

# Responsible AI

Jio Institute

## Analysis of Recidivism

Group 8 – Six Sigma

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Programme Instructor:

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# Six Sigma - 6 $\Sigma$



# COMPAS

- The COMPAS algorithm, or the Correctional Offender Management Profiling for Alternative Sanctions, is a risk assessment tool used in the criminal justice system to predict the likelihood of reoffending or failure to appear in court.
- The judges and probation officers are progressively utilizing calculations to evaluate a crook respondent's probability of turning into a recidivist.
- Recidivist is the term used to describe criminals who re-offend.

- Data:

| juv_fel_count | decile_score | juv_misd_count | juv_other_count | priors_count | days_b_screening_arrest | in_jail | c_days_from_compas | is_recid | ... | event | two_year_i |
|---------------|--------------|----------------|-----------------|--------------|-------------------------|---------|--------------------|----------|-----|-------|------------|
| 0             | 1            | 0              | 0               | 0            | 0                       | 5       | 0                  | 0        | ... | 0     | 0          |
| 0             | 8            | 1              | 0               | 1            | 0                       | 1       | 0                  | 1        | ... | 1     | 1          |
| 0             | 6            | 0              | 0               | 0            | 0                       | 1       | 0                  | 0        | ... | 0     | 0          |
| 0             | 2            | 0              | 0               | 0            | 0                       | 0       | 1                  | 0        | ... | 0     | 0          |
| 1             | 10           | 1              | 0               | 20           | 0                       | 1       | 0                  | 0        | ... | 0     | 0          |

28 columns

# ProPublica Debate : Machine Bias

| Two Shoplifting Arrests  |   | Two Drug Possession Arrests  |  | Two DUI Arrests   |   | Two Petty Theft Arrests   |   |
|--|---|--|--|---|---|---|---|
|   |  |   |  |    |  |    |  |
| JAMES RIVELLI  | ROBERT CANNON   | DYLAN FUGETT   | BERNARD PARKER   | GREGORY LUGO  | MALLORY WILLIAMS  | VERNON PRATER   | BRISHA BORDEN   |
| LOW RISK 3   | MEDIUM RISK 6   | LOW RISK 3   | HIGH RISK 10   | LOW RISK 1  | MEDIUM RISK 6   | LOW RISK 3  | HIGH RISK 8   |
| After Rivelli stole from a CVS and was caught with heroin in his car, he was rated a low risk. He later shoplifted \$1,000 worth of tools from a Home Depot. |   | Fugett was rated low risk after being arrested with cocaine and marijuana. He was arrested three times on drug charges after that. |  | Lugo crashed his Lincoln Navigator into a Toyota Camry while drunk. He was rated as a low risk of reoffending despite the fact that it was at least his fourth DUI. |   | Borden was rated high risk for future crime after she and a friend took a kid's bike and scooter that were sitting outside. She did not reoffend. |   |
| Two Shoplifting Arrests  |   | Two Drug Possession Arrests  |  | Two DUI Arrests   |   | Two Petty Theft Arrests   |   |
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| Prior Offenses<br>1 domestic violence<br>aggravated assault, 1<br>grand theft, 1 petty<br>theft, 1 drug trafficking  | Prior Offense<br>1 petty theft  | Prior Offense<br>1 attempted burglary  | Prior Offense<br>1 resisting arrest<br>without violence                            | Prior Offenses<br>3 DUIs, 1 battery   | Prior Offenses<br>2 misdemeanors  | Prior Offenses<br>2 armed robberies, 1<br>attempted armed<br>robbery  | Prior Offenses<br>4 juvenile<br>misdemeanors  |
| Subsequent Offenses<br>1 grand theft   | Subsequent Offenses<br>None   | Subsequent Offenses<br>3 drug possessions  | Subsequent Offenses<br>None  | Subsequent Offenses<br>1 domestic violence<br>battery   | Subsequent Offenses<br>None   | Subsequent Offenses<br>1 grand theft  | Subsequent Offenses<br>None   |
| LOW RISK 3   | MEDIUM RISK 6   | LOW RISK 3   | HIGH RISK 10   | LOW RISK 1  | MEDIUM RISK 6   | LOW RISK 3  | HIGH RISK 8   |
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# Methodology

## **Data Pre-processing**

### **Raw data**

Featuring Engineering

## **Model without PII features**

Logistic Regression  
Random Forest

## **Check Fairness of Model**

Equal Opportunity  
Predictive Equality  
Equalized Odds  
Predictive Parity  
Demographic Parity  
Average of Difference in FPR  
and TPR  
Treatment Equality

Continued...

