Final Project Report

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***Abstract*—**The following report provides a comprehensive analysis and bias mitigation strategy for a bank loan default dataset.

1 DATASET SELECTION & EXPLORATION (STEP 1)

- Dataset: Bank Loan Defaulter[1]
- Regulated Domain: Credit
- Number of Observations: 10,000
- Number of Variables: 14
- Dependent Variables:
  - "Exited" (Default; 1=yes, 0=no)
  - "CreditScore" (350-850 continuous range; will be discretized in later sections)
- Protected Class Variables: 2

Variable	Protected Class	Law
Age	Age	Age Discrimination in Employment Act of 1967
Gender	Sex	Equal Pay Act of 1963; Civil Rights Act of 1964, 1991

2 DATA DISCRETIZATION & SEGMENTATION (STEP 2)

2.1 Table for Steps 2.1-2.3

	No Default (Exited=0)	Default (Exited=1)	Bad Credit (Score < 600)	Good Credit (Score $\geqslant$ 600)	Total
Age < 40	5,390	597	1,822	4,165	5,987
Age $\geqslant$ 40	2,573	1,440	1,212	2,801	4,013
Male	4,559	898	1,668	3,789	5,457
Female	3,404	1,139	1,366	3,177	4,543

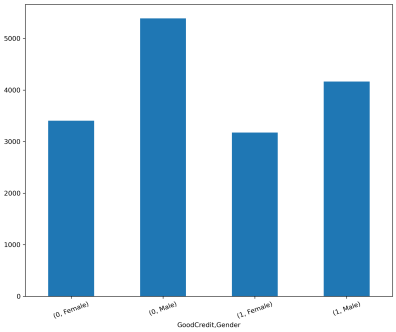
1 https://www.kaggle.com/datasets/vatsalkgandhi/churn-modelling

2.2 Histograms for Step 2.4

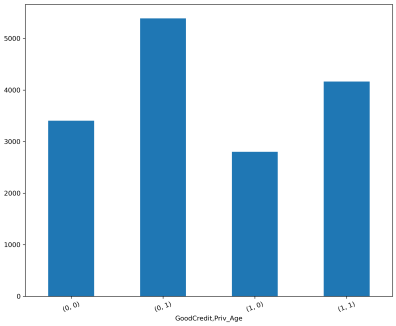
Credit: 1 = Good; 0 = Bad

Age: 1 = Age<40; 0 = Age⩾40

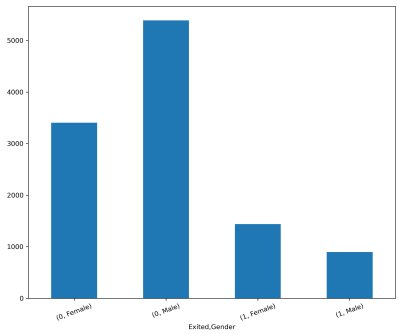
Credit-Gender



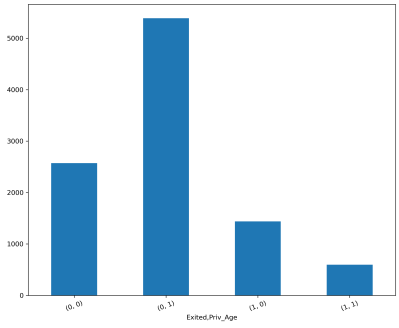
Credit-Age



Default-Gender



Default-Age



3 DATASET TRANSFORMATION & FAIRNESS METRIC COMPUTATION (STEP 3)

Pre-processing Bias Mitigation Algorithm: **Reweighing**
Chosen Dependent Variable: **Exited/Default**

Privileged Groups:

- Gender: **Male**
- Age: **< 40**

Unprivileged Groups:

- Gender: **Female**
- Age: $\geqslant$ **40**

Protected Class (Metric)	GoodCredit (Original)	GoodCredit (Transformed)	Exited/Default (Original)	Exited/Default (Transformed)
Age (DI)	1.003	1.003	3.599	0.772
Gender (DI)	1.007	1.007	1.524	0.966
Age (SPD)	0.002	0.002	0.259	-0.202
Gender (SPD)	0.005	0.005	0.086	-0.028

**_DI_ = Disparate Impact
**_SPD_ = Statistical Parity Difference

4 CLASSIFIER PREDICTIONS & FAIRNESS METRIC COMPARISON (STEP 4, OPTION A)

Chosen Dependent Variable: **Exited/Default**
Chosen Protected Class: **Gender**
Chosen Classifier: **Decision Tree (scikit-learn)**

The table below provides the values of our chosen fairness metrics across all stages of the transformation pipeline.

Fairness Metric	Original Dataset	Transformed Dataset	Original Test Dataset	Transformed Test Dataset
Disparate Impact	1.524	0.966	1.594	1.283
Statistical Parity Difference	0.086	-0.028	0.103	0.056

Given the tabular data above, the table below provides a comparative overview of the dataset's fairness across the pipeline stages.

Comparison	Disparate Impact	Statistical Parity Difference
Original vs. Transformed Data	Positive	Positive
Original vs. Original Test Data	Negative	Negative
Original vs. Transformed Test Data	Positive	Positive

5 GRAPHICAL REPRESENTATION & TEAM RESPONSE (STEP 5)

I am a team of one.