Chapter 12
Forecast Analysis for Sales in Large-Scale Retail Trade

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ABSTRACT

In large-scale retail trade, a very significant problem consists in analyzing the response of clients to product promotions. The aim of the project described in this work is the extraction of forecasting models able to estimate the volume of sales involving a product under promotion, together with a prediction of the risk of out of stock events, in which case the sales forecast should be considered potentially underestimated. Our approach consists in developing a multi-class classifier with ordinal classes (lower classes represent smaller numbers of items sold) as opposed to more traditional approaches that translate the problem to a binary-class classification. In order to do that, a proper discretization of sales values is studied, and ad hoc quality measures are provided in order to evaluate the accuracy of forecast models taking into consideration the order of classes. Finally, an overall system for end users is sketched, where the forecasting functionalities are organized in an integrated dashboard.

INTRODUCTION

Important business decisions and organization require a scientific framework to make systematic analysis of alternatives, as recognized since Taylor's classic work "The Principles of Scientific Management" (Taylor, 1911), that essentially marks the beginning of the Decision Science field.

A fundamental task in decision science is forecasting, involved in most decision making processes, sometimes even at an unconscious level. The basic idea is that the known history of the market (global or limited to a single company organization) can help to induce reasonable guesses of the effects of an action, therefore providing a valuable support in evaluating the several alternatives business managers typically have to sift through, and in choosing the most promising one.

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Forecasting in the business context, and sales forecasting in particular, can be studied and applied at several different levels:

- in global market analysis, also called the macro level, where offers and demands are studied in the general context of global market without a specific focus on single products or services;
- in sector- or product-specific market analysis, also called the micro level, where the above analysis is focused on single or families of products/services;
- in within-company market analysis, where the focus is in ascertaining the health status of the company activities, mainly in a evolution perspective that allows to recognize trends and possible weak points (actual or future), and in evaluating the future overall effects of actions to be taken within the company;
- in within-company product-specific sales analysis, where a single product is put under the lens of a microscope and analyzed in detail, highlighting its performances and its reactions to various kinds of inter-company stimuli (e.g., promotions or change of exposition level) and external ones (e.g., the introduction in the market of a new competitor product).

The aim of this work is to analyze a real case study in the latter context, focusing on the effects of promotions on the sales of a single product, mainly aimed at optimizing its stoking. The closed world context of such analysis, on one hand simplifies the forecasting problem by omitting external factors that are difficult to handle and that, in some cases, might have a large uncertainty; on the other hand, it allows to work with a complete and detailed history of previous sales, precise measures directly collected by the company, and even permits (to an economically-limited extent) to empirically evaluate models and strategies on the ground, by replicating situations and later measuring the effects.

This chapter contributes to two main topics covered by this book, namely the role and impact of data mining in the management and in the decision making tasks within private organizations. In particular, the chapter provides a view of both methodological aspects of the problem, technical solutions adopted, and empirical results on the field.

Coop Italia is today the largest holding of large retailers and the largest organization of consumers of Italy. Overall, Coop Italia includes 163 consumer cooperatives with approximately 1261 stores, 6 million members and over 52,000 employees. As part of this large organization, Unicoop Tirreno is a great reality of organized distribution that is present in Tuscany, Lazio, Umbria and Campania with 112 stores (in 3 different size store), more than 770,000 members and approximately 6,300 employees. In 2007 it exceeded 1.16 billion euro of total sales.

In this context Unicoop Tirreno decided to develop Business Intelligence solutions, reactive to market changes, and start the project Business Intelligence and Data Warehouse (BI-Coop). The objectives of the BI-Coop project can be summarized as follows: (one) to create and populate a data warehouse from the operational data and to create interactive data reports (two) to develop forecasting models through the use of data mining technologies. In particular, data mining is used to predict customer defection and promotion sales previsions.

In this paper we describe the methodology and results obtained on models for promotion sales. This forecasting task can use only promotion features and sales data over the recent past. Moreover, in order to face this problem, we need to consider a side effect of promotions: the so-called “out of stock” phenomenon, i.e. the event a store is found out of products to sell before the promotion is finished, a signal of an incorrect storage estimate and a cause of lost income. Out

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