Mining changes in customer behavior in retail marketing

Mu-Chen Chen[a,*], Ai-Lun Chiu[b], Hsu-Hwa Chang[c]

[a]Department of Business Management, National Taipei University of Technology, No. 1, Section 3, Chung-Hsiao E. Road, Taipei 106, Taiwan, ROC
[b]SAS, Taipei, Taiwan, ROC
[c]Department of Business Administration, National Taipei College of Business, Taipei, Taiwan, ROC

Abstract

During the past decade, there have been a variety of significant developments in data mining techniques. Some of these developments are implemented in customized service to develop customer relationship. Customized service is actually crucial in retail markets. Marketing managers can develop long-term and pleasant relationships with customers if they can detect and predict changes in customer behavior. In the dynamic retail market, understanding changes in customer behavior can help managers to establish effective promotion campaigns. This study integrates customer behavioral variables, demographic variables, and transaction database to establish a method of mining changes in customer behavior. For mining change patterns, two extended measures of similarity and unexpectedness are designed to analyze the degree of resemblance between patterns at different time periods. The proposed approach for mining changes in customer behavior can assist managers in developing better marketing strategies.
© 2005 Elsevier Ltd. All rights reserved.

Keywords: Data mining; Association rules; Retailing; Customer behavior; Change patterns

1. Introduction

Customized service is actually crucial in retail markets. Customized service has become a key issue in developing customer relationships. Marketing managers can develop long-term and pleasant relationships with customers if they can detect and predict changes in customer behavior. In the past, researchers generally applied statistical surveys to study customer behavior. Recently, however, data mining techniques have been adopted to predict customer behavior (Giudici & Passerone, 2002; Song, Kim, & Kim, 2001).

Data mining techniques search through a database without any specific pre-determined hypothesis to obtain implicit, previously unknown, and potentially useful information including knowledge rules, constraints and regularities (Chen, Han, & Yu, 1996). Data mining is a stage in Knowledge Discovery in Databases (KDD), involving the application of specific algorithms for pattern extraction (Mitra, Pal, & Mitra, 2002). Various successful applications have been reported in areas such as marketing, finance and banking. Applications in these domains generally involve the collection and storage of large amounts of data.

Data mining brings various techniques together to discover patterns (rules) and to construct models from databases. Currently businesses face the challenge of a constantly evolving market where customer needs are changing all the time. In such a situation, change mining can enable market analysts to better understand changes in customer needs and how those needs change. Change mining is more appropriate in dynamic business environments, and involves extensive human intervention (Song et al., 2001).

Retail market managers must not only provide high-quality products and services, but also must react appropriately to changes in customer needs. Data mining can be applied to identify useful customer behavior patterns from large amounts of customer and transaction data (Giudici & Passerone, 2002). As a result, the discovered information can be ascertained to support better decision-making in retail marketing. Data mining techniques have mostly been adopted to generate predictions and describe behaviors. Relatively little research has focused on mining changes in databases collected over time (Liu, Hsu, Han, & Xia, 2000).

---

* Corresponding author. Tel.: +886 2 2771 2171x3417; fax: +886 2 2776 3964.

E-mail address: bmcchen@ntut.edu.tw (M.-C. Chen).

In the dynamic retail market, understanding changes in customer behavior can help managers to establish effective promotion campaigns (Song et al., 2001). Liu et al. (2000) devised a method of change mining in the context of decision trees for predicting changes in customer behavior. Since decision tree is a classification-based approach, it cannot detect complete sets of changes (Song et al., 2001). Association rule extraction was widely used for analyzing the correlation between product items purchased by customers, and to support sales promotion and market segmentation (Changchien & Lu, 2001; Changchien, Lee, & Hsu, 2004). Song et al. (2001) employed an approach based on association rules to identify changes in customer behavior.

