is inductive in logic used and applied in purpose and deductive statistical models and methods (cross sectional correlation) are used to carry it.

The subjects are all accepted companies in Tehran Stock Exchange (924 companies) from 2003 to 2006.

Applying the following conditions that were necessary to do this research, the no. of sample companies is shown according to year, bankruptcy and non-bankruptcy in table 1

[1] THE SOME NUMBER ACCORDING TO YEAR & GROUP				
2006	2005	2004	2003	year
12	7	13	19	Number of bankrupted companies
22	17	13	29	Number of nonbankrupted companies
34	24	26	48	TOTAL

According to the information and data available in library of Tehran Stock Exchange, in that span of time only 51 companies were in accordance with Article 141 of Business law. To compare with bankrupted companies, some 81 non-bankrupted companies were also chosen via random sampling. So, the sample consists of 132 companies (5) bankrupted and 81 non-bankrupted ones. Those companies were classified into two groups of educational (to design the models) and experimental (to identify the accuracy of the models). The variables are classified into dependent and independent ones. In each year (2003 to 2006), a model using genetic algorithm using the information of that year was designed. Then, the accuracy of the designed model was evaluated with the real conditions of the companies.

The qualification of the error of the model using the genetic algorithm for the year 2003 data is as follows.

If $X_1 \leq 1/2752$ and, $X_2 \geq 0/8586$ and, $X_3 \leq 2/8236$ and, $X_4 \geq -4/5397$ and, $X_5 \geq -4/9736 \rightarrow$ Bankrupt

TABLE II

The result for 2003			
The in correct results	The correct results	The real number	Kind of company

0	19	19	bankrupted
0	27	27	No bankrupted
0	46	46	TOTAL

The results show that provided we use the data of the year 2003 the designed model using genetic algorithm can present accurate responses with 100% reliability. It means that it can discriminate these two companies without error and classify them correctly. So it can be inferred that the first hypothesis is accepted for the year 2003.

The quantification of the error of the model using the genetic algorithm for the year 2004 data is as follows:

If $X_1 \leq 1/5026$ and, $X_2 \geq 0/7875$ and, $X_3 \leq 1/5118$ and, $X_4 \geq -1/085$ and, $X_5 \geq -3/1431 \rightarrow$ Bankrupt

TABLE III: THE RESULT FOR 2004

The in correct results	The correct results	The real number	Kind of company
0	13	13	bankrupted
1	12	13	No bankrupted
0	25	26	TOTAL

The findings with dividing the correct results to real numbers show that in case of using the data of the year 2004, the designed model using the genetic algorithm can present correct responses with 96.3% reliability. The correct responses for the bankrupt group is 100% and for the non-bankrupt one is 92.3%, the mentioned model was inaccurate only regards the identification of a non-bankrupt company (Mahram Company).

The quantification of the error of the model using the genetic algorithm for the data of the year 2005 is as follows:

If $X_1 \leq 0/0323$ and, $X_2 \geq 0/4922$ and, $X_3 \geq 0/100299$ and, $X_4 \geq -1/5884$ and, $X_5 \geq -5/24629 \rightarrow$ Bankrupt

TABLE VI

TABLE VI: THE RESULTS OF 2006			
The in correct results	The correct results	The real number	Kind of company
0	7	7	bankrupted
0	17	17	No bankrupted

TABLE 8: THE CORRELATION BETWEEN THE REAL CONDITION OF THE COMPANIES WITH THE RESULTS OF GA

Sig.	r	
0.00	1.00	2003
0.00	0.926	2004
0.00	1.00	2005
0.00	0.875	2006

TABLE 8: THE CORRELATION BETWEEN THE REAL CONDITION OF THE COMPANIES WITH THE RESULTS OF GA			
Sig.	Z		
0.80	-0.25		2003
0.78	-0.27		2004
1.00	0.00		2005
1.00	0.00		2006

As it is shown in table 6, in 2005, the model can identify the bankrupt and non-bankrupt companies with 100% reliability.

