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   STATEMENT OF THE PROBLEM

   OBJECTIVES

   HYPOTHESES

   RESEARCH METHODOLOGY

   RESULTS & DISCUSSION

   FINDINGS

   RECOMMENDATIONS/SUGGESTIONS

   CONCLUSIONS

   SCOPE FOR FURTHER RESEARCH

   ACKNOWLEDGMENTS

   REFERENCES

   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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- Garg, Bhavet (2011): Towards a New Natural Gas Policy, Political Weekly, Viewed on January 01, 2012 http://epw.in/user/viewabstract.jsp

A NOVEL BANKRUPTCY PREDICTION MODEL BASED ON SUPPORT VECTOR DATA DESCRIPTION METHOD

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ABSTRACT

In today's world, investment security is one of the leading concerns of economic environment and bankruptcy is one of the major problems which associated with. In this paper, we provide a novel bankruptcy prediction model for one year before its outbreak. By background literature review, 42 variables were selected as the variables proposed. Then, using stepwise discriminate analysis, optimal variables were selected for entry into the model. These variables in order of importance are: total liabilities to total assets, retained earnings to total assets, operating income to sales and net income to total assets. Having selected the final variables, by using 10-fold cross-validation technique, the model was built by using Support Vector Data Description (SVDD) algorithm. Empirical tests show that the SVDD model that is a one-classed classifier reached 100% and 95.81% accuracy rates for training and hold-out data.

KEYWORDS

Bankruptcy prediction; Feature selection; Financial ratios; Support Vector Data Description (SVDD); Tehran Stock Exchange.

INTRODUCTION

In today's world, investment security is one of the leading concerns of the economic environment, rapid advances in technology and widespread environmental change, has affected economies. Thus, financial decisions making are more strategic than before and always associated with risk and uncertainty. Increasing knowledge of financial users contributes them in financial decisions-making. Hence, one way to help investors is providing good models and predictors of company's prospects and today's these models having focused the attention of investors and creditors lot.

Generally bankruptcy prediction is a commercial classification and carrying out such research requires a sample of two groups of bankrupt and non-bankrupt (e.g.: Chaudhuri and De, 2011; Chen, 2011; Andrés, Landajo and Lorca, 2012; Brezigar-Masten and Masten, 2012; Olson, Delen and Meng, 2012). In general, two main factors influencing the bankruptcy prediction (Lin, Liang and Chen, 2011):

1) Financial features: Using different variables may end up in different results of prediction. For this reason, in this study accompanied with a review of previous literature, various variables as proposed variables are presented.

2) The classifier used in building model: In addition to statistical techniques, in recent years, data mining techniques in the areas of finance, including bankruptcy prediction has been applied. New algorithms such as Support Vector Machine (SVM) (Chen, 2011; Chaudhuri and De, 2011; Tsai and Cheng, 2012), Particle swarm optimization (PSO)(Chen and et.al, 2011; Chen, 2011), Neural networks(Mokhatab Rafiei, Manzari and Bostanian,2011; Olson, Delen and Meng,2012; Xiao, Yang, Pang and Dang, 2012) are used. This research also examines a novel algorithm to predict bankruptcy.

Also several studies show that other factors affect the bankruptcy phenomenon. Special features of the industry and government regulations can also be effective for financial distress. The results also indicated that recent established companies compared to record companies and small firms compared to large firms are more vulnerable (Dun and Bradstreet Corporation, 1980).

The aim of this study consists of two parts: finding a subset of variables that can efficiently perform its role in classification and providing a model to predict bankruptcy. The results of this study can be used by managers (they want to know which one of financial items is more important to avoid being bankrupt or on the verge of bankruptcy), investors (for decision-making on keeping or selling stock), creditors and banks (for giving credit and loans), auditors (to evaluate the assumption of going concern) and investigators (to select the optimal variables in predicting bankruptcy)

LITERATURE REVIEW

Today, numerous studies have been conducted to predict bankruptcy using different techniques and methods. Generally these techniques are divided into three categories:

