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REVIEW OF LITERATURE

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STATEMENT OF THE PROBLEM

OBJECTIVES

HYPOTHESES

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

RECOMMENDATIONS/SUGGESTIONS

CONCLUSIONS

SCOPE FOR FURTHER RESEARCH

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APPENDIX/ANNEXURE

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CONTRIBUTIONS TO BOOKS

- Sharma T., Kwatra, G. (2008) Effectiveness of Social Advertising: A Study of Selected Campaigns, Corporate Social Responsibility, Edited by David Crowther & Nicholas Capaldi, Ashgate Research Companion to Corporate Social Responsibility, Chapter 15, pp 287-303.

JOURNAL AND OTHER ARTICLES

- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

CONFERENCE PAPERS

- Garg, Sambhav (2011): "Business Ethics" Paper presented at the Annual International Conference for the All India Management Association, New Delhi, India, 19–22 June.

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- Kumar S. (2011): "Customer Value: A Comparative Study of Rural and Urban Customers," Thesis, Kurukshetra University, Kurukshetra.

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A COMPARISON OF DATA MINING TECHNIQUES FOR GOING CONCERN PREDICTION

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ABSTRACT

Going concern is one of the fundamental concepts concerning auditing and accounting. Since financial statements contain a potentially large volume of diversified information, sometimes firm's going concern status evaluation is a complex and critical process and the complexity of this issue has led to development of numerous models for going concern prediction (GCP). In this paper we proposed a novel approach using Imperialistic Competition Algorithm (ICA). In addition, we have presented more advanced data mining techniques, like Adaptive Network Based Fuzzy Inference Systems (ANFIS) and Support Vector Data Description (SVDD) for GCP. For this purpose, after data collection we have selected the final variables from among of 42 variables based on feature selection method using stepwise discriminant analysis (SDA). In the second stage we have applied 10-fold cross-validation to find out the optimal model. Results of three models statistically have been compared by McNemar test. Our empirical experiment indicates that ICA is more efficient than ANFIS and SVDD, but ANFIS does not significantly differ from SVDD. The ICA model reached 99.85 and 99.33 percent accuracy rates so as to training and hold-out data.

KEYWORDS

Going concern prediction, Feature selection, Imperialistic competition algorithm (ICA), Adaptive Network Based Fuzzy Inference Systems (ANFIS), Support Vector Data Description (SVDD).

INTRODUCTION

Over the four decades, going concern prediction (GCP) has become an important research in finance areas. In general, the objective of GCP is to develop models that can extract novel knowledge from previous observations and appraise corporate status. Two major factors that are effective in GCP area are: significant predictor variables and the classifier used in developing the prediction model (Lin, Liang, & Chen, 2011). In this study, we have selected effective financial futures by prior studies and stepwise discriminant analysis (SDA). On the other hand, research methodologies used in GCP are divided into two categories: statistical methods and data mining techniques. The first group comprises methods like univariate analysis, multivariate discriminant analysis (MDA) and logistic regression (logit). Nowadays statistical methods because of the restrictive assumptions such as linearity, normal distributed independent variables and functional relations among them are less used today. These assumptions are not often compatible with real-world applications. In recent years, data mining, a novel field of intelligent data analysis established and developed and began to appear and grow promptly in the background of abundant data and poor information. During the last years, data mining plays a key role in financial area. These techniques do not have restrictive assumptions like statistical methods. There are many techniques that can be employed in prediction of financial status of firms (for example, see: Li & Miu, 2010; Mokhatab Rafiei &et al., 2011; Sun & Li, 2011; Harada & Kageyama, 2011; Chen, 2012; Hsieh & et al., 2012; Sun et al., 2011; Tsai & Cheng, 2012; Xiao & et al., 2012) . In this paper we have applied three models for GCP using Imperialistic Competition Algorithm (ICA), Adaptive Network Based Fuzzy Inference Systems (ANFIS) and Support Vector Data Description (SVDD). The survey results are useful for following people: 1. Auditors - they can exert these models in the final stages of the audit engagement, as a quality control device or as a benchmark. 2. Managers - they can keep track of firm's performance and these models will help them to identify important trends. 3. Investors, potential clients and stakeholders – these models can be evaluated risk of his loan and apprised viability of companies.

