Chapter 48
Comparative Analysis of Neural Network and Fuzzy Logic Techniques in Credit Risk Evaluation

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ABSTRACT

Credit risk evaluation techniques that aid effective decisions in credit lending are of great importance to the financial and banking industries. Such techniques assist credit managers to minimize the risks often associated with wrong decision making. Several techniques have been developed in the time past for credit risk evaluation and these techniques suffer from one form of limitation or the other. Recently, powerful soft computing tools have been proposed for problem solving among which are the neural networks and fuzzy logic. In this study, a neural network based on backpropagation learning algorithm and a fuzzy inference system based on Mamdani model were developed to evaluate the risk level of credit applicants. A comparative analysis of the performances of both systems was carried out and experimental results show that neural network with an overall prediction accuracy of 96.89% performed better than the fuzzy logic method with 94.44%. Finding from this study could provide useful information on how to improve the performance of existing credit risk evaluation systems.

INTRODUCTION

The banking Industry play an appreciated role in promoting the economic development of any nation in the world. Primarily, banks focus on credit lending to borrowers in other to generate income, which are later invested into local, national, or international community. For some years now, banks have been experiencing financial crisis in credit lending due to the high level risk associated with improper loan

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decisions often made by credit officers. This risk includes, loss of principal and interest, disruption to cash flow in the banking system, and increased collection cost, which arises when borrowers fail to pay back acquired credit facility in accordance with the agreed terms of the bank. Several methods have been used in the time past for credit risk evaluation. For instance, the traditional method of granting credit to borrowers is based on judgmental concept using the experience of credit officers and the problems associated with this approach include: high cost of training loan officers; inappropriate decisions; longer period of time required to evaluate a risk; and the possibility of making different decision by different loan officers for the same case (Handzic and Aurum, 2001). To address these problems, methods such as credit scoring, discriminant analysis, logistic regression, and multiple regression were proposed to manage credit risk. However, common limitations of these methods are: the credit scoring methods attempted to correct the biasness of the traditional method but sometimes it misclassify applicants, has the possibility of indirect discrimination, it is not standardized and it varies from one market to another (Crook, 1996) and it does not easily accommodate new changes, discriminant analysis and logistic regression assume multivariate normality and homoscedastic that are often violated in the real world banking data (Giang, 2005; Huang H. et al., 2004), multiple regression require model selection which is based on trial and error process (Leondes, 2005).

Advances in computational intelligence and engineering have led to the development and use of artificial intelligence technology tools such as Neural Networks (NNs) and Fuzzy Logic (FL) in credit risk evaluation in other to overcome the difficulties inherent in the traditional and statistical methods highlighted above. The concept of NNs is one of the most exciting developments in the last few decades and as a result, it has been widely applied in engineering, science, and in the business world. Recently, NNs have been moving from research laboratories into the business world and they have found practical applications in the world of banking and finance with promising results (Sangaiah et al., 2015a; Huang H. et al., 2004; Huang Z. et al., 2004; Jang and Sun, 1993; Hawley et al., 1990). In its basic form, neural networks consist of interconnected group of artificial neurons that uses mathematical or computational model for information processing based on the connectionist approach. It is capable of modeling very complex mathematical, logical, linear, and non-linear relationships in credit risks which are difficult to address using the conventional methods (Elmer et al., 2012). The network simply learns the relationships based on the representative sample data and produces output. Also, it can as well learn from past experience in order to provide better output when the system is trained with new set of data sample. FL invented by Lotfi Zadeh, is another interesting computing technique that uses method of reasoning that resembles human reasoning and decision making. The approach of FL imitates the way of decision making in humans that involves all intermediate possibilities between digital values of 0 and 1 (Tang and Chi, 2005). FL poses the ability to mimic the human mind to effectively employ modes of reasoning that are approximate rather than exact and as well represent knowledge that are imprecise and uncertain in nature. This technique has been used in wide range of applications which include industrial control, information processing, medicine, artificial intelligence, decision theory, operations research, banking and finance among others (Sangaiah et al., 2015b; Samuel et al., 2014; Samuel et al., 2013; Zadeh, 1988). FL is also used to model nonlinear functions of arbitrary complexity to a desired degree of accuracy as well as to conveniently map input space to an output space. Several works have used Neural Networks and Fuzzy Logic extensively to evaluate credit risk in financial institutions but a comparative study on the performances of these tools in credit risk evaluation has not been investigated.