# Methodology

## **Bias Detection**

Statistical Parity Difference

Disparate Impact

## **Reweighting** to Correct

Bias and produce fairer  
Model

## **Weighted Model**

Weighted Logistic  
Regression

Continued...

# Methodology

## **Check Unfairness on Weighted Model**

ACF on Weighted Model  
Equal Opportunity  
Predictive Equality  
Equalized Odds  
Predictive Parity  
Demographic Parity  
Average of Difference in FPR and TPR  
Treatment Equality

## **Compare**

Unfairness Metrics of Base  
Model vs. Weighted Model

## **Calculate Unfairness and Compare**

ACF vs. CUF

Continued...

# Methodology

## **Use Data with PII and Run two Base Models**

Logistic Regression  
Random Forest

## **Fairness after inclusion of PII data**

ACF on Weighted Model  
Equal Opportunity  
Predictive Equality  
Equalized Odds  
Predictive Parity  
Demographic Parity  
Average of Difference in  
FPR and TPR  
Treatment Equality

## **Comparison of Models without PII data and Models with PII Data**

Continued...



# Methodology

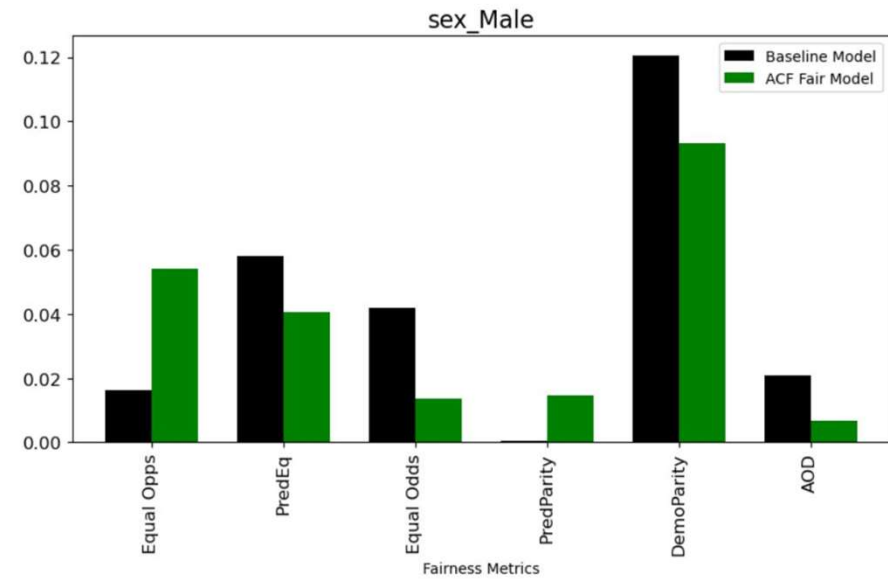
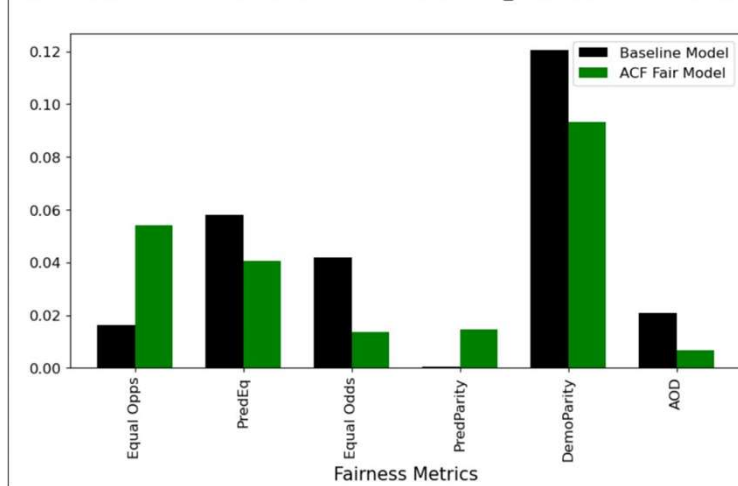
**Counter Factual Unfairness  
on ACF**