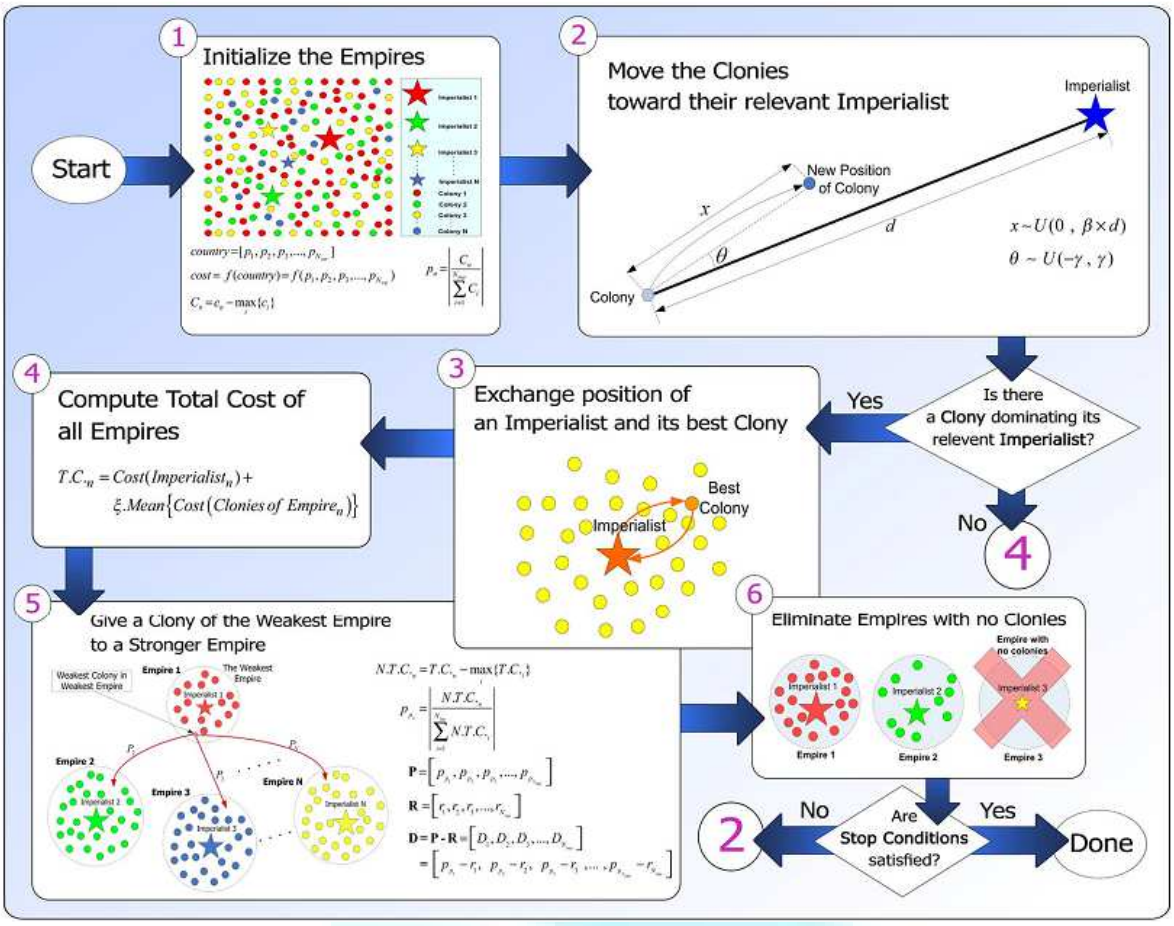
The reminder of this paper organized as follows. Section 2 introduces models of this study. Section 3 contains data and method of future selection. Section 4 presents the results of estimated models and the last section is conclusion.

PREDICTION MODELS

IMPERIALIST COMPETITIVE ALGORITHM (ICA)

Imperialist Competitive Algorithm (ICA) is a recent global search meta-heuristic that applies imperialism and imperialistic competition process as a source of inspiration. ICA considers the imperialism as a level of human's social evolution. ICA by mathematically modeling presents an algorithm for solving problems of optimization. Since its inception this new algorithm has been extensively adopted by researchers for solving various optimization tasks. This method can be applied to design optimal layout for factories, intelligent recommender systems and so on. ICA has divided countries into two categories: imperialist states and colonies. The main part of this algorithm is imperialistic competition and hopefully makes the colonies to converge to the global minimum of the cost function (Atashpaz-Gargari & Lucas, 2008). In Fig. 1, the stages of implementation of this algorithm are described.

