**Marcus J. Anderson – CS6603**

**Step 1**

**Dataset:** Student Alcohol Consumption (<https://www.kaggle.com/datasets/uciml/student-alcohol-consumption?select=student-mat.csv>)

* **Note:** I transformed the values within the ***sex*** column from **F (Female)** and **M (Male)** to **0** and **1** respectively for fairness metric calculations.

**Regulated Domain:** Education (Education Amendments of 1972; Civil Rights Act of 1964)

**Observation:** 649

**Variables:** 33

**Dependent Variables:** 3; ***Dalc*** *(workday alcohol consumption),* ***Walc*** *(weekend alcohol consumption),* and ***absences*** *(# of school absences)*

**How many and which variables in the dataset are associated with a legally recognized protected class? Which legal precedence/law (as discussed in the lectures) does each protected class fall under?**

**Number of Protected Class Variables:** 2

|  |  |  |
| --- | --- | --- |
| **Variable** | **Protected Class** | **Law** |
| **sex** | Sex | (Equal Pay Act of 1963; Civil Rights Act of 1964, 1991) |
| **age** | Age | Age Discrimination in Employment Act of 1967) (over 40 |

**Step 2**

**Step 2.1:**

|  |  |
| --- | --- |
| **Protected Class** | **Membership Categories** |
| **Sex** | 0 (Female), 1 (Male) |
| **Age** | Under 18, 18 and Over |

**Step 2.2:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Dependent Variable** | **Very Low** | **Low** | **Average** | **High** | **Very High** |
| **dalc** | 1 | 2 | 3 | 4 | 5 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Dependent Variable** | **Very Low** | **Low** | **Average** | **High** | **Very High** |
| **walc** | 1 | 2 | 3 | 4 | 5 |

|  |  |  |
| --- | --- | --- |
| **Dependent Variable** | **Low** | **High** |
| **absences** | 0 - 16 | 17 - 32 |

**Step 2.3:**

|  |  |
| --- | --- |
| **Protected Class** | **Frequency of Membership Categories** |
| **Sex** | 0 (Female) – 383  1 (Male) – 266 |
| **Age** | >18 (Under 18) – 468  <=18 (18 and Over) – 181 |

**Step 2.4:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Protected Class - Sex** | **Variable - Dalc** | **Variable - Walc** | **Variable - Abscences** |
| Sex: 0 (Female) | **Very Low:** 305  **Low:** 58  **Average:** 11  **High:** 7  **Very High:** 2 | **Very Low:** 176  **Low:** 99  **Average:** 71  **High:** 30  **Very High:** 7 | **Low:** 377  **High:** 6 |
| Sex: 1 (Male) | **Very Low:** 146  **Low:** 63  **Average:** 32  **High:** 10  **Very High:** 15 | **Very Low:** 71  **Low:** 51  **Average:** 49  **High:** 57  **Very High:** 38 | **Low:** 261  **High:** 5 |

|  |  |  |  |
| --- | --- | --- | --- |
| **Protected Class - Age** | **Variable - Dalc** | **Variable - Walc** | **Variable – Abscences** |
| Age: >18 (Under 18) | **Very Low:** 330  **Low:** 91  **Average:** 30  **High:** 7  **Very High:** 10 | **Very Low:** 181  **Low:** 111  **Average:** 86  **High:** 57  **Very High:** 33 | **Low:** 460  **High:** 8 |
| Age: <=18 (18 and Over) | **Very Low:** 121  **Low:** 30  **Average:** 13  **High:** 10  **Very High:** 7 | **Very Low:** 66  **Low:** 39  **Average:** 34  **High:** 30  **Very High:** 12 | **Low:** 178  **High:** 3 |