**ACF vs. CUF**

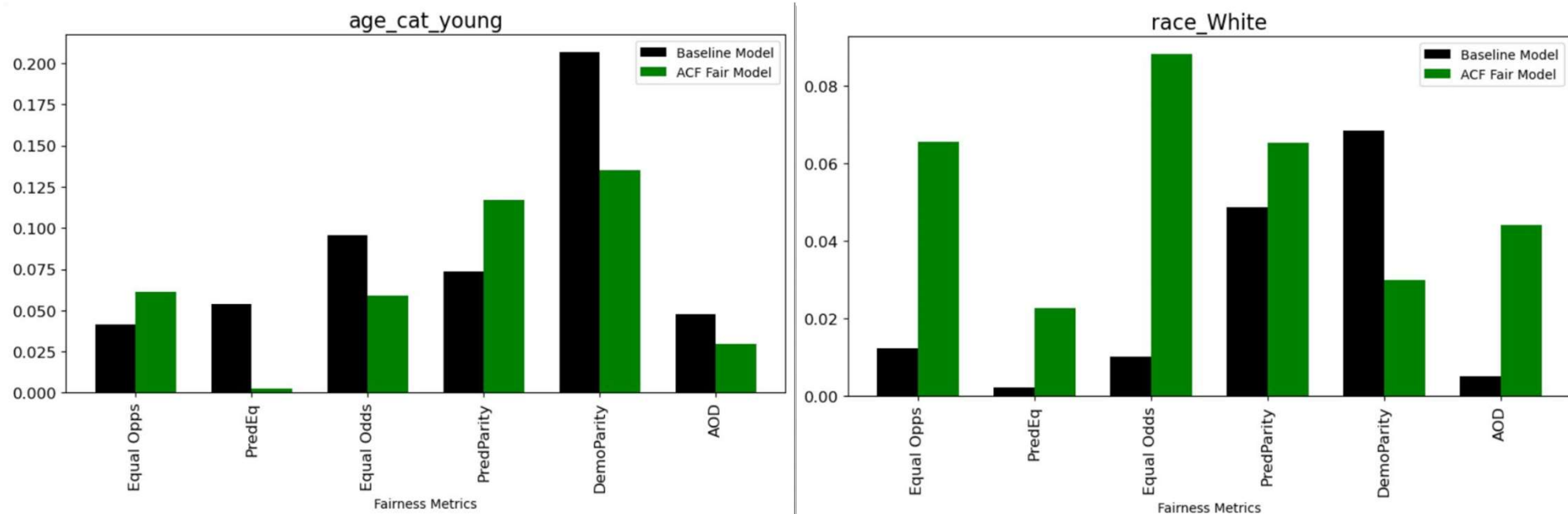
**Reweighting and  
Compare Base Model  
with reweighted Model**

