
# US Census dataset

YONGWE JEAN-LUC

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## Introduction

Basically humans live in a three dimensional world , that implies that they can understand data in one-dimension, two-dimension but also in three-dimension. Sometimes it requires to think beyond that n-dimensional world and the human brain can get easily overflowed , so it is preferable to use machine learning for it to become easily to recognize pattern in data that is not obvious at first sight.

*US census dataset* is a dataset assemble to be able to " drawn" the profil of people that earns more than 50000 dollars/year or less troughout differents variables (42 exactly ) such as AGE , level of Education , SEX , Employment situation , Marital situation , Skin tone....Yearly earnings.

The choosen technology to analyse our dataset was Python because it is very versatile and modular langage that allows the user to either simply manage and explore his dataset (preliminaries statistics and graphical vizualisation) and even pull off some more exotics insights by using advanced statistics.

## Approach

The approach to the problem was made steps by steps which are the following:

***STEP 1***

The target variable of our dataset is a two modalities-variable coded as " $-$ 50000." and "50000 $+$ ." , that we are going to recode into 1 if the person yearly earnings are above 50000 dollars and 0 if the person yearly earnings are under 50000 dollars.

***STEP 2***

The dataset is coming into two parts one where we are going extract any kind of pattern present and a second one to check the credibility of it.

In order not to let our analysis to be biaised by values that may be missing , the idea here is to clean the documents but first we need to know how much data are missing..

At first we recode the original dataset opened up as a csv file to code missing values as $NaN$ .
To count the number of $NaN$ elements in our dataset we need to count the frequency of every modalities in every variables , once we find the frequencies of $NaN$ element we make a simple addition of all of them and divide it by the dimensions of the dataset (number of rows X number of columns).

Second we run a simple basic statistic univariate description:(see the figure below)

```
####################### % STATISTIC AND UNIVARIATE AUDIT ##############################################
% missing values:  3.68 %
================================================================================
statistical description of the quantitative variables :
               index           var1           var3           var4  \
count  199523.000000  199523.000000  199523.000000  199523.000000
mean    99761.000000      34.494199      15.352320      11.306556
std     57597.473217      22.310895      18.067129      14.454204
min         0.000000       0.000000       0.000000       0.000000
25%     49880.500000      15.000000       0.000000       0.000000
50%     99761.000000      33.000000       0.000000       0.000000
75%    149641.500000      50.000000      33.000000      26.000000
max    199522.000000      90.000000      51.000000      46.000000

                var6          var17          var18          var19  \
count  199523.000000  199523.00000  199523.000000  199523.000000
mean       55.426908     434.71899      37.313788     197.529533
std       274.896454    4697.53128     271.896428    1984.163658
min         0.000000       0.00000       0.000000       0.000000
25%         0.000000       0.00000       0.000000       0.000000
50%         0.000000       0.00000       0.000000       0.000000
75%         0.000000       0.00000       0.000000       0.000000
max      9999.000000   99999.00000    4608.000000   99999.000000

               var25          var31          var37          var39  \
count  199523.000000  199523.000000  199523.000000  199523.000000
mean     1740.380269       1.956180       0.175438       1.514833
std       993.768156       2.365126       0.553694       0.851473
min        37.870000       0.000000       0.000000       0.000000
25%      1061.615000       0.000000       0.000000       2.000000
50%      1618.310000       1.000000       0.000000       2.000000
75%      2188.610000       4.000000       0.000000       2.000000
max     18656.300000       6.000000       2.000000       2.000000

               var40          var41         target
count  199523.000000  199523.000000  199523.000000
mean       23.174897      94.499672       0.062058
std        24.411488       0.500001       0.241261
min         0.000000      94.000000       0.000000
25%         0.000000      94.000000       0.000000
50%         8.000000      94.000000       0.000000
75%        52.000000      95.000000       0.000000
max        52.000000      95.000000       1.000000
```

**STEP 3**

Only $4percent$ of the data are missing , the next step is to erase those data in order to have a more managable dataset.
A closer look shows that 8 columns (variables) are concerned , in a sense that they some $NaN$ elements.
The dimensions of the dataset are 199523 rows and 42 colmuns which give us 8379966 elements.

There are 8 variables concerned by the missing data meaning 1596184 elements on that grid , a quick calculations shows , if we go about the columns this is $20percent$ of the data that will be passed on , so the decision is to go by the rows , where we will clearly loss less data .

**STEP 4**

**Dataset Analysis**

The dataset is containing 42 variables , according to the statistical description figure only 15 of them are numericals or quantitave type (if you will) , it would be intersting to include the qualitative variables in our analysis.

