ADS Audit: Assessing Performance and Fairness in Comment Toxicity Classification

DS-UA 202 Project by Wang Xiang, Veronica Zhao

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Background Information

- Jigsaw Unintended Bias in Toxicity Classification Challenge
- Purpose of the ADS: ensures high accuracy in detecting toxic comments with minimizing unintended model bias
- Data Source: public comments collected from Civil Comments platform
- Challenge: Accuracy vs Fairness (Trade-off)
- Our Goal
    - Analyze the challenge and the ADS's performance in both accuracy and fairness
    - Proposing viable methods of maintaining high accuracy with more bias across demographic groups

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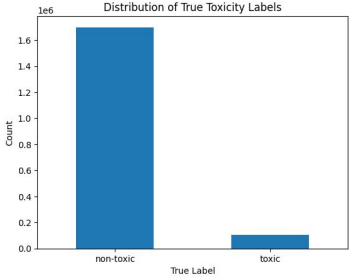
Exploratory Data Analysis

- Input: User's textual comments
- Output: Toxicity score (0~1), label=toxic if score>=0.5
- True label: toxicity score annotated by human annotators
- Sensitive features: sex, race, religion, sexual orientation, disability identified from comments by human annotators

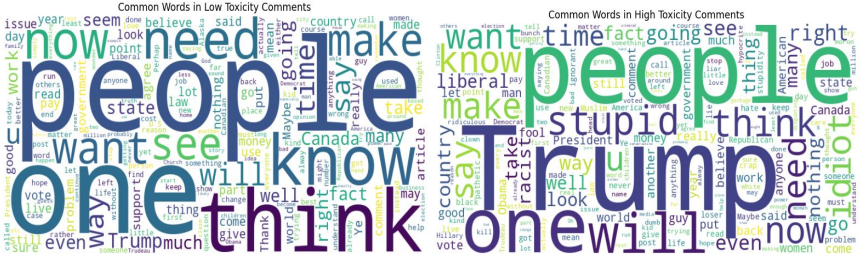
Observation 1: Imbalanced dataset



Observation 2: Fairness can only be measured in a subset of dataset

- # of rows in test set: 194640
- # of rows with labels in test set: 42870

Observation 3: Word Cloud



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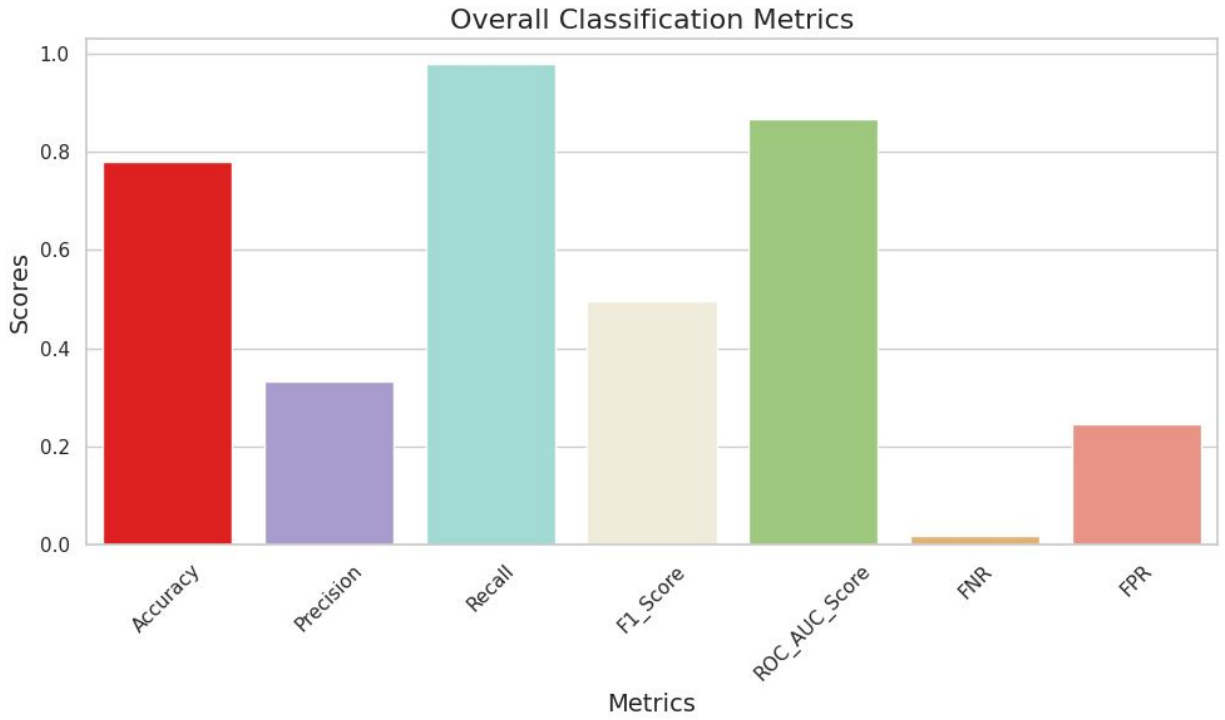
Automated Decision System