1) Statistical techniques: these techniques are the most common and popular techniques to predict bankruptcy. In these models, the standard classical modeling approach is used and focuses on the signs of financial distress. Statistical models are divided into two groups: univariate and multivariate that the multivariate models are the most frequent. Multivariate techniques can be pointed to these methods: discriminant analysis, linear probability model, logit, probit models, Cumulative Sums, Partial Adjustment Processes, Recursive Partitioning Algorithm, Case-Based Reasoning.At the first statistical studies, Beaver (1966) evaluated potential financial ratios to predict financial distress using univariate analysis that most of ratios of cash flows were used. In this study, financial distress is defined as the firm's inability to perform its financial obligations. Thirty financial ratios that he thought the best indicator of a company's financial health are selected. Afterwards Altman (1968) proposed z-score model using multivariate discriminant analysis. In 1993, he revised his model and this time used four

financial ratios in his model. In 1980 Ohlson used the developed logit model. His sample consisted of 105 bankrupt and 205 non-bankrupt firms between 1970 and 1976. Other research has also been conducted in this area by using statistical methods (e. g.: Zmijewski, 1984; Gentry et al., 1985)

2) Artificial Intelligence techniques: these techniques are non-parametric that based on knowledge, intelligence and wisdom of human. In fact, it is a system that learns and their problem solving performance improves due to past experiences. These days, due to the high performance and the lack of restrictive assumptions of statistical methods are very useful for researchers. In the areas of bankruptcy, these are mainly focus on signs of distress and are multivariate typically. In recent years, researchers have used these techniques to predict bankruptcy (e. g.: Gestel, Baesens and Martens, 2010; Andrés, Landajo and Lorca, 2012; Chaudhuri and De, 2011; Tsai and Cheng, 2012; Sun, He and Li, 2011; Shetty, Pakkala and Mallikarjunappa, 2012; Ashoori and Mohammadi, 2011; Sun and Li, 2011)

3) Theoretical models: Unlike statistical and artificial intelligence models that rely on business distress symptoms, theoretical models seek for "quality reasons" of business distress. These models are multivariable and model statistical technique commonly used to support the theoretical issues. The examples of this theory are: JP Morgan's credit metrics Model, gambler bankruptcy theory, credit risk theories.

PREDICTION MODEL

ONE-CLASSED CLASSIFIERS AND DATA DESCRIPTION IN A SPECIFIC SCOPE

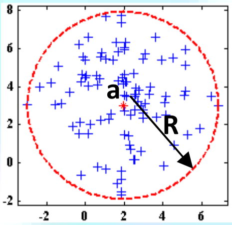
Nowadays, researchers pay a particular attention to data description as an important issue in machine learning and data mining. To describe and calculate data precisely is the main operation of this classifier, called target. This classifier offers a great application to figure out whether the new data belong to target or outlier data. Of course, it's crystal clear, to obtain more efficient multi class classifiers can come true by combining a series of one-class models.

In addition to above mentioned features, lace of necessity to employ the samples of other classes is another helpful feature of such classifiers in a learning process. In other words to reach an acceptable decision-making and assessment of belonging data-set to a class, system needs only a limited number of data. Thus, one-classed classifiers are of frequent application in data-mining such as: outlier samples recognition and designing efficient multi-class classifiers.

SUPPORT VECTOR DATA DESCRIPTION

A novel way of data description was presented by Tax and Duin (2004) which steamed from support vector machines. In this method, a range and boundary is specified by center *a* and radius *R*>0. In fact, a spherical range is shaped around the target.

FIGURE 1: TARGET DATA ARE DESIGNATED AND ILLUSTRATED BY A SPHERE AND A SET OF CENTER A AND RADIUS R



In this algorithm, minimizing the sphere volume is the main effort. For this reason, the arithmatic function of error which was introduced is in this way, but we must consider minimizing as a mandatory constrain.

$F(R,a) = R^2$, (1)

s.t $\|x_i - a\|^2 \le R^2, \forall i$ (2)

Regarding this possibility that, there are outliers data of training set, therefore, the distance between a (center) to x_i does not have to be less than R^2. But on the other hand, larger distances need to be fined. So, at this point, a slack variable is introduced and the issue of minimizing turns into following model:

$F(R,a) = R^2 + C\sum_i \xi_i$, (3)

But given the chance that, all of data would be in sphere.

$\|x_i - a\|^2 \le R^2 + \xi_i, \quad \forall i$. (4)

ξ_i is the slack variable that allows us to consider some of samples outside the model. The parameter *C* also controls the proportion between the errors and description. At this point; the constraint (4) can be used accompanied by Lagrange coefficient and the function (3). In this case, we obtain the following function whit Lagrange coefficient such as $\gamma_i \ge 0$and $\alpha_i \ge 0$.