FIG.1: OVERVIEW OF IMPERIALISTIC COMPETITION ALGORITHM



ADAPTIVE NETWORK BASED FUZZY INFERENCE SYSTEMS

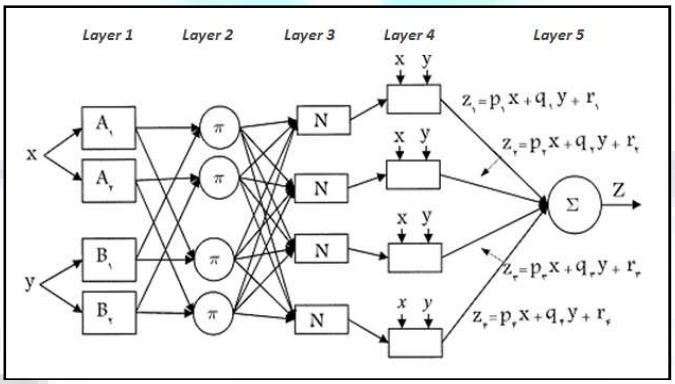
ANFIS is a multi-layer adaptive network-based fuzzy inference system proposed by Jang (1993). This method resembles to a fuzzy inference system except that it uses back-propagation for minimizing errors. ANFIS operates in a manner similar to both artificial neural networks and fuzzy logic. In both of them, by the input membership function the input goes through the input layer and by the output membership function the output is displayed in output layer. Due fuzzy logic applies neural networks, a learning algorithm can be applied to alter the parameters until finding an optimal solution. So ANFIS uses either back-propagation or a combination of least squares estimation and back-propagation to appraise the membership function parameters (Jung & Sun, 1997; Chen, 2011).

Assuming that the fuzzy inference system has two inputs (x and y) and one output (z) (see Fig. 2) a common rule set with two fuzzy if–then rules is as follows :

Rule 1: If x is A_1 and y is B_1 , then $z_1 = p_1 x + q_1 y + r_1$

Rule 2: If x is A_2 and y is B_2 , then $z_2 = p_2 x + q_2 y + r_2$

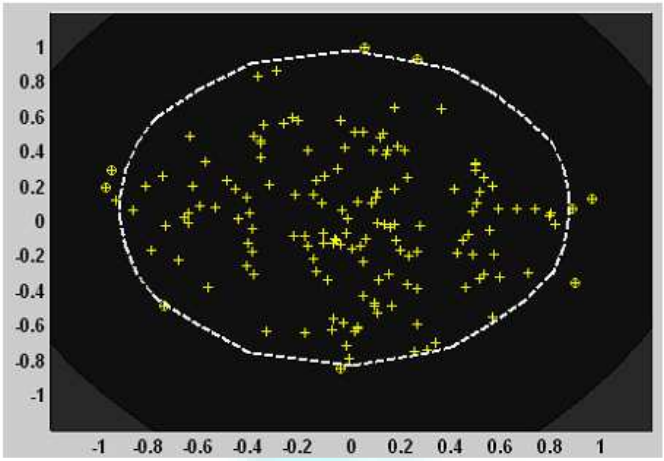
FIG. 2: SCHEMATIC STRUCTURE OF ANFIS



SUPPORT VECTOR DATA DESCRIPTION

The Support Vector Data Description is a one class classification algorithm. It evaluates the distributional support of a data set. A flexible limited boundary function is utilized to separate trustworthy data inside from outliers on the outside (as shown in Fig. 3). finding a minimum quasi-spherical with all the objective samples and none of the non-objective samples is the main purpose of SVDD (Gorgani & et al., 2010; Tax & Duin, 2004).

FIG. 3: MODELING OF GCP USING SVDD AND OUTLIERS DETECTION



RESEARCH DESIGN

DATA COLLECTION

The data set of this research consisted of 146 Iranian manufacturing companies. All of these companies were or still are listed on the Tehran Stock Exchange (TSE). 73 companies went bankrupt under paragraph 141 of Iran Trade Law[1] between 2001 and 2011. We applied "matched" companies and the number of bankrupt companies is equal to number of going concern companies (non-bankrupt) (like Min & Lee, 2005; Etemadi& et al., 2009; Chaudhuri & De, 2011; Chen, 2011; Andrés & et al, 2012; Brezigar-Masten & Masten, 2012; Olson et al., 2012). Due to low number of companies, we could not match two groups by industries completely together. Also size of the firms has been considered as a potential explanatory variable in feature selection steps.