To do so we have to recode each one of the modalities of the variables using the features extraction to extract and distinct all the modalities and OneHotEncoder to recode the modalities into vector of 0 and 1. UNfortunately in doing so we realized :

```
######################RECODING MODALITIES DATASET#########################################
recoding training file : 396 numbers of modalities
recoding test file : 395 number of modalities
```

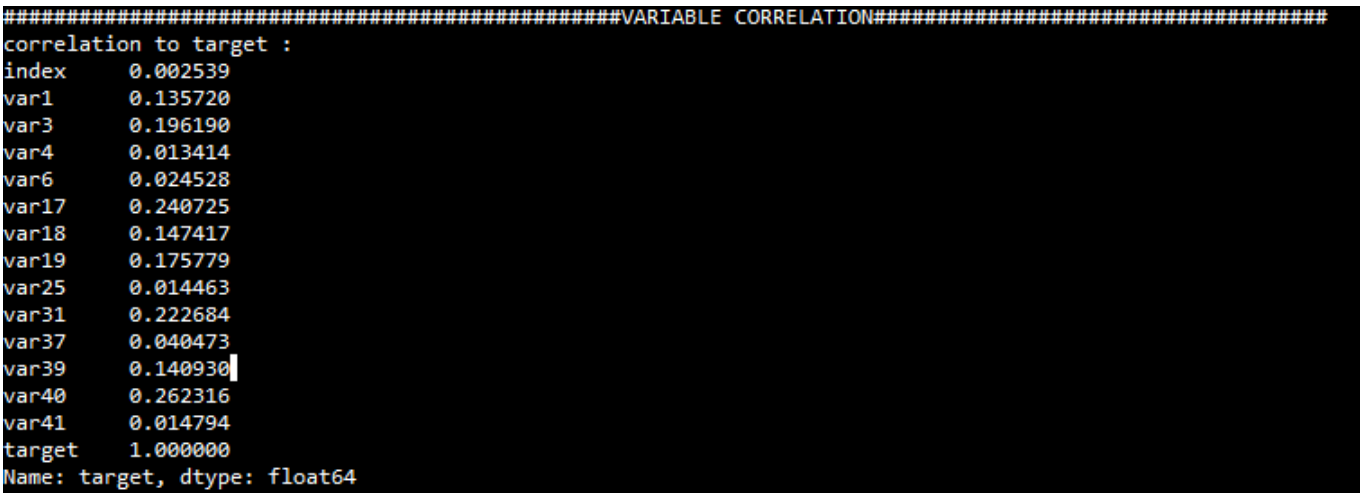
Even when trying to "dummies" our categorical data it became an issue when come time to test the pattern against the testing file because of that one modalities that is not there Not being able to find what went wrong in the process , we decide to report our analysis on solely quantitative data.

We have two files to our disposition one to learn from and another one to validate our discoveries. We decide to compare two clustering algorithm (Decision Tree and Neural Network) and one regression algorithm (Logistic Regression) on the learning file and finally to check both of them with the learning pattern extract by each one of them on the "testing file" and the results are the following :

```
#########################################DECISION TREE#########################################
=====================================MODEL TRAINING=========================================
matrice de confusion : [[143227   6514]
 [  5784   4093]]
precision ratio : 0.922953551604
error ratio : 0.0770464483955
=====================================MODEL TESTING==========================================
matrice de confusion [[87386  6198]
 [ 5776   402]]
taux de succes : 0.879974338927
taux d erreur : 0.120025661073
#########################################NEURAL NETWORK#########################################
=====================================MODEL TRAINING=========================================
matrice de confusion : [[149736      5]
 [  9876      1]]
precision ratio : 0.93809595409
error ratio : 0.0619040459096
=====================================MODEL TESTING==========================================
matrice de confusion : [[93577     7]
 [ 6178     0]]
precision ratio : 0.938002445821
error ratio : 0.0619975541789
#####################################LOGISTIC MODEL#########################################
=====================================MODEL TRAINING=========================================
confusion matrix : [[149043    698]
 [  7865   2012]]
precision ratio : 0.946353168189
error ratio : 0.0536468318109
=====================================MODEL TESTING==========================================
matrice de confusion : [[92039  1545]
 [ 6083    95]]
precision ratio : 0.923538020489
error ratio : 0.0764619795112
```

Looking back at the results we can see that the Neural Network is more stable and accurate in term of clustering and the Logistic model is the right one in term of prediction on the learning but a little less acurrate than the Neural Network. The decision would be to go with the Neural Network more precise and stable on the long run.

A quick look to the correlation matrix and focusing on the target column we can see than the most correlate variable are the 41st , the 17th and the 31st wich is the 'number of week worked in a year' (var41) , 'capital gain in investment' (var17) and 'number of people working in the household' (var31)




From there when can say that the more weeks people worked , the more people having a job in their household and also the capital gain , the more they are incline to have more than 50000 dollars savings yearly.

The subject was kinda fun to work on , but my greatest challenge was the data cleaning and the conversion of the categorical data because I had to make careful choices not to lost a lot of information and not lising by accident the most relevant variables in this case.