$L(R,a,\alpha_i,\gamma_i,\xi_i) = R^2 + C\sum_i \xi_i - \sum_i \alpha_i\{R^2 + \xi_i - (\|x_i\|^2 - 2a.x_i + \|a\|^2)\} - \sum_i \gamma_i\xi_i$. (5)

In function L is in possession of 2 models: Whit regard to R, a, ξ_i needs to get minimized and 2: Whit regard to α_i and γ_i needs to be maximized. These following constraints are obtained if we put partial derivatives equal zero.

$\frac{\partial L}{\partial R} = 0: \quad \sum_i \alpha_i = 1$, (6)

$\frac{\partial L}{\partial a} = 0: \quad a = \frac{\sum_i \alpha_i x_i}{\sum_i \alpha_i} = \sum_i \alpha_i x_i$, (7)

$\frac{\partial L}{\partial \xi_i} = 0: \quad C - \alpha_i - \gamma_i = 0$. (8)

The following result is obtained if the above-mentioned function would be substituted in the function L:

$L = \sum_i \alpha_i(x_i.x_i) - \sum_{i,j} \alpha_i\alpha_j(x_i.x_j)$, (9)

$s.t \quad 0 \le \alpha_i \le C, \quad \sum_i \alpha_i = 1$. (10)

It is a common practice to minimize this function accompanied by pointed constrain which is called and known none-linear programming. In case that x_k would be a sample located on boundary, the R is calculated by the following formula:

$R^2 = (x_k.x_k) - 2\sum_i \alpha_i(x_i.x_k) + \sum_{i,j} \alpha_i\alpha_j(x_i.x_j)$ (11)

Moreover, in orther to provide a test data such as Z, we must calculate its distance from the center. The Z data is accepted only if the distance would be equal or less than R.

$\|z - a\|^2 = (z.z) - 2\sum_i \alpha_i(z.x_i) + \sum_{i,j} \alpha_i\alpha_j(x_i.x_j) \le R^2$ (12)

In all presented formulas, x_i are in form of interior-multiplication which is allowed to be replaced by a Kernel-function so as to reach more flexible methods. For this reason, let's imagine that each function turns into another, there we can reach to such a Lagrange arithmatic formula:

$$L = \sum_i \alpha_i(\varphi(x_i).\varphi(x_i)) - \sum_{i,j} \alpha_i\alpha_j(\varphi(x_i).\varphi(x_j)) \quad (13)$$

And since the Kernel function is defined in following way:

$$K(x_i, x_j) = \phi(x_i).\phi(x_j) \quad (14)$$

By a simple substitute, a new is obtained in the below form:

$$L = \sum_i \alpha_i K(x_i, x_i) - \sum_{i,j} \alpha_i\alpha_j K(x_i, x_j) \quad (15)$$

So we can rewrite the (11) and (12) in scope of Kernel:

$$R^2 = (x_k.x_k) - 2\sum_i \alpha_i K(x_i.x_k) + \sum_{i,j} \alpha_i\alpha_j K(x_i.x_j) \quad (16)$$

$$\|z - a\|^2 = (z.z) - 2\sum_i \alpha_i K(z.x_i) + \sum_{i,j} \alpha_i\alpha_j K(x_i.x_j) \le R^2 \quad (17)$$

Now, using various kernel functions is possible. Regarding the conducted experiments, we can reach more acceptable results by employing the model of Gaussian kernel. Gaussian kernel is defined in following way:

$$K(x, y) = exp\ (-\frac{\|x - y\|^2}{S^2}) \quad (18)$$

By replacing the Gaussian kernel in the function (15) and regarding that $K(x, x) = 1$, we can simplify the function in this form:

$$L = -\sum_{i,j} \alpha_i\alpha_j\ exp\ (-\frac{\|x - y\|^2}{S^2}) \quad (19)$$

So, by using this technique known as kernel trick we can reach more precise results concerning Support Vector Data Description without any extra calculation. It goes without saying that, to determine a proper amount for parameters S is an affective factor in final result (Tax and Duin, 2004).