**Step 3**

**Step 3.1 - 3.2**

**\*Note: Threshold** values for both dependent values is **3** (**favorable** outcomes are variables **<=3**, **unfavorable** outcomes are **>3**)

|  |  |
| --- | --- |
| **Protected Class** | Sex |
| **Dependent Variable** | Dalc |
| **Privileged Group** | Female (383) |
| **Unprivileged Group** | Male (266) |
| **Original Disparate Impact** | 0.927818 |
| **Original Statistical Parity Difference** | -0.070486 |

|  |  |
| --- | --- |
| **Protected Class** | Sex |
| **Dependent Variable** | Walc |
| **Privileged Group** | Female (383) |
| **Unprivileged Group** | Male (266) |
| **Original Disparate Impact** | 0.711602 |
| **Original Statistical Parity Difference** | -0.260537 |

|  |  |
| --- | --- |
| **Protected Class** | Age |
| **Dependent Variable** | Dalc |
| **Privileged Group** | Under 18 (468) |
| **Unprivileged Group** | 18 and Above (181) |
| **Original Disparate Impact** | 0.940231 |
| **Original Statistical Parity Difference** | -0.057598 |

|  |  |
| --- | --- |
| **Protected Class** | Age |
| **Dependent Variable** | Walc |
| **Privileged Group** | Under 18 (468) |
| **Unprivileged Group** | 18 and Above (181) |
| **Original Disparate Impact** | 0.950802 |
| **Original Statistical Parity Difference** | -0.039737 |

**Step 3.4**

|  |  |
| --- | --- |
| **Protected Class** | Sex |
| **Dependent Variable** | Dalc |
| **Pre-Processing Algorithm** | Reweighting |
| **Mitigated Disparate Impact** | 1.000000 |
| **Mitigated Statistical Parity Difference** | 0.000000 |

|  |  |
| --- | --- |
| **Protected Class** | Age |
| **Dependent Variable** | Dalc |
| **Pre-Processing Algorithm** | Reweighting |
| **Mitigated Disparate Impact** | 1.000000 |
| **Mitigated Statistical Parity Difference** | 0.000000 |

**Step 4 – Option A**

|  |  |
| --- | --- |
| **Protected Class** | Sex |
| **Privileged/Unprivileged Groups** | 0 (Female) / 1 (Male) |
| **Dependent Variable** | Dalc |
| **Original Dataset** |  |
| **Disparate Impact** | 0.8958 |
| **Statistical Parity Difference** | -0.1042 |
| **Transformed Dataset** |  |
| **Disparate Impact** | 1.0811 |
| **Statistical Parity Difference** | 0.0721 |

**Fairness Metric: *Disparate Impact***

|  |  |  |
| --- | --- | --- |
| **Original Fairness Outcome** | **Transformed Outcome** | **Change** |
| 0.927818 | 1.000000 | Positive |

|  |  |  |
| --- | --- | --- |
| **Original Fairness Outcome** | **Classifier – Original Outcome** | **Change** |
| 0.927818 | 0.8958 | Negative |

|  |  |  |
| --- | --- | --- |
| **Original Fairness Outcome** | **Classifier – Transformed Outcome** | **Change** |
| 0.927818 | 1.0811 | Positive |

**Fairness Metric: *Statistical Parity Difference***

|  |  |  |
| --- | --- | --- |
| **Original Fairness Outcome** | **Transformed Outcome** | **Change** |
| -0.070486 | 0.000000 | Positive |

|  |  |  |
| --- | --- | --- |
| **Original Fairness Outcome** | **Classifier – Original Outcome** | **Change** |
| -0.070486 | -0.1042 | Negative |

|  |  |  |
| --- | --- | --- |
| **Transformed Fairness Outcome** | **Classifier – Transformed Outcome** | **Change** |
| -0.070486 | 0.0721 | Positive |

**Step 5**

**I am a team of one.**



**Code References**

1. **StandardDataset:** <https://github.com/Trusted-AI/AIF360/blob/master/aif360/datasets/standard_dataset.py>
2. **Classifier code:** <https://github.com/Trusted-AI/AIF360/blob/master/examples/demo_reweighing_preproc.ipynb>