Chapter IX

Predicting Consumer Situational Choice with Neural Networks

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ABSTRACT

This study shows how neural networks can be used to model posterior probabilities of consumer choice and a backward elimination procedure can be implemented for feature selection in neural networks. Two separate samples of consumer choice situations were selected from a large consumer panel maintained by AT&T. Our findings support the appropriateness of using neural networks for these two purposes.
INTRODUCTION

In recent years, there has been an upsurge in the business applications of artificial neural networks (ANNs) to forecasting and classification. Examples include prediction of bank bankruptcies (Tam & Kiang, 1992), success in joint ventures (Hu et al., 1996, 1999a), consumer choices (Kumar et al., 1995; West et al., 1997), derivative/option, stock prices (Lo, 1996; Refenes et al., 1996), and forecasting of currency exchange rates (Hu et al., 1999b), to name a few. An extensive review of forecasting models using ANNs is provided in Zhang et al. (1998). Despite this upsurge, many market researchers still treat ANNs as black boxes. However, just like any statistical model, neural networks must be carefully modeled for the application to be successful. In this study, we consider the various aspects of building neural network models for forecasting consumer choice. Specifically, a situational consumer choice model is constructed, and neural networks are used to predict what product or service a consumer will choose. Our approach relies on the estimation of posterior probabilities for consumer choice. The posterior probability, being a continuous variable, allows more interesting analysis of the relationships between consumer choice and the predictor variables.

The type of ANNs that we consider are multi-layer feedforward networks. Probably the most popular training method for such networks is back-propagation (Rumelhart et al., 1986). In this study, we use the algorithm developed by Ahn (1996) for training. As feedforward networks are now well established and discussions can be found in most textbooks on neural networks, they will not be presented here. But, one frequent and valid criticism of neural networks is that they can not explain the relationships among variables. Indeed, since neural networks usually use nonlinear functions, it is very difficult, if possible at all, to write out the algebraic relationship between a dependent and independent variable. Therefore, traditional statistical relationship tests — on regression parameters, for example — are either impossible or meaningless. A typical approach in neural network modeling is to consider the entire network as a function and just investigate the predicted value of a dependent variable against the independent variables. In this chapter, such analysis is reported. In addition, we highlight two modeling issues when using neural networks:

- **Model selection.** Selection of an appropriate model is a nontrivial task. One must balance model bias (accuracy) and model variance (consistency). A more complex model tends to offer smaller bias (greater accuracy), but also greater variance (less consistency). Among neural networks, a larger network tends to fit a training data set better, but perform more poorly when it is applied to new data.
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