- Approach: 8th ranked participant on challenge leaderboard
  - Text Preprocessing
  - Ensemble method combining predictions from BERT-base-uncased, BERT-large-uncased, GPT2, XLNET models (weighted average)
- Performance:
  - AUC: 0.9466

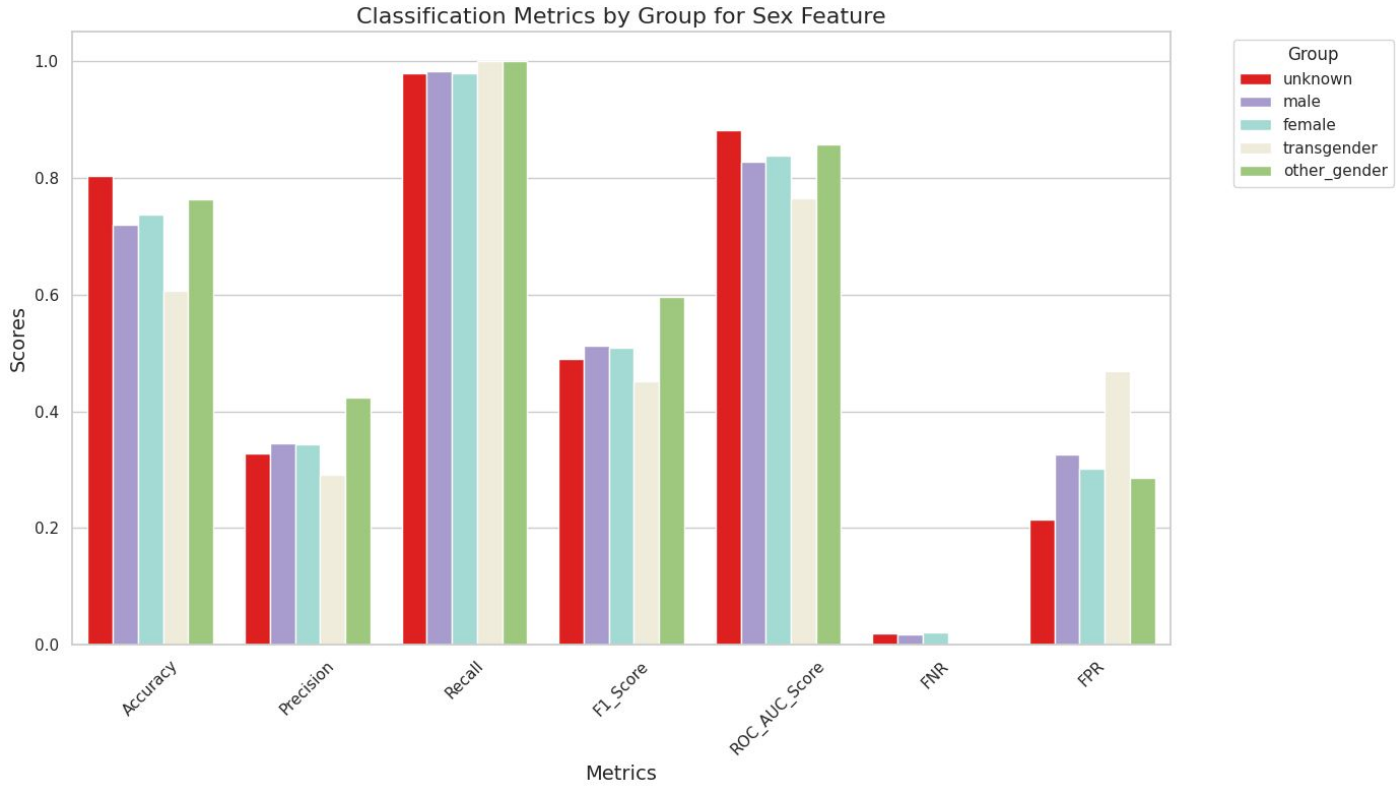
Preprocessing and Implementation

- Data Cleaning
  - Remove rows without sensitive labels
  - Drop irrelevant columns
  - Concatenate 2 expanded test sets
- Inverse one-hot encoding
  - Convert several dummy sensitive labels into a single categorical feature
- Implementation of the ADS on the test set
- Performance and fairness evaluation

