BIAS IN AI-DRIVEN HOUSING PRICE PREDICTIONS

A Case Study of the New York Metropolitan Area

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Introduction & Motivation

- Automated valuation models (AVMs), like Zillow's Zestimate, heavily influence real estate markets by estimating housing prices using extensive datasets.
- These algorithms claim fairness and efficiency but may unintentionally reinforce existing socioeconomic and racial inequalities.

Why it matters:

- AI-driven pricing models can significantly impact housing affordability and equity.
- Understanding biases within these models is crucial for creating fairer housing markets.

Research Questions

1. Are AI-driven pricing models inflating housing prices in certain demographic regions?
2. How accurate are algorithmic predictions compared to actual market trends across neighborhoods?
3. Which demographic factors correlate with discrepancies between AI-predicted and actual rental values?
4. How does short-term rental activity (Airbnb) influence AI-generated housing price estimates in the New York Metro Area?

KEY INSIGHTS FROM QUESTIONS...

- Initial evidence suggests discrepancies exist, particularly impacting neighborhoods with diverse socioeconomic and racial demographics.
- Preliminary analysis indicates that demographic factors significantly correlate with inaccuracies in AI pricing models.

Our Data

Zillow REAL ESTATE DATA	NYU FURMAN CENTER DEMOGRAPHIC DATA	INSIDE AIRBNB
• We compared rental prices from Zillow's Zestimate AVM, specifically utilizing Zillow's Observed Rent Index (ZORI), which aggregates monthly rental data.	• The NYC platform utilizes definitions consistent with New York City's neighborhood boundaries and derives its information directly from the U.S. Census Bureau	• Independent from Airbnb. This dataset comprises publicly available listings, reviews, and calendar availability, aggregated by neighborhood using geographic coordinates aligned with official city neighborhood boundaries.

Highlights from EDA

1. **Filtered Zillow Data:** Only using data from the 12 most recent months available (March 2024 - Feb 2025)
2. **ZIP Code Selection:** Manually selected ZIP codes that are apart of the target 10 NYC neighborhoods
3. **Data Preparation:** Averaged monthly rents per neighborhood
4. **Visualizations:** created a horizontal bar charts and heatmaps

METHODS

NEIGHBORHOOD FOCUS

Analyzed Airbnb rental prices in 10 NYC neighborhoods using only full-home listings for accurate price trends.

KEY INSIGHTS

- Income and rent showed weak correlation
- Race and rent patterns were stronger
- Heatmaps revealed potential links between algorithmic pricing and demographic composition

DATA VISUALIZATIONS

Heat Map 1: compared neighborhoods by

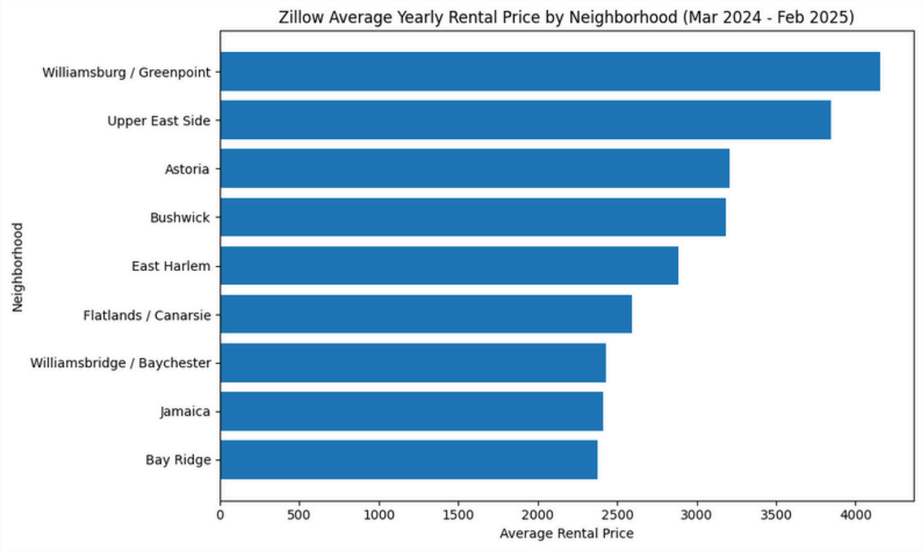
- zestimate rental values
- racial composition

