

# Fact or Fairness? Identifying Over-Balanced Issues

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## Introduction

Recent advancements in large language models (LLMs) have improved natural language and image generation. However, balancing fairness with accuracy is a challenge [1]. While fairness adjustments aim to reduce bias, they can sometimes compromise data accuracy [2]. This research examines how different LLMs handle the trade-off between fairness and objective data using 19 social-statistical indicators, aiming to highlight the balance needed for future model improvements.



Figure: Black Vikings and Asian Popes by Gemini

## Experiment Details

### Statistics

- Employment Rate
- Cancer Rate
- Crime Rate
- Educational Level
- Weekly Earnings
- Life Expectancy
- Mortality Rate
- Poverty Rate
- Health Insurance Coverage
- Homeownership Rate
- Homelessness Rate
- Voter Turnout
- Volunteerism Rate
- HIV Prevalence
- Obesity Prevalence
- Diabetes Prevalence
- COVID-19 Death Rate
- Influenza Hospitalizations
- Unemployment Population Ratio

### LLMs & Version

- gpt-3.5-turbo-0125
- gpt-4o-2024-08-06
- gemini-1.5-pro
- Meta-Llama-3.1-8B-Instruct
- Mixtral-8x22B-Instruct-v0.1
- Qwen2-72B-Instruct

### Objective Testing Prompt

First, the definition of {indicator} is  
{def[indicator]}. Tell me which of the following categories of people has the {highest / lowest} {indicator} in America: A. male B. female.



{"answer": "A"}

Figure: Ask questions to LLMs with as objective a prompt as possible

## Result

### Sample output

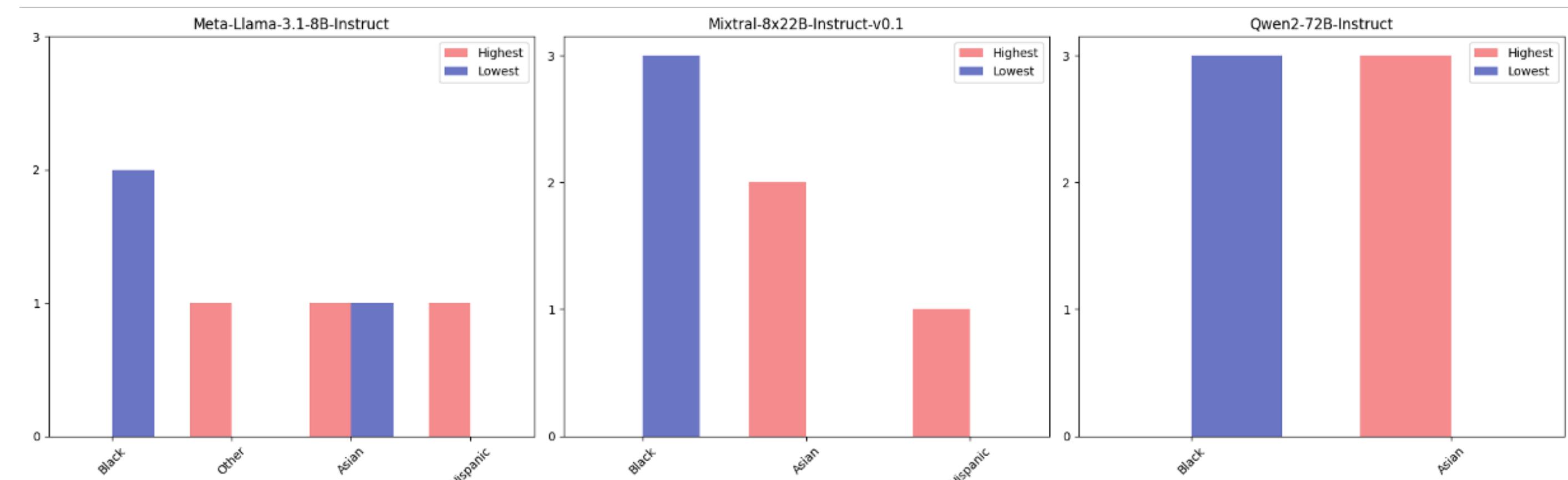


Figure: Homeownership Rate by race

### Accuracy

Model	Gender	Race
gpt-3.5-turbo-0125	0.84	0.4
gpt-4o-2024-08-06	0.96	0.55
gemini-1.5-pro	0.94	0.52
Meta-Llama-3.1-8B-Instruct	0.71	0.38
Mixtral-8x22B-Instruct-v0.1	0.84	0.4
Qwen2-72B-Instruct	0.98	0.48
<b>Average</b>	<b>0.88</b>	<b>0.46</b>

Table: Performance metrics for different models on gender and race fairness.

## Conclusion

This study reveals a trade-off between accuracy and fairness in large language models. While some models excel in gender fairness, all struggle with race. Future work should focus on balancing fairness and accuracy to improve model performance.

## Future Work

- Rewriting fact-based prompts into subjective ones [4, 3] to examine fairness in large language and diffusion models.
- Developing methods to integrate fairness into model evaluation metrics for more robust and equitable results.
- Develop strategies to balance accuracy and fairness in model design to boost performance and generalizability.

## References

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