Overall Accuracy Metrics



Accuracy Metrics by Group



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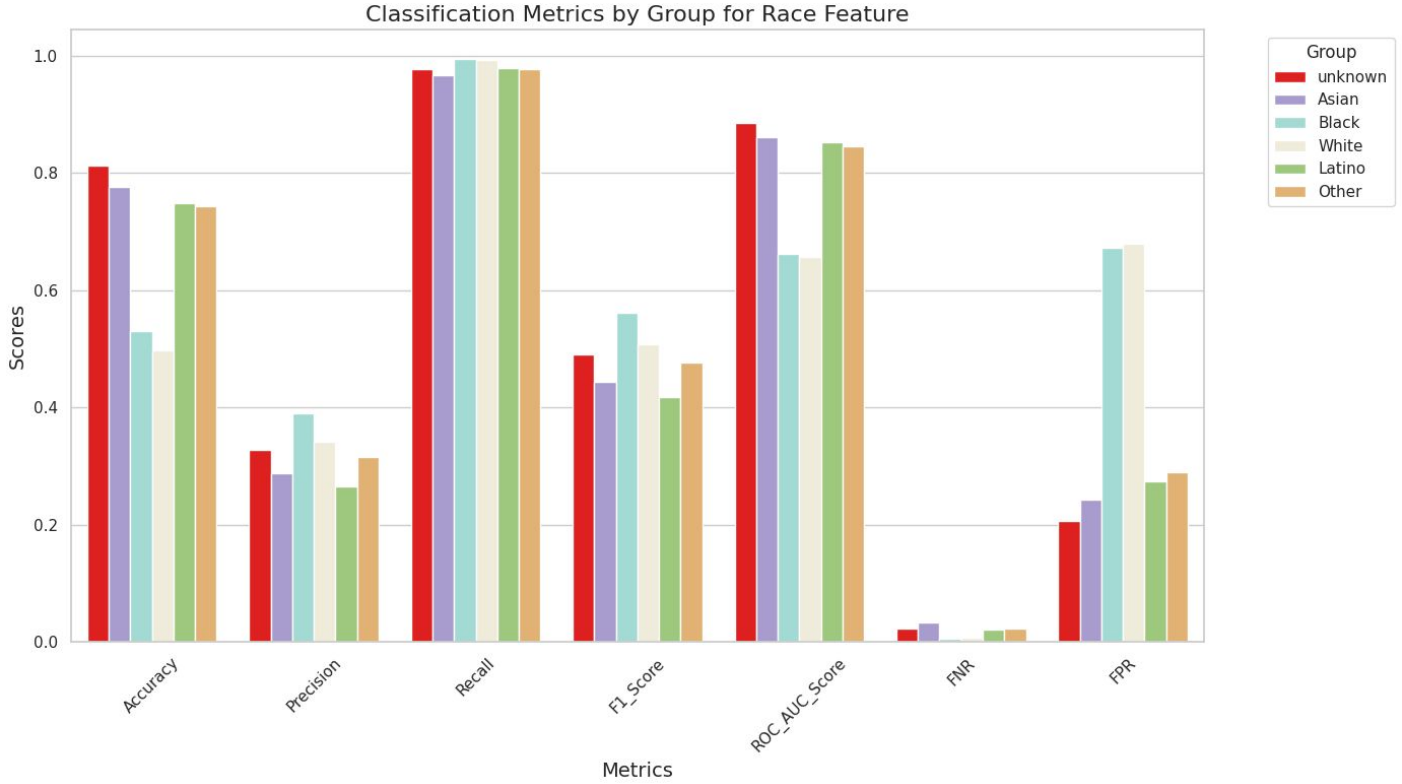

