Chapter III

Using Neural Networks to Model Premium Price Sensitivity of Automobile Insurance Customers

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This paper describes a neural network modelling approach to premium price sensitivity of insurance policy holders. Clustering is used to classify policy holders into homogeneous risk groups. Within each cluster a neural network is then used to predict retention rates given demographic and policy information, including the premium change from one year to the next. It is shown that the prediction results are significantly improved by further dividing each cluster according to premium change. This work is part of a larger data mining framework proposed to determine optimal premium prices in a data-driven manner.

INTRODUCTION

Insurance companies operate in an environment which becomes increasingly competitive. In order to succeed in this environment insurance companies strive for a combination of market growth and profitability, and these two goals
are at times conflicting. Premium prices play a critical role in enabling insurance companies to find a balance between these two goals. The challenge is to set premium prices so that expected claims are covered and a certain level of profitability is achieved, yet not to set premium prices so high that market share is jeopardized as consumers exercise their rights to choose their insurers.

Insurance companies have traditionally determined premium prices by assigning policy holders to pre-defined groups and observing the average behavior of each group. The groups are formed based on industry experience about the perceived risk of different demographic groups of policy holders. With the advent of data warehouses and data mining however comes an opportunity to consider a different approach to premium pricing: one based on data-driven methods. By using data mining techniques, the aim is to determine optimal premiums that more closely reflect the genuine risk of individual policy holders as indicated by behaviors recorded in the data warehouse.

In previous work we have proposed a data mining framework for tackling this problem (Smith et al., 2000; Yeo et al., 2001). This framework comprises components for determining risk groups, predicting claim costs and determining the sensitivity of policy holders to premium change, and combining this information to determine optimal premium prices that appropriately balance profitability and market share. Recently we have presented the results of the first component where clustering techniques are used to define risk groups and predict claim costs (Yeo et al., 2001). The purpose of this paper is to investigate the second component of the data mining framework: modelling the effect of premium price changes on the customer retention rate.

In the next section, we review the data mining framework employed in this study. A case study approach utilizing a database of over 330,000 policy holders is used to evaluate the effectiveness of various techniques within this framework. The third section summarizes the previously published results for risk group classification. The use of neural networks for modelling retention rates under various premium changes is then discussed in the fourth section. A strategy for improving the retention rate prediction by dividing the data into more homogeneous groups and using separate neural network models for each group is presented, and the results are compared to a single neural network model. Computational results of prediction error rates are presented in fifth section for all risk classification groups. Conclusions are drawn in the final section, where future research areas are identified.
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