DATA COLLECTION AND VARIABLE SELECTION

The data set of this study was obtained from Tehran Stock Exchange (TSE). Bankrupt companies were initially selected for data collection. Between 2002 and 2012, 73 manufacturing companies went bankrupt under paragraph 141 of Iran Trade Law. 73 companies selected as well as non-bankrupt companies. For variables selection studies were investigated between 2001 and 2012 and finally 42 variables were selected as proposed variables (see table 1). Therefore dependent variable is the economic and financial status of company (bankrupt or non-bankrupt) and independent variables are financial ratios based on size, coverage, solvency, profitability, efficiency and liquidity. Then in the next step was to select the optimal parameters by Stepwise Discriminant Analysis (SDA). It is clear from table 2 that the final selected variables have significant differences between the bankrupt and non-bankrupt firms. These variables in order of importance 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}).

TABLE 1: SELECTED VARIABLES FOR BANKRUPTCY PREDICTION

No.	Variable name	Mentioned by	
X1	EBIT/TA	Grice & Dugan(2001), Brabazon & Keenan(2004), Lin et al.(2011), Sun & Li(2011)	
X2	LTD/SE	Etemadi et al.(2009), Min & Jeong(2009)	
X3	RE/SC	Gestel et al.(2010), Andrés et al.(2011), Xiao et al.(2012)	
X4	MVE/TL	Sun & Shenoy(2007), Chaudhuri & De(2011), Chen et al.(2011)	
X5	MVE/SE	Tseng & Hu(2010), Chaudhuri & De(2011), Chen(2012)	
X6	MVE/TA	Ding et al.(2008), Martens et al.(2008), Etemadi et al.(2009)	
X7	Ca/TA	Etemadi et al.(2009)	
X8	Size	Etemadi et al.(2009)	
X9	TL/TA*	Min & Lee(2005), Shin et al.(2005), Bhimani et al.(2009)	
X10	CL/SE	Wu et al.(2007), Sun & Li(2011), Xiao et al.(2012),	
X11	CL/TL	Min & Lee(2005), Etemadi et al.(2009)	
X12	(Ca+STI)/CL	Sun & Shenoy(2007),Chen et al.(2011), Sun & Li(2011)	
X13	(R+Inv)/TA	Etemadi et al.(2009)	
X14	R/S	Grice & Dugan(2001), Min & Lee(2005),Wu et al.(2007), Min & Jeong(2009), Lin et al.(2011)	
X15	R/Inv	Sun & Shenoy(2007), Etemadi et al.(2009)	
X16	SE/TL	Grice & Dugan(2001), Ding et al.(2008), Martens et al.(2008),Tseng & Hu(2010), Andrés et al.(2011)	
X17	SE/TA	Brabazon & Keenan(2004), Sun & Shenoy(2007), Chen et al.(2011), Mokhatab Rafiei et al.(2011)	
X18	CA/CL	Wu et al.(2007), Etemadi et al.(2009), Xiao et al.(2012)	
X19	QA/CL	Brabazon & Keenan(2004),Koh & KeeLow(2004), Etemadi et al.(2009)	
X20	QA/TA	Wu et al.(2007), Mokhatab Rafiei et al.(2011), Sun & Li(2011)	
X21	FA/(SE+LTD)	Min & Lee(2005), Ding et al.(2008), Mokhatab Rafiei et al.(2011), Sun & Li(2011)	
X22	FA/TA	Ding et al.(2008), Etemadi et al.(2009), Chen et al.(2011), Andrés et al.(2012)	
X23	CA/TA	Grice & Dugan(2001), Martens et al.(2008), Lin et al.(2011), Sun & Li(2011)	
X24	Ca/CL	Koh & KeeLow(2004), Etemadi et al.(2009), Mokhatab Rafiei et al.(2011)	
X25	IE/GP	Etemadi et al.(2009), Chen et al.(2011)	
X26	S/Ca	Etemadi et al.(2009), Andrés et al.(2012)	
X27	S/TA	Ding et al.(2008), Chen et al.(2011), Sun & Li(2011)	
X28	WC/TA	Andrés et al.(2012), Chen(2011), Etemadi et al.(2009)	
X29	PIC/SE	Wu et al.(2007), Ding et al.(2008), Lin et al.(2011), Sun & Li(2011), Xiao et al.(2012)	
X30	S/WC	Brabazon & Keenan(2004), Etemadi et al.(2009), Lin et al.(2011)	
X31	RE/TA*	Brabazon & Keenan(2004), Min & Lee(2005), Chen(2011)	
X32	NI/SE	Etemadi et al.(2009), Chaudhuri & De(2011), Andrés et al.(2012)	
X33	NI/S	Brabazon & Keenan(2004), Tseng & Hu(2010), Chen(2011), Xiao et al.(2012)	
X34	NI/TA*	Wu et al.(2007), Ding et al.(2008), Tseng & Hu(2010), Lin et al.(2011)	
X35	S/CA	Martens et al.(2008), Min & Jeong(2009), Lin et al.(2011),Sun & Li(2011)	
X36	OI/S*	Min & Lee(2005), Wu et al.(2007), Ding et al.(2008), Chen(2011), Sun & Li(2011)	
X37	OI/TA	Min & Lee(2005), Chen(2011), Mokhatab Rafiei et al.(2011), Sun & Li(2011), Tseng & Hu(2010)	
X38	EBIT/IE	Shin et al.(2005), Min & Jeong(2009), Lin et al.(2011), Chen(2012)	
X39	EBIT/S	Brabazon & Keenan(2004), Min & Jeong(2009), Chaudhuri & De(2011), Chen(2011)	
X40	GP/S	Ding et al.(2008), Etemadi et al.(2009), Chen(2011)	
X41	S/SE	Sun & Shenoy(2007), Etemadi et al.(2009), Chen et al.(2011)	
X42	S/FA	Sun & Shenoy(2007), Ding et al.(2008), Chaudhuri & De(2011), Lin et al.(2011)	
CA: Current assets		Inv: Inventory	RE: Retained earnings
Ca: Cash		LA : Liquid assets	S: Sales
CL: Current liabilities		LTD: Long term debt	SC: Stock capital
PIC: Paid in capital		MVE: Marked value of equity	SE: Shareholders' equity
EBIT: Earnings before interest & taxes		NI: Net income	STI: Short term investments
FA: Fixed assets		OI: Operational income	TA: Total assets
GP: Gross profit		QA: Quick assets	TL: Total liabilities
IE: Interest expenses		R: Receivables	WC: Working capital