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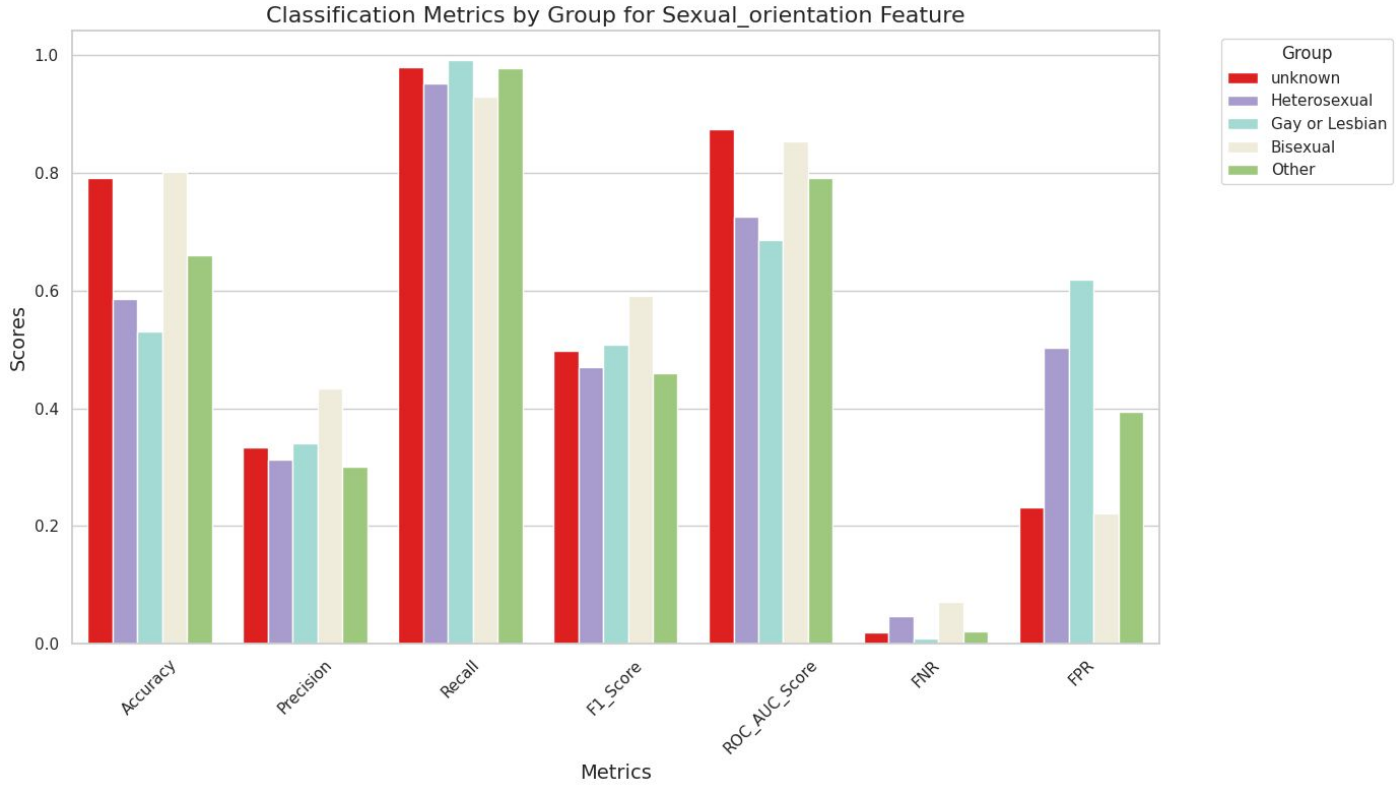