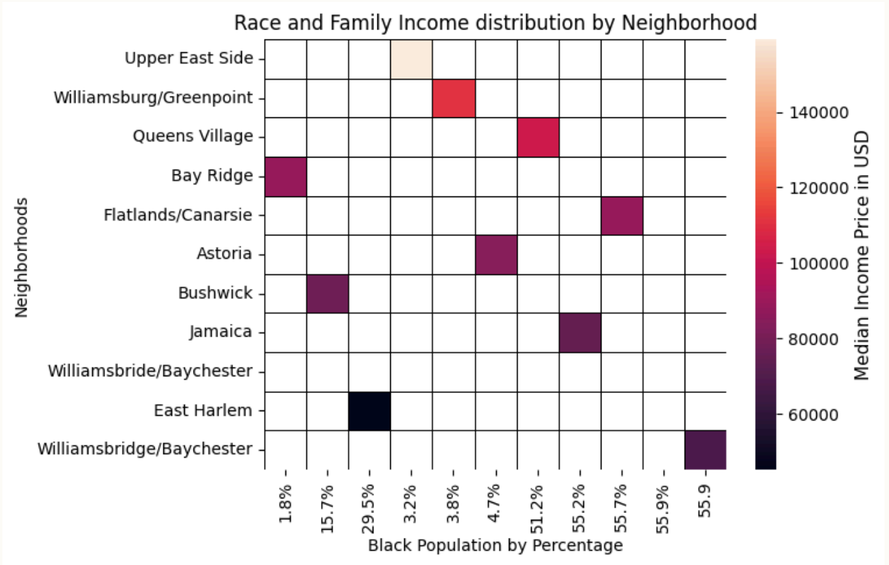
Heat Map 2: compared neighborhoods by

- racial composition
- average family income

HOUSING PRICE DISPARITIES ACROSS DEMOGRAPHIC GROUPS

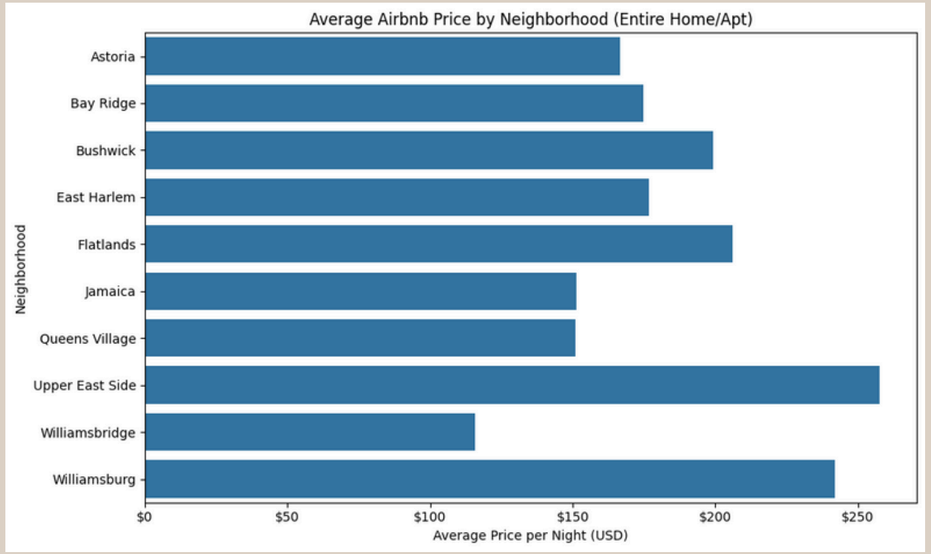
- Zillow's median home prices are significantly higher in neighborhoods with larger white populations (e.g., Upper East Side, Williamsburg).
- Predominantly Black neighborhoods (e.g., East Harlem, Williamsbridge) show lower median prices, reinforcing existing racial disparities.
- Race is a stronger predictor of pricing discrepancies than income.
    - Example: East Harlem and Bushwick have lower Zestimates despite similar median incomes to higher-valued areas.

