Knowledge Extraction from a Computational Consumer Model Based on Questionnaire Data Observed in Retail Service

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ABSTRACT

In service industries, matching the level of demand of the consumer and the level of service of the provider is important because it requires the service provider to have knowledge of consumer-related factors. Therefore, an intelligent model of the consumer is needed to estimate such factors because they cannot be observed directly by the service provider. This paper describes a method for computational modeling of the consumer by understanding his or her behavior based on datasets observed in real services. The proposed method constructs a probabilistic structure model by integrating questionnaire data and a Bayesian network, which incorporates nonlinear and non-Gaussian variables as conditional probabilities. The proposed method is applied to an analysis of the requested function from customers regarding the continued use of an item of interest. The authors obtained useful knowledge for function design and marketing from the constructed model by a simulation and sensitivity analysis.

Keywords: *Bayesian Network, Consumer Behavior Model, Data Modeling, Knowledge Extraction, Service Engineering*

INTRODUCTION

The concepts of values and lifestyles of consumers have become increasingly diverse. The demand of a consumer can vary over time depending on the situation or the state of mind of the consumer. A good situation for the consumer and the service provider is a matching of the level of demand of the consumer and the level of service of the provider. This

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matching requires the service provider to have knowledge of consumer-related factors, such as the satisfaction level or the concept of value of the consumer. In order for the service provider to understand consumer-related factors, a consumer model that sufficiently explains the behavior of the consumer is necessary because these factors cannot be observed directly by the service provider. If we can clarify such factors, then the behavior of a consumer can be simulated using a consumer model in order to predict the behaviors of consumers. As such, the service provider is able to use the simulation results to match the demand and level of service at the contact point of the consumer and the service.

In marketing research, mass-marketing or mass-production methods are not useful in such cases. Marketing to such consumers requires focusing on small communities or individuals, for example, by segment marketing or one-to-one marketing. The realization of such marketing first requires an understanding of the consumer. An understanding of the behavior, satisfaction level, or values of the customer can lead to an improvement in customer satisfaction and productivity in service industries (Japanese Ministry of Economy, Trade and Industry, 2007).

Moreover, in service industries, customer relationship management (CRM), the goal of which is continued use of a product, brand, or service, is a significant concern. In order to achieve efficient CRM, it is necessary to understand consumer related factors. Such considerations have been examined, in a general manner, through questionnaire data or interviews, and massive amounts of such data has been collected and stored for the purposes of assessing customer satisfaction or understanding customer behavior. The useful and practical estimation of such considerations requires effective modeling of the customer based on such data. However, in a practical marketing situation, it is difficult to extract useful knowledge using conventional consumer behavior models because most conventional models are qualitative models, as described in detail later herein. Since the structure or property of a qualitative model often depends on the designer. On the other hand, quantitative models of customer behavior, as typified by statistical modeling, have also been investigated using a probabilistic choice model or a logistic model (Luce, 1959; Domencich & McFadden, 1975). However, addressing the consumer behavior and/or decision making, including nonlinear or non-Gaussian variables, as well as the interaction between variables, is difficult by conventional statistical modeling, which assumes linearity, a Gaussian distribution, and independence among variables. The structural equation model (Fornell & Larcker, 1981) has been actively applied to research on consumer behavior. However, this model is not able to handle the nonlinearity and non-Gaussian property of the variables.

The present paper describes a method for clarifying consumer-related factors by computational modeling of the consumer based on questionnaire datasets for real services. The proposed method constructs probabilistic consumer models by combining a questionnaire data and a Bayesian network (Jordan, 1998; Pearl, 2000; Motomura & Kanade, 2005). The Bayesian network can deal with nonlinear and non-Gaussian variables as conditional probabilities. The model structure can be constructed automatically based on information criteria and can embed some of the experiences of the model designer and/or physical or social rules in advance. The proposed method is applied to an analysis of the requested function from customers regarding a product (customizable shoe insert) with a focus on the continued use of the product. We attempt to obtain useful knowledge for function design and marketing from the constructed model through a simulation and sensitivity analysis.

Figure 1 shows a schematic diagram of the proposed method for matching optimization at the contact point between the consumer and the provider. Service providers can use the consumer model to clarify consumer-related factors if the model sufficiently explains the behavior of the consumer.

The remainder of the present paper is organized as follows. In the following section, we review research on consumer behavior