COMP40370 Practical 1

DATA EXPLORATION AND PREPROCESSING (Part A)

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Academic year 2023-2024

This practical aims to familiarise with some basic data pre-processing and exploration tools and use some concepts discussed in the lectures. Python is the programming language to use to complete this practical. The datasets needed to complete the practical are described below.

Assignment Files

• ./Practical-01.pdf	assignment questions (this file).
• ./ *diabetes.csv*:	data file for the questions.

Expected output files

• ./Prcatical-01.ipynb	Python notebook programs.
• ./Prcatical-01.html	Notebook in HTML showing the outputs.

Requirements

- Python 3.8+, pandas 1.3+, numpy 1.20+, sklearn 0.24+.
- seaborn 0.11+, matplotlib 3.5+, scipy 1.9+.

Question 1: Data Exploration

The comma-separated file "*diabetes.csv*" consists of several medical variables and one target variable, `Outcome`. The variables include the number of pregnancies the patient has had, their BMI, insulin level, age, etc. This dataset is originally from the National Institute of Diabetes and Digestive and Kidney Diseases. The objective of the dataset is to diagnostically predict whether or not a patient has diabetes based on specific diagnostic measurements included in the dataset. The dataset has been modified for the purpose of this assignment.

Write a Python program to answer the following:

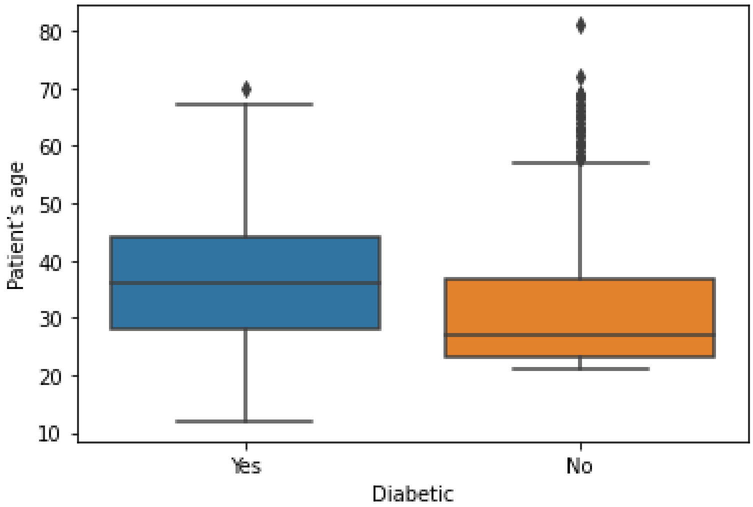
I) **Descriptive statistics**

1- Read the data file into a pandas data frame and print the first 5 rows
2- Print the number of rows and columns
3- Calculate the min, max, mean, and std of the 'age' column using pandas.
4- What is the mode of the 'age' column? Comment on the data's modality (i.e., bimodal, trimodal, etc.).
5- Use pandas to calculate the first quartile (Q1) and the third quartile (Q3) of the 'age' column.
6- What is the Interquartile Range of the 'age' column?
7- Print the five-number summary of the 'age' column.

II) **Data visualisation**

1-Show a boxplot of the ‘age’ column.

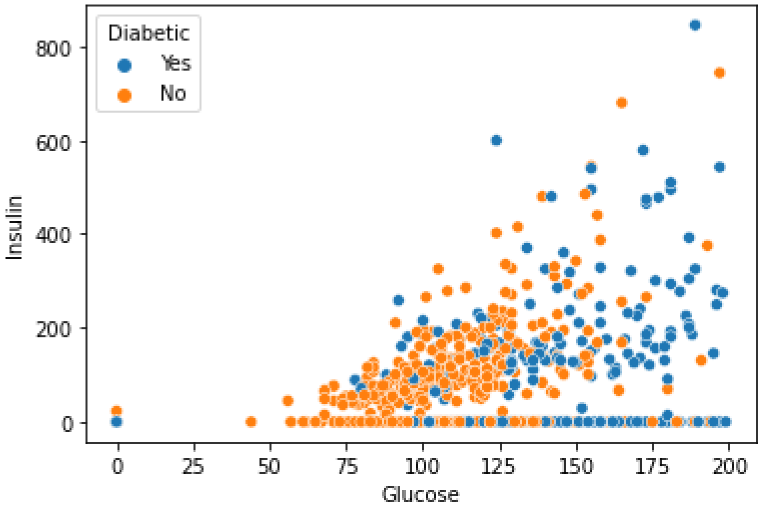
2-Show a boxplot of the ‘age’ column of the diabetic and no-diabetic groups side by side. The x-axis’s label should be (*diabetic) and ‘yes’ under positive patients and ‘no’ under negative patients, and the y-axis’s label should be (patient’s age), as follows:*



3-*Based on the boxplot of question 2, analyse the relationship between the patient’s age and being diabetic.*

4-Show a scatter plot with the patient’s Blood pressure on the x-axis and the patient’s BMI on the y-axis.