Most previous customer behavior studies applied customer demographic variables to analyze customer behavior (Song et al., 2001). However, valuable customer behavioral variables, such as recency, frequency, and monetary (RFM), can be used to differentiate customer contributions to a business (Miglautsch, 2000; Stone, 1995; Suh, Noh, & Suh, 1999; Tsai & Chiu, 2004). Researchers have observed that RFM is a widely used technique for customer behavioral analysis that can effectively investigate customer values and segment markets. Customer behavioral variables, RFM, respectively, measure the recency of customer purchasing behavior, the frequency of purchasing, and the average monetary expenditure on purchasing. RFM can be transformed using customer and transaction databases.

This study attempts to integrate customer behavioral variables (RFM), demographic variables, and transaction database to establish a method of mining changes in customer behavior. Song et al. (2001) designed two measures of similarity and unexpectedness to analyze the degree of resemblance between patterns at different time periods. However, these two measures are limited to the analysis of patterns with a single attribute on the right-hand-side (consequent part) of an association rule. This study designs two modified measures of similarity and unexpectedness to overcome the above limitations. In this study, the data required for analysis are integrated and transformed from customer, product, and transaction databases. The proposed approach for mining changes in customer behavior can assist managers in developing better marketing strategies.

2. Mining customer behavior changes

In this study, customer behavior patterns are first identified using association rule mining. Following the association rules of customer behavior are discovered, the changes in customer behavior are identified by comparing two sets of association rules generated from two datasets of different periods. Based on previous studies, changes in customer behavior include emerging patterns, added patterns, perished patterns, and unexpected patterns (Dong & Li, 1999; Liu & Hsu, 1996; Liu, Hsu, Mun, & Lee, 1999; Padmanabhan & Tuzhilin, 1999; Song et al., 2001). The discovered change patterns can be further explained and assessed to provide a basis for formulating marketing strategies. Fig. 1 illustrates the flowchart of change mining for customer behavior. Further details of the change mining procedure are discussed below.

2.1. Data pre-processing

Prior to analysis, data accuracy and consistency must be ensured to obtain truthful results. Generally, some useful variables can be hidden in a large quantity of raw data, and thus can be obtained through data integration and transformation. Customer behavioral variables (RFM) are hidden in customer and transaction databases, and can be extracted from data integration and transformation. Since the data required for analyzing association rules must be discrete, continuous variables are transformed to discrete variables, and a simple 3-4-5 rule is applied (Han & Kamber, 2001).

In RFM, recency represents the interval between the most recent transaction time of individual customers and the evaluation time (Stone, 1995). Moreover, frequency represents the number of purchases by individual customers during a specific period. Additionally, monetary represents the average expenditure of a customer during a specific period. Individual customers' recency, frequency, and monetary are scored to calculate the value of the purchasing behavior of each customer. This study adopts the RFM scoring approach of Miglautsch (2000) to transform the customer behavioral variables.
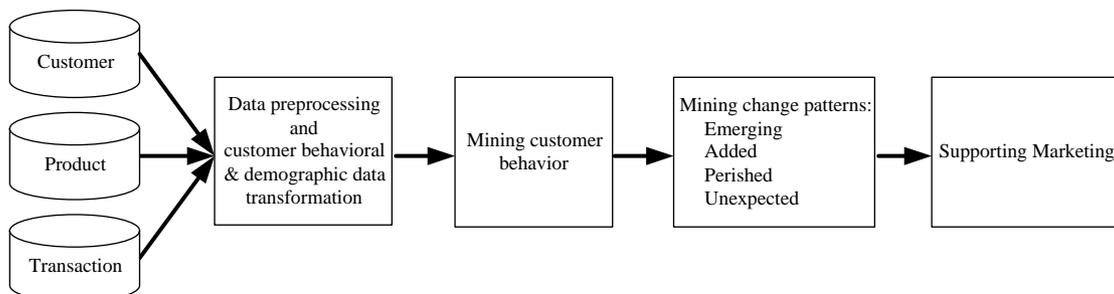
Fig. 1. Flowchart of mining changes for customer behavior.