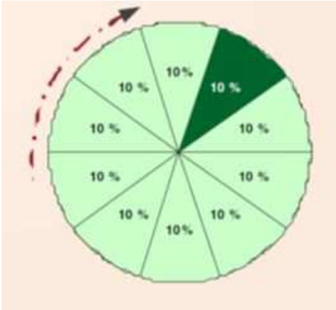
TABLE 2: SELECTED VARIABLES IN SDA ANALYSIS FOR t-1

Step		Tolerance	F to Remove	Wilks' Lambda
1	Net income to total assets	1.000	100.772	
2	Net income to total assets	0.938	56.243	0.748
	Total liabilities to total assets	0.938	9.068	0.550
3	Net income to total assets	0.513	8.617	0.522
	Total liabilities to total assets	0.912	11.103	0.532
	Operational income to sales	0.546	6.114	0.512
4	Net income to total assets	0.478	4.749	0.489
	Total liabilities to total assets	0.896	8.546	0.503
	Operational income to sales	0.539	4.586	0.488
	Retained earnings to total assets	0.770	4.369	0.487

PREDICTIVE RESULTS

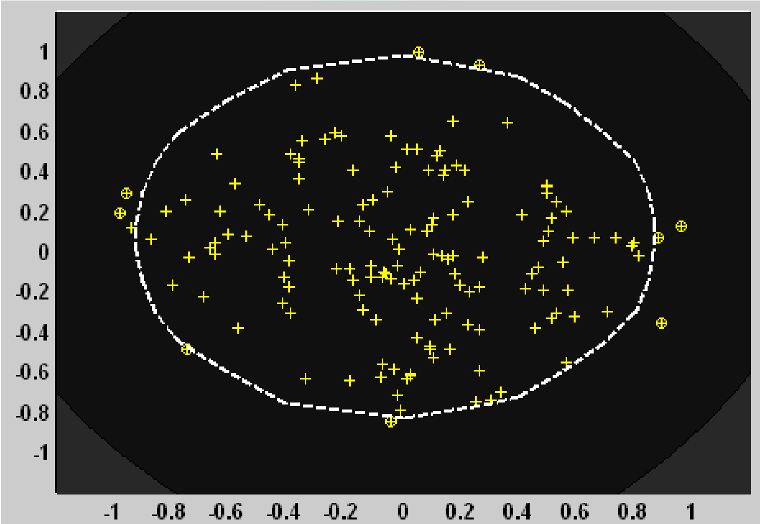
The proposed SVDD model is implemented using MATLAB ***7.6***. To assess the predictive accuracy of SVDD, the data set was divided into two groups of training and test set using 10-fold cross-validation technique. In 10-fold cross-validation the data is divided into 10 subsets of exactly or approximately equal size. Then, 10 iterations of training and test are done such that in each iteration a different fold of the data is held-out for validation while the rest 9 folds are used for learning and 10 outputs from the folds can be averaged and can produce a single estimation(as shown in Fig.2)(Alpadyn, 2010)