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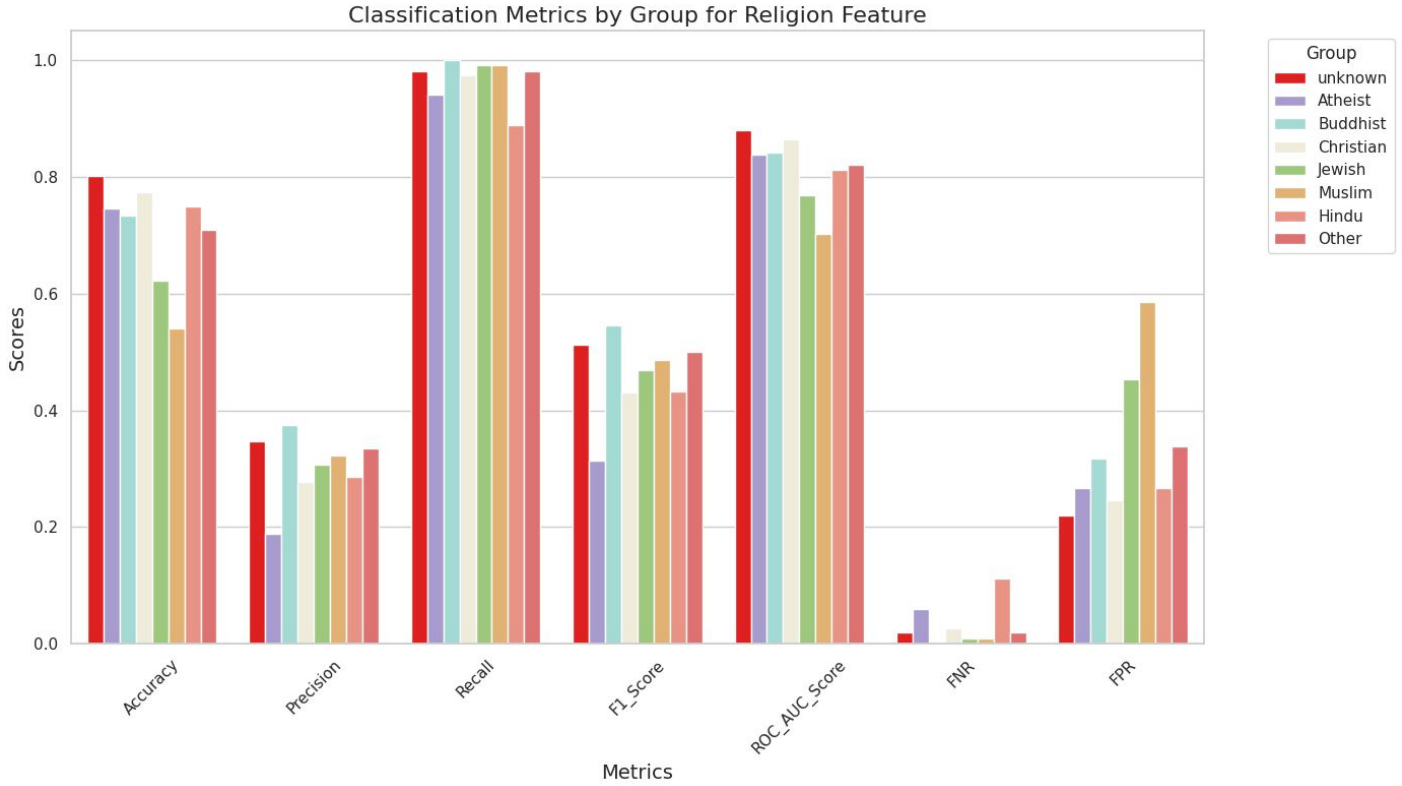

