

Bank Marketing Customer Findings

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Background

- Goal - In this project, we aim to develop a predictive model that tells us whether or not the existing customer will sign up for a new term deposit through a telemarketing campaign. With this goal in mind, we have decided to anchor the project development based on the following question:

Will an existing bank customer subscribe to a new term deposit through a direct marketing campaign?

- **Data** - The dataset was generated by a telemarketing campaign run by a Portuguese bank. The campaign aimed to encourage the bank's existing customers to sign up for a new term deposit. The dataset contains approximately 45,000 observations with both quantitative and qualitative data on 20 attributes. 15 of the attributes are demographic and bank-related behavioural information, while the remaining attributes are macroeconomic indexes recorded at the time of data collection. Finally, the dataset includes the final result of the campaign that indicates the successful sign-ups.
- **Scope**- The scope of the project is to focus on studying the personal and direct attributes of the existing customers. The macroeconomic attributes are the external factors that are not considered at this point of our study.

Analysis - Decision Tree Tree

Figure 1 shows a depth-3 tree generated on this dataset for illusive purpose only. The full tree has a maximum depth of 6, which can be founded at here. The training sample size is 80% of the total size. The dependent variable is the **sign-up** variable, which carries two values indicated by **class=Yes**, **class=No** in each node. The left side of the tree contains a smaller group compared to the right side of the tree.

While running Cross Validation on the Decision Tree Classifier, the result in Figure 2 suggests that the maximum depth of 1 gives the highest model score. In order to expand the tree, we decided to pick the next best score which is the depth of 6 for the full tree.

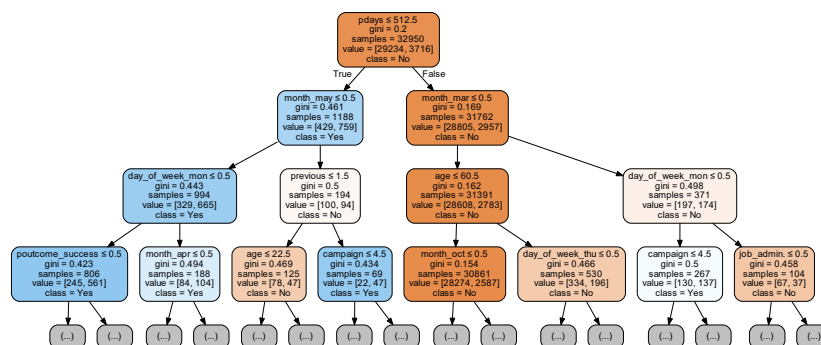


Figure 1: Decision Tree - Depth 3

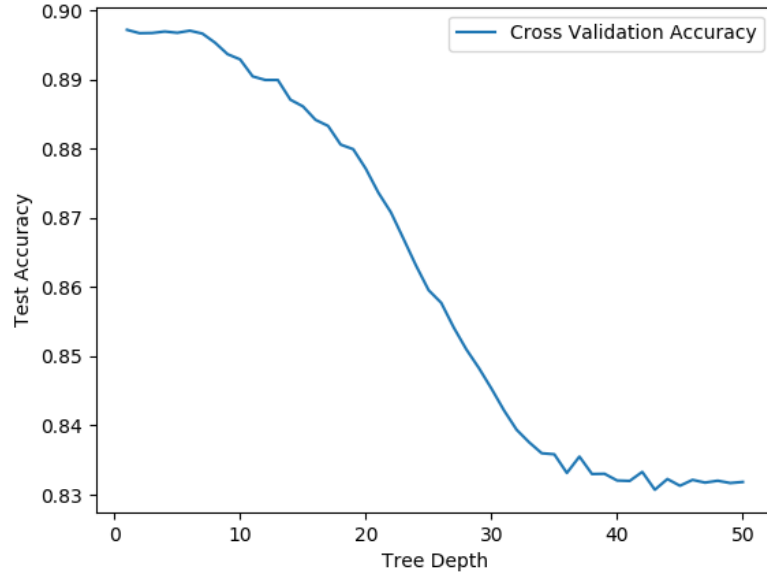


Figure 2: Cross Validation Score

Results

Feature Selection

The features the model selected as the most important, determined by the Gini Importance, are seen in Table 1 below. An interesting observation about these features is that all of them, besides age, are related to the timing of the call from the marketing campaign.

Model Accuracy

After cross validation to select the max depth hyperparameter value, the accuracy of the final model produced on the test data is seen in Table 2 below:

Table 1: Feature Importance

Feature	Feature-Importance
pdays	0.5636819
month_mar	0.0861684
age	0.0813169
month_jun	0.0657078
month_oct	0.0553642
contact_telephone	0.0435281
campaign	0.0137863
month_may	0.0089738
day_of_week_mon	0.0080626
month_apr	0.0080469

Table 2: Test Accuracy

X1	X2
Test Accuracy	0.8968196

Drawbacks and challenges

- Exploratory data analysis presentation - There are 15 qualitative and quantitative variables in the dataset, and each qualitative variable has its subcategories. Thus, it is challenging to bring all of the relevant variables together into one graph which could be helpful to explore the interdependence between the variables visually.
- Decision Tree Classifier - **pdays**: this variable contains numeric values that indicate the number of days, but it also includes '999', not as a numeric but a categorical value, to indicate that the customer was not previously contacted. This variable has the largest difference between the 'yes' and 'no' group within the target variable, so the tree chose this variable to begin the split. We believe that this may potentially distort the effectiveness of the tree.

Future work

Given the limited time we had for this project, we only explored the personal attributes at this point. In the future, we hope to expand our study to include the macroeconomic variables to understand the external environments that may indirectly affect the sign-up rate. For example, the macroeconomic indexes can indicate the right timing for the next telemarketing campaign. Such information will be useful for the telemarketing team.