Managing loan customers using misclassification patterns of credit scoring model

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Abstract

A number of credit scoring models have been developed to evaluate credit risk of new loan applicants and existing loan customers, respectively. This study proposes a method to manage existing customers by using misclassification patterns of credit scoring model. We divide two groups of customers, the currently good and bad credit customers, into two subgroups, respectively, according to whether their credit status is misclassified or not by the neural network model. In addition, we infer the characteristics of each subgroup and propose management strategies corresponding to each subgroup.
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1. Introduction

Credit industry in Korea has expanded rapidly over last several years. Due to the intense competition of credit card issuers and banks, more and more people can have credit card and get a loan from banks without the thorough check of their credit status. This reckless expansion policy has increased the delinquency rate. According to the Financial Supervisory Service (FSS), the delinquency rate rose to the 11% in May 2003.

Since the delinquency rate has increased continuously, most of major credit card companies and banks have had to set aside a large amount of money for a reserve for bad debts. Consequently, the companies and banks are suffering from cash liquidity problems and a decreased profit.

Now, the lenders are trying to decrease the delinquency rate by using various types of consumer credit risk management systems (Malhotra & Malhotra, 2003). There are two types of decisions that firms who lend to consumers have to make. First, they should decide whether to grant credit to new applicants. The tools that aid this decision are called credit scoring methods. The second type of decision is how to deal with existing customers. Techniques that help

with this decision are called behavioral scoring (Thomas, 2000).

The objective of both credit scoring and behavioral scoring models is to assign loan customers to either a 'good credit' group or a 'bad credit' group (Lee, Chiu, Lu, & Chen, 2002). Therefore scoring problems are related to the field of classification analysis (Anderson, 1984; Hand, 1981; Johnson & Wichern, 1998; Morrison, 1990). Classification model for the credit scoring is used to categorize new applicants as either accepted or rejected with respect to their characteristics such as age, income and martial condition (Chen & Huang, 2003). In the behavioral scoring, classification model is used to predict future credit status of existing customers by using the credit scoring variables and others which describe the behavior (Thomas, 2000).

Many studies have contributed to increasing the accuracy of the classification model with various kinds of statistical tools. However, most of the former studies have focused on only building more accurate credit scoring or behavioral scoring model.

Even with such highly accurate scoring models some misclassification patterns appear. One can find some insight from these patterns. For instance, good customers who are classified into bad could be interpreted as a group which has potential to default.

With this misclassification pattern we segment the existing loan customers into four groups. That is, the good

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customer group is classified into two groups: customers who are likely to delay future payments and customers who are not. The bad customer group is also classified into two groups: customers who would pay back and customers who would not. After segmentation, we infer the characteristics of each classified customer group. Then, we propose proper management strategies for each customer group according to their characteristics.

This study is organized as follows. Section 2 details the methodology used in this study. Section 3 explains the empirical results of segmentation and proposes proper management strategies to each group. Finally, Section 4 concludes and summarizes the study results.

2. The proposed methodology

In this study, the classification model for credit scoring is used as a tool of segmentation for the existing loan customers. For credit scoring analysis, many studies have reported that neural networks (NNs) perform significantly better than other statistical techniques such as linear discriminant analysis (LDA), multiple discriminant analysis (MDA), logistic regression analysis (LRA) and so on (Desai, Crook, & Overstreet, 1996; Lacher, Coats, Sharma, & Fant, 1995; Malhotra & Malhotra, 2003; Sharda & Wilson, 1996; West, 2000; Zhang, Hu, Patuwo, & Indro, 1999). Accordingly, we use NNs as the classification model.

The NNs are built with the data of the existing customers, which include variables from the application form. Then, all of the existing customers whose data are used to build the classification model are evaluated by the model in order to detect their predicted credit status, good or bad.

Because we have to use the data of current loan customers for both training and validation, we apply the cross-validation methodology. To implement 10-fold cross-validation, we divide the data sample into 10 mutually exclusive sub-samples. Then, we build a classification model with nine sub-samples and validate the models with the rest one sub-sample. This process is repeated 10 times with a different validation sub-sample and the remaining nine sub-samples as the training data (Malhotra & Malhotra, 2003). Therefore, the validation results of the customers become their predicted credit status.

Most of the good customers and bad customers would be validated to be in good credit status and bad credit status, respectively, by the scoring model. However, some good customers would be evaluated to be bad and some bad customers would be evaluated to be good as well. That is, some customers would be misclassified by the model. The good credit customers who are misclassified by the model would have more chance to delay future payments than other good credit customers. Also, the bad credit customers who are misclassified would have more chance to repay the delayed payments than the other bad credit customers.

Therefore, the currently good credit and bad credit customers are respectively divided into two subgroups according to their classification results. That is, the two groups of existing customers are classified into following four groups

Group 1: customers who have not delayed and are not likely to delay future payments;
Group 2: customers who have not delayed but are likely to delay future payments;
Group 3: customers who are currently delinquent but would pay back eventually; and
Group 4: customers who are currently delinquent and would not pay back.

Group 1 is the soundest group among the four because the customers have not delayed payments and are predicted not to be delinquent. Thus the customers in Group 1 should be encouraged to apply for other loans. The customers in Group 2 also have not delayed payments yet, but they are expected to delay the future payments. Thus they should be controlled not to be delinquent in the future.

The customers in Groups 3 and 4 are currently delinquent. The appropriate procedures for them should be conducted in order to collect the delayed payments. Among the customers in the two groups, people in Group 3 have more chance to pay back than customers in Group 4, thus they are the most profitable customers who would pay back not only their principal but also incurred interests. Therefore, mild and gentle collection procedures should be conducted to the customers in Group 3 while thorough and active collection procedures should be conducted to the customers in Group 4.

In order to propose management strategies that suit the customers in each subgroup, we need to infer the characteristics of the groups. In inferring the characteristics of those, we use some input variables turned out to be significantly different among the groups.

3. Empirical analysis

3.1. Data

The data used for this study is 'German credit' data obtained from UCI Repository of Machine Learning Databases (http://www.niaad.liacc.up.pt/statlog/datasets.html). The data have been mostly used to compare performance of various classification tools (Lee, Chiu, Lu, & Chen, 2002; Lee & Huh, 2002; Paredes & Vidal, 2000; West, 2000). However, we analyze the characteristics of people to propose proper management strategies to those people according to their predicted credit status.

The data consist of a set of loans given to a total of 1000 applicants. The applicants are divided into two groups: those who were accepted and maintain good credit and those