# Observations

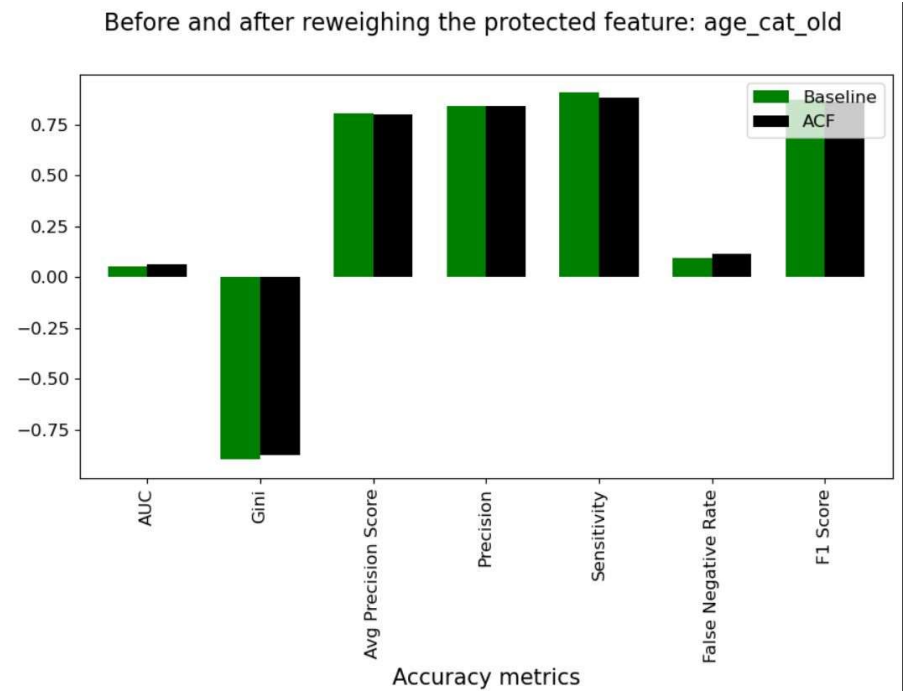
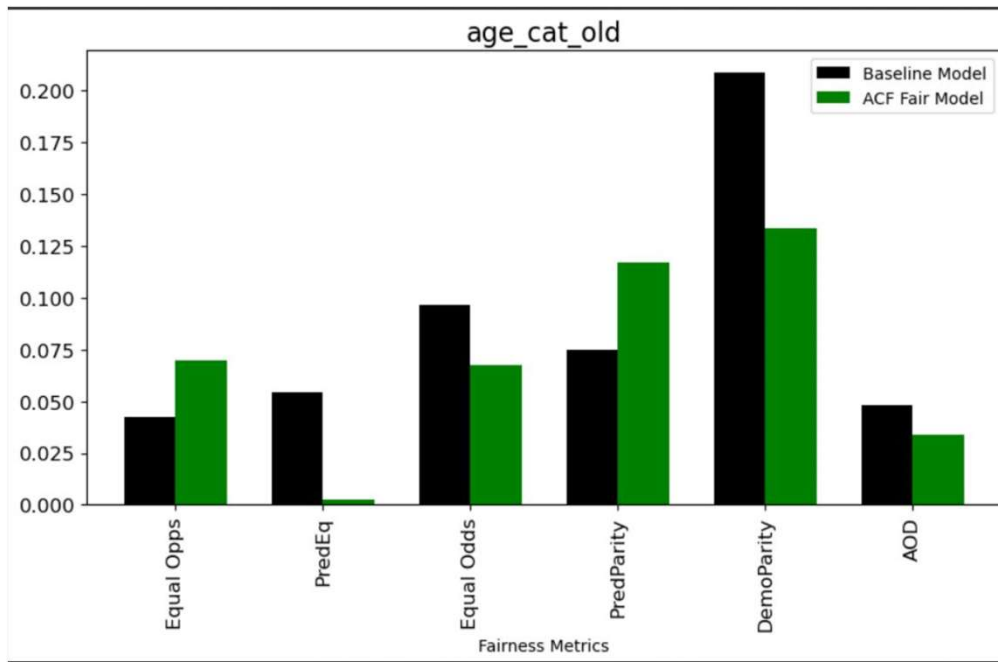
Absolute difference in various fairness metrics for sex\_Male: Baseline vs ACF model