FIGURE 2: 10-FOLD CROSS VALIDATION SCHEME



One problems of SVDD in BFP is noisy samples. This problem is solved by applying the appropriate value for the C coefficient in (3). If C choose 120 or more number of data by sphere, by reducing in (3) noisy samples explained as outliers (see Fig. 3).

FIGURE 3: CHOOSING APPROPRIATE VALUE OF AND OUTLIERS AND FINDING OUTLIERS



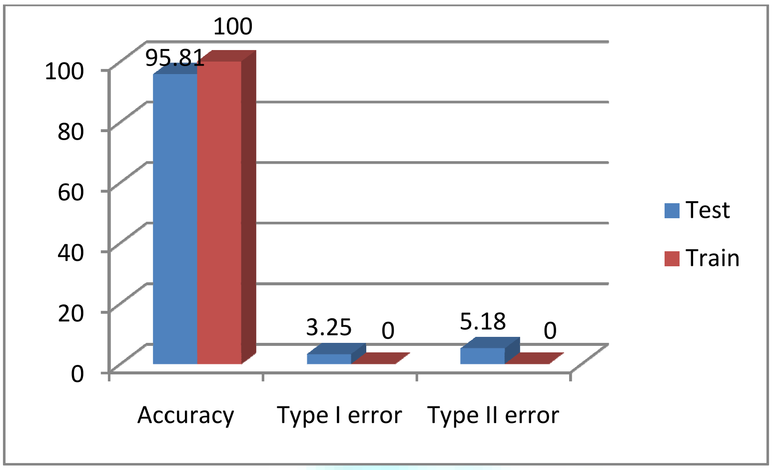
SVDD model could classify firms with 100% and 95.81% overall accuracy rate in the training and testing sample, respectively. The results of type I and Type II error is shown in Table 3 and figure 4.

TABLE 3

The detailed results obtained by SVDD via 10-fold cross- validation.

Fold	Accuracy (%)		Type I error(%)		Type II error(%)	
	TEST	TRAIN	TEST	TRAIN	TEST	TRAIN
1	100.00	100.00	0.00	0.00	0.00	0.00
2	100.00	100.00	0.00	0.00	0.00	0.00
3	93.33	100.00	0.00	0.00	12.50	0.00
4	93.33	100.00	12.50	0.00	0.00	0.00
5	100.00	100.00	0.00	0.00	0.00	0.00
6	100.00	100.00	0.00	0.00	0.00	0.00
7	92.86	100.00	20.00	0.00	0.00	0.00
8	92.86	100.00	0.00	0.00	14.29	0.00
9	85.71	100.00	0.00	0.00	25.00	0.00
10	100.00	100.00	0.00	0.00	0.00	0.00
Mean	95.81	100.00	3.25	0.00	5.18	0.00
Median	96.67	100.00	0.00	0.00	0.00	0.00
Max	100.00	100.00	20.00	0.00	25.00	0.00
Min	85.71	100.00	0.00	0.00	0.00	0.00
Variance	24.38	0.00	50.07	0.00	79.68	0.00

FIGURE 4: RESULT OF SVDD IN TEST AND TRAINING DATA



SUMMERY AND CONCLUSION

The purpose of this paper is to develop new constitutive model to predict the bankruptcy using Support Vector Data Description (SVDD). An important contribution of this research is finding a set of important and effective variables in bankruptcy phenomenon. Using these variables, a SVDD model was developed. This model reached 100% and 95.81% accuracy rates for training and test data. In summary, it can be said that SVDD can predict bankruptcy with high accuracy.

