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Monitoring and improving Greek banking services using Bayesian Networks: An analysis of mystery shopping data

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ABSTRACT

Mystery shopping is a well known marketing technique used by companies and marketing analysts to measure quality of service, and gather information about products and services. In this article, we analyse data from mystery shopping surveys via Bayesian Networks in order to examine and evaluate the quality of service offered by the loan departments of Greek Banks. We use mystery shopping visits to collect information about loan products and services and, by this way, evaluate the customer satisfaction and plan improvement strategies that will assist banks to reach their internal standards. Bayesian Networks not only provide a pictorial representation of the dependence structure between the characteristics of interest but also allow to evaluate, interpret and understand the effects of possible improvement strategies.

1. Introduction

The banking industry is a highly competitive and customer oriented organisation. Customer retention and attraction is a core element of its managing strategy; customer service is one of the factors allowing to differentiate a bank from its competitors.

Roughly speaking, customer satisfaction refers to the extent to which products and services supplied by a company meet or exceed customer expectation. Customer satisfaction levels can be measured using survey techniques and evaluation questionnaires. High levels of customer satisfaction indicate a good performance of the business since satisfied customers are most likely to be loyal to the specific company and use a wide range of services. Understanding which elements influence customer satisfaction is important not only to describe the actual situation but also to plan and implement possible improvement actions.

In this paper we use Bayesian Networks (BN hereafter) to analyse data gathered from mystery shoppers' report. To our knowledge, this is the first time that these techniques are used in combination. We present a real data analysis concerning customer evaluation of service provided by the loan unit of Greek Banks. For some recent works regarding customer satisfaction analysis of Greek Banks see e.g. Mihelis, Grigoroudis, Siskos, Politis, and Malandrakis (2001), Grigoroudis, Politis, and Siskos (2002), Mylonakis (2009) and Kagara and Voyiatzis (2010).

Mystery shopping is a well known marketing technique used by companies and marketing analysts to measure quality of service, and gather specific information about products and services. Nowadays, it is one of the most used techniques for performance evaluation of banks; see e.g. Schrader (2006), Sherman and Zhu (2006), Roberts and Campbell (2007) and references therein.

A BN is a probabilistic graphical model that represents a set of random variables and their conditional dependencies via a Directed Acyclic Graph (DAG). The use of a graph, as a pictorial representation of the problem at hand, simplifies model interpretation, and facilitates communication and interaction among experts with different backgrounds. For these reasons, BNs are widely applied in different fields for the analysis of multivariate data, see Neapolitan (2004).

Recently BNs have been successfully applied to the analysis of customer satisfaction data, see for example Salini and Kenett (2007) and Renzi, Vicard, Guglielmetti, and Musella (2009). Providing a DAG representation for the problem under investigation, BNs allow to easily identify the key elements influencing customer satisfaction. Furthermore they can be used to simulate improvement strategies, getting reliable results in a straightforward manner.

The paper is organised as follows. In Section 2.1 we present the mystery shopping methodology. BNs together with the procedure to construct them are illustrated in Sections 2.2 and 2.3. Section 3 is devoted to the application of BNs to service quality improvement in Greek Banks. Finally, in Section 4 we end up with some comments and final remarks.

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2. Background and preliminaries

2.1. Mystery shopping

Mystery shopping is a well established methodology which was introduced in the early 1940s primarily by the management of banks and retail chain stores to assess the integrity of their employees (Zikmund, Babin, Carr, & Griffin, 2009). Nowadays there are hundreds of companies providing services related to mystery shopping surveys (see for example http://www.mysteryshop.org/). For a comprehensive introduction and an exhaustive discussion on the topic we refer the reader to the publications of Wilson (2001) and Saha (2009).

Mystery shoppers are well trained individuals used to anonymously evaluate and monitor customer satisfaction and quality of the service in different sectors (*i.e.* top retail outlets, restaurants, cinemas, banks, theatres, travel companies, hotels, spas, cruise companies, airlines, amusement parks and leisure organizations). They act as normal or potential customers and make unannounced visits to the company. Through the use of mystery shoppers it is possible to monitor, not only the quality of the service, but also the efficiency of the process and the procedure followed to deliver the service. After each visit the mystery shoppers complete a predefined questionnaire report concerning their service experience. This report usually includes numerical ranking on a series of statements, check-lists, and open-ended questions regarding the shopper general impression. The results provided by such surveys can be used to evaluate and compare the performance of different companies or branches of the same company or individual employees. This information also assists company managers to monitor how the performance changes over time and to identify areas that require improvement.

