Assignment 5 – Fairness Bias

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Intro Questions (Step 2)

1) **Which dataset did you select?**
    a. Tawain Credit Data Set
2) **How many observations are in the dataset?**
    a. 3000 Observations
3) **How many variables in the dataset?**
    a. 24 Variables
4) **How many and which variables in the dataset are associated with a legally recognized protected class?**
    a. 3 variables are associated with legally protected classes, those are Age, Sex, and Marriage
5) **Legal Precedence/Law for above protected classes**
    a. Age: Age Discrimination in Employment Act of 1967
    b. Sex: Equal Pay Act of 1963, Civil Rights Act of 1964/1991
    c. Marriage: Civil Rights Act of 1968

Step 3

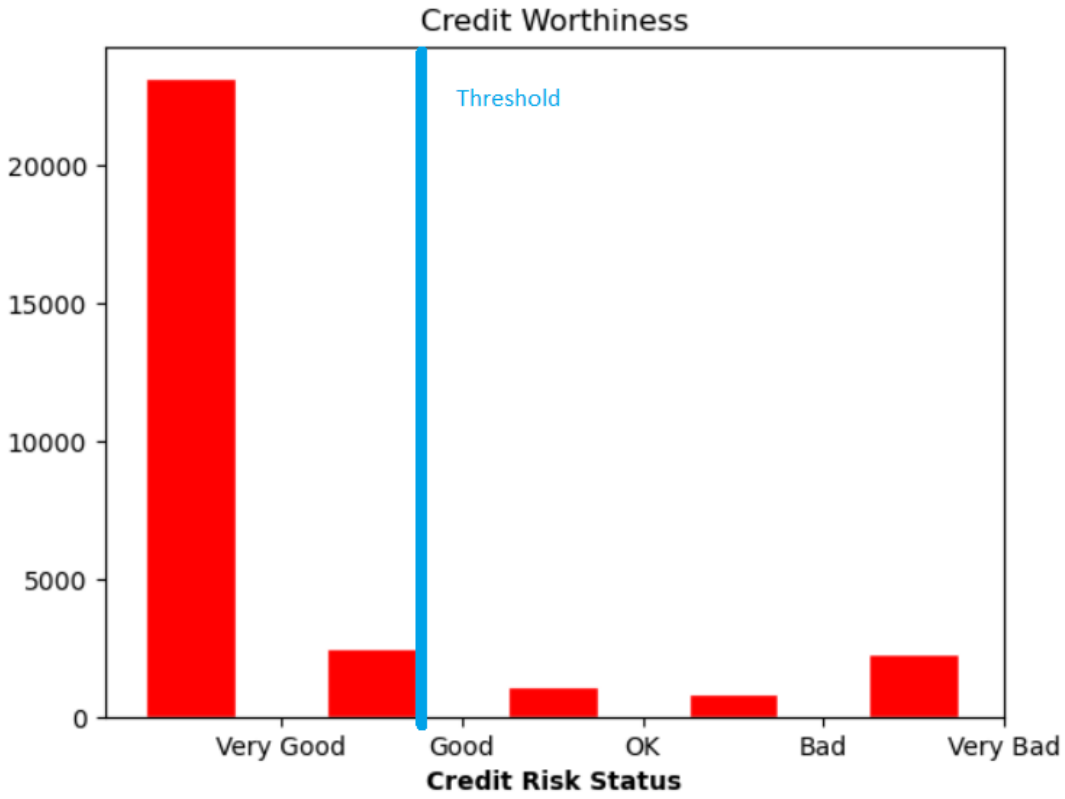
1) **Outcome variable:**
    a. Creditworthiness will be associated by whether or not an individual has defaulted
2) **Formula:**
    a. Using payment status category (x6-x11)
        i. -1 = 0
        ii. 1 = 10
        iii. 2 = 20
        iv. … each value X multiplied by 10
    b. Based on the 6 months of bill payment history they will be ranked on the score of 100 (capped if value goes over).
        i. 0-20: Excellent Credit Risk
        ii. 20-40: Good Credit Risk
        iii. 40-60: Ok Credit Risk
        iv. 60-80: Bad Credit Risk
        v. 80-100: Very Bad Credit Risk
3) **Selected Protected Class**
    a. Marriage (Familial Status)
    b. Unprivileged Group: Married
        i. Train Set Count: 6772
        ii. Test Set Count: 6887
    c. Privileged Group: Unmarried
        i. Train Set Count: 8036

ii. Test Set Count: 7928

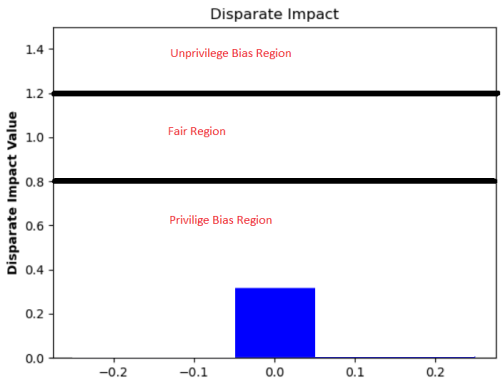
4) **Step 4**
   a. **Threshold Value:** 40
   b. **Profits using threshold:**