5-Show a scatter plot with the patient’s Blood pressure on the x-axis and the patient’s BMI on the y-axis, highlighting diabetic patients with different colours. The colouring label should be ‘diabetic’: yes and no. Illustrative example:



6-*Based on the scatterplot of question 5, analyse the relationship between BMI/*Blood pressure and diabetes.

III) **Data filtering**

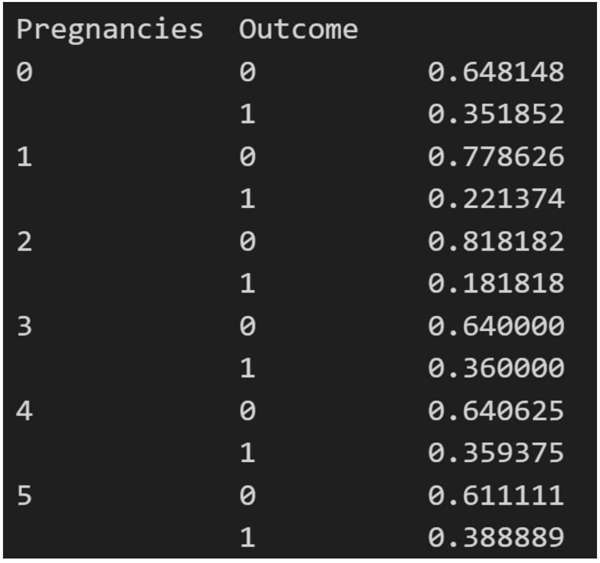
1-Select all patients with Insulin more than 400. How many patients are diabetic/no-diabetic among those selected?

2- Select all patients with Insulin greater than 400 and Glucose greater than 175. How many patients are diabetic/no-diabetic among those selected?

3- What is the average Glucose level of a patient with more than 5 pregnancies and older than 45?

4- Count the distinct values in the ‘pregnancies’ column.

5- List the distinct values of the ‘pregnancies’ column along with the percentage of diabetic/no-diabetic of each value. Illustrative example:



```
Pregnancies  Outcome
0            0          0.648148
             1          0.351852
1            0          0.778626
             1          0.221374
2            0          0.818182
             1          0.181818
3            0          0.640000
             1          0.360000
4            0          0.640625
             1          0.359375
5            0          0.611111
             1          0.388889
```

Question 2: Data Cleaning

I) **Duplicated removal**

1. Identify any duplicated records by printing “True” if the row is duplicated and “False” otherwise.
2. For all duplicated records, keep one record and remove its duplicates.
3. What is the dimension of the data frame after removing the duplicates?
4. How many duplicated rows were there (before removing the duplicates)?

In the following question (Q2-II), use the clean dataframe (without dublicates) from Question 2-I

II) **Missing values**

1- How many missing values are in the “blood pressure” column?

2- Remove the missing records in the “blood pressure” column. Use the clean dataframe (without missing values in ‘blood pressure’ column) for the rest of the questions Q-II-3 to Q-II-7

3- Copy the following columns into a separate data frame: 'Pregnancies', 'Glucose', 'BloodPressure', 'SkinThickness', 'Insulin', 'BMI', 'DiabetesPedigreeFunction', 'Age'

4- On the newly copied data from (3). Use sklearn’s train_test_split function to split the data into 90% training set and 10% testing set.

5- Keep a separate copy of the testing set (evaluation copy) for evaluation in the following questions (6-9). In the original testing set, set all the Glucose to null.

6- Fill in the missing values of the test set based on the mean of the Glucose of the training set (90%). Calculate the RMSEs for the imputed values of the test set (compared to the evaluation copy you have saved from (5)).

7- Fill in the missing values of the testing set based on the median of the Glucose of the training set (90%). Calculate the RMSEs for the imputed values of the test set (compared to the evaluation copy you have saved from (5)).

8- Use scikit-learn SimpleImputer with the 'most_frequent' strategy to impute the value of glucose in the testing set, and calculate RMSE for the imputed values of the test set (compared to the evaluation copy you have saved from (5)).

9- Use scikit-learn KNNImputer (for neighbours = 3) to impute the missing values in the testing set, KNNImputer must be trained with all the columns in the training set (: 'Pregnancies', 'Glucose', 'BloodPressure', 'SkinThickness', 'Insulin', 'BMI', 'DiabetesPedigreeFunction', 'Age'). Calculate RMSE for the imputed values of the test set (compared to the copy you have saved from (5)).

10- Which Imputer is better?

Please make sure that you have completed this practical. Next week, you will get the second part of the practical.