Nowadays mystery shopping is one of the most popular techniques used to evaluate customer satisfaction in the banking sector. Banking mystery shoppers provide information about the quality of financial products, the efficiency of the bureaucratic procedures and the politeness of the employees, amongst others. The long-term aim of their visit is to identify areas that require improvement and, by this way, offer advice and information concerning managerial actions that will improve the overall profile of the company. To be more specific, banking mystery shoppers assess the administrative functions and interpersonal skills of bank employees. They evaluate sales effectiveness of platform and teller staff by analysing whether the bank staff listens to its customers, how friendly tellers are, how much time the customers take to get to a teller and many other aspects.

2.2. Bayesian Networks

A BN is a multivariate statistical model that uses a DAG to represent statistical dependencies among variables; see for example Jensen (1996) and Cowell, Dawid, Lauritzen, and Spiegelhalter (1999). It combines features of graph and probability theory. The term "Bayesian" does not refer to the Bayesian inferential paradigm, but is due to an efficient information propagation algorithm based on the Bayes theorem. More precisely, a BN is characterised by:

(i) a DAG showing the set of dependencies among variables and
(ii) an inferential engine to make inference on the parameters of the model.

Here we summarize the main elements and terminology about BNs that will be used in this paper. A DAG is a mathematical object defined by the pair $D = (V; E)$, where V is the set of nodes and E is the set of directed edges (arrows) connecting pair of nodes. Nodes represent the variables of interest of the studied problem. Here, each node is associated with a random variable (item of the questionnaire) relative to one of the characteristics of the Bank surveyed and reported by the mystery shopper. Arrows represent relations (or, more statistically speaking, dependencies) between variables. The directed graph is said acyclic (DAG) since cycles are forbidden, *i.e.* it is not possible to start from a variable (node) and, following the directions of the arrows/edges, go back to the starting node. An example of DAG is provided in Fig. 1. If an arrow points from variable X_i to variable X_j then X_i is called parent of X_j, denoted by $pa(X_j)$, and the two variables are dependent. For example in Fig. 1 variables X_1 and X_5 are parents of X_4.

The graph can be used to describe and read marginal and conditional independencies among the variables under consideration. The absence of an edge between two variables might indicate a conditional independence statement. Let us consider variables X_1 and X_3 in Fig. 1. In order to go from node X_1 to node X_3 it is necessary to pass by node X_4. This allows us to say that variables X_1 and X_3 are independent conditionally on variable X_4, and therefore, knowing the observed value of variable X_4, variable X_1 becomes uninformative for X_3. In other words, suppose X_3 denotes the overall satisfaction, X_4 has a direct effect while X_1 an indirect effect on it. Therefore if an intervention on X_4 is done, intervening on X_1 has no additional effect on the overall satisfaction (X_3). In general any graph configuration such as $X_i \to X_j \to X_k$, indicates that variables X_i and X_k are independent given X_j. Consider now variables X_2 and X_4 in Fig. 1; they are separated by node X_1 and therefore they are independent conditionally on variable X_1. In general for a graph configuration such as $X_i \leftarrow X_j \to X_k$, we have that variables X_i and X_k are independent given X_j. This means that if two quality aspects, say X_i and X_k have a common parent X_j, then an intervention on X_j makes X_i and X_k independent.

Differently from the previous two cases, a graph configuration such as $X_i \to X_j \leftarrow X_k$ indicates that variables X_i and X_k are dependent given X_j. For example, if we consider nodes X_1 and X_5 in Fig. 1, they are not independent given node X_4, that is having information about variable X_4 makes its two parents, *i.e.* X_1 and X_5, dependent. For a detailed and rigorous account on the methods used to read independencies from a DAG we refer to Lauritzen (1996).

Given a network for K variables (*i.e.* the set of nodes V is made up of K nodes), each node X_i, $i \in V$, is associated with the conditional probability distribution of the corresponding variable of interest given its parents, $p(X_i|pa(X_i))$. We can factorise the joint probability distribution of $(X_1,\ldots,X_K)$ according to the dependencies encoded in the DAG

$$p(X_1,\ldots,X_K) = \prod_{i\in V} p(X_i|pa(X_i)). \tag{1}$$

If a node, say X_i, has no parents then it is associated with the marginal distribution of X_i, $p(X_i)$. For the DAG in Fig. 1 we have:

$$p(X_1,X_2,X_3,X_4,X_5) = p(X_1)p(X_2|X_1)p(X_3|X_4)p(X_4|X_1,X_5)p(X_5).$$

In order to use BNs, the graphical structure must be first specified and the corresponding parameters of the distributions in (1) must

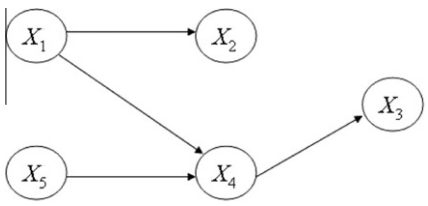

Fig. 1. An example of DAG.