FEATURE SELECTION

By reviewing research literature in the field of financial forecasting status of firm, it is characterized that the most of the researchers selected a limited set of variables recommended by prior studies (including financial and non-financial indicators).This problem often leads to reduce generalization of model (Naes & Mevik, 2001). Feature selection boosts the prediction performance of the predictors and prepares faster and more cost-effective predictors, and provides a better understanding of the underlying process that is stemmed from the data. Moreover, reducing the number of irrelevant or redundant variables reduces the running time of a learning algorithm. There are many advantages of feature selection such as reducing the measurement, facilitating data visualization and understandable data and storage requirements such as: reducing times of training and utilization and etc (Guyon & Elisseeff, 2003; Ashoori & Mohammadi, 2011). Accordingly, the variables selected in this research are based on a combination of all feature selection techniques and experiments. In addition there is no reliable published relevant data about cash flow statement before 2008 and that's why our candidate financial variables do not include indicators directly related with cash flows.

This study applied a three stages process for future selection. In the first stage, The 42 variables applied in this study as shown in Table 1, were chosen after reviewing the financial and accounting literature dealing with financial status prediction models in Iran. In the next stage, we applied T-test at a significant level of 0.05 and according to this experiment; variables that potentially had the ability of predicting going concern in the model were selected. In the final stage, stepwise discriminant analysis (SDA) selected optimal variables. We have chosen SDA because it is a dominant method in researches conducted in the accounting field (e.g.: Chen & Shemerda, 1981; Taffler, 1982; Altman, 1993; Alici, 1996;).

With significant level set at the 0.05 level, the discriminant stepwise procedure selected 4 variables for t-1 from the 42 candidate variables for the models which could best differentiate the going concern of firms from the non-going concern firms. These selected financial ratios are: Total liabilities to total assets (x_9) , Retained earnings to total assets (x_{31}), Operational income to sales (x_{36}) and Net income to total assets (x_{34}).

[1]Under paragraph 141 of Iran Trade Law, a company is bankrupt when its total value of retained earnings is equal or more than 50% of its listed capital.

TABLE 1: VARIABLES USED IN THE RESEARCH

No.	Predictor variable name	Financial ratios	Means of group 1	Means of group 2	Sig level
X1	Earnings before interest & taxes/ Total assets	EBIT/TA	0.18	0.05	0.00
X2	Long term debt/Shareholders' equity	LTD/SE	0.20	0.56	0.06
X3	Retained earnings/Stock capital	RE/SC	0.65	0.02	0.00
X4	Marked value of equity /Total liabilities	MVE/TL	1.40	0.66	0.00
X5	Marked value of equity /Shareholders' equity	MVE/SE	2.42	2.57	0.22
X6	Marked value of equity /Total assets	MVE/TA	0.77	0.48	0.00
X7	Cash /Total assets	Ca/TA	0.05	0.03	0.00
X8	Log (total assets)	Size	5.25	5.23	0.83
X9	Total liabilities/Total assets	TL/TA*	0.67	0.80	0.00
X10	Current liabilities/Shareholders' equity	CL/SE	2.27	4.76	0.00
X11	Current liabilities/Total liabilities	CL/TL	0.86	0.85	0.94
X12	(Cash+Short term investments)/Current liabilities	(Ca+STI)/CL	0.11	0.05	0.00
X13	(Receivables+Inventory)/Total assets	(R+Inv)/TA	0.57	0.57	0.88
X14	Receivables/Sales	R/S	0.53	0.40	0.10
X15	Receivables/Inventory	R/Inv	1.18	1.00	0.93
X16	Shareholders' equity/Total liabilities	SE/TL	0.63	0.32	0.00
X17	Shareholders' equity/Total assets	SE/TA	0.35	0.22	0.00
X18	Current assets/Current liabilities	CA/CL	1.31	1.07	0.00
X19	Quick assets/Current liabilities	QA/CL	0.70	0.57	0.00
X20	Quick assets/Current assets	QA/TA	0.37	0.36	0.73
X21	Fixed assets/(Shareholders' equity+Long term debt)	FA/(SE+LTD)	0.60	0.91	0.01
X22	Fixed assets/Total assets	FA/TA	0.22	0.24	0.63
X23	Current assets/Total assets	CA/TA	0.70	0.68	0.66
X24	Cash/ Current liabilities	Ca/CL	0.09	0.04	0.00
X25	Interest expenses/Gross profit	IE/GP	-0.02	-1.21	0.48
X26	Sales/Cash	S/Ca	35.30	44.80	0.11
X27	Sales/Total assets	S/TA	0.93	0.70	0.00
X28	Working capital/Total assets	WC/TA	0.13	0.00	0.00
X29	Paid in capital/Shareholders' equity	PIC/SE	0.53	0.86	0.00
X30	Sales/Working capital	S/WC	2.87	1.73	0.96
X31	Retained earnings/Total assets	RE/TA*	0.08	-0.03	0.00
X32	Net income/Shareholders' equity	NI/SE	0.42	-0.03	0.00
X33	Net income/Sales	NI/S	0.16	-0.02	0.00
X34	Net income/Total assets	NI/TA*	0.13	0.00	0.00
X35	Sales/Current assets	S/CA	1.34	1.07	0.00
X36	Operational income/Sales	OI/S*	0.20	0.06	0.00
X37	Operational income/Total assets	OI/TA	0.17	0.03	0.00
X38	Earnings before interest & taxes/ Interest expenses	EBIT/IE	-5.21	-0.45	0.05
X39	Earnings before interest & taxes/Sales	EBIT/S	0.52	0.10	0.00
X40	Gross profit /Sales	GP/S	0.27	0.15	0.00
X41	Sales/Shareholders' equity	S/SE	3.32	4.68	0.05
X42	Sales/Fixed assets	S/FA	6.29	6.44	0.33
*Final variables selected by SDA.					
Group 1: going concern firms & Group2: non-going concern firms					