REFRENCES

1. Altman, E.I. (1968), "Financial ratios, discriminant analysis and the prediction of corporate bankruptcy," Journal of Finance, Vol. 23, pp. 589–609.
2. Altman E.I. (1993) Corporate Financial Distress and Bankruptcy: A Complete Guide to Predicting & Avoiding Distress and Profiting from Bankruptcy, Second Edition, John Wiley & Sons.
3. Alpaydin E. (2010) Introduction to machine learning (2th ed.). London: MIT Press.
4. Andrés, J.D., Lorca. P., Juez. F.J. and Sánchez-Lasheras. F. (2011), "Bankruptcy forecasting: A hybrid approach using Fuzzy c-means clustering and Multivariate Adaptive Regression Splines (MARS)", Expert Systems with Applications, Vol. 38, pp. 1866–1875.
5. Andrés. J., Landajo. M. and Lorca. P. (2012), "Bankruptcy prediction models based on multinorm analysis: An alternative to accounting ratios," Knowledge Based Systems, doi: 10.1016/j.knosys. 2011.11.005.
6. Ashoori, S. and Mohammadi, S. (2011), "Compare failure prediction models based on feature selection technique: empirical case from Iran," Procedia Computer Science, Vol. 3, pp. 568–573.
7. Beaver, W. (1967), "Financial ratios predictors of failure, Empirical research in accounting: selected studies 1966," Journal of Accounting Research, Vol. 4, pp. 71–111.
8. Bhimani, A., Gulamhussen, M.A. and Lopes, S. (2009), "The effectiveness of the auditor's going-concern evaluation as an external governance mechanism: Evidence from loan defaults," The International Journal of Accounting, Vol. 44, pp. 239– 255.
9. Brabazon, A. and Keenan, B. (2004), "A hybrid genetic model for the prediction of corporate failure," Computational Management Science, Springer-Verlag, pp. 293-310.
10. Brezigar-Masten, A. and Masten, I. (2012), "CART-based selection of bankruptcy predictors for the logit model," Expert Systems with Applications, doi:10.1016/j.eswa.2012.02.125.
11. Chaudhuri, A. and De, K. (2011), "Fuzzy Support Vector Machine for bankruptcy prediction," Applied Soft Computing, Vol. 11, pp. 2472–2486.
12. Chen, M.Y. (2011), "Predicting corporate financial distress based on integration of decision tree classification and logistic regression," Expert Systems with Applications, Vol. 38, pp. 11261–11272.
13. Chen, M.Y. (2012), "Visualization and dynamic evaluation model of corporate financial structure with self-organizing map and support vector regression," Applied Soft Computing, Vol. 12, No. 8, pp. 2274-2288.
14. Chen, H.L., Yang, B., Wang, G., Liu, J., Xu, X., Wang, S.J., and Liu, D.Y. (2011), "A novel bankruptcy prediction model based on an adaptive fuzzy k –nearest neighbor method," Knowledge-Based Systems, Vol. 24, pp. 1348–1359.
15. Ding, Y., Song, X. and Zen, Y. (2008), "Forecasting financial condition of Chinese listed companies based on support vector machine," Expert Systems with Applications, Vol. 34, pp. 3081–3089.
16. Dun and Bradstreet Corporation, (1983) Business Failure Record, Author, New York.
17. Etemadi, H., Anvary Rostamy, A.A. and Farajzadeh Dehkordi, H. (2009), "A genetic programming model for bankruptcy prediction: Empirical evidence from Iran," Expert Systems with Applications, Vol. 36, pp. 3199–3207.
18. Gentry, J.A., Newbold, P. and Whitford, D.T. (1985), "Classifying Bankrupt Firms with Funds Flow Components," Journal of Accounting Research, Vol. 23, No. 1, pp. 146-161.
19. Gestel, T.V., Baesens, B. and Martens, D. (2010), "From linear to non-linear kernel based classifiers for bankruptcy prediction," Neurocomputing, Vol. 73, pp. 2955–2970.
20. Grice, G.S. and Dugan, M.T. (2001), "The Limitations of Bankruptcy Prediction Models: Some Cautions for Researcher," Review of Quantitative Finance and Accounting, Vol. 17, pp. 151-166.
21. Koh, H.C. and Kee Low, C. (2004), "Going concern prediction using data mining techniques," Managerial Auditing Journal, Vol. 19, no.3, pp. 462-476.
22. Leon Li, M.Y. and Miu, P. (2010), "A hybrid bankruptcy prediction model with dynamic loadings on accounting-ratio-based and market-based information: A binary quantile regression approach," Journal of Empirical Finance, Vol. 17, pp. 818– 833.
23. Lin, F., Liang, D. and Chen, E. (2011), "Financial ratio selection for business crisis prediction," Expert Systems With Applications, Vol. 38, pp. 15094-15102.
24. Martens, D., Bruynseels. L., Willekens, B.M. and Vanthienen, J. (2008), "Predicting going concern opinion with data mining," Decision Support Systems, Vol. 45, pp. 765–777.
25. Min, J.H. and Jeong, C. (2009), "A binary classification method for bankruptcy prediction," Expert Systems with Applications, Vol. 36, pp. 5256–5263.
26. Min, J.H. and Lee, Y.C. (2005), "Bankruptcy prediction using support vector machine with optimal choice of kernel function parameters," Expert Systems with Applications, Vol. 28, pp. 603–614.
27. Mokhatab Rafiei, F., Manzari, S.M. and Bostanian, S. (2011), "Financial health prediction models using artificial neural networks, genetic algorithm and multivariate discriminant analysis: Iranian evidence," Expert Systems with Applications, Vol. 38, pp. 10210–10217.
28. Ohlson, J. (1980), "Financial ratios and the probabilistic prediction of bankruptcy," Journal of Accounting Research, Vol. 18, No. 1, pp. 109–131.

