Working Title: Predicting Customer Behavior Using a Portuguese Financial Institution Dataset

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2024-06-13

# 1. Summary/Abstract

This project will seek to identify a model for predicting consumer financial behavior using a dataset from a Portuguese Bank.

# 2. Introduction

## 2.1 General Background Information

Providing businesses with a model that will allow prioritization of consumers could save time and allow for a more accurate use of resources.

## 2.2 Description of data and data source

The data was donated on 2/13/2012. It was collected from phone call marketing campaigns performed by a Portuguese banking institution.I have accessed this data from the UC Irvine Machine Learning Repository.

There are 45,212 records, and includes: age, marital status, job, education,details related to the phone call, as well as answers related to questions about past credit history. Additionally, the classification variable is whether or not the person subscribed to a term deposit. There are 16 features in total.

## 2.3 Questions/Hypotheses to be addressed

The research question I plan to address with my analysis is which features or combination of features are the best predictors of consumers making a deposit. The desired output of this analysis is a model which allows a financial institution to better prioritize/make decisions regarding future marketing campaigns. I don’t currently have specific predictors in mind to begin with, as I plan to test all of the available features while also looking at some combinations or concatenation of features.

# 3. Methods

I want to first perform some EDA to identify if there are any variables with extreme variation or conversely if there some patterns that can be seen already. Then I will test for correlation between different features and proceed from there.

## 3.1 Schematic of workflow

## 3.2 Data aquisition

Data retrieved from UCI ML Repository

## 3.3 Data import and cleaning

### 3.3.1 Reading in the Data

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| Table 1: Data Snapshot  age job marital education default balance housing loan contact day 1 58 management married tertiary no 2143 yes no unknown 5 2 44 technician single secondary no 29 yes no unknown 5 3 33 entrepreneur married secondary no 2 yes yes unknown 5 4 47 blue-collar married unknown no 1506 yes no unknown 5 5 33 unknown single unknown no 1 no no unknown 5 6 35 management married tertiary no 231 yes no unknown 5  month duration campaign pdays previous poutcome y 1 may 261 1 -1 0 unknown no 2 may 151 1 -1 0 unknown no 3 may 76 1 -1 0 unknown no 4 may 92 1 -1 0 unknown no 5 may 198 1 -1 0 unknown no 6 may 139 1 -1 0 unknown no |

### 3.3.2 Dimensions:

dim(raw)

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| Table 2: Data Dimensions  [1] 45211 17 |

### 3.3.3 Describing raw data

str(raw)

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| Table 3: Data Description  'data.frame': 45211 obs. of 17 variables:  $ age : int 58 44 33 47 33 35 28 42 58 43 ...  $ job : chr "management" "technician" "entrepreneur" "blue-collar" ...  $ marital : chr "married" "single" "married" "married" ...  $ education: chr "tertiary" "secondary" "secondary" "unknown" ...  $ default : chr "no" "no" "no" "no" ...  $ balance : int 2143 29 2 1506 1 231 447 2 121 593 ...  $ housing : chr "yes" "yes" "yes" "yes" ...  $ loan : chr "no" "no" "yes" "no" ...  $ contact : chr "unknown" "unknown" "unknown" "unknown" ...  $ day : int 5 5 5 5 5 5 5 5 5 5 ...  $ month : chr "may" "may" "may" "may" ...  $ duration : int 261 151 76 92 198 139 217 380 50 55 ...  $ campaign : int 1 1 1 1 1 1 1 1 1 1 ...  $ pdays : int -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 ...  $ previous : int 0 0 0 0 0 0 0 0 0 0 ...  $ poutcome : chr "unknown" "unknown" "unknown" "unknown" ...  $ y : chr "no" "no" "no" "no" ... |

## 3.4 Statistical analysis

# 4. Results

## 4.1 Exploratory/Descriptive analysis

[Table 4](#tbl-summarytable) shows a summary of the data.