RESULTS

PREDICTIVE RESULTS

The three models of ICA, ANFIS and SVDD that were constructed based on optimal feature set selected by SDA using 10-fold cross-validation. This method splits the data into two subdivisions: a training set and test set. Quality of the prediction assessed on the test set. In 10-fold cross-validation the data is firstly partitioned into10. Then, 10 iterations of training and test are done such that in each iteration a different fold of the data is held-out for validating while the rest 9 folds are used for learning and 10 outputs from the folds can be averaged and can produce a single estimation. (Alpaydin, 2010). The predictive results of each models listed in table 2.

TABLE 2: PREDICTIVE ACCURACIES (%) OF HOLD-OUT DATA

Data sets	ANFIS			ICA			SVDD		
	Accuracy	Error type I	Error type II	Accuracy	Error type I	Error type II	Accuracy	Error type I	Error type II
1	100.00	0.00	0.00	100.00	0.00	0.00	86.67	0.00	28.57
2	93.33	11.11	0.00	100.00	0.00	0.00	93.33	0.00	16.67
3	100.00	0.00	0.00	93.33	0.00	12.50	80.00	0.00	37.50
4	86.67	25.00	0.00	100.00	0.00	0.00	86.67	12.50	14.29
5	93.33	0.00	12.50	100.00	0.00	0.00	86.67	0.00	25.00
6	92.86	12.50	0.00	100.00	0.00	0.00	100.00	0.00	0.00
7	92.86	20.00	0.00	100.00	0.00	0.00	100.00	0.00	0.00
8	100.00	0.00	0.00	100.00	0.00	0.00	92.86	0.00	14.29
9	100.00	0.00	0.00	100.00	0.00	0.00	92.86	0.00	12.50
10	92.86	14.29	0.00	100.00	0.00	0.00	92.86	0.00	14.29
Min	86.67	**0.00**	**0.00**	**93.33**	**0.00**	**0.00**	80.00	**0.00**	**0.00**
Max	**100.00**	25.00	**12.50**	**100.00**	**0.00**	**12.50**	**100.00**	12.50	37.50
Mean	95.19	8.29	**1.25**	**99.33**	**0.00**	**1.25**	91.19	1.25	16.31
Median	93.33	5.56	**0.00**	**100.00**	**0.00**	**0.00**	92.86	**0.00**	14.29
Variance	20.93	91.29	**15.63**	**4.44**	**0.00**	**15.63**	39.42	15.63	137.09
Times of achieving best Statistics	1	1	4	5	5	5	1	2	1

