

An integrated data mining and behavioral scoring model for analyzing bank customers

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Abstract

Analyzing bank databases for customer behavior management is difficult since bank databases are multi-dimensional, comprised of monthly account records and daily transaction records. This study proposes an integrated data mining and behavioral scoring model to manage existing credit card customers in a bank. A self-organizing map neural network was used to identify groups of customers based on repayment behavior and recency, frequency, monetary behavioral scoring predictors. It also classified bank customers into three major profitable groups of customers. The resulting groups of customers were then profiled by customer's feature attributes determined using an Apriori association rule inducer. This study demonstrates that identifying customers by a behavioral scoring model is helpful characteristics of customer and facilitates marketing strategy development.

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1. Introduction

Contemporary marketing strategies perceive customers as important resources to an enterprise. Therefore, it is essential to enterprises to successfully acquire new customers and retain high value customers. To achieve these aims, many enterprises have gathered significant numbers of large databases, which then can be analyzed and applied to develop new business strategies and opportunities.

However, instead of targeting all customers equally or providing the same incentive offers to all customers, enterprises can select only those customers who meet certain profitability criteria based on their individual needs or purchasing behaviors (Dyche & Dych, 2001). Credit scoring and behavioral scoring are techniques that help decision makers to realize their customers. Credit scoring models help to decide whether to grant credit to new applicants by customer's characteristics such as age, income and marital status (Chen & Huang, 2003). Behavioral scoring models help to analyze purchasing behavior of

existing customers (Setiono, Thong, & Yap, 1998). These two scoring models are highly related to the field of classification analysis by statistical analysis (Hand, 1981; Johnson & Wichern, 1998), especially classification analysis by neural networks in the field of data mining (Lancher, Coats, Shanker, & Fant, 1995).

Until now, most existing data mining approaches have been discovering general rules (Agrawal, Imielinski, & Swami, 1993; Bult & Wansbeek, 1995; Setiono et al., 1998), predicting personal bankruptcy (Dasgupta, Dispensa, & Ghose, 1994; Desai, Crook, & Overstreet, 1996; Zhang, Hu, Patuwo, & Indro, 1999) and credit scoring (Kim & Sohn, 2004; Lancher et al., 1995; Sharda & Wilson, 1996) in bank databases. Few works have studied the mining of bank databases from the viewpoint of customer behavioral scoring (Sharda & Wilson, 1996). More specifically, we wanted to look at both the account data of the customers and their credit card transactions. With these data, the aim was to discover interesting patterns in the data that could provide clues about what incentives a company could offer as better marketing strategies to its customers. As shown in Fig. 1, this study presents a two-stage approach for behavioral scoring analysis of implicit knowledge using bank customer account and transaction data. Topics discussed include data

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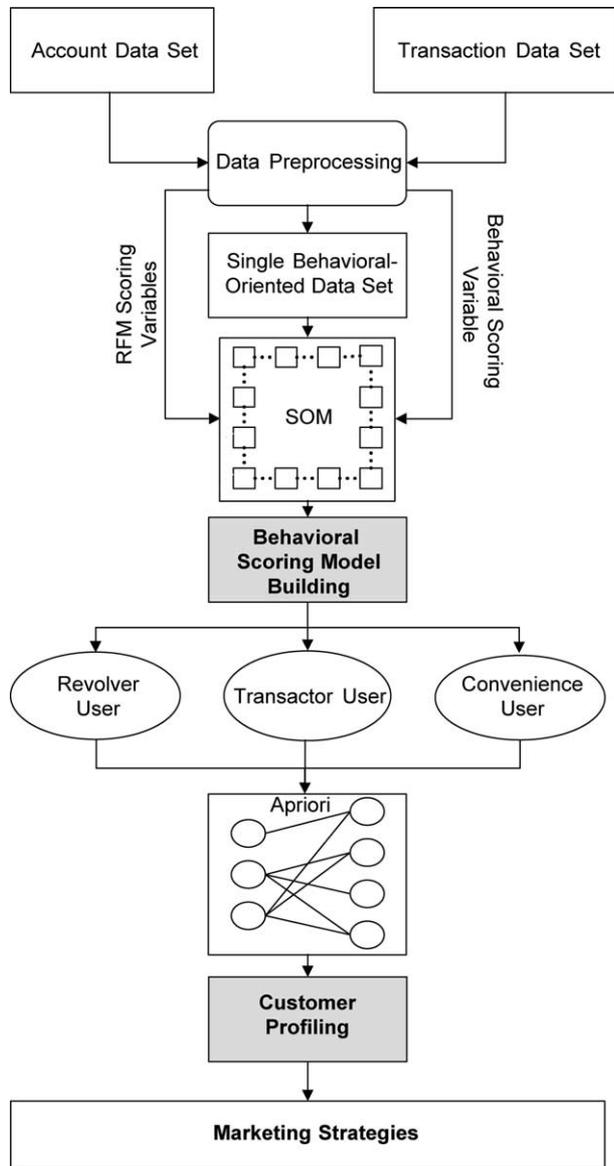