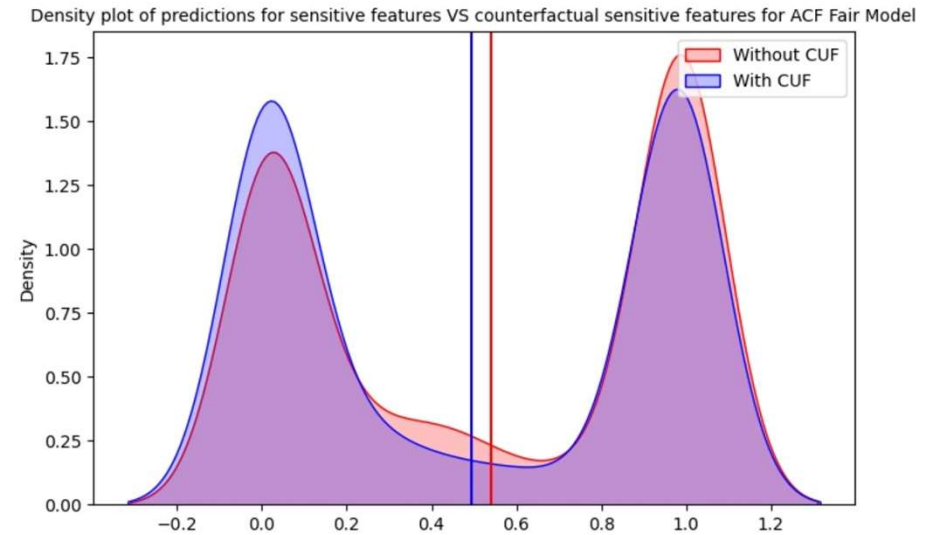
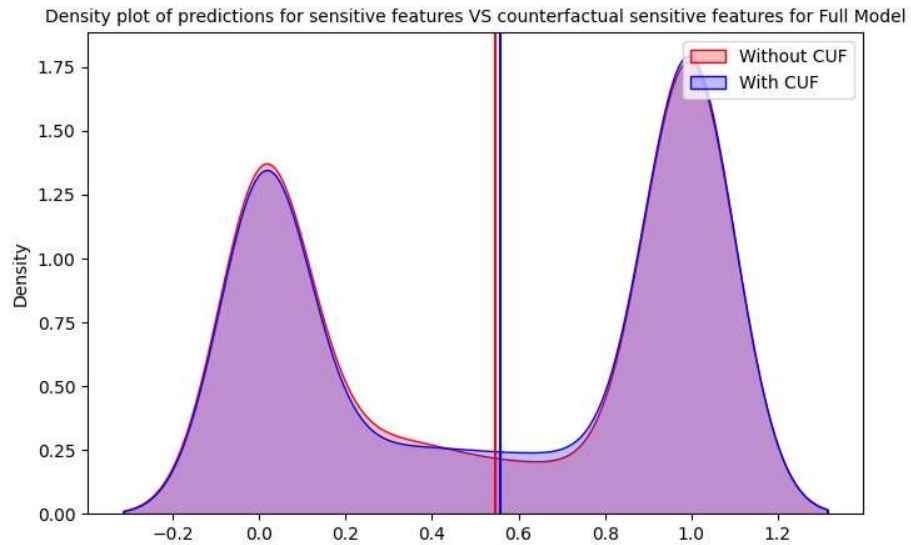
# Observations



# Observations



# Observations



# Importance and benefits of our Algorithm

- Removal of Bias: Colored litigants were frequently anticipated to be at a higher gamble of recidivism than they really were. Our algorithm is designed to remove that bias.
- Diverse Business Scope: If an algorithm is free from bias, its business scope can be broader and more diverse.
- Trustworthiness: Bias-free algorithms can increase trust and credibility in the results.
- More accurate predictions: Bias-free algorithm leads to more accurate predictions, enabling organizations to make better decisions and allocate resources more effectively.
- Compliance friendly tool: Eliminating bias can help organizations to comply with regulations and avoid potential legal issues, such as discrimination lawsuits.

# Business Use Case

The government can use this algorithm to decide extension of prison sentence. However there seems to be discrimination.

The purpose is to create a new model to facilitate judges/courts to take a decision on extension of criminal sentences without bias.

This will ensure people who may not do an offence are sentenced illogical unjust which will in turn lead to:-

- Social balance/stability
- Political stability
- Legal trust
- International benchmarking
- Reduce cost of litigation
- Reduced pendency of litigation
- Reduction in reappeal

Apart from above judicial use case, our fair and bias-free algorithm can be used in industries like Banking and Financial Institutions, Insurance Companies for Actuarial Risk Analysis, Employment Firms, Housing and Government Agencies.

# Bibliography

- 1.Book: “Responsible AI: Implementing Ethical and Unbiased Algorithms” by Sray Agarwal and Shashin Mishra.
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- 3.Image Source: <https://www.propublica.org/>
- 4.Source of data: <https://www.propublica.org/datastore/dataset/compas-recidivism-risk-score-data-and-analysis>
- 5.Reference for functions:  
[https://jioinstitute1-my.sharepoint.com/personal/nikita\\_divay\\_jioinstitute\\_edu\\_in/\\_layouts/15/onedrive.aspx?id=%2Fpersonal%2Fnikita%5Fdivay%5Fjioinstitute%5Fedu%5Fin%2FDocuments%2FRAI%20%2D%20code&ga=1](https://jioinstitute1-my.sharepoint.com/personal/nikita_divay_jioinstitute_edu_in/_layouts/15/onedrive.aspx?id=%2Fpersonal%2Fnikita%5Fdivay%5Fjioinstitute%5Fedu%5Fin%2FDocuments%2FRAI%20%2D%20code&ga=1)



**Thank you!**