Technologies for Information Systems project on Data Ethics Report

Measure fairness in healtcare-related database using the **Aequitas** toolkit

Simone Callegarin

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POLITECNICO
MILANO 1863

Reference professors: Letizia Tanca, Chiara Criscuolo and Tommaso Dolci

The practical project on Data Ethics consisted in the creation and presentation of a python notebook.
The assignment required the use of the **Aequitas toolkit** to measure fairness in an healthcare-related dataset that in my case concerns **diabetes**.
The content of the **notebook** can be divided into four main **phases**:

1. Load the dataset
2. Set the inputs
3. Basic preprocessing and prediction algorithm
4. Fairness results with Aequitas

1 Load the dataset

The dataset provided in `Kaggle`[1] is an already preprocessed version of the original dataset available in `OpenML`[2], named *"Diabetes 130-Hospitals"*, collected by *Beata Strack, Jonathan P. DeShazo, Chris Gennings, Juan L. Olmo, Sebastian Ventura, Krzysztof J. Cios*, and *John N. Clore* in 2014.
The notebook provides a comprehensive description and a preliminary analysis of the dataset, involving libraries such as `Seaborn` and `MatPlotLib` for graphs plotting.

2 Set the inputs

In order to audit the dataset it's necessary to define some inputs first:

- the attributes to audit (i.e. sensitive attributes)
- the reference group for each attribute (majority groups)
- the fairness metric(s) that we care about (in this case `FNR, TPR`)
- the disparity tolerance ($\tau = 1.25$)

In our analysis the sensitive attribute was the *AgeCategory* and the interested fairness metrics were the `FNR` and the `TPR` due to the fact that the interventions made by our predictive model are assistive and intervening with a big part of the population[14].

3 Basic preprocessing and prediction algorithm

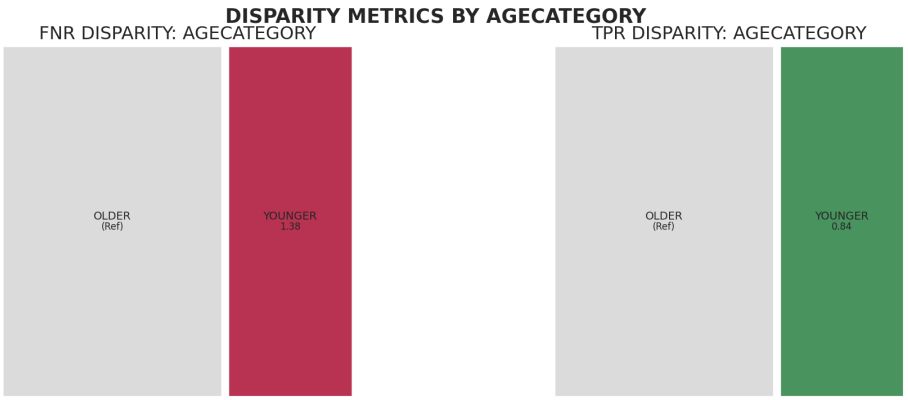
The predictive algorithm used is the `Random Forest Classifier`[3] that is imported from `sklearn` library that also offers tools to handle Data training and test splits.
Data obtained from the predictive algorithm undergoes a preprocessing phase that will lead to the creation of a dataframe, containing entities from the test set and the related algorithm's predictions, that is directly uploaded into the GitHub repository[11].

4 Fairness results with Aequitas

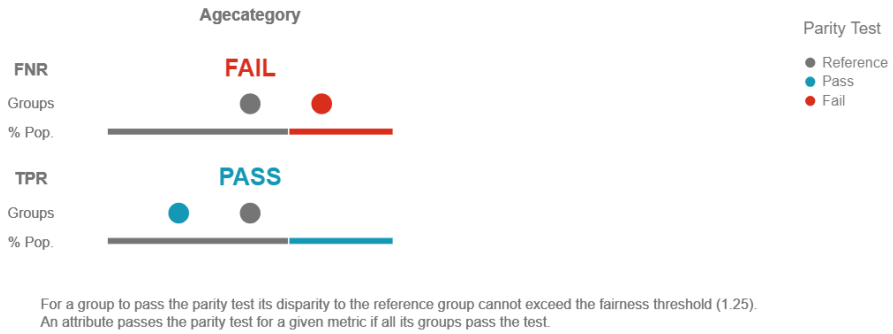
Applying Aequitas[4] programmatically is a three step process represented by this three python classes:

1. `Group`
2. `Bias`
3. `Fairness`

The analysis consist in measuring bias and fairness between the true *outcome* that is the true binary label of a given entity and the *score* assigned to each entity by the predictor[3].
The **results** of the audit highlighted that the model tends to indicate that *people actually with diabetes are more likely to be labeled negative at a younger age.*



This is determined by the fact that the *False Negative Rate* (`FNR`) of the `YOUNGER` group exceed the disparity tolerance treshold, highlighting an unfairness in our model.
On the contrary the *True Positive Rate* (`TPR`) shows that the `YOUNGER` group does not exceed the disparity tolerance treshold, revealing that the predictive model is unbiased over this measure.



In conclusion we can state that the model didn't pass the `FNR parity` **test**, while it passed the `TPR parity` **test** instead.
The predictive model[3] is then biased because it tends to *label diabetic people as negative at a younger age*

References

[1] Kaggle - diabetes dataset

[2] OpenML - Diabetes-130-Hospitals dataset

[3] ScikitLearn - Random Forest Classifier

[4] Aequitas

[5] Aequitas - paper

[6] Aequitas - textbook

[7] Aequitas - tools guide

[8] Aequitas - tutorial python notebook

[9] Aequitas - tutorial

[10] PyPi

[11] GitHub

[12] StackOverflow

[13] Pandas

[14] Fairness in ML

[15] Confusion metrics

[16] Python projects packaging

[17] Hex calculator

[18] Tkinter colors

[19] SCdataframeFormatter