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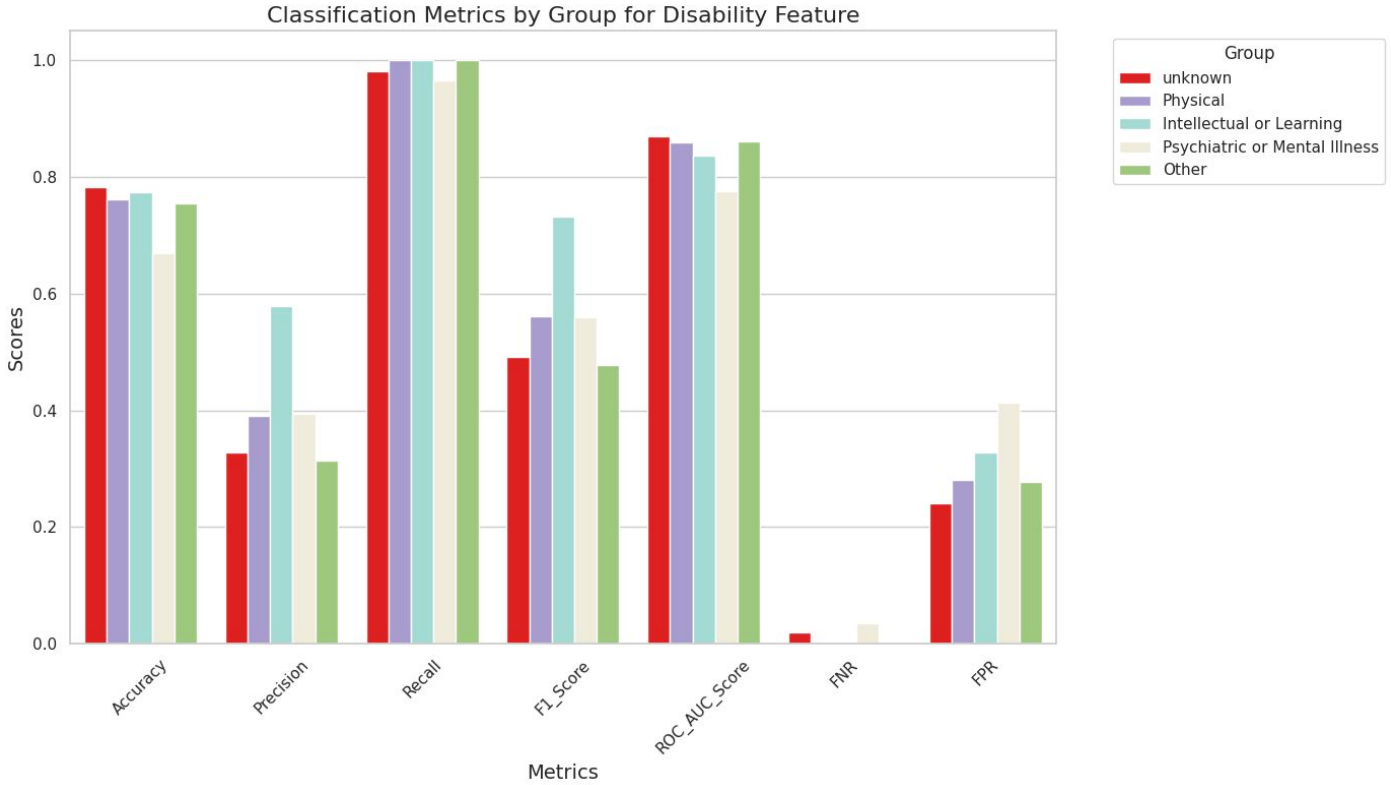
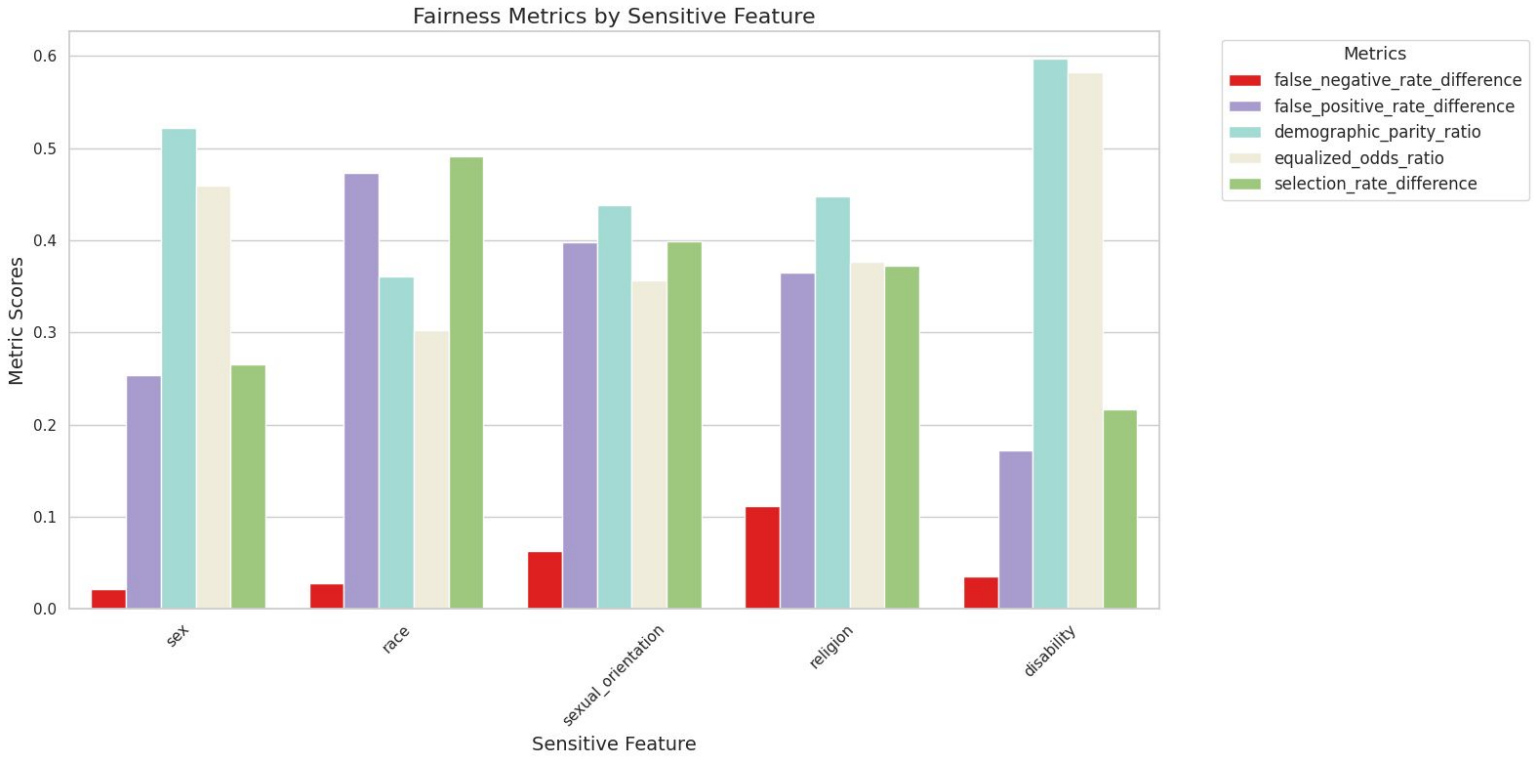


