Evaluating Marketing Campaigns of Banking Using Neural Networks

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Abstract—Marketing campaigns of banking institutions is vital in all banks. The marketing campaigns were based on phone calls. Phone calls have an important influence in the behavior of customers. This paper proposed neural network to evaluate the bank marketing. This assessment will highlight the importance of marketing in the banks and thus the importance of phone calls. A feed-forward back propagation neural network with tan-sigmoid transfer functions is used in this paper to predict if the customer subscribes the deposit. The data set is obtained from UCI machine learning repository. The results of applying the proposed neural network methodology to predict subscribe based upon selected phone calls parameters show abilities of the network to learn the patterns corresponding to customer subscribes the deposit. The percent correctly classified in the simulation sample by the proposed neural network is 90 percent.

Index Terms—Bank marketing, Banking advertisement, Business intelligence, Artificial neural networks and Feed-forward back propagation network.

I. INTRODUCTION

The increasingly vast number of marketing campaigns over time has reduced its effect on the general public. Furthermore, economical pressures and competition has led marketing managers to invest on directed campaigns with a strict and rigorous selection of contacts [1]. Mylonakis [2] examined the relationship between bank advertising and the needs of a bank customer in Greece and its possible influence on potential customers to select their banks. The research demonstrated the issue of customers’ indifference to advertising in their decision to cooperate with a bank. Advertising is not the determinant factor in their final choice. Selecting a banking institution is based on the traditional products and services it offers. However, its existence is a prerequisite, as it verifies a bank's critical presence in the market and plays an important role in customers’ choices. The examination of a banking institution is made based on price and product-related criteria and not promotion.

Charles et al. [3] investigated bank choice/selection criteria in a range of cultural and country economic scenarios. More specifically, the purpose of their study is to understand international consumers' selection criteria of banks using the USA, Taiwan, and Ghana as illustrations.
An artificial neural network (ANN) is a computational model that attempts to account for the parallel nature of the human brain. An (ANN) is a network of highly interconnecting processing elements (neurons) operating in parallel. These elements are inspired by biological nervous systems. As in nature, the connections between elements largely determine the network function. A subgroup of processing element is called a layer in the network. The first layer is the input layer and the last layer is the output layer. Between the input and output layer, there may be additional layer(s) of units, called hidden layer(s). Neural network can be train to perform a particular function by adjusting the values of the connections (weights) between elements. Fig. 2 represents a typical neural network with one hidden layer.

An ANN have been shown to be very promising systems in many forecasting applicati ons and business classification applications due to their ability to “learn” from the data, their non parametric nature and their ability to generalize.

### III. EXPERIMENTAL RESULTS

#### A. Data Analysis

The dataset is obtained from UCI Machine Learning Repository. The data is related with direct marketing campaigns of a Portuguese banking institution, based on phone calls. Often, more than one contact of the same potential customer was required, in order to determine if the product (bank term deposit) would (or would not) be bought. The goal is to predict if the customer will subscribe or not. With a valid prediction, the marketing department can focus on the most promising leads and increase the overall ROI of the campaign.

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<th>Table I: BANK CUSTOMER VARIABLE OF DATASETS USED IN THE STUDY</th>
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Data related to the last contact of the current campaign are:
1. Contact: contact communication type (telephone, cellular or unknown).
2. Day: last contact day of the month.
3. Month: last contact month of year.
4. Duration: last contact duration, in seconds.

Data related to the contact of the various marketing campaigns are:
1. Campaign: number of contacts performed during this campaign and for this customer.
2. Pdays: number of days that passed by after the customer was last contacted from a previous campaign.
3. Previous: number of contacts performed before this campaign and for this customer.
4. Poutcome: outcome of the previous marketing campaign.

The target is binary to predict if the customer will subscribe or not. The data is processed to be suitable input to the network using Microsoft Office Excel.

#### B. Performance Evaluation

A two-layer feed-forward network with 15 inputs and 20 sigmoid hidden neurons and linear output neurons was created as shown in Fig. 3. The dataset contains 4521 samples. Training is done using scaled conjugate gradient back propagation network. The scaled conjugate gradient algorithm (SCG) developed by Moller [8] was designed to avoid the time-consuming line search. This algorithm combines the model-trust region approach with the conjugate gradient approach.

The results of applying the proposed neural network to predict if the customer will subscribe or not based upon selected bank customer variables showed good abilities of the network to learn the patterns corresponding to customer subscribes the deposit. The results were good; the network was able to classify approximately 89% of the cases in the training set as shown in Fig. 4. Fig. 4 shows the confusion matrices for training, testing, and validation, and the three kinds of data combined. The diagonal cells in each table show the number of cases that were correctly classified, and the off-diagonal cells show the misclassified cases. The blue
The percent correctly classified in the simulation sample by the feed-forward back propagation network is approximately 90 percent as shown in Fig.7.

IV. CONCLUSION

Artificial neural networks have powerful pattern classification and prediction capabilities. In this study feed-forward back propagation neural network with tan-sigmoid transfer functions in both the hidden and the output layer is applied for predict if the customer subscribes the deposit thus evaluate the bank marketing. In all these cases neural networks performed better prediction and less variation across different subgroups.

REFERENCES