FIG. 4. THE MAP OF MIN, MAX AND MEAN ACCURACY OF THE THREE METHODS

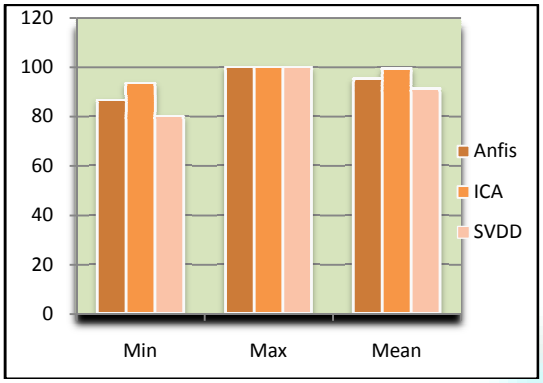
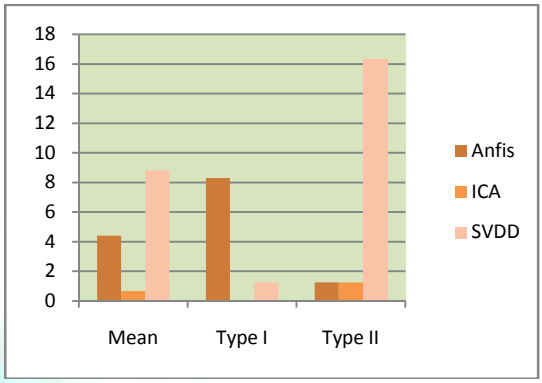


FIG. 5. THE MAP OF MIN, MAX AND MEAN OF DIFFERENT TYPES OF ERRORS



RESEARCH HYPOTHESES TEST

Determine which of the models that are more applicable than others in GCP, we make the following three hypotheses:

H_1: There is no significant difference between the two methods of ICA and ANFIS for GCP of Tehran listed companies.

H_2: There is no significant difference between the two methods of ICA and SVDD for GCP of Tehran listed companies.

H_3: There is no significant difference between the two methods of ANFIS and SVDD for GCP of Tehran listed companies.

To test the research hypothesis, we applied a nonparametric test. McNemar test examine whether or not the classification performance of each pair of methods is significantly different from other methods (see table 4-6). Results of McNemar test are presented in Table 3.

From Table 3, we can be understood that ICA outperforms ANFIS on the mean accuracy. The significance level on the hypothesis shows that there is significant difference between ICA and ANFIS. Thus, the hypothesis of H_1 is rejected by the result. It means that ICA outperforms ANFIS significantly in statistic when they are used to predicting going concern of Tehran listed firms. The second hypothesis is interpreted in the same way. From table 5, we can find that ANFIS is outperformed by SVDD on the mean accuracy. McNemar test shows that there is no significant difference between ANFIS and SVDD and H_3 is accepted.

TABLE 3: RESULTS OF SIGNIFICANCE TEST BETWEEN EACH PAIR OF MODELS

Methods	ICA	SVDD	
ANFIS	-2.058^{a} (0.040^{b})		-1.205 (0.228)
ICA	-		-2.536 (0.011)

[a] *t* statistic , [b] *p* value.

TABLE 4 : RESULT OF MCNEMAR TEST OF ANFIS AND ICA

Methods	Mean accuracy	Signicance test on difference	Hypothesis
ANFIS	95.19	Significant at the level of 5%	Reject H_1
ICA	99.33		

TABLE 5: RESULT OF MCNEMAR TEST OF CART AND ICA

Methods	Mean accuracy	Signicance test on difference	Hypothesis
ICA	99.33	Significant at the level of 5%	Reject H_2
SVDD	91.19		

TABLE 6: RESULT OF MCNEMAR TEST OF ANFIS AND SVDD

Methods	Mean accuracy	Signicance test on difference	Hypothesis
ANFIS	95.19	No significance	Accept H_3
SVDD	91.19		

DISCUSSION AND CONCLUSION

This study demonstrated feasibility of using ICA, ANFIS and SVDD to GCP from view of significance test and predictive accuracy with data collected from Iran. This paper considered a set of financial and non-financial futures that include 42 variables proposed in prior literature dealing with predicting of financial status in Iran and applied SDA to identify potential futures for entry into the GCP model and eventually four financial ratios were chosen and constructed GCP models based on selected variables. What results can be understood from this research show that ICA >ANFIS>SVDD from the view of mean accuracy. The empirical tests show that ICA model has achieved 99.33 and 99.85 percent accuracy rates respectively for training and hold-out data. Since 1988 no guidelines have not been issued for evaluation of going concern and from 1988 to today, SAS No.59 is authoritative guidance available for investigation of going concern status of an entity (Bellovary & et al., 2007), seems proposed models of this study would be useful in this regard.

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