Fairness Metrics by Sensitive Feature



Introduction to Population Stability Index (PSI)

https://www.aporia.com/learn/data-science/practical-introduction-to-population-stability-index-psi/#

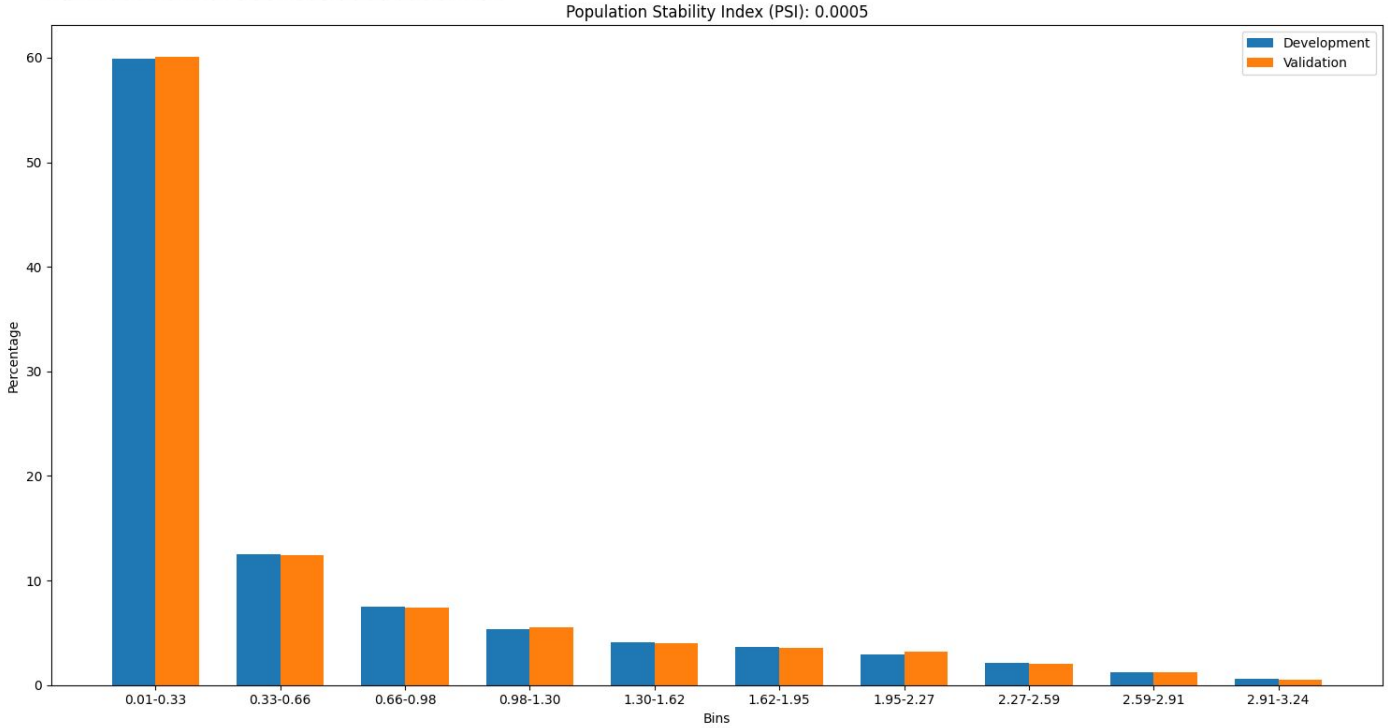
- **Definition:**
  PSI is a measure used to assess the stability of a model by comparing the distribution of a variable between a development dataset and a validation dataset.

