Apprendimento Statistico

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Data Analysis applied to a Marketing Dataset

1 Introduction

The main goal of this report is to apply different machine learning tecniques to a dataset that can be found on the UCI Machine Learning Repository. The data is related with direct marketing campaigns (phone calls) of a Portuguese banking institution. Each entry represents a phone call to a client of whom several features are provided.

The responce variable is binary (yes or no) and indicates whether a phone call successfully convinced the client to purchase a financial product the bank is tryng to sell (bank term deposit). Among the 20 provided features, 11 are categorical and the remaining are numerical. An extensive description of each feature will now follow.

1.1 Attribute information

Table 1 provides an extensive overview about each attribute featured in the dataset.

Important notes about some of the attributes are the following:

- Attributes from `Contact` to `duration` are related to the last contact of the current campaign
- The attribute `duration` affers to the call duration and it's not known until the call is completed. It highly affects the prediction (e.g. if `duration=0` then the outcome will always be *not successful*), hence it will be deleted since the model is ment to be deployed with real world data.

Name	Description	Type	Possible values
Age	Age of each client	numeric	-
Job	Type of job	categorical	Admn, blue-collar, entrepreneur...
Marital	Marital Status	categorical	Divorced, married, single, unknown
Education	level of education	categorical	basic.4y, basic.6y, basic.9y, high-school,...
Default	whether a client has credit in default	Categorical	Yes, No, Unknown
Housing	whether a client has an housing loan	Categorical	Yes, No, Unknown
Loan	whether a client has a personal loan	Categorical	Yes, No, Unknown
Contact	contact communication type	Categorical	cellular, telephone
Month	last contact month of the yeah	Categorical	jan, feb, mar...
Day of the week	last contact day of the week	Categorical	mon, tue, ...
Duration	Last contact duration in seconds (see notes)	Numeric	-
Campaign	number of contacts performed during this campaign for that client	Numeric	-
pdays	number of days that passed by after the client was last contacted from a previous campaign	numeric	-
previous	number of contacts performed before this campaign for this client	numeric	-
poutcome	outcome of the previous marketing campaign	Categorical	Failure, nonexistent, success
emp.var.rate	employment variation rate - quarterly indicator	Numeric	-
cons.price.idx	consumer price index - monthly indicator	Numeric	-
cons.conf.idx	consumer conficence index - monthly indicator	Numeric	-
euribor3m	euribor 3 month rate - daily indicator	Numeric	-
nr.employed	Number of employees - quarterly indicator	Numeric	-
Responce variable: y	Has the client subscribed to a term deposit	Binary	Yes, No

Table 1: Extensive description for each attribute in the dataframe

2 Data Exploration and Preprocessing

We first import the dataset and encode each categorical feature using *one-hot encoding*. This means that numerical features will be left unchanged while for each categorical feature the process is the following:

1. Determine all the distinct values of that feature (categories)

2. For each category generate a new binary column

3. Assign values to the binary columns according to categories featred in each line.

feature
category 1
category 2
category 3
category 2

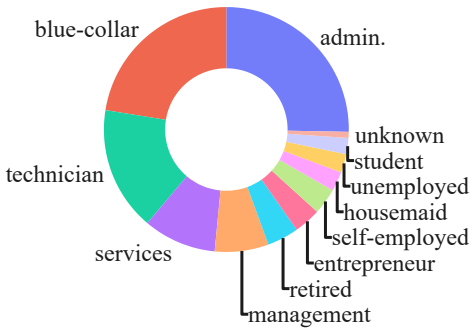
category 1	category 2	category 3
1	0	0
0	1	0
0	0	1
0	1	0

```
import pandas as pd

df = pd.read_csv('Data/bank/bank-additional-full.csv', sep=';')
display(df.head())
cat_col = df.dtypes=='O'
df_enc = pd.get_dummies(df.loc[:, cat_col], prefix=df.columns[cat_col])
df_enc = df_enc.join(df.loc[:, np.logical_not(cat_col)])

df_enc = df_enc.drop('y_no', axis=1) #deleting column since attribute "y" is
binary
df_enc = df_enc.drop('duration', axis = 1) #drop the duration column (see
attribute information)
```

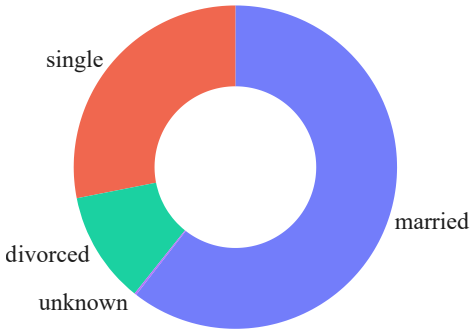
Listing 1: Data encoding

2.1 Data Exploration

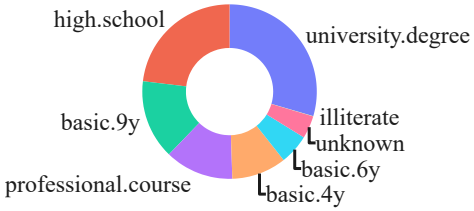
Independently from encoding we can also perform some data exploration, in order to gain useful insights about some of the attributes featured in the dataset. There are 11 categorical features and the remaining are numerical. Categorical data will be explored by means of *pie charts* while numerical data will be explored by means of a *scatterplot matrix*



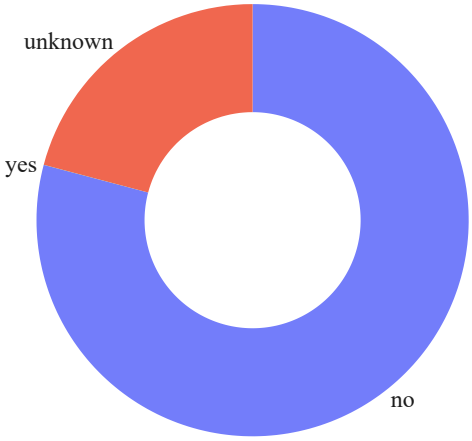
(a) Pieplot relative to `job`



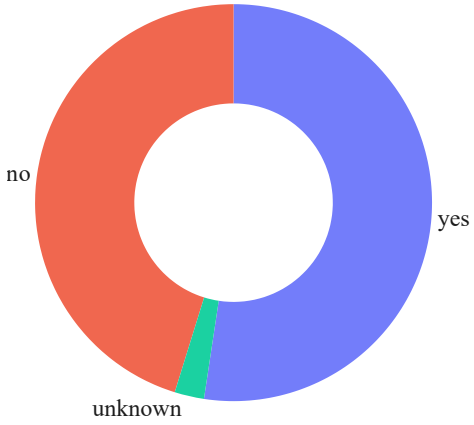
(b) Pieplot relative to `marital`



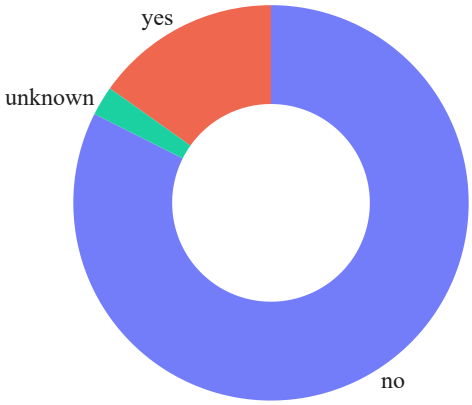
(c) Pieplot relative to `education`



(d) Pieplot relative to `default`



(e) Pieplot relative to `housing`



(f) Pieplot relative to `loan`