Fig. 1. Two-stage behavioral scoring modeling.

preprocessing, customer behavior scoring modelling, sensitivity analysis of relative importance attributes contributing to the customer profiling, and the two stages of the behavioral scoring model itself.

The key feature of the two-stage behavioral scoring model is a cascade involving self-organizing map (SOM) and an Apriori association rule inducer. An SOM (Kim & Sohn, 2004; Kohonen, 1995) is an unsupervised learning algorithm that relates multi-dimensional data as similar input vectors to the same region of a neuron map, and Apriori (Agrawal et al., 1993) is mainly used to find out the potential relationships between items or features that occur synchronously in the database. In the first stage of the approach presented here, a conceptual customer behavioral scoring model was established to predict profitable groups of customers based on previous repayment behavior and RFM (Bult & Wansbeek, 1995) behavioral scoring

predicators. This SOM was employed to classify customers into three major profitable groups of customer: revolver user, transactor user, and convenience user.

Once the SOM identified the profitable groups of customers, an Apriori profiled each group of customers focusing on demographic and geographic characteristics for building and maintaining the most profitable customer base. The customer profile then was used to describe a representative case in each group of customers, and served as a tool for establishing better bank marketing strategies. After analyzing the bank database, this study demonstrates that customer behavior scoring models are an effective method for banks to realize their most profitable customers. We conclude by analyzing target groups of customers using the proposed two-stage behavioral scoring model.

For a better understanding of our solutions, this study is organized as follows. Section 2 makes a description of the analyses methodology. An integrated data mining and behavioral scoring model was presented. Section 3 assesses neural networks as a tool for customer segmentation while using past repayment behavior and RFM scoring variables to build behavioral scoring models. Section 3 also presents the processes of creating customer profiles according to their feature attributes as determined by an Apriori association rule inducer. Finally, conclusions are made in Section 4.

2. Description the analyses methodology

2.1. Credit and behavioral scoring models

Credit and behavioral scoring models (Thomas, 2000) are one of the most successful applications of statistical and operational research modelling in finance and banking, and the number of scoring analysts in the industry is constantly increasing. The main objective of both credit and behavioral scoring models is to classify customers into groups (Lancher et al., 1995). Hence scoring problems are related to the field of classification analysis (Hand, 1981; Johnson & Wichern, 1998; Morrison, 1990). Applying to bank databases, classification analysis for credit scoring is used to categorize a new applicant as either accepted or rejected with respect to his features such as age, income and marital status (Chen & Huang, 2003). On the other hand, classification analysis for behavioral scoring is used to describe the behavior of existing customers by using behavioral scoring variables and also to predict future purchasing behavior or credit status of existing customers (Setiono et al., 1998).

Until now, the building of both scoring models has been always based on a pragmatic approach; because of this, the best and most standard scoring models for every unique circumstance most certainly does not exist. Most previous studies have focused on building more accurate credit or behavioral scoring models and increasing the accuracy of the classification model with various kinds of statistical

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