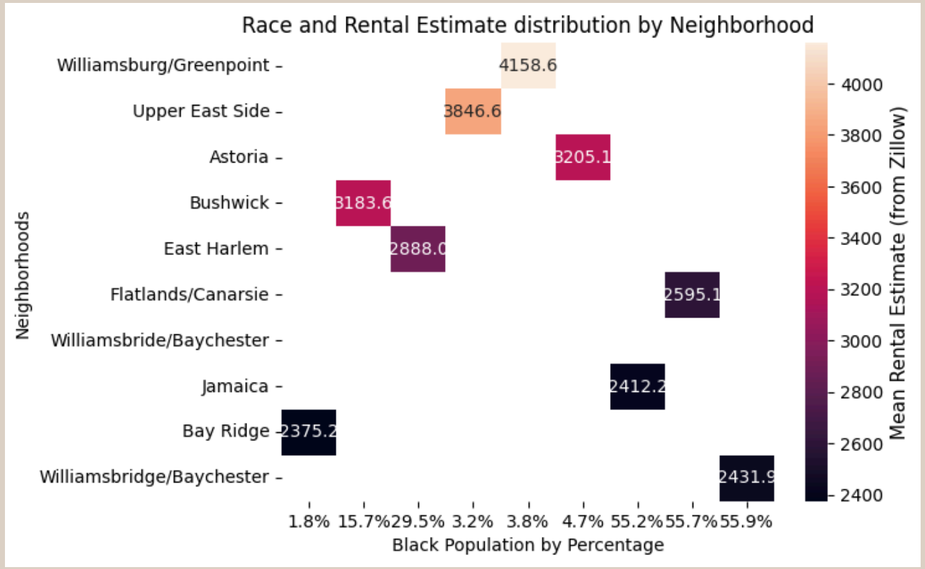




ALGORITHM BIAS AND SHORT-TERM RENTAL INFLUENCE

- Zestimate deviations are greater in racially and economically diverse neighborhoods.
- Systematic underestimation in Black and Latinx communities suggests potential racial bias.
- Airbnb activity positively correlates with Zillow rent estimates.
- Short-term rentals may inflate AVM (Automated Valuation Model) estimates, exacerbating affordability issues.





Objective: Investigate whether AI pricing models reproduce racial and socioeconomic disparities in NYC housing markets. We specifically used Zillow's Zestimate.

SOME KEY FINDINGS WE FOUND:

- **There was Racial Bias in Valuation of the Homes.** Zestimate overvalues homes in majority white neighborhoods. An example is Upper East Side. Zestimate undervalues those in majority-Black areas. An example is East Harlem.
- There was a strong correlation between Airbnb median prices and Zestimate rent values. This suggests short-term rental activity inflates Automated Valuation Model(AVM - is a computer program that estimates a property's value using data), predictions and **may accelerate gentrification.**
- There **were persistent disparities**. Discrepancies are not fully explained by income. Racial demographics show stronger correlations to valuation gaps.

SOME ETHICAL IMPLICATIONS WE HAD:

AI pricing tools may accidentally reinforce segregation, displacement, and wealth inequality. Findings support the need for algorithmic audits and bias strategies in AVMs.

SOME LIMITATIONS WE HAD:

- We only had a **small neighborhood sample**.
- There was a time-related mismatch in Zillow vs. Airbnb data
- There was reliance on a potentially incomplete user and tax provided data

Possible Future Work based on Our Data

- We can **expand** our Dataset Scope and see more cities to improve **generalizability** and space resolution.
- We can also partner with **AVM developers** to model inputs, weights, and training data for **algorithmic fairness**.
- Apply **regression modeling** or instrumental variable analysis to **isolate** the effect of race, income, and Airbnb activity on valuation errors.