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| Table 4: Data summary table.   | skim\_type | skim\_variable | n\_missing | complete\_rate | factor.ordered | factor.n\_unique | factor.top\_counts | numeric.mean | numeric.sd | numeric.p0 | numeric.p25 | numeric.p50 | numeric.p75 | numeric.p100 | numeric.hist | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | factor | job | 0 | 1 | FALSE | 12 | blu: 9732, man: 9458, tec: 7597, adm: 5171 | NA | NA | NA | NA | NA | NA | NA | NA | | factor | marital | 0 | 1 | FALSE | 3 | mar: 27214, sin: 12790, div: 5207 | NA | NA | NA | NA | NA | NA | NA | NA | | factor | education | 0 | 1 | FALSE | 4 | sec: 23202, ter: 13301, pri: 6851, unk: 1857 | NA | NA | NA | NA | NA | NA | NA | NA | | factor | default | 0 | 1 | FALSE | 2 | no: 44396, yes: 815 | NA | NA | NA | NA | NA | NA | NA | NA | | factor | housing | 0 | 1 | FALSE | 2 | yes: 25130, no: 20081 | NA | NA | NA | NA | NA | NA | NA | NA | | factor | loan | 0 | 1 | FALSE | 2 | no: 37967, yes: 7244 | NA | NA | NA | NA | NA | NA | NA | NA | | factor | contact | 0 | 1 | FALSE | 3 | cel: 29285, unk: 13020, tel: 2906 | NA | NA | NA | NA | NA | NA | NA | NA | | factor | month | 0 | 1 | FALSE | 12 | may: 13766, jul: 6895, aug: 6247, jun: 5341 | NA | NA | NA | NA | NA | NA | NA | NA | | factor | poutcome | 0 | 1 | FALSE | 4 | unk: 36959, fai: 4901, oth: 1840, suc: 1511 | NA | NA | NA | NA | NA | NA | NA | NA | | factor | y | 0 | 1 | FALSE | 2 | no: 39922, yes: 5289 | NA | NA | NA | NA | NA | NA | NA | NA | | numeric | age | 0 | 1 | NA | NA | NA | 40.9362102 | 10.618762 | 18 | 33 | 39 | 48 | 95 | ▅▇▃▁▁ | | numeric | balance | 0 | 1 | NA | NA | NA | 1362.2720577 | 3044.765829 | -8019 | 72 | 448 | 1428 | 102127 | ▇▁▁▁▁ | | numeric | day | 0 | 1 | NA | NA | NA | 15.8064188 | 8.322476 | 1 | 8 | 16 | 21 | 31 | ▇▆▇▆▆ | | numeric | duration | 0 | 1 | NA | NA | NA | 258.1630798 | 257.527812 | 0 | 103 | 180 | 319 | 4918 | ▇▁▁▁▁ | | numeric | campaign | 0 | 1 | NA | NA | NA | 2.7638407 | 3.098021 | 1 | 1 | 2 | 3 | 63 | ▇▁▁▁▁ | | numeric | pdays | 0 | 1 | NA | NA | NA | 40.1978280 | 100.128746 | -1 | -1 | -1 | -1 | 871 | ▇▁▁▁▁ | | numeric | previous | 0 | 1 | NA | NA | NA | 0.5803234 | 2.303441 | 0 | 0 | 0 | 0 | 275 | ▇▁▁▁▁ | |

## 4.2 Basic statistical analysis

[Figure 1](#fig-result) shows a scatter plot figure produced by one of the R scripts.

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| Figure 1: Age and bank account balance stratified by marital status |

## 4.3 Full analysis

Example [Table 5](#tbl-resulttable2) shows a summary of a linear model fit.

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| Table 5: Linear model fit table. |

# 5. Discussion

## 5.1 Summary and Interpretation

## 5.2 Strengths and Limitations

## 5.3 Conclusions

# 6. References