29. Olson, D.L., Delen, D. and Meng, Y. (2012), "Comparative analysis of data mining methods for bankruptcy prediction," Decision Support Systems , Vol. 52, pp. 464 – 473.
30. Salehi Moghaddami N. (2011): "Decision Tree based on Support Vector Machine Cost Functoin," Thesis, Ferdowsi University, Iran.
31. Shetty, T.P.M., Pakkala, T. and Mallikarjunappa, A. (2012), "A modified directional distance formulation of DEA to assess bankruptcy: An application to IT/ITES companies in India," Expert Systems With Application, Vol. 39, pp. 1988-1997.
32. Shin, K.S., Lee, T.S., & Kim, H.j. (2005), "An application of support vector machines in bankruptcy prediction model," Expert Systems with Applications, Vol. 28, pp. 127–135.
33. Sun, J., He, K.Y. and Li, H. (2011), "SFFS-PC-NN optimized by genetic algorithm for dynamic prediction of financial distress with longitudinal data streams," Knowledge-Based Systems, Vol. 24, pp. 1013–1023. 1
34. Sun, J. and Li, H. (2011), "Dynamic financial distress prediction using instance selection for the disposal of concept drift," Expert Systems with Applications, Vol. 38, pp. 2566–2576.
35. Sun. L. and Shenoy, P.P. (2007), "Using Bayesian networks for bankruptcy prediction: Some methodological issues," European Journal of Operational Research, Vol. 180, pp. 738–753.
36. Tax, D. and Duin, R. (2004), "Support Vector Data Description," Machine Learning, Vol. 54, pp. 45–66.
37. Tsai, C.F. and Cheng, K.C. (2012), "Simple instance selection for bankruptcy prediction," Knowledge-Based Systems, Vol. 27, pp. 333–342.
38. Tseng, F.M. and Hu, Y.C. (2010), "Comparing four bankruptcy prediction models: Logit, quadratic interval logit, neural and fuzzy neural networks," Expert Systems with Applications, Vol. 37, pp. 1846–1853.
39. Wu, C.H., Tzeng, G.H., Goo, Y.J. and Fang, W.C. (2007), "A real-valued genetic algorithm to optimize the parameters of support vector machine for predicting bankruptcy," Expert Systems with Applications, Vol. 32, pp. 397-408.
40. Xiao, Z., Yang, X., Pang, Y. and Dang, X. (2012), "The prediction for listed companies' financial distress by using multiple prediction methods with rough set and Dempster–Shafer evidence theory," Knowledge-Based Systems, Vol. 26, pp. 196–206.
41. Zmijewski, M.E. (1984), "Methodological Issues Related to the Estimation of Financial Distress Prediction Models," Journal of Accounting Research, Vol. 24, pp. 59-82.

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