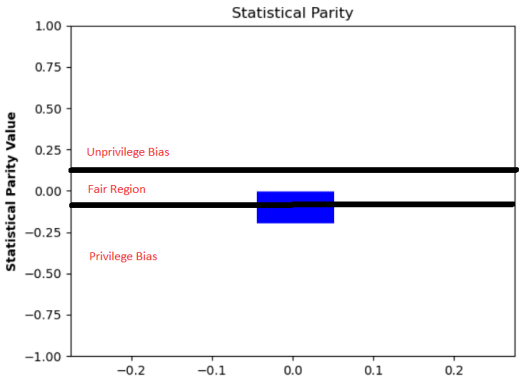
	Approved Loan/Good Credit	Approved Loan/Bad Credit	Unapproved Loan/Good Credit	Unapproved Loan/Bad Credit	Total
Count	21583	4118	1781	2518	30000
Profit	$215,830	($25,162)	($5,343)	0	$189,897
Privileged Group	17040	3025	1297	2120	23482
Unprivileged Group	4543	1093	484	398	6518

   c. **Per analysis the privileged group (singles) faired much better when receiving loan approval than the married couples**



5) **Fairness Metrics**
   a. **Metrics Selected**
      i. Disparate Impact
         1. Value: .32 (Privilege Bias Displayed)
      ii. Statistical Parity
         1. Value: -.21 (Privilege Bias Displayed)

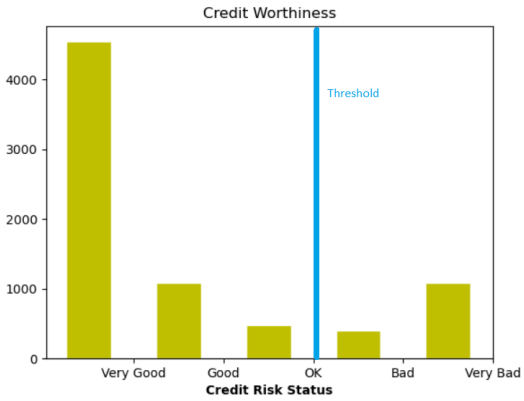




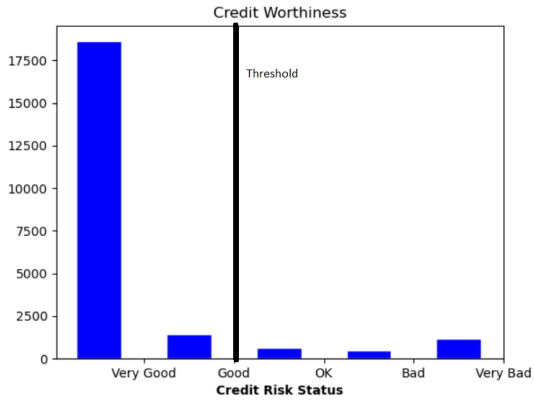
6) Bias Mitigation Attempts

- **a.** In order to mitigate bias amongst our unprivileged group, the creditworthiness threshold was set to <60 (OK Credit Risk)for that category rather than the standard <40 (Good Credit Risk).
- **b.** When compared against Disparate Impact it was found that the new threshold for the unprivileged group brought the fairness metric to a value of .86 which is within the "Fair" threshold for both privileged and unprivileged groups.

Unprivileged Loan Approvals



Privileged Loan Approvals



	Approved Loan/Good Credit	Approved Loan/Bad Credit	Unapproved Loan/Good Credit	Unapproved Loan/Bad Credit	Total
Count	21840	4345	1524	2291	30000
Profit	$218,400	($21,725)	($4,572)	0	$192,103
Privileged Group	17040	3025	1297	2120	23482
Unprivileged Group	4800	1320	227	171	6518

7) Step 7

- **a.** The privilege group (singles) tended to have an advantage based on the creditworthiness scoring algorithm. As shown in both fairness metrics, statistical parity, and disparate impact, once measured made clear there was a difference. To try and

mitigate this bias against married individuals we applied a different threshold (score of <60 rather than <40) to that group, allowing a lower creditworthiness score to be acceptable for loans. And in turn it actually made the loans more profitable based on the profitability equation. After the mitigation step the privileged group is at a disadvantage as they're held to a different standard than the other. But in the effort to balance fairness this was an appropriate step to take.