- Importance of PSI: It helps detect shifts in data distribution, indicating potential model drift, which can affect the model's predictive accuracy and reliability.

- Application: Regular use in monitoring models, especially in sectors like finance for credit scoring, to ensure models remain accurate over time.

PSI Analysis and Interpretation

PSI Value: 0.0004679388387301154



PSI Interpretation Guide

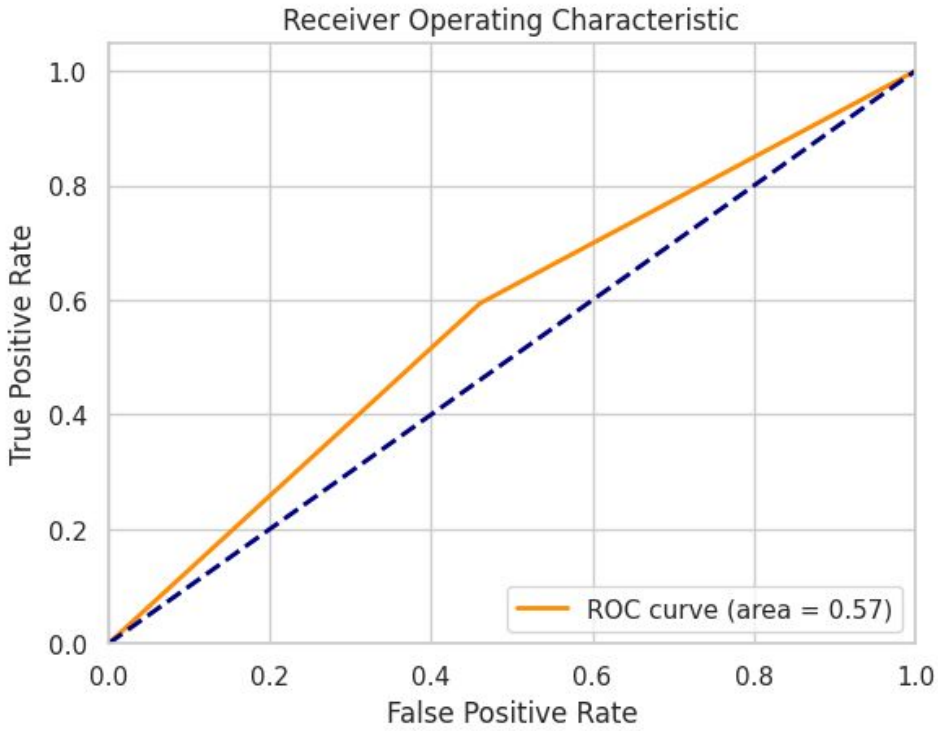
PSI Value	Description
PSI < 0.1	Very low change between the two groups, considered stable.
0.1 <= PSI < 0.25	High change between the two groups, is considered significant.
PSI >= 0.25	High change between the two groups, considered significant.

- ➔ Bisn shows nearly identical percentages, demonstrating high stability with minimal differences.
- ➔ The low PSI value affirms no significant data shifts, suggesting the model's predictions remain reliable.
- ➔ No recalibration needed at present. Continuous monitoring is advised to maintain model accuracy.

Performance on Marginal Predictions

Performance on marginal cases:
Accuracy: 0.5412844036697247

	precision	recall	f1-score	support
0	0.97	0.54	0.69	3055
1	0.04	0.59	0.08	106
accuracy			0.54	3161
macro avg	0.51	0.57	0.39	3161
weighted avg	0.94	0.54	0.67	3161



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Conclusion

- Stakeholder: Comment platform, users
- ADS should be further improved for deploy in industry
- Accuracy: overall performs well, FPR remains relatively high
- Fairness: should be improved especially for racial groups
- Potential Improvement
  - Imbalanced dataset - oversampling / undersampling
  - Tokenizers for social media platform - TweetTokenizer in NLTK
  - Revise the prediction calculation method

Thank you!