The quantification of the error of the model using the genetic algorithm for the data of the year 2006 is:

If $X_1 \geq -1/62491$ and, $X_2 \geq 0/8529$ and, $X_3 \geq -1/9038$ and, $X_4 \geq -0/1$ and, $X_5 \geq -0/83149 \rightarrow$ Bankrupt

TABLE VII

TABLE VII: The result for 2005			
The in correct results	The correct results	The real number	Kind of company
1	11	12	bankrupted
1	21	22	No bankrupted
2	29	34	TOTAL

As the table shows, dividing the number of correct results to the real numbers of companies in 2006, the model can identify correctly the bankrupt and non-bankrupt companies. The model did not work correctly only regarding a non-bankrupt company (Navarde Aluminum Co) and a bankrupt company (Permit Co). So the first hypothesis is accepted regarding 2006 data.

The designed models could identify bankrupt and non-bankrupt companies with high accuracy.

The designed models can identify the bankrupt and non-bankrupt companies with high accuracy. To accept and generalize this hypothesis, non parametric statistics is used. First, Spearman correlation is used to test the correlation between the results of genetic algorithm and the real conditions of the companies. As it is shown in table 8, in all the years there is a correlation between those abovementioned items. Then Yuman-Whitney test is used to investigate the differences between the averages and acceptance or rejection of the hypothesis. The results of this test are shown in table 9. As it is shown, since in all the years p value is more than 0.05, the equality of the averages is accepted. It means there is no significant difference between the results of genetic algorithm and real genetic algorithm can be used to predict the bankruptcy in Iran. The findings are compatible with these discussed in the literature.

III. CONCLUSION

This research aimed at finding the possibility of the use of the genetic algorithm in identifying and medicating bankruptcy of the companies. The findings show that the genetic algorithm can be used in Tehran Stock Exchange. Besides, based on the research findings, those companies that enjoy less profit and most their assets are obtained though liabilities are more in danger of bankruptcy than other companies. Meanwhile, the liquidity is one of factors

that is of adverse relationship with bankruptcy. To decrease bankruptcy, the companies should use more conservative strategies that lead to a decrease in liabilities and financial leverage and try to control the expenses more. The genetic algorithm faces more difficulties in identifying the bankrupt companies than non-bankrupt ones. Therefore, it is suggested that the genetic algorithm be used with caution in Iran.

REFERENCES

- [1] F. Varetto, "Genetic algorithms applications in the analysis of insolvency risk", *Journal of Banking & Finance*, 22, 1988, pp. 1421-1439.
- [2] G.W. Newton, "Bankruptcy Insolvency Accounting Practice and Procedure", Wiley, 1998, pp: 21 – 41.
- [3] H. Etemadi and H. Farajzadeh dehkardi, "A review on the models to predict bankruptcy" *Hesabdar Journal*, No. 200, pp. 39-56
- [4] J. Ohlson, "Financial ratios and the probabilistic prediction of bankruptcy", *Journal of Accounting Research*, 18 (1), 1980, pp. 109–131.
- [5] J.H. Min and C. Jong, "A binary classification method for bankruptcy prediction", *Expert Systems with Applications*. 2008
- [6] K. Shin and Y. Lee, 2002, A genetic algorithm application in bankruptcy prediction modeling, *Expert Systems with Applications*, 23 (3), 321-8.
- [7] M.J. Gordon, "Towards theory of financial distress," *The journal of finance*, 36, 1971, pp. 1347-56. ,
- [8] S. Falahpour, "Predicting the financial bankruptcy of the companies using neural networks", MA Thesis, University of Tehran.
- [9] S.H. Min, J, Lee and I. Han, "Hybrid Genetic algorithms and support vector machines for bankruptcy prediction", *Expert Systems with Applications*, 31, 2006, pp. 652-660.
- [10] S.M. Kia, "The genetic algorithms in MATLAB" Tehran, Kian Rayane Sabz Publication