Applying Machine Learning to the Development of Prediction Models for Bank Deposit Subscription

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ABSTRACT

It is not easy for banks to sell their term-deposit products to new clients because many factors will affect customers' purchasing decisions and because banks may have difficulties in identifying their target customers. To address this issue, the authors use different supervised machine learning algorithms to predict if a customer will subscribe a bank term deposit and then compare the performance of these prediction models. Specifically, the current paper employs these five algorithms: naïve bayes, decision tree, random forest, support vector machine, and neural network. This paper thus contributes to the artificial intelligence and big data field with an important evidence of the best performed model for predicting bank term deposit subscription.

KEYWORDS

Machine Learning, Naïve Bayes, Decision Tree, Random Forest, Support Vector Machine, Neural Network

INTRODUCTION

In the past few decades, banks have experienced some problems of selling their term-deposit products to new clients (Elsalamony, 2014). This is mainly due to the fact that it is difficult for banks to figure out who are their target customers and that many factors will affect a customer's decision to purchase a term deposit (Moro et al., 2014). Meanwhile, more and more customers start to complain about the irrelevant phone calls received from banks (Elsalamony, 2014). To address these business issues, banks start to leverage their huge customer data to gain insight into customer behavior and buying preferences, and thus to improve their marketing effectiveness (Moro et al., 2014). This strategic business initiative relies on artificial intelligence and Big Data technologies.

Artificial intelligence refers to using computer systems to perform tasks that normally require human intelligence and can be considered as a concept broader than machine learning, even though

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they are often used interchangeably (Bali et al., 2017). Nowadays, more and more organizations are employing artificial intelligence and Big Data to gain an edge over the rest of the market. There are a variety of machine learning based predictive techniques to be used to predict if customers will subscribe a term deposit. Many researchers consider machine learning as one of the most useful research methodologies to transform data into intelligent action and to capture the meaningful information and hidden patterns from the historic datasets (Kohavi & Provost, 1998).

In this paper, we use machine learning with R to develop prediction models to forecast whether customers will purchase bank term-deposit products. Five different machine learning algorithms have been employed: Naïve Bayes (NB), Decision Tree (DT), Random Forest (RF), Support Vector Machine (SVM), and Neural Network (NN). A real dataset from a European bank has been used for this research. The dataset includes 45221 observations and 21 variables. The current study uses R to analyze the data and to examine the results. Below, we present the details about the design and implementation of this research.

RESEARCH QUESTIONS

It is always challenging for banking institutions to market to new potential clients and to retain them successfully for a long time. To reach out to profitable customers, banks often deploy mediums such as social media, digital media, customer service, and strategic partnerships. But would it be possible for a bank to accurately market to a specific location, community, and group of people? Fortunately, with the inception of machine learning technologies, banking institutions can leverage their data and analytics solutions to reach out to specific target clients, and to accurately and intelligently predict which customers are more likely to purchase financial products and services.

The objective of this study is to (1) explain how a banking institution can utilize its client data and machine learning technology to predict which client would subscribe to a bank term deposit, (2) use five different machine learning algorithms to build up five predictive models, and (3) compare these five predictive models and find out which algorithm is best suited for term deposit subscription prediction. By doing so, our aim is to address two main research questions: (1) whether client purchasing behavior is predictable and how accurate the prediction can be? and (2) which machine learning algorithm would be more effective in such a prediction task? This study thus helps IS researchers expand their baseline knowledge of different machine learning algorithms, better understand how to build various predictive models, and more effectively design and conduct research on financial client behavior.

RESEARCH METHODOLOGY

A time deposit or term deposit is a deposit with a specified period of maturity and earns interest (Kagan, 2020). In other words, it is a money deposit at banking institution that cannot be withdrawn for a specific term or period unless a penalty is paid (Kagan, 2020). Although banks have various outreach plans to raise the capitals, one key plan is through engaging in direct marketing campaigns to sell their deposit products to clients. Therefore, identifying potential clients is of key importance for any banking institution. With the development of artificial intelligence, identifying potential clients becomes more feasible and manageable. Machine learning, as a powerful form of artificial intelligence, is one of the most exciting technological developments in history. Machine learning based predictive techniques can help banks determine which customers are more likely to subscribe a term deposit. Therefore, it is worthwhile for researchers to analyze historic datasets by making a prediction model to forecast whether clients will subscribe a term deposit (Elsalamony, 2014).

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